Energy and Decarbonization in Southeast Asia

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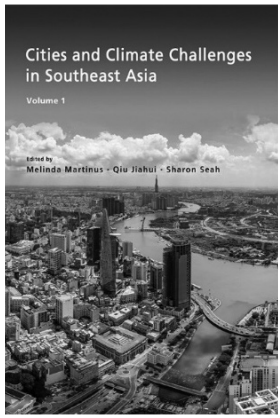

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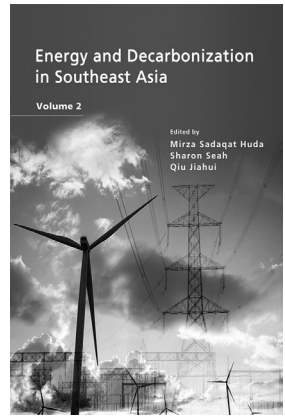

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Energy and Decarbonization in Southeast Asia

Volume 2

Edited by

Mirza Sadaqat Huda • Sharon Seah • Qiu Jiahui

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Foreword

As with many other subjects, the academic and policy discourse on climate and energy transitions is dominated by the Global North. Yet, it is clear that different parts of the world face different challenges in tackling climate change, and therefore call for tailor-made solutions that are relevant to the regional context.

Southeast Asia is one of the fastest-growing regions in the world while also being one of the most vulnerable to the impacts of climate change. Its emissions are projected to more than double in the next few decades under a business-as-usual scenario, largely due to increases in population and economic growth.

While Southeast Asia has enormous potential for renewable energy generation, the region must deal with its ageing electricity infrastructure, outdated regulatory environment and other barriers to financing low-carbon energy projects, while addressing the threats to energy justice during the transition. Diversity of energy market structures and growing resource nationalism may also pose challenges for the realization of the ASEAN Power Grid, a long-standing shared goal for a regional power network that offers the potential to greatly accelerate the integration of renewable sources.

To address region-specific energy and decarbonization issues, we need platforms that encourage knowledge generation and exchange within the Southeast Asian context. As a modest step in this direction, this book is the second volume in the Climate Change in Southeast Asia Compendium Series, which provides opportunities for early and mid-career academics and practitioners to explore current topics and develop policy-relevant recommendations under the guidance of experts in the field. Spearheaded by the Institute's Climate Change in Southeast Asia

Programme, qualified researchers attended three virtual workshops where they engaged in a peer review process and received feedback on their chapter contributions from experts in various forms of decarbonization.

The resulting volume captures some of the most salient trends in the region's decarbonization journey, such as renewable energy trade, green financing, carbon capture and storage technology, smart grids and low-carbon hydrogen. By delving into case studies of national and regional policy processes, regulations and socio-economic conditions, each chapter produces focused and up-to-date analyses and recommendations that can enhance the toolkit of Southeast Asian policymakers looking to make a bigger impact.

Choi Shing Kwok
Director & CEO
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INTRODUCTION

Mirza Sadaqat Huda, Sharon Seah and Qiu Jiahui

Southeast Asian countries face the complex challenge of providing affordable, accessible and secure supplies of energy while facilitating rapid decarbonization. Currently, 67 per cent of Southeast Asia's electricity is generated from fossil fuels (ACE 2024) and the region is home to the world's youngest coal power plant fleets. By 2040, Southeast Asia's energy demand will reach 3,123 terawatt-hours—a threefold increase on current levels. If fossil fuels are used to meet future energy demand, the region's CO2 emissions will increase by 2.5 times of existing levels to reach 4,171 million tonnes by 2040 (ACE 2021a). Unabated emissions from the energy sector will negatively impact Southeast Asia's populations, economies and biodiversity ecosystems, as well as hamper global mitigation efforts.

Compounding Southeast Asia's energy challenges is the region's extreme vulnerability to climate change. Myanmar, Vietnam, the Philippines and Thailand are among the top ten countries in the world that were most affected by extreme weather events between 1999 and 2018 (ASEAN Secretariat 2021). In addition to exacerbating climatic impacts, the continued use of fossil fuels, particularly coal, will negatively affect the health of Southeast Asian citizens. Emissions from coal-fired power plants will increase the incidence of respiratory diseases and can potentially result in 69,660 annual excess deaths in the region by 2030 (Fossum Sagbakken et al. 2021; Koplitz et al. 2016). Fossil fuel power generation produces waste that contaminates drinking water, poisons agricultural fields and threatens fisheries in Southeast Asia (Fossum Sagbakken et al. 2021). The continued use of fossil fuels will

also undermine economic development as the region is set to become a net importer of gas and coal by 2025 and 2039 respectively, which may drive up energy prices (ACE 2023). The Russia-Ukraine war has demonstrated that fossil fuel dependencies can leave regional countries vulnerable to supply disruptions caused by geopolitical conflicts.

While the use of fossil fuels can undermine socio-economic development, decarbonization can bring enormous benefits to Southeast Asia. Transitioning to renewables can save as much as US$160 billion in costs relating to energy supply and avoid up to US$1.58 trillion worth of externalities from air pollution and climate change, cumulatively to 2050 (IRENA 2022). Accelerating decarbonization may increase Southeast Asia's average annual gross domestic product (GDP) by 3.4 per cent, regional employment by 1 per cent and social welfare by 10.9 per cent in the 2021–50 period (IRENA 2023).

At the global level, the continued use of fossil fuels in Southeast Asia has garnered international criticism (Overland et al. 2021; Fossum Sagbakken et al. 2021). Currently, the region contributes only 8 per cent to global emissions but unabated coal use will see a doubling of emissions from the energy sector alone by 2040 (ACE 2022). Accelerating decarbonization in the larger economies of Indonesia, Vietnam and Thailand is thus particularly important to slow down global warming. Should Southeast Asia prove that developmental progress is not hampered by decarbonization, other developing regions such as South Asia and Africa can be spurred to decarbonize as well. This can be done through the exchange of best practices, the development of carbon credit markets, and joint investment in green technologies.

Decarbonization is thus important for Southeast Asian countries to facilitate sustainable development in their own economies while also meeting their global climate commitments. The region has sufficient resources to accelerate decarbonization and can meet two-thirds of its energy demand through renewables (IRENA 2022). Southeast Asia's solar photovoltaic and wind power capacities exceed 41 terawatts and 1.8 terawatts respectively (Lee et al. 2020), and it also has exceptional hydropower as well as significant geothermal and ocean resources (IRENA 2018).

In the last decade, a number of policies at the regional and national levels have aimed to accelerate decarbonization. To date, all the ten Association of Southeast Asian Nations (ASEAN) countries, with the exception of Myanmar and the Philippines, have submitted their

net-zero commitments[1] (Seah et al. 2023). In their updated nationally determined contributions submitted in 2020–2021, all ASEAN countries have increased their climate ambition in some form[2] (Qiu, Seah, and Martinus 2024).

Growing policy focus on decarbonization has facilitated an increase in the commissioning of clean energy projects in Southeast Asia. In 2020, more than 80 per cent of new additions to national grids were from renewables (ACE 2021b). Some landmark projects in the last decade include the commissioning of the region's largest solar farm,[3] floating solar farms[4] and battery storage systems[5] in Vietnam, Indonesia, and Singapore respectively. In 2022, the region's first multilateral power project, the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP), commenced trading using existing infrastructure, which provided a much-needed boost to the ASEAN Power Grid initiative. Currently, the region's second multilateral power project is being planned between Brunei, Indonesia, Malaysia and the Philippines. These projects have contributed towards meeting ASEAN's collective target of increasing the share of renewable energy in the total primary energy supply to 23 per cent by 2025.

In addition to power generation and transmission, Southeast Asian countries have made important progress in the development of domestic green industries. Malaysia and Vietnam are the world's second- and third-largest manufacturers of solar photovoltaic modules, while Thailand is the region's largest manufacturer of electric vehicles (EV), with a market share of over 70 per cent (Hamano 2024). In 2024, Indonesia introduced multiple legislations on the use of technologies such as carbon capture and storage (CCS) and carbon capture, utilization and storage (CCUS) to more effectively utilize its vast geological resources to generate revenue and mitigate emissions (Reuters 2024).

The Philippines and Indonesia, which have large deposits of nickel and copper, are moving up the supply chain of critical minerals by developing integrated EV and battery supply chains (IEA 2022). If Southeast Asia can implement policy reforms to utilize the region's existing renewable energy potential and critical mineral resources, it can become a key manufacturing hub for green technology with a market opportunity of US$800 billion by 2050 (ibid.).

However, as of 2020, only 14.2 per cent of Southeast Asia's total primary energy supply was from renewables, and there is significant doubt whether ASEAN's 23 per cent target can be met by 2025 (ACE

2022). The region faces a number of challenges to decarbonization. One crucial impediment is the huge gap in clean energy finance. To keep within the 1.5°C limit, Southeast Asian countries will need investments of around US$230 billion annually up to 2050 (IES 2022). Between 2016 to 2020, the annual average energy investment in Southeast Asia was approximately US$70 billion, out of which less than US$30 billion was allocated to renewables (IEA 2022). International public development finance provided only US$12.8 billion to the region's energy sector from 2009 to 2019 (Martinus and Qiu 2022).

The economic impact of the COVID-19 pandemic has also undermined energy transition, particularly in the increase of energy subsidies and reduction of fossil fuel taxes in Indonesia, Vietnam and the Philippines (Martinus and Seah 2022). While subsidies perpetuate the use of fossil fuels, high levels of inequality in countries such as Indonesia, the Philippines and Laos make energy sector reform politically unfeasible (ADB 2023). Having exceeded their debt ceilings by borrowing to tide over the pandemic, many governments now find themselves in a poorer fiscal position. As many as fifty-three developing countries are struggling with this growing debt problem, and they hardly have the appetite to embark on costly energy transition plans. In 2024, Indonesia scaled back its renewable energy targets for 2030 from 23 per cent to 19–21 per cent, due to perceived negative economic impacts of greenflation (Maulia, Goh, and Hoang 2024).

The limited number of regional interconnections and the poor state of domestic grids have slowed the uptake of renewable energy. At the domestic level, existing power grids cannot support the high intermittency of renewable sources. Vietnam, for example, expanded its solar capacity 200-fold from 85 megawatts in 2017 to nearly 17,000 megawatts but experienced grid congestion, curtailment, and blackouts in 2023 due to poor transmission systems (Seah 2023). To facilitate energy transition, Southeast Asian countries will need to invest as much as around US$200 billion into upgrading grid infrastructures by 2030 (IRENA 2022). Regionally, only nine out of eighteen key interconnection projects of the ASEAN Power Grid have been completed to date, which has constrained opportunities for exploiting resource interdependencies and economies of scale (Huda, Seah, and Qiu 2023).

Decarbonization is also impeded because of the imperative of maintaining the agriculture sector's contributions to GDP in several regional countries. Agriculture, land-use change and forestry contribute

significantly to greenhouse gas emissions, and six out of ten ASEAN member states—Cambodia, Indonesia, Laos, Myanmar, the Philippines and Vietnam—are bulk commodity and agricultural producers (Seah 2023).

Geopolitical conflicts between major emitters such as China, India, Russia, the United States and the European Union hamper global decarbonization efforts, and have impacts on Southeast Asia (Glasser, Johnstone, and Kapetas 2022). For example, the 2024 State of Southeast Asia report shows that more than 68 per cent of the region's citizens believe that the decade-old Russia-Ukraine conflict continues to put upward pressure on energy prices (Seah et al. 2024). The United States has initiated the Inflation Reduction Act and the Minerals Security Partnership to reduce dependence on China for critical technologies and resources, given Beijing's dominance in multiple supply chains (Huda 2024). However, these initiatives also impact Southeast Asia's efforts to decarbonize by bifurcating existing supply chains and instigating trade disputes between major economies (Seah and Huda 2024). Minilateral efforts such as the European Union's Carbon Border Adjustment Mechanism, which aims to compel its trading partners to adopt a carbon price, can also slow down decarbonization in Southeast Asia by fomenting trade conflicts and counter-coalitions (Overland and Huda 2022).

A growing body of literature has examined the opportunities of and challenges to the decarbonization of energy systems in Southeast Asia. This includes technical analysis (Endo et al. 2023), academic studies (Do 2024; Aleluia et al. 2022), policy reports (International Energy Agency 2023) and books (Phoumin, Taghizadeh-Hesary, and Kimura 2022). Existing scholarship has engaged with both the broad issue of energy transition in Southeast Asia, as well as more sector-specific topics such as climate finance (Anantharajah and Setyowati 2022), the ASEAN Power Grid (Aris and Jørgensen 2020) and emerging clean energy technologies (Lau et al. 2022; Phoumin, Kimura, and Arima 2021). While these studies are useful, a majority are authored or led by renowned experts based in international organizations or academic institutions. There is a need for publications that prioritize novel discourses on decarbonization from emerging scholars and policymakers. Such diversity in knowledge generation is important for the development of policies that are inclusive, which can more effectively address the multifaceted sociotechnical challenges of decarbonization.

This compendium developed by the Climate Change in Southeast Asia Programme of the ISEAS – Yusof Ishak Institute brings together ten emerging scholars and experts to examine critical policy imperatives relating to the decarbonization of the region's energy systems. The chapters provide novel insights into technological, societal and geopolitical facets of decarbonization, while also engaging with established literature on the topic.

The compendium was developed through three online workshops in February 2023 where each author presented the main findings of their research, engaged in a peer review process and received both oral and written feedback from a scientific committee comprising practitioners and academics. The analysis of this compendium does not provide exhaustive discourses on decarbonization but highlights brief policy prescriptions to help practitioners in the region address challenges and catalyse opportunities.

The compendium incorporates a diversity of case studies, ranging from low-carbon hydrogen, the digitalization of regional grids, just transition and resource nationalism, which collectively contribute to three thematic areas of decarbonization: (1) socio-economic and environmental issues, (2) the interplay between politics and technology, and (3) regional cooperation. The three sections, each dedicated to a theme, are described below:

SECTION 1: SOCIO-ECONOMIC AND ENVIRONMENTAL CHALLENGES OF DECARBONIZATION

The first section highlights the deficiencies in just transition frameworks, energy investments and community participation in addressing the socio-economic and environmental challenges of decarbonization. The chapters in this section describe the gaps between national policies on decarbonization and international frameworks and the importance of accelerating green investments while prioritizing the involvement of communities and the protection of the environment in decarbonization efforts.

Paul Bertheau examines financial flows into the energy sector in Southeast Asia from 2010 to 2021 and discusses their implications for energy transition. The findings show that fossil fuel projects are being financed in multiple Southeast Asian countries, indicating that current

energy investments contradict global climate change mitigation and sustainable energy development goals.

Fikri Muhammad applies the concept of justice to Indonesia's energy transition and climate finance policies to highlight conceptual, legal and procedural shortcomings. The author proposes the development of new economic and legal policies that can more effectively facilitate a just transition.

Zul Ilham places Malaysia's decarbonization efforts within distributive, procedural and recognized dimensions of environmental justice. Two case studies—the Kota Damansara Community Forest Movement and the Ampang Forest Park Movement—are used to demonstrate the implications of environmental justice and injustice on decarbonization efforts.

SECTION 2 TECHNO-POLITICAL PATHWAYS TO DECARBONIZATION

This section examines the political and technological factors that determine the pace and trajectory of decarbonization efforts. The three chapters in this section provide insights into the interplay between regulation, bureaucracy and politics on one hand, and technologies such as low-carbon hydrogen and CCS/CCUS on the other, in driving decarbonization.

Christopher Len provides an overview of the potential role of hydrogen within Southeast Asia's decarbonization goals. Global experiences and historical data are used to highlight technological, financial and policy imperatives for accelerating the deployment of low-carbon hydrogen in the region.

Tadzkia Nurshafira, Dias Prasongko and **Nils Oskar Tronrud** place the emerging technologies of CCS and CCUS within Indonesia's historical and contemporary energy policies. The authors recommend that carbon capture technologies should not be used to perpetuate the use of fossil fuels but be deployed in specific sectors and combined with the rapid increase in renewable energy generation to meet mitigation targets.

Weena Gera identifies imperatives and opportunities for the LTMS-PIP to be at the forefront of regional coordination on smart grids. The chapter provides an overview of regulatory mechanisms that can be

used to accelerate regional cooperation on the digitalization of cross-border grids.

SECTION 3: REGIONAL COOPERATION ON DECARBONIZATION

The third section assesses existing and potential initiatives for regional cooperation on energy decarbonization, particularly the development of renewable-integrated power interconnections between ASEAN countries. The chapters in this section identify recommendations for pursuing common interests in the energy-climate nexus, which could ultimately help member countries meet their own decarbonization goals.

Phan Xuan Dung proposes higher levels of subregional cooperation between Cambodia, Laos and Vietnam on developing non-hydro renewables. The author provides policy recommendations on enhancing subregional trade on solar and wind energy.

Daniel del Barrio Alvarez, Prasongchai Setthasuravich and **Aphisit Pukdeewut** employ a historical process perspective to examine the policy processes that allowed member countries of the Greater Mekong Subregion to build robust cross-border power trade relations despite political tensions in the late twentieth century. The chapter highlights key requirements for the development of regional energy trade in Southeast Asia.

Aji Said Muhammad Iqbal Fajri proposes that the export of renewable energy from Indonesia to Singapore is influenced by growing resource nationalism in Indonesia. The author maps the key Indonesian stakeholders that shape nationalistic discourse and traces their influence on the evolution of the country's energy export policies.

Hazleen Aris, Iskandar Shah Mohd Zawawi and **Bo Nørregaard Jørgensen** conduct in-depth analyses of ASEAN member states' electricity supply industries to evaluate their readiness for a future open regional electricity market. The findings highlight contemporary progress and existing challenges in developing deregulated and integrated energy systems in Southeast Asia.

CONCLUSION

Sitting at the sidelines while the global energy transition momentum gathers pace is not an option for Southeast Asia. Without a doubt,

transitioning to low-carbon economies would mean undertaking structural reforms at every level, but 66.5 per cent of Southeast Asians believe that reduction of fossil fuel usage will be painful in the short term but beneficial in the long term (Seah et al. 2023). In the same vein, 7 in 10 Southeast Asians are confident that adopting climate measures and policies will drive innovation and enhance the competitiveness of their economy (Seah et al. 2022). Energy transition requires a multistakeholder, whole-of-society approach—involving all sectors and actors of society from government to academia to the private sector and even down to the individual.

NOTES

1. Myanmar's net zero commitments aim to phase out emissions from land use, land use change and forestry (LULUCF) by 2040.
2. Brunei Darussalam, Laos, Malaysia, Myanmar, the Philippines, Singapore, and Vietnam increased their unconditional carbon emissions reduction targets, while Cambodia, Laos, Myanmar, Thailand, and Vietnam increased their conditional carbon emissions reduction targets—See Qiu et al. (2024).
3. The 420-megawatt Dau Tieng 1 and 2 solar power project was completed in 2019 in Bình Dương, Vietnam. More details can be found at https://www.aurecongroup.com/projects/energy/dau-tieng-solar-power-plant
4. The 192-megawatt peak Cirata floating solar farm was completed in 2023 in West Java, Indonesia. More details can be found at https://www.aseanbriefing.com/news/indonesia-unveils-largest-floating-solar-power-plant-in-southeast-asia/
5. The 285-megawatt hour Sembcorp Energy Storage System began operations in 2022 on Jurong Island, Singapore. More details can be found at https://www.ema.gov.sg/news-events/news/media-releases/2023/southeast-asias-largest-energy-storage-system-officially-opens

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