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Integrative Report on Implementation of the Circular Economy in ASEAN

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Foreword

The circular economy is gaining momentum worldwide and across Southeast Asia, as governments and companies increasingly focus on the circularity of trade and businesses. Faced with resource depletion and environmental degradation, it is imperative to understand the limits of our planet and take action against urgent global issues such as climate change, biodiversity loss, and pollution.

However, the circular economy is not merely a response to environmental problems; it is also about capturing opportunities. It serves as a means to foster new economic growth, generate jobs, and promote social inclusion. Embracing circularity provides solutions and transformative changes that strengthen economic systems, maximise social benefits, and mitigate the risks associated with today's linear economic model.

To capitalise on these opportunities, the Framework for Circular Economy for the ASEAN Economic Community was established in 2021 as a guiding principle for ASEAN Member States to transition towards circularity. ERIA (Economic Research Institute for ASEAN and East Asia) is honored to collaborate with the ASEAN Secretariat in developing the Framework and other circular initiatives. This comprehensive report stands as evidence of ERIA's support, offering an overview of the circular economy's journey within ASEAN.

The report encompasses a background analysis of the circular economy in ASEAN, an introduction to the circular economy policies and implementation of ASEAN Member States, persistent challenges, and policy recommendations. Additionally, it tracks the progress of each ASEAN Member State, highlighting crucial factors such as the Fourth Industrial Revolution (4IR) and technological innovation, accountability and transparency, and multi-stakeholder engagement and cooperation.

We believe that this report will provide valuable insights contributing to a resilient, resource-efficient, inclusive, and sustainable ASEAN economy. ERIA remains committed and looks forward to supporting ASEAN in embracing the circular economy.

Tetsuya Watanabe

President of ERIA

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4IR	Fourth Industrial Revolution
AEC	Asean Economic Community
AEDP	Alternative Energy Development Plan
AMS	Asean Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
ASCC	Asean Socio-Cultural Community
ASEAN	Association Of Southeast Asian Nations
B2B	Business-To-Business
BCG	Bio-Circular-Green
CCUS	Carbon Capture Utilisation and Storage
CO_2	Carbon Dioxide
COE	Certificate Of Entitlement
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
COVID-19	Novel Coronavirus Disease
CPV	Communist Part of Viet Nam
DENR	Department Of Environment and Natural Resources
DEQP	Department Of Environment Quality Promotion
DOE	Department Of Energy
EBT	New And Renewable Energy
EDL	Électricité Du Laos
EPR	Extended Producer Responsibility
ERIA	Economic Research Institute for ASEAN And East Asia
ESDM	Ministry Of Energy and Mineral Resources
EU	European Union
EV	Electric Vehicle
FOLU	Forestry And Other Land Use
GDP	Gross Domestic Product
GEOP	Green Energy Option Program
GGP	Guidelines On Green Procurement
GHG	Greenhouse Gas

GW	Gigawatt
ICT	Information Communications and Technology
KPI	Key Performance Indicator
Lao PDR	Lao People's Democratic Republic
LCGC	Low-Cost Green Car
LTS4CN	Long-Term Strategy for Carbon Neutrality in Cambodia
MAFI	Ministry Of Agriculture and Food Industries
MEM	Ministry Of Energy and Mines
MEMR	Ministry Of Energy and Mineral Resources
MEPS	Minimum Energy Performance Standards
MOA	Ministry Of Agriculture
MOEF	Ministry Of Environment and Forestry
MONRE	Ministry Of Natural Resources and Environment
MOT	Ministry Of Transportation
MPI	Ministry Of Planning and Investment
MPIC	Ministry Of Plantation Industries & Commodities
MPWT	Ministry Of Public Works and Transport
MRV	Monitoring, Reporting, And Verification
MSDP	Myanmar Sustainable Development Plan
MSMEs	Micro, Small, And Medium-Sized Enterprises
MT	Metric Tons
MTIC	Ministry Of Transport and Infocommunications
MW	Megawatt
NAP	National Agrofood Policy
NBP	National Biofuel Policy
NDC	Nationally Determined Contribution
NEDA	National Economic and Development Authority
NSEDP	National Socio-Economic Development Plan
NSTDA	National Of Science & Technology Development Agency
NTP	National Transport Policy
NXPO	National Higher Education Science Research and Innovation Policy Council
PAP4SCP	Philippine Action Plan for Sustainable Consumption and Production

PDP	Philippine Development Plan
PEFC	Programme For the Endorsement of Forest Certification
PLN	*Perusahaan Listrik Negara*
R&D	Research And Development
RE	Renewable Energy
RPJMN	National Medium-Term Development Plan
SCP	Sustainable Consumption and Production
SDGs	Sustainable Development Goals
SGP	Singapore Green Plan
SMEs	Small And Medium-Sized Enterprises
TEI	Thailand Environmental Institute
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WTE	Waste-To-Energy

Chapter 1

Background of the Circular Economy in ASEAN

In the face of sharp volatility across the global economy and proliferating signs of resource depletion, the call for a new economic model is gaining traction. A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems. The new economic model can extend the lifetime of products, improve resource efficiency, and reduce waste. At the heart of the circular economy is the idea of moving away from linear value chains, which means breaking with the 'take-make-waste" tradition and make the transition towards a circular approach, hence greater competitiveness, efficiency, and resilience. This requires a fundamental change in incentives faced by producers and consumers, adoption of appropriate production methods and technology, and new regulations and policies at the national and regional level.

The novel coronavirus disease (COVID-19) crisis has had disastrous human and economic consequences, revealing our integrated economic system's exposure to a variety of risks. It challenged us to adopt credible circular economy solutions such as reusability, repairability, reduced consumption, and the potential for remanufacturing and refurbishing industrial equipment. Another domain in which the circular economy was relevant during the pandemic is food production and distribution. It is well documented that the current industrial agriculture supply chain relies on high-polluting inputs that are built around supply chains and generate high levels of waste. As several studies point out, the regenerative bioeconomy[1] is also a powerful force in bringing competitiveness and resilience and could be a tool for climate change mitigation. These two specific examples only constitute a small opening onto the wider possibilities presented by the circular economy when it comes to post-pandemic recovery plans by the Association of Southeast Asian Nations (ASEAN).

Given the growing imperative of better resource management and to respond to consumer and in turn industry demand, as well as the momentum on sustainable recovery, there is a need to develop a clear framework for the circular economy under the ASEAN Economic Community (AEC), which would define and provide the scope for ASEAN's work on the circular economy within the context of the AEC. Such a framework would integrate circular economy principles and ideas into ASEAN's long-term growth and economic integration strategies and ensure its compatibility with existing ASEAN principles as articulated in the AEC 2025 Blueprint. It would also identify priority areas and/or channels for collaboration with the relevant work under the ASEAN Socio-Cultural Community (ASCC). In fact, the circular economy is a clear example of the increasingly cross-cutting nature of the issues faced by ASEAN.

The objective of this report is to provide a better understanding of the scope of the circular economy, map out relevant ASEAN work and mechanisms to address this issue, identify potential priority areas

[1] The bioeconomy refers to as a set of economic activities relating to the invention, development, production and use of biological products and processes, with expected benefits of improvement of health outcomes, boosting the productivity of agriculture and industrial processes, and enhancement of environmental sustainability. For further details, see, for example, OECD (2018).

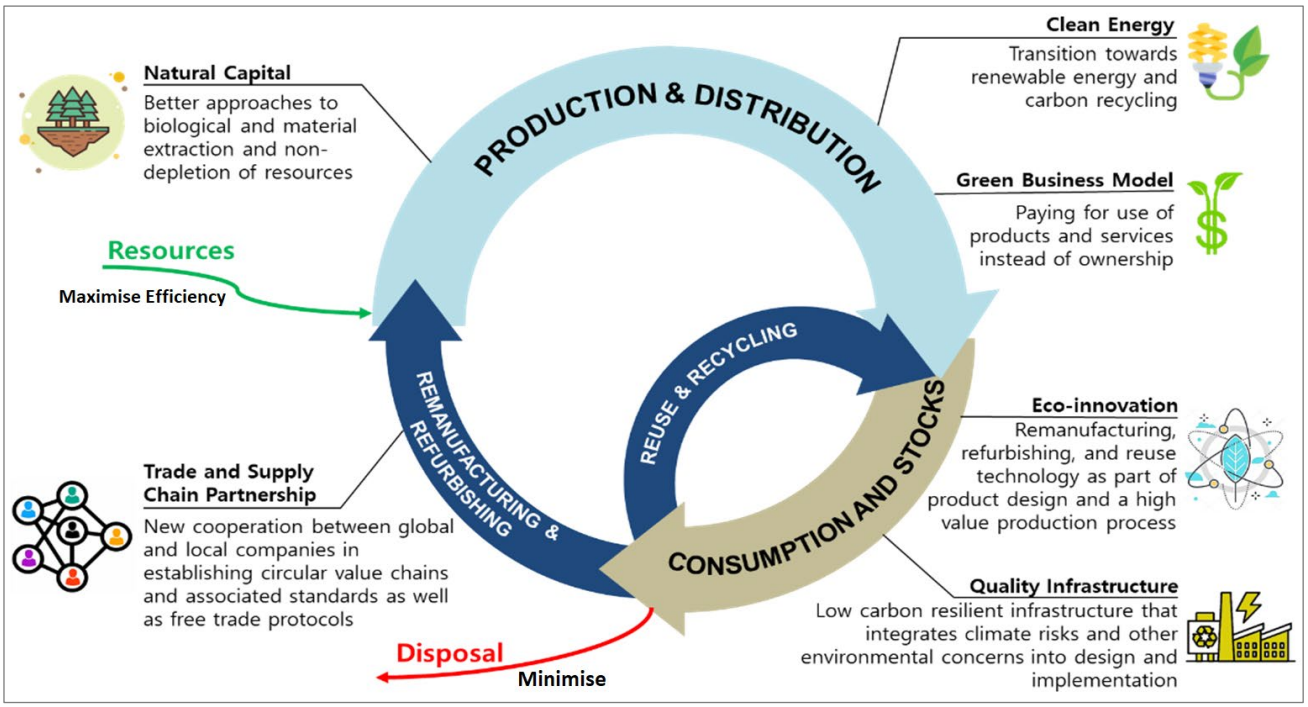
for ASEAN's work in this regard, especially within the AEC framework, and explore potential entry points for collaboration with other ASEAN Community pillars, especially the ASCC, as well as other cross-pillar initiatives, e.g. smart cities and sustainable urbanisation. This report will refer to relevant ASEAN documents, particularly the AEC Blueprint 2025, the ASCC Blueprint 2025, the ASEAN Comprehensive Recovery Framework, and the global trends in ASEAN Vision 2040 (ERIA, 2019) as the main basis, in addition to global best practices.

1. Definition and Motivations for the Circular Economy

The Ellen MacArthur Foundation (2013) defines a circular economy as one that is restorative, and one which aims to maintain the utility of products, components, and materials and retain their value. It thus minimises the need for new inputs of materials and energy, whilst reducing environmental pressures linked to resource extraction, emissions, and waste. This goes beyond simple waste management, requiring that material resources be managed efficiently and sustainably throughout their life cycles. A circular economy thus provides opportunities to create well-being, sustainable growth, and jobs, whilst reducing environmental pressures. The concept can, in principle, be applied to all sectors, such as agriculture, forestry, manufacturing, minerals, and transport. Eco-design, repair, reuse, refurbishment, remanufacture, product sharing, waste prevention, and waste recycling are all important in a circular economy.

The main characteristics of a circular economy will differ for different types of systems, such as food consumption, metals that can be recycled, or water used in processing that can be recycled. A wide range of changes in production, consumption, and distribution will be needed to trigger or advance the transition to circular economy. Key elements of the circular economy in the context are illustrated in Figure 1.1.

Figure 1.1. Key Elements of the Circular Economy



Source: ERIA (2020a).

The circular economy does not only require closed-loop material cycles for resource efficiency improvement, but also system thinking. Natural capital, clean energy, new business models, innovation, quality infrastructure, high value trade, and supply chain collaboration are key elements of system thinking for the circular economy. Together, they form into a network of actions, with each action influencing the other. Central to achieving the necessary systemic changes, however, will be to find synergy in economic and social incentives, for example through policies and technologies that encourage consumers and producers to adopt circularity principles through modular innovations. Thus, the major factors that drive circular economy can be grouped into:

a) *Economic interests*, such as increasing competitiveness, securing access to raw materials and energy, and improving production efficiency.

b) *Environmental concerns*, such as reducing pressures on the environment, preventing bio-environmental degradation, or reducing greenhouse gas emissions.

c) *Pursuit of broader collective commitments*, such as commitment to the 2030 agenda, compliance with international climate targets on and commitments for economic cooperation and integration.

2. Global Mega Trends on the Circular Economy and Imperatives for ASEAN

The scope and comprehensiveness of circular economy strategies vary widely across countries. Since the early 2000s, when the resource efficiency concept of the circular economy was introduced by the United Nations Environment Programme (UNEP) and its International Resource Panel, many countries started various policy debates, as the concept provided inspiration for mutually reinforcing initiatives in the areas of resource efficiency, eco-innovations, and supply chain resilience (UNEP, 2017). As can be expected, policy frameworks introduced by early adopting countries were extensive.

In 2000, Japan enacted the Basic Act for Establishing a Sound Material-Cycle Society,[2] which is similar to the European Union's (EU) 2020 Action Plan on a Circular Economy.[3] A Sound Material-Cycle Society is a society in which the consumption of natural resources will be conserved, and the environmental load will be reduced to the greatest extent possible, by preventing or reducing the generation of waste, etc., from products, etc., by promoting proper cyclical use of products, etc. In 1991, 10 years before the introduction of this basic act, the Act on the Promotion of Effective Utilization of Resources (Act No. 48 of 199), initiated by the Ministry of Economy, Trade and Industry, was enacted, which requires industries to undertake recycling initiatives.

Likewise, China has long considered the circular economy a national policy. The country's rapid growth over the past decades has been accompanied by substantial depletion of natural resources and the ecosystem. The Chinese government recognises such a challenge and has committed to building a resource-saving and environmentally friendly society as a stated national policy (World Bank, 2009). The government, for example, adopted, in 2008, the Circular Economy Promotion Law,[4] which was

[2] For further details of this Act, see, for example, the official website of the Ministry of Environment of Japan at https://www.env.go.jp/en/laws/recycle/12.pdf

[3] For further details of this Action Plan, see the official website of the European Commission at https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

[4] The translated version of this Law is available at https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/China_CircularEconomyLawEnglish.pdf

subsequently amended in 2018. Specific reference to the circular economy has also been made in China's Eleventh Five-Year Plan (2006–2010), as well as the Thirteenth Five-Year Plan (2016–2020), validating the importance of the circular economy both as a national policy and as a fundamental pillar of the Chinese economy.

Another prominent example from Asia is the Republic of Korea. Although the country does not have a comprehensive plan on the circular economy, it has long adopted a green development strategy, such as the National Strategy for Green Growth (2009–2050), anchored on low carbon growth through, amongst others, increased use of renewable energy, resource efficiency, recycling, and energy recovery (see for example, OECD website). The Republic of Korea's focus on the efficient use of resources has placed it amongst the countries with the highest rate of recycling around the world (McCarthy, 2016). The Government of the Republic of Korea also unveiled the Green New Deal in July 2020, a KRW114 trillion (US$94.5 billion) financing plan to support the Republic of Korea's economic recovery from the COVID-19 pandemic (IISD, 2020).

Globally, the EU is ahead of other regions in implementing its Circular Economy Road Maps. In 2015, the European Commission adopted 'Closing the Loop – An EU Action Plan for the Circular Economy', which identifies various actions such as the development of quality standard for secondary raw materials and eco-design working plan to promote repairability, durability, and recyclability of products.[5] The 54 actions identified in the Action Plan had been delivered or were implemented by 2019. A new Circular Economy Action Plan was adopted by the European Commission in 2020, which introduces legislative and non-legislative measures in areas where actions at the EU level can bring real added value.[6]

The European Economic and Social Committee together with the EU Commission founded the European Circular Economy Stakeholder Platform in 2017. Through this platform, relevant stakeholders, including civil society organisations, are involved in the realisation of key areas of the EU Action Plan on the Circular Economy. The EU made the Single-Use Plastic Directive in 2019,[7] which is mandatory. This typically involves a wide-reaching stakeholder engagement in policy development, a negotiated consensus with the business community and other key actors such as academia, and the wider civil society organisations, and often a reliance on voluntary agreements. An overview of priority areas under circular economy strategies in selected European countries are listed in Table 1.1.

[5] Further details of this Action Plan are available in the official website of the European Union Law at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614

[6] See the official website of the European Commission at https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

[7] Further details of this Directive see the official website of the European Union Law at https://eur-lex.europa.eu/eli/dir/2019/904/oj

Table 1.1 Overview of Circular Economy Strategies of Selected European Countries

Country	Priority Areas
Belgium – federal level	Focus on products including increasing recovery of components and materials from products, making products more robust, avoiding use of hazardous chemicals, promoting use of renewables, and recovery of secondary materials.
Denmark	Six areas of intervention: 1. Strengthen enterprises as a driving force for circular transition. 2. Support circular economy through data and digitisation 3. Promote circular economy through design. 4. Change consumption patterns through circular economy. 5. Create a proper functioning market for waste and recycled raw materials 6. Get more value out of buildings and biomass.
Finland	Mainly cross-sectoral circular economy actions are defined for each stakeholder group: state administration, municipalities and cities, companies and citizens.
France	50 actions envisaged in four topic areas: production, consumption, management of waste, and wide stakeholder involvement.
Italy	Product design, new business and consumption models, industrial symbiosis, bioeconomy, fiscal and economic instruments, green public procurement, efficient use of resources, monitoring and indicators.
Netherlands	Five priority sectors: biomass and food, plastics, manufacturing industry, construction, consumer goods.
Portugal	Four key sectors: tourism, construction, textiles/footwear, agri-food and retail.
Slovenia	Four priority fields: food system, forest-based value chains, manufacturing industry, and mobility.
Scotland	Four priority areas: food and drink and bio-economy, energy infrastructure, construction and buildings, remanufacturing.

Source: Author.

In the countries listed in Table 1.1, circular economy initiatives have been developed typically by two leading ministries – those responsible for the environment and for the economy. In some cases, this also includes ministries responsible for industry, energy, or sustainable development. Responsibilities and competencies were typically delegated for individual tasks, for example, policy development, coordination, and monitoring. Countries usually have a centralised approach for roadmap development, unless they have a federal structure or devolved administrations with a high degree of autonomy. Several countries in Europe and Japan and China have mechanisms in place, such as working groups or task force committees, to coordinate the activities across various institutions. Other institutional arrangements include public–private partnerships. Some countries like Finland have also launched specialised agencies to promote circular economy innovation.

There are two noticeable policy trends in those countries that have developed circular economy roadmaps or action plans. First, there is generally a greater emphasis on private sector involvement and societal buy-in. Second, the role of the government is slowly shifting from that of facilitator and promoter of the circular economy model, to one of regulator and enforcer of regulations, which is evident in Japan and EU cases. At its initial stage, industries usually undertake voluntary circular economy-related initiative by developing their business model and finding partners. Governments in these economies typically intervene, such as by imposing stricter environmental regulations once the

industry expresses its readiness.

Most evolving circular economy practices have a non-mandatory/voluntary character – economic incentives, influencing consumer behaviour, providing information through various mechanisms, supporting research and innovation, green public procurement. Mandatory practices, where existing, refer to those that are related to relevant regulations such as those on waste and products.

Setting targets for the broad concept of the circular economy is found to be challenging, in part because of difficulties in measuring circularity. The few circular economy monitoring frameworks that exist in Belgium, France, Germany, and Japan consist of several indicators, drawing on indicators that are already available for waste management. They aim to cover all stages of a life cycle – production, consumption, and waste management, although typically at a macro level.

To share the good practices and to stimulate collaboration and partnership amongst stakeholders, international gatherings have been held. The Finnish Innovation Fund Sitra organised the first World Circular Economy Forum in 2017.[8] A regional reduce, reuse, and recycle (3R) forum has been organised in Asia and the Pacific region by the United Nations Centre for Regional Development since 2009. In 2020, the event was renamed Regional 3R and Circular Economy Forum.[9]

3. Circular Economy Initiatives in ASEAN Member States

The circular economy is increasingly gaining ground across Southeast Asia, with governments and companies demonstrating their political consensus, economic dynamism, and industrial innovation as they move towards this goal. Some examples of how circular economy-related policies have been developed and applied by ASEAN Member States are provided below.

The Government of Indonesia issued Presidential Regulation No. 97/2017 on Policy and Strategy for the Management of Household Waste and Household-like Waste, or *Jakstranas*, which aims to reduce household waste by 30%, and ensure treatment of 70% of household waste by 2025.[10] More recently, Indonesia is also preparing to create a circular economy system where resources and waste are managed sustainably and targeting its full implementation by 2024 (Yasmin, 2020).

Meanwhile, adopting a whole of government approach, the Government of Malaysia issued Version 3.0 of the Guidelines on Green Procurement (GGP) in October 2020 to guide government ministries and agencies on the acquisition of products, services, and works in the public sector.[11] This initiative is in line with the country's 11th Malaysian Plan, which has stated the target for 20% GGP by 2020. In 2017 alone, the initiative had resulted to the cumulative value of GGP amounting to RM482 million

[8] Further details of this event are available on the official website of the Finnish Innovation Fund at https://www.sitra.fi/en/projects/wcef/#events

[9] Further details of this event are available on the official website of the Sustainable Development Goals at https://sdgs.un.org/events/tenth-regional-3r-and-circular-economy-forum-asia-and-pacific-series-webinars

[10] The full text of the Presidential Regulation is available in the official website of the Ministry of Maritime and Fisheries Affairs of the Republic of Indonesia at https://kkp.go.id/an-component/media/upload-gambar-pendukung/djprl/P4K/Pencemaran%20Laut/Marine%20Debris/03.%20Perpres%20Nomor%2097%20Tahun%202017%20-%20Jakstranas.pdf

[11] Version 3 of the Guidelines is available on the official website of MyHijau at https://www.myhijau.my/wp-content/uploads/2021/01/GGP-Guidelines-3.0.pdf

(US$119.0 million), with cumulative CO_2 emissions reductions of 100.4 kilotons.[12]

Although no integrated circular economy or policy framework exists in the Philippines, a number of national policies and initiatives link directly and indirectly to the circular economy in a number of different industry sectors, including food processing, building, and construction (Schroeder, 2020). The country, for example, has enacted a comprehensive law on integrated solid waste management, known as the Ecological Solid Waste Management Act (Republic Act 9003), which is the main legal basis for waste management, waste prevention, and recycling in the country (Akenji and Bengtsson, 2019).

Singapore has long introduced integrated waste management measures and practices, such as the 1987 Environmental Public Health Act, the 1999 Prevention of Pollution of the Sea, and the 2002 National Environment Agency Act. With the interest on the circular economy growing rapidly in the city-state, the government of Singapore is working to develop a series of policies aimed at encouraging sustainable consumption, sustainable production and sustainable waste, and resource management (Akenji and Bengtsson, 2019). In encouraging sustainable production and consumption, the government enacted the Resource Sustainability Act in 2019, which apply the extended producer responsibility to electronic-waste and packaging by 2021, with a feasibility study is currently being conducted to extend this initiative to packaging waste.[13]

Several circular economy-related measures have also been undertaken by the Government of Thailand. To ensure the proper management of solid waste, the Government of Thailand has launched the National 3R Strategy and the National Master Plan for Waste Management (2016–2021). It has, furthermore, launched the Plastic Debris Management Plan 2017–2021, which establishes the frameworks and directions for systemic plastic waste management in the country (Withchai-utcha and Chavalparit, 2019).

Finally, although the circular economy is not clearly referred to in any of Viet Nam's existing legislation, the Government of Viet Nam has paid great attention to the minimisation and utilisation of resource consumption in many areas of the economy. Viet Nam, for example, has for a long time implemented reduce, reuse, and recycle, which encourages actions that lead to the reduction of materials consumed in the production process (Hai, et al., 2019) activities that promote the reuse or repurposing to avoid waste, and recycling initiatives. In 2020, discussions had also begun on a legal framework for the circular economy that focuses on resource efficiency.

4. ASEAN's Circular Economy-Related Initiatives

To date in ASEAN, the concept of the circular economy has been picked up mostly under the ASCC, and mainly, if not solely, from the environmental perspective. Within the AEC, whilst there are no initiatives expressly focusing on circular economy concepts related to it have been discussed or considered under selected sectors (e.g. sustainable consumption under the work on consumer protection).

The development of the Sustainable Consumption Toolkit is an ongoing project under the AEC's consumer protection programme. The toolkit is aimed at enhancing the capacity of consumer protection authorities in ASEAN to promote sustainable consumption to business, consumers, and other relevant stakeholders with information on behavioural, communications, regulatory, and

[12] MyHijau 'Green Procurement', https://www.myhijau.my/green-procurement/

[13] Towards Zero Waste. 'Circular Economy', https://www.towardszerowaste.gov.sg/circular-economy/

economic tools. The toolkit will cover five modules on promoting sustainable consumption: (i) concepts and principles, (ii) best practices and policy approaches, (iii) tools and instruments, (iv) application of tools and instruments in select industries, and (v) development of advocacy materials.

In addition to the toolkit, there are several initiatives under the AEC that are relevant to the circular economy. A few examples of ongoing projects under the key sectors of energy, transport, agriculture, finance, and standards are presented in Table 1.2.

Table 1.2. Related Initiatives under the ASEAN Economic Community

Sector	Measures / Initiatives	Status
Agriculture	Promotion of Biomass Energy for Agricultural Communities and Rural Development in ASEAN Region: to promote bioenergy development for sustainable agriculture and strengthen national policy on sustainable bioenergy development in ASEAN.	Sectoral Body: Senior Officials Meeting of the ASEAN Ministers of Agriculture and Forestry Approved by the Committee of Permanent Representatives to ASEAN on 3 April 2013, but implementation was moved to 2019 due to funding issues and extended to 2021 due to COVID-19.
Energy*	Develop and adopt an ASEAN Renewable Energy Roadmap by 2020	Postponed. Carried over to Phase II of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025.
	Complete Phase 1 and Phase 2 of the ASEAN Interconnection Masterplan Study (AIMS) III to recommend the transmission infrastructure needed to support multilateral power trade and renewable energy integration into the ASEAN Power Grid.	Ongoing
	Harmonisation and Promotion of Energy Efficiency Standards and Labelling on various kinds of energy-related products (targeted products: air conditioning and lighting).	Two major components: one targets air conditioners (AC), and the other targets lighting products. The AC component is more advanced as the sector initially viewed AC implementation as a 'pathfinder' before expanding to lighting and other products. Some milestones have been completed, but overall status is ongoing.
	Develop green building codes that support the use of high energy efficient products.	Some milestones have been completed, but overall status is ongoing.
	Develop the regional approach to renewables development	Ongoing
	Define the target and develop the plan for achieving a more ambitious energy intensity reduction target by 2025 under APAEC Phase II.	Completed and endorsed at the ASEAN Ministers on Energy Meeting in November 2020
	Energy transition towards sustainable development	One of Viet Nam's priority economic deliverables. Completed in 2020
	The energy sector also recently completed the ASEAN Plan of Action for Energy	Some energy efficiency initiatives are linked to the ASEAN Comprehensive

Sector	Measures / Initiatives	Status
	Cooperation (APAEC) 2016–2025: Phase II 2021–2025, which builds on the accomplishments under Phase I. The same programme areas are covered, including Programme Area No. 4 on Energy Efficiency and Conservation, and No. 5 on Renewable Energy.	Economy Recovery Framework and the 2021 annual priorities of the energy sector.
Finance	Roadmap for ASEAN Sustainable Capital Markets – provides strategic direction for the development of action plans and initiatives on sustainability.	Published https://www.theacmf.org/initiatives/sustainable-finance/roadmap-for-asean-sustainable-capital-markets
	ASEAN Sustainability Bond Standards – guide for the issuance of ASEAN Sustainability Bonds for financing or re-financing projects with environmental and social benefits.	Published https://www.theacmf.org/initiatives/sustainable-finance/asean-sustainability-bond-standards
	ASEAN Green Bond Standards – provides guidance on the application of the International Capital Market Association's (ICMA) Green Bond Principles across ASEAN.	Published https://www.theacmf.org/initiatives/sustainable-finance/asean-green-bond-standards
Standards	Roadmap and Action Plan To Promote Smart Manufacturing Development in ASEAN – to assess the status and provide a guide for promoting smart manufacturing in ASEAN.	One of Viet Nam's priority economic deliverables. Completed in 2020 Smart manufacturing entails intelligent and efficient processes and use of resources.
	ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEESRR)	The agreement was signed on December 2005 and implemented starting December 2010. https://asean.org/storage/images/archive/documents/AHEEERR.pdf In addition to facilitating trade on these products within the region, one of the objectives of the AHEEERR is to ensure 'the protection of human health and safety and property and the preservation of the environment insofar as they are affected by trade of electrical and electronic equipment in ASEAN'.
Transport	Guidelines for the development of Sustainable Urban Mobility Plans (SUMP) in ASEAN Metropolitan Regions and Toolbox for the establishment of Metropolitan Transport (MTE) Executives in ASEAN Metropolitan Regions	Targeted for completion by end 2021. The guidelines will provide guidance on the integration of land use planning and transport planning, whilst the toolbox will serve as a tool for government to develop a comprehensive metropolitan mobility plan and to assist in management of metropolitan transport systems, in medium-sized metropolitan regions in ASEAN.

Sector	Measures / Initiatives	Status
	Capacity building activities related to the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	ASEAN Air Transport Working Group (ATWG) will hold workshops and seminars with industry, incorporating the exchange of experience and best practices to support the effective implementation of the CORSIA.
	ASEAN Guidelines on Airport Environmental Management System (EMS)	The Guidelines will serve as reference for the implementation of environmental management system (EMS) in ASEAN airports, to enhance capability for environment protection in aviation. The Guidelines will be developed by the ASEAN Air Transport Working Group.
	Airport Study (Eco-Airport) is one of key air transport initiatives under the ASEAN–Japan Transport Partnership (AJTP)	An eco-airport training programme is organised on an annual basis.
	Several initiatives related to Sustainable Land Transport and Sustainable Maritime Transport have also been completed.	ASEAN Regional Strategy on Sustainable Land Transport (https://asean.org/storage/2019/03/ASEAN-Regional-Strategy-for-Sustainable-Land-Transport-Final.pdf) ASEAN Fuel Economy Roadmap for Transport Sector 2018–2025: with Focus on Light Duty Vehicles (LDVs) (https://asean.org/storage/2019/03/ASEAN-Fuel-Economy-Roadmap-FINAL.pdf) Guidelines on the Sustainable Transport Indicators on Energy Efficiency and GHG Emissions in the ASEAN Region (https://asean.org/storage/2019/03/Sustainable-Transport-Indicators-ASEAN-Final.pdf) Best Practices on Green Freight Logistics measures in Japan and ASEAN Member States (https://www.ajtpweb.org/ajtpcms/wp-content/uploads/2017/10/ASEAN-Japan-Best-Practices-on-Green-Logistics.pdf) ASEAN Green Ship Strategy

Note: * Two programme areas under the energy sector are related to the concept of the circular economy, one is energy efficiency and conservation, and the other is renewable energy. Several initiatives have been completed under these two, but for brevity, only the ongoing ones and select completed ones are included in the list. Under the minerals sector, the development of the ASEAN Minerals Cooperation Action Plan (AMCAP) 2016–2025: Phase II: 2021–2025 is also ongoing. AMCAP Phase I does not include circular economy concepts, but this may be considered in Phase II.
Source: ASEAN Secretariat.

Under the ASCC, the first initiative related to the circular economy was the Gap Analysis on Circular Economy for Plastics (Akneji and Bengtsson, 2019) that was completed in 2020. The study looked at the whole life-cycle of plastics – from the raw materials, production processes, use, and waste management – and identified four main gaps, i) information and knowledge, ii) policy and governance, iii) technical capacity; and iv) markets and finance. Accordingly, five policy recommendations were proposed: i) technical standards for plastics, recycled plastics, and plastics products; ii)) guidelines on circularity in plastics use; iii) phasing out a harmful additive; iv) an ASEAN-wide network for research and innovation on plastics; and v) ASEAN framework agreement on plastic pollutions.

Following through from the recommendations in the gap analysis, work on Establishing an ASEAN Circular Economy Stakeholder Platform has started. The ASEAN Circular Economy Platform aims to help achieve sustainable consumption and production in the ASEAN region by accelerating a transition to a circular economy. It would be a multi-stakeholder platform, with three main types of activities: i) an annual regional conference; ii) a knowledge and information portal for awareness raising, information sharing, and capacity building; and iii) a portfolio of collaborative projects. Strategic sectors may include industries that are significant sources of plastic waste and marine debris, and other areas or sectors could be chosen based on their significance for sustainability, including climate change mitigation potential and opportunities for creating green jobs in the ASEAN.

The ASCC also has an ongoing project on sustainable consumption and production (SCP), the Development of the SCP Framework, which is distinct from the SCP-related project under the AEC's consumer protection. The SCP framework is intended to guide collaboration and coordinated investment in efforts between interested partners in regional and national level activities, with a view of strengthening synergies and bringing all networks together for greater collective impact in the region. It is expected to be a key step for the ASEAN Member States (AMS) to mainstream SCP, and possibly the circular economy, into the regional action plan that will assist multi-stakeholders in designing and implementing specific policy-oriented and approaches to shift towards SCP. Based on the scope of the above-mentioned initiatives, some of these are actually inter-related. Nonetheless, at present there is no clear evidence of cross-sectoral, let alone cross-pillar conversation or coordination on this topic within ASEAN.

5. Circular Economy Frameworks/Criteria and Entry Points for the AEC

Given the cross-dimensional nature of the circular economy, achieving transformation towards the circular economy requires ASEAN to adopt a dramatic transformation and systemic approach in addressing cross-cutting sustainable economic development policy areas. In this regard, three elements have been identified to serve as indicative criteria to facilitate the framing for circular economy work across different AEC sectors:

Prioritising regenerative resources and use waste as resource: This involves initiatives that ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way (Circular Economy, n.d.), such as the utilisation of waste streams along the value chains and the recovery of waste for reuse and recycling.

Rethinking creative business models: Circular business models are key levers for the implementation of a circular economy (Geissdoerfer, et al., 2020). This includes the development of innovative business models that create value and align economic incentives through public–private partnerships.

Designing for the future: This involves the adoption of systematic approaches during the industrial design process that encourages the utilisation of appropriate materials to ensure extended lifetime of products.

In considering the adoption of the circular economy across the different AEC sectors, it is important to identify sectoral and/or area entry points in which the circular economy concept can be effectively applied in the AEC. One point of reference is ERIA's 2020 scoping study for Advancing ASEAN Roadmap to a Circular Economy, which included an online survey and consultation conducted with experts, business leaders, and policymakers, particularly those in environmental agencies, across ASEAN that identified five sectors: agriculture, food and forestry, mining, construction, manufacturing, and transport, as priority for the circular economy (ERIA, 2020a).

Collectively, these sectors account for more than half of resource and energy use. They cover the three largest sectors (agriculture & forestry, mining, and construction in terms of employment) and growth expectations (manufacturing and transport). Taken together food and transportation accounts for more than two-thirds of household spending in urban centres of ASEAN (ERIA, 2018). The increased use of recycled material, and the new service-based sharing economy models offer these sectors opportunities for circular innovations and experimentations (ERIA, 2020b). Some of these high-potential economic sectors already have sectoral bodies in ASEAN (ASEAN Ministerial Meeting on Agriculture and Forestry for agriculture, food and forestry; ASEAN Ministerial Meeting on Minerals for mining; ASEAN Transport Ministers Meeting for transportation), whilst manufacturing and construction are covered under the ASEAN Consultative Committee for Standards and Quality. Other sectors under the AEC that have also initiated circular economy-related initiatives, such as energy, finance, and science and technology, can also serve as initial sectoral entry points for AEC work on the circular economy.

In developing a circular economy environment for ASEAN, the ASEAN Framework on the Circular Economy under the AEC should adhere to and complement the following ASEAN principles and realities:

Principle 1: Conceptualise the circular economy within the reality of international production linkages.

The fact that inputs from other AMS and non-ASEAN partners are used heavily in production of goods in the region means that the notion of the circular economy has to be cross-border in nature. Likewise, due to reliance on export-oriented economic growth, the ASEAN-specific circular economy strategy needs to recognise and respond effectively to those adopted by key trade partners (the ASEAN+6 countries [Australia, China, India, Japan, Republic of Korea, New Zealand] and the European Union) in order to ensure open and seamless trade linkages. This is as reflected in Vision 10 of the AEC 2025 Blueprint: 'work towards a common position and enhance ASEAN's role and voice in global economic fora.'

Principle 2: Support and enhance ASEAN integration and promote development of a single production base.

This principle is related to Characteristic 1 of the AEC 2025 Blueprint '*highly integrated and cohesive ASEAN economy*'. This means, for example, ensuring transparency of any new measures for the circular economy, creating least possible disruption to flow of goods within the region.

Principle 3: Ensure adequate impact asessment of circular economy policies on production cost and market prices, especially in sectors relevant to micro, small, and medium-sized enterprises (MSMEs).

This requires active engagement with the private sector, as articulated in Vision 4 'responsive regulatory regimes' of the AEC 2025 Blueprint.

Principle 4: Acknowledge the development gap and thus, ensure the adoption of circular economy principles and practices are in support of long-term growth prospects.

Principle 5: Enshrine the ASEAN way by ensuring ASEAN-wide coordination, e.g. through the mutual recognition arrangements of circular economy standards.

Principle 6: Ensure that financial sustainability and feasibility of circular economy-related projects and initiatives are carried out before moving forwards.

Therefore, it is most important that the ASEAN Circular Economy Framework under the AEC guide ASEAN Member States in their policy and regulatory approaches in developing their respective measures or initiatives in ASEAN. It is important that all future ASEAN economic initiatives take the principles mentioned above before developing further in order to incorporate a circular economy .

6. Circular Economy Enablers for ASEAN

In ensuring the acceleration of the adoption and scaling-up of circular economy principles as mentioned above, circular economy enablers are key in reducing costs and increasing customer and market acceptance of more circular business models (World Economic Forum, 2014). With regard to ASEAN, a number of circular economy enablers can be taken into consideration:

Policy framework and institutions: These can play important roles in guiding the AMS in pursuing appropriate policy interventions to encourage circular economy in the region, encourage and direct private sector and consumers towards circular business models and consumption patterns, and determining the right institutions involve in strategising and designing relevant regional circular economy initiatives.

Enhanced awareness and competences across sectors: Although the circular economy has evolved as a result of the growing environmental awareness and legislation, as well as the need for social responsibility, awareness of the issue remains lacking, with practices further behind than they should be (Liakos, et al., 2019). Awareness rising and strengthening of capacity with regard to circular economy are, therefore, key to ensuring effective implementation of circular economy-related initiatives in the region.

The Fourth Industrial Revolution (4IR) for the circular economy: Restorative and regenerative by design, the circular economy promotes the efficient use of materials along with the reduction and, ultimately, elimination of waste. 4IR technologies, such as artificial intelligence, machine learning, the Internet of Things, Big Data, Blockchain, robotics, and so on, have proven to be effective in promoting circular business model in several industries, such as information and communication technology, mining and manufacturing, education, healthcare, and others. Adapting circular business model could also provide business opportunities, especially for start-ups. The new 4IR frontier can further unlock the potential of the circular economy, and, eventually, restore nature's cycles.

Partnership and collaboration: The circular economy model emphasises the need for engaging all relevant stakeholders, and this requires the shift from a 'customer-oriented' approach, which is

typically focused on the economic dimension, to the 'multiple stakeholder' perspective that is rooted in integration and circularity principles (Salvioni and Almici, 2020). In the context of ASEAN, multi-stakeholder perspective is also needed to bridge better sustainability-related initiatives undertaken by different pillars of ASEAN Community, whilst partnerships with ASEAN's external partners, such as in the areas of knowledge sharing and resource mobilisation, will be key in ensuring successful implementation of circular economy-related initiatives in the region.

Chapter 2

Navigating ASEAN's Circular Economy Transition in the Agriculture, Energy, and Transport Sectors

The world has started to recognise the importance of economic sustainability and resilience, and several collective initiatives have been made. At the global level, some of the efforts to reduce greenhouse gas emissions, for example pledges made by ASEAN Member States (AMS) in the Paris Agreement at the 2015 United Nations Framework Convention on Climate Change (UNFCCC). In ASEAN itself, guidelines for sustainability can be identified under the AEC Blueprint 2025, Section B.8. Furthermore, the ASEAN Framework on the Circular Economy has been published as a non-binding guideline for the AMS to start transitioning into more sustainable, resilient, and inclusive growth. This report has identified Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), Malaysia, the Philippines, Singapore, Thailand, and Viet Nam who have started or utilised technologies who helped them achieving a circular economy.

1. Brunei Darussalam

The circular economy is still in its early stages in Brunei Darussalam, with no official definitions of the circular economy or green products and services. However, there has been a rise in circular economy-related initiatives by the government, the private sector, and the community in recent years. The circular economy is recognised at the national level in *Wawasan Brunei 2035*, with 12 national outcomes, 28 key areas, and 37 key performance indicators (KPIs), including circular economy-related metrics such as the resilient and sustainable city index and the green city index. The Ministry of Finance and Economy launched the *Brunei Darussalam Economic Blueprint* (MOFE, 2020), which includes six aspirations: Productive and Vibrant Businesses; Skilled, Adaptive, and Innovative People; Open and Globally Connected Economy; Sustainable Environment; High-Quality and Competitive Economic Infrastructure; and Good Governance and Public Service Excellence. The blueprint is also supplemented by industry roadmaps detailing the implementation plans of the five priority sectors: downstream oil and gas, food, tourism, information communications and technology (ICT), and services including transport, logistics, and maintenance, repair, and overhaul. Brunei Darussalam's policies related to the circular economy are aligned with the country's long-term vision, relevant to international and regional agreements and frameworks such as the United Nations Sustainable Development Goals (SDGs), the UNFCCC, Kyoto Protocol, Paris Agreement, the AEC, and the ASCC.

Another crucial dimension to a successful circular economy is finance. In this regard, the Brunei Darussalam Central Bank has been tasked to facilitate the issuance of green sukuk (Islamic bonds). Under the Brunei Darussalam National Climate Change Policy, the Islamic Bank of Brunei Darussalam has committed B$2 billion towards sustainability funding by 2030, which was recently announced during the ASEAN Business and Investment Summit 2021.

1.1. Agriculture

The primary sector – agriculture, fisheries, and forestry – has specific initiatives or regulatory measures to ensure sustainability, such as good agricultural, husbandry, and aquaculture practices, control and prevention of overfishing, the Brunei Selection Felling System, and the National Forestry Policy.

The main national legislation for the primary sectors are the Brunei Darussalam Fishery Limits Act (Chapter 130), Fisheries Order 2009, Forest Act (Chapter 46), Wildlife Protection Act (Chapter 102), and Wild Flora and Fauna Order 2007. Laws related to food are Public Health (Food) Act (Chapter 182), and Halal Meat Act (Chapter 30). At the international and regional level, Brunei Darussalam is party to the United Nations Convention on the Law of the Sea, the ASEAN–Southeast Asian Fisheries Development Center's Joint Declaration on Regional Cooperation for Combating Illegal, Unreported and Unregulated Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products, the Convention of Biological Diversity, and the Asian Forest Cooperation Organization.

Agriculture: Institutions and Players

The Ministry of Primary Resources and Tourism is tasked to enhance the growth of the primary resources sectors (agriculture, fisheries, and forestry) to achieve *Wawasan Brunei 2035*. The Brunei Darussalam Food Authority also looks after food safety and quality and the Halal Food Control Division oversees the importation of Halal meat products.

1.2. Energy

The energy sector is a core driver of Brunei Darussalam's economy, accounting for more than half of the gross domestic product (GDP) and three-quarters of exports and government revenue. A key policy document is the Energy White Paper released in 2014, which includes strategies related to energy efficiency and conservation and promotion of renewable energy sources. Another key policy document is the National Climate Change Policy that was launched in 2021, providing a structured pathway to drive decarbonisation efforts towards a low-carbon and climate-resilient future. The main goal is to reduce greenhouse gas (GHG) emissions by more than 50% compared with a business-as-usual scenario. Brunei Darussalam so far has issued policy initiatives on energy efficiency and conservation, renewable energy, and climate change (BCCS, 2020).

The legislation in Brunei Darussalam that regulates the mining, exploration, and production of energy resources is mainly contained in the Mining Act, the Petroleum Mining Act, the Petroleum Pipelines Act, and the Electricity Act. The country has also established subsidiary legislation and guidelines to promote the circular economy in the energy sector, such as the Prevention of Pollution of the Sea Order, Environmental Protection and Management Order, and Energy Efficiency (Standards and Labelling Order). Brunei Darussalam has ratified international agreements and frameworks related to climate change, including the UNFCCC, the Kyoto Protocol, and the Paris Agreement. In line with its commitment to reduce GHG emissions, the country submitted its first Nationally Determined Contribution to the UNFCCC with a 20% reduction target by 2030 and declared a net-zero target by 2050 at the Conference of Parties in Glasgow, Scotland in 2021 (COP26). Its climate change policies are aligned with SDG 13, and its energy efficiency and renewable energy targets are consistent with the goals under the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025. On climate change, Brunei Darussalam is guided by the ASEAN Working Group on Climate Change Action Plan 2020–2025. Moreover, Brunei Darussalam is a party to the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol, and the Basel Convention on the Control of Transboundary

Hazardous Movements of Hazardous Wastes and their Disposal. Regional involvement is mainly through the ASEAN Socio Cultural Community (ASCC) sectoral areas on environment and transboundary haze.

Energy: Institutions or Players

As a central development institution of country's energy sector, the Ministry of Energy along with its departments, the Sustainable Energy Division and the Petroleum Authority of Brunei Darussalam, the Ministry of Energy has also been exploring the potential of carbon capture utilisation and storage (CCUS) to mitigate emissions from the oil and gas industry. Another regulatory authority, Autoriti Elektrik Negara Brunei Darussalam, oversees the activities of the electricity industry, including the development of a more efficient and sustainable industry.

1.3. Transportation

The transport sector is responsible for 50% of Brunei Darussalam's energy consumption, with cars alone accounting for nearly 80% of that. In 2014, the Land Transport White Paper was launched with two key strategic goals: to reduce car dependency and to safeguard the environment. To achieve these goals, the government has implemented several policy initiatives such as environmental impact assessments, enhancing emissions standards and labelling for all vehicles, improving alternative transport modes, and reviewing fuel subsidies whilst ensuring low-income groups can still meet their basic travel needs. The Strategic Plan for the Ministry of Transport and Infocommunications (MTIC) 2025 also includes increasing the number of hybrid and electric vehicles by 50% and increasing bus ridership by 10% by 2025. The government aims to minimise growth in car ownership and reduce the transport sector's impact on the environment whilst minimising GHG emissions.

The main national legislation initiatives on transport are the Road Traffic Act (Chapter 68) and the Maritime and Port Authority of Brunei Darussalam Order 2017. Brunei Darussalam is a party to several international and regional agreements affecting the transport sector, such as the ASEAN Framework Agreement on the Facilitation of Goods in Transit, the ASEAN Framework Agreement on Facilitation of Inter-state Transport, the ASEAN Framework Agreement on Multimodal Transport, the ASEAN Framework Agreement on Cross-Border Transport of Passengers by Road Vehicles, and the Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area Memorandum of Understanding on Transit and Inter-State Transport of Goods. However, circular economy elements in the national legislation and international and/or regional agreements are limited.

Transportation: Institutions and Players

For institutions, the MTIC oversees the development of the transport and information and communication (ICT) sectors as well as spearheading the national research and development (R&D) and innovation agenda. The MTIC consists of the Land Transport Department, the Department of Civil Aviation, and the Maritime and Port Authority of Brunei Darussalam. The Muara Port is the only deep-water port and main gateway of international trade, whilst the Brunei International Airport is the only international gateway for departures, arrivals, and transit. Darussalam Assets is a private limited company set up to own government-linked companies. Its portfolio of companies includes aviation and logistics, such as Royal Brunei Airlines, Brunei International Airport Cargo Centre, and Muara Port Company. The main trade associations in the transport sector are Brunei Automobile Traders

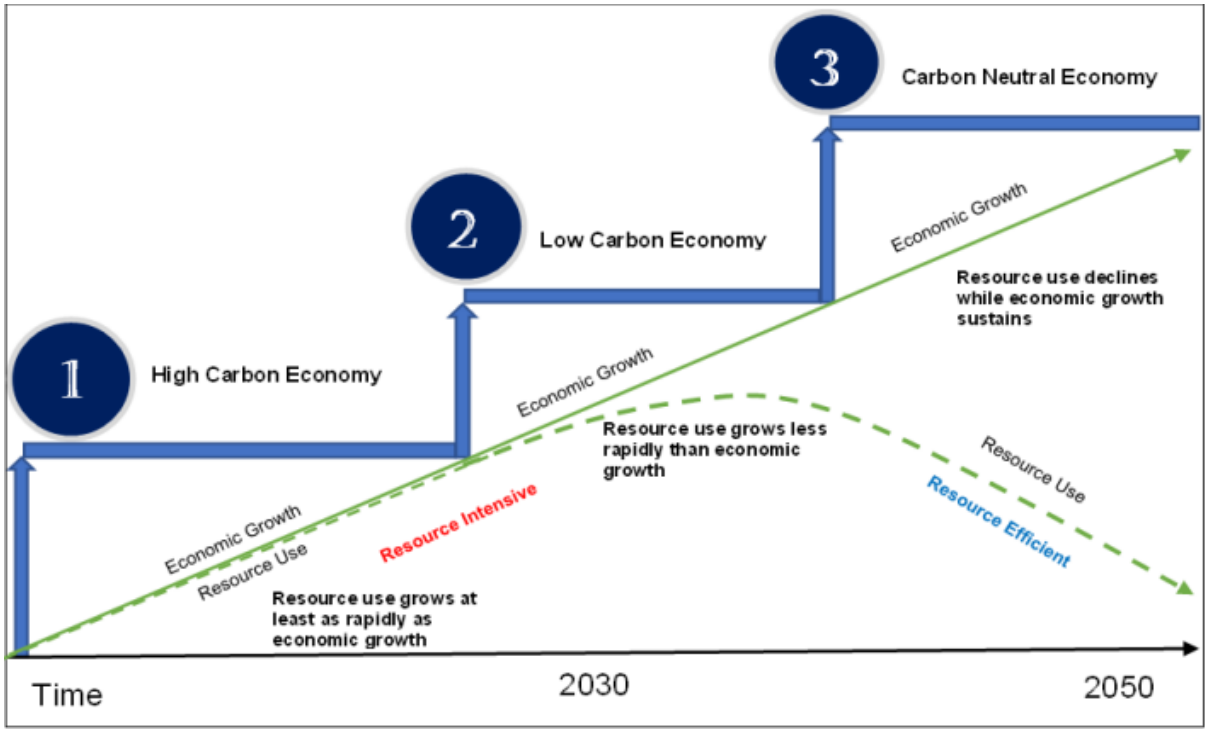
Association, Shipping Association of Brunei Darussalam, and Brunei Darussalam Freight Forwarders Association.

2. Cambodia

Rapid economic development, improved income, and population growth have led to high demand in energy consumption, high waste generation, and high GHG emissions. Cambodia's economy has experienced robust growth over the last 2 decades, with an average annual growth rate of 7.3% between 1995–2020. The share of agriculture in Cambodia's GDP was 22%, industry contributed approximately 35%, and the services sector contributed about 37% in 2020. The per capita GDP has increased from $323 in 1995 to $1,643 in 2019 before dropping to US$1,544 in 2020 (Royal Government of Cambodia, 2019; World Bank, 2022). Cambodia aims to become an upper-middle income country by 2030 and a high-income country by 2050.

The economic growth of Cambodia must consider resource efficiency. Otherwise, the country will face environmental challenges such as natural resource depletion, energy shortages, increasing levels of soil and air pollution and GHG emissions. There is also a risk from climate change. According to the study conducted by the Ministry of Economy and Finance and the National Council for Sustainable Development in 2018, climate change could reduce Cambodia's GDP in 2015 by 10%. According to the Global Climate Risk Index, Cambodia was ranked 12th out of 181 countries as the most climate risk-prone country in the period 1999–2018, indicating high vulnerability to extreme weather events (Eckstein, et al., 2020). Therefore, Cambodia's development pathway needs to integrate the circular economy to promote resource efficiency and sustainable production and consumption (Figure 2.1). Currently, Cambodia has put in place key policies and strategies to promote the circular economy, such as the Rectangular Strategy for Growth, Employment, Equity, and Efficiency (2019–2023); the National Strategic Development Plan (2019–2023); Cambodian Sustainable Development Goals Framework (2016–2030); National Circular Economy Strategy and Action Plan 2021; Cambodia's Updated Nationally Determined Contribution (NDC); Long-Term Strategy for Carbon Neutrality in Cambodia (LTS4CN) (GSSD and MOE, 2021b); Cambodia Climate Change Strategic Plan 2014–2023; and Cambodia's National Cooling Action Plan and National Strategic Plan on Green Growth 2013–2030.

Figure 2.1. Cambodia's Pathways towards Carbon Neutral Economy by 2050 Structural Changes
(investment, technology adoption, behaviour changes, etc.)



Source: Author.

In line with the updated NDC, ministries have submitted their proposed priority mitigation actions. For vulnerable sectors, actions (58 in total) will be directed to agriculture (17 actions), coastal zones (2 actions), energy (2 actions), human health (5 actions), industry (1 action), infrastructure including roads, buildings and urban land use planning (15 actions), livelihoods, poverty and biodiversity (7 actions), tourism (3 actions), and water resources (6 actions). For enablers, there are 29 actions focusing on education (4 actions), gender (6 actions), governance (2 actions), information (4 actions), knowledge sharing (1 action), and policy and planning (12 actions).

2.1. Agriculture

Agriculture is one of the major sectors that has the potential to switch to the circular economy according to the Circular Economy Strategy and Action Plan (GSSD and MOE, 2021a). The agriculture sector produces large volumes of waste and one of the circular economy opportunities is to increase the use of biodigesters, which could be supported by the National Policy on Biogas in Cambodia (2016–2025). The policy targets mainly animal waste as inputs for producing biogas for cooking and other household use purposes (MAFF, 2016). Thus, animal waste generation is avoided. The LTS4CN mapped the starting point of the agriculture sector towards carbon neutrality by 2050, such as arranging less methane-intensive rice cultivars, direct seeding practices, alternate wetting and drying practices, promotion of organic fertiliser and deep fertiliser technology, feed additives for cattle, improved fodder management, introduction of composting technology (Royal Government of Cambodia, 2021).

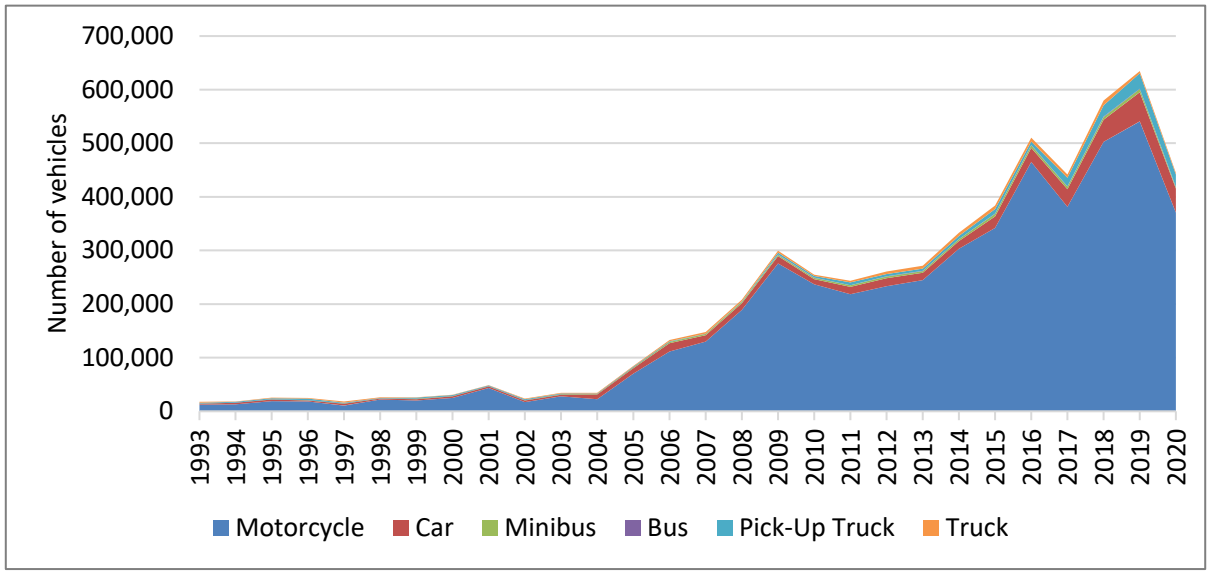
2.2. Energy

The Royal Government of Cambodia has been working to develop several policies in response to the increasing demand of energy consumption due to strong economic growth in the last decades. Policies such as the Draft National Energy Efficiency Policy 2018–2035 and the Draft Sub-decree on Energy Efficiency Standards and Labelling for Electrical Appliances and Equipment by the Ministry of Mines and Energy aim to ensure that the consumption of energy is more efficient, in addition to meeting the growing demand. These policies also clearly respond to the goal of the circular economy in increasing efficiency in natural resource consumption by implementing the minimum energy performance standards (MEPS) and energy efficiency labelling on regulated electrical appliances and equipment (Royal Government of Cambodia, 2020). A case study was documented on waste-to-energy (WTE) in Tbong Khmum province of Cambodia (ADB, 2020). The LTS4CN mapped the starting point of the energy sector towards carbon neutrality by 2050, such as no new coal generation capacity beyond commitment, substitution of coal in the industry and power sector, use of natural gas as a dispatchable transition fuel, increase renewables, investment in LNG import, storage, and infrastructure, including grid modernisation and energy storage (Royal Government of Cambodia, 2021).

2.3. Transportation

The number of registered vehicles has been increasing in line with increasing economic activity and population. As of 2020, more than 5.8 million vehicles were registered. Motorcycle registrations have increased by 10% per year since 2005, and as of 2020, motorcycles represented around 85% of all vehicle registrations. There are 4,974,486 registered motorcycles, 615,133 registered cars, and 260,808 registered heavy vehicles (minibuses, buses, pick-up trucks, and trucks) (Figure 2.2).

Figure 2.2. New Registrations of Vehicles, Cambodia, 1993–2020



Source: Ministry of Public Works and Transport, Cambodia (MPWT) (2021).

Most vehicles in Cambodia are fossil-fuel based. The National Policy on the Development of the Land Transport Sector 2021–2030 (MPWT, 2021a) and the Climate Change Action Plan for the Transport Sector 2020–2023 are developed to promote the use of low-emissions vehicles and thus, supporting the transition to the circular economy in terms of the transport sector in Cambodia. The LTS4CN

mapped the starting point of the transport sector towards carbon neutrality by 2050, such as more use of public transport, penetration of electric vehicles, use of rail for freight and passengers, including penetration of compressed natural gas (CNG) for interregional buses and trucks (Royal Government of Cambodia, 2021).

Agriculture, Energy, and Transportation: Institutions and Players

Transformation into circularity in agriculture is led by the Ministry of Agriculture, Forestry and Fisheries, whilst for energy is led by the Ministry of Mines and Energy, and transport by the Ministry of Public Works and Transport (MPWT).

3. Indonesia

The circular economy initiative has come under different names in Indonesia for years. In 2021, the Coordinating Ministry for Economic Affairs adopted the circular economy concept into its vision with focus on five sectors as follows: (i) food and beverage, (ii) construction, (iii) electronics, (iv) textiles, and (v) plastics (Fardaniah, 2014). Meanwhile, the Ministry of National Development Planning (Bappenas) is the main conductor in setting up the circular economy plan in Indonesia. This role is mandated by the national legal frameworks. For the first time in Bappenas history, the circular economy concept is mentioned and included in the National Medium-Term Development Plan *(*RPJMN) 2020–2024 (Bappenas, 2022). The Indonesian government through its ministries has started implementing the circular economy in many sectors, even though most of them are in an early stage. Currently, there are efforts amongst the Ministry of Agriculture (MOA), the Ministry of Energy and Mineral Resources (MEMR), and the Ministry of Transportation (MOT) (MOT, 2022) to synchronise each policy with the RPJMN 2020–2024. Indonesia aims to reduce greenhouse gas emissions by 29% with a business-as-usual scheme in 2030 and hopefully achieve 41% with international collaboration (Ministry of Environment and Forestry, 2017).

Indonesia has enacted Law No. 7/2021 on the Harmonization of Taxation Regulations and Presidential Regulation No. 98/2021 on the Implementation of Carbon Economic Value to Reduce Greenhouse Gas Emissions to introduce carbon taxes and require certain private sectors to take measures to prevent or minimise the causes of climate change. Private sectors in food, water, energy, health, and ecosystems must take mitigation steps to prevent climate change. These regulations will also strengthen the implementation of carbon trading and facilitate the use of carbon credits. Before the introduction of these regulations, foreign trade schemes had been used due to the lack of legal frameworks for national carbon trading. East Kalimantan's Forest carbon credit facility programme has pledged to reduce 86.3 metric tons of carbon dioxide equivalent (MT CO_2e) from 2020 to 2024 at a carbon price of $5 per ton CO_2e, but this is considered under-priced in the current market. Indonesia sets a net-zero emissions target by 2060 or sooner following the Long-Term Strategies for Low Carbon and Climate Resilience 2050 commitment (Government of Indonesia, 2021).

Bappenas is the leading ministry in developing the circular economy adoption plan, and further details on the circular economy will be revealed in the RPJMN 2025–2029 (Bappenas, 2022). Bappenas is also in its efforts in finding the best circular economy concept from other leading countries. Bappenas does not have the authority in coordinating the circular economy adoption and implementation within the ministries and local government but only provides guidance (Bappenas, 2022).

3.1. Agriculture

The shift into the circular economy in agriculture is guided by the Masterplan on Agriculture Development 2013–2045. The masterplan is in line with Law No. 22/2019 on Sustainable Agriculture Cultivation System which aims to (i) manage natural resources to be in line with agricultural commodity production; (ii) determine relevant agricultural technology and equipment with reference to the national standard (*Standar Nasional Indonesia,* SNI); (iii) improve product control and management; and (iv) aim for zero-waste in 2045.

Prior to the Coordinating Ministry for Economic Affairs' circular economy vision announcement in 2021, the circular economy has been closely linked or identical to waste management. The Ministry of Environment and Forestry (MOEF) enacted Law No. 18/2008 on Waste Management. The law is deemed as the early stage in shifting from a linear economy to implementing the circular economy without explicitly using 'circular economy' terminology (MOEF, 2022). The MOEF currently focuses, amongst others, in empowering Indonesian waste banks, improving domestic plastic waste quality, providing fiscal incentives for waste recycle, and setting up cross-ministerial cooperation to limit or ban recycled plastics and paper raw materials import (MOEF, 2022). However, the establishment of waste bank infrastructure depends on the Ministry of Industry (MOI). The MOA has also conducted some programmes with small and medium-sized enterprises (SMEs) in the implementation of the circular economy. In agriculture, Law No. 22/2019 covers the sustainable agriculture cultivation system. The MOA has also issued updated regulations on sustainable palm oil plantation certification through Minister of Agriculture Regulation No. 38/2020 on Implementation of Sustainable Palm Oil Plantation Certification in Indonesia.

3.2. Energy

There are several identified guidelines for energy transitions. Presidential Regulation No. 22/2017 on National Energy General Plan targets an energy mix consisting of oil (25%), gas (22%), coal (30%), and new and renewable energy (23%). Moreover, the National Energy Policy 2014 encourages the importance of renewable energy and to reduce fossil-based energy utilisation, and the National Energy Masterplan 2017 encourages trans-sectoral coordination on national energy utilisation and provides further detail regarding its implementation plan.

With regards to the energy sector, Indonesia has established and enacted the national energy management blueprint 2006–2025 based on Presidential Regulation No. 5/2006 and Law No. 30/2007. To reduce fossil-based energy, Government Regulation No. 79/2014 on National Energy Policy has been enacted, where one focus is to reduce Liquefied Petroleum Gas (LPG) imports (National Energy Council of Indonesia, 2021). To add, Indonesia has issued laws (Law No. 27/2021) on the Harmonisation of Taxation Regulations, which includes carbon tax and carbon trading provisions, government regulation on waste management and green environment economy instrument, and presidential regulation on marine debris mitigation and waste management, to name a few.

The Ministry of Energy and Mineral Resources Regulation Number 26 of 2021 (MEMR 26/2021) on Solar PV Connected to The Power Supply Grid Owned by the Holders of Power Supply Business Licence for the Public Interest, currently regulates the installation of solar panels for public use. The electricity generated from solar panels can be exported to the network system owned by the holders of power supply business licences that could help to reduce electricity bills. The maximum installation capacity is 100%, customers only need to pay the installation of the metres for electricity export and import.

The capacity charge and costs for purchasing emergency electrical energy are free, except for industrial needs.

3.3. Transportation

The 'green transport' terminology is found in the Ministry of Transportation Strategic Plan 2020–2024 (or Minister of Transportation Regulation No. 80/2020) and aims to reduce carbon emissions to be in line with the goals of Paris Agreement of 2015; improve sustainability transportation quality and ensure any technology utilised is environmentally friendly, and to mitigate climate change.

Transportation: Laws and Regulations

For fuel and low-cost green cars (LCGC), the government also issued Presidential Regulation No. 191/2014 plan to eliminate more emitting fuel. Government Regulation No. 41/2013 to introduce LCGCs and set up tax exemptions for energy efficient cars; which was amended by Government Regulation No. 74/2021 to include 15% luxury selling tax and 40% basic selling tax for full hybrid vehicles with maximum 3,000 cc. MOI Regulation No. 36/2021 is enacted to implement Government Regulation No. 74/2021, where 0% luxury selling tax is currently set. Furthermore, the Ministry of Transportation Regulation No. KP 201/2013 provides guidelines to land (including train and railways), water, and air transport sectors to mitigate carbon emissions. The issues regulated, amongst others, are mass-rapid transportation development and biofuel utilisation.

Agriculture, Energy, and Transportation: Institutions and Players

Bappenas is the main conductor in setting up the circular economy plan in Indonesia. Bappenas works alongside the Ministry of Agriculture, the Ministry of Energy and Mineral Resources, and the Ministry of Transportation. Some projects rely on coordination with other ministries, such as fiscal incentives (Ministry of Finance), production plan (Ministry of Industry), and business plan (Ministry of State-Owned Enterprise).

4. Lao People's Democratic Republic

The Lao PDR is a significant exporter of resource- and agriculture-based products and has developed a vision for a circular economy that protects its natural and cultural ecosystems. In 2017, with the support of the United Nations Development Programme, circular economy strategies for the Lao PDR are developed by the Institute of Renewable Energy Promotion under the Ministry of Energy and Mines. The country made considerable progress towards achieving a circular economy that focuses on reducing the input of raw materials, improving the use of existing assets, and lowering the output of harmful waste, particularly greenhouse gases (MEM and UNDP, 2017). The concept of the circular economy was integrated into the National Green Growth Strategy till 2030 (Government of Lao PDR, 2018), the Lao PDR's Nationally Determined Contribution (Government of Lao PDR, 2021a), and the 9th National Socio-Economic Development Plan 2021–2025 (NSEDP). The NSEDP emphasises that economic growth must go hand in hand with sustainable, efficient, and effective use of natural resources by ensuring the lifespan and quality of products in compliance with the concept of the circular economy aimed at reducing, reusing, and recycling to create added value (Government of Lao PDR, 2021). Key sectors for the circular economy in the Lao PDR include the energy sector, particularly hydropower dams, and the agriculture and forestry sector, with the aim of developing a green-based

economy. The government has also recently issued a policy to promote electric vehicles and reduce fuel imports, further contributing to its efforts towards a circular economy.

4.1. Agriculture

The agriculture sector in the Lao PDR has the potential to contribute significantly to economic growth and inclusivity (ADB, 2018). The Agriculture Development Strategy and Vision to the Year 2030 aim to ensure food security, produce competitive agricultural commodities, and shift gradually to modernisation and industrialisation of agriculture, contributing to the national economic basis (MAF, 2015). The policies are based on various references, including the Resolution of the 11th Lao People's Revolutionary Party Congress (2021–2025), the 9th National Socio-Economic Development Plan (2021–2025), and the National Green Growth Strategy until 2030. A National Green Growth Steering Committee has been established to integrate green growth into sectoral and local development plans 2030 (Government of Lao PDR, 2018), The 9th National Socio-Economic Development Plan is set in line with green and sustainable development and focuses on quality development, green development, and inclusive sustainable development to ensure economic growth goes hand in hand with socio-cultural development. The plan aims to improve people's well-being, ensure a balanced system for international trade and settlement, and prepare for the country's smooth graduation from the least developed country status. Other than the NSEDP, the National Green Growth Strategy of the Lao PDR until 2030 (Government of Lao PDR, 2018) integrates green growth into sectoral and local development plans.

Agriculture: Institutions and Players

The National Green Growth Strategy is under the responsibility of the Ministry of Natural Resources and Environment, and the Ministry of Agriculture Forestry. Agriculture and natural resource management policies have been revised every 5-year years.

4.2. Energy

The energy sector plays a key role in the economic development of the Lao PDR. From 2016 to 2020, the country has been able to export electricity to five countries (Thailand, Viet Nam, Cambodia, Myanmar, and Malaysia) with the estimated value of US$7.2 billion, an increase of 164% compared to the export figure between 2011 and 2015 (Government of Lao PDR, 2021). The Lao PDR has large hydropower potential, and a major portion of existing hydropower capacity is for power exports. The key energy sector objectives of the government include bringing electricity to all by expanding and improving the main grid or, where cost effective, by off-grid electrification; and earning foreign exchange by setting up export-oriented hydropower projects and exporting electricity (ADB, 2010). The Lao PDR is also endowed with significant resource potential for non-hydro renewable energy that includes solar, biomass, small or mini-hydro, and wind – which are currently being explored to substitute hydropower when electricity generation does not meet the needs of the low water season. Through its Renewable Energy Development Strategy, 2011–2025, the country is seeking to promote large non-hydropower renewable resources to reach a 30% share of the country's total energy demand by 2025 (Government of Lao PDR, 2011). The Lao PDR has issued several policies, including the NSEDP 2021–2025, which emphasises a need to review the strategy for electricity development, review state-owned enterprises in the energy sector, and strengthen the knowledge and green economy through new technologies. Additionally, the government also issued the Renewable Energy Development Strategy 2011–2025; Policy on Sustainable Hydropower; and Power Development Plan

which is prepared by Électricité du Laos (EDL) that aims to promote SMEs in green and sustainable directions, encourage tourism-supporting businesses to use natural resources and energy more efficiently, and reduce waste. In the energy sector, the main law governing the electricity supply in the Lao PDR is the Electricity Law 1997, amended in 2012. Further guidance is provided in the Power Sector Policy Statement 2001, the 9th NSEDP 2021–2025, the Renewable Energy Development Strategy (2011), the Policy on Sustainable Hydropower, and the Power Development Plan by EDL.

Energy: Institutions and Players

For responsible institutions, the Ministry of Energy and Mines (MEM) is the main responsible government stakeholder for the energy sector of the country that controls energy policy, strategy, and management of the energy industries across the country, including supervising activities of several state-owned enterprises involved like EDL. The Ministry of Finance provides support to the role of MEM by ensuring financial management and accountability within the sector. It is also in charge of strategy and investments of the aforementioned state-owned enterprises as well as the Lao Holding State Enterprise. The Ministry of Planning and Investment (MPI) and Ministry of Natural Resources and Environment (MONRE) also provide additional oversight to the MEM (ADB, 2019).

To sustain the energy sector, it is recommended to evaluate market demand trends to be in line with the electricity supply by using more prudent assessment methods to ensure profitability and sustainable energy consumption. Therefore, effective energy management measures are needed to increase economic competitiveness and reduce greenhouse gas emissions and other emissions (Government of Lao PDR, 2021).

4.3. Transportation

Major policies in the transport sector are described in the 5-year development plan (2021–2025) by the Ministry of Public Works and Transport (MPWT) to develop the sector to be a leading, specific priority, highly effective, modern, safe, climate resilience, integral and sustainable sector. Through the NSEDP 2021–2025, the government is particularly interested in transforming a landlocked country into a land-linked nation. This would see the Lao PDR as a point of connection amongst neighbouring countries, bridging China, Thailand, and Viet Nam. The country strongly depends on road transport for internal and external trade. Significant advances have been realised for which the road network has been extended from just 14,000 kilometres in 1990 to over 44,000 kilometres in 2012 (ADB, 2012). Currently, the Lao PDR–China Railway (from Boten to Vientiane) as a part of China's Belt and Road Initiative, was completed and has been in operation since December 2021 (World Bank, 2020). Major policies in the transport sector are described in the 5-year development plan (2021–2025) by the MPWT. The sector vision is to 'develop the sector to be a leading, specific priority, highly effective, modern, safe, climate resilience, integral and sustainable sector'. The development plan outlines several goals: (i) high quality and reliable regional and internal connectivity in the ASEAN and the Greater Mekong Subregion; (ii) an efficient transport service that creates comprehensive logistics systems and reduces transport costs, (iii) improvement of infrastructure quality for climate resilience, (iv) road safety, (v) sustainable urban development, (vi) development of infrastructure that supports social development of rural communities, (vii) ensuring access to water, (viii) contribution to economic growth 7% of GDP per year, (ix) balances socioeconomic development through maintenance of infrastructure and investments, and (x) environmental improvements towards implementing the green growth strategy and reducing environmental pollution. The enablers set by the MPWT are

efficient and effective management, multi stakeholder cooperation, data sharing and knowledge management, inclusive consultation, and improvement of research, financial management, and public investment. Moreover, according to the National Green Growth Strategy of the Lao PDR up to 2030, the government sets to increase the production and consumption of clean energy, including promotion of the use of electric vehicles (EVs), reach 14% of the use of EVs and sustainably fuelled vehicles nationwide by 2025.

Transportation: Institutions and Players

National government activities in the transport sector are undertaken primarily by the Ministry of Public Works and Transport. The Ministry of Finance continues to play a major role in financing transport sector activities through the national budget. Under the National Green Growth Strategy, the MPWT has a key role to promote the use of EVs including a policy framework and work plan improvement to attract funding and implement the green city development pilot projects.

5. Malaysia

In Malaysia, the Ministry of Environment and Water has been appointed to lead grand circular economy initiatives at the national level. Aligned with the sustainable development agenda, Malaysia is moving towards plastic circularity to close the waste loop and protect the environment. Shifting from a linear economy to a circular economy for plastics is crucial to decoupling Malaysia's growth from environmental degradation and will help ensure a more sustainable way of life for future generations. Therefore, the Ministry of Environment and Water has developed the Malaysia Plastics Sustainability Roadmap, 2021–2030. This roadmap is the guidance policy for all stakeholders in ensuring plastic sustainability along the value chain guided by circularity and being part of the solution towards a sustainable environment.

5.1. Agriculture

Malaysia has three important policies in place to drive the circular economy to support sustainable development. The National Commodity Policy 2011–2020 (MPIC, 2012) aims to increase the yield per hectare to optimise land use and fertiliser use, whilst the National Agrofood Policy (NAP) 2011–2020 focuses on ensuring food security, making the agro-food industry competitive and sustainable, and increasing the income level of agro-based entrepreneurs (MAFI, 2011). The NAP has been upgraded to NAP 2.0, which aims to transform the agro-food sector into a sustainable, competitive, and high-technology industry (MAFI, 2021). For this reason, two strategies, modernisation and intelligent agriculture would be supported by financing funds, investment incentives, and a workforce to increase the adoption of the fourth industrial revolution (4IR) technologies. The NAP 2.0 also seeks to utilise bioresources amongst farmers' practices to preserve the delicate balance of the environment and the ecosystem. Moreover, Malaysia also focused on investment opportunities in green technologies like net energy metering, large scale solar, biomass, biogas, and mini hydro (below 30 megawatts) that is expected to spur the effect to the circular economy goals. In the transport sector, circular economy initiatives focus on protecting the green environment and using alternative sustainable fuels based on NTP 2019–2030, NAP 2020 and the NBP. The Malaysian agro-food sector is committed to reducing its greenhouse gas emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005, in line with the Paris Agreement, and aims to support the 10 Goals in the 2030 Agenda for Sustainable Development.

Agriculture: Institutions and Players

The three most vital ministries involved in circular economy agriculture initiatives are the Ministry of Energy & Natural Resources, the Ministry of Agriculture and Food Industries (MAFI), and Ministry of Plantation Industries & Commodities (MPIC). These ministries are supported by various related agencies such as the Department of Agriculture, the Department of Environment, the Malaysian Palm Oil Board, amongst others.

5.2. Energy

Malaysia performs a role as the critical regulator aligning with the nations' energy industry via collaboration between the Government and Energy Commission. Based on the 12th Malaysia Plan (EPU, 2021) that was established to encourage growth using sustainable energy, a few policies were introduced to follow the path of the 12th Malaysia Plan. The Sustainable Energy Development Authority has also developed a Malaysia Renewable Energy Transmission Roadmap (SEDA, 2021), involving several ministries and government agencies with PETRONAS and the Malaysia Economic Planning Unit to balance the economy, environment, and energy needs. In 2010, National Renewable Energy Policy (2010) was issued to prolong the lifespan of oil and gas domestically. This is continued by National Energy Efficient Plan (2015) and Green Technology Master Plan (2017) to implement efficiency and accelerate sustainability in national economy. Malaysia also focuses on bioenergy through biomass conversion into energy sources through the Malaysia Biomass Industry Action Plan (MIGHT, 2013). Malaysia is also targeting to have 20% of clean energy generation by 2025 by focusing on green energy, consisting of renewable energy and energy efficiency.

Energy: Institutions and Players

Ministries involved in circular economy energy initiatives are the Ministry of Energy and Natural Resources and Malaysia Economic Planning Unit, assisted by industrial players, i.e. Tenaga Nasional Berhad, PETRONAS, and Ernst and Young.

5.3. Transportation

The Ministry of Transport Malaysia (MOT) signed related strategic CE plans for transportation on the Paris Agreement in 2016, as mentioned earlier. The alternatives for reducing GHG emissions are energy efficient vehicles and alternative fuel, which is sustainable**.** Malaysia joined the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) voluntarily in 2021 to demonstrate the country's high commitment to addressing climate change issues. In Malaysia, some of the policies constructed to protect the green environment and sustainability include the National Transport Policy (NTP) 2019–2030 (MOT, 2019), the National Automotive Policy (NAP) 2020 (MITI, 2020), and the National Biofuel Policy (NBP) (MPIC, 2006). The NBP aims to reduce vehicular emissions through various strategies, such as encouraging the use of a biodiesel blend of processed palm oil and petroleum diesel, setting up bio-diesel plants, and establishing industry standards for bio-fuel quality. The NTP 2019–2030 provides an overarching policy to guide relevant federal ministries, agencies, state governments, and local authorities to develop and streamline transport initiatives towards a common goal.

Malaysia also provides incentive schemes such as green investment tax exemption and green income tax exemption, focusing on waste management, and allocating funds to acquire up to 500 electric buses for public transport in selected cities nationwide. Malaysia's National Electric Mobility Blueprint

(2015–2030) aims to have 100,000 electric cars, 100,000 electric motorcycles, 2,000 electric buses, and 125,000 charging stations on the roads by 2030. The adoption of advanced technology and innovative practices related to the circular economy would enable these sectors to improve management activities, reduce reliance on manual labour, increase conservation of natural resources, and adapt to the effects of climate change.

Transportation: Institutions and Players

Ministries involved in circular economy energy initiatives are the Ministry of Transport Malaysia, the Ministry of International Trade and Industry, and the Ministry of Energy and Green Technology and Water.

6. Myanmar

Myanmar has witnessed rapid urban and economic growth, becoming one of the world's fastest growing economies. This is expected to further accelerate with the recent government approval of the Myanmar Sustainable Development Plan (MSDP) (2018–2030). This is supported Myanmar's National Waste Management Strategy and Master Plan 2018–2030.

There are several guiding documents that indicate the development of circularity in Myanmar, including Myanmar Agriculture Development Strategy 2018/19–2022/23, Myanmar Financial Inclusion Roadmap 2014–2020, Myanmar Industrial Policy 2016, Private Sector Development Framework and Action Plan, National Strategy for Rural Roads and Access 2016, SME Policy 2015, Myanmar National Transport Master Plan 2016, Myanmar National Climate Change Policy 2017–2030, Myanmar Action Plan on Disaster Risk Reduction 2017, Myanmar Energy Master Plan 2015, National Biodiversity Strategy and Action Plan 2015–2020, Myanmar Elephant Conservation Action Plan 2018–2027 (MOPF, 2018).

6.1. Agriculture and Waste

Myanmar's National Waste Management Strategy and Master Plan 2018–2030 aims to address the increasing waste management challenges faced by the country. The plan includes an overview of the current waste management situation in Myanmar, including the existing policy and regulatory framework, institutional arrangements, and the challenges and opportunities for improving the waste management system (ECD and MONREC, 2018).

The MSDP strives to create an enabling environment that supports a diverse and productive economy through inclusive agricultural, aquacultural, and polycultural practices as a foundation for poverty reduction in rural areas (Ministry of Planning and Finance, 2018). Myanmar's economy is highly agro-dependent, the private sector's involvement in agriculture is already significant, contributing towards job creation at all stages throughout the value chain – from cultivating, harvesting, animal husbandry to value-added processing. All of these require willing and able workers, market and logistics infrastructure to support agricultural value chain, enhanced irrigation and drainage, improve investment regulations for agri-investors, including facilitating foreign investor access, improve food safety standards to protect human health and extract greater value from agricultural products are few of the action plans to be executed before 2023 (MOPF, 2018). In regard to food security, Myanmar plans to make the National Action Plan for Food and Nutrition and a National Strategy on Micronutrient Fortification and other relevant guidelines, develop plans for emergency food reserves

at different levels, secure plant and animal genetic resources for food and agriculture related research, and enhance food and food-borne disease surveillance.

Agriculture and Waste: Institutions and Players

The MSDP is led by The Ministry of Planning and Finance and Myanmar's National Waste Management Strategy and Master Plan (2018–2030) is led by the Ministry of Natural Resources and Environmental Conservation. Under the MSDP, agricultural targets require strategy with the Ministry of Labour, Immigration and Population, the Ministry of Agriculture, Livestock and Irrigation, Ministry of Education, Ministry of Natural Resources and Environmental Conservation, Ministry of Home Affairs, the Ministry of Construction, the Ministry of Commerce, and Myanmar Investment Commission.

6.2. Energy

The MSDP under the pillar of People and Planet, targeted the utilisation of Natural Resources and the Environment for Posterity of the Nation. Myanmar's rich biodiversity underpins a range of critical sea, air and land-based ecosystems; and well managed use of sustainable land and marine use practices, these plans have the potential to contribute to a more stable climate, boost agricultural productivity, contribute to energy security and sustain growth for generations to come. Moreover, as electricity access will led to greater productivity, Myanmar needs to prioritise the long-term benefits gained by managing the safe and sustainable development of the energy sector, including ensuring careful consideration of available energy resources, together with analysis of consumption patterns and future projections. Under the action plans, to provide affordable and reliable energy to populations and industries via an appropriate energy generation mix, the government needs to achieve an optimal level of renewable sources in the primary energy supply mix, scale up renewable energy resources, develop subnational energy development plans, regulations and governance that enable greater investment in energy, promote energy generation and distribution efficiency and conservation, and facilitate international and private sector cooperation.

Energy: Institutions and Players

Under the MSDP, the Ministry of Electricity and Energy, the Ministry of Industry, the Ministry of Planning and Finance, the Ministry of Agriculture, Livestock and Irrigation, the Ministry of Construction, the Ministry of Natural Resources and Environmental Conservation, the Ministry of Transport and Communications, and Federation of Chambers of Commerce and Industry are expected to cooperate to provide affordable and reliable energy to the population and industries.

6.3. Transportation

Based on the MSDP, the government pledged to further reform the trade sector and strengthen regional and international cooperation and linkages. Myanmar has made regional commitments to facilitate the transport of goods and services across our borders via key economic corridors. To do so, this the MSDP notes that Myanmar will review its institutional and legal framework governing domestic and international trade like the Greater Mekong Subregion Cross-Border Transport Facilitation Agreement and pursue a range of policies to facilitate trade and to diversify its exports, facilitate transition to low-carbon transport, including improve their connectivity with rural areas and neighbouring countries. Myanmar also plans to upgrade and expand road, rail, and other transport networks and infrastructure. The infrastructure has to be sustainably developed, safe and convenient

to all. For climate resilient and low-carbon energy, industrial, and transport systems, the government needs to support skill development for green economy transition.

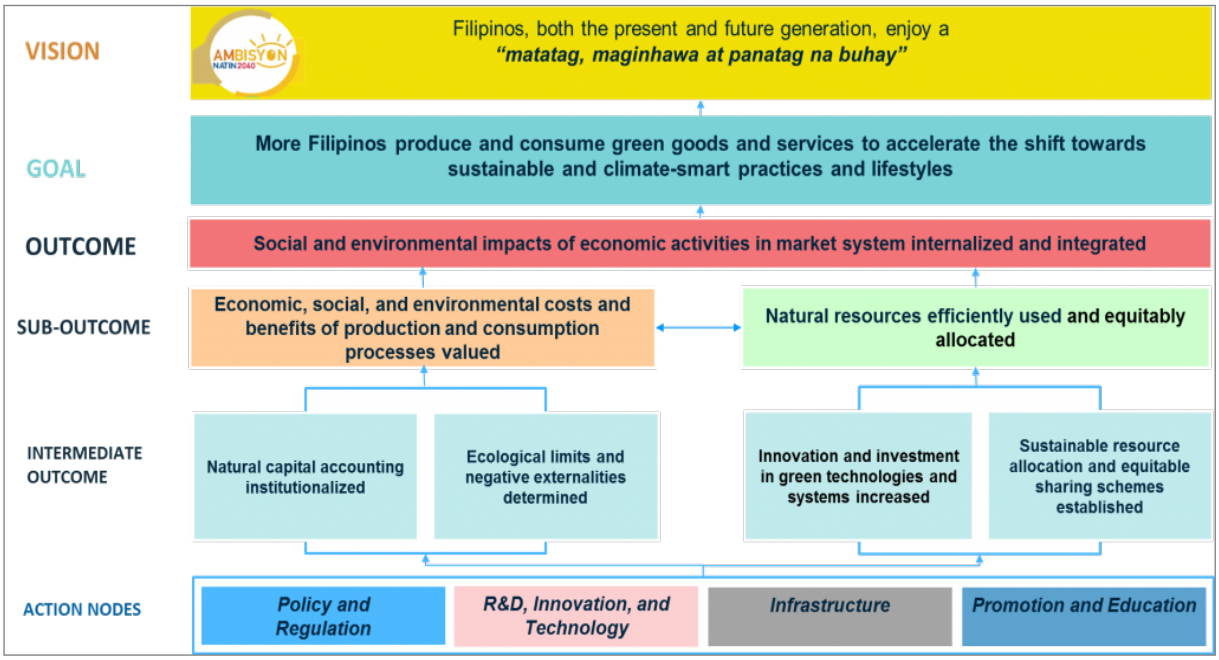
Transportation: Institutions and Players

Under the MSDP, the local government, the Ministry of Transport and Communications, the Ministry of Commerce, the Ministry of Natural Resources and Environmental Conservation, the Ministry of Planning and Finance, and the Ministry of Agriculture, Livestock and Irrigation are institutions that will be responsible for transportation reform.

7. Philippines

Whilst the Philippines has yet to develop an overall strategy or policy framework for Circular Economy, the Philippine Action Plan for Sustainable Consumption and Production (PAP4SCP) until 2030 was developed in 2020 to mainstream elements of circularity in the development activities of various stakeholders. The PAP4SCP serves as guidepost in attaining better circularity by identifying 'sustainable pathways to sustainable consumption and production (SCP) patterns and thus to a sustainable economy', reflecting SDG 12 of the UN Development Goals. The National Economic and Development Authority (NEDA) is the lead implementor of the Philippine PAP4SCP. The updated Philippine Development Plan (PDP) 2017–22, the country's mid-term development plan, adopts SCP as a cross-cutting strategy for ensuring ecological integrity, clean and healthy environment (NEDA, 2021). The PDP 2017–22 was updated in 2021 to reflect the impact of the COVID-19 pandemic. The updated plan aligns with the goals of the ASEAN Comprehensive Economy Recovery Framework and the ASEAN Framework on Circular Economy, particularly, the (i) efficient use of energy and other resources, (ii) enhanced role of innovation, digitalisation, and emerging technologies, and (iii) sustainable financing. The first strategy is outlined in various policy documents and reflected in a variety of laws some of which are mentioned in this report. The second strategy is laid out in detail in the PAP4SCP, and the third is addressed by the Sustainable Finance Framework aimed at the development of a domestic sustainable financing market to support the country's commitment to sustainability. This would cover green, social or sustainability bonds, loans, and other debt instruments (Sustainable Finance Framework Republic of Philippines, 2022). Moreover, 'Ensuring Ecological Integrity, Clean, and Healthy Environment' is one of four themes that serve as foundation for the various strategies government identified in all areas of national life, to attain its development objectives. The COVID-19 pandemic highlighted the importance of air quality and food, and human health, hence, the 'shift towards sustainable development has now become an urgent matter of survival.'

Figure 2.3. Philippine Action Plan for SCP Strategic Framework



SCP = sustainable consumption and production.
Source: NEDA (2020).

To achieve the goals mapped in Figure 2.3, the PAP4SCP has identified priority legislation related to food waste, electronic waste, extended producer responsibility, and green public procurement. The Circular Economy Act of 2020 (House Bill 7609), filed in the House of Representatives in September 2020, aims to promote sustainable consumption and production through research, innovation, and regulation. The draft law mandates the phase-out of single-use plastic and waste minimization through extended producer responsibility schemes. It also includes standardisation on calculating ecological footprints and circularity indicators, guidelines on damage compensation, finance modalities for payments for ecosystem services, and data transparency arrangements and reporting system, and adequate ICT infrastructure.

7.1. Agriculture

The primary and overwhelming concern in Philippine agriculture and food policy is food security and resiliency (NEDA, 2021). The Organic Agriculture Act of 2010 (Republic Act 10068), amended by Republic Act (RA) 11511 (2020), established the National Organic Agricultural Program led by the Department of Agriculture. The law aims to address problems related to industrial waste and community garbage disposal through appropriate waste management methods, promote commercially viable biodegradable farm waste and by-products, and integrate organic agriculture concerns into school curricula at all levels. The amendment introduced adoption of the Participatory Guarantee System as a group-based certification process for protection of crops, livestock and marine products against contamination by genetically engineered organisms; including access to marketing by organic producers to ensure decent prices. Second, the Clean Water Act of 2004 (RA 9275) is a basic law on the prevention, control, and abatement of pollution of the country's water resources that aims to protect the country's water bodies from pollution from land-based sources. Other existing

environmental laws, such as the Clean Air Act (RA 8749), the Ecological Solid Waste Management Act (RA 9003), and the Clean Water Act (RA 9275), will also be reviewed to address implementation challenges and ensure their responsiveness to changing economic development towards sustainable consumption and production. As an ongoing process, HB 7596 (An Act Reducing Food Wastage by Donating and Recycling Excess Edible Food), and SB 1242 (Zero Food Waste Act) have been filed in 2020 to implement a zero-waste food campaign through food donation, and the segregation of inedible food waste for recycling into fertiliser or compost, livestock feed or sources of biofuel.

Agriculture: Institutions and Players

The Department of Agriculture also oversees the reuse of wastewater for irrigation and other agricultural uses, and pollution control and abatement from agricultural and aquaculture activities under the Clean Water Act. Meanwhile, the Department of Environment and Natural Resources (DENR) is responsible for implementing the Clean Air Act, the Clean Water Act, and the Solid Waste Management Act. The Ecological Solid Waste Management Act of 2000 devolves solid waste management from planting or harvesting to local levels, enforces the closure of illegal dumpsites, and mandates investment in facilities for the proper treatment and reduction of solid waste. The Department of Trade and Industry also has a role in promoting circular economy in food products, such as through eco-designs for food packaging and requiring new food-related businesses to integrate a life cycle assessment for their products in their Department of Trade and Industry business registration.

7.2. Energy

The national policy for the energy sector is set out in the Philippine Energy Plan 2020-2040 where renewable energy figures as a pathway to sustainable growth. Herein, the goal is to attain an inclusive and equitable economic growth through secure, sustainable, and resilient energy strategies; ensure sustainability and availability of energy to wean away from traditional sources, and the development of alternative ones. To facilitate this transition, the present government has declared a moratorium on new coal-fired power projects and adopted aggressive renewable energy (RE) and energy efficiency and conservation institutionalization programmes (Department of Energy, 2020b).

The Renewable Energy Act of 2008 (RA 9513) aims to promote the development of renewable energy resources such as biomass, solar, wind, hydro, geothermal, and ocean energy sources through the establishment of a national framework for renewable energy. The law also sets a minimum share of energy from eligible renewable energy resources and introduces a feed-in tariff system for electricity produced from renewable sources. It aims to establish a Renewable Energy Market, a Green Energy option program, net-metering for renewable energy, and the development of the transmission and distribution system. Waste-to-energy technologies, such as biogas systems, are encouraged. Fiscal incentives like tax, subsidies and Renewable Energy Trust Fund will be established. Second, Energy Efficiency and Conservation Act (RA 11285) institutionalizes fundamental policies on energy efficiency and conservation, including the promotion of efficient and judicious utilisation of energy efficiency and renewable energy technologies. Under the law, the Government Energy Management Program requires all concerned government agencies to realise at least 10% energy cost savings from both petroleum and electricity consumption (based on their 2015 consumption level) and introduce the Philippine Energy Labelling Program and Minimum Energy Performance for products with mandatory policies for a standard performance level on energy consuming products before they can be sold or

used for residential, commercial, transport, and industrial purposes. Third, the Biofuels Act of 2006 (RA 9367), amended by Republic Act No.10745, introduces mandatory use of biofuels in the fuel mix. Incentives are introduced to encourage biofuel projects. These laws are supported with Department Circulars related to the production, blending, storage, handling, transportation, distribution, use and sale of biofuels, biofuels-blends and biofuel feedstock. This including duty-free importation of machinery, equipment, materials, and spare parts used for RE operations, including rules governing the phasing out of fuel inefficient transport vehicles. Furthermore, the Waste Treatment Technology Act was passed in 2020 (Republic of the Philippines House of Representatives, 2021), that allows the use of waste-to-energy technologies to help solve the country's perennial garbage problem.

Energy: Institutions and Players

The Department of Energy (DOE), on the other hand, holds main responsibility for the implementation of the Biofuels Act, and the Renewable Energy Act. Under the Clean Air Act, the DOE is responsible for the setting of the fuel standards, the allowable content additives in all types of fuels and fuel-related products, and the phase-out of such additives. The proposed legislation on electric vehicles (SB 1382 and HB 10213), also identifies the DOE as the lead agency in the promotion of the adoption of electric vehicles and the charging infrastructure. The Department of Transportation takes care of the demand side and registration of electric vehicles.

7.3. Transportation

Consistent with the country's commitments under the Montreal Protocol on Substances that Deplete the Ozone Layer and other relevant treaties, ozone-depleting substances will be phased out. The Department of Transportation is responsible for the implementation of the emissions permit system, including the collection of emission fees mandated by the Clean Air Act of 1999. The Integrated Air Quality Improvement Framework serves as the blueprint for a comprehensive air pollution management and control programme, after which an Air Quality Action Plan is to be developed. The law also mandates the establishment of an inventory list of all sources of persistent organic pollutants in the country and programmes for the reduction and elimination of pollutants such as dioxins and furans. Moreover, the National Transport Policy, developed in 2018, envisions a 'safe, secure, reliable, efficient, integrated, intermodal, affordable, cost-effective, environmentally sustainable, and people-oriented national transport system that ensures improved quality of life of the people' (NEDA, 2020). Under this policy, the use of environmentally sustainable technologies and approaches is required in planning and project selection of transport agencies and local governments.

For transportation, the Clean Air Act of 1999 (RA 8749) is the basic law to address air pollution, which imposes emissions fees on polluters. On the other hand, industries that install pollution control devices or retrofit their existing facilities with pollution reduction mechanisms are entitled to tax incentives. The law prohibits the manufacture, import, selling, conveying, or disposal of leaded gasoline and engines and components requiring the use of leaded gasoline. Furthermore, the use of EVs and its industry development has been proposed under Senate Bill 1382 (Electric Vehicles and Charging Stations Act) (Rivera, 2021) and House Bill 10213 (Electric Vehicle Industry Development Act) has been passed by bicameral committee by January 2022 (Cervantes, 2021). The Electric Vehicle Industry Development Act provides the framework for the use of EVs and the development of the electric vehicle industry. Sustainable and promotion of mass transportation also being filed in 2020 under House Bill 6890 (Sustainable Transportation Act of 2020).

Transportation: Institutions and Players

The Land Transportation Office is in charge of inspection and registration of motor vehicles, issuance of licenses and permits, enforcement of land transportation rules and regulations. The Department of Environment and Natural Resources through the Environmental Management Board has issued several issuances on regulations governing the classification, registration and operation of all types of electric motor vehicles, under the context of environmental quality standards, pollution control, and environment protection.

8. Singapore

Singapore has acknowledged the need to adopt a circular economy model to reduce resource consumption and waste production, replacing the linear economic model with circular one. In this context, the government launched in 2019 the Zero Waste Masterplan (MEWR, 2019), which emphasises the need for new policies to promote sustainable production and consumption, building a sustainable and climate-resilient nation. This included adopting a circular economy approach to waste and resource management practices and shifting towards more sustainable production and consumption. In 2021, the Ministry of Sustainability and the Environment, along with four other ministries, launched the Singapore Green Plan 2030 (SGP 2030) to advance Singapore's sustainable development agenda. The Green Plan includes concrete sectoral initiatives and targets, strengthening Singapore's efforts to implement the 2030 Agenda for Sustainable Development and the Paris Agreement, and achieve net-zero emissions (Singapore Government, 2021). The Green Plan involves multiple ministries, in addition to the Ministry of Sustainability and the Environment, like the Ministry of Education, Ministry of Trade and Industry, Ministry of Transport, and Ministry of National Development. It charts bold and concrete sectoral initiatives and targets in this critical decade, strengthening efforts to implement the 2030 Agenda for Sustainable Development and the Paris Agreement (Singapore Government, 2021).

In addition, the GreenGov.SG initiative was launched together with the SGP 2030 to fully support the sustainability agenda from the public sector. The initiative outlines ambitious measures to improve resources efficiency and reduce the carbon footprint in all government offices, with the aim of becoming a positive influence on society at large (Singapore Government, 2021). On the global stage, Singapore has adopted the United Nations' 2030 Agenda for Sustainable Development (UN, 2015). Singapore has pledged to reduce its emissions intensity by 36% below 2005 levels by 2030, stabilise its carbon emissions at 65 metric tons of carbon dioxide equivalent (Mt CO_2e), and halve its emissions from its peak to 33 Mt CO_2e by 2050, with a view to achieving net-zero emissions as soon as viable in the second half of this century (MSE, 2020).

Singapore has established a regulatory framework to control environmental pollution under the Environmental Pollution Control Act in 1999, amended with the Environmental Protection and Management Act that consolidated the previous laws related to air, water, and noise pollution control (Singapore Attorney General's Chambers, 1999) with specification of emissions standards and testing methods. Moreover, whilst the adoption of waste-to-energy (WTE) incineration technology allows the reduction in volume of waste disposed of by up to 90%, Singapore's only landfill site, Semakau, will run out of space by 2035 at current waste disposal rates. Considering Singapore's limited space, the government introduced the landmark Resource Sustainability Act to impose regulatory measures to address priority waste streams of electrical and electronic waste (e-waste), food waste, and packaging

waste including plastics (Singapore Attorney General's Chambers, 2019).

8.1. Agriculture and Waste

Singapore is firmly committed to adopting a circular economy approach to waste and resource management practices aiming to become a zero-waste nation, as stated in the Zero Waste Manufacturing Policy (MEWR, 2019). Although Singapore has been effective in reducing overall waste generation, it needs to speed up. To prolong the Semakau Landfill site, the overall recycling rate in the landfill must reach 70% by 2030, and the amount of per capita waste sent to landfill must drop by 30%. This goal will be frontloaded to achieve a 20% reduction in waste-to-landfill per capita per day by 2026 under the SGP 2030.

Singapore has been facing a growing problem of food waste, with each household disposing of 2.5 kilogrammes of avoidable food waste every week (MEWR, 2019). The amount of food waste generated has grown by about 20% over the past decade. In 2021, food waste made up to 45% of the total amount of domestic waste disposed of, but only 19% was recycled (NEA, 2021). A guidebook has been released by the National Environment Agency to reduce waste food in retail food establishments and supermarkets, and food manufacturing establishments, as well as the guidelines for consumers are promising steps to avoid food waste from the outset (AVA and NEA, 2017a, 2017b, 2017c; NEA, 2017). Pilot projects to test the feasibility of using onsite systems to treat food waste at hawker centres and markets have yielded positive results (NEA and PUB, 2019) and from 2024, premises such as hotels and malls, supermarkets, industrial developments, housing food manufacturers, food caterers and food storage houses, schools and hospitals will be required by law to segregate their food waste. The SGP 2030 sets to meet 30% of Singapore's nutritional needs through local production by 2030 to ensure a more resilient food supply (30 by 30 scenario, Singapore Government, 2021).

Agriculture and Waste: Institutions and Players

The Ministry of the Sustainability and the Environment has the task of ensuring a clean and sustainable environment, with resilient supplies of safe food and water for Singapore. It formulates, reviews, and implements strategic policies to address key concerns on Singapore's environment. The Ministry of the Sustainability and the Environment is also committed to invest in research and development and build science and technology capabilities to address the complex challenges posed by climate change, environmental sustainability, water, and food security. The Ministry works alongside four statutory boards: the National Environment Agency, the National Water Agency (PUB), the Energy Market Authority, and the Singapore Food Agency.

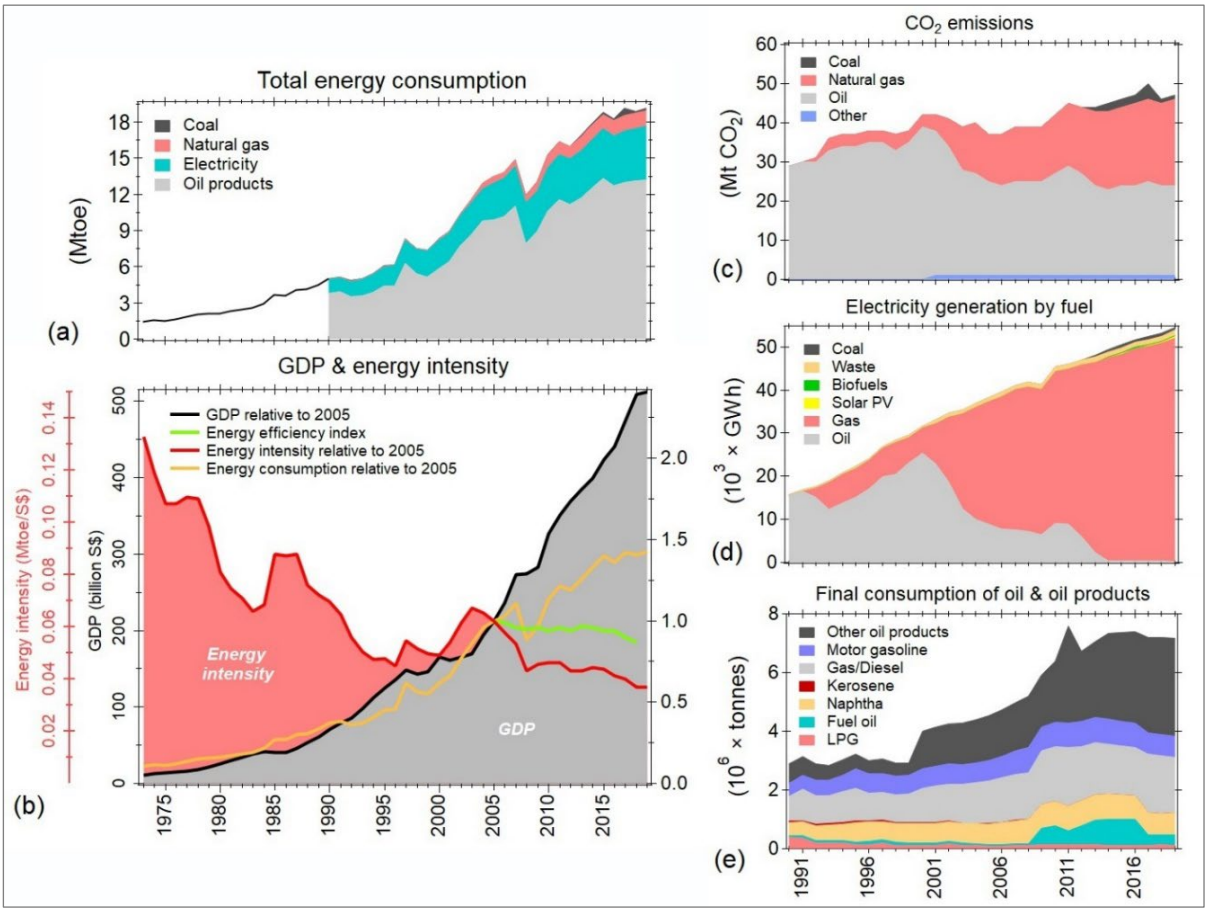
8.2. Energy

Singapore's successful transformation into a developed nation has been underpinned by an energy policy framework that has been flexible enough to enable it to cope with the ever-evolving global energy landscape (Chang, 2015). Singapore's focus is on improving energy efficiency rather than increasing energy production in the face of an expanding economy and a growing population. The most significant greenhouse gas emitted in Singapore is CO_2, primarily produced by burning fossil fuels to meet energy needs in various sectors of the economy.

As alternative energy sources like solar and wind power have limited potential in Singapore, Singapore is instead seeking to become a major liquified natural gas (LNG) trading hub by promoting cooperation and integration throughout the ASEAN region. However, energy consumption has increased 14-fold

over 50 years, although since 2005 its growth has slowed, whilst the energy intensity has decreased about one-third, making CO_2 emissions remain relatively constant since then (Figure 2.4a, 2.4b). The energy intensity has declined along this period due to reduced dependence on fossil fuels as consumption as a percentage of GDP, the introduction of cleaner technologies, a relative decline in manufacturing's share of GDP relative to that of less energy-intensive services as income rise, and conservation practices. Natural gas now constitutes over 95% of Singapore's fuel mix for electricity generation (EMA, 2021). The combustion of fossil fuels is the major source of GHG emissions in Singapore (Figure 2.4c). Electricity generation accounts for 40% of total emissions, 45% of the national emissions come from the industrial sector, whilst land transport makes up about 14%. With limited access to alternative energy options, natural gas will remain Singapore's primary energy source for the foreseeable future. Nevertheless, the SGP 2030 states that low-carbon energy sources utilisation need to be higher across all economy sectors. For such endeavour, the Energy Market Authority launched the 'Four Switches' plan to drive the transformation of Singapore's energy supply towards sustainability (EMA, 2022). The first switch is to scale up the use of available renewable energy sources. The second switch aims to develop regional power grids to increase low-carbon electricity. The third switch consists of exploring emerging low-carbon alternatives such as hydrogen, as well as carbon capture and utilisation. Through the fourth switch the government will continue working with companies to encourage the adoption of more efficient power generation technologies.

Figure 2.4. Historical Consumption and Intensity of Energy and Associated CO_2 Emissions in Singapore



Notes: (a) Total energy consumption by source in million tonnes of oil equivalent (Mtoe). (b) Gross domestic product GDP (S$ billion), and energy intensity (S$ Mtoe/million), and energy efficiency index, energy intensity, and energy consumption relative to 2005. The GDP is at 2021 market prices as reported by the Department of Statistics Singapore (https://www.singstat.gov.sg/). (c) CO_2 emissions from fuel combustion. (d) Electricity generation by type of source. (e) Consumption of oil and oil products by type of fuel. Energy and CO_2 emissions data were extracted from the International Energy Agency (IEA) World Energy Balances 2019 (https://www.iea.org).

In 2013 the Energy Conservation Act was enacted seeking to increase energy conservation for large energy users (companies that consume over 54 terajoules of energy annually) by conducting regular energy monitoring and reporting and implementing energy management systems (Singapore Attorney General's Chambers, 2013). In 2017 the Act was enhanced to stipulate more energy management practices as part of Singapore's efforts to achieve its pledge under the Paris Agreement on climate change to increase energy intensity 36% from 2005 levels by 2030, by achieving energy efficiency improvement rates of 1%–2% per year. The enhancements included strengthening the measurement and reporting requirements of GHG emissions, requiring companies to develop improvement plans for energy efficiency, undertake regular energy efficiency opportunity assessments, and introducing minimum energy efficiency standards for common industrial equipment and systems. To phase out inefficient common industrial equipment and systems, Minimum Energy Performance Standards (MEPS) have been introduced for induction motors and cooled chilled water systems in recent years (NEA, 2022).

Energy: Institutions and Players

The National Climate Change Secretariat coordinates the Inter-Ministerial Committee on Climate Change and spearheads the actions to promote energy efficiency through legislation, incentives, and public education with the support of the National Environmental Agency, the Energy Market Authority, the Building Construction Authority, and Land Transport Authority.

8.3. Transportation

Singapore has implemented several regulatory measures to control traffic pollution, including fuel composition, vehicle emissions standards, vehicle inspection and maintenance programmes, and scrapping old cars. Leaded gasoline was phased out in 1999, and since 2017, the use of ultra-low or near sulphur-free diesel and gasoline has been mandatory (Singapore Attorney General's Chambers, 2022). All new diesel and gasoline vehicles have to meet the Euro 6 emissions standards or equivalent since 2018, whilst motorcycles have to comply with Euro 4 standards since 2020. Vehicles that do not comply with emissions standards are fined and required to rectify any issues. To encourage earlier retirement of older cars, motorists receive a rebate for the certificate of entitlement (COE) and registration fee for a new car when they deregister vehicles with still valid COEs (Singapore Attorney General's Chambers, 2022).

According to the Land Transport Master Plan 2040, Singapore plans to prioritise walking, cycling, and public transport, with autonomous vehicles complementing those modes in the future. By 2040, 75% of all peak-period journeys are expected to be undertaken on public transport, up from 67% in 2022 (LTA, 2019). Rail and bus networks will be expanded, with the rail network growing to 360 kilometres (km) by 2030. The SGP 2030 aims to triple the length of cycling paths to 1320 km from 460 km in 2020. To enhance accessibility and safety for pedestrians and cyclists, the government has introduced innovations in urban infrastructure, such as bike parking lots at public transport nodes and public housing void decks, the installation of lifts at overhead bridges, and the construction of silver zones designed for elderly pedestrians. Singapore aims to ensure that all journeys to the nearest neighbourhood centre take less than 20 minutes by a combination of walking, cycling, and riding public transport, whilst nine of ten peak-period journeys should be completed in less than 45 minutes. The Walk2Ride programme has connected schools, healthcare facilities, and other public amenities within a 400-metre radius of train stations and within a 200-metre radius of bus interchanges and selected bus stops (LTA, 2021b).

Regarding freight land transport, trucks are the primary mode of transportation for goods in Singapore, with approximately 4,000 trucks making over 20,000 delivery trips daily and occupying about 25% of the city's road space (Centre for Liveable Cities, 2016). To reduce the number of trucks on the road, the government is exploring new technologies and models to consolidate and coordinate a comprehensive logistics system, such as in-mall distribution models, offsite consolidation centres, and federated lockers and collection points (IMDA, 2020). These initiatives are expected to decrease the number of trucks on the road by 25%, reduce delivery manpower by 40%, and decrease waiting and queuing time for deliveries by 65% (IMDA, 2016). New schemes based on the so called 'Industry 4.0' for Singapore's logistics ecosystem are under analysis (e.g. Ernst & Young Advisory Pte Ltd., 2020). These schemes propose new models based on emerging technologies that will transform the whole logistics market, and in turn the movement of goods.

The number of daily journeys completed by both taxi and private hire cars fell from 1 million in 2015 to 550,000 in 2021. Currently the ridership share is 21% for taxis and 79% for private hire cars. To compensate this situation, a new regulatory framework was released in 2020 granting taxi drivers the ability to sign up with any ride-hailing firm to provide fixed-fare rides, for example BlueSG – the first large scale electric car sharing service (LTA, 2020). This private initiative supported by the Land Transport Authority and Singapore's Development Board provides access to a network of shared vehicles 24 hours a day all-year-round at 380 self-service charging stations located in public housing, the city centre, and shopping mall across the city. Singapore also aims to phase out internal combustion engine vehicles by 2040. The SGP 2030 states that new registrations of diesel cars and taxis will cease from 2025, and all new car and taxis registrations will be of cleaner-energy models from 2030 (Singapore Government, 2021). For passenger vehicles, the most promising clean energy option is electric vehicles. The electric vehicles' share of new car registration jumped from 0.2% in 2020 to 3.8% in 2021, and more than half the fleet of taxis has already switched to petrol-electric models. An ambitious programme has been launched to build electric vehicle charging points closer to where people live, with the target being 60,000 charging points nationwide.

Transportation: Institutions and Players

The Land Transport Authority spearheads the operation and maintenance of transport infrastructure and systems, as well as harnesses technology to build a connected and integrated city by clean public transport and active transport modes that support a healthy lifestyle.

9. Thailand

Thailand aims to become a leading eco-friendly and sustainable producer and innovator by 2036, using sufficiency economy principles and sustainable consumption and economy. Thailand's constitution, revised and introduced in 2017, emphasises human development, social inequalities, sustainable development, sufficiency economy, and climate change adaptation. This has been the building block for the country's 12th National Economic and Social Development Plan and the present 13th National Plan. Thailand's National Reform Plans and Procedural Act BE 2560 that began 2017 coincided with the insertion of a new provision in the country's new 2017 Constitution, which included a sustainable and inclusive development agenda to bridge the country's priorities many socioeconomic priorities of the 21st century. The Thailand Circular Economy Framework is governed under the 12th national economic and social development plan that include the Master Plan on Municipal Solid Waste Management in 2018 and the Plastic Waste Management Plan in 2017 (2017–2021). The ongoing circular economy initiative is overseen by the Prime Minister and key ministries through the Bio-Circular-Green (BCG) National Steering Committee. Thailand has natural advantages in agriculture and food, public healthcare and pharmaceuticals, energy-bio based and biotechnology sectors, and the tourism and creative industry.

Circular innovation measures involve four key elements: legal and standards, business models, data and data platforms, and governance. Legal and standards measures include developing safety and import standards for secondary materials, as well as recycling and waste disposal guidelines. The data platform element includes standardised data collection, mapping material and energy flows, and developing a circular material database. The business model element involves government support and incentives for circular economic ecosystems, circular economy solution providers, and development of circular products and services. Finally, governance measures include policy and

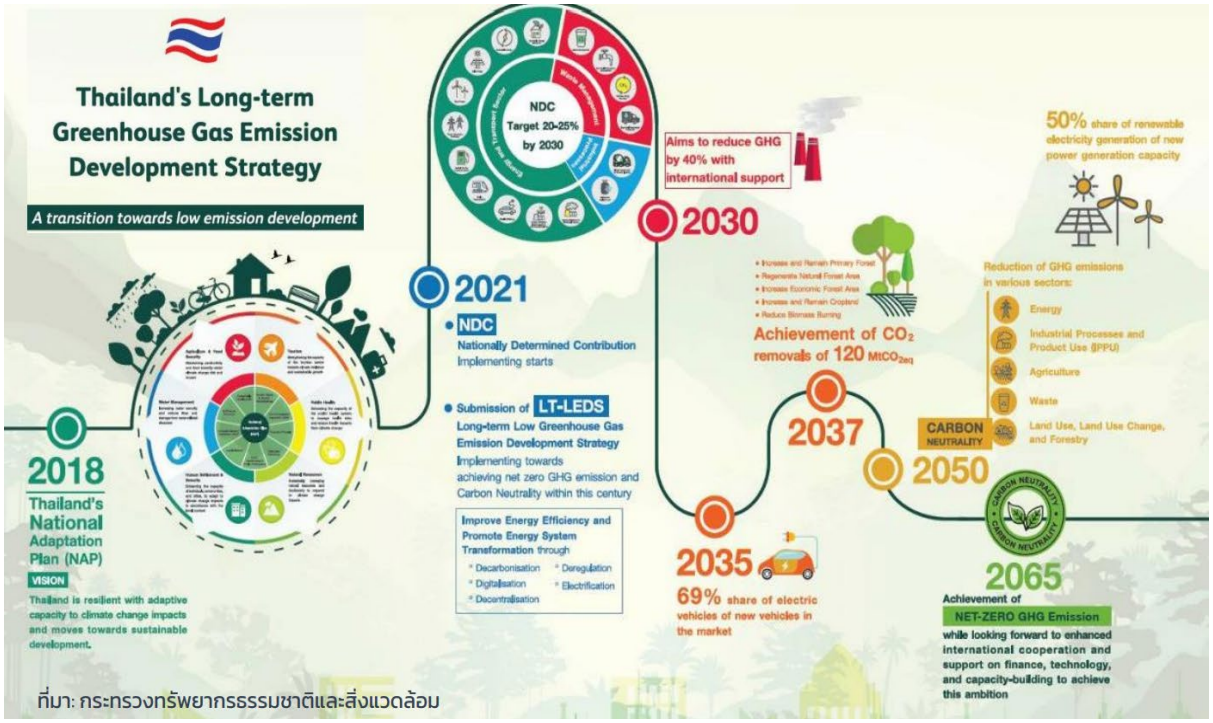
quality assurance systems, such as certification, carbon markets, and green marketing, as well as industry and material standards.

Thailand also aims to create a sustainable Carbon Credit System and Carbon Emission Trading Exchange to monitor its progress towards becoming a zero-carbon society and to counter the EU's Carbon Border Adjustment Mechanism. The country hopes to develop its official voluntary carbon market and use it to monetise the Bio-Circular Green initiative. The Thailand Convention and Events Bureau has launched the Carbon Balance Scheme and the Food Waste Project to reduce the carbon footprint and food waste in the tourism and events industry. The Department of Industrial Work has also launched the Bio-Circular Green Scheme to reduce energy consumption and greenhouse gas emissions in the manufacturing sector.

The target applies to all operations from micro to community levels to large corporations, which the country views as part of the general large ecosystem that needs to be integrated to achieve (i) circularity target, (ii) international commitments, (iii) enabling a new class of innovators in Thai society, and (iv) closing the entire loop using sufficiency economy principles (core enablers).

Key higher level strategy or masterplans include the National Climate Change Master Plan (2015–2050), National Water Resource Management Master Plan (2015–2026), National Solid Waste Master Plan (2016–2021), Thailand Roadmap on Plastic Waste Management (2018–2073), Green Government Procurement Guideline, Action Plan Thailand Zero Waste (2016–2017), Thailand National 3R Strategic Plan, 20 Year Pollution Management Strategy and Pollution Management Plan 2017–2021, Annual 'Clean Province' Action Plans, National Greenhouse Gas Reduction Action Plan for Municipal Waste Sector (2021–2030), Thailand Power Development Plan (2018–2037), Thailand National Adaptation Plan (NAP) (2020–2037), Climate Adaptation for Public Health (2018–2030), Strategy for Climate Change in Agriculture (2017–2021), Thailand Smart Grid Development Master Plan (2015–2036), Energy Efficiency Plan, 2015–2036 (EEP2015), Alternative Energy Development Plan (2015–2036) (AEDP2015), Master Plan for Sustainable Transport System and Mitigation of Climate Change Impacts, National Industrial Development Master Plan (2012–2031), Waste Management Master Plan (2016–2021), Environmental Quality Management Plan, 2017–2021, Montreal Protocol Implementation, Refrigeration and Air Conditioning (RAC) National Appropriate Mitigation Action (NAMA) Project, etc. The circular economy mandate is clearly reflected via its budget in the 13th plan along with KPIs and capacity building resources. The Sustainable Production and Consumption (SCP) group has completed updating the new SCP Action Plan for Implementing Sustainable Production and Consumption B.E. 2560–2080 and the Ministry of Industry revised its regulation to allow transboundary movement of factory waste (toxic and non-toxic) to support the circular economy. The government is also developing laws for carbon pricing, such as the Climate Change Act, Greenhouse Gas Reporting Law, and Emissions Trading System Law. Figure 2.5 details the timeline of Thailand's long term GHG Development (reduction) strategy after the finalisation of the NAP.

Figure 2.5. Thailand's Long-term GHG Development Strategy



GHG = greenhouse gas.
Source: Ministry of Environment and Natural Resources.

9.1. Agriculture

The Thai government, under the current administration, has implemented various ministerial regulations related to the circular economy in food and agriculture. These include the carbon market credit system, new regulations for bio-refinery classification, coastal marine areas replanting and maintenance, carbon sequestration activity regulations, and banning single-use plastics and types, imports of plastic waste and e-waste, and slash and burn practices. In November 2021, the cabinet approved the establishment of the country's first carbon market. The Food and Drug Administration has also approved the use of secondary materials, particularly plastics, for packaging food and drugs. Thailand also set circularity targets for each group to achieve the zero-carbon society transitions, in industrial biotech group, plastic waste, food loss and waste, and construction materials. In Table 2.1, several targets have been recorded in the agriculture sector.

Table 2.1. Thailand's Circularity Targets

No.	Sectors	Target
1	Industrial Biotech Group	Use of biomaterial in plastic targets at 20%, 25%, and 30% by 2022, 2023, and 2024.
2	Food Loss	Reduction by 30% from present level to 10% in 2030.
3	Food Waste	Reduction from 5% (2023-2024), 10% (2024-2025), and 15% (2026-2027).
4	Construction Materials	Use of recycled materials from 5% (2023-2024), 10% between 2024 till 2025, and 15% between 2026-2027.

Source: Author.

9.2. Energy

Since becoming party to the United Nations Facility for Climate Change Conference (UNFCCC) in 1994, the country has submitted its Nationally Determined Contribution (NDC) with a goal of reduction of the country's greenhouse gas emission after 2020 by 20%–25% from the projected business-as-usual (BAU) scenario. On January 2016, the government assigned the Office of Natural Resources and Environmental Policy and Planning together with relevant agencies to prepare a roadmap specifying guidelines and detailed measures to achieve the greenhouse gas reduction targets under the NDC Roadmap on Mitigation 2021–2030. Under this roadmap, three key sectors were earmarked for meeting the target: (i) energy and transport, (ii) industrial processes and product applications, and (iii) waste management.

9.3. Transportation

Thailand is an early mover in the region in implementing carbon pricing with the government started several voluntary carbon pricing instruments, such as the Thailand Voluntary Emissions Reduction Program and the Thailand Carbon Offsetting Program in 2013. Thailand's commitment towards decarbonising its economy has seen significant impact even before the BCG model through its earlier initiatives such as the launch of the eco-products standards and label scheme in 2005 and the national bio-fuel development, reducing the government's environmental expenditure account, from 75% (2007) to 64% in 2016. Indicating that the private sector – especially the manufacturing and transport sectors – (two main polluters) commitment to protecting the environment, stricter compliance measures and a gradual lowering its carbon footprints. Whilst Thailand is the 17th largest biofuel producer in the world, the government still envisions going green by promoting electric vehicle (EV) technology versus the biofuel option. Thailand has identified three key sources of green energy: biofuel, hydrogen, and solar power for marine, road, and air transport.

Table 2.2. Sources of Green Energy, Thailand

Type of Transport	Government Efforts in Source Transition
Marine Transport	• Pursuing 'green methanol' with hydrogen (under the bio-base model). • 'Green Port' scheme by Port Authority of Thailand inspired by the APEC Port Service Network.
Road Transport	• Pursuing intermodal transport system and EVs. Banning internal combustion technology in road vehicles by 2035. • However, biofuel has been identified as a hybrid option, which the country is looking into making greener than before.
Air Transport	• Pursuing renewable jet fuel using biofuel. • Thai Airways flew its first maiden flight in 2011 powered by biofuel imported by Netherlands. There are now plans to develop locally made biofuel in the country that will meet the sustainable aviation fuel standard in EU and US markets. • (IATA 73rd annual general meeting in Cancun declares usage of sustainable aviation fuel for all airlines, and in 2021 IATA declared aviation industry to reach net-zero carbon by 2050).
Public Transport	• Pursuing EV technology and sharing economy.

APEC = Asia-Pacific Economic Cooperation, EU = European Union, EV = electric vehicle, IATA = International Air Transport Association, US = United States.
Source: Author.

Agriculture, Energy, and Transportation: Institution and Players

The key institutions and players for the circular economy in Thailand include the BCG National Committee and the Office of National Higher Education Science Research and Innovation Policy Council (NXPO). The BCG National Steering Committee consists of 11 working groups and one network coordinating team comprising four organisations: Department of Environment Quality Promotion (DEQP), National of Science & Technology Development Agency (NSTDA), Sustainable Production and Consumption (SCP) Foundation, and Thailand Environment Institute (TEI). The DEQP is involved with the NDC Roadmap on Mitigation 2021–2030 to address long-term greenhouse gas (GHG) 2065 and zero-carbon emissions 2050, whilst the NSTDA is involved in research and innovation in implementation of the circular economy. The NXPO was established in 2018 to monitor and deploy national policies addressing higher education, science, research, and innovation, and has since become a platform to integrate all circular economy activities, including policy coordination, research, funding, and innovation sandbox.

10. Viet Nam

The policy on environmental protection has been established in Viet Nam since the early 1990s. However, the term circular economy had not been officially used in government policies and laws before 2020. The viewpoint on sustainable development was finalised in the Socio-Economic Development Strategy for the period 2011–2020, emphasised the need to induce development of a circular economy model for integrated and efficient use of output of the production process, which was approved at the 11th Congress (CPV, 2021a). Moreover, the government also issued important strategic documents such as Decision No. 1393/QD-TTg dated 25 September 2012 approving the

National Green Growth Strategy for the period 2011–2020 with a vision to 2050. Also in 2017, Resolution No. 11-NQ/TW of the 5th Conference of the 12th Communist Part of Viet Nam (CPV) Central Committee on improving institutions for socialist-oriented market economy instructed to actively implement the '2030 Agenda for Sustainable Development', including the green growth strategy (Party Central Committee, 2017). Resolution No. 36-NQ/TW dated 22 October 2018 of the 12th CPV Party Central Committee then issued the strategy for sustainable development of marine economy to 2030, with a vision to 2045 (Party Central Committee, 2018). The 13th Congress of CPV formally recognised the requirements and tasks of developing a central economy. The report on socioeconomic performance from 2016–2020 and socioeconomic development tasks for 2021–2025 proposed building a roadmap, mechanisms, policies, and regulations to develop a central economy (CPV, 2021b).

Viet Nam's government aims to promote both rapid and sustainable economic development and sustainable social development, with a focus on combining circular economy practices with sustainable consumption and production (SCP). (National Assembly, 2010). In 2021, Decision 1658/QD-TTg dated 1 October 2021, outlining goals and principles for promoting a green economy and sustainable development. The legal framework on plastic waste management is also gradually improved in the Prime Minister Decision No. 1746/QD-TTg dated 4 December 2019 and Prime Minister Directive No. 33/CT-TTg dated 20 August 2020 on strengthening management, reuse, recycling, treatment and reduction of plastic waste. The Ministry of Natural Resources and Environment (MONRE) under Decree 08/2022/ND-CP in 2022, is mandated to take the lead in developing National Action Plan on circular economy development, to be completed by the end of 2023. MONRE is also in charge of other issues related to the circular economy, such as waste management and international cooperation on climate change.

The revised Law on Environmental Protection, enacted in 2020, introduced the concept of the circular economy, and in January 2022 (National Assembly, 2020), and the Ministry of Natural Resources and Environment issued Decree No. 08/2022/ND-CP, which provides guidance on CE implementation and related aspects under the Law on Environmental Protection (Government of Viet Nam, 2022). In 2021 and early 2022, the Ministry of Planning and Investment has also prepared a report on circular economy development in Viet Nam, including a proposal for a pilot mechanism in priority sectors and amendments to policies and regulations for CE in the medium to long-term (MPI, 2022). On that basis, the Prime Minister issued Decision No. 687/QD-TTg in June 2022 approving the Project to Develop Circular Economy in Viet Nam (Prime Minister of Viet Nam, 2022). This is supported with Investment Law 2020 that encourages investment in clean energy production, renewable energy, energy-saving products, management of waste, and planting and protecting forests. Likewise, Decree No. 08/2022/ND-CP in January 2022 also provides for incentives and support for environmental protection activities in production, business, services, urban and rural areas, and in a number of fields: waste management, responsibilities for recycling, and handling products and packages of manufacturing and importing organisations and individuals (Government of Viet Nam, 2022). The Law on Technology Transfer specifies technologies that are encouraged to be transferred, with supporting provisions on technology import tax exemption and reduction, which are energy saving technology, new energy use technology and clean and environmentally friendly production technology. (National Assembly, 2017). Apart from policies, the major cities (Ha Noi, Ho Chi Minh city, etc.) have implemented national policies on various related aspects of circular economy models in different sectors such as agriculture, transport, energy, smart city, waste treatment and recycling, amongst others.

The government has extensively consulted with stakeholders in developing policies for the development of a circular economy. During the drafting process of Decree 08/2022/ND-CP, MONRE received comments from various parties, including the Ministry of Planning and Investment (MPI), on circular economy criteria, priority sectors, and timelines, including the Ministry of Finance that is responsible for tax and expenditure policies related to promoting circular economy projects, green bonds, and carbon market development. Tax policies have been adjusted to encourage the use of biofuels, environmentally friendly cars, and low tax rates for renewable resources. The government is also improving domestic laws and regulations for green financial products and markets through policy dialogues and cooperation.

10.1. Agriculture

As of May 2022, there has been no policy and legal document that explicitly addresses the circular economy in agriculture, even in Decree No. 08/2022/ND-CP in January 2022 guiding the implementation of the Law on Environmental Protection. The general incentives for investment in agriculture are specified in Decree No. 57/2018/ND-CP in 2018. These include the reduction or exemption of land use fees, land lease fees, access to preferential credits, support in research and development, transfer of technology, human resource development, investment in facilities and infrastructure, etc. (Government of Viet Nam, 2018b). If circular economy development can be quickly promoted in agriculture, it would be aligned with the strategic measure of Develop new and appropriate technologies, best practices and management systems to ensure food safety and address health and environmental issues, particularly in the fast-growing aquaculture, livestock and horticulture sub-sectors' (ASEAN, 2015) under Sustainable Economic Development (element B.8) of the ASEAN Economic Blueprint 2025.

Decree 109/2018/ND-CP in 2018 on organic agriculture has regulations related to the circular economy model, such as resource management according to ecological and systematic principles, not using factors that have adverse impacts on the ecological environment, combining traditional techniques and scientific progress to benefit the environment (Government of Viet Nam, 2018a). Decision 255/ QD-TTg of the Prime Minister in February 2021 specifies the need to improve land law policies towards protecting and improving efficiency of agricultural land use, encouraging and facilitating concentration and accumulation of agricultural land, and creating favourable conditions for flexible use of agricultural land to improve its efficiency. The Decision also sets specific targets for the circular economy in husbandry, including developing livestock production in the direction of industry, applying high technology, circulating livestock production, and ensuring biosecurity, disease safety, and environmental friendliness (Prime Minister of Viet Nam, 2021). In addition, the government issued Decree No. 109/2018/ND-CP in 2018 on organic agriculture to support SMEs, grade promotion, application of high technology in agriculture and others. (Government of Viet Nam, 2018a). The Decree prohibits the use of synthetic chemicals, antibiotics, genetically modified organisms, growth hormones, pesticides, fertilisers, preservatives, and additives.

Agriculture: Institutions and Players

The Ministry of Agriculture and Rural Development is in charge of sectoral issues related to agriculture and rural development, including organic agriculture, development of agricultural and rural value chains, development of agricultural and rural infrastructures, etc., including international cooperation on these issues. They are also responsible to work with related ministries and provinces to develop

circular economy specific criteria in agriculture, consistent with the general criteria in Decree 08/2022/ND-CP.

10.2. Energy

For energy, in the Conclusion No. 26-KL/TW of the Politburo of Viet Nam in 2003, a key direction is to promote research and development of new and renewable forms of energy (Politburo of Viet Nam, 2003). Resolution 55-NQ/TW of the Politburo of Viet Nam in 2020 emphasises that using energy economically, efficiently, and protecting the environment must be considered an important national policy and the responsibility of the whole society. The resolution emphasises the need to develop and prioritise renewable energy sources and invest in the construction of power plants that generate energy from waste, encourage the development of renewable energy centres and the assessment of geothermal energy, ocean waves, tides, ocean currents, and hydrogen energy. The government also plans to implement mandatory standards and regulations for energy efficiency and to encourage households to use clean and renewable energy, especially in industry and transport. Finally, Resolution 55-NQ/TW also set out the tasks to (i) study and develop appropriate carbon tax policies for the use of fossil fuels; (ii) improve national standards on emissions and wastes in energy industry aligned with those developed countries; and (iii) develop and implement project to integrate the circular economy into the development strategy of energy enterprises and waste management, amongst others. Small hydropower plants will receive incentives via the avoidable-cost tariff schedule, whilst power projects using other sources will receive incentives through a feed-in tariff schedule, which guarantees an above-market price for producers.

Energy: Institutions and Players

To implement those policies, the Ministry of Industry and Trade has prepared various incentives for approval by the government. The Ministry of Industry and Trade is in charge of sectoral issues related to energy and manufacturing, SCP, energy conservation and environmental industry, including international cooperation on these issues.

10.3. Transportation

The transport sector also saw various policy changes towards green transition and climate change adaptation. Prime Minister Decision 355/QD-TTg in 2013 on Amending Transport Development Strategy until 2020, Vision to 2030 presented one key viewpoint to develop transport in the direction of modernity, with increasingly improved quality at a reasonable and safe cost, to restrain environmental pollution and conserve energy. Resolution 36-NQ/TW of CPV Central Committee on Marine Economy Development Strategy to 2030, Vision to 2045 also emphasises one direction to develop coastal eco-urban areas, which may also cover the green transformation of transport activities in these areas. (Party Central Committee, 2018). In addition, the Minister of Transport issued Decision No. 2027/QD-BGTVT on the Project to Develop Green Seaports in Viet Nam in a sustainable way in 2020. In 2021, the Prime Minister of Viet Nam issued various decisions to approve master plans for transport networks from 2021–2030 with a vision to 2050. The plans aim to actively promote the use of modern science and technology in construction, management, and operation, to limit environmental pollution and efficiently use natural resources. Key tasks include conducting environmental impact assessments of projects, integrating climate change factors and efficient resource use, and implementing regulations for environmental protection in traffic construction and

operation projects. The plans also aim to build a modern public transport system that combines efficient fuel use, especially in urban areas, to reduce pollution and minimise negative environmental impacts. Additionally, there is an emphasis on reducing traffic activities that harm the environment.

Transportation: Institutions and Players

The Ministry of Transport is in charge of sectoral issues related to transport, including issues related to green transport, including international cooperation.

Chapter 3

From Plan to Actions: Assessing Circular Economy Practices in ASEAN Countries

1. Assessing ASEAN Circular Economy Implementation

Transition into a more sustainable agriculture, energy, and transport has been found in the ASEAN Countries based on the existing policies and legal frameworks. Noting the different level playing fields and priority areas of each ASEAN Member State (AMS), this section analyses Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam implementations of circular economy policies and legislation.

1.1. Brunei Darussalam

The circular economy is a relatively new concept and model for Brunei Darussalam. Most policies were announced or planned in recent years with progressive implementation over the next 15 years, i.e. aligned to meet the *Wawasan Brunei 2035* goals. The Brunei Darussalam National Climate Change Policy document is perhaps the most comprehensive and impactful, with clearly defined goals and timeframes up to 2035 covering CE elements.

Other government-led initiatives include 'No Subsidy Day' to raise awareness on the actual price of petrol without subsidy and car-free days every Sunday morning during '*Bandarku Ceria*'. Private sector initiatives include the Sustainable Nation Campaign launched by the largest bank in the country, Bank Islam Brunei Darussalam, to encourage small but impactful actions to fight climate change and move towards a circular economy.

Agriculture

Agricultural land use has increased due to the national policy to improve food security, encouraging local production of paddy and agricultural produce. Similarly, aquaculture sites have grown due to increased fish and shrimp farming. There has been relatively little focus on circularity in food production. Environmental policies that have been implemented include prohibiting open burning and guidelines on pollution control. Brunei Darussalam has good air quality most days of the year.

The Ministry of Primary Resources and Tourism has introduced an initiative to recycle waste from poultry farms into organic fertiliser, led by agricultural authorities and a leading local environmental services company. To control and prevent overfishing, there are regulatory measures that include allocation of licenses and quotas in specified fishing zones, specific allowable types of fishing gear, banning of trawlers, and policies for exploitation up to a maximum sustainable yield. Other initiatives include banning any catching or landing of endangered species as well as encouraging the development of alternatives for seafood production such as offshore cage fish farming. To preserve forest resources, policies include devoting adequate and permanent areas to the National Forest Estate for prudent management, ensure responsible commercial exploitation, rehabilitate wastelands, and ensure efficient harvesting of production forests.

Policies on the preservation of natural resources, including minerals, forest, and marine, have been implemented for decades. Forests make up more than 70% of Brunei Darussalam's land area, with almost 50% protected terrestrial area. The level of water stress at 3.5% is low, compared to the international benchmark of 25% as water-stressed. Brunei Darussalam has also pledged 58% of its total land area for the Heart of Borneo initiative and declared Tasek Merimbun as an ASEAN Heritage Park. Brunei Darussalam's policies on sustainable use of primary resources, marine protection, and forest conservation are aligned to SDG Goals 12, 14, and 15, respectively.

Energy

The use of renewable energy is only a tiny fraction of total energy consumption. Although greenhouse gas (GHG) emissions have declined in recent years, this is in part due to dwindling hydrocarbon production from mature oil and gas fields. Some reduce, reuse, recycle (3R) initiatives have been implemented in recent years, but waste generation continues to increase. Although, the declining or stabilising trend in consumption of electricity, water, and ozone-depleting substances is encouraging. This could reflect recently implemented policies such as electricity tariff reform in the residential sector, use of prepaid utility meters, and awareness campaigns.

Transportation

New car registrations have decreased but car ownership has hardly changed, reflecting a preference for used cars. Oil consumption remains high, although the COVID-19 pandemic reduced demand significantly for air and land transport due to mobility restrictions. Subsidies review has been planned, but no changes has been implemented. The decline in the value of fuel subsidies is due to the sharp decline in oil and gas prices since 2014–15. Additionally, a 2-year pilot project on electric vehicles was launched in 2021 by the Electric Vehicles Joint Task Force, co-chaired by the Minister of Energy and the Minister of Transport and Infocommunications. Royal Brunei Airlines has also implemented initiatives to reduce fuel consumption, including using eco-friendly fleets and participating in the Carbon Offsetting and Reducing Scheme for International Aviation (CORSIA).

1.2. Cambodia

Agriculture

Waste to Energy for the Rice Milling Sector in Cambodia (2012–2015) is a project that established a training package through the National Polytechnic Institute of Cambodia for rice millers, small and medium-sized enterprises (SMEs), local technology manufacturers as well as importers. The overall goal of this project is to contribute towards economic prosperity and poverty reduction and to mitigate the effect of climate change by enhancing competitiveness of the rice sector through increased uptake of environmentally responsible waste-to-energy (WTE) technologies. Specific objectives of the project are to promote sustainable production of milled rice through the replication of existing WTE rice milling technologies and promote sustainable transformation and consumption of rice by consolidating fragmented guidelines into a single operational industry standard with policymakers, SMEs, and financial sector actors together in a multi-stakeholder platform.

In Cambodia, rice is either exported raw or processed through diesel powered engines because of high electricity prices, limited access to technology and logistics, resulting in high rice prices in the regional markets. Very few rice millers have access to efficient drying and other processing technologies. Access to finance is also another major problem for the rice milling sector. There is a potential to

convert rice husk into energy by utilising rice husk gasifier technology. However, there exist no standards for gasification equipment making it difficult for rice mills to decide on the appropriate technology. The price of imported gasifiers is high, and many millers do not trust locally manufactured gasifiers. All these factors result in higher processing costs, low quality, and low volumes of production.

Energy

At the same time, total final energy consumption in Cambodia grew by an annual average of 6.9% during 2010–2015. Final energy consumption in 2015 was 3.4 million tons of oil equivalent, comprising 50.5% petroleum products, 36.0% biomass, 13.1% electricity, and 0.4% coal. The transport sector is responsible for nearly half (46%) of final energy consumption. In terms of fuel uses, more than 40% of biomass is used in the residential sector for cooking and heating, another 40% is used to produce charcoal (which is also consumed by households), approximately 15% is used in industry, and a small portion contributes to electricity generation (ADB, 2018). Cambodia's GHG emissions are small compared to countries in the region, but the emissions trend is increasing. In 2016, the largest emission source such as Forestry and Other Land Use (FOLU) were 163.6 million tCO_2e (GSSD, 2020).

Table 3.1. Emissions Trends by Sector, Cambodia

Sector	1994	2000	2005	2010	2015	2016
Energy	2.7	3.1	3.5	5.3	8.4	9.6
IPPU	0.004	0.006	0.013	0.493	1.0	1.8
Waste	1.5	1.9	2.1	2.4	2.7	2.8
Agriculture	11.2	13.0	15.3	18.1	18.1	18.4
FOLU	27.0	27.0	27.0	131.0	131.0	131.0
Total (without FOLU)	15.4	18.0	20.9	26.3	30.1	32.6
Total (with FOLU)	42.5	45.0	48.0	157.3	161.1	163.6

FOLU = Forestry and Other Land Use, IPPU = industrial processes and product use.
Source: GSSD (2020).

Along with energy consumption and GHG emissions, waste generation has also seen an increasing trend in recent years. In 2017, the average daily amount of municipal solid waste taken to the Dangkor landfill site of Phnom Penh was 2,215 tonnes per day, and it is projected to increase until 2030 (PPCA, et al., 2018). A large share of this waste was burnt (57%) and around 38% of the waste was deposited at landfill sites without environmental controls such as landfill gas management and flaring (GSSD, 2020).

1.3. Indonesia

Indonesia has committed to conduct energy transformation as a result of the United Nations Climate Change Conference (COP26) in Glasgow in 2021. The implementation plan focuses on three issues: (i)

developing electricity vehicles ecosystem, (ii) building the biggest solar power plant in ASEAN, and (iii) developing renewable energy and green industry (President of the Republic of Indonesia, 2021).

Agriculture

The Ministry of Environment and Forestry (MOEF) currently focuses, amongst others, in empowering Indonesian waste banks, improving domestic plastic waste quality, providing fiscal incentives for waste recycling, and setting up cross-ministerial cooperation to limit or ban recycled plastics and paper raw materials import (MOEF, 2022). In February 2022, there were 11,610 waste banks in Indonesia that could become a booster in encouraging the circular economy (MOEF, 2022). However, the establishment of waste bank infrastructure relies on other ministries, one of them is the Ministry of Industry. The MOEF faces a situation that it is not independent enough to realise its own plan, including the Ministry of Agriculture (MOA). They are only allowed to engage at household scale (or small-medium enterprise scale) business only; but not at industrial scale which becomes the Ministry of Industry domain (MOA, 2022).

The MOA best practice set is to obtain the intellectual property rights (IPR), then utilise the IPR to private enterprise. One of the most successful examples is the collaboration between the Ministry of Agriculture and Cap Lang (PT Eagle Indo Pharma) in eucalyptus production (MOA, 2022). The former's asset is IPR, whilst the latter's is the production machines. In a much smaller scale, the MOA has supported SME products in circular economy implementation (e.g. shoes with rice husk as basic material, and rice bran oil from rice paddy). However, the production is not sustained noting a lack of management at the household scale (MOA, 2022). At the end, low awareness on the circular economy is one of the main roots in circular economy adoption and implementation. Little research funding on the circular economy also implies low awareness (MOA, 2022).

Energy

With regards to the energy sector, Indonesia has established and enacted its national energy management blueprint 2006–2025 based on Presidential Regulation No. 5/2006 and Law No. 30/2007. A target to ensure energy elasticity coefficient below 1 in 2025 is aimed (Ministry of Energy and Mineral Resources, 2019). In 2006, Indonesia's energy source heavily relied on oil and coal and in 2025, the use of oil is targeted at a maximum 20%; coal 33%; gas a minimum 30%; and geothermal, biothermal, and renewable energy is 5% (Table 3.2).

Table 3.2. Indonesia's Energy Source Target for 2025 (designed in 2006)

Type of Energy	Utilisation Target in 2025	Utilisation (as of August 2021) National Electricity (Total 73,600 MW)
Oil	maximum 20%	3.75%
Gas	minimum 30%	17.89%
Coal (brown coal, coal liquefaction, and briquette)	33%	63.59%
Geothermal	5%	
Biofuel	5%	
Renewable energy (other than geothermal)	5%	12.77%

MW = megawatt.
Source: Mediana (2021).

However, energy source utilisation in August 2021 is still dominated by coal (Mediana, 2021). The current progress shows the renewable energy realisation is still far from target. None of the realisation could match the target since 2013. For example, in 2021, the realisation rate is still 11.33% from 14.5% (MEMR, 2021).

Table 3.3. Indonesia's Renewable Energy Target and Realisation, 2013–2021

Year	Target	Realisation
2021 (until Q2)	14.5%	11.33%
2020	16.0%	11.20%
2019	16.0%	9.15%
2018	15.0%	8.00%
2017	15.0%	8.43%
2016	13.0%	7.70%
2015	9.8%	6.70%
2014	8.8%	6.40%
2013	8.2%	5.20%

Source: Mediana (2021).

The Ministry of Energy and Mineral Resources estimates Indonesia has more than 3,600 gigawatts (GW) renewable energy potential, but its realisation is only 11.5 GW (Prasetyo, Mediana, and Perdana, 2022). Solar energy is deemed as the biggest potency calculated at 3,295 GW (Prasetyo, Mediana, and Perdana, 2022). Unfortunately, the current tension between PLN and private enterprises with solar panels for household business (one of them is Mitsubishi) pictures a challenge in transition to renewable energy. PLN faces disruption after many years of being the sole energy producer and seller to households and responds by enacting a net-metering system, which avoids their household customers using 100% solar energy generated from the solar panels on household rooftops. This

situation discourages people shifting to renewable energy, not to mention the high cost of the solar panels.

To boost renewable energy, in February 2022, the Energy and Mineral Resources minister mentioned a Presidential Regulation on Renewable Energy Electricity is currently being drafted to ensure green investment could return in a 10-year period. Furthermore, *Perusahaan Listrik Negara* or PLN (state-owned electricity enterprise) is obliged to buy electricity from renewable energy plants is also discussed during the drafting; which includes a scheme to compensate PLN in case the selling price (through cost of supply) does not fit with its business model (Mediana, 2021). The presidential regulation is drafted to encourage renewable energy investment target and realisation meet up current target. In 2021, the green investment realisation is below target, only fulfilling 74% realisation (US$1.51 billion of US$2.04 billion) (Fajrian, 2022).

The Ministry of Energy and Mineral Resources noted that the input capacity for new and renewable energy (EBT) power plants installed in 2023 will increase by 368 megawatts (MW). As an illustration, 368 MW is estimated to provide electricity for more than 400,000 homes that have a power capacity of 900 Volt Ampere (VA). This additional input will be divided into a number of projects, from a 136 MW hydroelectric power plant, a 161 MW PLTS, a 13 MW geothermal power plant, and a bioenergy power plant or PLT Bioenergy with a capacity of 58 MW. The results of the EBT will be allocated to enter the PLN electric power network. In addition, the government has also set a target of adding 100 MW peak PLTS rooftop installations.

Transportation

Regarding transportation, the MOT currently sets three sustainability or circular economy approaches concerning national transportation: (i) avoid (to avoid travel, smart logistics or smart city concept are the solution, amongst others), (ii) shift (to shift to other transportation modes that are more environmentally friendly), and (iii) improve (to improve transportation efficiency) (MOT, 2022). The National E-Mobility Plan 2021–2045 is still being discussed; with 100% public transportation electricity based by 2045 as the target. There are three scopes of public transportation pertaining to the plan: intracity, regional, and interprovincial. In regard to intracity public transportation, the E-Mobility Plan started in2021 in Bandung (1 route) and Surabaya (2 routes). The current E-Mobility Plan on intercity public transportation period is until 2030 with the aim of 90% public transportation electrification in 34 provinces. A further step is to reach 100% public transportation electrification in 2040–2045 for buses and minibuses (*angkot*) across Indonesian big cities. Indonesia also encourages public transportation electrification within the 11 new strategic tourist destinations, such as Danau Toba, Tanjung Kalayang, Tanjung Lesung, Tana Toraja, Candi Borobudur, Mandalika, Gunung Bromo, Wakatobi, Labuan Bajo, Morotai, and Likupang. The electrification plan will start in 2025 due to current inadequate infrastructure and electricity. The plan aims to reach 60 electricised fleets in 2030. Moreover, for interprovince, the MOT realises current battery technology is limited to 300 kilometres (maximum speed 70 kilometres per hour) per charge. The E-Mobility plan refers to this situation and therefore only include trans-Java and trans-Sumatra routes. The pilot project first phase started in 2022. The target for 2030–2040 is 25% bus electrification and the 2040–2045 period target is 50% bus electrification for all Trans-Java and Trans-Sumatra interprovince routes.

For fuel, Presidential Regulation No. 191/2014 plans to wipe out more emitting fuel Pertamina Premium (RON 88) and reduces Pertalite (RON 90) circulation. However, this went unimplemented and Pertamina Premium and Pertalite fuels are still guaranteed available for the public, thus

hampering the plan to set up less emitting Pertamax (RON 92) as the minimum fuel standard in Indonesia. In addition, the use of vehicles has increased by 5.3% (2019) and 5.9% (2018), led by motorcycles as the national transportation portion (84.3%) (Gaikindo, 2020). Noting the massive number of vehicles and impacts to climate change, in December 2021, the MEMR re-discussed and found the shift from Premium fuel to Pertalite fuel shall reduce carbon dioxide by 14%; and the shift from Pertalite fuel to Pertamax fuel shall reduce carbon dioxide by 27% (Widyastuti, 2021). Due to the impact of the Russian Federation–Ukraine conflict, Pertamina's Pertamax (RON 92) price across Indonesia was raised in April 2022. The government is monitoring its impact whether the middle class continues to buy non-subsidised Pertamax or shifts to subsidised Pertalite fuel (RON 90). Emissions will increase in case the shifting to Pertalite fuel takes place. Currently, the Ministry of Energy and Mineral Resources sets RON 92 fuel as the minimum standard to be classified as green energy.

There were 133,617,012 motorcycles leading the national transportation portion (84.3%) followed with passenger cars with a total of 15,592,419 (11.6%) in 2019. Pre-COVID-19 pandemic showed a steady growth of vehicles of 5.3% (2019) and 5.9% (2018). Noticing the massive number of vehicles and impacts to climate change, in December 2021, the Ministry of Energy and Mineral Resources calculated the success in shifting Premium fuel to Pertalite fuel shall reduce carbon dioxide by 14%. Further success in shifting Pertalite fuel to Pertamax fuel (RON 92) will reduce CO_2 by 27%.

Another circular economy initiative driven by the market is the low-cost green car (LCGC) as one of the most selling products in Indonesia. Government Regulation No. 41/2013 introduced LCGCs and set up tax exemptions with the condition that the car is capable in reaching 20 kilometres or more referring to one litre of fuel. This is added with Government Regulation No. 74/2021 that sets luxury selling tax at 15% and basic tax charge at 40% from selling price for full hybrid car with maximum 3,000 cc. As electric vehicles are more expensive, an incentive of 0% luxury selling tax is currently set under MOI Regulation No. 36/2021. The government is setting 15 million electric vehicles as the target in 2030, consisting of 13 million electric motorcycles and 2 million electric cars. Currently, 219 charging stations have been built in 185 locations. In 2021, LCGC amounted 16.4% sales from total cars sold in Indonesia (Gaikindo, 2020).

Table 3.4. Low-cost Green Cars Sold in Indonesia, 2017–2021

Year	LCGCs Sold	Percentage of Total Cars Sold in Indonesia
2021	145,219	16.4%
2020	116,475	21.9%
2019	221,006	21.5%
2018	225,480	19.6%
2017	242,680	22.5%

LCGC = low-cost green car.
Source: Gaikindo (2020).

1.4. Lao PDR

The concept of the circular economy has recently gained attention to the key policy formulation of the Government of the Lao PDR. With the UNDP's support to develop the national circular economy strategy in 2017, the Lao PDR has already made considerable progress in its transition to a circular economy (Government of Lao PDR and UNDP, 2021). The circular economy concept was introduced

in the National Green Growth Strategy till 2030 (Government of Lao PDR, 2018) and the Lao PDR's Nationally Determined Contribution (NDC) (Government of Lao PDR, 2021a). The critical step is that the circular economy concept was introduced for the first time in the 9th National Socio-Economic Development Plan 2021–2025 as prioritised activities for the output of 'green growth promoted and actions taken towards climate change mitigation'. It emphasises that economic growth must go hand in hand with sustainable, efficient, and effective use of natural resources by ensuring the lifespan and quality of products in compliance with the concept of circular economy aimed at reducing, reusing, and recycling to create added value (Government of Lao PDR, 2021).

1.5. Malaysia

Malaysia has actively promoted and strategised for three circular economy initiatives. Despite the unavailability of exclusive circular economy policies for individual sectors, the Ministry of Environment and Water has been appointed to lead grand initiatives at the national level. For now, Malaysia is focusing on how to recycle raw materials into new products. This step is being implemented to produce new products by minimising the usage of virgin materials. Since Malaysia is blessed with agricultural resources, it is also focusing more on resource efficiency to attain sustainable biomass projects that integrate biorefineries and bio-hubs. Thus far, the following roadmaps and guidelines are closely related to the circular economy: Malaysia's Roadmap towards Zero Single-Use Plastics (KASA, 2021), the Energy Transition Pathways for the 2030 Agenda Sustainable Energy Transition Roadmap for Iskandar Malaysia (UNESCAP, 2021), and the Shared Prosperity Vision 2030 (MEA, 2019).

Agriculture

For agriculture, Malaysia has initiated NAP 2.0 initiatives to optimise the efficient use of resources in the value chain to reduce carbon emissions, solid waste, and hazardous material in the agriculture and food industry. Under NAP 2.0, collaboration with the industries along the value chain was aimed to achieve end-to-end digitalisation and improve competitiveness in accelerating technology adoption processes. NAP 2.0 also encourages greater sustainable consumption and production adoption by increasing efficiency and productivity through modern technology application clearly stated in 10-10 Malaysian Science, Technology, Innovation and Economy (10-10 MySTIE) for the agro-food sector.

Domestic institutions such as MAFI, MPIC, KETSA, and the private sector to reduce redundancy and overlap regulatory and approval. Several initiatives have been developed to enhance collaboration and coordination, including National Policy on Biological Diversity 2016-2025 (MONRE, 2016), National 4IR Policy (EPU, 2020) and Green Technology Master Plan 2017-2030 (KeTTHA, 2017). A close relationship with ASEAN is also detected in agriculture by following the circular economy -related policy on zero burning. To meet the NDC commitments, the Malaysian agriculture has run feed-in tariff (FIT) biomass since 2012. It aims to increase the quota release for biomass from the year 2019-2025 to overcome resource scarcity. Agrofood Malaysia is also exploring opportunities to access international funding, primarily from the Green Climate Fund, to overcome the financial barrier. The agro-food sector is also committed to supporting ASEAN policy on zero burning by advancing sustainable growth by adopting reverse supply chain and green practice.

Energy

In the energy sector, Malaysia has focused on the four primary energy resources: oil, gas, coal, and hydro, to enhance resource efficiency. The national-level programmes are focused more on the

climate crisis, biodiversity issues, waste management, and recycling. More investment in bioenergy is expected to achieve 20% clean energy by 2025. The energy sourced from renewables is given a FIT, i.e. electricity sold to power utilities at a premium price. Another example is in the energy sector where Sustainability Achieved via Energy Efficiency (SAVE) and Minimum Energy Performance Standards (MEPS) are deployed to measure energy efficiency, involving the Sustainable Energy Development Authority using certified trainers to provide information and knowledge about solar PV. In the energy sector, regarding COP21, the government is keen on more sustainable and green energy initiatives in the medium term (2016–2020) and long run (2021–2030). Thus, stakeholders and regulators need to balance options and look for midpoints without losing sight of the energy imperatives, mainly available volume of molecules (gas) and tonnage (coal) and economic thresholds that drive the merit order of dispatch participating power plants in the national grid.

Transportation

On the other hand, the transport sector increased resource efficiency by coordinating the development of the Electric Vehicle Infrastructure Roadmap, pushing towards using non-emissions vehicles to replace internal combustion engines. Furthermore, the National Logistics and Trade Facilitation Master Plan 2015–2020 (MOT, 2015), the National Land Public Transport Master Plan (NLPTMP) (LPTC, 2012), the Greater Kuala Lumpur/Klang Valley Land Public Transport Master Plan and Intercity (LPTC, 2011), and cross-border connectivity have been important tenets for the resilience of the circular economy. The Malaysian Palm Oil Board is also in consultation with the automobile industry to resolve the technological barriers to utilising the higher blend biofuel. In addition, SIRIM is collaborating with Sime Darby in conducting a pilot-scale production of bionatural gas from palm oil mill effluent for land transport and industry usage (MyGov portal).

1.6. Myanmar

Based on the MSDP, productivity remains below regional averages. Myanmar needs to address structural and systematic constraints in the agriculture sector to remain competitive. High production costs and high harvesting losses due to a lack of adequate support in financing, technological inputs, and market access have also weakened Myanmar's ability to participate in and move along the agricultural value chain, both domestically and regionally. Whilst progress is being made, many people remain vulnerable to periods of food insecurity, often exacerbated by their exposure to social, economic and environmental shocks. As a result of Myanmar's shift towards an open, market-based economy, the range of actors that may contribute to addressing food security is changing, with the private sector playing an increasingly important role.

Myanmar also needs to adapt industrial and transportation systems to mitigate the heightened risk of disasters and climate conditions, with transition to more efficient, low-carbon technologies. Myanmar is a country blessed with great development potential; however, the infrastructure gap risks hampering Myanmar's ability to sustain the high rates of growth. Myanmar should embark on a low-carbon, green economy development trajectory that prioritises the efficient use of natural resources.

1.7. Philippines

Agriculture

In the agriculture sector, a major issue is the problem of agricultural waste, particularly from rice production. Rice straw and husk, which are by-products of rice production, are considered agricultural

waste that poses an ecological problem. Rice production generates an equivalent of equivalent 11.3 million metric tons (MT) of rice straw, whilst one-fifth of this is rice husk, also called rice hull in 2018 (LTA, 2018). Burning or leaving the rice straw on the ground is the customary practice during rice harvesting, and some municipalities have tried to resolve this through ordinances prohibiting the burning of rice straw, but the prohibition is not always implemented (Glushankova, 2018; Eleria, 2021). Recent estimates on the amount of waste (agricultural and food waste) will increase from 21.4 million MT in 2020 to 23.6 million MT in 2025. Biodegradable waste comprises about half (52.31%) of total waste and most is food waste (86.2%) (EMB, 2008). The only waste disposal method allowed under the Ecological Solid Waste Management Act is a sanitary landfill, but only 39% of the population has access to it, and many landfill sites are close to filling up.

Citizen awareness, engagement, and participation from the Organic Agriculture Act (and its immediate implementation in June 2021) has been institutionalised in the Participatory Guarantee System, a quality assurance system that certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks, and knowledge exchange (Research Institute of Organic Agriculture FiBL and IFOAM – Organics International, 2021). The Participatory Guarantee System engages small farmers and producers in a highly participatory way and allows them to achieve organic status more easily. However, the amendment of the Organic Agriculture Act is still seen as having gaps mainly because it does not adequately address the transition from conventional agriculture to organic and ecological agriculture systems, and food supply could be put at risk (Montemayor, Villegas, and Mendoza, 2021).

For solid waste, the Philippines has depended on the Solid Waste Act that was enacted 20 years ago. Progress has been slow but starting to speed up. For example, until 2018, only 20% of 10-year solid waste management plans submitted by local governments were approved. By February 2022, this increased to 68% of the total. Whilst there are still no established waste-to-energy (WTE) facilities in the country, there are several proposals and feasibility studies. For instance, the feasibility study of the construction of WTE facility in Davao City is being conducted. WTE technologies are also a priority intervention under the Manila Bay Sustainable Development Master Plan.

A government initiative related to food waste is declaring January as Zero Waste Month (Proclamation No. 760, issued in 2014) (Carretero, 2021). At the moment there is no national strategy on WTE but local governments are starting their own initiatives. Puerto Princesa City in partnership with Austworks put up a plant in the Sta. Lourdes Sanitary Landfill site, which plans to use the city's 110 metric tons/day municipal waste to generate 5.5 MW of electricity (Teves, 2019). On forestry, there is a local initiative in the Caraga to craft a roadmap and develop a database to generate science-based information necessary to advance circular economy in the forestry sector (Balanay, Varela, and Halog, 2022). In addition, projects such as the *Palayamanan*, Urban Aquaponics, and Methane Recovery and Combustion with Renewable Energy Generation from Anaerobic Animal Manure Management under the Land Bank of the Philippines' Carbon Finance Support Facility have been initiated.

Energy

For the energy sector, the Philippines' heavy dependence on coal and fossil fuel imports for power generation, oil price volatility, and supply constraints, were the impetus for the government's drive to develop alternative energy sources, mainly renewable energy. When the Renewable Energy Act was passed in 2008, the share of renewable energy (RE) to the country's energy mix was about 34%. As of 2020, however, it had gone down to only 21%. The Philippines, however, is amongst those with the

highest share of renewable energy in the total final energy consumption, in the Asia-Pacific region at 47.5%, according to a 2019 REN21 report. The Philippines has been guided by The Philippine Energy Plan 2020–2040 that sets the clean energy scenario such as increasing the power generation mix by 50% in 2040; inclusion of 5% biodiesel blending in 2022; 10% penetration target of electric vehicles by 2040; 5% energy savings on oil and electricity by 2040 by electric vehicles; and 12% reduction of GHG emissions for the Nationally Determined Contribution. To implement the Renewable Energy Act, the Philippines introduced the Green Energy Option Program (GEOP) in December 2021. Under the programme, electricity users with at least a monthly average peak demand of 100 kW can opt to acquire purely RE in their supply contracts. As of December 2021, 18 RE suppliers were granted GEOP operating permits by the DOE. More recently, the DOE published the list of operational RE projects eligible for the Renewable Portfolio Standards, which mandates the country's electricity providers to source an agreed portion of their energy supply from eligible RE power projects. Of this, 36 are biomass schemes with an aggregate capacity of 264.8 MW (DOE, 2021b). The government has also recently signed up to the OECD Clean Energy Finance and Investment Mobilisation Programme which identifies innovative financing solutions and effective investment vehicles (DOE, 2021a). As of September 2021, 933 RE service contracts have been awarded, including hydropower, ocean, geothermal, wind, solar, and biomass energy. Those that are already installed and integrated into the energy system currently provide 5,442.71 MW into the energy system. With these recent developments, the energy sector can be said to have taken a leap in shifting the perspective on renewables, from grid-centred to a more consumer-centred approach (DOE, 2020a).

The Philippines is implementing several initiatives to promote the use of RE and ensure complementation through energy storage technologies in farming and crop processing methods. The government has developed sectoral roadmaps for the period 2017–2040, with a priority focus on biofuels. The country aims to establish an RE market to facilitate trading of RE certificates, and the energy sector is shifting to a more consumer-centred approach. As biomass represents 8.6% of the country's estimated energy generated from RE sources, in the medium term, the government plans to evaluate for the adoption of cellulosic biomass feedstock for bioethanol production and woodchips production, and efficient domestic cookstoves using woodchips. The prospect of end-use biomass consumption, however, is not very optimistic, it is estimated to grow only 1.2% until 2030 (DOE, 2016).

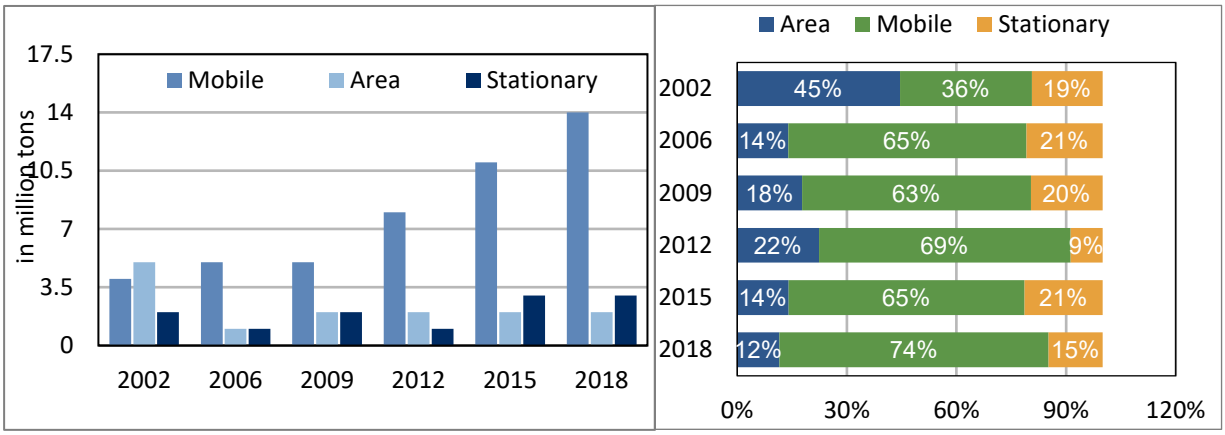
There is also the net metering programme which is an incentive scheme that allows users to partially source out their power requirements, as well as to export electricity, using RE technology through a two-way connection to the grid. Such arrangements benefit end users through lower electricity costs either through (i) earning credit from exported energy, or (ii) reduction in electricity sourced from distribution utilities. Based on the Philippine Energy Plan (2020–2040), about 4,118 qualified end users are registered under this programme, translating to a total capacity of around 33.21 MW peak.

The Biofuels Act of 2006 requires the Department of Energy to prepare a biofuels roadmap, but a comprehensive or detailed roadmap appears to be lacking. In terms of reaching blending targets since the enactment of the Biofuels Act in 2007, the Philippines has stalled in the implementation of the biofuel roadmap targets. Insufficient feedstock is a well-identified issue. Local ethanol facilities are only equipped to use molasses and sugarcane. Only half of the required ethanol for gasoline blending can be supplied locally, however, importation to make up the slack has not been approved. A proposal to increase the current coconut methyl ester blend B2 by one percentage point over the next 3 years starting in 2019 was not pursued. As a result of the expansion of the biodiesel industry in anticipation of the shift to higher blend mandates, there is currently excess capacity in serving the B2 blend.

Transportation

The Philippines ranked 70th out of 106 most polluted countries in terms of air quality (Institute for Climate and Sustainable Cities, 2021). The 2018 data from the Environment Management Bureau attributes 74% of emissions to mobile sources such as cars, trucks, jeepneys, motorcycles, and buses, which keeps increasing as shown in Figures 3.1 and 3.2. The use of electric cars has had very poor uptake, and electric buses for public use are just being introduced in the country (ABS-CBN News, 2021). According to the Land Transportation Office, the registered number of electric vehicles as of 2020 was 12,965, most of which are electric tricycles (e-trikes). As of mid-2021, there were only 136 charging stations nationwide.

Figures 3.1–3.2. Historical Emissions Growth by Source and by Share in the Philippines, 2002–2018



Source: Emissions Management Bureau. Emissions Inventory (2018).

A 2021 report (Suarez and Garcia, 2019) finds that vehicles (mobile source) have no firm upgrading schedule to increase their fuel standards from Euro 4 to 5 or 6. Plans to transition and expand zero emissions public transport and infrastructure in major cities are lacking. Inspections on emissions standards are lax and penalties are low. For industries, under the Data Acquisition Handling System, important progress is being made to collect real-time data from industrial sources, although the industrial emissions monitoring programme in the country is nascent. The Clean Air Act mandates all motor vehicles to undergo an emissions test before they can be registered by the Land Transportation Office, however, the process is fraught with lack of testing centres (18th Congress of the Republic of the Philippines, 2021), and opportunistic behaviour and corruption (Akhbari and Nejati, 2019). The Philippines also has not revised its stationary standards in the last 20 years.

The high cost of electricity and unstable electricity supply are the main concerns for EV charging infrastructure in the Philippines (Rivera, 2021), as well as low technology utilisation and strong competition for investments (Rosellon, 2021). An unexpected development was the strong demand for electric-powered small vehicles, mainly tricycles during the COVID-19 pandemic. However, there are very few local manufacturers of electric vehicles. The country imports small electric vehicles from other countries deploying them mainly as replacement of public transport vehicles (tricycles). Several government programmes have been issued, like the Public Utility Vehicle Modernization Program launched by the Department of Transport to address air quality, which required operators to maintain fleets having at least Euro 4-compliant engines. Part of this programme is to replace the traditional jeepneys with electric ones (e-jeepneys). Its implementation, however, has been limited and received

backlash over financing issues particularly from drivers and operators of small vehicles who lack the necessary capital to acquire and maintain the requisite 15 new public utility vehicles (Pateña and Parrocha, 2018). There is also an e-trike programme by the DOE. The programme aims to (i) deploy 100,000 e-tricycles nationwide to replace the same number of traditional gasoline-fed tricycles; (ii) reduce the transport sector's annual petroleum consumption by 2.8% (equivalent to 89.2 million litres) per year; and (iii) achieve 79% carbon dioxide (CO_2) footprint avoidance. Also, an interesting example of multi-sectoral collaboration is the e-mobility R&D group that aims to develop indigenous EV technologies, installing the solar charging station network, faster electric charging, designing and manufacturing e-vehicles, including motors for e-vehicles. The group is led by the University of the Philippines Electrical and Electronics Engineering Institute, with support from the Department of Science and Technology.

1.8. Singapore

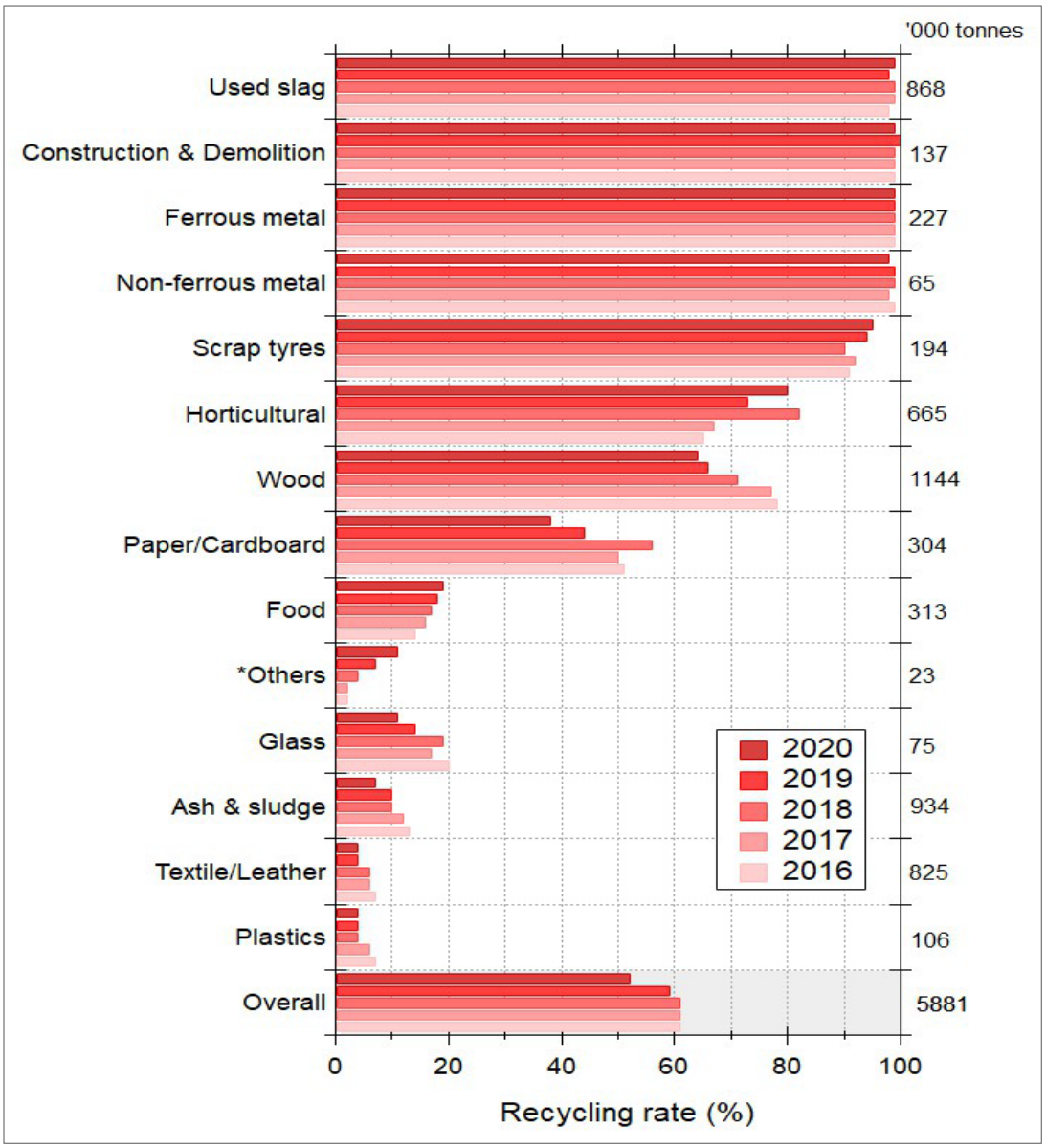
In 2019, Singapore was the first country in ASEAN to introduce a carbon tax. The initial carbon tax rate was set at S$5 per tCO_2e, but at the beginning of 2022 the government announced that the carbon tax will be raised to S$25 in 2024 and S$45 per tCO_2e in 2026, with a view to reaching S$50–$80 per tCO_2e by 2030. The carbon tax currently applies on facilities emitting 25,000 tCO_2e or more annually and covers all large emitters such as oil refineries and power generation plants, which contribute to 80% of the national GHG emissions (NCCS, 2022). The revenue aimed to support decarbonisation efforts and the transition to a green economy, as well as to cushion the impact on lower income households.

Waste

Plastic waste is the most significant challenge facing Singapore's waste management system, accounting for one-third of all domestic waste (Tan, 2018). In 2021, 6.94 million tonnes of solid waste were generated, 26% and 74% corresponded to the domestic and non-domestic sectors (NEA, 2022a). A survey found that each resident uses 3–4 disposable plastic items per day, adding up to 1.8 billion nationally each year (Singapore Environmental Council, 2018). During the 2-month COVID-19 lockdown there was a 70%–80% increase as reported by food delivery companies and online surveys, producing an extra 1,334 tonnes of disposable plastic waste (Deliveroo, 2021; SMU, 2021; Elengovan, 2020). These surveys also found that people today are willing to use food delivery and take-out services more often. The country has implemented an integrated waste management system to sort recyclable materials from general waste at waste-to-energy facilities, and residents can conveniently recycle paper, plastic, metal, and glass waste streams. The Mandatory Packaging Reporting scheme requires companies that supply regulated goods to report annually on the packaging they introduce into Singapore, laying the groundwork for an Extended Producer Responsibility framework for managing packaging waste. As a start, the MPR requirements apply to companies with an annual turnover of more than US$7.25 million. The beverage container return scheme is the first phase of Singapore's extended producer responsibility (EPR) approach for packaging waste, and larger supermarkets implemented a minimum charge of 5 cents per disposable carrier bag in mid-2023 to reduce their use. Singapore is constructing a new integrated waste management facility that is expected to meet the country's future solid waste management needs in the long term once completed in 2025 (NEA, 2019a). Singapore is promoting circularity by recycling as much as possible. By focusing on individual waste streams, 55% of waste generated in 2021 was recycled (NEA, 2022a). Authorities and organisations are implementing campaigns to curb demand for single-use items and

recycle used plastic. Since 2021, firms are required to report the amount of material used to pack their products, and submit plans to reduce, reuse, and recycle (3R) packing waste (NEA, 2021). As shown in Figure 3.3, Singapore has recycled around 50% of various types of waste in 2020.

Figure 3.3. Recycling Rates by Type of Waste, Singapore



Note: Recycling rates by type of waste reported by the National Environmental Agency (2021). The figures at the right indicate the amount of generated waste in 2020 in thousands of tonnes. The category of others includes stones, ceramics, and other material.
Source: Author.

To add, Singapore imports over 90% of its food from more than 180 countries and consumes 367 kg per capita with carbon footprint due to food loss of 954 kg CO_2e per capita in 2018 (Deloitte and A*Star SiTech, 2019). Production, processing, and transportation contributed over 80% of greenhouse gas (GHG) emissions. The environmental impact of red meats was the most severe. Although they represented about 11% of consumption by weight annually, they contributed 40% of GHG emissions due to being largely transported by air.

Table 3.5. Per Capita Consumption, Import Volumes, Three Major Sources of Supply of the Most Consumed Food Items in Singapore

Food Item	Per Capita Consumption (kg per year)[1]	Import Volumes ('000 tonnes per year)	Top Three Suppliers
Fruit[2]	72	433	Malaysia, China, South Africa
Leafy vegetables[1]	16	80	China, Malaysia, Singapore
Other vegetables[1]	82	479	Australia, China, Malaysia
Chicken[2]	36	214	Brazil, Malaysia, United States
Duck[1]	2	12	Ireland, Malaysia, Thailand
Pork[2]	22	128	Brazil, Indonesia, Australia
Mutton[2]	2	15	Australia, New Zealand, Ireland
Beef[2]	4	39	Brazil, Australia, United States
Hen shell eggs[2]	388 pieces	2,138 million pieces	Malaysia, Singapore, Poland
Fish[1]	16	100	Malaysia, Indonesia, Viet Nam
Other seafood[1]	6	34	China, Indonesia, Malaysia
Rice[3]	45	347	India, Thailand, Viet Nam
Wheat[4]	46	253	Japan, Malaysia, Sri Lanka
Sugar[5]	57	314	Australia, Malaysia, Thailand
Cooking oil[4]	5	262	Australia, Indonesia, Malaysia

kg = kilogramme.
[1] As of 2020 (SFA, 2021).
[2] As of 2021 (SFA, 2022).
[3] As of 2017 (Goldstein Market Intelligence, 2021).
[4] As of 2018 (AVA, 2019).
[5] As of 2021 (IndexMundi, 2022).

Another important aspect is to curb food waste. Pilot projects to test the feasibility of using on-site systems to treat food waste at hawker centres and markets have yielded positive results, as well as the partnership of authorities and the public sector to segregate food waste in large commercial and industrial waste generator (NEA and PUB, 2019).

Agriculture

In terms of food production, the government set aside over $23 million in 2019 (SFA, 2019) to encourage research and development in sustainable urban food production. Some initial test-bed projects have included commercial rooftop farming and placing farms in under-utilised spaces (e.g. Citiponics). The SFA has also supported innovative projects such as the Sky Green's 9-metre-tall system that allows vegetables to grow vertically outdoors (e.g. Skygreens), the Sustenir indoor controlled environment agriculture farm that optimise crop growth, and three-tier vertical recirculating aquaculture system developed by the Apollo Agriculture Group. The SFA's website, 'From SG to SG,' showcases other examples of local farms using technology and sustainable practices to improve production. The government is also planning a high-tech agri-food zone in Lim Chu Kang (north-western Singapore), which already has farms, to increase production in a sustainable and resource-efficient manner by developing infrastructure and shared facilities under Our Food Future project. The SFA is also studying the expansion of sustainable fish farming in the deeper southern waters to boost

local fish production (Lim, Jiang, and Tan, 2020). Additionally, there are plans to establish an Agri-Food Innovation Park within *Sungei Kadut* Eco-District to spur innovation in the agri-food tech ecosystem, bringing together high-tech urban farming in both agriculture and aquaculture. The SGP 2030 aims to meet 30% of Singapore's nutritional needs through local production by 2030, (30 by 30 scenario, Singapore Government, 2021) and the National Parks Board is inviting citizens to grow their edible vegetables in small plots set up in parks. However, only local production of fish and leafy vegetables can realistically be scaled up to meet this target.

Energy

Although all economic sectors have shown some success improving energy efficiency and conservation, changes have not been homogeneous. Through a comprehensive decomposition analysis Su et al. (2022) found that industries have improved energy efficiency about 18% since 2005, but increased 27% energy consumption. Similarly, the commercial sector has improved 30% energy efficiency, but increased 52% energy consumption. For the transport sector, energy efficiency improvements and changes in the demand structure have led to reductions of 23% and 14% in energy consumption for passenger and freight transport, despite demand increases in both cases. For the residential sector, a shift toward larger housing and acquisition of new types of household appliances have prevented a net reduction of energy consumption (DOS, 2019). Lastly, structural changes in the power generation sector have brought the largest reductions in GHG, mostly due to an overall shift from oil to natural gas for power generation.

Singapore is highly focused on transitioning to renewable energy, with solar energy being the most promising source. This made Singapore as one of the most solar-dense cities in the world, with 527-megawatt peak (MWp) of installed solar energy capacity as of the end of 2021, targeting 1.5 gigawatt peak (GWp) and at least 2 GWp by 2025 and 2030. It has been deployed in areas such as rooftops, offshore spaces, reservoirs, walkways, and vacant land (EMA, 2021). This is a commendable effort, but it covers only a small fraction of the country's total electricity demand (Figure 2.3d). A lack of space for large solar arrays and the environmental impact of installing photovoltaic panels are major constraints to effective transition to solar energy in Singapore. According to the roadmap for solar photovoltaic energy, only 36.8 square kilometres across the island can be used to deploy solar photovoltaic arrays, with 62% on buildings, both roof space and facades (SERIS, 2020). The balance would be shared between temporary land-based installations, floating installations on reservoirs and unused near-shore sea areas, and panels installed above land, canals, and roads. Comprehensive life cycle analysis is required to evaluate the environmental impact of photovoltaic panels at a large scale and initial assessments at building scale suggest positive benefits (e.g. Patil, Shabunko and Ramakrishna, 2021; Kosorić, et al., 2018; Luo, et al., 2018). Initial assessments conducted by PUB suggest minimal impacts on water quality and biodiversity with appropriate planning and design. Floatovoltaics have shown to perform 5%–15% better than typical rooftop solar arrays due to the cooler temperature of the reservoir environment (PUB, 2021). A 45-hectare floating solar farm was recently put into operation, producing 60 MWp and making it one of the world's largest inland floating solar systems (Sembcorp, 2022).

Singapore's Green Plan 2030 includes the '80–80–80' plan, which aims to achieve a low-carbon built environment by 2030 with three targets. The first target is to have 80% of buildings (by floor area) to be green, but as of end-2020, only 43% of Singapore's buildings have been greened. The second target is to classify 80% of new developments (by floor area) as super low energy buildings that must achieve

at least 60% energy efficient improvement over building made in 2005. The third target is to increase energy efficiency from 65% to 80% (over levels in 2005) for best-in-class green buildings by 2030 (e.g. en-bloc/collective sales) (Singapore Attorney General's Chambers, 2021). Indeed, this practice enables urban renewal and land use optimisation, strengthens the construction sector, and often offers a windfall to those selling. However, it jeopardises the efforts to build a sustainable built environment (Lin, 2021). Singapore faces a growing trend of tearing down old buildings, which goes against the efforts to build a sustainable built environment. The process of tearing-down and re-building is highly carbon-intensive, especially when buildings in good condition are demolished. About 14%–18% of total CO_2 emissions from global economic activities come from the construction sector (Fennell, et al., 2022; Huang, et al., 2018; Napp, et al., 2014). Singapore needs to compensate its pledges for sustainability against the pressure to build bigger and denser modern buildings. All of this, on top of not counting the cultural loss and social displacement associated with moving people out of their neighbourhoods (Teo, 2015; Soh and Yuen, 2011). Refurbishing or repurposing old buildings could be an alternative.

To mitigate climate change, the government is designing energy-efficient public housing real estate that includes innovative features such as solar panels on rooftops and public programmes to encourage people to choose more efficient electrical appliances and adopt energy-saving habits. However, many residents are reluctant to modify their habits, and the most recent household energy consumption study showed slow progress in energy-saving actions (NEA, 2019b). For example, the proportion of households setting air-conditioning at 25°C or higher only reaches 54%. The ongoing initiative of installing advanced electricity metres at residential premises is expected to encourage consumers to be more energy-efficient. The metres allow households to track their electricity consumption every half-hour via a mobile application and get a better idea of where and when they can start cutting down on usage (EMA, 2019). As of the end of 2020, about 400,000 such metres had been installed across Singapore.

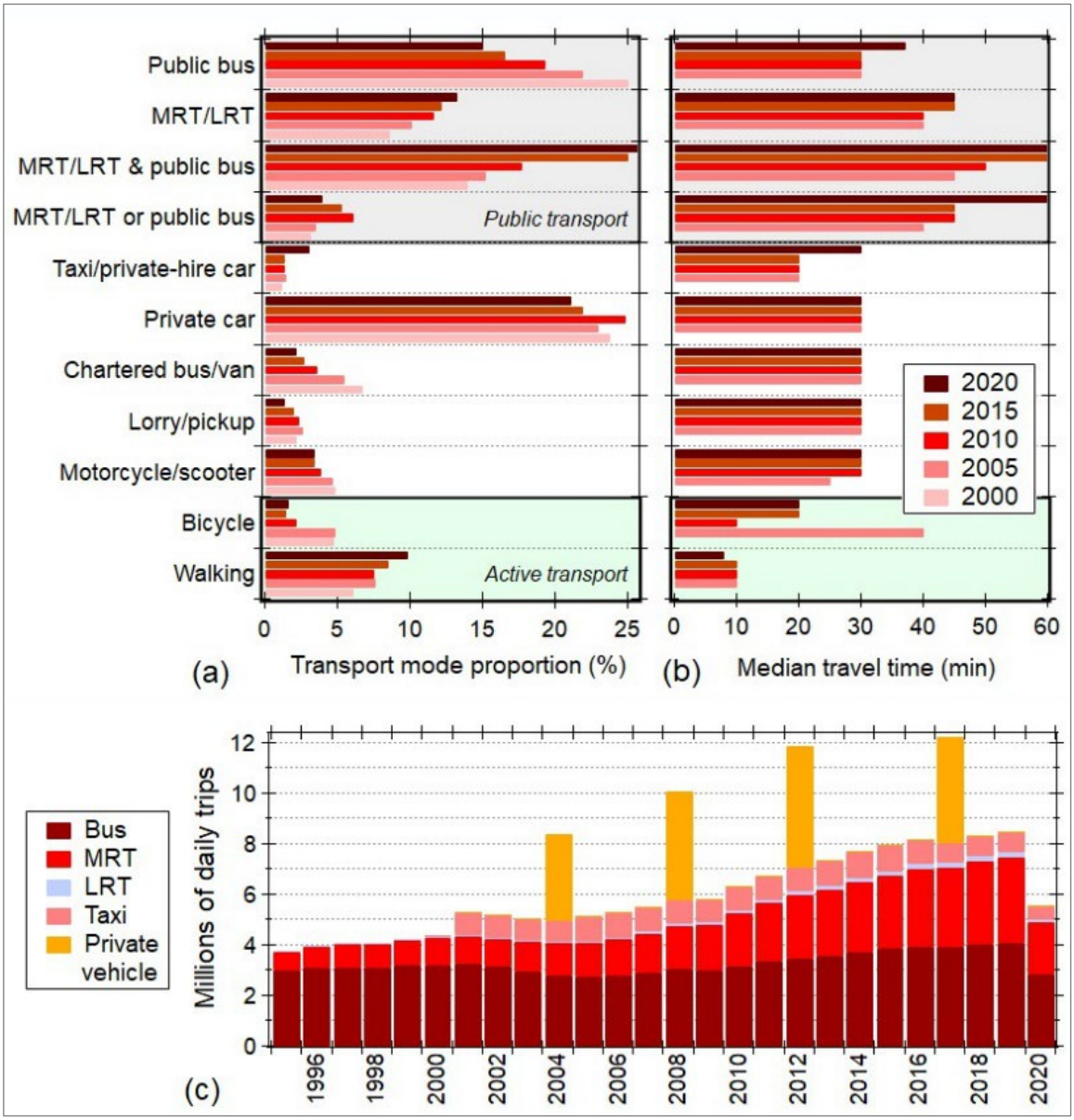
Transportation

According to the latest population census (DOS, 2021), more people are taking trains and buses (57.8%) to commute to work, whilst fewer people are driving to the office compared to 1 decade ago (54.7%). The share of those who relied solely on a car for their work commutes dropped from 24.8% to 21.9%, whilst the proportion who travelled only by taxi or private-hire car increased from 1.3% to 3.0% over the same period. The share of residents who used other transport modes, such as motorcycles and private chartered buses, also fell over the past 10 years. About 9.8% of residents do not need any transport to get to work, up from 7.5% in 2010; but fewer people are cycling, the proportion dropped to 1.6% from 2.1% 10 years ago and 4.7% 20 years ago. Moreover, in the last decade, bus and train capacity have increased by 20% and 50%, respectively. Eighty new bus routes have been included and commuters wait no more than 8 minutes to board a bus during peak hours, and not more than 15 minutes during off-peak hours (MOT, 2017). Concession rates given to children, students, senior citizens, national servicemen, people with disabilities, and those on workfare income supplements (PTC, 2021).

The rail and bus networks are the backbone of Singapore's land transportation, with the rail network spanning over 230 km, set to grow to 360 km by 2030. The expansion will mean that eight in 10 households will be located within 10 minutes walking distance from a train station (MOT, 2017). In addition, three light rail lines (light rail transit) provide connections for residents living in residential

states to the nearest mass rapid transit station. Almost 6,000 buses ply the roads, 50% are double-decker buses, and most are powered by diesel engines under Euro 5 or 6 emissions standards (LTA, 2020). Public transport ridership has increased with the availability of more buses and trains, cleaner and more comfortable vehicles, closer bus stops and train stations, and affordable fares. However, commuting by public transport still takes longer than using private transport, which could be due to people living further away from their offices or taking longer journeys via public transport. Figure 3.4 shows the transportation trends.

Figure 3.4. Transportation Trends, Singapore



LRT = light rail transit, MRT = mass rapid transport,

Notes: (a) Ridership proportion and (b) travel time by transport mode amongst Singapore residents travelling to work (DOS, 2021). (c) Average daily ridership by transport mode. Ridership data by private vehicle are released every 4–5 years as part of the Household Interview Travel Survey (LTA, 2018, 2013).

Source: Author.

Singapore has implemented various measures to manage private transport, including controlling the growth rate of vehicle population, restricting car ownership, and managing traffic congestion through the Electronic Road Pricing (ERP) system. The ERP system, which was introduced in 1998, charges motorists according to the hour, location, traffic volume, and vehicle characteristics. The government plans to make the scheme more flexible by charging motorists according to the distance travelled on congested roads. (LTA, 2019). Several studies have evaluated its effectiveness to manage traffic congestion as a unique case of innovation in public sector (e.g. Chia and Phang, 2001; Agarwal and Koo, 2016; Quirapas, et al., 2018). The cost of owning a car is also controlled through the certificate of entitlement (COE) scheme, which is needed to get the legal right to own a car for 10 years. The cost of this certificate depends on demand and can often exceed the cost of the car itself (LTA, 2021). However, Singapore has created an environment that paradoxically encourages it, with parking being abundant and subsidised. To move towards a 'Car-Lite Singapore,' it may be necessary to reduce the number of annual COEs available for bidding to gradually decrease private car ownership (Centre for Liveable Cities, 2016). On average, a typical Singapore family using public transport on a daily basis spends 4.8% of its disposable income on transportation (Li and Reza, 2018). The fare structure is integrated, and almost 92% of commuters are satisfied with the service provided by buses and trains (PTC, 2022). Smartphones have allowed for the development of applications to plan door-to-door journeys that best meet commuter needs in real-time. The vehicular fleet has increased just 3.3% in 10 years, reaching a maximum of 988,755 vehicles in 2021, whilst the road network has expanded over 8% (LTA, 2022).

Cycling is being promoted as a means of transport in Singapore, with efforts to expand and improve active mobility, including building cycling paths. However, the response has been low, due to safety concerns, as there are not enough dedicated lanes for bicycles. Most cycling paths have been built within and between residential states, but do not connect with workplaces. About 74% of commuters refuse to cycle. Singapore residents walk on average 1.2 km to get around each day with public transit, whilst 14% walk more than 2 km per day (Moovit, 2022). A set of rules and a code of conduct for cyclists were enacted in 2018 (Singapore Attorney General's Chambers, 2018); however, it is unclear if these rules are enough to solve the problem (Liu, 2021).

1.9. Thailand

Thailand's circular economy development is separated into three phases. Phase 1 is considered from 2022–2024 where circular economy innovation projects are identified and quick win projects are emphasised in order to identify feasible, practical, or near potential solution ready for capacity building. Here, a policy sandbox and an innovation sandbox were launched simultaneously to enable more co-creation type engagement across broad groups of stakeholders, including waste symbiosis and reverse logistics with a recycling loop within the key sectors of agriculture and food waste, and plastic and construction material. Also, this stage is where a network of players and stakeholders is formed to support ideation and circular economy design as well as laying out core principles of Thailand's circular economy initiatives as circularity and retention value hierarchy, ensuing key project themes under the Policy Innovation and Innovation Sandbox (2021 onwards) in food and agriculture, manufacturing, finance, digital platforms, and start-ups (Table 3.6).

Table 3.6. Ongoing Policy Sandbox and Business Start-Ups Sandbox, Thailand (2021 onwards)

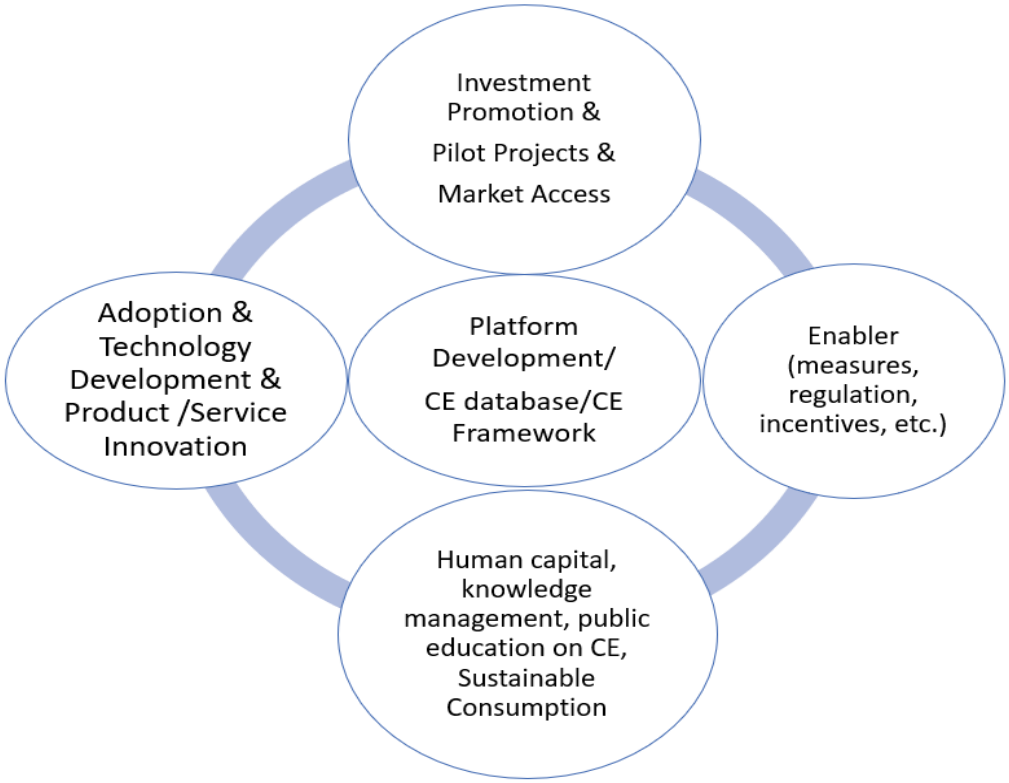
Food and Agriculture under G-Green	Manufacturing Under Circular Material Hub (CMH)	Finance and Capital Market	Digital Platform	Plastic Consortium	Start-Ups
• Green production • Green hotel • Green national park • Green office • Green restaurant	• Business matchmaking for secondary material exchange • Value recovery • Targeting 50% material recovery (est. B9 billion)	• Sustainable finance and capital market • ESG • Steering group to develop ESG market	• Software for restaurants and consumers • 8,000 users with 100 listed restaurants • Reduce waste which are recyclable • Eliminate 50% food waste	• Develop innovative reuse solutions • Create new business models and employment	• Promote CE start-ups with angel funding • Platform for sharing economy such as hotel as a sleeping service • Green bond launch • Designated 2022 to reduce waste by 45,000 tonnes and GHG by 63,000 tonnes

CE = circular economy, ESG = environmental, social, and governance, GHG = greenhouse gas.
Sources: National Higher Education Science Research and Innovation Policy Council, Knowledge Exchange, National of Science & Technology Development Agency, Ministry of Industry, National University of Bangkok, etc.

Phase 2 from 2025 to 2027 is known as the circular economy enabler and ecosystem development stage. This phase will focus on developing the building blocks of circular economy, which will include the development of certification and standards, including for public procurement, financial and nonfinancial incentives including from tax and investment measures under Board of Investment laws and regulations on extended producer responsibility (EPR), and establishing agencies responsible for the circular economy. Lastly, Phase 3 from 2028 to 2030 is when Thailand's circular economy model will be integrated into the ASEAN Circular Economy Innovation Hub. This includes developing best practices for establishing hubs for recycling in cities, demonstration pilot projects that are scalable into commercial and live models, and developing circular economy champion products for export including leading or integrating into the circular economy global value chain. The third phase is considered as moving out of the trial period into real world implementation. There are four elements of circular innovation measures: (i) the legal and standards, (ii) the business model, (iii) the data

(digitalisation) and data platform, and (iv) governance (Figure 3.5.).

Figure 3.5. Thailand's Circular Innovation Measures



CE = circular economy.
Source: Author.

Thailand is currently in the first phase. The four areas (manufacturing, consumption, waste management, secondary materials) have been planned as summarised in Table 3.7.

Table 3.7. Overall Progress and Measures in Manufacturing, Consumption, Waste Management, and Secondary Materials, Thailand

Key Action Areas	New Regulations Needed	Funding & Incentives	Enablers
Manufacturing	• Standard for minimum content of secondary material in product specifications (MOI, OIE) • Promotion of bio-material as raw material (OIE, MOI) • Biomaterial definition and standards (TISI, MOI)	• Incorporate into existing funds, namely Energy Conservation Funds, Innovation Funds ((MOE) • Investment regulations for start-ups (BOI) • Treasury/finance measures for	• Agriculture and bio waste, smart farming (MOA) • R&D with universities and industry, Business match-making, tech development, CE innovation (research network, MOI, MOHESRI)

	• Recycled plastic for food and beverage packaging (FDA) • Carbon pricing and carbon trading system (BCG) (MOE, MOI, MOF)	promoting biotech in CE (MoF) • New CE Incentive Fund (MOHESRI, OIP, MOF, MOI, Pvt)	
Consumption	• Rewrite public procurement rules and guidelines (MOF, BB) • Set standard pricing for garbage disposal fee (polluter pay) based on waste generated (in kg) • Apply tax for packaging cost for consumer (MOI, MOC, Pvt) • New excise tax (MOF)	• Incentives and funding for business and startups adopting "Sharing Economy" model (MOC, OIP, MOI, MOF) •	• Public education on responsible garbage disposal and sorting (MOE, MOIR, MOI) • Promote use of CE product labels and standards and EPR (MOE, TISI, MOI)
Waste Management	• Advance EPR and related regulations for recycling, collection and elimination of waste (MOIR, DOIW, MOI) • Levy on waste (MOF) • Technical standard for imported secondary materials (MOF, MOC, FDA, DOIW, MOI) • Develop profit-sharing business model with provincial authority (MOIR, MOE)	• Start-up funding including app development (BOI, MoF) • Include CE funding in existing funding scheme (MOE, BOI, MOC) • Exempt business registration fee (DIF, MOI)	• Cooperation in R&D, innovation dev for waste management (MOHESRI, DIPM, MOI) • Establish Pilot Plant/R&D Centre as PPP and Univ (DIPM, MOI, MOHESRI) • Technical outreach on waste management (DIPM, OIP, MOI, MOHESRI)
Secondary Material	• Establish import quota secondary material (MOC) • Establish export surcharge(tax) to prohibit certain export items	• Attractive incentives to promote secondary material adoption in domestic production or promotion of inter-industry material	• Support the adoption of technology, tools, and materials for private sector (DIPM, MOI, MOHESRI)

	• Establish secondary material standard	exchange (MOF, OIE, MOI)	• Promote area-based cluster development linking sources of secondary materials (OPI, DOIW, MOIR) • Centralised database on waste management tracking system and secondary material flow(MOE, DIPM, MOI) • Develop online central platform for resource management (MOE, MOI, Network of Related Organisations)

BB = Budget Bureau, MOI = Ministry of Industry, OIE = Office of Industrial Economics, FDA = Food and Drug Administration, MOA = Ministry of Agriculture, MOF = Ministry of Finance, OIP stands for Office of Industrial Promotion, Pvt = private sectors, MOHESRI = Ministry of Higher Education, Science, Research and Innovation, MOC = Ministry of Commerce, MOE = Ministry of Natural Resources and Energy, MOIR = Ministry of Interior, TISI = Thailand Industrial Standards Institution, DOIW = Department of Industrial Works, DIP = Department of Primary Industries and Mines, OPI = Office of Permanent Secretary of Ministry of Industry.
Source: Author.

The country is still working within the timeline. Some of the initiatives which have been advanced progresses into subsequent second phases, such as those under the 'S Curve' industries, like plastic waste, construction material, food loss and food waste, and other priority industries such as tourism and hospitality, EVs, renewable energy and start-ups. Between phases 2 and 3, there are scaling challenges which a few of the piloted projects have begun mostly in large enterprises. SMEs are mostly in the 'proof of concept' stage (business model viability, closing the loop, addressing climate change measures including waste) with a lot of feedback.

Agriculture

The Office of Agriculture Economics reported that Thailand's agriculture sector has performed poorly in the past 5 years, with annual growth rates ranging between 1%–5%. The sector is expected to slow down further due to an ageing population. Agriculture also produces 15% of the country's greenhouse gas emissions but generates little return. Compared to neighbouring countries, the sector is less

productive and competitive in terms of land use and employment of labour. Moreover, it is estimated that almost 193 million tonnes of agriculture waste (pre-harvest) are produced annually, and 8 million tonnes annually for post-harvest agriculture waste and other forms of biowaste, estimated to cost the economy B4 billion to B9 billion loss, annually. However, in 2021, the country declared food loss reduction by 30% from present level to 10% in 2030 and food waste reduction by 15% (2026–2027). Analysing the overall condition of circularity in agricultural sector, Table 3.8. shown the status on Thailand's initiative in food and agriculture.

Table 3.8. Status of Thailand's Initiative in Food and Agriculture in Line with ASEAN Pillars

Gap Areas	Solution
Awareness and lack of circular model for agriculture	• Adopting Good Agriculture Practices guidelines • Establish living learning centres for community, zero-waste schools, and the Environment Education Centre for CE model • Develop people-public-private sector collaboration to co-create new products and process • Develop urban farming • Function food and food innovation, i.e. plant-based food • Promote organic farming as part of CE
Lack of uniform quality	• Develop CE standard for agriculture sector • Support smart farming and precision farming • Promote organic farming practices standard and geographical indications • Renewable and recyclable standard for packaging
Identifying key indicators	• Material circularity indicators • CE data on secondary material • Precision farming • Standard appraisal method for food and agriculture waste • EPR packaging measures
Zero waste practices	• Ban slash and burn practices by farmers • Bio-mass energy recovery • Introduce close loop system in agriculture sector from farm-to-farm concepts which incorporates value chain management (upstream, middle stream, and low stream) at community, provincial, and national level. • Determine new feed-in-tariff to incentivise community biomass plant • Adopt traditional know-how on addressing waste with nature's help • Support community level education on zero waste best practices • Waste water treatment tax, etc.

CE = circular economy, EPR = extended producer responsibility.
Source: Author.

To enhance the sector's competitiveness, the country plans to focus on 'less for more' using technology through smart farming and precision agriculture practices, complemented with the bio-circular model linking circular with bio-based initiatives using biotechnology for upcycling and new product innovation. The circular economy development outside Bangkok and the Eastern Economic Corridor follows the area-based development strategy, with a customised adaptation approach to consider the area's general situation. The four designated economic corridors are the Northern Economic Corridor, the North-Eastern Economic Corridor, the Eastern Economic Corridor, and the Southern Economic Corridor, with each focusing on specific areas.

Energy and Transportation

In 2013, carbon emissions in the power sector were 0.506 $kgCO_2$/kWh. In 2015, the Power Development Plan was developed to reduce carbon emissions more aggressively than the previous development plans through the promotion of renewable energy and fuel diversification, and aimed for an emissions reduction of 37% compared to 2013 levels (0.319 $kgCO_2$/kWh). The Alternative Energy Development Plan (AEDP) aims for the proportion of renewable energy to reach 30% of total final energy consumption by 2036 (MOE, 2015). Targets of AEDP are shown in Table 3.9.

Table 3.9. AEDP Target for Renewable Energy, Thailand

Energy	Share of Renewable Energy (%)		Final Energy Consumption at 2036 (ktoe)
	Status as of 2014	Target by 2036	
Electricity: Electricity	9	15-20	27,789
Heat: Heat	17	30-35	68,413
Biofuels: Fuels	7	20-25	34,798
RE: Final Energy Consumption	12	30	131,000

AEDP = Alternative Energy Development Plan, ktoe = kilotons of oil equivalent, RE = renewable energy.
Source: Alternative Energy Development Plan by EPPO.

The government has set the share of renewable energy in total electricity generation at 20% by 2036 in both the PDP and the AEDP. It demonstrates an attempt to integrate the AEDP with the PDP to achieve objectives of fuel diversification and renewable energy promotion outlined in the Power Master Plan. By 2036, the main sources of power from renewable energy are expected to target solar power, biomass, and wind power. Thailand's Energy Efficiency Plan also aims to decrease the country´s energy intensity by 30% from 15.28 in 2010 to 10.7 in 2036 and to reduce final energy consumption by 51,700 kilotons of oil equivalent in 2036, particularly in the energy intensive transport, large building, industrial, and commercial and residential sectors.

Furthermore, Thailand has the capacity for producing electricity from numerous renewable sources such as solar power, biomass, and wind power. Located close to the equator, solar power is becoming the dominant alternative to be implemented and potentially to be exported to nearby Asian countries. The target of solar power for electricity in 2036 is set at 6,000 MW, whilst the targets of biomass and

wind power are at 5,570 MW and 3,002 MW, respectively (Table 3.10). To achieve these targets according to the AEDP, the government supports RE development through various fiscal and nonfiscal measures, and investment promotion. Moreover, technological innovation and adoption has been emphasised to enhance the competitiveness of renewable alternatives, particularly solar, to achieve the final goal of 20% of renewable energy share of electricity consumption by 2036.

Table 3.10. Status and Target of Electricity Generation by Type of Fuel, Thailand

Fuels	Status at end of 2014* (MW)	Target at 2036 (MW)
MSW	65.72	500.00
Industrial Waste	-	50.00
Biomass	2,451.82	5,570.00
Biogas (WW/SW)	311.50	600.00
Small Hydro	142.01	376.00
Biogas (Energy Crop)	-	680.00
Wind	224.47	3,002.00
Solar	1,298.51	6,000.00
Large Hydro	-	2,906.40**
Total Install Capacity	4,494.03	19,684.40
Electricity Energy (million units)	17,217	65,588.07
Total Electrical Energy Demand (million units)	174,467	326,119.00
Share of RE in Electricity Generation (%)	9.87	20.11

MSW = municipal solid waste, MW = megawatt, RE = renewable energy, SW = solid waste, WW = waste water.
* Including off grid power generation and not including power generated from large hydro
** It is the existing capacity and the generation from large was included in the Target of AEDP2015
Source: Alternative Energy Development Plan by EPPO.

1.10. Viet Nam

In general, Viet Nam has a direction for circular economy development. However, whilst seeing the circular economy as instrumental for realising green growth and sustainable development, there has been no official target or aspiration for circular economy development. As noted earlier, Decree No. 08/2022/ND-CP in January 2022 sets out a task for developing National Action Plan on CE Development only by the end of 2023, (Government of Viet Nam, 2022), so the aspirations and targets remain to be developed. A parallel effort by the Ministry of Planning and Investment under its project report to the government sets out different targets for circular economy development at the national level, but these have not been approved by the end of May 2022. For the three sectors of agriculture,

energy, and transport, therefore, there are no official plan or targets for circular economy development.

Another challenge like in the ability to promptly realise circular economy initiatives at the sectoral level, including for agriculture, energy, and transport. As per Decree 08/2022/ND-CP in January 2022, the National Action Plan would only be developed by the end of 2023. (Government of Viet Nam, 2022). The decree only requires action plans for the circular economy at sectoral levels to be consistent with the National Action Plan, so these sectoral action plans may need to wait for some time until the National Action Plan is approved. Meanwhile, the MPI proposal for developing pilot mechanism on the circular economy in priority sectors still awaits approval from the government and, if approved, will need some time to produce meaningful policy changes.

2. Role of Fourth Industrial Revolution and Technological Innovation

Technological advancement could be helpful to achieve circularity. However, with increasing consumption, businesses are often under pressure to innovate and produce goods cheaply and quickly, which led to the linear take-make-waste model. Therefore, to support circularity in a country, technologies shall take into account the benefits of environment and the society. In ASEAN, the report has identified Brunei Darussalam, Cambodia, Indonesia, the Lao PDR, Malaysia, the Philippines, Thailand, Singapore, and Viet Nam who have started or utilised technologies who helped them in achieving the circular economy.

2.1. Brunei Darussalam

In Brunei Darussalam, there are several policy initiatives and strategies related to the fourth industrial revolution (4IR): the National ICT White Paper 2016, the National Digital Strategy 2016–2020, the National Broadband Policy 2014–2017, he Digital Government Strategy 2015–2020, the Digital Economy Masterplan 2025 (DEC, 2020), the Ministry of Transport and Infocommunications Strategic Plan 2025 (MTIC, 2020), and the Authority for Infocommunications Technology Industry Strategic Plan 2025 (AITI, 2021). ICT adoption in Brunei Darussalam is high and about 95% of the population has access to the internet and many mobile broadband subscriptions.

However, digital and technological investment, adaptability and adoption in the private sector has been slow, in part due to the availability of cheap labour and the lack of digital skills in micro, small, and medium-sized enterprises (MSMEs). Despite the directions and goals of the government in transforming the country towards greater digitalisation and embracing 4IR, identifying and addressing the underlying causes in underinvestment in the private sector and underperformance in science, technology, innovation, and R&D is needed.

2.2. Cambodia

Whilst there are no specific examples of 4IR in Cambodia for the circular economy, there are some initiatives related to the use of digital technologies for sustainable development in the country. The Industrial Development Policy 2015–2025 sets out to develop and modernise Cambodia's MSMEs for instance, through support in expanding and strengthening MSMEs' manufacturing base, and by ensuring technology transfer and industrial linkages amongst MSMEs and other key players (GGGI, 2021). Increasing demand for cooling technology from a growing middle class with unsustainable management of coolants and minimal standards for energy efficiency in air conditioners has led to

creation of Cambodia's National Cooling Action Plan in 2023. Moreover, Cambodia Climate Change Strategic Plan 2014–2023 includes strategies of efficient transport technology for climate change mitigation and low-carbon development.

2.3. Indonesia

The Indonesian government has designed a roadmap to implement several strategies in jumpstarting the nation's development by formulating 'Making Indonesia 4.0' to boost competitiveness in 4IR, enhance export opportunities focusing on five essential sectors: food and beverages, textiles and clothing, automotive, electronic, and chemical, which was extended to pharmaceuticals and medical devices in 2020. The current 4IR stage realised by the Ministry of Transportation is the plan to adopt green transportation system through smart logistics. Internet of things (IoT) and big data are utilised, starting with paperless innovation whereas e-ticketing has been successfully implemented within the integrated transportation system in the *Jabodetabek* area or Greater Jakarta area (MOT, 2022). Furthermore, the internet of things (IoT) and big data are being utilised in determining the E-Mobility Roadmap for mass transportation based on electricity vehicles in Bandung, Surabaya, and Medan, funded by the World Bank (MOT, 2022). In the agriculture sector, IoT and big data are used to enhance food security. For example, onions are a harvest commodity found with high probability of post-harvest losses. The Ministry of Agriculture, with ASEAN and Japan, have collaborated to provide coolers for onion logistics transportation in Indonesia. As a result, the post-harvest losses percentage decreased. However, sustainable funding is needed since the programme has stopped. In the energy sector, the IoT and big data could provide renewable energy potency. However, banks often refuse to finance solar panel investment with household rooftop-rent scheme. Banks still consider days without sun as risks in addition to no collateral provided by the borrower.

2.4. Lao PDR

The Lao PDR is somewhat left behind in comparison to other ASEAN countries when it comes to 4IR. Digitalisation of the local economy was vaguely described in the government policies. According to the 9th National Socio-Economic Development Plan (NSEDP), the government urged private investment projects to closely link 4IR in order to support adaptation to the era of artificial intelligence and value chain creation to produce quality and diversified products, moving towards international standards (Government of Lao PDR, 2021). The NSEDP relates 4IR for the technology sector by promoting and utilising scientific research, technology, innovation, and knowledge to drive socio-economic development. The government aims to develop a strategy for the development of science, technology, and innovation, and establish policies, legislation, and mechanisms to promote the work of science, technology, innovation, innovation funds and intellectual property protection, as well as appropriate standards and measurements aiming to promote innovation (Government of Lao PDR, 2021).

According to *We Are Social's Digital 2019* report, of the approximately 7 million Laotians, 39% (approximately 2.7 million) are internet users, 39% are also active social media users, and 37% (approximately 2.6 million) are mobile social media users. Referring to the World Economic Forum's Global Competitiveness Index 2019 edition (Schwab, 2019), the Lao PDR was ranked 113 out of 141 countries indexed. Out of the 12 pillars, the Lao PDR earned the lowest score for business dynamism, ranking 137 out of 141 countries for the pillar. The pillar the Lao PDR that earned the second lowest score for also raised alarm bells as far as being 'ready' to face the Fourth Industrial Revolution goes.

This pillar was innovation capacity, ranked 119 out of 141 countries for the pillar. A poor education system plays a big part in that problem especially considering the Lao PDR's relatively young population compared to most other ASEAN countries (Khidhir, 2019).

2.5. Malaysia

The National 4IR Policy has been launched as a guideline in enhancing circularity in Malaysia. Although the process is not easy and straightforward, stakeholders must be determined to penetrate the foreseen challenges such as lack of automation system, unclear economic benefit and lack of process design (Abdul-Hamid, et al., 2020). Remarkably, the 4IR is expected to optimise the operation and production process by reducing natural resources dependency. Advanced technology in the agriculture and food sector has been given a particular focus on the 10-10 MySITE introduced at the end of 2020. Amongst technological advancements are efficient precision farming and the centralised agricultural and forestry database in ASEAN. In transportation, GreenTech Malaysia has partnered with Plus Malaysia Berhad under the Fifth Global Environment Facility–United Nations Industrial Development Organization (GEF5–UNIDO) initiative towards the circular economy by installing 10 electric vehicle charging stations around Langkawi Island, Kedah, Malaysia, and other locations. Phase 2 will focus on decarbonising charging structures using solar PV–EV charging stations. 4IR is expected to establish intelligent waste management in the utility industry. Financial incentives will be provided for companies that upgrade resource efficiency equipment and 4IR enabled machines. NTP 2019–2030 strategies have been formulated to strengthen the transport infrastructure and intensify digitisation to improve connectivity and mitigate carbon dioxide (CO_2) emissions. With the expansion of the 4IR skill sets amongst the workforce, the sector will promote interoperability where efficient use of resources can be stimulated. Additionally, resilience is a crucial element to increase the robustness of the regulatory framework to support the adoption of transportation and logistics-related 4IR technologies. Such efforts are also essential to help research and development (R&D) and commercialisation and innovation to develop green mobility solutions.

2.6. Myanmar

E-waste is one of the fastest-growing waste streams in Myanmar due to increased consumer demand, rapid changes in technology, inventions of new electronic devices and availability of cheap import products. The situation is compounded by the short lifespans of certain products and products not being designed with recycling in mind. E-waste comes from a broad range of electronic products such as computers, televisions, and video games, as well as all kinds of electrical equipment, often divided into large equipment. A 2015 report by the United Nations University estimated that 29,000 tonnes of e-waste was generated in 2014 with 0.4 kg per capita (ECD and MONREC, 2018). However, as no national data or information currently exist about these waste types and their operation, it can only be inferred that the volume has been increasing, and that the existing informal treatment and recycling practices result in major environmental pollution and public health impacts.

Considering the importance of handling hazardous waste, the Environmental Conservation Department has been working with the Norwegian Environmental Agency and SINTEF in developing the Hazardous Waste Management Master Plan for Myanmar. This aims to assist in developing a regulatory framework for hazardous waste management in Myanmar, including implementation of the Basel Convention. In addition, the Department of Marine Administration under the Ministry of Transport and Communication has implemented a port reception facility for systematic management

of wastes from international shipping (ECD and MONREC, 2018).

2.7. Philippines

In the agriculture sector, the 4IR is changing food production systems, making it more productive and sustainable through the use of innovation in digital, physical, and biological technologies. For example, precision agriculture integrates data analytics and crop management tools to optimise the use of agricultural inputs and contribute to sustainable agriculture. Global positioning system (GPS), soil sensors, weather data, and Internet of Things (IoT), ensures the use of minimum resources to achieve optimum results with minimal environmental impact. Moreover, the use of advanced digitalisation and ICT can provide timely and site-specific weather and climate advisories, as well as use of early warning systems and other anticipatory mechanisms to help anticipate potential hazards and disturbances that can disrupt production operations. The controlled environment agricultural techniques, such as hydroponics, aeroponics, and aquaponics. These techniques are the method of growing crops within a closed ecosystem and managing numerous variables to reduce the threat of diseases and pests, maximise efficiency, increase sustainability and yield, and reduce the overall cost of operation.

In the energy sector, 4IR could facilitate the development of cheaper and more efficient renewable energy systems and establishment of energy forecasting systems and smart grids. The government, however, has yet to develop a comprehensive framework for the utilisation of 4IR technologies in the sector. In the meantime, the Department of Energy has started implementing the Energy Virtual One Stop Shop Act that streamlines the permit process for power projects thus encouraging the uptake of up-to-date green technologies and infrastructure.

In the transport sector, 4IR could herald the introduction of autonomous driving transport services and growth in ride-hailing/vehicles-on-demand services. The integration of artificial intelligence and automation to further streamline and optimise the collection of mobility-related data must be prioritised to fully realise the advantages of big data in the sector.

2.8. Singapore

In the area of waste management, Singapore has utilised waste-to-energy (WTE) incineration technology, resulting in a significant reduction in waste volume, only one-tenth of the waste volume disposed, and Singapore's only landfill site is planned to be closed in 2035 at the current disposal rate. A new Integrated waste management facility (Tuas Nexus integrated waste management facility) is currently under construction and is expected to meet Singapore's solid waste management needs in the long term (NEA, 2019). It will be able to incinerate 5,800 tonnes per day of incinerable waste, 250 tonnes per day of household recyclables will be sorted through the use of advanced equipment, and 400 tonnes of food waste will be treated and co-digested in concert with 800 tonnes per day of dewatered sludge from a neighbouring water reclamation plant. The Tuas Nexus facility will reduce residues for disposal and help to extend the lifespan of the Semakau landfill site under Singapore's vision and strategies for a zero-waste nation.

For the emerging low carbon alternatives, Singapore is currently studying emerging technologies such as low-carbon hydrogen, and carbon capture, utilisation and storage as alternatives to decarbonise the power sector (EMA, 2022). Hydrogen is considered a clean fuel as it does not produce CO_2 when burnt, but only if produced from renewable sources. (Fenell, et al., 2022). Green technologies to store

and generate hydrogen are still nascent and expensive, but they have been considered as an alternative to achieve net-zero emissions in the medium to long term when costs come down as more plants are built (Jain, 2009; Edwards, et al., 2008). Moreover, technologies such as geothermal, biomethane, nuclear fission, and nuclear fusion are also seen as low-carbon alternatives in the future. Future generation of fission small modular reactors and advancements in nuclear fusion technology hold promise for unlocking low-carbon and low-radiation energy, allowing to cover up to 10% of the country's needs through nuclear energy by 2050 (EMA, 2022b). Regarding energy in the household, the ongoing initiative of installing advanced electricity metres at residential premises is expected to reverse this situation and encourage consumers to be more energy efficient. These metres allow households to track their electricity consumption every half-hour via a mobile application and get a better idea of where and when they can start cutting down on usage (EMA, 2019). As at the end of 2020, about 400,000 such meters had been installed across Singapore, where the remaining 1.1 million homes will have them installed by 2025.

Singapore is also focusing on clean public transport and active transport modes that support a healthy lifestyle. The Land Transport Authority is spearheading the operation and maintenance of transport infrastructure and systems. In addition to freight land transport, new schemes based on the so called 'Industry 4.0' for Singapore's logistics ecosystem are under analysis (e.g. Ernst & Young Advisory, 2020). These schemes propose new models based on emerging technologies that will transform the whole logistics market, and in turn the movement of goods. However, the benefits of the models already tested have not been disclosed.

2.9. Thailand

4IR can be considered as both an enabler and lead in the transformation into the circular economy. Under the bio-circular-green model where S-curve targeted industries have been earmarked to advance Thailand's 4.0 vision, emerging 4IR technologies include (i) precision agriculture and biotechnology, (ii) smart electronics, (iii) high-end medical and wellness tourism, (iv) next generation automotive, and (v) future food. The current S-curve industries are (i) biofuel and biochemical, (ii) digital technology for digital economy, (iii) medical hub, (iv) automation and robotics, and (v) aviation and logistics. The latter industries are existing industries which are targeted for an upgrade.

2.10. Viet Nam

Viet Nam has acknowledged the importance of Industry 4.0 and related technological innovations (artificial intelligence, big data, Internet of Things, etc.) on improving circularity in agriculture, energy, and transportation. Resolution 52-NQ/TW in 2019 on the guidelines and policies for active participation in Industry 4.0 set priorities for digitalising agriculture, developing new technologies in energy and biology, upgrading infrastructure for energy and transportation for Industry 4.0 (Politburo of Viet Nam, 2019). Cameron et al. (2018) show that the top technologies for agriculture in Viet Nam for agriculture household is autonomous equipment, followed by real-time data analytics, and sensors. For agriculture firms, the top technologies are real-time data analytics, autonomous equipment and sensors (Cameron, et. al, 2018).

3. Accountability and Transparency

The availability of and access to reliable information are crucial for the circular economy. Transparency is important to develop standards to avoid greenwashing, traceability of substances in the value chains, and maintain stakeholders' expectations on green products or services. All ASEAN Member States have imposed eco-labelling or national standards or monitoring, reporting, and verification (MRV) systems to ease monitoring and traceability.

3.1. Brunei Darussalam

The Brunei government has been taking efforts in ensuring the policymaking process is more open and transparent. In terms of legislation, the country's Legislative Council meetings are broadcast live on television and the internet. The minutes of the meetings are posted online and made available to the public. However, the preparation of strategic and policy documents is still limited to internally appointed committees and taskforces. Evidence-based methods from the design stage to monitoring and evaluation should be shared and discussed openly to a wider group of stakeholders.

3.2. Cambodia

Audubon International, Certified Wildlife Friendly, EarthCheck, Green Globe Certification, Programme for the Endorsement of Forest Certification (PEFC), and TCO Certified are all environmental certification programmes that help individuals and organisations meet specific sustainability performance requirements. Audubon International's programmes include standards for communities, schools, businesses, golf courses, and lodging facilities, whilst Certified Wildlife Friendly certifies products that contribute to the conservation of key species and benefit local economies. EarthCheck helps travel and tourism businesses become more environmentally and socially responsible by providing benchmarking and advisory services. Green Globe Certification promotes sustainable environmental and social activity in the travel and tourism industry. The PEFC works towards sustainable forest management by certifying the entire forest supply chain. Lastly, TCO Certified provides an international sustainability certification for IT products that ensures manufacturing, use, and recycling is carried out with environmental and social responsibility. These certification programmes encourage sustainable practices and help consumers make informed choices when choosing products and services (Ecolabel Index, n.d.).

3.3. Indonesia

The Ministry of Environment and Forestry has set Indonesia's ecolabel product standards ranging from textiles, plastic bag, paper, and glass (Standard Application Facilitation Center or PUSFASTER, 2021). Where its components refer to ISO 14020 (PUSFASTER, 2022). As last updated in December 2021, there are eight ecolabelling certification institutions in operations (PUSFASTER, 2021). This effort is based on Indonesian National Standard (*Standar Nasional Indonesia or SNI*) for such products. Furthermore, the Ministry of Environment and Forestry has launched *Bimbingan Teknis Elektronik Standardisasi Lingkungan Hidup dan Kehutanan or Batik Darlingku* (Online Technical Guidance on Environment and Forestry Sector Standardization based on Massive Open Online Course) at udemy.com. This programme is to encourage achievement of the SDG 12 (Sustainable Consumption and Production) goal; including ecolabelling socialisation. In addition, the eco-labelling with reference to SNI also include services such as tourism (accommodation – hotels, resorts, and villas) to reduce

energy, water consumption, and waste. Sustainable honey production is also a part. Furthermore, there are also non-government initiatives to set up ecolabelling such as *Lembaga Ekolabel Indonesia*.

3.4. Lao PDR

The Lao PDR has risen six places to 128th on the Corruption Perceptions Index for 2021, moving up with a few other Southeast Asian countries experiencing less corruption. To promote transparency in the Lao PDR, the government has focused on developing anti-corruption knowledge amongst civil officials and students. The government is pursuing capacity building in the development of human resources as well as improved legislation such as the Anti-Corruption Law to combat corruption (ECCIL, 2022). Currently, there are six ecolabelling organisations for Lao products including a certification and advisory group for travel and tourism (e.g. EarthCheck), sustainable management of forest plantations (e.g. Forest Stewardship Council, Forest Management Certification), organic agriculture (e.g. Lao Organic), and IT products (e.g. TCO Certified) (Ecolabel Index, 2022). The Lao PDR organic labelling programme is operated by the Department of Agriculture of Ministry of Agriculture and Forestry.

In the forestry sector, there was a research project for developing an MRV system for REDD+[14] from 2010 to 2012, which aims at scaling up from the project level to a national level. There was also an initiated workshop activity on the national MRV system development in 2018 in collaboration with the Department of Climate Change of Ministry of Natural Resources and Environment, and the Green Technology Center Korea under the support of the Global Green Growth Institute. The concept of MRV in the Lao PDR is relatively new and some steps have been taken to develop a sectoral MRV system. The forestry sector has the most advanced knowledge of MRV. Currently, subnational greenhouse gas emissions data is not collected or monitored, and very little capacity exists to do this (Urban LEDS, 2020).

3.5. Malaysia

Malaysia is committed to supporting transparency by introducing ecolabelling in the agriculture sector. Three ecolabelling programmes – myGAP, MSPO, and myOrganic – are the transparency effort to support resource efficiency and mitigate carbon emissions through circular economy practices. MSPO and myHijau are programmes that enhance the resilience of the agri-food sector, particularly from the context of stakeholder commitment. For energy consumption, an MRV system is also planned, i.e. (i) feed-in tariff (FIT), (ii) non-FIT private license and public regulated usage of RE electricity generators, (iii) blended petroleum diesel with palm-oil-based biodiesel, application of geothermal energy, (iv) rating scheme for green building, and (v) many green practices. Several ecolabelling schemes include the Energy Efficiency Ratings and Labelling Scheme, SIRIM QAS International, and MyHijau. In transportation, several transparency schemes have been developed aligned with NTP 2019–2030. For instance, energy efficient vehicle labels are specifically designed to lower CO_2 emissions. Moreover, the myHijau mark is one of the resilient elements to show consumer willingness to pay more for green products. Alongside this, NAP 2020 intends to adopt a green practice process at the manufacturer and assembler levels. Therefore, schemes like the SIRIM ecolabel consisting of several related standards have been initiated to support sustainable development.

[14] According to the UNFCCC, REDD stands for 'reducing emissions from deforestation and forest degradation in developing countries'. The '+' stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks.

3.6. Myanmar

Based on the ecolabel index, Myanmar has adopted four ecolabels. EarthCheck is a certification and advisory group for the travel and tourism industry. It has been helping businesses, communities, and governments deliver sustainable and healthy destinations since 1987. Green Globe Certification facilitates responsible and sustainable environmental and social activity. The structured assessment of the sustainability performance of travel and tourism businesses and their supply chain partners enables monitoring of improvements and documentation of achievements. The PEFC promotes sustainable forest management. Lastly, TCO Certified is an international sustainability certification for IT products (Ecolabel Index, n.d.).

3.7. Philippines

Transparency may be promoted through ecolabelling programmes and MRV systems. In the Philippine Action Plan for Sustainable Consumption and Production (PAP4SCP), one of the actions that promotes this is the valuation of the economic, social, and environmental costs of SCP processes, which will then be reported. The Natural Capital Accounting institutionalisation roadmap based on the United Nations System of Environmental-Economic Accounting will be implemented.

The idea of ecolabelling is new in the Philippines, and consumers have a low awareness of sustainability considerations that go into it. One of the initiatives related to the sectors of focus in this study, is the National Ecolabelling Program – Green Choice Philippines by the Philippine Center for Environmental Protection and Sustainable Development, a nongovernment organisation. Based on ISO 14024, it is a voluntary, multiple criteria-based, and third-party programme that aims to encourage clean manufacturing practices and consumption of environmentally preferable products and services. The Philippine Center for Environmental Protection and Sustainable Development administers Green Choice Seal, Kalikasan GP3, Philippine Green Pages, and the Philippine Forest Certification System. Also, the Energy and Efficiency Conservation Act mandates the establishment of the Philippine Energy Labelling Program. The programme was created in 2020 and provides a national labelling system for energy consuming products based on the energy performance of products. The Department of Energy recently implemented Philippine Energy Labelling Program, providing consumers with information on the energy efficiency rating of different energy consuming products available in the market. For transport vehicles, the Department of Energy is currently formulating corresponding guidelines that will prescribe a system to enable energy labelling on automobiles, i.e. fuel economy performance.

3.8. Singapore

Sustainable labelling (or marking) has been imposed on buildings and household machinery like air conditioners. The Building and Construction Authority's Green Mark Certification Scheme is Singapore's strategy to increase energy efficiency in buildings (BCA, 2021a). It is a rating system tailored for the tropics to evaluate and set benchmarks for environmental sustainability in buildings. The scheme is part of Singapore's Green Building Masterplan (BCA, 2014), and encourages developers and owners to build and maintain greener buildings. The design of a building has direct impact on energy efficiency. Existing buildings can be retrofitted to incorporate green designs to increase their energy efficiency. The Green Mark Certification Scheme also encompasses a series of standards that developers and owners must meet to achieve a 28% improvement in energy efficiency over 2005 building codes. These standards, which apply to both new and existing buildings undergoing major retrofitting works (with a gross floor area of 2,000 m^2 or more), help buildings achieve energy savings

of between 20% to 40% over their lifetimes. The scheme places emphasis on designing for maintainability, reducing embodied carbon across a building's life cycle, using smart technologies, enhancing a building's resilience to climate change, and creating healthier environments for building users.

To add, air conditioners, water heaters, and refrigerators, account together for 52% of energy consumption in households (NEA, 2019). To encourage the use of more energy- efficient appliances, the minimum energy performance standards (MEPS) and Mandatory Energy Labelling Schemes (MELS) have been introduced for air conditioners, refrigerators, televisions, clothes driers, and lamps (NEA, 2022b). MEPS removes energy inefficient models from the market, whilst MELS allow consumers to make more informed purchasing decisions. Since the introduction of both the average energy efficiency of air conditioners and refrigerators has improved by about 13% and 26%, respectively. Moreover, Singapore already has labelling schemes for healthy packed food and locally produced fresh food (e.g. Healthier Choice Symbol by the Health Promotion Board). These schemes could be modified to incorporate food products from the ASEAN region that are produced through sustainable and resource-efficient practices.

3.9. Thailand

The green leaf label scheme administered by the Thailand Environmental Institute (TEI) and organic label and standard TAS 9001-2552 for the agriculture sector, called Organic Agriculture Certificate under ACT Organic Company Limited, has been recognised by IFOAM, ISO/IEC 17065 IOAS, Canadian Organic Regime, and EU's Regulation (EC) No. 1235/2008 (Article 10). Thailand has also announced the circular business guidelines for enterprises based on the UK BS8001:2017. It is currently being piloted with the first batch of applicants using a locally developed circular economy criterion in 2021. Moreover, The UN Eco-Factory Award recognises factories that demonstrate environmentally sustainable practices. The Energy Efficiency Certificate Label (No.5) certifies electrical appliances and specific industries for quality and carbon neutrality. Bangkok Port has been certified as a 'Green Port' for reducing greenhouse gas emissions and implementing circular economy principles. The Federation of Thai Industries recently launched a self-declaration green scheme based on ISO 14021, allowing members to apply for an environmental claim for their products or services. Thailand's ecotourism industry has achieved recognition under the Global Sustainable Tourism Council, with over 10 destination standards and 30 hotels and tour operators achieving GSTC-recognised status.

Thailand also is in the process of developing new regulations and standards, that includes the Circular Economy Mark established in 2023 (ASEAN Circular Economy Stakeholder Platform, 2023). Since 2013, Thailand has been developing legal frameworks for an Emissions Trading System, an Energy Performance Certificate System, and abatement plans for low-carbon cities. Apart from promoting domestic certification and standards which are forthcoming, the country also plans to adopt international benchmarks on food waste such as the EU's Code of Conduct for Responsible Food Business and Marketing Practices and Japan's Green Food System Strategy.

3.10. Viet Nam

In 2004, the Prime Minister of Viet Nam issued Decision No. 153/2004/QD-TTg on Strategic Orientation on Sustainable Development in Viet Nam (Viet Nam's Agenda 21). Since then, various strategies, plans, and regulations have been issued and updated with a view to balance the economic interest and the negative externality on the environment. Ecolabelling has also been introduced for

the products of which the environmental impacts from resource extraction, production, distribution, and consumption were minimal.

4. Multi-Stakeholder Engagement, Cooperation, and Communication

Transition to the circular economy is the responsibility of each stakeholder, ranging from the government, the private sector, the community, and educational institutions, amongst others. Despite not all ASEAN Member States (AMS) having a clear circular economy agenda, several AMS have cooperated with the private sector, international partners, and initiatives from businesses including educational institutions have been identified.

4.1. Brunei Darussalam

Policy formulation usually includes cross-agency involvement (i.e. whole-of-government) but engagement with the private sector and communities during this design phase is relatively limited, as reflected by very low scores in multi-stakeholder collaboration. Although the government stresses the whole-of-nation approach, communication with the public is often done only after policies have been finalised. Industry–university collaboration is also relatively weak, although there have been efforts.

In the energy industry, the main production companies – Brunei Shell Petroleum (BSP) has set a goal to achieve 25% reduction in greenhouse gas (GHG) emissions by 2025 through deploying technology and digitalisation. Large industry players maintain environmental management systems that are ISO14001 certified. As main players, these include Brunei LNG (liquefied natural gas), Hengyi Industries (petrochemicals), Brunei Methanol Company (methanol), and Brunei Fertilizer Industries (ammonia and urea). Other oil and gas producers are Total E&P Borneo, Petronas Carigali Brunei, and Murphy Oil. The key logistics players include Brunei Gas Carriers (transport of LNG) and Brunei Shell Marketing (marketing, sales, and distribution of Shell products).

The government has made numerous commitments towards ASEAN's circular economy-related initiatives across various ASEAN sectoral bodies. These include areas such as energy and power, agriculture, fishery and forestry, transportation, environment, and transboundary haze. At the international level, the government has reaffirmed its commitments towards carbon neutrality by 2050 as declared during COP26. Special focus is given to nine of the 17 UN SDGs, which include responsible consumption and production as well as climate action. However, the government's responsiveness for change is relatively low, which could be a limiting factor in adapting the regulatory and institutional framework with the dynamics of the circular economy, particularly in non-energy sectors.

4.2. Cambodia

In Cambodia, the Asian Development Bank has funded a 10-megawatt (MW) grid-scale solar farm in 2016 and worked with the national power utility Électricité du Cambodge to construct a 100-MW National Solar Park in Kampong Chhnang province along with a transmission system that connects to the national grid (Varma, 2023). Cambodia's Circular Economy Strategy and Action Plan was developed with assistance from the United Nations Development Programme (UNDP), and Cambodia's National Cooling Action Plan was developed with support from the United Nations Environment Programme (UNEP) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

4.3. Indonesia

In Indonesia, there are efforts towards cross-sectoral collaboration in the adoption and implementation of circular economy initiatives. The Ministry of Environment and Forestry (MOEF) collaborates with the private sector, such as Le Minerale mineral water company, to focus on plastic and paper waste management (MOEF, 2022). However, there are challenges in execution, as garbage collectors are often unaware of the issue and lack facilities to differentiate waste during collection. Cooperation between ministries also needs to be synchronised, with the Ministry of Agriculture (MOA) calling for clearer stakeholder engagement to determine domain responsibilities between ministries (MOA, 2022). For example, one of the MOA domains is handling research to improve rice paddy quality. However, it is classified as an agro-industry when it has been produced in form of rice, thus becomes the Ministry of Industry (MOI) domain (MOA, 2022). Overall, most ministries are open for cooperation support pertaining to circular economy adoption and implementation. Bappenas and the UNDP have worked together and now are developing circular economy initiatives in Indonesia, one of them is setting up KPIs and benchmarks. Bappenas is also open to government-to-government engagement such as with Denmark and the European Union. The MOEF collaborates with Denmark, Viet Nam and GIZ, through the Indonesia National Plastic Action Partnership to implement the circular economy (MOEF, 2022). The agriculture sector is also committed to supporting ASEAN policies on zero burning and sustainable growth.

In terms of best practices, examples from the industry, such as GoJek and Grab Indonesia in the transport sector, play a role in driving the transformation towards electric vehicles. Environmental nongovernment organisations and government organisations, including local government, are also key players. Universities in Indonesia are also engaging in renewable energy initiatives through corporate social responsibility programmes with private enterprises.

4.4. Lao PDR

The Lao PDR has been engaging in multi-stakeholder communication and collaboration with international organisations, particularly the UNDP, to promote circular economy projects. Recently, the UNDP, in collaboration with the Institute of Renewable Energy Promotion and support from the European Union (EU), as well as other development partners, are working to accelerate the transition to a circular economy in the Lao PDR. The Community of Practice is one of the activities under the Circular Economy Project in the Lao PDR, which aims to identify barriers to circular economy implementation and develop practical solutions to enhance circular business models, with a focus on eco-tourism.

The development of the circular economy in the Lao PDR is seen mainly in the forestry and climate change sector, as reflected in the Nationally Determined Contribution (NDC) under the Paris Agreement. The NDC outlines three greenhouse gas (GHG) emissions scenarios, including a baseline scenario, an unconditional mitigation scenario, and a more ambitious conditional mitigation scenario, with the goal of achieving net-zero GHG emissions by 2050 (Government of Lao PDR, 2021a). Additionally, the government has committed to reducing GHG emissions per GDP by at least 15% by 2030 and at least 30% by 2050 compared to 2014 as part of the National Green Growth Strategy to 2030.

The Lao PDR is also engaged in regional cooperation, such as the development of the Lao PDR–China Railway as part of China's Belt and Road Initiative, which aims to create trade linkages between the Lao PDR and China, as well as other economies in the initiative. The Global Green Growth Institute is

providing technical assistance to the Lao PDR in establishing a national MRV system in line with the transparency requirements of the Paris Agreement.

4.5. Malaysia

In Malaysia**,** community and stakeholders have significantly taken part and have far-reaching involvement in all government programmes and initiatives. NAP 2.0 aims to increase end-to-end engagement with the private sector in R&D efforts, which will increase the agri-food sector resilience. At the same time, industrial players have practised the circular economy concept by assimilating the national aspiration in firms' objectives and missions. For instance, Sime Darby aims to minimise carbon emissions and deliver sustainable quality, where IOI Corporation Berhad committed to mitigating GHG emissions and transforming towards a green approach and innovative technology. In the energy sector, top private energy companies in Malaysia have started implementing energy efficiency and renewable energy by initiating programmes such as applying solar energy at the rooftop of households. The electricity supply industry in Malaysia is still over-dependent on fossil fuel, with approximately 90% of the overall generation mix attributed to coal and natural gas, due to inevitable gas price increase. On the other hand, the transportation sector has responded to more end users' engagement. For example, on September 2013, the National Cycling Federation was organised in Kuala Lumpur for the World Car-Free Day, supported by the Lord Mayor in Kuala Lumpur. Perodua bore the RM50 million investment in the National Emissions Test Centre, and the facility is managed by the Malaysian Automotive Institute. The centre is open to all vehicle manufacturers in ASEAN and Malaysia, which previously had no option for local emissions testing. This centre has signed a memorandum of understanding between the MAI and Universiti Kebangsaan Malaysia. Ernst and Young, one of Malaysia's Big Four, has started incentivising investment opportunities for the circular economy and green technology by focusing on renewable energy and energy efficiency.

In the energy sector, the National Energy Efficiency Action Plan (KeTTHA, 2015) provides a 10-year strategy of a national agenda for Malaysia to develop efficient plans for energy consumption, especially for electrical use. PETRONAS has invested in a solar photovoltaic (PV) system start-up that provides sustainable energy for the residential and small and medium-sized enterprise (SME) sectors in Malaysia (PETRONAS, 2020). The Ministry of Transportation has collaborated with stakeholders, academia, and the private sector for the transport sector. The implementation of NTP 2019–2030 requires close collaboration and cooperation amongst different agencies responsible for transport planning, regulation, and operations. Malaysia also pledges to reduce carbon emissions from vehicles by improving the fuel economy level in Malaysia by 2025, in line with the ASEAN Fuel Economic Roadmap (ASEAN Secretariat, 2019) of 5.3 litres of gasoline equivalent per 100 kilometres. Industrial players such as Malaysian Airlines Berhad have adopted national and international policies such as the Kuala Lumpur Transport Strategic Plan 2016–2025 (ASEAN Secretariat, 2015).

4.6. Myanmar

The Ministry of Natural Resources and Environmental Conservation, Ministry of Education, nongovernment organisations, media partners, and educational centres play central roles in raising public awareness about the importance of waste management and effectively motivating communities to engage in waste avoidance and the 3Rs. In managing waste, Myanmar's government in 2018 cooperated with the Norwegian Environmental Agency and SINTEF in developing the Hazardous Waste Management Master Plan for Myanmar and the Japanese government in building a waste-to-energy model plant in Yangon city with funding of US$16 million: US$8 million came from

the Yangon City Development Committee and US$8 million from the Japanese government under its financial support scheme, the Joint Credit Mechanism (ECD and MONREC, 2018).

4.7. Philippines

The Philippines has shown positive engagement of non-state actors in climate change-related initiatives, with publicly available climate change content and efforts to include stakeholders in policy development. However, poor management of non-state actors' interests has hindered progress, and the roles of industries, the private sector, civil society, and academia in the circular economy are not well defined in national plans (Climate Action Tracker, 2019). Some programmes involving these sectors are in early stages. Government branches like the Department of Agriculture, the Department of Energy, and the Department of Transportation have produced and disseminated information, education, and communication materials on organic agriculture, energy efficiency, and mass transport. Private sector initiatives include the League of Organic Agriculture Municipalities, Cities, and Provinces of the Philippines, University of the Philippines' Electrical and Electronics Engineering Institute, and the Philippine Center for Environmental Protection and Sustainable Development, Inc. The Philippines is committed to achieving the SDGs by 2030 and participates in the 10-Year Framework of Programmes on Sustainable Consumption and Production under SDG 12.1. The National Economic and Development Authority as the national focal point, coordinates and reports the country's policy instruments that contribute to the shift to SCP, including the circular economy, in critical sectors, such as agriculture, energy, transport, amongst others (One Planet Network). The Philippines has collaborated with bilateral and multilateral partners for circular economy programmes, including the Asian Development Bank (ADB), ASEAN, the Asia-Pacific Economic Cooperation forum, the EU, UNDP, United States Agency for International Development, and the World Bank (Climate Action Tracker, 2019; One Planet Network).

4.8. Singapore

The Singapore government recognises that achieving a sustainable economy requires the participation of citizens, industry, companies, academia, and authorities. As part of its efforts towards sustainability, the government is working with companies to adopt more efficient power generation technologies under the SGP 2030 initiative. They are also promoting a cleaner industrial ecosystem through co-funding support and voluntary partnership programmes for companies, including the Energy Efficiency Fund that provides subsidies for a company's effort in energy efficiency initiatives such as facility design, energy assessments, adoption of energy efficient equipment, and implementation of energy management systems.

Singapore is also exploring regional cooperation to tap into renewable energy sources through bilateral and regional agreements. These include trials to import 100 megawatts (MW) (1.5% of peak demand) of electricity from Malaysia, and another 100 MW from Indonesia, as well as a joint commitment with the Lao PDR, Thailand, and Malaysia to integrate a cross-border integrated network to trade 100 MW under the ASEAN Power Grid programme (Lao PDR–Thailand–Malaysia–Singapore Power Integration Project) (EMA, 2022a). Furthermore, the deployment of a super-grid to interconnect Australia, Indonesia, and Singapore has also been proposed through Sun Cable to supply up to 15% of Singapore's electricity needs by harnessing solar energy from the Northern Territory of Australia. Singapore also plans to import up to 4 GW of electricity by 2035, about 30% of electricity demand by then (EMA, 2022b). Cross-border power integration would enhance electricity security, improve affordability, and increase sustainability in Southeast Asia. However, there are challenges

such as grid harmonisation, regulatory frameworks, and political considerations that need to be addressed for successful cross-border power trade (Wong and Onn, 2022).

To ensure fair and sustainable trade, cooperation amongst governments and the alignment of policies will be crucial in building transparent and accountable institutional trade capacities. Moreover, strict transboundary environmental governance will be required to prevent social and environmental risks (Yong, 2021; Middleton and Dore, 2015).

4.9. Thailand

Mainstreaming the education on the circular economy is achieved through several multi-stakeholder platforms, organising online forums for the public, public workshops to learn about the circular economy, townhall meetings, and through community social media channels. The Thailand Environment Institute (TEI), a think tank specialising in environmental issues to drive sound environmental policies, assist the community on natural resources management, raise public awareness on environmental and sustainable development, and provide training to strengthen environmental management capacity through research and technical outreach. The Green Label and Carbon Reduction Label are the TEI's flagships for environmentally friendly goods and services, which were initiated in 1993 by the TEI and the Thailand Business Council for Sustainable Development.

Thailand has several international commitments related to the circular economy such as COP26, Paris Accord on zero-carbon neutral by 2050, zero greenhouse gas by 2065, biodiversity targets Aichi (post 2020) in progress, ASEAN Framework of Action on Combating Marine Debris 2019, ASEAN Agreement on Transboundary Haze, United Nations Sustainable Development Goals 2030, and the ASEAN Framework for Circular Economy and others. Thailand has cooperated with UNCTAD, the OECD, and UN Compact for sustainable and responsible investment framework; Luxembourg for environmental, social and governance and related investment, green stock exchange; the Food and Agriculture Organisation of the United Nations and ADB for sustainable agriculture and food loss and waste; the International Union for Conservation of Nature and UNEP for sustainable consumption and production; GIZ and UNEP for sustainable energy; UNDP, ADB, and the World Bank for young innovation and entrepreneurs; SWITCH Asia and UNIDO for recycling; the European Commission and Germany for Smart City and recycling; and Netherlands and Denmark for a circular economy business model and society.

4.10. Viet Nam

Viet Nam also extends international cooperation in the areas of energy. The country continued to discuss with various countries about promoting investment in the renewable energy sector in Viet Nam. In 2022, Samsung in a consortium with LILAMA of Viet Nam won the US$940 million contract for the first LNG-fired power plants in Viet Nam (Reuters, 2022). Viet Nam also worked with other Mekong countries to promote regional energy cooperation. As a member of ASEAN, Viet Nam also implements the ASEAN Plan of Action for Energy Cooperation. Moreover, Viet Nam is actively engaged in international cooperation like net-zero target by 2050 during the COP26 World Leaders' Summit. Viet Nam also joined the ASEAN Framework on Circular Economy. Moreover, in the period 2014–2019, the Ministry of Planning and Investment coordinated with UNIDO and a number of donors to pilot the eco-industrial park model, achieving positive results in institutional building and applying advanced technology and production methods, recognised by international organisations. Vietnamese agencies also worked extensively with ASEAN Institutions on circular economy-related issues. As noted

previously, Viet Nam joined the ASEAN Framework for Circular Economy, and joined the development of CE-related work, such as ASEAN Taxonomy for Sustainable Finance.

Various private firms have implemented projects or developed proposals on the circular economy in agriculture, ecological industrial zones, renewable energy, green transport, etc. A notable project includes Nam Cau Kien industrial park in Hai Phong city – the first eco-industrial park in Viet Nam that boasts the first and only wastewater treatment plant in the country that meets technical specifications (Kland Viet Nam, 2022).

Chapter 4

Building a Circular Future: Addressing Impediments in ASEAN Transformation into the Circular Economy

This report analysed challenges of pursuing circularity in agriculture, energy, and transportation. Recommendations to address each ASEAN Member State issues are also provided in this section.

1. Brunei Darussalam

The government of Brunei Darussalam supports the circular economy in various national, regional, and international policy documents. However, there are challenges to implementing the circular economy in the country. One challenge is the lack of policy coordination, resulting in conflicting targets and statements in different policy documents, such as conflicting targets for electric vehicle (EV) adoption and gross domestic product (GDP) growth. Slow policymaking processes and lack of statutory backing also delay and hinder effective execution of initiatives, such as land use planning and infrastructure development. The circular economy elements in the national legislation and international and regional agreements ratified are limited. Additionally, the non-oil and gas manufacturing sector is limited, with challenges in obtaining financing and bureaucratic procedures, and the innovation ecosystem is weak with low expenditures on research and development. Lack of support mechanisms and fiscal incentives from the government for private firms promoting sustainable initiatives is also a challenge. Unconstructive consumption habits, inadequate recycling infrastructure and education, and perceived risks associated with used and refurbished equipment further hinder circular economy efforts. Partnership and collaboration could be the most important enabler of circular economy in Brunei Darussalam.

Policy incoherence and inconsistency are systemic issues in the government and would not be limited to circular economy strategies. There are apparent gaps in terms of coordinating the existing policies. As an example, the agricultural authority's initiatives in recycling waste into organic compost would be somewhat nullified if there are no changes being made in the current subsidies on chemical-based fertilisers. Similarly, the government's push towards decarbonising transport by the gradual introduction of EVs would have limited success due to the comparatively low purchasing and running costs of internal combustion engine vehicles. Car prices are controlled in Brunei Darussalam, whilst fuel prices have been kept low through the fuel price stabilisation programme. Other costs such as vehicle license and car insurance are also relatively low.

Recommendations for Brunei Darussalam to implement the circular economy include developing a National Circular Economy Framework, adopting a whole-of-nation approach involving government agencies, the private sector, nongovernment organisations (NGOs), and civil society, implementing education programmes to promote changes in consumption and production patterns, supporting innovation and transition to the circular economy through regulatory preparedness and fiscal support, mandating food labelling, and establishing a green labelling scheme for electronic products, encouraging green public procurement, introducing an extended producer responsibility framework, and promoting the circular economy in agriculture. It is also recommended to establish an

organisational system, such as the Brunei Darussalam National Council for Circular Economy, to oversee implementation. These efforts should go beyond climate change and energy-related sectors and include other sectors such as agriculture and food waste, guided by the Brunei Darussalam Climate Change Policy as a reference point.

2. Cambodia

Cambodia is in the early stage of the integration and implementation of the circular economy policy. Cambodia has formulated various national policies and strategies to support the development of the circular economy to transform itself into a more efficient economy. Sectoral policies and strategies have also been developed to support key development sectors such as agriculture, energy and transport. Although Cambodia has various supporting policies and strategies, the implementation of the circular economy in the current economic system is still limited. Even with several supporting policies and regulations for circular economy, insufficient clarity, understanding and implementation in roles and responsibilities, low levels of awareness and, in particular, inadequate waste and recycling related infrastructure are still challenges. Moreover, lack or limited economic incentives and economic benefits result in minimal changes to existing practices, leading to slow improvements in resource use efficiencies. Moreover, limited circular economy-aligned infrastructure and modern technologies prevents the required moves forward in the waste and resources sectors. Furthermore, insufficient information and data inhibits investment and promulgates suboptimal waste management practices, compounded by limited general awareness on waste and inadequate domestic skills base to meet circular economy requirements.

More enabling legislative and policy frameworks are required to support circular economy practices or innovations and improvements to transition to a circular economy. This is complemented with financial support from development partners, donors, bilateral and multilateral cooperation in transforming Cambodia into a more competitive and efficient economy. Additionally, financial incentives should be put in place to encourage the private sector to transform its production system to be more efficient. Furthermore, coordination across government sectors such as natural resource management, energy, manufacturing, transport, waste management, and education, with the help of the private sector, citizens, academic and NGOs is required. Intersectoral and ministerial collaboration shall be further promoted. It is also recommended that more piloting studies on the circular economy should be conducted to demonstrate to the public and private sectors the benefits of the circular economy.

3. Indonesia

In Indonesia, the National Development Planning Agency (Bappenas) is tasked with defining and establishing national key performance indicator (KPI) guidelines for other ministries. The potential for new sectors in Indonesia, such as food and beverages, textiles, construction, wholesale and retail, and electronics, to create jobs and increase GDP has been identified by Bappenas. These sectors could create 4.4 million jobs and increase GDP by US$42 billion–US$45 billion in 2030 (Bappenas, 2022). However, Bappenas does not have supervisory authority towards other ministries, but merely enacting and socialising its national medium-term development plan. Several ministries in Indonesia, such as the Ministry of Environment and Forestry and the Ministry of Industry, have their own units dealing with the circular economy. However, the lack of a clear definition and indicators for the circular economy hampers its implementation.

Also, lack of awareness about the circular economy at the ministerial level often leads to insufficient funding or lack of approval for circular economy-related programmes, as seen in the case of the Ministry of Agriculture. As an example, the Ministry of Agriculture has requested for Rp21 trillion from the state budget, but approved only Rp14.5 trillion (MOA, 2022). This lack of awareness also results in uneven implementation of circular economy initiatives amongst local governments, such as varying tax initiatives on electric vehicles in different provinces. Another main challenge identified for circular economy implementation includes high initial costs for projects, lack of access to technology and funding opportunities, and lack of technical skills and measurement tools.

Balancing profits with a view for circularity are also important. Tension between *Perusahaan Listrik Negara* or National Electricity Company (PLN) and private enterprises with solar panel for household business (one of them is Mitsubishi) pictures a challenge in transition to renewable energy. After disruption for many years becoming the sole energy producer and seller to household, PLN responds by enacting a net-metering system which avoid their household customers using 100% solar energy generated from the solar panel at household rooftop without paying to PLN.

Strengthening national regulations and coordination, increasing awareness amongst all income segments, promoting pro-green investment, and prioritising education on the circular economy are key recommendations to accelerate circular economy adoption and implementation in Indonesia. Transitioning to a circular economy requires sustainable funding, and the Indonesian government cannot bear the cost alone. Private sector participation, supported by top management commitment and institutional reforms, plays a crucial role in driving circular economy adoption and implementation. The culture of circularity should be the foundation for developing new green businesses that prioritise both income and environmental sustainability. The Ministry of Finance has introduced green bonds to encourage circular economy implementation, but more participation from the private sector with incentives from the government is needed. Success in circular economy adoption within this decade can encourage further investment in renewable energy and promote the shift from fuel-based to electricity-based vehicles, as evidenced by the example of the PLN issue regarding new solar panel business for households and zero tax on electric vehicles implemented by the DKI Jakarta provincial government.

4. Lao PDR

The Lao PDR has made progress in transitioning to a circular economy, with the development of a circular economy strategy supported by the United Nations Development Programme (UNDP) in 2017 and integration of circular economy concepts into national development plans and strategies, according to a report by the government and the UNDP in 2021. However, the application of circular economy concepts is considered relatively new to the government and private sectors, with limited experience in agriculture, energy, and transportation. Challenges include high initial costs of projects, lack of targets and key performance indicators for complex supply chains, economies of scale for business-to-business (B2B) cooperation, lack of markets and information on product design and production, technical skills and measurement tools, and access to technology and funding opportunities. The public sector is seen as having an important role in facilitating this transition.

To avoid falling behind in the global shift towards circular economy strategies, the report recommends several steps. These include expanding the National Green Growth Steering Committee and establishing an inter-agency circular economy taskforce to coordinate efforts amongst stakeholders, defining circular businesses and technologies in alignment with regional frameworks, developing a

comprehensive 10-year work programme for institutionalising circular economy principles, improving coordination within the government and stimulating private sector adoption, fostering collaboration and knowledge transfer, monitoring progress through national circular economy indicators, and integrating outcomes into the next National Socio-Economic Development Plan. Enhancement of awareness and competences across sectors, as well as partnership and collaboration with international organisations and economic actors, are highlighted as key initial enablers for introducing circular economy in sectoral policies, strategies, and plans. By implementing these recommendations, Laos can create a clear vision and pathway for a circular economy transition, unlocking new opportunities for sustainable development.

5. Malaysia

The energy sector can be considered the core sector that will contribute the most to the success of Malaysia's Nationally Determined Contribution, and it is also interrelated with the agro-food sector and the transport sector using natural resources to generate machines and engines. Remarkably, different sectors have different challenges in adopting circular economy practices. Thus, it is essential to focus on each industry differently to tailor the most efficient design. In general, several challenges identified are strategic planning, limited resources, low public awareness, lack of automation systems, unclear economic benefits, and lack of process design (Abdul-Hamid, et al., 2020). Uncertainty in the business environment also brings several challenges for firms, which can be conquered through developing 4IR and further achieving competitive advantage to sustain the circular economy.

In Malaysia, there are several key recommendations to expedite the transition to a circular economy. These include the implementation of new and innovative circular initiatives and mechanisms, as well as the development of a universal circular economy policy with general guidelines that all industries can adopt. Economic initiatives and funding, particularly from the government through special funding programmes, are crucial for supporting the transition in developing countries. The involvement of large industrial players in collaboration with smaller firms, such as PETRONAS FutureTech with local start-ups, can catalyse and support circular economy initiatives and help overcome challenges such as strategic planning, limited resources, and low public awareness. Higher investment in research and development, innovation, and capacity building in sustainable and circular economy -friendly initiatives can also accelerate productivity growth and resource efficiency in targeted sectors. Collaboration with relevant organisations, both locally and internationally, can help enforce industrial compliance with localised circular economy policies and initiatives, whilst training programmes and an education system that cater to current and future skills needs can help build a skilled workforce. Harnessing the potential of technological advances and fostering a competitive private sector with modern technology and automation can also boost the sector's image and encourage youth participation in circular economy initiatives (Abdul-Hamid, et al., 2020).

6. Myanmar

The circular economy requires multiple programmes, projects, and activities, hence, each strategy (i.e. the Myanmar Sustainable Development Plan and the National Waste Management Strategy and Master Plan for Myanmar 2018–2030) will require strong coordination amongst ministries, international cooperation, and the rural government to ensure implementation, including monitoring and evaluation mechanisms.

7. Philippines

The circularity rate in the Philippines, which measures the extent to which resources are recycled and waste is minimised, is estimated to be only around 9%, lower than the global average, according to a 2020 report by the Asian Development Bank (Schröder, 2020). This low rate is mainly due to the heavy use of primary materials in the construction sector, limited municipal waste management capacity, and significant leakage of waste into the environment. The National Economic and Development Authority (NEDA) acknowledges that the concept of circular economy is still new and lacks clear quantification, which limits targeted interventions. Challenges identified by NEDA include technological constraints, financial constraints, market-related constraints, and regulatory constraints. It also identified that climate mitigation is not yet an explicit priority of the Department of Transportation, although some of its policies may have a mitigation benefit. There is a lack of strong institutional framework as well as dedicated coordination mechanism to support climate mitigation and cutting GHG emissions.

To transition to a circular economy, significant changes in economic and social development planning are required, along with strong coordination amongst different sectors of the economy. NEDA suggests the formation of an appropriate body charged with developing a national framework plan for circular economy and identifies more ambitious and broader-scope draft bills related to energy and transport that recognise the role of business, non-state actors, and private investments in circular economy initiatives. One proposal is to establish a high-level commission for the circular economy under the Office of the President of the Philippines, composed of experts from various fields and sectors, with a permanent secretariat and advisory body. This commission would be responsible for formulating circular economy policy directions and overseeing actions and programmes. Close coordination with relevant government agencies and stakeholder participation are crucial for effective implementation. The involvement of academia, especially in the development and pilot-testing of technologies should be pursued, or where already existing, must be ramped up. In the former case, for technologies related to energy efficiency and to clean transport. In the latter case, for agriculture-related technologies such as rice and agricultural waste-to-energy solutions.

In the agriculture sector, recommendations include the adoption of solar-powered irrigation systems to reduce dependency on monsoon rains and promote energy efficiency. Government support through well-structured financing schemes and assistance programmes for small farmers. is needed to make these technologies more accessible. The adoption of 4IR technologies such as precision agriculture, digitalisation, and controlled environment agriculture techniques is also recommended. In the energy sector, adoption of waste-to-energy (WTE) technologies such as incineration, gasification, and pyrolysis can be a significant step towards circular economy. WTE facilities can provide a sustainable source of energy and reduce waste volume and greenhouse gas emissions. However, there are policy challenges related to local government capacities and financing (Agaton, et al., 2020). Public–private partnerships could be an option for financing WTE projects. For transportation, travel demand management strategies, improvement of information technology infrastructure, and use of digital technologies for efficient transport operations are recommended. In terms of supporting businesses across various industries including sectors of focus in this report, circular economy programmes can adopt resource efficient technologies, promote comprehensive product and process innovation and tapping new and emerging market opportunities driven by the growing demand for green products and services to balance profitability and competitiveness with environmental sustainability.

8. Singapore

Singapore's success and experience in implementing circular economy policies could serve as an example for other high-density cities in the ASEAN region and tropical areas worldwide (Carrière, et al., 2020). Singapore has taken the lead in transitioning to a circular economy in sectors such as water, mobility, housing, and energy efficiency.

Singapore has the necessary foundations to achieve a zero-waste and zero-carbon emissions nation by the mid-21st century. However, tools to assess progress in implementing circularity policies are still being developed, and the framework must be constantly evolving to address challenges posed by climate change, technology advancements, and political and economic issues on local, regional, and global scales. The COVID-19 pandemic has exposed the flaws in the current framework and highlighted the need for more ambitious and concrete action plans to build a resilient and inclusive nation in harmony with the environment. Shifting from a linear economic model of 'take-make-dispose' to a circular one, prioritising reduction of consumption and production of resources, is a challenging task for a society that values material wealth and possessions as status symbols.

Analysing policies and its implementation, the government must strike a balance between the carbon tax's impact on the cost of living and the competitiveness of local companies. It can also improve waste management by implementing stronger legislation and standards for recycling and promoting domestic markets for recycled material. Environment impact labelling combined with nutritional information can empower consumers to choose a healthy and environmentally friendly option. The government can create partnerships with retailers to encourage the preference for food produced locally or regionally. Whilst importing renewable energy from other countries is one possible option to increase the share of renewable energy, it is crucial to evaluate the environmental impact of importing. Finally, electric vehicles are not a panacea to reduce carbon emissions and solve mobility needs. The use of electric cars will incur almost identical environmental and social impacts as conventional cars. Therefore, Singapore needs to explore alternative sustainable mobility solutions, such as public transport and active mobility, and renewable energy sources to power them.

Achieving sustainability requires a strong commitment from the entire society, and Singaporeans need to negotiate and change their lifestyles to reduce their environmental footprint. Ultimately good science and well-chosen technologies can direct towards a circular economy, but without strong commitment from the entire society, no amount of science or technology can help. Sustainable development needs to be grounded in culture, aligning with the values and aspirations of the people. Examining environmental issues from social sciences, humanities, education, communication, and arts perspectives is also crucial, and scientists and scholars should work closely with journalists to communicate scientific information effectively to laypeople. In the end, Singapore needs to re-evaluate its economy and production and consumption patterns in collaboration with its ASEAN neighbours and beyond to achieve a fully circular economy. As Singapore's economy is dependent on the well-being of the region and the global economy, actions taken inevitably impact the environment.

9. Thailand

Thailand has taken initial steps towards implementing a circular economy based on the ASEAN Circular Economy Framework, with a focus on strategies such as closed loop systems, addressing climate change towards zero carbon society, and circular economy innovation for sustainable economic growth. Technology and financial measures are seen as enablers to advance the new economy,

including the use of metadata analytics, carbon market mechanisms, and tools for monitoring and evaluation to achieve system optimisation and identify leaks. Challenges identified include achieving economies of scale for B2B cooperation, lack of market information on product design and production, lack of technical skills and measurement tools, building consumer trust for certain types of products, recognition of circular economy labelling internationally, traceability of products from pre to post-consumption, waste management and value recovery from recycling, market demand for secondary materials, reluctance of businesses to adopt extended producer responsibility (EPR), technical barriers such as the EU Carbon Border Adjustment Mechanism, rising protectionism on technology, and the remapping of global production and supply chains post-pandemic and the China–US trade war.

The Thai government is recommended to implement new circular initiatives and mechanisms that could accelerate the transition to a circular economy by fortifying regional value chains, developing new regional value chains, minimising regional imports for virgin material, and developing a common market for secondary material trading in ASEAN. Possible organisational systems at the sectoral level for target setting, standardisation and harmonisation of circular products and service standards, and monitoring of progress to implement a circular economy should also be imposed. Multi-stakeholder groups should be conducted to address circularity issues, exchange experience on industries' voluntary compliance schemes and standards within the industry. A market fair for ASEAN should be developed to expand market access and common circular economy standard initiatives. A 10-year comprehensive work programme towards the institutionalisation of the circular economy through multi-stakeholder approach should be initiated to ensure the country and the ASEAN region achieve competitiveness in the circular economy and are transformed into a lucrative and innovative market of producers and consumers. The structure could be filled by a circular economy service design framework and taxonomy; circular economy mark criteria and recognition system; circular economy bond scheme; carbon credit system; technology and a development roadmap for circular economy; and green marketing standard development for Thailand and the broader market. For carbon offsetting programmes and emissions reduction, legal and institutional frameworks and developed capacity of public and private stakeholders are needed to understand and implement carbon pricing measures. Policy coherence and whole-of-government coordination will be needed to balance economic growth and sustainability.

Thailand's journey in adopting the circular economy can be viewed as two pathways: productivity foundation focused on inclusivity and sustainability of industries, and the country's participation in the global climate change dialogue. Integrating these two journeys, Thailand's focus will be to increase circularity, maximise value retention and enable circular economy innovation. Eco-innovation can support increased productive efficiency, increased production, and diffusion, as well as increased diversity. However, those apparently positive effects need to be contrasted with rebound effects such as increased consumption of the same or new products, the transference of impacts from one stage of the supply chain to another one, and the green consumerism linked to planned obsolescence. These undesired consequences working against the circular economy principles must be avoided. Business models are considered a key instrument for eco-innovation to pave the way to a circular economy. For business models to work and foster a real shift towards a circular economy, policy support is necessary. In particular, the good performance of business models cannot be achieved without functioning markets, including those necessary for products life extension, used goods, and for the resale of goods and components. Research and Innovation Policies must shift towards the direction of innovative activities and technology frontiers to target emerging environmental issues. Legal and

regulatory frameworks and the overall shift in the tax system architecture need to be modified to favour circular resources instead of non-renewable resources.

Table 4.1. Gap Analysis and Recommended Measures Identified for Implementation within the Circular Economy Action Plan for Thailand

Key Action Areas	New Regulations Needed	Funding and Incentives	Enablers
Manufacturing	• Standard for minimum content of secondary material in product specifications (MOI, OIE) • Promotion of biomaterial as raw material (OIE, MOI) • Biomaterial definition and standards (TISI, MOI) • Recycled plastic for food and beverage packaging (FDA) • Carbon pricing and carbon trading system (BCG) (MOE, MOI, MOF)	• Incorporate into existing funds: Energy Conservation Funds, Innovation Funds (MOE) • Investment regulations for start-ups (BOI) • Treasury/finance measures for promoting biotech in CE (MOF) • New CE Incentive Fund (MOHESRI, OIP, MOF, MOI, Pvt)	• Agriculture and bio-waste, smart farming (MOA) • R&D with universities and industry, business matchmaking, tech development, CE innovation (research network, MOI, MOHESRI)
Consumption	• Rewrite public procurement rules and guidelines (MOF, BB) • Set standard pricing for garbage disposal fee (polluter pay) based on waste generated (in kg) • Apply tax for packaging cost for consumer (MOI, MOC, private sector) • New excise tax (MOF)	• Incentives and funding for business and start-ups adopting 'Sharing Economy' model (MOC, OIP, MOI, MOF)	• Public education on responsible garbage disposal and sorting (MOE, MOIR, MOI) • Promote use of CE product labels and standards and EPR (MOE, TISI, MOI)
Waste Management	• Advance EPR and related regulations for recycling, collection and elimination of	• Start-up funding including app dev. (BOI, MOF) • Include CE funding in existing funding	• Cooperation in R&D, innovation development for waste management (MOHESRI, DIPM, MOI)

Key Action Areas	New Regulations Needed	Funding and Incentives	Enablers
	waste (MOIR), DOIW, MOI) • Levy on waste (MOF) • Technical standards for imported secondary materials (MOF, MOC, FDA, DOIW, MOI) • Develop profit-sharing business model with provincial authority (MOLR, MOE)	scheme (MOE, BOI, MOC) • Exempt business registration fee (DIF, MOI)	• Establish pilot plant/R&D centre as PPP and universities (DIPM, MOI, MOHESRI) • Technical outreach on waste management (DIPM, OIP, MOI, MOHESRI)
Secondary Material	• Establish import quota secondary material (MOC) • Establish export surcharge(tax) to prohibit certain export items. • Establish secondary material standard	• Attractive incentives to promote secondary material adoption in domestic production or promotion of inter-industry material exchange (MOF, OIE, MOI)	• Support the adoption of technology, tools and materials for private sector (DIPM, MOI, MOHESRI) • Promote area-based Cluster development linking sources of secondary materials (OPI, DOIW, MOIR) • Centralised database on waste management tracking system and secondary material flow (MOE, DIPM, MOI) • Develop online central platform for resource management (MOE, MOI, Network of Related Organisations)

BB = Budget Bureau, MOI = Ministry of Industry, OIE = Office of Industrial Economics, FDA = Food and Drug Administration, MOA = Ministry of Agriculture, MOF = Ministry of Finance, OIP = Office of Industrial Promotion, MOHESRI = Ministry of Higher Education, Science, Research and Innovation, MOC = Ministry of Commerce, MOE = Ministry of Natural Resources and Energy, MOIR = Ministry of Interior, TISI = Thailand Industrial Standards Institution, DOIW = Department of Industrial Works, DIP = Department of Primary Industries and Mines, OPI = Office of Permanent Secretary of Ministry of Industry.
Source: Author.

10. Viet Nam

After over 35 years of rapid socioeconomic development, Viet Nam is facing challenges from resource depletion, environmental pollution, and climate change. The circular economy has emerged as a direction to sustain economic growth whilst minimising adverse impacts on the environment. Despite various policies and institutions involved in circular economy-related aspects, Viet Nam formalised the concept of the circular economy only in 2020 and has been working to improve policies and regulations since then. However, as of July 2022, the country still lacks specific scope and criteria, including economic and innovative aspects, for the circular economy at sectoral levels. This raises questions about Viet Nam's ability to contribute timely to economic recovery and green transition after the COVID-19 shock. Definition of a circular economy scope is important, for instance, it is still ambiguous whether the innovation of agricultural process – based on Industry 4.0 achievements such as Big Data, Internet of Things, artificial intelligence, etc. – to transform agricultural remainders into organic fertilisers to restore land quality falls into the categorisation of a circular economy. In this regard, the private investors/firms still have to wait for specification of a circular economy criteria for various sectors, including agriculture, energy and transportation.

To address the gap, Viet Nam needs to improve institutions, reform and restructure the national economy in agriculture, energy, and transportation to effectively use existing resources. This includes building a synchronous legal framework, specific regulations, and a roadmap for a circular economy in priority sectors, consistent with international commitments and economic integration in natural resources and environment. Stable, long-term policies with a cohesive scope across sectors are needed to create favourable conditions and confidence for enterprises. Viet Nam should also promote the development of a circular economy models in priority sectors to facilitate green transitions post COVID-19, and review and improve mechanisms to promote corporate social responsibility and sustainability. Additionally, Viet Nam should review, research, amend, and promulgate new regulations on investment, small and medium-sized enterprises, bidding, industrial parks, economic zones, and official development assistance. It is also encouraged to establish a roadmap for replacing hazardous materials and single-use products with environmentally friendly alternatives and promote the application of science and technology for renewable energy and new economic models. Viet Nam can learn from international experiences, assess the readiness of the local economy, protect environmental laws, and consider regulatory impacts in various sectors. Pilot mechanisms for implementing the circular economy in agriculture, energy, and transportation can be developed, along with raising awareness amongst the business community and the public.

Furthermore, Viet Nam should promote exchange and cooperation with developed countries to learn from their experience and improve research capacity on the circular economy, in accordance with Viet Nam's economic conditions and characteristics. This can be facilitated through partnerships with countries in APEC, ASEAN, and free trade agreements, to harmonise standards, regulations, and mutual recognition of goods and services from circular economy models.

Chapter 5

Work Programmes for ASEAN

The findings from each ASEAN Member State (AMS) in this study are translated in this report as recommendations that can be used to facilitate discussions amongst policymakers, professionals, and businesses on the economic circularity discourse in ASEAN. In March 2022, the ASEAN Economic Ministers Meeting agreed to develop a Work Programme to Support the Implementation of the Framework for the Circular Economy for the ASEAN Economic Community (AEC) as one of the Priority Economic Deliverables for 2022 under Cambodia's ASEAN chair. It would also serve as reference in developing awareness programme and capacity building modules for AMS' government officials for future project implementation on the circular economy.

Based on triangulation between this study and the circular economy for the AEC as one of the priority economic deliverables, the five work programmes offered are (i) education and awareness, (ii) sharing of best practices, (iii) stakeholder partnership and collaboration, (iv) development of a general policy for a circular economy, and (v) training and capacity building for ASEAN officials. The suggested work programmes aim at:

1) Enhancing awareness in AMS on the importance of the circular economy within the context of ASEAN regional integration. This will support AMS, particularly the least developed AMS, to better understand the fundamentals of a circular economy and the characteristics of a circular business model, including the benefits accruing to the private sector as they transition to a circular business model;

2) Creating a structured approach to facilitate the exchange of policies, practices and approaches amongst policymakers, professionals, and businesses on the circular economy;

3) Assessing possible synergies across different sectors and stakeholders to identify collaborative actions to promote the adoption of circular economy in AMS and its incorporation in their national development plans to foster regional integration, narrowing the development gaps, and supporting sustainable development in the region; and

4) Strengthening capacity and competence across sectors societies in the design and implementation of circular economy policies and initiatives, particularly to least developed AMS that have relatively limited resources with regards to, for instance, national policies concerning circular economy and infrastructure for the transition into the circular economy model.

Chapter 6
Conclusion

The circular economy is a new concept and is still under development in ASEAN. Although there are no laws or regulations that directly regulate the circular economy, the plans and initiatives that have been carried out by the ASEAN Member States (AMS) are closely related to the circular economy. Strategies and action plans mentioning the circular economy have been identified in Brunei Darussalam's Wawasan Brunei 2035, Cambodia's National Circular Economy Strategy and Action Plan 2021, Indonesia's National Medium-Term Development Plan, and Viet Nam's Law on Environmental Protection in 2020. On the other hand, rigorous efforts in ecolabelling have been done by Malaysia, whilst the Philippines and Thailand are putting more attention into reducing carbons from transportation. Similar awareness is reflected in the Lao PDR, where the government recently issued new policy to promote electric vehicles. Overall, most of the programmes in the AMS focus on the elimination of food waste, the promotion of electric vehicles, and use of renewable energy such as solar energy and biofuels.

Observing the implementation of laws, regulations, and programmes, there are differences in the level of implementation between the AMS. In most countries, obstacles are rooted mostly in the awareness of the circular economy itself either from the government, business actors, or society. Despite policies and actions progressing to circularity, fragmentation of initiatives between ministries, lack of business and household participation, limited access to technology and infrastructure, and social perceptions related to waste are lingering. To address these problems, whole-of-nation approaches are needed. Policy coherence between institutions, education programmes, collaboration with private institutions for financing green infrastructure and innovations, subsidies or incentives targeted to support green transformation, and monitoring mechanisms, e.g. ecolabelling and extended producer responsibility, could accelerate the transition. The ASEAN work programmes have offered capacity building and education on the circular economy as the main deliverables, whilst providing opportunities for collaborations in the spirit of inclusivity.

ASEAN must be able to define what sustainability means in its economy. Recovering from the pandemic, it shall be noted that the need for higher economic growth must consider environmental risks. The hazards of environmental risk due to an irresponsible linear economy has affected ASEAN society negatively and will be worse if left untreated. The ASEAN Circular Economy Framework has offered the opportunity for sustainable, resilient, and inclusive transitions, setting regional standards. It is time for ASEAN to forge its collective leadership, and together ensure a better future for all.

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Annex 1

Laws and Regulations

Table A1.1. Circular Economy

Country	Related Guidelines and Policies
Myanmar	• Myanmar Financial Inclusion Roadmap 2014–2020 • Myanmar Industrial Policy 2016 • Private Sector Development Framework and Action Plan • National Strategy for Rural Roads and Access 2016 • SME Policy 2015 • Myanmar National Climate Change Policy 2017–2030 • Myanmar Action Plan on Disaster Risk Reduction 2017 • National Biodiversity Strategy and Action Plan 2015–2020 • Myanmar Elephant Conservation Action Plan 2018–2027
Singapore	• Resource Sustainability Act 2019 • Carbon Pricing Act 2018 • Active Mobility Act 2018 • Energy Conservation Act 2012 • Radiation Protection Act 2007 • Public Utilities Act 2001 • Environmental Protection and Management Act 1999 • Road Traffic (Motor Vehicles, Construction and Use) Rules 1999 • Hazardous Waste Act 1997 • Environmental Public Act 1987
Thailand	• Climate Change Act • Greenhouse Gas Reporting Law • Emission Trading System Law
Viet Nam	• 2020 Law on Environmental Protection • Decree No. 08/2022/ND-CP in January 2022 guiding the implementation of the Law on Environmental Protection • Resolution 36-NQ/TW of CPV Central Committee on Marine Economy Development Strategy to 2030 • Decree 82/2018/ND-CP dated May 22, 2018 on management of industrial parks and economic zones

Table A1.2. Agriculture

Country	Related Laws and Regulations
Brunei Darussalam	• Brunei Darussalam Fishery Limits Act (Chapter 130) • Fisheries Order 2009, Forest Act (Chapter 46) • Wildlife Protection Act (Chapter 102), and Wild Flora and Fauna Order 2007 • Public Health (Food) Act (Chapter 182) • Halal Meat Act (Chapter 30)
Indonesia	• Law No. 22/2019 on Sustainable Agriculture Cultivation System • Minister of Agriculture Regulation No. 38/2020 on Implementation of Sustainable Palm Oil Plantation Certification in Indonesia • Minister of Agriculture Regulation No. 7/2019 on the Development of Human Resources, R&D, Rejuvenation, and Facilities concerning Palm Oil Plantation • Minister of Agriculture Regulation No. 03/Permentan/Sm.200/1/2018 on Agriculture Counselling Guidelines • Minister of Agriculture Regulation No. 50/Permentan/KB.020/9/2015 on Plantation Seeds Production, Certification, Distribution and Supervision • Minister of Agriculture Regulation No. 11/Permentan/ot.140/3/2015 on Indonesian Sustainable Palm Oil Certification System • Minister of Agriculture Regulation No. 19/2011 on Indonesian Sustainable Palm Oil Guidelines • Minister of Agriculture Regulation No. 39/2006 on *Bina* Seeds Production, Certification and Distribution • Presidential Regulation No. 97/2017 on Policy and National Strategy in Waste Management; • Government Regulation No. 27/2020 on Specific Waste Management; • Government Regulation No. 46/2017 on Green Environment Economy Instrument • Government Regulation No. 81/2012 on Household Waste and Similar Household Waste • Minister of Environment and Forestry Degree No. 14/2021 on Waste Management in Waste Banks • Minister of Environment and Forestry Degree No. 75/2019 on Roadmap for Reducing Waste by Producers
Malaysia	**Primary Regulation** • Biosafety Act 2007 • Environmental Quality (Clean Air) Regulation 2014 • Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977 • Environmental Quality (Scheduled Waste) Regulation 2005, • Environmental Quality Act 1974 (Act 127)

Country	Related Laws and Regulations
	• Land Conservation Act 1960 • National Forestry Act 1984 • Pesticides Act 1974 (Act 149) • Solid Waste and Public Cleansing Management Act 2007 • Water Services Industry Act 2006 • Fisheries Act 1985 (Act 317) • Federal Agricultural Marketing Authority Act 1965 • Land (Group Settlement Areas) Act 1960 • Control of Paddy and Rice Act 1994 (Act 522) • New Plant Variety Protection 2004 (Act 634) • Pesticides Act 1974 [Act 149] • Animal Welfare Act 2015 (Act 772) • Animal Act 1953 (Checked 2006) (Act 647) • Feed Act 2009 (Act 698) • Abattoirs (Privatization) Act 1993 (Act 507) • Veterinary Surgeons Act 1974 (Act147) **Secondary Regulation** • Malaysian Quarantine and Inspection Services Act 2011 (Act 728) • Malaysian Agricultural Research and Development Institute Act 1969 (Act 11) • Fishermen's Association 1971 (Act 44) • Kemubu Agricultural Development Authority Act 1972 (Act 69) • Muda Agricultural Development Authority Act 1972 (Act 70) • Farmer's Organization Authority Act (Act 110) • Farmer's Organization Act 1973 (Act 109) • Federal Agricultural Marketing Authority Act 1965 (Act 141) • Pineapple Industry Act 1957 (Act 427) • Bank Pertanian Malaysia Berhad Act 2008 (Act 68) • Malaysian Palm Oil Board Act 1998 (Act 582) • Malaysian Biofuel Industry Act 2007 (Act 666) • National Kenaf and Tobacco Board Act 2009 (Act 692) • Malaysian Rubber Board (Incorporation) Act 1996 (Act 551) • Malaysian Timber Industry Board (Incorporation) Act 1973 (Act 105) • Malaysian Pepper Board Act 2006 (Act 656)
Myanmar	• Myanmar Agriculture Development Strategy 2018/19 – 2022/23
Philippines	• Organic Agriculture Act of 2010 (Republic Act 10068), amended by RA 11511 (2020) • Clean Air Act (RA 8749) • Ecological Solid Waste Management Act (RA 9003) • Clean Water Act (RA 9275)

Country	Related Laws and Regulations
Viet Nam	• Incentives for agriculture under Decree No. 57/2018/ND-CP in 2018 • Decision No. 255/ND-CP of the Prime Minister in February 2021 on restructuring agriculture during 2021-2025 • Decree No. 109/2018/ND-CP in 2018 on organic agriculture

Table A1.3. Energy

Country	Related Laws and Regulations
Brunei Darussalam	• Mining Act (Chapter 42) • Petroleum Mining Act (Chapter 44), • Petroleum Pipelines Act (Chapter 45) • Electricity Act (Chapter 71)
Lao PDR	• Electricity Law 1997, amended in 2012
Indonesia	• Law No. 30/2007 on Energy • Minister of Environment and Forestry Regulation No. P.20/Menlhk/Setjen/Kum.1/3/2017. This regulation sets up fuel product simplification from current RON 88 and RON 90 fuel into minimum RON 91. These products refer to Pertamina's as the only SOE with gasoline business
Malaysia	• Energy Commission Act 2001 • Sustainable Energy Development Authority Act 2011 • Malaysian Biofuel Industry Act 2007 • Renewable Energy Act 2011 (Act 666) • Electric Supply Act (Amendment) 2001, or known as Act A1116
Myanmar	• Myanmar Energy Master Plan 2015
Philippines	• Energy Efficiency and Conservation Act (Republic Act 11285) • Renewable Energy Act of 2008 (Republic Act 9513) • Biofuels Act of 2006 (Republic Act 9367), amended by Republic Act No.10745 of 2006

Table A1.4. Transportation

Country	Related Laws and Regulations
Brunei Darussalam	• Road Traffic Act (Chapter 68) • Maritime and Port Authority of Brunei Darussalam Order 2017
Indonesia	• Law No. 23/2007 on Train and Railways • Law No. 17/2008 on Sea Transportation • Law No. 1/2009 on Aviation • Law No. 22/2009 on Land Transportation • Minister of Transportation Regulation No. 44/2020 on Electricity Vehicle Physical Examination as revised by Minister of Transportation Regulation No. 86/2020 • Minister of Transportation Regulation No. 45/2020 on Electricity Vehicle • Minister of Transportation Regulation No. 65/2020 on Conversion on Motorcycle Energy Source to Battery-based
Malaysia	• Road Transport Act 1987 • Land Public Transport Act 2010 • Malaysian Airline System Berhad (Administration) Act 2015 • Malaysian Aviation Commission Act 2015 • Merchant Shipping (Oil Pollution) Act 1994
Myanmar	• Myanmar National Transport Master Plan 2016
Philippines	• Joint Administrative Order 2008-01 on • Guidelines Governing the Biofuel Feedstocks Production, and Biofuels and Biofuel Blends Production, Distribution and Sale under the Biofuels Act • Department Order 2020-06-0015 on Prescribing the Guidelines of the Philippine Energy Labelling Program (PELP) for Compliance of Importers, Manufacturers, Distributors and Dealers of Electrical Appliances and other Energy-Consuming Products (ECP) • Department of Environment and Natural Resources (DENR) Order No. 2019-21 on Guidelines Governing Waste-to-Energy Facilities for the Integrated Management of Waste • NSWMC Resolution 86 series of 2014 on Creating a Multi-Agency Sub-Group (MASG) to develop the Guidelines on Composting, Compost Quality and Market Development (CCQMD) • NSWMC Resolution 1017 series of 2017 on Adopting the Guidelines on Composting and Market Development for Compost • Department of Transportation Administrative Order 2021-039 on Guidelines in the Classification, Registration and Operation of all Types of Electric Motor Vehicles • Department of Agriculture Circular No. 01, Series of 2018 on Guidelines for Official Accreditation of Third-party Organic Certifying Bodies

Country	Related Laws and Regulations
	• Department of Energy Circular No. 2007-05-0006 on Implementing Rules and Regulations (IRR) for Republic Act No. 9637 • Department of Energy Circular No 2013-05-009 on Guidelines for the Selection Process of RE Projects under Feed-in-Tariff (FIT) System and the Award of Certificate for FIT Eligibility • Department of Energy Circular No 2016-07-0013 on Implementing Rules and Regulations for RA 10745 (which amends the Biofuels Act of 2006) • Department of Energy Circular No 2017-12-0015 on Promulgating the Rules and Guidelines Governing the Establishment of the Renewable Portfolio Standards for On-Grid Areas • Department of Energy Circular No 2018-07-0019 on Promulgating the Rules and Guidelines Governing the Establishment of the Green Energy Option Program Pursuant to the RE Act of 2008 • Department of Energy Circular No 2019-10-0013 on Omnibus Guidelines Governing the Awarding and Administration of RE Contracts and the Registration of RE Developers • Department of Energy Circular No 2020-02-005 on Guidelines on the Duty-Free Importation and Monitoring of the Utilization of RE Machinery, Equipment, Materials and Spare Parts • Department of Energy Circular No 2020-10-0023 on Policy Framework for the Development of the Fuel Economy Rating, Fuel Economy Performance, and Related Energy Efficiency and Conservation Policies for the Transport Sector and Other Support Infrastructures
Viet Nam	• Decision 355/QD-TTg of the Prime Minister in 2013 on Transport Development Strategy until 2020 • Minister of Transport Decision No. 2027/QD-BGTVT on the Project to Develop Green Seaports in Viet Nam

Annex 2

Related Guidelines and Policies

Table A2.1. Circular Economy

Country	Related Guidelines and Policies
Cambodia	• Rectangular Strategy for Growth, Employment, Equity, and Efficiency (2019–2023) • National Strategic Development Plan (2019–2023) • Cambodian Sustainable Development Goals (CSDGs) Framework (2016–2030) • National Circular Economy Strategy and Action Plan 2021 • Cambodian Sustainable Development Goals (CSDGs) Framework (2016–2030) • National Circular Economy Strategy and Action Plan 2021 • Cambodia's Updated Nationally Determined Contribution (updated NDC) • Long-Term Strategy for Carbon Neutrality in Cambodia • Cambodia Climate Change Strategic Plan (CCCSP) 2014–2023 • National Strategic Plan on Green Growth 2013–2030
Lao PDR	• National Green Growth Strategy till 2030 • Lao PDR's Nationally Determined Contribution (NDC) • 9th National Socio-Economic Development Plan 2021–2025 (NSEDP)
Indonesia	• Bappenas or the Ministry of National Development Planning National Medium-Term Development Plan 2020–2024 • Nationally Determined Contribution (NDC) Indonesia
Malaysia	• National Commodity Policy (NCP) 2011–2020 • National Agrofood Policy (NAP) 2011–2020 • National Agrofood Policy, 2021-2030 (NAP 2.0)
Philippines	• Philippine Action Plan for Sustainable Consumption and Production (PAP4SCP)
Singapore	• Sustainable Singapore Blueprint 2015 • Singapore Green Plan 2030 • Zero Waste Masterplan • Climate Action Plan • GreenGov.SG • Integrated Waste Management Facility • Charting the Energy Transition to 2050 • Solar Photovoltaic (PV) Roadmap for Singapore • 3rd Green Building Masterplan

Country	Related Guidelines and Policies
	• Green Towns Programme • Digitalisation initiatives in support of the logistics industry transformation map • Our Water, Our Future • Key Environmental Statistics • Sustainability @ MSE 2022 • Singapore's fourth biennial update report under the United Nations Framework Convention on Climate Change
Thailand	• Master Plan on Municipal Solid Waste Management • Plastic Waste Management Plan in 2017 • National Climate Change Master Plan (2015–2050) • National Water Resource Management Master Plan (2015–2026), • National Solid Waste Master Plan (2016–2021) • Thailand Roadmap on Plastic Waste Management (2018–2073) • Green Government Procurement Guideline, Action Plan Thailand Zero Waste (2016–2017) • Thailand National 3R Strategic Plan • 20 Year Pollution Management Strategy and Pollution Management Plan 2017–2021 • Annual 'Clean Province' Action Plans • National Greenhouse Gas Reduction Action Plan for Municipal Waste Sector (2021–2030), • Thailand Power Development Plan (2018–2037) • Thailand National Adaptation Plan (2020–2037) • Climate Adaptation for Public Health (2018–2030) • Strategy for Climate Change in Agriculture (2017–2021), • Thailand Smart Grid Development Master Plan (2015–2036) • Energy Efficiency Plan, 2015–2036 (EEP2015), • Alternative Energy Development Plan (2015–2036) (AEDP 2015) • Master Plan for Sustainable Transport System and Mitigation of Climate Change Impacts • National Industrial Development Master Plan (2012–2031) • Waste Management Master Plan (2016-2021) • Environmental Quality Management Plan, 2017–2021, • Action Plan for Implementing Sustainable Production and Consumption B.E. 2560–2080
Viet Nam	• Sustainable Consumption and Production based on National Action Plan (2016)

Table A2.2. Agriculture

Country	Related Guidelines and Policies
Cambodia	• National Policy on Biogas in Cambodia (2016–2025)
Lao PDR	• Resolution of the 11th Lao People's Revolutionary Party Congress (2021–2025) • 9th National Socio-Economic Development Plan (2021–2025) • National Food Security Strategy and Agriculture and Forestry Development Plan (2010) • Forestry Strategy to the year 2030 of the Lao PDR • National Green Growth Strategy of the Lao PDR till 2030 • National Growth and Poverty Eradication Strategy (NGPES) • National Nutrition Strategy to 2025 • Rural Development Programs of the Government
Indonesia	• Masterplan on Agriculture Development 2013–2045 • Crude Palm Oil Sustainability Roadmap 2019–2045 (enacted through Presidential Instruction No. 6/2019)
Malaysia	• Shared Property Vision 2030 (SPV 2030) • Twelfth Malaysia Plan 2021–2025 • National Fourth Industrial Revolution Policy (National 4IR Policy) • Malaysia Digital Economy Blueprint (MDEB) • Agriculture National Key Economic Area (NKEA), 2010–2020 • National Sustainable Consumption and Production Blueprint • Food Waste Management Development Plan for Industry, Commercial and Institution (2016–2026) • Green Technology Master Plan Malaysia 2017–2030
Singapore	• Growing Our Food Future • Food waste minimisation guidebook for food retail and establishments • Food waste minimisation guidebook for supermarkets • Food waste minimisation guidebook for food manufacturing establishments

Table A2.3. Energy

Country	Related Guidelines and Policies
Cambodia	• Draft National Energy Efficiency Policy 2018–2035 • Draft Sub-decree on Energy Efficiency Standards and Labelling for Electrical Appliances and Equipment
Lao PDR	• Power Sector Policy Statement 2001 • 9th National Socio-Economic Development Plan (NSEDP) 2021–2025 • Renewable Energy Development Strategy (2011) • Policy on Sustainable Hydropower • Power Development Plan by Électricité du Laos (EDL)
Indonesia	• National Energy Management Blueprint 2006-2025 (Enacted through Presidential Regulation No. 5/2006) • National Energy Policy 2014 (Enacted through Government Regulation No. 79/2014) • National Energy Masterplan 2017 (enacted through Presidential Regulation No. 22/2017)
Malaysia	• National Renewable Energy Policy (NRE) 2010 • National Energy Efficient Plan (NEEP) 2015 • Green Technology Master Plan (GTMP) 2017 • Malaysian Biomass Industry Action Plan (MBIAP) 2020 • Shared Property Vision 2030 • Twelfth Malaysia Plan 2021–2025 • Malaysia Digital Economy Blueprint • National Sustainable Consumption and Production Blueprint • MySTIE 10-10
Philippines	• Philippine Energy Plan 2020–2040

Table A2.4. Transportation

Country	Related Guidelines and Policies
Cambodia	• National Policy on the Development of the Land Transport Sector 2021–2030 • Climate Change Action Plan for the Transport Sector 2020–2023
Indonesia	• Ministry of Transportation Strategic Plan 2020–2024 (enacted through Minister of Transportation Regulation No. 80/2020) • Ministry of Transportation Regulation No. KP 201/2013
Malaysia	• National Transport Policy (NTP) 2019–2030 • National Automotive Policy (NAP) • National Biofuel Policy (NBP) • National Land Public Transport Master Plan (NLPTMP) • Mega Public Transportation Infrastructure Projects • Cleaner Fuel and Improved Fuel Standard • Green Initiative Programmes by Public Transport Operators • Market and Technology Assessment • Human Capital Development
Philippines	• National Transport Policy (NTP), 2018
Singapore	• Land Transport Master Plan 2040 • Creating liveable cities through Car-Lite urban mobility

Annex 3

Implemented National Programmes and Projects

ASEAN Countries	Implemented National Programmes and Projects
Brunei Darussalam	• Wawasan Brunei 2035 • Brunei Darussalam Economic Blueprint • No Subsidy Day, Car-Free-Day, *Bandarku Ceria* • Green Sukuk (Bonds), Sustainable Nation Campaign by BIBD • 2 Year Pilot Project on Electric Vehicles by Electric Vehicles Joint Task Force (EVJTF) (2021) • Farm Waste Recycling to Organic Fertiliser by MPRT • Save our Ocean, Report and Rescue and No Plastic Bag Everyday by BruWILD • Appliance energy efficiency standards and labelling • Energy management standards and energy audit • Progressive electricity tariff for the residential sector • Financial incentives for energy-efficient appliances and vehicles • Raise awareness through the national education curriculum, campaigns for the public, and incentives to induce behavioural change • Scale-up market deployment of solar photovoltaic (PV) and promote waste-to-energy technologies • Raise awareness through public campaigns and strengthen industry-university collaboration • Support research, development, and demonstration as well as technology transfer • Reduce industrial emissions through zero flaring to as low as reasonably practicable • Increase the country's carbon sink by planting 500,000 new trees by 2035 • Increase the share of electric vehicles to 60% of total annual sales by 2035 • Increase the share of renewable energy to at least 30% of the total capacity in the power generation mix using mainly solar PV by 2035 • Reduce GHG emissions from power generation by at least 10% by 2035 by focusing on energy efficiency and conservation practices • Introduce carbon pricing to industrial sectors and power utilities by 2025 • Reduce waste to 1 kg per person per day, mainly methane gas emissions, through waste minimisation and innovative technologies • Strengthen climate resilience and adaptation through research and collaboration

ASEAN Countries	Implemented National Programmes and Projects
	• Mandatory reporting of GHG emissions for all stakeholders • Raise awareness through the national education curriculum and campaigns for the public
Cambodia	• Waste to Energy for the Rice Milling Sector (2012–2015) • Rectangular Strategy Phase III and NSDP Environmental Priorities
Indonesia	• Green Airport • Compensation for PLN through *biaya pokok penyediaan* • Fuel shifting from high emitting Premium or Pertalite to Pertamax • Tax exemption for low-cost green car • Patent cooperation with private companies by MOA • Forest carbon credit facility in East Kalimantan 2020–2024 • Making Indonesia 4.0 • E-Ticketing in *Jabodetabek* transportation system. • Eco-Labelling initiatives by *Lembaga Ekolabel Indonesia* • Indonesian National Plastic Action Partnership by MOEF with Denmark, Viet Nam, and GIZ
Lao PDR	• Integration of green growth under National Green Growth Strategy 2030 • Poverty Eradication Programmes by NGPES • Nutritional Programme by Ministry of Agriculture and Forestry • Rural Development Programmes • Promote the use of electric vehicles and green city pilot project by MPWT
Malaysia	• Lao PDR–Thailand–Malaysia Power Interconnection Project by TNB • Mega Public Transportation Infrastructure Project • Green Initiative Programmes by Public Transport Operators • Eco Labelling Programmes – MyGAP, MSPO, and My Organic • Rooftop Solar Energy • Car Free Day by National Cycling Federation • Pilot scale production of bio-natural gas from palm oil mill by Sime Darby and SIRIM
Philippines	• Renewable Energy and Energy Efficiency and Conservation (EEC) • National Organic Agriculture Program (NOAP) by the Department of Agriculture • Renewable Energy Market • Government Energy Management Program (GEMP) • Philippine Energy Labelling Program (PELP) • Minimum Energy Performance (MEP) • National Eco-Labelling Program (NELP) • Green Energy Option Program (GEOP)

ASEAN Countries	Implemented National Programmes and Projects
	• Public Utility Vehicle Modernization Program (2017) • E-Trike Program and E-Mobility R&D Group • Tax Exemption on Biofuels (2006)
Singapore	• Energy Efficiency Fund (2022) • Green Mark Scheme (2021) • Building Retrofit Energy Efficiency Pilot Scheme (2021) • Built Environment Transformation Gross Floor Area Incentives Scheme (2021) • Super Low Energy Buildings Programme (2021) • Building Energy Benchmarking Report (2021) • GreenGov.SG Initiatives (2021) • Green Buildings Innovation Cluster Programme (2021) • Climate-friendly Household Programme (2020) • BlueSG • Walk2Ride Programme
Thailand	• Thailand Voluntary Emission Reduction Program and the Thailand Carbon Offsetting Program in 2013 • National Appropriate Mitigation Action (NAMA) Project • Bangkok and the Eastern Economic Corridor (EEC) • Area Based-Value Chain outside of Bangkok and the Eastern Economic Corridor (EEC) • Policy Innovation and Innovation Sandbox • 'Quick Win' projects • Food Waste Project in 2018 and Carbon Balance Scheme by TCEB • Green Label and Carbon Reduction Label by TEI • Green Port initiative in 2011 by Thailand Port Authority
Viet Nam	• Sustainable Consumption and Production based on National Action Plan (2016) • Incentives for renewable power source by Ministry of Industry and Trade • Incentives for Agriculture under Decree No. 57/2018/ND-CP in 2018 • Project Report on Promoting CE Development in Viet Nam, MPI • Green seaports by Ministry of Transport

Annex 4

Related Government Institutions

Countries	Sectors	Key Stakeholders
Brunei Darussalam	Agriculture	• Ministry of Primary Resources and Tourism (MPRT) • Brunei Darussalam Food Authority (BDFA) • Halal Food Control Division (HFCD)
	Energy	• Ministry of Energy (ME) • Autoriti Elektrik Negara Brunei Darussalam (AENBD)
	Transportation	• Ministry of Transport and • Infocommunications • Land Transport Department (JPD) • Department of Civil Aviation (DCA) • Maritime and Port Authority of Brunei Darussalam (MPABD)
Cambodia	Agriculture	• Ministry of Agriculture, Forestry and Fisheries (MAFF) • Ministry of Economy (MOE)
	Energy	
	Transportation	

Indonesia	Agriculture	• Ministry of Agriculture
		  ○ Directorate of Agricultural Infrastructure and Facilities
		  ○ Directorate of Horticulture
		  ○ Directorate of Plantations

	Energy	• Ministry of Energy
		  ○ Directorate of Oil and Natural Gas
		  ○ Directorate of Electricity
		  ○ Directorate of Mineral and Coal
		  ○ Directorate of New and Renewable Energy
		• National Energy Council

	Transportation	• Ministry of Transportation
		  ○ Directorate of Land Transportation
		  ○ Directorate of Sea Transportation
		  ○ Directorate of Civil Aviation
		  ○ Directorate of Train and Railway

Lao PDR	Agriculture	• Ministry of Agriculture and Forestry • Ministry of Natural Resources and Environment
	Energy	

Countries	Sectors	Key Stakeholders
	Transportation	• Ministry of Public Health
Malaysia	Agriculture	• Ministry of Agriculture & Food Industries (MAFI) o Department of Agriculture o Department of Veterinary Services o Malaysian Agriculture Research and Development Institute o Paddy Industry Development Division (IPB) o Federal Agricultural Marketing Authority (FAMA) o Kemubu Agricultural Development Authority (KADA) o Farmers Organization Authority (LPP) o Fisheries Development Authority of Malaysia (LKIM) o Muda Agriculture Development Authority (MADA) o Malaysian Pineapple Industry Board (LPNM) o Department of Fisheries (DOF) o Integrated Agricultural Development Area (IADA) • Ministry of Plantation Industries & Commodities (MPIC) o Malaysian Palm Oil Board o Malaysian Rubber Board o Malaysian Cocoa Board • Ministry of Natural Resources and Environment (KeTSA) o Department of Environment Malaysia (DOE)
	Energy	• Economic Planning Unit (EPU) of the Prime Minister's Department o Ekuiti Nasional Berhad (EKUINAS) o Malaysia Petroleum Resources Corporation Berhad (MPRC) o Johor Petroleum Development Corporation (JPDC) o Sabah Economic Development Corporation (SEDCO) o Sarawak Economic Development Corporation (SEDC) o Johor Corporation (JCORP) o Perbadanan Kemajuan Negeri, Negeri Sembilan, Melaka, Kelantan, Kedah, Selangor, Perak, Pahang, Terengganu, Perlis o Penang Development Corporation (PDC)

Countries	Sectors	Key Stakeholders
		○ My Digital Corporation • Ministry of Energy and Natural Resources (KETSA) ○ National Institute of Land and Survey (INSTUN) ○ Department of Director General of Lands and Mines (JKPTG) ○ Department of Mineral and Geoscience Malaysia (JMG) ○ Forestry Department Peninsular Malaysia (JPSM) ○ Department of Wildlife and National Parks (PERHILITAN) ○ Department of Survey and Mapping Malaysia (JUPEM) • Ministry of Science, Technology, and Innovation (MOSTI) ○ Space energy of Malaysia (MYSA) ○ Malaysia Nuclear Agency (NUCLEAR MALAYSIA) ○ Department of Chemistry (CHEMIST) ○ Atomic Energy Licensing Board (LPTA) ○ Academy of Science Malaysia (ASM) ○ Malaysian Institute of Chemistry (IKM) ○ Malaysian Board of technologists (MBOT) ○ Yayasan Inovasi Malaysia (YIM) Foundation • Ministry of Plantation Industries and Commodities (MPIC) ○ Malaysian Palm Oil Board ○ Malaysian Rubber Board ○ Malaysian Timber Board ○ Malaysian Cocoa Board (MCB) ○ Malaysian Pepper Board (MPB) ○ National Kenaf and Tobacco Board (NKTB) ○ Malaysian Palm Oil Council ○ Malaysian Rubber Council ○ Malaysian Timber Council ○ Institute of Malaysia Plantation and Commodities (IMPAC)
	Transportation	• Ministry of Natural Resources and Environment (KeTSA) ○ Department of Environment Malaysia (DOE)

Countries	Sectors	Key Stakeholders

		• Ministry of Transport (MOT)
		  ○ Land Public Transport Commission (SPAD)
		  ○ Malaysia Aviation Commission
		  ○ Federation of Malaysian Freight Forwarders (FMFF)
		  ○ KL Airport Services Sdn Bhd (KLAS)
		  ○ Malaysia Airport Holdings Berhad (MAHB)
		  ○ Frost and Sullivan Perunding Strategi Sdn Bhd
		  ○ Westport Malaysia Sdn Bhd
		  ○ Kuala Lumpur City Hall (DBKL)
		  ○ Malaysian Highway Authority (MHA)
		  ○ Land Public Transport Land Public Transport Agency (APAD)
		  ○ Prasarana Malaysia Berhad
		  ○ SMRT Corporation Ltd
		  ○ Express Rail Link Sdn Bhd (ERL)
		  ○ MyRapid
		  ○ MyBAS

Philippines	Agriculture	• Department of Agriculture (DA) • Department of Environment and Natural Resources (DENR)
	Energy	Department of Energy
	Transportation	Department of Transportation (DOTR)
Thailand	Agriculture	• Department of Environment Quality Promotion (DEQP) • National of Science & Technology Development Agency (NSTDA) • Sustainable Production and Consumption (SCP) Foundation • Thailand Environment Institute (TEI) • Ministry of Natural Resources and Environment • Office of the Agriculture Economics • AEDP • Office of National Higher Education Science Research and Innovation Policy Council (NXPO)
	Energy	
	Transportation	
Singapore	Agriculture	• Ministry of Sustainability and the Environment • National Environment Agency • Singapore Food Agency • National Water Agency
	Energy	• Ministry of Trade and Industry • Energy Market Authority

Countries	Sectors	Key Stakeholders
	Transportation	Ministry of Transport Land Transport Authority
Viet Nam	Agriculture	Ministry of Agriculture and Rural Development
	Energy	Ministry of Industry and Trade
	Transportation	Ministry of Transport

Annex 5

ASEAN-Led Initiatives under Strategic Priorities

Table A5.1. List of Circular Economy Initiatives in ASEAN Economic Community (AEC) and ASEAN Socio Cultural Community (ASCC)

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
SP 1. Standard Harmonisation and Mutual Recognition of Circular Products and Services	**(1) Explore trade-related standards and regulations that would support the circular economy in the region**	AEC Market Integration – Services and Investment	Market Integration – Services and Investment • Explore initiatives to promote investment that contributes to the sustainable development goals • Exchange information and practices on responsible business conduct (RBC)/corporate social responsibility (CSR) including their impact on investment and the community in general
		AEC Sectoral Development – Energy and Minerals	Sectoral Development – Energy and Minerals • Promotion of higher efficient air conditioners in ASEAN through harmonisation of standards and strengthening of market verification and enforcement capabilities (CSPF) • Launch regional product registration database on air conditioner
	(2) Develop and promote the utilisation of mutual recognition arrangements (MRAs) for product and service standards embedding circular economy principles, in accordance with prevailing international	AEC Sectoral Development – ICT and Tourism	Study to develop criteria for sustainable development in ASEAN tourism destinations based on impact assessment post covid-19 and existing ASEAN sustainable and inclusive tourism indicators.

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
	regulations, standards, and practices, where these exist, including those of MSMEs		
	(3) Harmonise circular products and services standards with other existing MRAs and standards in various ASEAN sectoral bodies and pillars	AEC Market Integration – Standards	Harmonisation of digital trade standards in priority areas identified in DTSCWG's Work Programme contributing to /digital trade and digital economy.
	(4) Initiate inclusive capacity building and develop guidelines on agreed priority sectors	ASCC – PEGD (Poverty Eradication and Gender Division)	Institutionalised territorial rural development planning process that strengthens rural-urban linkages and facilitates inclusive rural transformation leading to economic self-sufficiency of rural people.
SP 2. Trade Openness and Trade Facilitation in Circular Goods and Services	**(5) Considered a review of existing agreements and regulations with aim of identifying entry points for circularity and addressing possible trade barriers**	Market Integration – Trade Facilitation	The study on the possibility of including provisions on emerging issues, including the circular economy, remanufactured goods, refurbished products, trade-related sustainable development, essential goods, amongst others, to support the negotiations of upgrading the ASEAN Trade in Goods Agreement (ATIGA).
		Market Integration – EERD	• ASEAN–Australia–New Zealand Free Trade Agreement (FTA) upgrade negotiation to include a chapter on trade and sustainable development (ongoing) • ASEAN–Canada FTA negotiation, which will start next year may include provisions (if possible chapters) on labour, environment, and possibly gender and indigenous people

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
			• Other non-FTA economic cooperation (Japan, Russian Federation, United Kingdom, United States) also have some elements of sustainable growth or sustainability
SP 3. Enhanced Role of Innovation, Digitalisation, and Emerging/Green Technologies	**(1) Promote inclusive dialogue and partnerships amongst private sector, academia and research institutions, governments including ASEAN development partners, and with circular economy experts, to collaborate on open innovations, effective policy frameworks for fulfilling circular objectives and facilitate knowledge and technological exchange and know-how**	Sectoral Development – FAFD	• Regional collaborative research and capacity building for monitoring and reduction of marine debris from fisheries.
		ASCC – EYS	• Engage relevant sectors and actors (including youth) to highlight the importance of nature-based solutions to prevent future pandemics through cross-sectoral • Collaboration and multi-stakeholder engagement and as part of ASEAN's agenda on mainstreaming biodiversity across relevant sectors; and to encourage individuals and community to become 'bio-literate' to address future pandemic (ACRF 5e.6(ii)).
		ASCC – PEGD	ASEAN forum on agricultural production development based on circular agricultural model in building a new rural development (includes Special Areas for Agricultural Development (SAAD).

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
	(2) Promote collaboration between ASEAN sectoral bodies, innovative technology platforms, investment structures, and business models that can accelerate the scaling up of promising circular innovations at different levels	ASCC – CID	ASEAN Cultural Heritage Digital Archive.
	(7) Develop circular economy technology policy frameworks, certification protocols, and transparency mechanisms	Market Integration – Trade Facilitation	• Technical assistance to conduct Paperless Trade Legal and Technical Readiness Assessment (UNESCAP) • AMS Alignment to UNESCAP Framework Agreement on Facilitation of Cross-Border Paperless Trade in Asia and the Pacific (the Framework) • Development of a national plan to align e-transactions laws and regulations with any of the prescribed UNCITRAL legislative texts • Development of ASEAN Digital Economy Framework Agreement • Conducting UN Global Survey on Digital and Sustainable Trade Facilitation
SP 4. Competitive Sustainable Finance and Innovative Environmental, social, and corporate governance (ESG)	**(1) Consider the use of different and new financial instruments for circular economy-related projects such as but not limited to, blended financing, green, transition and sustainable bonds, carbon pricing, and catalytic capital, in accordance with existing**	Market Integration – FID	• Report to promote sustainable finance (ACRF 5g.1) • Roadmap on ASEAN sustainable capital market • Development of ASEAN green finance taxonomy • Promotion of ASEAN Green, Social and Sustainability Bond Standards

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
Investment	**standards or mechanisms such as the ASEAN Green Bond Standards, the ASEAN Green Catalytic Finance Facility of the ASEAN Infrastructure Fund, or through the development of an ASEAN Taxonomy**		
		ASCC – ENV	ASEAN cooperation on measurement, reporting, verification (MRV) and carbon pricing
	(4) Re-orient financial, institutional, and investment policies to prioritise responsible and sustainable businesses and infrastructure, including the development of green technologies and the transformation of public–private partnerships (PPP) towards the circular economy	Market Integration – FID	Promotion of Sustainable Banking Principles to guide future related policies and commitments to promote sustainable banking by ASEAN central banks
SP 5. Efficient Use of Energy and Other Resources	**(1) Strengthen coordination and collaboration amongst ASEAN sectoral bodies, institutions, governments, the private sector and the broader ASEAN community, in promoting the use of renewable energy and energy efficiency, including the development and deployment of new technologies and renewable energy sources, and implementation of energy efficiency and conservation measures, to harness related mineral resources**	Sectoral Development – Energy and Minerals	Policy dialogue on energy issues related to affordable and clean energy (SDG7) and climate action (SDG13)
		Sectoral Development – FAFD	Promotion of biomass energy for agricultural communities and rural development in ASEAN
		Sectoral Development – Science and Technology	Role of Hydrogen in ASEAN's Energy Transition: Recent Developments and Stakeholders' Consultation for Regional

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
	(2) Reconsider existing policies that discourage circularity in operations, and explore those which support the circular economy	Market Integration – Standards	• Develop concrete initiatives to help businesses in their digital transformations in the area of smart manufacturing • Enhance/facilitate the use of digitalisation in healthcare, where appropriate e.g., in areas such as telemedicine
		Sectoral Development – ICT and Tourism	Develop the ASEAN Climate smart tourism network
		Sectoral Development – FAFD	• Improving the soil health to capture carbon emission and maintain circular agriculture (project proposal stage) • ASEAN–Japan Project on Project on the Development of Circular Economy with Bioenergy and Coproducts
		Sectoral Development – Science and Technology	ASEAN Network on Bio-Circular-Green Economy (ASEAN BCG Network)
		ASCC – ENV	• Develop ASEAN Sustainable and Consumption (SCP) Framework • Explore potential establishment of ASEAN Circular Economy Stakeholder Platform

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
	(3) Promote responsible business conduct, and greening of supply chains and production processes, which may include effective waste management	Sectoral Development – Transport	• ASEAN green ship strategy • ASEAN guidelines on airport environmental management system (EMS)
		Sectoral Development – ICT Tourism	Sustainable practices for hotel waste management in ASEAN Tourism industry workshop
		Sectoral Development – Science and Technology	• Regional Workshop on Low Carbon Technologies for MSMEs in the ASEAN • Low-cost, low-grade waste/solar-heat driven solid-desiccant dehumidifier for air pre-conditioning • Knowledge Transfer on Best Practices for Small and Medium Scale of Waste to Energy Technologies by Using Life Cycle Assessment (LCA) Approach in Malaysia, Lao PDR and Indonesia • Study and Development of Recommendation on Industrial Wastewater Treatment Technologies for Industrial Enterprises
	(5) Drive the growth of circular low-carbon infrastructure and sustainable transport to accelerate reduction of carbon emissions	Sectoral Development – Transport	• Guidelines for the development of sustainable urban mobility plans (SUMP) in ASEAN

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
			• Study on policy gaps and recommendations for the implementation of the ASEAN fuel economy roadmap
		Sectoral Development – Energy and Minerals	• Capacity building workshop: promoting the use of natural gas and ecologically-friendly fuel in transport sector, households, and industries • ASEAN energy efficient buildings and ASEAN cooling roadmaps
		Sectoral Development – Science and Technology	Workshop on Higher Blending of Biofuels for Transportation in ASEAN Countries: Testing and Strategy
	(6) Enhance the role of primary sectors in resource management, by promoting sustainable and smart agriculture practices, including the use of technology	Sectoral Development – FAFD	• Identification and planning of infrastructure investment for reducing agricultural postharvest/postproduction losses • Development of the ASEAN guidelines for sustainable infrastructure • collaboration to address the issue of crop burning

SP	Covered SP Initiatives	Sectors	Existing Initiatives in ASEAN
		Sectoral Development – Science and Technology	• Capacity Building and Knowledge Sharing on Mushroom Production, Biofertiliser and Composting Technologies in Different Farming Systems in the Philippines, Viet Nam, and Thailand and Pioneering the Establishment of a linked ASEAN Macrofungi Germplasm Collection • Sustainable Production of Biofuels in the ASEAN Region From Oil Palm Residues • ASEAN Network of Excellence Centre of Biomass Conversion Technology (ANEC)
		ASCC – PEGD	Senior Officials Meeting on Rural Development and Poverty Eradication (2021–2025) • Outcome 3.1. Improved knowledge management system for natural resource management and climate change adaptation and mitigation Climate Smart Farmer and Bio-Circular Green Economy in support of rural development and poverty eradication

ACRF = ASEAN Comprehensive Recovery Framework, CID = Culture & Information Division, CSPF = Cooling Seasonal Performance Factor, DTSCWG = Digital Trade Standards and Conformance Working Group, EERD = External Economic Relations Division, ENV = Environmental Division, EYS = Education, Youth & Sport Division, FAFD = Food, Agriculture & Forestry Division, FID = Finance Integration Division, ICT = information and communication technology, MSMEs = micro, small, and medium-sized enterprises, SDG = Sustainable Development Goals, SP = strategic priority.
Source: Authors.