SINGAPORE INSTITUTE OF INTERNATIONAL AFFAIRS

Building a Digital-Green ASEAN

Growing intersections between digital growth and sustainability goals

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About this Report

This special report by the SIIA provides research and analysis on the dual emerging trends of digitalisation and sustainability in ASEAN. Through a lens of innovation, inclusion, interoperability and sustainability, the SIIA conducted closed-door roundtables and interviews to garner insights from policymakers and the private sector between September 2022 to April 2023, which feeds into this report. With the lifting of travel restrictions, the SIIA also conducted policy research trips for this report to the ASEAN key economies of Indonesia, Thailand and Vietnam. The report launches at the ATxSG 2023, co-organised by Singapore's Infocomm Media Development Authority (IMDA) and InformaTech.

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All views expressed in the report are those of the authors, unless otherwise credited. We would like to thank the following partners and organisations for sponsoring the report: The Infocomm Media Development Authority of Singapore (IMDA), Equinix, Huawei, Microsoft and Tata Consultancy Services. We appreciate the insights sharing from our partners as well as other companies we engaged with for this report. A full list of the participating organisations for our research interviews and roundtables is listed in the appendix. The report's contents do not necessarily reflect the views or stated policies of the above contributors.

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Foreword

The Singapore Institute of International Affairs (SIIA) focuses on politics, economic policy and sustainability issues. We are Singapore's oldest think tank and over the last ten years has been globally ranked as one of the leading institutions in ASEAN and the best independent think tank in Asia. We are aware of trends in technology but are not, as such, specialized in technology or the digital economy.

During the pandemic however we had much cause to look more closely at these issues. We were not the only ones. As many have noted, during the national lockdowns and the border closures that marked the policy response to the pandemic, the digital economy accelerated. Digital strategies for companies, consumers and countries went from the nice-to-have next thing to essential and ASAP.

When the Singapore government and private sector formed a task force on how to emerge stronger from the crisis of the pandemic, digitalization was a key component of the efforts. The SIIA served as the think tank and learnt in this process, especially emphasizing the need for efforts to link the digital economy across borders in our region, and beyond. Our New Horizons Report of 2021 said, "Singapore's role as a living lab involves not only deploying new innovations in Singapore, but also testing solutions for ASEAN as a whole."

This Report develops our analyses and recommendations on the digital economy in our region. In the first report, Charting ASEAN's Digital Future (2022), we surveyed the emerging policy challenges for the region such as the need for capacity building and regulatory certainty. In this report, one year on, we zoom in on key issues concerning digital-green growth including greener data centres, renewable energy grids and sustainable digital trade.

From this work, we realize that while almost all agree on the potential of a regional and global digital economy, there are many differences on key issues that can be obstacles to greater cooperation. Even among ASEAN, while members have committed since 2015 to the ASEAN Economic Community, consensus and integration of the digital economy remains to be agreed and will require more time and work. That effort must take into account not only what the ten members do with each other. Bilateral and plurilateral initiatives on the digital economy with other partners are also increasingly active and can be path finders for dialogue, understanding and cooperation.

The dynamic pace of the sector is pushing things forward, but much remains to be done. It is our hope that this Report and the SIIA's work on the digital economy will contribute to the efforts to grow the digital economy in ways that assist the economy, society and planet.

Simon Tay
Chairman SIIA

Executive Summary

The opportunities to grow the digital economy in ASEAN are tremendous, especially in tandem with the broader economic integration of the region. Yet so are the challenges. This is not only to harmonise policies among the different member states, recognising their different interests and concerns. This is also in respect of commitments to sustainability. This report highlights the growing intersections between digitalisation and decarbonisation, and the implications for ASEAN's economic growth and integration. The regional context, opportunities, challenges and recommendations are provided in this report.

Opportunities & Challenges

In ASEAN and around the world, there is an acceleration of digital adoption and connectivity, further necessitated by the COVID-19 pandemic. Yet, digitalisation is at a crossroads for reasons including concerns about sustainability and climate action. The digital economy has a physical energy and carbon footprint, which will continue to grow with increasing demand for data and data infrastructure. Unless addressed, the acceleration of growth and economic activity from digitalisation will exact a heavy impact. The solutions must not however aim to restrain or reverse the drive towards digitalisation and 'de-digitalise'. We instead require innovative and transformative ways to mitigate and reduce carbon emissions.

There are ways that the current digital revolution can be an enabler for countries and corporates to better meet sustainability goals. Three ways we consider in this Report will be through increased efficiencies, facilitating the measuring and reporting of climate-related standards, and providing new technologies to counter carbon emissions e.g. carbon capture, utilisation and storage.

In looking at these approaches, we consider our region closely and optimistically. ASEAN has the potential to pioneer a digital-green ecosystem instead of approaching digital and sustainable growth as disparate sectors in "silos". The current and emerging availability of technologies also provides opportunities to create a foundation for new structure and strategies to be put in place can serve to drive a "digital-green" transition with potentially critical contributions to the broader economy and societies across the region.

Our Report focuses on the landscape for sustainable digital growth in ASEAN and what types of regional cooperation can be forged to help enable and drive forward this 'digital-green' transition. The economies of Indonesia, Singapore, Thailand and Vietnam in particular, have made strides for the next steps for industry and how we live and work – often referred to as "4IR". They exemplify the ambition and potential for advancements in digital and green policies across the region.

But such transitions will not be made automatically or easily. Governments in ASEAN will need to map out economic growth plans and work with people, the private sector and across borders, towards creating ecosystem for digital transformation and green growth. Recognising the convergence of digitalisation and sustainability, our Report makes a number of key recommendations that can help ASEAN move forward towards a "digital-green" future.

KEY RECOMMENDATIONS TO BUILD A DIGITAL GREEN ASEAN

Digital Economy Actors:

1. **End-to-end supply chain digitalisation:** Companies should continue to fully digitalise their supply chains to increase the efficiency of material management as well as onboard their main suppliers onto complementary systems to measure and track their Scope 3 emissions.

2. **Greening data centres:** Mitigating the carbon footprint of data centres must be considered. Data centre providers have explored utilising tech innovations to mitigate their environmental impact, which must be complemented by government efforts to facilitate renewable energy trade and setting interoperable standards to incentivise efforts towards greener data centres.

Digital Policymakers:

3. **Enable cross border data flows:** Enabling cross-border data flows with appropriate data protection safeguards for greater efficiency of online transactions and leveraging global platforms that facilitate interoperability.

4. **Harmonise standards in Digital and Green Economy Agreements:** Digital and Green Economy Agreements (DEAs and GEAs) provides opportunities to develop norms and standards for the digital and green economies.

5. **Incorporate the digital-green agenda into existing ASEAN mechanisms:** ASEAN first needs to ensure that sufficient rhetoric and discussion around the digital-green nexus is present in current ASEAN mechanisms. This can further be developed in coming years with input from the private sector and other stakeholders for feedback, even as ASEAN looks towards developing its Post-2025 Community Vision towards 2045.

Wider Economy Changes:

6. **Connect ASEAN's carbon markets:** Interconnectivity across carbon market platforms in ASEAN would be needed to support the trade of carbon credits. Harmonizing standards will allow purchasers to confidently buy credits for their businesses with some level of certainty to the quality, quantity, and reliability of the credit.

7. **Develop a regional, renewable power grid:** Connecting electricity grids across Southeast Asia will allow the region to leverage on AMS' innate strengths and accelerate the wider energy transition. This will enable the growth of data centres and other essential digital infrastructure, as well as help the region achieve its net-zero goals.

8. **Foster innovation:** Regulatory sandboxes will be crucial to support the development and innovation of technology tools and new virtual systems, and must be assisted by funding support.

9. **Bridge the skills gap:** Demand for talent will continue to grow in tandem with the digital and green economies and there is a need to ensure that a pipeline for talent is established. Upskilling workers and improving the quality of education should be a priority for AMS to ensure that everyone can participate in the digital and green economies.

10. **Promote digital-green norms:** Promoting a framework of thinking about the digital and green economies will require efforts from both the public and private sector. Policymakers can help create rhetoric and regulation around reporting standards, while tech platforms can offer sustainable options by default, nudging both business and consumers towards greener habits.

This is a shortened summary of key recommendations identified by the SIIA to build a "Digital-Green" ASEAN. An expanded version with more context is found in the last chapter of the report.

1. Introduction

Why ASEAN?

The Association of Southeast Asia Nations (ASEAN) is projected to become the world's fourth-largest economy by 2030[1]. ASEAN has strong growth prospects supported by favourable demographics with a relatively young median age of 30.2 years[2] and a growing urbanised middle class. While diverse, ASEAN member states (AMS) are increasingly integrated, with the ASEAN Economic Community (AEC) making the bloc an attractive investment destination and a key production base in the global economy.

The emergence of digitalisation further enhances ASEAN's growth prospects. The e-Conomy SEA report considers six countries from Southeast Asia and estimates the region's digital economy could reach $1 trillion by 2030.[3] Yet, there are also immense challenges for ASEAN economic integration and stability. The global COVID-19 pandemic has receded and lockdowns and border obstacles have eased, but new factors have arisen to create a "poly-crisis". These include the war in Ukraine, a tense Sino-US relationship, supply chain disruptions and increasing impacts from climate change.

Why Digital-Green?

Climate change is neither distant nor abstract. Increasing calls to take immediate action drive demand to move on sustainability and to decarbonise our economy and society. These demands have a complex interplay with the trends in digitalisation. How do they overlap?

Firstly, both trends have emerged as contemporaries in time. Concerns about climate and the growth of the digital economy have grown in parallel among corporations and consumers, governments, and citizens. The internet economy has boomed, and mobile phones have become ubiquitous, while at the same time more nations have begun to recognise that the earth's temperature is increasing alarmingly.[4]

The two trends again intertwined during the pandemic. A world that was in lockdown for the majority of 2020-2021 required digital connectivity for work, school, and social cohesion, and for a brief spell, there was some environmental dividend with less pollution and less carbon. Yet, as pandemic concerns eased and activity restarted, carbon emissions have not only returned but jumped.

A second commonality is that both are cross-cutting issues, rather than isolated silos. The "digital economy" does not only affect tech companies but, in combination with other aspects of technology, challenges many aspects of more traditional "brick-and-mortar" businesses e.g., shopping malls have bankable digital services or purely transitioned online to e-commerce. To get to a "green economy", there are many changes that are needed in economic and social activity, especially linked to the sources of power for factories, households, transportation, and supply chains.

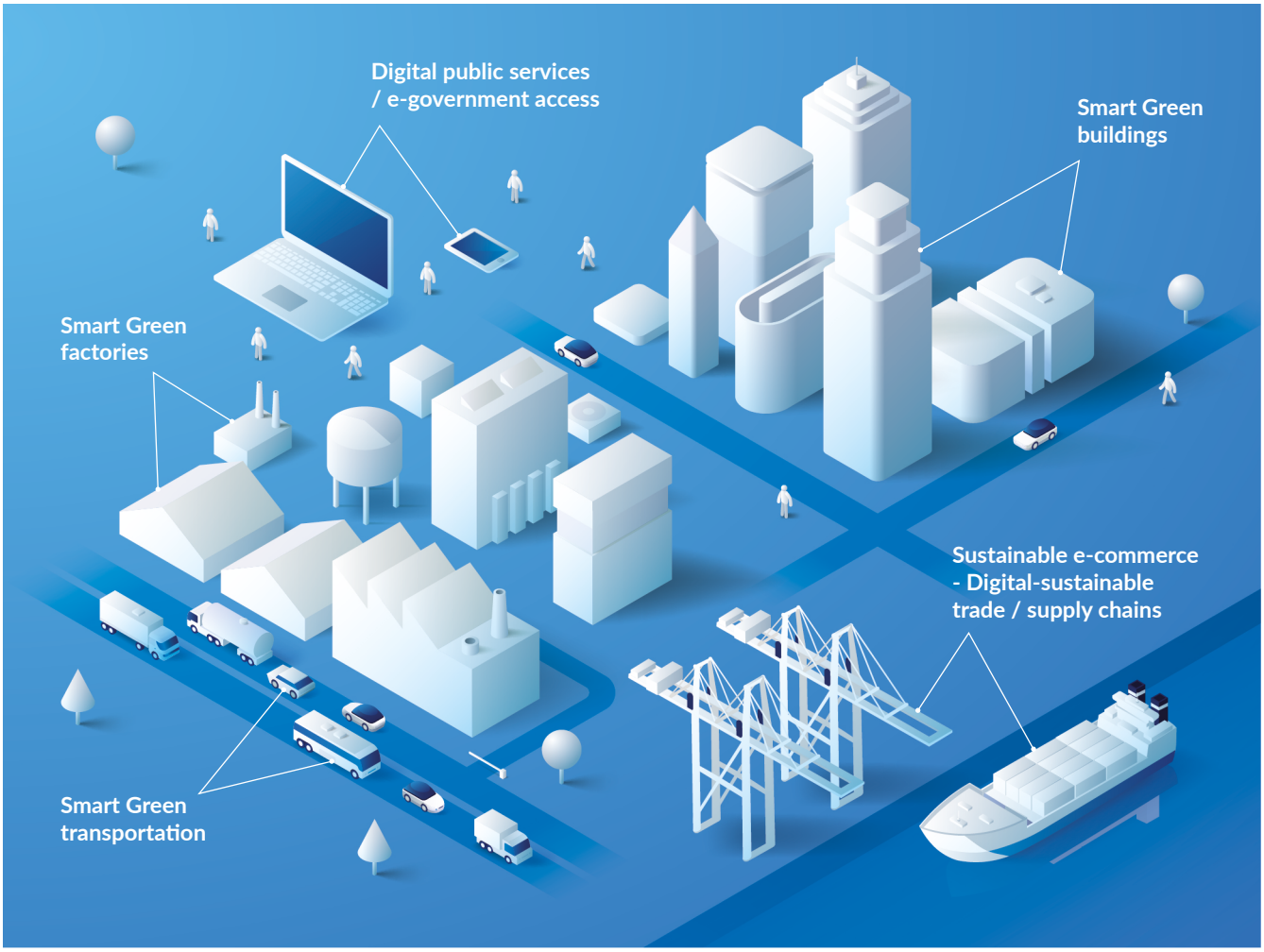
1 *OECD. Economic Outlook for Southeast Asia, China and India 2018: Fostering Growth through Digitalisation. Economic Outlook for Southeast Asia, China and India. OECD, 2018. https://doi.org/10.1787/9789264286184-en.*

2 *James Fox, "Industries to Watch Out for Growth in Southeast Asia in 2023," ASEAN Briefing from Dezan Shira & Associates, January 17, 2023, https://www.aseanbriefing.com/news/industries-to-watch-out-for-growth-in-southeast-asia-in-2023/.*

3 *Google, Temasek, and Bain & Company, "E-Conomy SEA 2022," 2022, https://economysea.withgoogle.com/home/.*

4 *In 2015, the Conference of the Parties (COP21) held in Paris was seen as a significant international climate agreement adopted by 196 parties to limit global warming to 1.5 degrees Celsius by the end of this century. https://unfccc.int/process-and-meetings/the-paris-agreement.*

Figure 1: Growing intersections: Digitalisation and environmental sustainability



The interplay between digitalisation and sustainability is inevitable. Corporates are developing strategies of "Greening Tech", by mitigating the environmental impact of technology, and "Tech for Environmental Sustainability", by using technological innovations to improve sustainability practices. With both cross-cutting issues embedded in the modern economy, current regulatory frameworks around related policies should be updated. This includes the need to address related factors such as financing, security and cooperation.

How Can We Build a Digital-Green ASEAN?

This report outlines the growth of digitalisation in ASEAN and highlights the growing intersections between this trend and the challenges for sustainability and decarbonisation. It attempts to answer the question of how we can build a digital-green ASEAN for strong, sustainable, and inclusive growth.

We begin by examining the landscape for digital and green growth in ASEAN as an organisation. We then survey digital and sustainable policy strategies across selected key ASEAN economies: Indonesia, Singapore, Thailand and Vietnam. Second, the report considers issues relating to data, which many consider the lifeblood of the digital economy. We examine the infrastructure needed to support its growth, including energy grids that need to be more sustainable. Third, the report explores supply chains where digital tools and sustainability practices naturally aggregate, especially for businesses that seek to tackle not only their own carbon footprint but their entire value chain – what is termed, "Scope 3 emissions". Lastly, the report addresses the challenges and opportunities for a digital-green ASEAN, with recommendations on how regional cross-border collaboration can help governments and businesses achieve policy and strategic goals. These must not only be reconciled but can generate synergy, to drive forward sustainable, inclusive, and strong growth for ASEAN – even in this period of global challenges and uncertainty.

2. Digital-Green Growth: The Landscape for ASEAN Key Economies

Digitalisation and decarbonisation are key policy areas that governments are keen to develop. The key economies of ASEAN have begun mapping out their own national digital roadmaps as well as announced their climate targets. While economic growth remains a priority for many AMS, trends in digitalisation and sustainability will shape the type of growth achieved. The region will need investment in infrastructure, capacity building for green and digital talent, and the involvement of micro, small and medium-sized enterprises (MSMEs), that form the backbone of ASEAN's economy.

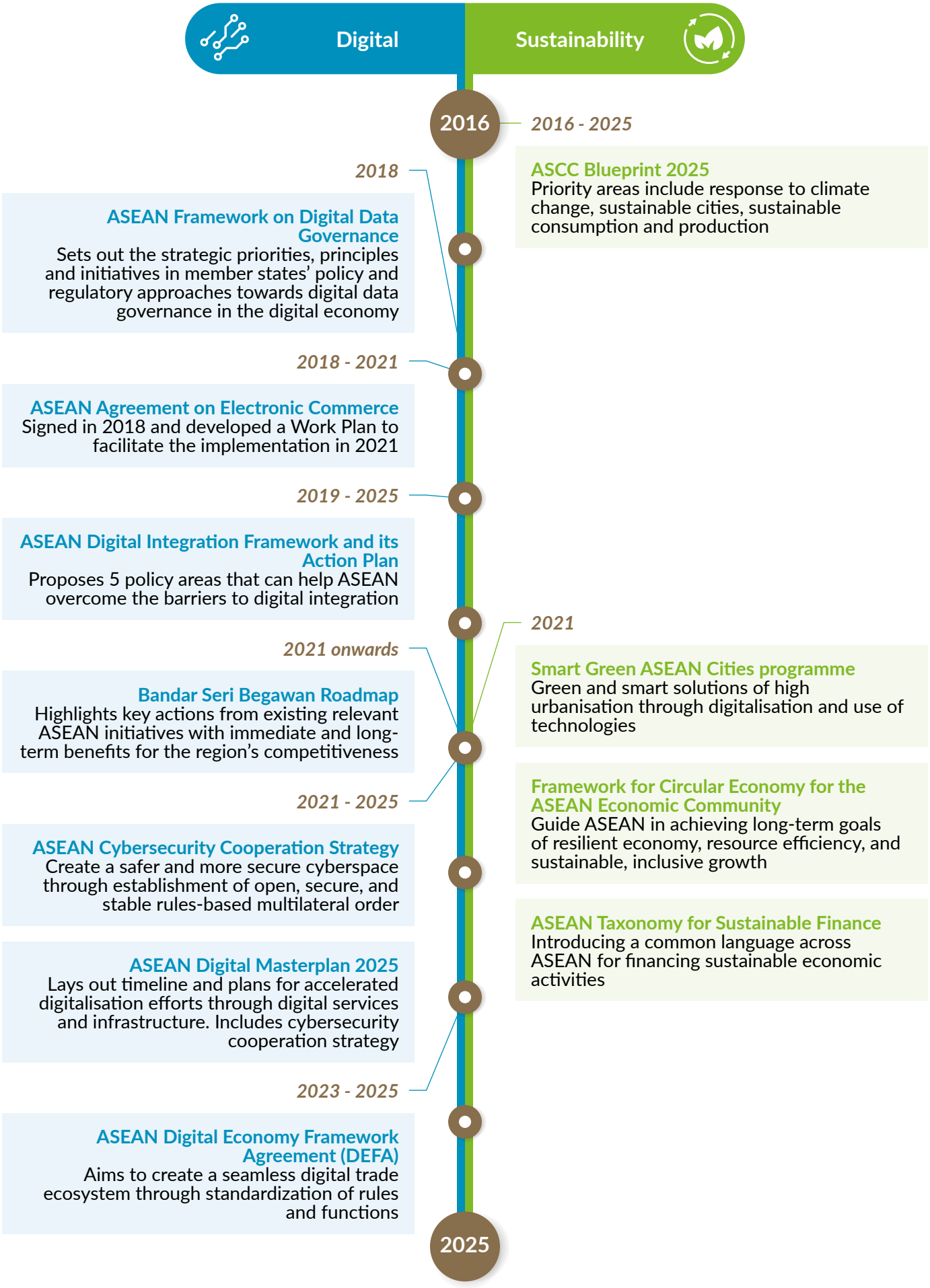
2.1 The ASEAN Digital Roadmap

Since the signing of the e-ASEAN Framework Agreement in 2000, ASEAN leaders have attempted to catalyse digital growth through various frameworks. This includes the ASEAN Digital Integration Framework Action Plan (DIFAP) 2019-2025, the adoption of the ASEAN Digital Masterplan 2025 and the ASEAN E-commerce Agreement. While COVID-19 spurred countries towards digital adoption, it also revealed gaps within and between AMS. Thus, the ASEAN Comprehensive Recovery Framework (ACRF) and Bandar Seri Begawan Roadmap were subsequently developed to highlight the need for inclusive digital transformation and identify existing initiatives to aid with the three phases of recovery, acceleration, and transformation.

The current overarching framework guiding AMS on their path towards digitalisation is the ASEAN Digital Masterplan (ADM) 2025. The outcome is a society where everyone is able to use digital services to enhance their daily lives, while businesses and public bodies can use digital services to become more productive and accessible to citizens. In addition, digital services will allow for fast frictionless trade among AMS, accelerating businesses to expand across the ASEAN region. Achieving this vision requires AMS governments and regulators to ensure high-quality and ubiquitous connectivity throughout ASEAN, and develop services which are safe and relevant to the needs of end users, while removing barriers that hinder access to digital services.

AMS have actively prioritised digital transformation and adopted digital goals either in part or whole in their respective national-level frameworks. However, current digital roadmaps lack a green chapter or any elaboration on how digital tools might be leveraged to achieve sustainability goals.

Figure 2: ASEAN's timeline of digital & sustainability initiatives



2.2 ASEAN's Path to Carbon Neutrality

The ASEAN region is rich in natural resources and is the centre of the world's marine biodiversity.[5] However, the region is vulnerable to climate change-related impacts such as floods, droughts, and rising temperatures. According to the Intergovernmental Panel on Climate Change (IPCC), "South-east Asia will witness increased losses in coastal settlements and infrastructure due to flooding caused by unavoidable sea-level rise".[6]

While AMS are at risk, its economies are growing rapidly and demanding large amounts of energy. The ASEAN power sector's CO_2 emissions will continue to grow and peak at 805 million metric tons (MMt) in 2029.[7] While most energy demand comes from the four AMS of Indonesia, Vietnam, Thailand and Malaysia, AMS must collectively address increasing energy use as economies have grown 6 per cent[8] annually in the last two decades. ASEAN accounts for about 5 per cent of global energy demand with per capita emissions at 1 per cent of the global total in 2020.[9] The ASEAN Plan of Action for Energy Cooperation (APAEC) is in its second phase: 2021 – 2025, and will continue to evolve as new technology and priorities emerge.

AMS have also committed to net-zero goals. Nine out of ten governments have pledged to achieve net zero targets by 2050. Going forward, the ASEAN Secretariat (ASEC) is also working on an 'ASEAN Strategy for Carbon Neutrality', to develop a net-zero regional strategy. A regional framework for a cross-border strategy has the intrinsic benefit of leveraging on the innate strengths of each AMS while strengthening the ties that bind them.

2.3 National Roadmaps for Key ASEAN Economies

In addressing how AMS can grow both digitally and sustainably, the SIIA has identified the four key economies of Indonesia, Singapore, Thailand, and Vietnam as starting points for our research. Singapore is relatively advanced in its digital economy and has taken the lead on DEAs, and Thailand, Indonesia and Vietnam are strong manufacturing hubs that are relatively advanced in digital readiness and infrastructure and have shown strong political will to grow the digital economy. This section explores different digital and green roadmaps adopted by key AMS to establish a digital-green ecosystem.

[5] *ASEAN, "Environment - Overview," Association of Southeast Asian Nations, n.d., https://asean.org/our-communities/asean-socio-cultural-community/environment/.*

[6] *Cheryl Tan, "South-East Asia among Regions Hardest Hit by Climate Change, Must Prioritise Adaptation: IPCC," The Straits Times, March 7, 2022, https://www.straitstimes.com/singapore/south-east-asia-among-regions-hardest-hit-by-climate-change-must-prioritise-adaptation-ipcc.*

[7] *Cecillia Zheng, "Which ASEAN Countries Will Be the Front-Runners to Decarbonize Their Power Sectors?," S&P Global Community Insights, August 24, 2022, https://www.spglobal.com/commodityinsights/en/ci/research-analysis/which-asean-countries-will-be-the-frontrunners-to-decarbonize.html.*

[8] *"Electricity Market Report – December 2020", International Energy Agency https://www.iea.org/reports/electricity-market-report-december-2020/2020-regional-focus-southeast-asia.*

[9] *Hannah Ritchie, Max Roser, and Pablo Rosado, "CO_2 and Greenhouse Gas Emissions," Our World in Data, n.d., https://ourworldindata.org/co2-and-greenhouse-gas-emissions.*

Table 1: AMS' carbon emissions contribution to the world (2021)

Country	Net-zero targets	Global share of emissions	Per capita emissions (tonnes)
Brunei	2050	0.02%	16.05
Cambodia	2050	0.04%	1.0
Indonesia	2060	1.59%	2.19
Laos	2050	0.05%	2.83
Malaysia	2050	0.66%	7.56
Myanmar	2050	0.11%	0.72
Philippines	No target set	0.39%	1.33
Singapore	2050	0.15%	9.71
Thailand	2065	0.71%	3.88
Vietnam	2050	0.85%	3.24

Source: Emissions Database for Global Atmospheric Research (EDGAR) [10]

Table 2: Top challenges for the growth of the digital economy in ASEAN

(1) Need for Whole-of-Government Approach	Multiple ministries and initiatives involved given that the digital economy is a cross-cutting issue, need for a coordination mechanism with clear, measurable objectives
(2) Lack of Digital Talent and Skills	Digital readiness has improved, but many are still unequipped with the relevant digital skills. Countries are actively developing human resources to meet the future demands of the digital economy
(3) Cultivating the Right Policy Environment	(i) Regulation around cybersecurity and data protection – need to foster trusted cross-border data flows within ASEAN
	(ii) Encouraging investment, innovation, research, and development without overregulating emerging technologies
(4) Inclusive Growth – Supporting Digital Transformation for MSMEs	The main barriers inhibiting digital transformation for SMEs include the (i) lack of digital literacy, (ii) perception of increased and unnecessary cost, and (iii) lack of guidance and skills to execute digital transformation

Source: Authors' research from stakeholder interviews

[10] *IEA-EDGAR CO2, a component of the EDGAR (Emissions Database for Global Atmospheric Research) Community GHG database version 7.0 (2022) including or based on data from IEA (2021) Greenhouse Gas Emissions from Energy, www.iea.org/data-and-statistics, as modified by the Joint Research Centre. https://edgar.jrc.ec.europa.eu/report_2022?vis=pop#emissions_table.*

Indonesia

As Southeast Asia's largest economy, Indonesia's 270 million population offers an attractive digital consumer market, especially as there is high mobile penetration. However, the country currently lacks a mature digital workforce. Policymakers predict that the country needs 9 million digital talents by 2030.[11] Indonesia's Ministry of Communication and Informatics (KOMINFO) is tackling this issue under the 'Indonesia Vision 2045' to create a "National Digital Literacy Movement" to improve the digital capabilities of Indonesians. The Ministry of Industry is also partnering with MNCs to upskill personnel, forming capability centres to train in data analytics, robotics, IoT, and cloud computing to support the digital ecosystem.

Indonesia is investing in building large national data centres to house government data in Bekasi, Batam, Nusantara and Labuan Bajo. This would propel the 'One Data Indonesia' plan developed by the Ministry of Planning and National Development (BAPPENAS) to accelerate the digitisation of public services. However, businesses still face data localisation requirements. According to Government Regulation (GR) No. 71 of 2019 on the Provision of Electronic System and Transaction, Indonesia has relaxed restrictions for data in the private domain and only places limits on government data.[12] However, there is an exception for the Banking, Security, Financing and Insurance (BFSI) industry, where data still must be localised.

> **"Our hope is that Indonesia's economic transformation would really take place toward a green economy."**
>
> Indonesia President Jokowi (February 2023, Ground-breaking of hydropower plant)

As the G20 chair in 2022, President Jokowi emphasised that a green economy is key to Indonesia's future. The country will leverage on its resources, such as nickel, to produce lithium batteries as part of Electric Vehicle (EV) market. Indonesia is also keen to become a global market leader in carbon trading schemes.[13] Indonesia's "2060 or sooner" net zero target was adopted in 2021 and included in its Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) under the Paris Agreement. Stronger 2030 emission reduction targets were adopted in its Enhanced NDC under the Paris Agreement in 2022.

[11] *Tempo.co, "Indonesia Needs 9 Million Digital Talents, Minister Airlangga Says," Tempo (TEMPO.CO, April 6, 2023), https://en.tempo.co/read/1711800/indonesia-needs-9-million-digital-talents-minister-airlangga-says#:~:text=Indonesia%20Needs%209%20Million%20Digital%20Talents%2C%20Minister%20Airlangga%20Says,-Translator&text=TEMPO.CO%2C%20Jakarta%20%2D%20Coordinating,US%24146%20billion%20in%202025.*

[12] *Daniel Pardede, "Indonesia: New Regulation on Electronic Systems and Transactions," Global Compliance News, November 7, 2019, https://www.globalcompliancenews.com/2019/11/07/indonesia-new-regulation-electronic-systems-transactions-20191028/.*

[13] *Office of Assistant to Deputy Cabinet Secretary for State Documents & Translation, "President Jokowi Highlights Strategies to Kick-Start Green Economy," Cabinet Secretariat of the Republic of Indonesia, January 20, 2022, https://setkab.go.id/en/president-jokowi-highlights-strategies-to-kick-start-green-economy/.*

What's next for Indonesia?

The industries of e-commerce, transportation, health and edutech are likely to be drivers for the next wave of digital transformation in Indonesia. Aside from working with the ASEAN Secretariat (ASEC) to develop the Digital Economy Framework Agreement (DEFA), Indonesia is also working on developing a whole-of-government approach to the digital economy. The Coordinating Ministry of Economic Affairs (Kementerian Koordinator Bidang Perekonomian) is leading a National Strategy for Digital Economy 2030 which will outline the main priorities for Indonesia's digital economy moving forward. It will build on the findings from the DEFA study, and data collected from the relevant ministries involved.

Singapore

Positioning digitalisation at the forefront of growth and innovation, Singapore has taken the global lead in integrating technology into the fabric of its society. The country's "Smart Nation" initiative was launched in 2014 to leverage digital tools to improve people's lives and increase productivity across the economy. Smart Nation is a whole-of-government initiative and encompasses a comprehensive network of state and non-state actors that aims to effect widespread digital transformation across Singapore.

One integral development has been mainstreaming cashless transactions and e-payments, evidenced by universal tools like PayNow, which enables immediate peer-to-peer transfers, and the Singapore Quick Response Code (SGQR), a unique QR code for merchants to accept payments from different service providers. With the ubiquity of digital payments, digital financial services growth will be further propelled by the "digitalisation of investments and lending via digibanks and fintechs".[14] Other initiatives include autonomous vehicles, a National Digital Identity (NDI), digitalisation of the healthcare system, consolidation of digital government services, and upskilling professionals in AI technology.

> **"The pandemic has accelerated digitalisation in many of our countries. It is a driver for future growth and for the achievement of our Sustainable Development Goals. There are many opportunities for win-win international cooperation in this field."**
>
> Singapore Prime Minister Lee Hsien Loong (November 2022, G20 Bali Summit)

Additionally, Singapore has been championing increased cross-border collaboration in ASEAN, having signed Memorandum of Understandings (MOU) with Malaysia, Vietnam, Thailand, and Laos respectively on the digital and green economies. Collaboration is expected in areas like personal data protection, cyber security, digital connectivity, and renewable energy. Singapore views digital and green growth as a priority for ASEAN and hopes to leverage subsequent DEAs and GEAs to develop norms

[14] *Google, Temasek, and Bain & Company, "E-Conomy SEA 2022," 2022, https://economysea.withgoogle.com/home/.*

Exploring the Intersections between Digital and Sustainability

The Infocomm Media Development Authority (IMDA) has made strides in exploring the intersections between Digital and Sustainability. Under the GreenGov.SG movement[15], it has endeavoured to estimate its own carbon profile, which has been published in its 2022 annual report. This process has enabled them to identify the challenges faced by companies in the tracking, monitoring, and reporting of Scope 3 emissions. IMDA is working to support companies to use digital technologies to improve their carbon management.

and standards for these economies. On sustainability, the Green Plan 2030[16] is a ten-year action plan that outlines targets to achieve Singapore's sustainable development agenda and strengthen its commitment to the Paris Agreement. The country recently raised its national climate target to achieve net zero emissions by 2050 and reduce emissions to around 60 $MtCO_2e$ in 2030 as part of their Long-Term Low-Emissions Development Strategy (LEDS) and 2030 Nationally Determined Contribution (NDC).[17]

Thailand

Thailand has made both the digital and green economy its main priorities in recent years. Captured in its 2021 Bio-Circular-Green (BCG) model, its national level framework which was presented at the Asia Pacific Economic Cooperation (APEC) 2022, the digital and green economies have been identified as key levers for pandemic recovery and sustainable economic growth. Since then, it has made significant progress in digital infrastructure and regulation. This includes expanding the quality and coverage of fixed mobile broadband[18] [19] and exploring 5G capabilities, as well as the launch of the National Cyber Security Agency (NCSA) in 2021 and fully adopting the Personal Data Protection Act (PDPA) in 2022.

The Digital Economy and Society Development Plan (DESP) is currently being revised, and the Office of the National Digital Economy and Society Commission (ONDE) is in the process of developing new goals for the next five and ten years. The future phases would mainly focus on geographical-based development, with projects like the Smart City Initiative and the Eastern Economic Corridor (EEC). The revised plan will also consider recent trends and pressing societal issues such as climate change and an ageing society.

This revision is timely as Thailand has accelerated its plans to become carbon neutral by 2050, with an intermediate goal of reducing emissions by 40 per cent within 2030[20], which it announced in mid-2022. Its Long-Term Low GHG Emission Development Strategy in 2022 (LT-LEDS)[21] outlines key mitigation efforts, detailing policies, priorities, and measures which must be taken. This will complement efforts undertaken in

[15] *Ministry of Sustainability and the Environment, "GreenGov.SG Movement Sets New Measures and Targets to Cut Carbon Emissions across Public Sector," July 12, 2021, https://www.mse.gov.sg/resource-room/category/2021-07-12-press-release-on-greengov.*

[16] *The plan includes five key programmes encapsulating focus areas such as green infrastructure, energy usage and transition, sustainable living, green economy, and developing long-term resiliency.*

[17] *National Climate Change Secretariat (NCCS), "Addendum to Singapore's Long-Term Low-Emissions Development Strategy," 2022, https://www.nccs.gov.sg/files/docs/default-source/publications/nccsleds_addendum_2022.pdf.*

[18] *Bangkok Post, "NBTC Sets out Plan to Boost Broadband," Bangkok Post, October 28, 2022, https://www.bangkokpost.com/business/2424405/nbtc-sets-out-plan-to-boost-broadband.*

[19] *Ministry of Digital Economy and Society, "Village Broadband Internet Project (Net Pracharat)," 2022, https://www.unescap.org/sites/default/files/Village%20Broadband%20Internet%20Project%20%28Net%20Pracharat%29%2C%20MDES%20Thailand.pdf.*

[20] *Royal Thai Embassy, Washington D.C. , "» Thailand Will Raise Its 2030 Net-Zero Target," thaiembdc.org, accessed May 10, 2023, https://thaiembdc.org/2022/09/08/thailand-will-raise-its-2030-net-zero-target/.*

[21] *Office of Natural Resources and Environmental Policy and Planning , "Long-Term Low Greenhouse Gas Emission Development Strategy," November 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.*

The National Climate Change Master Plan (CCMP) developed in 2015, which was designed to help Thailand achieve sustainable growth and develop resilience by 2050[22]. The 2021-2027 BCG Action Plan will be key in identifying synergies between existing sustainability approaches with other economic growth frameworks. It remains to be seen how the BCG model will influence the priorities identified in Phase 3 and 4 of the DESP. This is especially given the focus on 'S-curve' industries and Special Economic Zones (SEZs), which are likely to be carbon-intensive endeavours.

Formalising Channels for Public-Private Partnerships (PPP)

Thailand has consistently involved the private sector in its process of digital transformation. This includes collaborations to build capabilities in digital talent and innovation with tech MNCs, as well as local conglomerates. Moving forward, there is an opportunity to move past the existing project-by-project basis of collaboration and establish formal channels of consultation to ensure an alignment of goals in the long run. This will be especially useful in the case of geographical-focused initiatives, where the private sector has raised concerns about the viability of executing some of these large-scale projects within projected timelines.

Vietnam

COVID-19 was an inflection point for the exponential growth of Vietnam's digital economy, and has since become a priority for the country moving forward. While Vietnam is well-positioned to reap the benefits of digital transformation, the government is still defining which aspects of the digital economy to prioritise. The National Digital Transformation Programme by 2025 with a vision towards 2030 aims to accelerate digital transformation through increasing digital literacy, enterprise strategies, and incentives to encourage a whole-of-government approach to digitalisation. This is in line with the goal set by the government to have the digital economy contribute 30 per cent of GDP by 2030[23], with specific targets for each province[24]. The National Committee on Digital Transformation was established in 2021 to coordinate between the relevant ministries involved, and is currently chaired by Prime Minister Pham Minh Chinh.

The increased focus on digital regulation over the last five years reflects the challenge faced by the government in regulating the digital economy. Concerns primarily centre around content regulation (rise of misinformation, internet scams, political speech etc.) and cybersecurity, alongside encouraging fair competition between MNCs and MSMEs, and implementing corporate taxes. This has resulted in a series of decrees which contain data localisation clauses and targets digital service providers – the latest of which seeks to regulate data centre, cloud computing, and over-the-top (OTT) services[25]. Some of these requirements include the need for a representative office located in Vietnam and data to be stored locally[26] to facilitate the enforcement and implementation of these decrees. Another key challenge relates to digital inclusion. There is a need to bridge the gap between urban and rural areas in the areas of digital infrastructure, digital adoption, and human resource development.

[22] *The Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment, "Climate Change Master Plan 2015-2050," July 2015, https://climate.onep.go.th/wp-content/uploads/2019/07/CCMP_english.pdf.*

[23] *Bloomberg, "Vietnam Wants Digital Economy Equal to 20% of GDP in Four Years," Bloomberg.com, August 12, 2021, https://www.bloomberg.com/news/articles/2021-08-12/vietnam-wants-digital-economy-equal-to-20-of-gdp-in-four-years#xj4y7vzkg.*

[24] *Ministry of Information and Communications, "Vietnam Approves National Planning for 2021-2030," Ministry of Information and Communications of the Socialist Republic of Vietnam, October 27, 2022, https://english.mic.gov.vn/Pages/TinTuc/155524/Vietnam-approves-national-planning-for-2021-2030.html.*

[25] *Connect on Tech, "Vietnam: New Draft Telecoms Law Regulating OTT Communication, Data Center, and Cloud Computing Services," Connect On Tech, February 7, 2023, https://www.connectontech.com/vietnam-new-draft-telecoms-law-regulating-ott-communication-data-center-and-cloud-computing-services/.*

[26] *PricewaterhouseCoopers, "Decree 53 Guiding Cybersecurity Law," September 8, 2022, https://www.pwc.com/vn/en/publications/2022/220908-pwc-vietnam-legal-newsbrief-decree-53.pdf.*

> **"Along with the trend of green transformation, digital transformation is an inevitable trend that is evolving very strongly, widely and daily."**
>
> Vietnam Prime Minister Pham Minh Chinh (October 2022 celebrating National Digital Transformation Day)

On sustainability, Vietnam has announced a 43.5 per cent emission-reduction target by 2030 as laid out in its National Strategy on Climate Change, including sector-specific targets for 2030 and 2050[27]. The latest draft of the Power Development Plan 8 (PDP8) also aims to have renewable energy comprise 53 per cent of total capacity by 2045 and phase out new coal power projects entirely by 2030[28]. As Vietnam's coal power plants are relatively new, the drawdown will take time and require significant transition financing.

Enabling Cross-border Data Flows

Facilitating seamless cross-border trade will be imperative to capitalise on the immense potential of Vietnam's booming e-commerce sector. A lack of clarity regarding regulation or application processes would result in uncertainty and increased cost for stakeholders involved. The drafting of a replacement law on E-transactions in 2022 which contains more detailed guidelines reflects greater commitment to promoting digital trade. However, data governance continues to be a sensitive issue, and the increase in data localisation clauses in recent decrees has been a cause of concern for businesses. Thus, there is need to enable trusted cross-border data flows through compliance with regional frameworks and standards.

[27] *McKinsey, "Charting a Path for Vietnam to Achieve Its Net-Zero Goals," October 14, 2022, https://www.mckinsey.com/capabilities/sustainability/our-insights/charting-a-path-for-vietnam-to-achieve-its-net-zero-goals.*

[28] *Global Compliance News, "Vietnam: Key Highlights of New Draft of National Power Development Plan (Draft PDP8)," Global Compliance News, March 13, 2021, https://www.globalcompliancenews.com/2021/03/13/vietnam-key-highlights-of-new-draft-of-national-power-development-plan-draft-pdp8-04032021-2/.*

Table 3: Snapshot of digital & sustainability plans in Singapore, Thailand, Indonesia, Vietnam

	Indonesia	Singapore	Thailand	Vietnam
Key Sustainability Frameworks	National Medium-Term Development Plan (RPJMN) for 2020-2024 on Low Carbon Development[29]	Green Plan 2030[30]	Bio-Circular-Green (BCG) Model[31] National Climate Change Master Plan (CCMP) 2015 – 2050[32] Long-Term Low GHG Emission Development Strategy (LT-LEDS)[33]	Decree 06: Reduction targets for each ministry and relevant areas[34] Decision No: 896/QD-TTg: National Strategy on Climate Change[35] Power Development Plan 8 (PDP8)[36]
National Digital Frameworks	National Strategy for the Digital Economy (2023-2030)[37] Making Indonesia 4.0[38]	Smart Nation - Digital Government, Society, and Economy[39]	Digital Economy and Society Development Plan (DESP)[40]	National Digital Transformation Program[41]

[29] *Republic of Indonesia, "National Medium-Term Development Plan (RPJMN) for 2020-2024 ," 2020, https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/migrasi-data-publikasi/file/RP_RKP/Narasi-RPJMN-2020-2024-versi-Bahasa-Inggris.pdf.*

[30] *SG Green Plan, "Singapore Green Plan 2030," www.greenplan.gov.sg, 2022, https://www.greenplan.gov.sg/.*

[31] *National Science and Technology Development Agency, "Bio-Circular Green-Economy 2021-2027 Action Plan," 2021, https://www.nstda.or.th/en/images/pdf/bcg_action_plan.pdf.*

[32] *The Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment, "Climate Change Master Plan 2015-2050," July 2015, https://climate.onep.go.th/wp-content/uploads/2019/07/CCMP_english.pdf.*

[33] *Thailand, "Mid-Century, Long-Term Low Greenhouse Gas Emission Development Strategy," October 2021, https://unfccc.int/sites/default/files/resource/Thailand_LTS1.pdf.*

[34] *Socialist Republic of Vietnam, "Decree on Mitigation of Green House Gas (GHG) Emissions and Protection of Ozone Layer" (2022), https://thuvienphapluat.vn/van-ban/EN/Tai-nguyen-Moi-truong/Decree-06-2022-ND-CP-mitigation-of-green-house-gas-emissions/503148/tieng-anh.aspx.*

[35] *Socialist Republic of Vietnam, "Decision Approving the National Strategy for Climate Change until 2050" (2022), https://thuvienphapluat.vn/van-ban/EN/Tai-nguyen-Moi-truong/Decision-896-QD-TTg-2022-approving-the-National-strategy-for-climate-change-until-2050/525126/tieng-anh.aspx.*

[36] *Socialist Republic of Vietnam, "Decision Approving the National Power Development Plan in the 2021-2030 Period, with Vision to 2045" (2021), https://vepg.vn/wp-content/uploads/2021/09/5.9.2021-Draft-PDP8_En.pdf.*

[37] *Kementerian Koordinator Bidang Perekonomian, "Kegiatan Koordinasi Percepatan Strategi Nasional Pengembangan Ekonomi Digital 2023-2030," 2023, https://rekrutmentp.ekon.go.id/assets/downloads/2023/G1/20230125-kak-tenaga-pendukung-administrasi-akuntansi.pdf.*

[38] *Ministry of Industry, "Indonesia's Fourth Industrial Revolution," July 2018, https://www.kemenperin.go.id/download/19347.*

[39] *Smart Nation Singapore, "About SNDGG," www.smartnation.gov.sg, 2023, https://www.smartnation.gov.sg/about-smart-nation/sndgg/.*

[40] *International Telecommunications Union, "Thailand Digital Economy and Society Development Plan," April 2016, https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2016/Apr-Digital2016/S2_Present_Pansak_Siriruchatapong.pdf.*

[41] *Bộ Nội vụ (Ministry of Home Affairs), "Thủ Tướng Chính Phủ Phê Duyệt 'Chương Trình Chuyển Đổi Số Quốc Gia Đến Năm 2025, Định Hướng Đến Năm 2030,'" moha.gov.vn, May 6, 2020, https://moha.gov.vn/kstthc/baocao/thu-tuong-chinh-phu-phe-duyet-chuong-trinh-chuyen-doi-so-quoc-gia-den-nam-2025-dinh-huong-den-nam-2030-44452.html.*

3. Data and Data Infrastructure

1. Data centres are the backbone infrastructure for the digital services we use every day.
2. Regulatory standards and policy frameworks are needed to establish greener data centres.
3. Cross border data flows are important in facilitating the expansion of data centres in ASEAN.

Data has been deemed as the lifeblood of digital transformation. Governments and businesses harnessing data in large-scale applications need dedicated computing infrastructure and integrated ecosystems. Functioning as centralised facilities that accommodate computing equipment such as servers, networked computers and storage equipment, data centres have become the foundation of the global Information and Communications Technology (ICT) ecosystem.

Figure 3: Data centres – foundational for the digital economy

The term "data centre" is often broadly applied to rooms or buildings that offer space, power and cooling to house and host servers, compute, storage and other ICT equipment.

Modern data centres have evolved from efforts to house ICT equipment to the need to support thousands of interconnected devices efficiently and effectively.

It powers your:

(i) mobile apps (ii) online videos (iii) work documents (iv) cloud photo storage

The following section studies the prospects for data centre markets in ASEAN, the intersection between data centres and sustainability, and data localisation regulations across jurisdictions.

3.1 Data Centre Outlook in ASEAN

Demand from businesses and governments across ASEAN is propelling the heated race for data centres, driven by the push for digital governments and accessible public services. For example, in Indonesia, the government has commissioned four National Data Centres (PDN) to consolidate government data under the One Data Indonesia framework and accelerate digitalisation across agencies.[42] COVID-19 has also contributed to this by accelerating migration to hybrid work and online learning, enterprise digital transformation, and IT modernisation. Computation-intensive technologies, such as artificial intelligence, cloud computing, big data analytics and IoT products (e.g. autonomous vehicles), have also contributed to the growth of the data centre industry.

[42] *Yen Ocampo, "Indonesia's National Data Centres to Improve Public Service," OpenGov Asia, November 18, 2022, https://opengovasia.com/indonesias-national-data-centres-to-improve-public-service/.*

The need for cost-effective and scalable solutions is incentivising businesses to transition from on-premise to colocation data centres[43] which allow customers to directly connect enterprise-to-enterprise in a professionally managed environment. Direct interconnection improves speed, performance, security and reduces cost and delays in transfer of data. Southeast Asia is slated to be the fastest-growing colocation region internationally, ballooning by a Compound Annual Growth Rate (CAGR) of 16.5 per cent to hit US$6.5 billion in 2026.[44] Singapore is Asia-Pacific's most mature and competitive colocation market, accounting for 60 per cent of the region's data centre capacity,[45] while Indonesia, Malaysia, Thailand, and to a smaller extent, Vietnam and the Philippines are emerging as promising colocation hotspots. Indonesia is projected to enjoy the highest five-year CAGR in market size of 21.8 per cent in the region.[46] Another notable trend is the rise of edge data centres in non-metropolitan areas or suburban areas with lower population densities to maintain low latency and cost competitiveness. Edge facilities could take the form of containerised or modular data centres, which have higher mobility and support more flexible redeployment.

Singapore is predicted to experience decelerating growth due to colocation market saturation, land scarcity and stricter sustainability standards in the long term. The moratorium on building data centres imposed by the Singapore government in 2019[47] catalysed the shift of data centre investment towards emerging markets, notably Indonesia and Malaysia. Governments across ASEAN are proactively courting investments through policy instruments such as SEZs, tax incentives and expedited land procurement. For instance, Indonesia's Nongsa Digital Park in Batam has attracted colocation providers, namely China-based GDS Services and Singapore-based Data Center First, and some of Vietnam's 110 SEZs have specific mandates for data centres.[48]

3.2 Greener Data Centres

The data-intensive computations performed by data centres consume a considerable amount of electricity to power not only computer servers, but also essential systems like Uninterruptible Power Supply (UPS), cooling, and ventilation infrastructure. According to conservative estimates, data centres account for nearly 1 per cent of global electricity consumption.[49] [50] Thus, the expansion of data centres in ASEAN will give rise to a significant challenge as the region seeks to meet its net-zero targets. Greening data centres is thus necessary and can be considered with these two frames in mind: (i) reducing the base demand for energy required through increasing operational efficiencies, and (ii) increasing the supply of renewable energy.

Reducing Base Demand

In order to fulfil their net-zero commitments, there will be a need for ASEAN governments to implement stricter sustainability rules to decarbonise the data centre sector. Following the lifting of Singapore's moratorium on building data centres, the IMDA and Economic Development Board (EDB) launched a

[43] *Colocation data centres refer to facilities that rent out rack space and servers to third-party companies. Rack Solutions, "What Is a Colocation Data Center?," RackSolutions, January 16, 2018, https://www.racksolutions.com/news/data-center-trends/what-is-a-colocation-data-center/.*

[44] *Bhaskar Rakshit et al., "How Data Center Operators Can Win in Southeast Asia," Kearney, November 11, 2022, https://www.southeast-asia.kearney.com/article/-/insights/how-data-center-operators-can-win-in-southeast-asia.*

[45] *Kent Chow, "Commentary: Where Do Data Centres Fit into Singapore's Vision of Green Growth?," Channel NewsAsia, March 23, 2022, https://www.channelnewsasia.com/commentary/data-centres-energy-digital-economy-jobs-sustainability-2550996.*

[46] *Christine Li and Xian Yan Wong, "Data Centres In Southeast Asia Poised For Rapid Growth" (Cushman and Wakefield, August 2019), https://www.cushmanwakefield.com/en/singapore/insights/data-centres-in-southeast-asia-poised-for-rapid-growth.*

[47] *Jun Yuan Yong, "New Data Centres in Singapore to Meet Higher Standards When Moratorium Lifts in Q2 2022," The Business Times, January 27, 2022, https://www.businesstimes.com.sg/companies-markets/new-data-centres-singapore-meet-higher-standards-when-moratorium-lifts-q2-2022.*

[48] *Arizton Advisory & Intelligence, "Southeast Asia Data Center Market - Investment Analysis & Growth Opportunities 2022-2027," September 2022, https://www.arizton.com/market-reports/southeast-asia-data-center-market.*

[49] *George Kamiya, "Data Centres and Data Transmission Networks" (Paris: International Energy Agency, September 2022), https://www.iea.org/reports/data-centres-and-data-transmission-networks.*

[50] *Francesca Montevecchi et. al., "Energy-efficient Cloud Computing Technologies and Policies for an Eco-friendly Cloud Market" (Vienna: Environment Agency Austria, 2020), https://op.europa.eu/s/yBbk.*

Call for Application exercise (DC-CFA) to pilot greener data centres. Eligible designs should have a Power Usage Effectiveness (PUE) of less than 1.30,[51] and obtain platinum certification under the Building and Construction Authority (BCA)-IMDA Green Mark for New Data Centre (GM-NDC).

Apart from government-mandated standards, the data center industry has embarked on a slew of other initiatives to mitigate their environmental impact. Data centre providers are looking at deploying technology that reduces the energy consumption of servers on site (e.g., multi-core processor-based applications, virtual machines), and improving efficiencies through energy-efficient cooling and technology-guided management solutions. The tech industry is also embracing the movement towards green computing and green coding to reduce their overall carbon footprint. The notable mitigation measures include the following examples:

Energy

- Microsoft and Google have pledged to fulfil the 24/7 Carbon-free Energy Compact in data centres by pivoting from offsets to hourly procurement from renewables by 2030. Microsoft is piloting 24/7 for data centres in Sweden and the Netherlands with local energy providers – Vattenfall and Eneco respectively.[52]
- Equinix is deploying fuel cell technology to help achieve cleaner energy, resiliency and energy security. By the end of 2022 it had installed 43.5 megawatts of capacity in the USA and is part of a consortium, co-funded by the Clean Hydrogen Partnership, to develop a next-generation fuel cell platform with tri-fuel compatibility including hydrogen, natural gas and Liquefied Petroleum Gas (LPG) as part of the EcoEdge PrimePower (E2P2) project.[53]

Cooling

- Promising energy-efficient cooling solutions include hot-and-cold-aisle containment, direct-to-chip liquid cooling and close-coupled cooling. Equinix deploys hot and cold aisle containment and novel surface cooling in the Equinix Cooling Array to support high-density clients while reducing water and power consumption needs in its Tanjong Kling data centre in Singapore (SG5).[54]
- Google utilises close-coupled cooling by converting server rooms into cold corridors and installing cooling pipes in close proximity to computer servers. The arrangement shortens the airflow distance from the heat source to liquid cooling.

[51] *The PUE is a ratio of the total amount of power consumed by a data centre facility to the power used to operate its IT equipment. A lower PUE translates into higher efficiency. Generally, highly efficient data centres should benchmark at PUEs of less than 1.20, while industry-leading providers (e.g. Google) have PUEs of close to 1.10.*

[52] *Joppa, Lucas, and Noelle Walsh. "Made to Measure: Sustainability Commitment Progress and Updates." Microsoft, July 14, 2021. https://blogs.microsoft.com/blog/2021/07/14/made-to-measure-sustainability-commitment-progress-and-updates/.*

[53] *Equinix, "Design, Innovate and Build for the Environment," 2022, https://sustainability.equinix.com/environment/design-and-innovate-for-the-environment/#design_innovation.*

[54] *"Building the Green Data Centre of the Future," Channel NewsAsia (Equinix, April 12, 2022), https://www.channelnewsasia.com/advertorial/building-green-data-centre-future-2583306.*

Technology

- Google and DeepMind have developed an AI-powered data centre management software to optimise cooling efficiency, reducing electricity consumed in a Google data centre by 40%.[55] The algorithm harnesses Machine Learning to generate predictive models to calculate PUEs, detect overheating and deliver cooling recommendations.
- Huawei incorporates AI and ML in its prefabricated FusionDC technology for a suite of power, cooling and computation resource management tools. Its iManager applies AI and IoT to optimise space, power and cooling, and automate asset allocation.

Increasing Supply of Renewable Energy

Access to renewable energy remains a key challenge for companies that have committed to internal net-zero targets. To minimise and offset emissions, many operators are investing in building renewable energy capacity, negotiating renewable Power Purchase Agreements (PPAs), obtaining Renewable Energy Certificates (RECs), and purchasing carbon credits. However, these solutions have their constraints – the high cost of RECs[56], the inflexibility of physical PPAs which are common in ASEAN[57], and the lack of an established market for high-quality, tradable carbon credits within ASEAN has resulted in increased cost for companies to be more sustainable. Eventually, enabling cross-border low-carbon energy flows are needed to decarbonise the industry. In the intermediate, greater clarity and consistency of policy regulation, particularly with regards to green certification and carbon taxes, would help incentivize data centre providers to adopt greener practices.

3.3 Cross-border Data Flows

Given the importance of data in the digital economy, cross-border data flows (CBDF) will be integral in facilitating regional growth and innovation. Besides improving national economies and living standards in developing countries[58], CBDF are also integral in supporting sustainability goals. Digital technologies can aid in information-sharing, which supports the acceleration of innovation and R&D in climate mitigation and adaptation solutions. CBDF will also be integral to the sustainable growth of data centres in ASEAN. Regulatory frameworks which enable CBDF will allow for the efficient allocation of resources, reducing the need for companies to store data locally in their countries of operation. This would, in turn, reduce the overall number of data storage facilities and thus, the energy required to power them.

While CBDF are important, some AMS have shown resistance to the free flow of data due to varying concerns such as personal data protection and privacy, national security, control over data and perceptions that CBDF will undermine domestic economic growth (Table 4). This has manifested in data localisation clauses in local regulations. These concerns can be partially attributed to the intangible nature of data, which presents an obstacle in quantifying the value of data flows.

[55] *Richard Evans and Jim Gao, "DeepMind AI Reduces Google Data Centre Cooling Bill by 40%," DeepMind Technologies, July 20, 2016, https://www.deepmind.com/blog/deepmind-ai-reduces-google-data-centre-cooling-bill-by-40.*

[56] *S&P Global Commodity Insights, "Record High Certificates Prices Bring Renewable Energy Buying in Focus," www.spglobal.com, December 1, 2022, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/120122-record-high-certificates-prices-bring-renewable-energy-buying-in-focus.*

[57] *International Energy Agency, "Southeast Asia Energy Outlook 2022" (IEA Publications International Energy Agency, May 2022), https://iea.blob.core.windows.net/assets/e5d9b7ff-559b-4dc3-8faa-42381f80ce2e/SoutheastAsiaEnergyOutlook2022.pdf.*

[58] *Joshua P. Meltzer and Peter Lovelock, "Regulating for a digital economy understanding the importance of cross-border data flows in Asia," March 2018, https://www.brookings.edu/wp-content/uploads/2018/03/digital-economy_meltzer_lovelock_working-paper.pdf.*

While countries believe localising data will support domestic economic growth, the long-term comparative benefits of liberalised data flows by allowing for increased foreign investments outweigh those of protectionist regulation. Such localisation laws ultimately undermine efficiency, impede digital trade, and confer substantial costs to all stakeholders involved.

Table 4: Main concerns over cross-border data flows in ASEAN

	1. **Personal data protection and privacy** – protecting consumers from cybersecurity attacks, rise of fake news and misinformation and scams
	2. **National security** – wary of external interference in domestic affairs
	3. **Loss of control over data** – countries resort to overregulating data flows to ensure that they are safeguarded against the risks of CBDF
	4. **Undermine growth in domestic economy** – inability to quantify the value of data flows, lack of fair competition between MNCs and MSMEs

Source: Authors' research from trips

Such concerns should not be diminished, and stakeholders will need to develop new ways to manage them. Subsequent solutions should prioritise fostering a certain degree of trust and protection to ensure CBDF is secure while remaining open. Certain AMS have already implemented laws which help facilitate this. For example, Singapore[59] and Thailand's[60] respective Personal Data Protection Acts (PDPA) stipulate that data may only be transferred overseas if the recipient country is able to ensure at least an equal degree of protection as the domestic regulation.

Moving forward, ASEAN-mechanisms that facilitate trusted data flows will also need to be refreshed. There is currently no obligation to comply with ASEAN's current Data Management Framework (DMF) and Model Contractual Clauses (MCCs), which aim to support SMEs in navigating complex regulations on data privacy and protection. This has made it difficult to track overall utilisation, which appears to be low at best.

AMS can also consider joining the Global Cross-Border Privacy Rules (CBPR), which facilitates data protection while supporting open data flows. The Global CPBR is open to all and can complement efforts by ASEAN to streamline data regulation. This would benefit AMS by allowing for easier international development and data transfer, as well as offering businesses a competitive advantage[61]. As ASEAN establishes the Digital Economic Framework Agreement (DEFA), some of these standards and principles on data flows could be enshrined either in part or full for better business clarity.

[59] *PDPC, "Singapore Now Recognises APEC CBPR and PRP Certifications Under PDPA," Personal Data Protection Commission Singapore, June 2, 2020, https://www.pdpc.gov.sg/news-and-events/announcements/2020/06/singapore-now-recognises-apec-cbpr-and-prp-certifications-under-pdpa.*

[60] *Dhiraphol Suwanprateep and Thananya Chaikamonsuk, "Thailand: Operationalising PDPA - Data Transfers and Localisation - Part Two," OneTrust DataGuidance, September 2022, https://www.dataguidance.com/opinion/thailand-operationalising-pdpa-data-transfers-and.*

[61] *Mathieu Legendre, "What Are the Benefits of an APEC CBPR/PRP Certification?," Schellman Compliance, September 6, 2022, https://www.schellman.com/blog/benefits-of-an-apec-cbpr/prp-certification.*

4. Powering Data & the Digital Economy: Seeking Clean Energy Solutions

1. **Liberalisation of cross-border energy flows is needed for countries to meet climate targets.**
2. **An ASEAN Power Grid can help to accelerate regional decarbonisation.**
3. **Green and transition finance will be needed for an integrated and low carbon grid.**

Most of the world still relies on significant amounts of fossil fuels to generate electricity, releasing tremendous greenhouse gas (GHG) emissions. To ensure that the growth of the digital economy does not exacerbate climate change, there is a need to decarbonise the electrical grid and transition to a low-carbon energy base. The reluctance to do so in part is due to the reliability of certain power generation sources and capabilities needed for existing energy grids to handle the spikes and troughs that come with low-carbon sources. Countries can choose to do this with a combination of batteries or smart grid technologies, and in more extreme cases, curtailment.

In 2015, ASEAN committed to increase the share of solar, wind and hydropower in the energy mix from 9 per cent in 2014 to 23 per cent in 2025, this was a highly progressive pledge at the time. To reach this target, it was estimated that ASEAN would need to attract US$27 billion in renewable energy generation and infrastructure investment every year from 2016 to 2025. Cumulatively a total of approximately US$290 billion will be needed over the 10 years. In recent years, momentum has built in the right direction with 82 per cent of new power capacity, estimated at 22GW, being generated from renewable sources.[62]

4.1 Cross-border Energy Flows

Southeast Asia has the potential to generate gigawatts of renewable energy from different sources. As these renewable resources are not evenly distributed geographically across AMS, there is potential for some members to consider selling their surplus energy. Cross-border energy flows could be in the form of electricity or even involve other forms of surplus energy such as green hydrogen or ammonia.

Creating an integrated grid to trade and move renewable energy to other countries has a number of benefits. First, having a larger and interconnected grid would allow countries bringing on large renewable energy projects to manage the fluctuations in power across their grid. Second, selling renewable energy to neighbouring countries helps ASEAN in its decarbonisation journey, and leads to a greening of the supply chain for production in ASEAN. Third, it would support the commercialisation of renewable energy projects that would otherwise not be feasible in export countries as the economics of their installed domestic base would not support such a large facility nor would they be willing to pay the price premium. Lastly, it can also be a stable source of national revenue. To realize these benefits, policy frameworks would need to be harmonised to support cross-border energy flows and energy exports within ASEAN.

[62] *Shi Ning Teh, "Asean Power Grid — Option for S'pore to Source Green Energy," The Straits Times, September 19, 2021, https://www.straitstimes.com/singapore/environment/asean-power-grid-option-for-spore-to-source-green-energy.*

AMS have had years of experience in the cross border trade of electricity. Laos has built up its power generating capacity through the construction and operation of several hydroelectric dams. It exports up to 78 per cent of its generation capacity.[63] Sarawak, in East Malaysia, generates 3500MW of hydropower and has the potential for more capacity - it currently exports 200MW of electricity to West Kalimantan in Indonesia. Myanmar exports electricity to China through two hydropower projects that support the China-Myanmar Economic Corridor. Recently, Singapore has signed agreements bilaterally with Cambodia and Indonesia to collaborate on cross-border electricity trade and the development of renewable energy projects.[64] These bilateral arrangements for the trade and financing of renewable energy could have the potential to form the template for future initiatives that could be multilateral in nature and are much needed in a multi-stakeholder grouping like ASEAN. Moving forward, the ability to link different national grids to each other would create a system that is more reliable, better balanced, and increasingly green. While a fully integrated ASEAN power grid is still a long time away, there have been several advancements towards achieving that outcome.

4.2 Climate Technology

Hydrogen is increasingly being explored as a new energy source for the region due to the relative ease of adjusting supply chains and retro-fitting existing infrastructure to run on it. According to the ASEAN Centre for Energy (ACE), coal and natural gas are the two largest sources of fuel for power generation in the region.[65] Singapore is currently the only AMS to have a formal national strategy to implement hydrogen technology. However, in Malaysia and Philippines, the development has been led by private companies such as PLN and Petronas.[66] [67] In Indonesia, Pertamina has signed an MOU with Tokyo Electric Power Company Holdings (TEPCO HD) on the development of green hydrogen and green ammonia development.[68] The development of a hydrogen ecosystem among AMS could accelerate the decarbonisation of the electrical grid.

In the IEA's Clean Technology Scenario, CCUS represents almost 20 per cent of emissions reductions needed across the industry sector.[69] There are large hopes riding on the success of CCUS technologies at scale. For example, Petronas, in Malaysia, is embarking on one of the largest offshore carbon capture and sequestration (CCS) site in Sarawak, with the capacity to reduce CO_2 emissions from flaring by 3.3 $MtCO_2e$.[70] R&D in CCUS projects will be needed and could range from sequestering carbon in newer forms of concrete and cement, to injecting CO_2 into depleted oil fields. A lot of funding is being directed into different forms of CCUS technology that will potentially lead to different decarbonisation pathways for different countries as they seek to turn their hard-to-abate industries carbon neutral.

[63] *Tok Hong Ling, Jennifer Tay, and Saumya Rao, "Regional Electricity Trade in ASEAN" (PWC, October 2022), https://www.pwc.com/sg/en/publications/assets/page/regional-electricity-trade-in-asean.pdf.*

[64] *Cheryl Tan, "Singapore could soon import renewable energy like solar, hydrogen from Indonesia," The Straits Times, March 17, 2023, https://www.straitstimes.com/singapore/singapore-and-indonesia-to-boost-renewable-energy-cooperation; https://www.mti.gov.sg/Newsroom/Press-Releases/2022/10/Singapore-and-Cambodia-sign-Memorandum-of-Understanding-on-Energy-Cooperation.*

[65] *Adhityo Gilang Bhaskoro, Azaria Haykal Ahmad, Suwanto, Beni Suryadi, Nuki Agya Utama, "How Southeast Asia Should Embrace Hydrogen: Energy Security and Climate Change Perspectives". Asean Centre for Energy. April 10, 2023, https://aseanenergy.org/sea-hydrogen/.*

[66] *"MHI and PLN Nusantara Power to Jointly Investigate Co-Firing with Hydrogen, Ammonia and Biomass in Indonesia's Power Plants". March 23, 2023, https://www.mhi.com/news/23032302.html.*

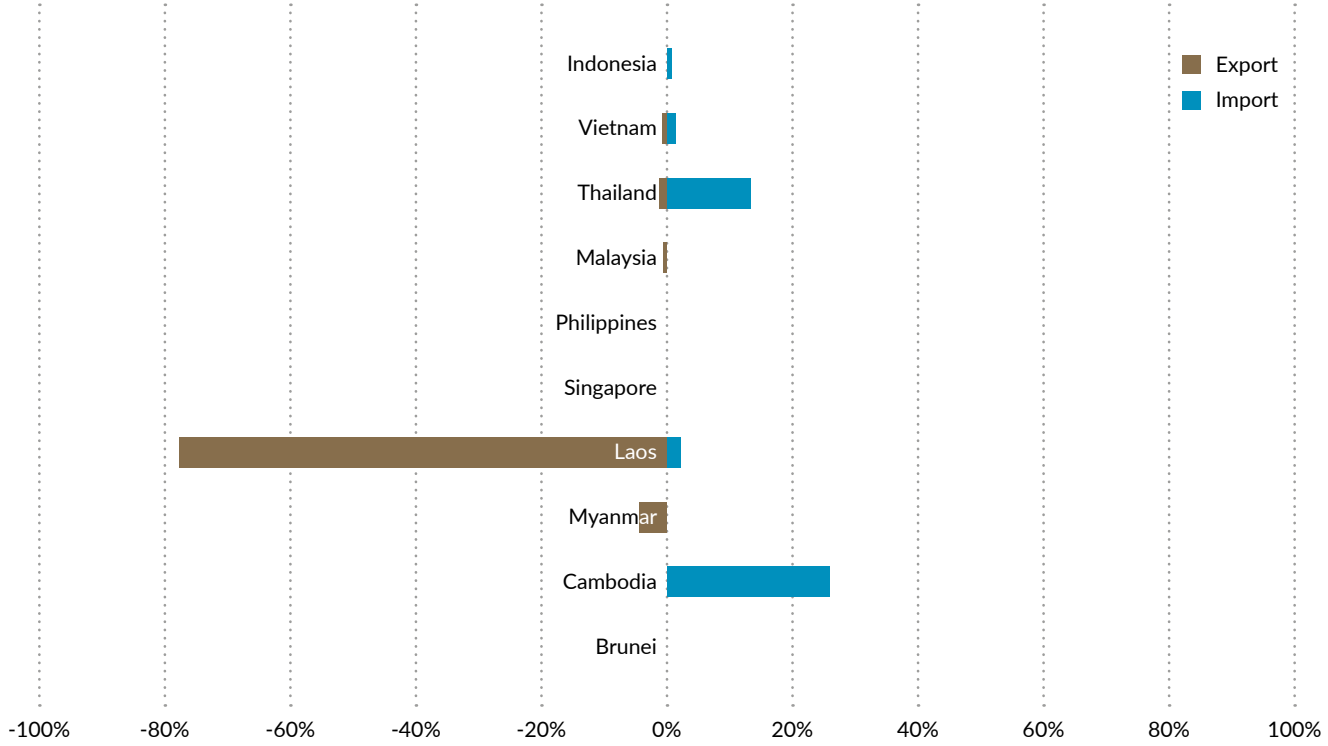
[67] *"PETRONAS Partners ENEOS For First Commercial Scale Hydrogen-To-MCH Project". March 11, 2023, https://www.petronas.com/media/media-releases/petronas-partners-eneos-first-commercial-scale-hydrogen-mch-project-0.*

[68] *Fadjar Djoko Santoso, "Pertamina NRE-TEPCO HD Consolidate Green Hydrogen and Green Ammonia Development," Pertamina, March 3, 2023, https://www.pertamina.com/en/news-room/news-release/pertamina-nre-tepco-hd-consolidate-green-hydrogen-and-green-ammonia-development.*

[69] *IEA, "Transforming Industry through CCUS" (Paris: IEA, May 2019), https://www.iea.org/reports/transforming-industry-through-ccus.*

[70] *Baker Hughes, "Baker Hughes to Supply Key Technology for One of the World's Largest Offshore Carbon Capture & Sequestration Facilities," Baker Hughes, January 3, 2023, https://investors.bakerhughes.com/news-releases/news-release-details/baker-hughes-supply-key-technology-one-worlds-largest-offshore.*

Figure 4: Percentage of exports, imports vs. generated energy in ASEAN countries (Averaged 2018-2020)



Source: PwC analysis based on IEA, Government information, US EIA, Enerdata
Note: Figures for Singapore's electricity imports are as of July 2022.

4.3 ASEAN Power Grid

The ASEAN Power Grid (APG) was one of six programme areas that was initially identified in the first ASEAN Plan of Action for Energy Cooperation (APAEC) series, 1999-2004. As we enter the fourth APAEC, there are several trials between countries to test the interconnections between grids (e.g. Laos-Thailand-Malaysia and Sumatra-Malaysia). These trials have been relatively successful with the Laos-Thailand-Malaysia trial having been renewed and expanded, with the inclusion of Singapore. While progress over the last two decades has been relatively slower compared to other regional grids globally, momentum has been building to drive interconnectivity among AMS.

ASEAN's move towards net-zero would benefit greatly from a fully integrated grid, allowing renewable energy rich AMS to export energy to the rest of the region. This integration would allow for firms to make better business decisions on the location of their business units to leverage the different skills, demographics and languages that exist in AMS. The exporting of renewable energy would also assist in the transition of electricity away from carbon intensive sources, potentially without the need to retire older carbon intensive assets earlier. This can be accomplished by building capacity in renewable energy generation while in parallel, drawing down aging infrastructure in an accelerated schedule supported by the revenue by green energy sales.

As more types and sources of renewable energy become accessible, there will be a need to manage the ebb and flow of electricity through a particular grid. Smart grids[71] will increasingly become the standard to balance the loads for national grids, as identified by the ACE to be essential to establish reliable and cost-effective power supply.[72] They are instrumental in integrating renewables into the grid to maintain

[71] *An electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of the end users.*

[72] *ASEAN-German Energy Programme (AGEP) Team, "Study on Smart Grid Overview in ASEAN" (ASEAN Center for Energy, November 2018), https://aseanenergy.org/study-on-smart-grid-overview-in-asean/.*

the performance and resilience of transmission and distribution systems. Thus, there should be increased investment in the digitalisation of all grid components, including power transformers, substation automation, flexible alternating-current transmission systems, and advanced sensors. Adoption of such technologies will allow AMS to transition out of carbon intensive production cycles and allow them to begin decarbonising their economies.

4.4 Transition and Green Finance

To make the transition to low carbon energy technologies as well as to build the necessary infrastructure, a significant amount of financing would be required. McKinsey estimates that private financial institutions could facilitate as much as US$3.5 trillion of annual financing globally between 2022 and 2050, with commercial banks providing between US$2.0 and US$2.6 trillion, approximately 66 to 74 per cent of total private sector financing.[73] Banks and non-banking financial institutions have a role to play in providing this capital. However, banks have been slow to support newer technology platforms, instead prioritising transitional efforts by firms to reduce their carbon footprint using proven technologies.

This must be complemented by government efforts to build new infrastructure while borrowing from the market using green and transition financial products. This would allow the market to begin to build and test appropriate products, while incurring lower risk, as national institutions are less likely to default. State run companies in the region have begun using transition finance to build biofuel supply chains as well as carbon capture utilisation and storage facilities.

One of the challenges hindering the development of green and transition finance is the availability of good quality data. This is especially since the type of data most commonly available revolve around economic activity measurement, and conversions to emissions data have not yet been established. This will likely change with time, as consistent standards for sustainability reporting are developed by institutions like the International Sustainability Standards Board (ISSB), and companies start to report along more standardised formats. As large corporates start to align their reporting along ISSB standards there will be a ripple effect as SMEs in their supply chains are also required to report similar information. As more elements of sustainability data gets recorded and reported, financial institutions would be more willing to extend financing, as the risk of greenwashing and meeting their own net-zero targets is minimized.

[73] *Mark Azoulay et al., "Financing the Net-Zero Transition: From Planning to Practice," McKinsey & Company, January 23, 2023, https://www.mckinsey.com/capabilities/risk-and-resilience/our-insights/financing-the-net-zero-transition-from-planning-to-practice.*

5. Sustainable Digital Trade

1. **Supply chains are a natural area of confluence for digitalisation and sustainability.**
2. **Tackling Scope 3 emissions are top of mind for businesses serious about net zero.**
3. **Digitisation and using monitoring technologies can help decarbonise value chains.**

With the advent of the fourth industrial revolution (4IR) or industry 4.0, digitalisation has transformed the movement of goods and services across borders.[74] Many have embraced the emergence of digital economy products and services such as e-commerce, paperless trade and the automation of logistics. As trade becomes increasingly digitalised, the right governing frameworks are needed to ensure environmental sustainability costs are mitigated, and benefits realised.

Trade is a natural area of confluence for digitalisation and sustainability. For example, the use of digital tools like Artificial Intelligence (AI) and Machine Learning to optimize shipping routes in real time not only increases operational efficiencies, but results in less emissions being produced per shipment.

Examining supply chains through the lens of both digitalisation and sustainability will be at the core of future business strategies. This requires enabling 'Digital Trade Facilitation' (DTF) – "the application of modern information and communication technologies to simplify and automate international trade procedures"[75], to create a policy ecosystem for digital trade. Developing more efficient and resilient supply chains can support efforts towards climate goals, as digitalisation can aid supply chain traceability. This can address what many businesses view as their key challenge – the ability to gain insight into their entire value chain.

5.1 Digitalising Supply Chains

The fragility of the global value chains (GVCs) were exposed during the COVID-19 pandemic, as cross border movement of goods were disrupted due to lockdown measures. Although there has been some measure of recovery and the restarting of GVCs, multiple barriers to the global trading system will cause friction and fragmentation, which in turn would negatively affect global growth. The International Monetary Fund (IMF) predicts that the long-term cost of trade fragmentation could be as high as 7 per cent of global GDP.[76]

The digitisation of supply chains can help to optimise supply chain processes, thereby improving efficiencies and reducing cost. While much has been said about the need for paperless trade, trade transactions globally remain highly dependent on paper documents. The International Chamber of Commerce (ICC) notes that less than 1 per cent of trade documents are digitized and that one cross-border transaction requires the exchange of 36 documents and 240 copies on average.[77]

[74] *Susan Lund and James Manyika, "How Digital Trade Is Transforming Globalisation" (Geneva: International Centre for Trade and Sustainable Development (ICTSD) and World Economic Forum, January 2016), https://www.tralac.org/images/docs/8854/how-digital-trade-is-transforming-globalisation-e15-initiative-january-2016.pdf.*

[75] *Yann Duval and Mengjing Kong, "Digital Trade Facilitation: Paperless Trade in Regional Trade Agreements," ADBI Working Paper Series (Tokyo: Asian Development Bank Institute, June 2017), https://www.adb.org/publications/digital-trade-facilitation-paperless-trade-regional-trade-agreements.*

[76] *Hannah Ward-Glenton, "IMF Says Fragmentation Could Cost Global Economy up to 7% of GDP," CNBC, January 16, 2023, https://www.cnbc.com/2023/01/16/imf-says-fragmentation-could-cost-global-economy-up-to-7percent-of-gdp.html#:~:text=Fragmentation%20could%20cost%20the%20global.*

[77] *ICC, "Standards Toolkit for Cross-Border Paperless Trade" (International Chamber of Commerce, June 21, 2022), https://iccwbo.org/news-publications/policies-reports/standards-toolkit-for-cross-border-paperless-trade.*

Figure 5: The case for paperless trade[78]

10% improvement in paperless trade implementation = **6%** reduction in trade time on average in Asia-Pacific

SMEs' exports could increase by **13%** if trade documents were digitized

Full digitization of trade documents could save **13 million** tons of paper = planting **one billion** trees

There are positive signals that more countries are digitalising their supply chains. The fourth UN Global Survey on Digital and Sustainable Trade Facilitation[79] revealed that over 140 countries had made progress in adopting DTF measures. This includes implementing electronic payment systems, paperless trade and electronic customs.

DTF can smoothen barriers to trade by countering supply chain disruptions[80] and overcoming the inefficiencies and inequalities that trade presents to business. With ports and logistics facilities affected by pandemic movement restrictions, AI-guided cranes, sensors and robots were identified by the APEC Policy Support Unit as digital solutions to mitigate such disruptions. Digitalising customs documents and using data combined with blockchain-enabled platforms were also necessary to circumvent the obstacles of moving goods across borders. Even as the world emerges from the pandemic, these tools and practices are important to develop more resilient GVCs. They also contribute to the formation of a 'single window' which speeds up trade processes and reduces the cost for business.

For ASEAN, progress in digitalising trade has been evident with the ASEAN E-commerce Statement and the development of the ASEAN Single Window (ASW). The ASEAN E-commerce Statement[81] aims to facilitate cross-border e-commerce in the region through (i) Paperless trading, (ii) Electronic authentication and electronic signatures, (iii) Online consumer protection, (iv) Cross-border transfer of information by electronic means, (v) Online personal information protection, and (vi) Location of computing facilities, while the ASW allows for the electronic exchange of trade-related documents. All ten AMS joined ASW live operations at the end of 2019 with an increasing range of forms being digitalised. At the latest ASW symposium, studies revealed that more than 1 million electronic Certificates of Origin (e-Form D) were exchanged in 2022, resulting in cost savings of $150 million.[82]

These practices can be promoted further by governmental agreements. Individual AMS have embarked on bilateral trade agreements like DEAs and GEAs to facilitate digital and green trade. Singapore first piloted the Digital Economy Partnership Agreement (DEPA) with New Zealand and Chile in 2020 and has since embarked on DEAs with Australia, the UK, and Korea respectively. It has also signed various

[78] *Kati Suominen, "Trust in Trade: Challenges to the Global Convergence on Digital Standards," Hinrich Foundation, March 28, 2023, https://www.hinrichfoundation.com/research/wp/digital/global-race-to-converge-on-digital-standards/.*

[79] *UNESCAP, "Digital and Sustainable Trade Facilitation: Global Report 2021" (Bangkok: United Nations Economic and Social Commission for Asia and the Pacific, February 2, 2022), https://www.unescap.org/kp/2022/untf-survey-2021-global.*

[80] *Andre Wirjo and Sylwyn Calizo Jr, "Trade Networks amid Disruption: Promoting Resilience through Digital Trade Facilitation," Policy Brief (Asia-Pacific Economic Cooperation, December 2022), https://www.apec.org/publications/2022/12/trade-networks-amid-disruption-promoting-resilience-through-digital-trade-facilitation.*

[81] *ASEAN, "ASEAN Agreement on Electronic Commerce Officially Enters into Force," Association of Southeast Asian Nations, December 3, 2021, https://asean.org/asean-agreement-on-electronic-commerce-officially-enters-into-force/; "ASEAN Agreement on Electronic Commerce," signed on January 22, 2019, https://agreement.asean.org/media/download/20190306035048.pdf.*

[82] *ASEAN, "ASEAN Single Window," Association of Southeast Asian Nations, accessed April 25, 2023, https://asean.org/our-communities/economic-community/asean-single-window/.*

MOUs with AMS like Thailand, Malaysia, and Vietnam. While the terms and level of commitment vary for each country, these agreements signal a commitment towards establishing standards and norms for the digital and green economies. Aside from promoting interoperability, DEAs and GEAs also help facilitate trust between the parties involved through cross-border collaboration on mutual areas of interest. For example, the Singapore-Australia GEA encourages the exchange of information in its key modules, which includes the development of skills and capabilities needed for green growth, and spurring R&D and commercialisation of green technologies[83].

5.2 Tackling Scope 3 Emissions

Major companies follow the GHG protocol[84] corporate standard that classifies emissions into three 'scopes'.[85] Scope 3 emissions often comprise majority of a business' carbon footprint[86], but are the most difficult to measure given the difficulties in collecting data throughout the value chain. Although Scope 3 does not directly fall under an organisation's control, it is important that firms recognise that they can influence their suppliers and nudge them towards reporting their Scope 1 and 2 emissions. This can be achieved through providing monetary incentives, as well as training and capacity building to help suppliers develop skills and adopt relevant digital tools.

Supply chain companies have embarked on a lengthy process to redesign their businesses to reduce costs and emissions on each item in the value chain. Some of these methods include simply optimizing packaging, design, and materials used, while others involve using more advanced tools like computer programs to process batch shipping and optimise delivery batches. This results in cost savings due to reduced packaging and fuel required in transportation.[87] Major companies have also invested in route optimisation software to increase the timeliness of deliveries whilst lowering the emissions of shipping products.

However, the movement towards tracking, measuring and mitigating Scope 3 emissions is still at the beginning stages. Most firms have not planned for Scope 3 emissions as part of their overall emissions, mainly since the reporting of Scope 3 emissions is not mandatory in most major markets save the EU[88], and there continues to be a lack of harmonized reporting standards for this category. Another challenge relates to the availability and quality of data surrounding Scope 3 emissions. Firms that have endeavoured to voluntary report their Scope 3 emissions cite that the main challenge pertains to collecting reliable data from their suppliers, given that most of them comprise of SMEs that are either ill-equipped or have no impetus to report their emissions. Firms then default to using proxies such as industry averages, spend-based data, or other estimates, which are less accurate and can have large margins of error.

Since the formation of the International Sustainability Standards Board (ISSB) at COP26, it is expected that there will soon be a single unifying sustainability reporting standard. This baseline standard will likely include reporting of all three GHG scopes for companies and harmonize standards and frameworks proposed by previous disclosure initiatives.[89] The emphasis Scope 3 reporting was also reflected at the

[83] *Green Economy Agreement, "Singapore Australia Green Economy Agreement," www.gea.gov.sg, April 13, 2023, https://www.gea.gov.sg/sagea/.*

[84] *Greenhouse Gas Protocol, Corporate Value Chain (Scope 3) Accounting and Reporting Standard (Washington, DC: World Resources Institute and World Business Council for Sustainable Development, 2011), https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf.*

[85] *Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions. https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf.*

[86] *"What Is the Difference between Scope 1, 2 and 3 Emissions, and What Are Companies Doing to Cut All Three?," World Economic Forum, September 20, 2022, https://www.weforum.org/agenda/2022/09/scope-emissions-climate-greenhouse-business.*

[87] *DHL, "The Importance of Eco-Friendly Packaging," DHL, October 13, 2022, https://www.dhl.com/discover/en-sg/logistics-advice/sustainability-and-green-logistics/importance-of-eco-friendly-packaging.*

[88] *CDP Worldwide, "Q&A: Corporate Sustainability Reporting Directive (CSRD) ," March 2021, https://cdn.cdp.net/cdp-production/cms/policy_briefings/documents/000/005/787/original/02_CSRD_Corporate_Q_A_External_Final.pdf?1623133188.*

[89] *This includes the: Climate Disclosure Standards Board (CDSB), the Task Force for Climate-relate Financial Disclosures (TCFD), the Value Reporting Foundation's Integrated Reporting Framework, and industry-based Sustainability Accounting Standards Board (SASB) standards.*

recent ISSB Board meeting[90], where a unanimous decision was made to include company disclosures on Scope 3 emissions, beyond just Scope 1 and 2. Relief provisions were also committed to help companies meet these new requirements. While this remains a relatively new area, some companies have embarked on initiatives to track and trace their Scope 3 emissions. These initiatives highlight the need to engage suppliers and help them start their decarbonisation journeys (Figure 6).

Figure 6: Scoping out Scope 3 - Examples of initiatives to tackle Scope 3 emissions

Schneider Electric (SE)'s "Zero Carbon Project" aims to cut 50% in emissions (Scope 1 and 2) from its suppliers' operations by 2025. It has actively embarked on providing decarbonisation training to 1,000 companies in its value chain to help them reduce their emissions. Through this process, SE estimates that it can cut emissions by 6 million CO_2e, approximately 20 times more than they would have been able to reduce on their own.

Equinix is working with its suppliers and assisting them in setting science-based targets by 2025. They have built a deep relationship with their suppliers allowing them to gather data and help them develop their own corporate-level GHG reduction targets. Equinix has made progress towards its 2025 goal of engaging 66% of its suppliers by emissions. In 2022, 17% of suppliers by emissions committed to the goal. Equinix recognises that their suppliers are at different stages of the sustainability journey and has offered tools to accelerate their learning.

In line with Microsoft's corporate sustainability goals, their procurement teams worked with their supply chain counterparts to revise its Supplier Code of Conduct in 2020. The code obliges suppliers to disclose their emissions to Carbon Disclosure Project (CDP) or other reporting avenue and provide a plan to reduce emissions. More than 87% of their suppliers now provide their data to CDP, which allows Microsoft to provide Scope 3 transparency to their customers.

[90] *International Financial Reporting Standards Foundation , "ISSB Update October 2022," 2022, https://www.ifrs.org/news-and-events/updates/issb/2022/issb-update-october-2022/.*

6. Digital Solutions to Sustainability Challenges

1. **Digitalisation and new technologies can help drive decarbonisation efforts.**
2. **Investments and relevant digital and green skills will be required.**
3. **Regional collaboration in ASEAN can foster an environment of innovation and support a market for digital-green products.**

There is optimism that technological innovations can help countries and companies achieve their net zero goals. This can be as simple as increasing efficiencies as alluded to in earlier chapters; but more significantly, the introduction of new technologies such as AI, machine learning, and blockchain technology to 'green' processes. Emerging applications can be observed in the areas of supply chain monitoring and the verification of carbon credits.

6.1 Artificial Intelligence (AI)

The benefits of AI can also be applied to climate.[91] AI has also been proven to be a useful tool for achieving sustainability goals – a study by PwC estimates that using AI could reduce GHG emissions by 4 per cent in 2030 or 2.4 Gt CO_2e – equivalent to the 2030 annual emissions of Australia, Canada and Japan combined.[92] Other examples include supporting environmental conservation and securing sustainable food sources; as well as tracking, monitoring, and managing systems to enable more transparent and efficient industries. For example, Huawei's 'Farm to Fork Strategy'[93] uses AI capabilities to monitor soil and yield to help farmers maximise produce and ensure an adherence to global environmental standards.

Climate data sets are extremely large and take a considerable amount of time to collect, analyse, and use to make informed decisions to execute eventual policy decisions. Using AI would allow for a better analysis of constantly evolving perimeters to make informed predictions about changes in the environment. AI is a tool that could potentially allow scientists and policymakers to have useful conversations by linking climate models with the decisions that need to be made based on the results of those models. However, trust or assurance, is a key aspect of using AI and that has yet to be completely accepted.

6.2 Green Fintech

The overlap of digital and sustainability is also shaping the future of the financial services industry. Although Fintech has experienced significant growth in ASEAN, sustainability concerns are starting to receive more attention. While global FinTech funding has dropped in recent years, Green FinTech funding has increased by approximately 140 per cent year on year (YoY) for 2022.[94] However, most of the funding available is targeted towards European firms, with France and the UK receiving the most venture capital (VC) funding. Nevertheless, the ambiguity presents a significant opportunity for companies and banks to determine the niches they want to operate in and ultimately own.

[91] *Will Evison, "How AI Can Enable a Sustainable Future" (PWC), accessed April 25, 2023, https://www.pwc.co.uk/services/sustainability-climate-change/insights/how-ai-future-can-enable-sustainable-future.html.*

[92] *ibid.*

[93] *Huawei, "Artificial Intelligence and the European Green Deal," Huawei, September 30, 2020, https://huawei.eu/story/artificial-intelligence-and-european-green-deal.*

[94] *Amy O'Brien and Freya Pratty, "Climate Fintech Funding Reaches Record High in 2022," Sifted, January 10, 2023, https://sifted.eu/articles/climate-fintech-funding-record-2022.*

Payments company, Stripe, recently launched a new service called Stripe Climate[95], that allows firms to direct a fraction of their revenue from payments to help scale emerging carbon removal technologies. This has allowed thousands of companies that use Stripe Climate to partner with large MNCs like Alphabet, Meta, and JP Morgan Chase to co-fund Frontier, an advance market commitment, to buy an initial US$1 billion of permanent carbon removal between 2022 and 2030. Frontier will play three roles in the process: first, by aggregating demand to determine how much willing capital is available to purchase carbon removal, next, by vetting the suppliers of carbon removal and lastly, through acting as the platform for approving the removal purchases.

Green FinTech has also extended to the raising of capital, as the proliferation of platforms have allowed individuals and organisations to confidently invest in green companies, as the platforms themselves verify green credentials. RaiseGreen, partnering with IBM, has a platform that allows individuals to invest in clean energy projects for as little as US$100. By democratising investment in clean energy and technologies, Green FinTech can potentially open companies to new sources of investment and allow investors to be involved in the early stages of development.

For ASEAN, connecting its carbon markets to facilitate the trade of carbon credits would likewise attract Green Fintech. AMS can begin to pilot ways to promote interoperability across carbon credit platforms and provide the necessary regulatory frameworks for businesses to access and trade quality credits.

[95] *Stripe, "Climate," Stripe, accessed April 19, 2023, https://stripe.com/en-sg/climate.*

7. Exploring an ASEAN-wide Framework for Digital Sustainability

The challenge for ASEAN to address the digital-sustainability nexus depends not only on efforts within the tech sector or the sustainability sector, but also on the wider context of integration and regional cooperation. Yet the diversity among AMS needs to be considered when setting policy direction for deeper collaboration and harmonised rules for the region, and this applies to the digital sector and linkages to sustainability. One key is for AMS to understand that the digital transformation presents an opportunity for countries to move up the value chain and better position themselves, or even leapfrog, and to further recognize that climate concerns make it imperative to address the digital-sustainability nexus. Ideally, there needs for an ASEAN roadmap on the digital economy and to develop policies and capacity to address the linkages to sustainability and climate concerns.

7.1 Leveraging on ASEAN-led Mechanisms

ASEAN Economic Community (AEC)

The broad context is set by the AEC, which was formally established as a pillar of the ASEAN community in 2015 to more closely integrate the regional economies. The 2015 AEC Blueprint was developed to realise this vision, providing directions and integrative efforts to be implemented by various AEC sectoral bodies. This has been followed up in the 2025 AEC Blueprint.

Following the mid-term review (MTR) of the 2025 Blueprint, ASEAN realized the need to consider the increasing volatile and uncertain global context, and emerging areas for action were identified including as the digital economy, sustainability and inclusivity. ASEAN recognized that the digital and green factors cut across economic sectors and also connect to the other pillars of the ASEAN Community – political-security, and socio-cultural.

There is an opportunity to restructure the AEC to make it more responsive and adaptable to external challenges, allowing it to support ASEAN's digital-green economic transformation.

The AEC has already moved on various digital and sustainability initiatives[96] and embarked on several cross-cutting initiatives, like the adoption of the Framework on Circular Economy for the AEC, and the development of an ASEAN Strategy on Carbon Neutrality. The 2023 ASEAN chairman, Indonesia, aims to accelerate inclusive digital economy transformation and increase participation for sustainable economic growth[97]. ASEAN is reviewing the AEC and has appointed a High-level Task Force on ASEAN Economic Integration (HLTF-EI) to further these discussions. Sustainable development, including the energy transition and the development of electric vehicles were issues that featured strongly in the recent 43rd HLTF-EI meeting[98].

ASEAN will take further steps to compile the ASEAN Community Post-2025 Vision towards ASEAN 2045[99]. The recognition of the digital and green factors as cross-cutting challenges combine with

[96] *This includes the 2021 Bandar Seri Begawan Roadmap and the 2021 ASEAN Taxonomy for Sustainable Finance.*

[97] *ASEAN, "Three Strategic Pillars of Indonesia's ASEAN Chairmanship 2023 on the Economic Track," asean2023.id, March 7, 2023, https://asean2023.id/en/news/three-strategic-pillars-of-indonesias-asean-chairmanship-2023-on-the-economic-track#:~:text=The%20Chairmanship%20of%20ASEAN%20Indonesia.*

[98] *Embassy of the Republic of Indonesia Yangon Myanmar, "Embassy of the Republic of Indonesia Yangon Myanmar," Kementerian Luar Negeri Repulik Indonesia, March 7, 2023, https://www.kemlu.go.id/yangon/en/news/23618/indonesia-must-push-sustainable-development-in-asean-official.*

[99] *Kementerian Kominfo, "ASEAN Leaders to Meet HLTF-ACV to Discuss the Post-2025 ASEAN Vision Formulation," asean2023.id, April 23, 2023, https://asean2023.id/en/news/asean-leaders-to-meet-hltf-acv-to-discuss-the-post-2025-asean-vision-formulation.*

these steps in the ASEAN process to present an opportunity for ASEAN to create elements within its broader Community project that can be more responsive and adaptable to support a digital and green economic transformation.

Digital Economy Framework Agreement (DEFA)

The DEFA is another ASEAN work in progress and one that is more specific to the digital economy. Under the Indonesia's chairmanship for 2023, it is pledged as a key deliverable, with hopes to address key issues including: (a) Digital Trade and Standards; (b) Digital Payment and Identification; (c) Cybersecurity and Data Protection; (d) Digital Skills and Talent. Indonesia hopes to have a Leaders' Statement on the DEFA and initiate negotiations before the end of its chairmanship. The 3rd ASEAN Digital Ministers' Meeting and Related Meetings (ADGMIN) held in February highlighted the importance of the DEFA study for the development of the framework, and this is likely to remain high on the agenda even as Singapore takes over as chair for the 4th ADGMIN in 2024[100].

Based on our research, some of the key issues the DEFA hopes to address would include (i) building ASEAN's digital readiness for the bloc to become an innovator for digitalisation, (ii) providing connectivity through infrastructure and affordable access, (iii) enabling inter-ASEAN data flows, (iv) strengthening public-private collaboration, and (v) mapping and prioritising based on the level of readiness of AMS.

It is important to ensure that the DEFA addresses concerns on interoperability, and thus clear standards will need to be established for the focus areas above. In this regard, referencing existing agreements such as DEAs will help determine how best to provide capacity building and models for the region to adopt trade terms that are beneficial for business. Subsequently, we recommend that ASEAN can follow up to integrate aspects of the green economy to the DEFA and subsequent agreements. This is important to regulate and develop standards for the development and use of new green technologies in efficient ways and to achieve a scale that is effective.

7.2 Building Blocks for Digital Sustainability

Establishing a digital-green foundation for ASEAN will first be crucial. While ASEAN as a whole and its member states have yet to consider these two areas in tandem, there are several commonalities between AMS National Roadmaps for Digital and Sustainability that can form the basis for developing an ASEAN-wide framework for digital sustainability. These can be seen as 'building blocks' to address the digital-green nexus, and many have already been incorporated to varying extents by different AMS. For the digital economy, some examples include developing digital infrastructure, governance and skills. For the green economy, one example is the emphasis on resource and energy efficiency, and another is to create carbon markets. The table below lists a number of these building blocks that can support efforts to address the digital-green nexus in ASEAN economies.

[100] *ASEAN, "The 3rd ASEAN Digital Ministers' Meeting and Related Meetings," February 2023, https://asean.org/wp-content/uploads/2023/02/Endorsed-3rd-ADGMIN-JMS.pdf.*

Table 5: Examples of building blocks in different AMS

Digital Economy	• Infrastructure and Data • Laws, Regulations and Governance • Widespread Digital Adoption • Digital Trade • Digital Literacy and Skills • Digital Payments
Green Economy	• Resource Efficiency • Low-carbon Energy • Carbon Markets (Voluntary and Compliance) • Green Skills (e.g. GHG Calculation, Transition Planning) • Green Finance

Source: Authors' research from interviews

Public-Private Partnerships (PPPs)

While governments in ASEAN must take the lead, there is much to be gained from PPPs to address the digital-green nexus. Collaboration and cooperation between the public and private sector will be crucial for progress to be made on these building blocks, particularly in the aspects of innovation and inclusion. Indeed the private sector is often likely to be the first mover in these sectors. Nevertheless, there remains a need for government support either in terms of taking the first losses or in providing funding for training. Thus, PPPs will be fundamental to the growth of the digital-green economy.

While the private sector has been actively involved in the digital and green economies in most AMS, collaborations tend to be on a project-by-project basis, or after a draft of a policy has been formulated. While this has been relatively successful to date, the dynamic nature of the digital and green economies, and by extension, the digital-sustainability nexus, will require subsequent frameworks to be agile and flexible.

Innovation: There is a need to set the right policy paradigm to foster innovation. This could look like establishing an iterative policy development process involving the private sector, to ensure that policy keeps pace with the evolution of technology and operating models; and adopting a pragmatic approach to new technologies as they develop. Regulatory sandboxes have proven successful in the evolution of FinTech, and a similar approach can be adopted for digital sustainability.

Examples of PPPs for Innovation:

1. Project Guardian is a collaborative initiative between the Monetary Authority of Singapore and the financial industry aimed at exploring the economic potential and use cases of asset tokenisation. It tests the feasibility of applications in asset tokenisation and decentralised finance (DeFi) while managing potential risks to financial stability and integrity. DBS Bank, JP Morgan and Marketnode will lead the first pilot[101], which will explore DeFi applications in wholesale funding markets. The pilot aims to carry out secured borrowing and lending on a public blockchain-based network through the execution of smart contracts.

[101] *"MAS partners the industry to pilot use cases in digital assets," MAS, 31 May 2022, https://www.mas.gov.sg/news/media-releases/2022/mas-partners-the-industry-to-pilot-use-cases-in-digital-assets.*

2. The Singapore GreenTech Challenge 2023[102] by Microsoft, IMDA and SGTech calls for software-based solutions to address key environmental challenges. These include setting and tracking sustainability targets, helping businesses identify renewable energy sources, and creating tradeable carbon assets through digitally enabled sequestration measurement.

3. The Digital Economy Promotion Agency (DEPA) has collaborated with both Huawei and Advanced Info Services (AIS) to establish 5G Innovation Centres in Thailand. The 5G Ecosystem Innovation Centre (EIC) aims to accelerate 5G innovation through ecosystem collaboration and will serve as a sandbox for 5G applications and services across various industries in Thailand[103].

Inclusion: Policymakers can identify sectors in the digital and green economies where there is a skills gap, and subsequently engage the private sector to develop initiatives to target different groups of stakeholders. Examples include providing specialised vocational programmes to upskill workers, collaborating with universities to introduce new programmes, or developing initiatives to help MSMEs.

Examples of PPPs for Inclusion:

1. IMDA has worked with Accenture and Stone Forest Group to provide digital consultancy and project management services as part of their Chief Technological Officer as-a-service (CTOaaS) initiative[104]. Launched in 2021 as part of the SMEs Go Digital programme, it seeks to provide an end-to-end service for SMEs looking to embark on their digital transformation journey, which includes helping SMEs determine digital readiness, and providing information on relevant solutions and grants available.

2. The Industry 4.0 Digital Center (PIDI 4.0) was established under the Making Indonesia 4.0 framework and aims to be a one-stop shop for solutions to help accelerate Indonesia's 4.0 transformation. As part of the program, PIDI houses a Capability Training Centre[105] which engages private sector partners to provide digital training courses, namely in the areas of data analytics, robotics, IoT and cloud computing.

[102] *Microsoft, "Singapore GreenTech Challenge 2023 Powered by Microsoft, IMDA and SGTech to Accelerate Nationwide Innovation for a Resilient and Sustainable Future.," Singapore News Center, April 12, 2023, https://news.microsoft.com/en-sg/2023/04/12/singapore-greentech-challenge-2023-powered-by-microsoft-imda-and-sgtech-to-accelerate-nationwide-innovation-for-a-resilient-and-sustainable-future/.*

[103] *Bangkok Post, "Thailand MDES-Depa, Huawei Open 5G Ecosystem Innovation Center to Boost Digital Transformation," Bangkok Post, September 21, 2020, https://www.bangkokpost.com/thailand/pr/1989231/thailand-mdes-depa-huawei-open-5g-ecosystem-innovation-center-to-boost-digital-transformation.*

[104] *Infocomm Media Development Authority, "Chief Technology Officer-As-a-Service," Infocomm Media Development Authority, 2023, https://www.imda.gov.sg/how-we-can-help/smes-go-digital/ctoaas.*

[105] *Pidi 4.0, "PIDI 4.0," PIDI 4.0, 2021, https://cc-pidi4-kemenperin-go-id.translate.goog/?_x_tr_sl=id&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc.*

8. Policy Recommendations

The earlier chapters have highlighted how digitalisation and the green transition will be intertwined. Data and data infrastructure, clean energy solutions, supply chains and new technologies have been identified as key areas of convergence. Yet, a supporting ecosystem of data infrastructure, data flows, access to renewable energy and harmonised regulations will be crucial for this digital-green growth to occur. The following are policy recommendations that we believe ASEAN should prioritise in order to reap the benefits of the digital and green transformation.

Digital Economy Actors:

1. **End-to-end supply chain digitalisation:** Companies should continue to fully digitalise their supply chains to increase operational efficiency. While most large firms have adopted nearly end-to-end supply chain solutions, MSMEs may not be fully integrated with the digitalised supply chain and will need to scale-up their digitalisation efforts. Firms can leverage on digitised supply chains to measure and trace their Scope 3 emissions, allowing them to identify suppliers that can provide goods or services at a carbon cost that is aligned with their long-term decarbonisation targets. Having an integrated system would incentivise suppliers to track and manage their emissions, enabling them to embark on their own decarbonisation journeys.

2. **Greening data centres:** Our report demonstrates the fundamental role played by data centres in powering the digital economy. Data centre providers have accelerated efforts to mitigate their climate impact with energy-efficient cooling systems and AI optimisation, which can continue to improve with technological innovation. Governments can develop policies that incentivize the production and the availability of renewable energy, including through the facilitation of cross border energy trade. Policymakers can further raise standards to encourage greener data centres by setting interoperable standards of Power Usage Effectiveness (PUE) and pushing for green building certification.

Digital Policymakers:

3. **Enable cross border data flows:** Cross-border data flows should be enabled, with appropriate data protection safeguards for greater efficiency of online transactions. While ASEAN has its own Data Management Framework (DMF) and Model Contractual Clauses (MCCs) to help SMEs navigate data transfers in the region, more can be done to support the free flow of data outside ASEAN. As a first step, AMS would benefit from joining platforms that promote global data flows and interoperability such as the Global Cross-Border Privacy Rules Forum (Global CBPR).

4. **Harmonise standards in Digital and Green Economy Agreements (DEAs and GEAs):** Governments are moving forward on both DEAs and GEAs, providing opportunities to develop consensus on both digital and green standards. For the digital economy, enabling interoperability and increasing efficiencies can aid with sustainability, while platforms like the ASEAN Digital Economy Framework Agreement (DEFA) can help in digital standard setting. On environmental sustainability, harmonised certification on carbon credits and emissions standards can be achieved through GEAs. Singapore has moved on these agreements in hopes that these can serve as pathfinders for the region. More countries should consider these approaches and advance with information sharing and capacity building.

5. **Incorporate the digital-green agenda into existing ASEAN mechanisms:** There is an opportunity to restructure the ASEAN Economic Community (AEC) to address the cross-cutting nature of the digital and green economies. ASEAN first needs to ensure that sufficient rhetoric and discussion around the digital-green nexus is present in current ASEAN mechanisms. Potential areas for consideration could be including a green chapter in the Digital Economy Framework Agreement (DEFA) or leveraging on the

High-Level Task Force on Economic Integration (HLTF-EI), where recent discussions already include the need to progress on the digital and sustainability fronts. This can further be developed in coming years with input from the private sector and other stakeholders for feedback, even as ASEAN looks towards developing its Post-2025 Community Vision towards 2045.

Wider Economy Changes:

6. **Connect ASEAN's carbon markets:** ASEAN is likely to host several carbon market platforms in the region, driven by the need to list carbon credits generated from Nature Based Solutions (NBS) projects and from potential compliance markets. A balkanisation of credits in an already fractious market would be detrimental to the goals of carbon reduction and forest preservation or enlargement. This would also inevitably raise costs and friction for the trading of carbon credits. Interconnectivity across platforms would be needed to support the trade of carbon credits across the region. There should also be a standard for the regulation of carbon markets to allow purchasers to readily buy credits for their businesses with some level of certainty to the quality, quantity, and reliability of the credit.

7. **Develop a regional, renewable power grid:** The digital economy consumes power rapidly and will face increasing expectations to be carbon neutral. The sector must boost efforts in energy efficiency and carbon reduction (including appropriate carbon off-setting strategies). However, more needs to be done at the national and regional energy grid level to facilitate access to green electrons and renewable energy. Linking electricity grids across Southeast Asia is still nascent, with only some bilateral and trilateral connections across the ASEAN power grid. This needs to be further accelerated with multilateral investments and stronger political will, further facilitating the wider energy transition and allowing growth in data centres and other essential digital infrastructure. The ASEAN Strategy for Carbon Neutrality can also leverage on AMS' strengths to achieve a net-zero outcome.

8. **Foster innovation:** Policymakers can play a role in creating sandbox environments to support the development and innovation of technology tools and new virtual systems, especially in driving sustainability solutions. Similar to how sandboxes were created for the evolution of Fintech, a similar approach may be required for digital-green growth. Funding support will also be needed either through grants or financial incentives for companies. Adoption by large public sector operators can also help create feed-in demand.

9. **Bridge the skills gap:** Demand for talent will continue to grow in tandem with the digital and green economies. For the digital economy, this includes increasing basic literacy, but also the need to cultivate more advanced skills. The growing awareness and interest for green skills for climate accounting measures also means that an understanding of science-based targets and green coding will come into demand in the job market. Therefore, a pipeline for talent will have to be developed in the region. By bridging the skills gap, SMEs would be able to source for a workforce that would help them stay within more complex supply chains and leverage new trends to expand their businesses and connect to newer markets.

10. **Promote digital-green norms:** Both the public and private sector have a role to promote a framework of thinking around the digital and green economies. This includes creating enough rhetoric and regulation around reporting standards, while also leveraging on DEAs and GEAs as signalling mechanisms for stakeholders to consider both digital and green in their policy strategies. There is also an opportunity to promote norms by offering the most sustainable option on digital platforms by default. With technology embedded in our lives, tech platforms can nudge both businesses and consumers towards more sustainable decisions and green habits.

9. Conclusion

Digitalisation and sustainability (especially decarbonisation) are increasingly embedded in policymaking, economic considerations and business decisions going forward. In ASEAN, countries are pushing to be more digital and charting pathways towards net zero goals. As both the private and public sectors develop digital transformation strategies and incorporate green practices, this report has not only presented the existing frameworks that can be leveraged and utilised but also provided recommendations on how the region can continue developing frameworks for a digital-green ASEAN.

In the current global context, amid the threat of geopolitical tensions and macroeconomic risks, the future for a Digital-Green ASEAN remains bright. Governments have signalled ambition and political will towards transforming and transitioning their economies to be digitalised and green, while Industry has invested significantly in innovation and development in these areas. This has been followed with various mechanisms facilitating greater cross-border and regional collaboration in the digital and green economies.

This report highlights three key areas where there are opportunities to explore the intersections between the digital and green economies – Data and Data Infrastructure, Clean Energy Solutions, and Sustainable Digital Trade.

In Chapter 3, we laid out how regulatory standards, policy frameworks and digital innovation are necessary to establish greener data centres as ASEAN's digital economy grows. Cross-border data flows are thus essential for ensuring data centres' sustainable growth, preventing the need for companies to store data domestically due to data localisation restrictions.

We then investigate how clean energy solutions can help accelerate regional decarbonisation in Chapter 4. A fully integrated grid would enable renewable energy-rich AMS to export surplus energy to other countries in the region. Smart grids will be necessary for establishing a reliable and cost-effective power supply. Green finance will be required to enable this low-carbon transition, with governments and banks having to play an integral role in building the infrastructure required to support ASEAN's digital-green ecosystem.

In Chapter 5, we explore how trade is a natural confluence area for digitalisation and sustainability. Digitalising supply chains remove the need for unnecessary paperwork and optimises supply chain processes. It also enables businesses to have better visibility of their carbon emissions across their value chain, including tracking their indirect emissions (Scope 3); thus, allowing companies to "green" their supply chain, reducing their carbon footprint. We elaborated on how digital innovation plays a vital role in driving decarbonisation efforts in Chapter 6 – exploring how Artificial Intelligence and Green Fintech are being used in supply chain monitoring and carbon credits verification.

Finally, the report ties the previous chapters together by exploring an ASEAN-wide framework for digital sustainability. As a first step, AMS can leverage on existing ASEAN mechanisms like the ASEAN Economic Community (AEC) and the Digital Economy Framework Agreement (DEFA) to drive discussions on the digital-green nexus. Next would be to strengthen connectivity and create an ecosystem with a policy infrastructure that has trust and transparency. Building this digital-green ecosystem will also require building blocks like data flows, access to renewable energy, harmonised regulatory frameworks, targeted investments, and public-private partnerships. The emergence of Digital and Green Economy Agreements will become pathfinders towards a future where digital-green chapters are found in global trade standards; one where digital and green jargon is accepted and established as the norm in society.

Appendix: Participating Organisations

This is a list of companies that the SIIA engaged with as part of Phase 2 of its Digital Programme. This was either in the form of roundtable participation, research interviews or overseas stakeholder engagement. We are grateful to all parties for sharing their insights and perspectives with us.

- Alibaba
- Amazon Web Services (AWS)
- ASEAN Secretariat
- Asian Development Bank (ADB)
- Bank of Investment and Development Vietnam (BIDV)
- Central Group
- Central Institute for Economic Management (CIEM)
- Centre for Strategic and International Studies (CSIS), Indonesia
- Coordinating Ministry for Economic Affairs, Republic of Indonesia
- CP Group
- DHL
- Digital Economy Promotion Agency (DEPA), Thailand
- DiMuto
- Diplomatic Academy of Vietnam (DAV)
- Economic Research Institute for ASEAN and East Asia (ERIA)
- Energy Market Authority (EMA), Singapore
- Equinix
- Expedia
- Gojek
- Google
- Hinrich Foundation
- Huawei
- IBM
- Industry 4.0 Digital Centre (PIDI 4.0)
- Infocomm Media Development Authority (IMDA), Singapore
- Institute of Policy Studies and Media Development (IPS), Vietnam
- International Chamber of Commerce (ICC)
- Karavan.VN
- Lazada
- Meta
- Metta DC
- Microsoft
- Ministry of Communication and Information Technology (KOMINFO), Republic of Indonesia
- Ministry of Communications and Information (MCI), Singapore
- Ministry of Digital Economy and Society (MDES), Thailand
- MDES, Plan and Policy Division
- Ministry of Foreign Affairs, Singapore
- Ministry of Foreign Affairs, Socialist Republic of Vietnam
- Ministry of Foreign Affairs, Thailand
- Ministry of Industry and Trade (MoIT), Socialist Republic of Vietnam
- Ministry of Information and Communication, Socialist Republic of Vietnam
- Ministry of Planning and Investment (MPI), Department of Science, Education, Natural Resources and Environment
- Ministry of Planning and Investment, Socialist Republic of Vietnam
- Ministry of Science and Technology, Socialist Republic of Vietnam
- Ministry of Trade and Industry, (MTI), ASEAN Division, Singapore
- Ministry of Trade and Industry (MTI), International Cluster, Digital Economy and Services, Singapore
- Ministry of Trade, Republic of Indonesia (KEMENDAG)
- Nikkei Asia
- Office of Personal Data Protection Committee (PDPC)
- Office of the National Digital Economy and Society Commission (ONDE), Thailand
- Posts and Telecommunications Institute of Technology (PTiT), Vietnam
- SAP
- SGTech
- Stripe
- Tech For Good
- Telenor
- Thai Startup Trade Association
- TMA Solutions
- Traveloka
- True Digital Academy
- UOB
- UPS
- US Embassy
- Vietnam Chamber of Commerce and Industry (VCCI)
- Vietnam Institute of Digital Transformation and Innovation (VIDTI)
- Visa

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