Energy Transitions in ASEAN
COP26 Policy Report

November 2021

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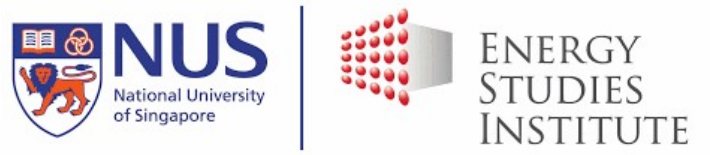

Foreword

This report is part of an overarching project developed in collaboration with the COP26 Universities Network and the British High Commission in Singapore. The COP26 Universities Network is a growing group of over 55 UK-based universities working together to help deliver an ambitious outcome at COP26 and beyond. In this first ever collaboration of its kind, the network has brought together top researchers and academic figures from the UK and Singapore to publish a series of four reports aimed at supporting policy development and the UK's international COP26 objectives in Singapore and across Southeast Asia. The reports focus on the following areas:

Energy Transition
The COP26 Policy Report on Energy Transition starts by exploring the impact of COVID-19 on ASEAN countries. This is followed by an examination of how CO_2 emissions can be reduced, while at the same time maintaining a sustained economic growth with a mix of renewable and non-renewable energy consumption. This report also provides an analytical discussion on employment and social justice following the energy transition.

Nature-based Solutions
Nature-based climate solutions (NbS) are widely available, scalable, and cost-effective mechanisms to sequester carbon and safeguard Southeast Asia's large carbon stocks. In addition, NbS provide ample co-benefits such a reducing haze, protecting biodiversity and shorelines, ecosystem services, and can provide economic opportunities through carbon credits and small-scale economies.

Green Finance
The Green Finance report addresses the rationale for carbon credits to be traded across ASEAN. It tackles policy considerations, a carbon offsets' financial markets response based on consultations with industry partners, and the accounting review applied to carbon finance. Ultimately, it examines and assesses voluntary carbon markets connecting the dots with nature-based solutions and decarbonization.

Adaptation and Resilience
The ASEAN region is under increasing threat from natural hazards, some of which are exacerbated by climate change. The Adaptation and Resilience report presents the hazards, exposures and vulnerabilities that the region is experiencing, as well as strategies to reduce disaster risk at the sub-national and national levels and in transboundary contexts.

These bite-size and highly condensed papers will provide a high-level understanding of the challenges and opportunities arising from climate science and policymaking in the ASEAN region, as we seek to transition to a greener economy. Readers are encouraged to review all four reports to gain a more comprehensive picture of climate change issues in the ASEAN region.

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List of Abbreviations

ADB	Asian Development Bank
AMEM	ASEAN Ministers on Energy Meeting
AMS	Association of Southeast Asian Nations Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
ASEAN	Association of Southeast Asian Nations
COVID-19	Coronavirus disease 2019
CO_2	Carbon dioxide
COP26	26^{tn} Meeting of the Conference of Parties to the Convention
DRE	Decentralized renewable energy
EV	Electric vehicle
EU	European Union
FiT	Feed-in-tariffs
GDP	Gross domestic product
GHG	Greenhouse gas
IEA	International Energy Agency
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
JT	Just Transition
LED	Light emitting diode
MSME	Micro, small, and medium enterprises
NDC	Nationally Determined Contribution
R&D	Research and Development
SHS	Solar home systems
UNFCCC	United Nations Framework Convention on Climate Change

Contents

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Key Policy Recommendations

Despite recognition that the energy sector is the main source of greenhouse gas emissions of most ASEAN member states, institutional challenges to addressing climate change and the desire to remain competitive present challenges to countries in the transition away from fossil fuels. Although ASEAN member states are giving more attention to renewable energy, climate action is undermined by fossil fuel growth, particularly coal.

Our recommendations are presented in the hope of helping create a more enabling environment to facilitate renewable energy deployment in the short-term, and to find greater cooperation across the region in the long-run to leverage the comparative advantage of each country to meet its Nationally Determined Contributions (NDCs) while recovering from the global COVID-19 pandemic, and addressing developmental priorities. Phase 2 of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 from 2021-2025, which serves as the regional blueprint on energy cooperation endorsed at the 38th ASEAN Ministers on Energy Meeting (AMEM) last November is a good starting point. The recommendations in this report, which are summarized below, can be integrated into the APAEC Action Plans so that the efforts are fully embraced by the ASEAN Member States (AMS).

COVID-19 Recovery in Southeast Asia

- Greater regional synergies needed to institutionalize green recovery.
- Build synergies between environment, energy, and trade/industry/economic development ministries.
- Collectivize small-scale renewable energy projects under a single regional portfolio to increase bankability and investment attractiveness.

Key Results of Economic Modelling of Energy Transition in ASEAN-5

- ASEAN-5 economies share some commonalities: a positive association between economic growth and energy consumption, as well as the prevalence of a positive relationship between economic growth and CO_2 emissions.
- From a policy perspective, the ASEAN-5 countries could incentivize non-fossil fuel energy production and patents based on environmental-related technologies with the objective of reducing CO_2 emissions.
- Given that Indonesia has the highest GDP and the highest CO_2 emissions among the ASEAN-5 countries, the adoption of the above-mentioned polices in Indonesia would help the entire region to significantly reduce carbon emissions and, thus, to meet the climate change goals. To avoid an economic slowdown, Indonesian policymakers could stimulate their economy by increasing R&D expenditure.

ASEAN Energy-Climate Plan in 2025

- Enhance and transform the multilateral policy approach to address climate and energy security.
- Promote multilateral trading to unlock the benefits of the cross-country power grid, which include greater economies of scale, better access to resource diversity, and improved stability of energy supply.
- ASEAN could tap into resources from external partners.

Just Transitions and Job Creation

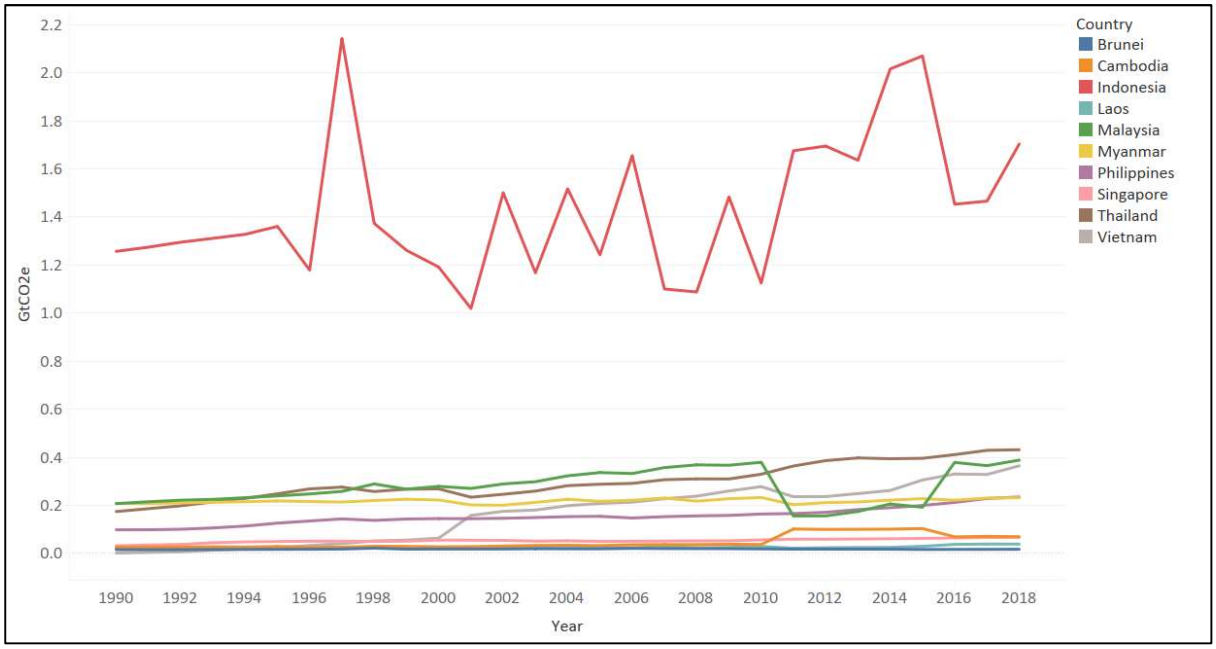
- Ensure that decarbonization policies and programmes pay attention to creating quality jobs and decent work
- Highlight social inclusion, gender empowerment and sustainable rural development for local communities as three key performance indicators of the success of the renewable energy transition.
- Take into account the financial, technical and logistical limitations of rural communities so as to ensure that renewable energy transitions are just, feasible and inclusive.

Introduction

The Association of Southeast Asian Nations (ASEAN) produces 5.6% of the total global greenhouse gas emissions (World Bank, 2018). In 2018, Indonesia contributed 48% of the region's CO_2 emissions and Thailand (12%), Malaysia (11%) and Vietnam (10%) emitted a further 33% (Figure 1). These four countries, therefore, contributed more than 80% of the region's CO_2 emissions. Southeast Asia is home to a population of 650 million with a combined GDP of US$9.34 trillion and is projected to become the world's 4th largest economy by 2030 (*ASEAN Matters for America/America Matters for ASEAN Report*, 2021).

According to the ASEAN Centre for Energy, the region's energy-related GHG emissions are expected to rise by 34% to 147% between 2017 and 2040 (*ASEAN State of Climate Change Report*, 2021). Coal makes up the lion's share of ASEAN's energy mix and is projected to make up almost half the region's total GHG emissions by 2040 (Overland *et al*, 2021).

Figure 1: Greenhouse gas emissions of ASEAN countries 1990-2018 ($GtCO_2e$)



Source: CAIT, Climate Watch, and World Resources Institute data

In 2021, 64.6% of Southeast Asian respondents to a regional climate survey conducted by the ISEAS-Yusof Ishak Institute wanted their governments to prioritize climate change alongside COVID-19 in their policy response to the global pandemic, up from 61% in 2020. There was a consistent majority in all ten AMS for climate change to be taken seriously, even as public

health shocks and lockdowns were declared across the region. In other words, climate change and the COVID-19 pandemic were deemed clear and present crises.

Close to two years since the start of the COVID-19 pandemic, countries are now looking towards a recovery, preferably a green recovery. Global leaders and experts argue that the global pandemic is a window of opportunity to trigger a major transformation from fossil-driven, high carbon-based economies to low-carbon or, better still, decarbonized economies. Multilateral development agencies such as the Asian Development Bank (ADB) began to offer toolkits and strategies for countries to start planning their green recovery in phases. The production and supply of COVID-19 vaccinations made it possible to consider the gradual re-opening of economies, travel, tourism and a return to normalcy for those in the developed world.

At the time of this publication's release in November 2021, the hopes of a recovery are more distant for this region as countries continue to face new outbreaks with the Delta variants, with challenges in securing sufficient vaccine supplies for their population. But this is where, it is hoped, this report on Energy Transitions in ASEAN, written with the COP26 climate talks in Glasgow in November 2021 in mind, can provide useful context to governments in this region when strategizing their post-pandemic recovery plans and when aligning their energy policies with the goals of the Paris Agreement. We have deliberately kept this policy report short and digestible.

In the first section, Sharon Seah and Melinda Martinus (ISEAS-Yusof Ishak Institute) examine whether Southeast Asia's stimulus packages are driving towards a greener COVID-19 recovery, particularly renewable energy transition and decarbonization pathways. In the second section, Atanu Ghoshray and Marco Lorusso (Newcastle University) focus on the economic modelling of the energy transition paths in ASEAN-5 countries, namely Indonesia, Thailand, Singapore, Philippines and Malaysia. The energy transition analysis makes use of a long dataset starting from the early 1980s. The empirical results help to inform policymakers on how to achieve sustained economic growth with less reliance on fossil fuels and at the same time, aiming towards a low-carbon environment.

In the third section, Ryan Wong and Lee Poh Onn (ISEAS-Yusof Ishak Institute) investigate the energy-climate nexus in ASEAN and how member countries might tip the balance towards the greater use of renewable energy. This is followed by an analysis of social justice in energy transitions and potential impacts on vulnerable groups by Lorraine Elliott (Australian National University), Abidah Setyowati (Technological University of Delft) and Serina Rahman (ISEAS-Yusof Ishak Institute).

Finally, Melissa Low and Mary Ann Joy Quirapas Franco (Energy Studies Institute, NUS) conclude with a look at the road to, and beyond Glasgow and ask what opportunities and challenges lie ahead for the countries of Southeast Asia in achieving their energy transitions towards a low-carbon future.

COVID-19 Recovery in Southeast Asia

Sharon Seah and Melinda Martinus, ISEAS Yusof-Ishak Institute

Regional Stimulus Spending

As of 28 May 2021, the ten members of the Association of Southeast Asian Nations (ASEAN) have authorized a total of US$730 billion in stimulus measures, equivalent to 7.8% of its total GDP. Its borrowings have also increased, with Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines and Thailand receiving a total of US$15.6 billion COVID-19-related assistance to aid immediate and short-term relief, health and economic measures.

Beyond just a public health crisis, the COVID-19 pandemic is a global economic crisis and a growing debt crisis for developing countries. It is very clear that ASEAN governments have prioritized stimulus disbursements in order to stimulate a faster economic recovery, particularly for the protection of vulnerable livelihoods and businesses. The key interventions in all regional countries are:

- Disbursement of cash assistance to retrenched workers and vulnerable groups,
- Support for micro, small, and medium enterprises (MSMEs) operations,
- Provision of financial assistance and incentives to the heavily-hit critical economic sectors, namely aviation and tourism, and most importantly,
- Strengthening of emergency health responses such as testing capacity and vaccination programmes.

Three ASEAN countries – Singapore, Malaysia, and Myanmar – have incorporated extremely modest green components in their COVID-19 stimulus packages, especially with regards to decarbonization and renewable energy transition.

- Singapore included limited ecological protection measures, such as a S$5 billion coastal and flood protection fund to protect against rising sea levels and provided support to the Ministry of Sustainability and the Environment's SG Eco-Fund for community partnerships on sustainability initiatives in its 2020 Unity Budget. The Unity budget, complemented by three supplementary COVID-19 stimulus packages will cost a total of S$93 billion. Other programmes, such as the public housing Green Town Programme, incentives for low-income households to buy energy-efficient household appliances, and increasing the number of electric vehicle (EV) charging stations and rebates on EV registration fees, were also introduced in the budget. However, these measures may have been part of pre-COVID-19 measures, not as a particular response to pandemic recovery.

- Malaysia introduced energy efficiency and renewable energy transition as part of their COVID-19 recovery measures. Measures such as improving LED street lighting, rooftop solar panels and transmission lines were introduced as part of a RM$13 billion stimulus for infrastructural upgrade.
- Myanmar's COVID-19 Economic Relief Plan introduced a tender of 30 solar projects totalling 1,060MW capacity as a component of its renewable energy infrastructure.

Both Indonesia and the Philippines articulated some green components in their COVID-19 stimulus packages However, these interventions are not for the immediate or medium-term but are much more focused on long-term adaptation and building institutional resilience.

- Indonesia will utilize a US$500 million loan from the ADB to enhance its Disaster Resilience Improvement programme, which targets reform of the country's risk management and health emergency programmes.
- In the Philippines, the Duterte Administration's 4-Pillar Socioeconomic Strategy Against COVID-19 will support food-security and Agri-fishery programmes aimed at enhancing the country's most vulnerable sectors against health and climate crisis in the future. The Philippines government also received a US$1 million loan from the World Bank and the ADB to strengthen their institutional capacity in disaster management that includes policy and institutional framework and community's capacity to recover from environmental disasters.

Environmentally Harmful Interventions

Unfortunately, even under the current discourse of needing to build back better, some ASEAN member states have nonetheless integrated environmentally harmful COVID-19 interventions in their stimulus packages. To name a few:

- Indonesia recently announced a plan to temporarily remove a luxury tax on cars to help the automotive industry recover from the pandemic.
- The government of Vietnam introduced a 30% reduction in environmental protection tax on jet fuel to help to offset losses caused by the COVID-19 pandemic and keep the aviation industry afloat.
- The Malaysian government used part of its stimulus package to accelerate the construction of the Pan-Borneo Highway which is expected to be completed this year. The project is intended to play a critical role in opening up new economic corridors and opportunities, although environmental experts are concerned about the destruction of the Borneo forests resulting in the significant increase in environmental problems such as flooding and biodiversity loss.

ASEAN Comprehensive Recovery Framework

As a region, ASEAN's collective efforts are articulated in the ASEAN Comprehensive Recovery Framework and its implementation plan at the 37th ASEAN Summit in 2020. The framework offers guiding principles for the region to recover from COVID-19 and includes the following measures relating to renewable energy transition and decarbonization pathways:

- Cross-sectoral coordination to frame and sustain an ASEAN energy transition that combines public policy, investments, and behavioral change effectively;
- Design of economic stimulus packages at the national levels that consider green measures, such as leveraging fiscal spending on energy supply and demand infrastructure in support of energy decarbonization in ASEAN;
- Identification of specific measures in member states to support investments that deploy clean electricity sources, expand and modernize power grids, improve the energy efficiency of appliances, buildings, and industrial equipment and increase the spread of cleaner transport and use of sustainable biofuels and other clean energy innovations;
- Generate green jobs and leverage the use of holistic tools and frameworks to assess the impact of relevant measures to cover not only the cost of energy but also broader impacts in terms of emissions, biodiversity impacts, water footprint, air quality and human health, job creation, energy access and resilience;
- Enhance collaboration and partnerships to ensure ASEAN's capacity to access innovations and deploy emerging technologies (including through establishment of public-private funds developing technical assistance and knowledge exchange hubs, R&D investments; and upskilling and reskilling ASEAN's workforce for green jobs, etc.);
- Ensure that the ASEAN energy sectoral work plan achieves, at the minimum, its clean energy targets by 2025 (i.e., 23% share of renewable energy in the ASEAN energy mix and at least 30% energy intensity reduction);
- Strengthen the energy supply chain through diversification to enhance resilience.

Although the ASEAN Comprehensive Recovery Framework advocates green recovery (including green growth, green jobs, green infrastructure, decarbonization pathways), the decision to take up proposed measures remains at the country level, and is not coordinated at the regional level. It is likely that national decisions and actions regarding energy transitions will take priority over regional actions in the near term. Without strategy and coordination, the region runs the risks of missing opportunities for a green recovery.

Moving forward, ASEAN as a regional organization needs to further explore ways for its member states to ramp up its decarbonization efforts in a collective manner. This could be done by:

- Building synergies between environment, energy and trade/industry/economic development ministries. This effort could drive a whole-of-government effort towards achieving Paris Agreement goals and provide opportunities for economic growth and ensure energy security in the region.
- Collectivising renewable small-scale renewable energy projects under a regional portfolio. The main challenge in scaling up renewable energy transition is bankability of projects. Managing a collection of small-scale renewable energy projects across ASEAN countries under a single regional portfolio could increase investment attractiveness.

Key Results of Economic Modelling of Energy Transition in ASEAN-5

Atanu Ghoshray and Marco Lorusso, Newcastle University

Dynamic Interactions in Economic Modelling

The economic analysis in this section considers the dynamic interactions between key economic and environmental variables that would help understand issues related to energy transition. The variables included in the model are energy consumption (both renewables and non-renewables), Gross Domestic Product (GDP), CO_2 emissions, and number of patent applications (as a proxy for technological innovation).

The model captures the long-run relationship between the variables (approximately five years), and any short-run effects as well (less than one year) using long time series data (starting from the early 1980s). Simulations of the estimated model are provided for cases where external shocks hit one or more of the variables that are analysed, such as economic booms or recessions, a sudden plunge or surge in energy consumption, or a sudden and sharp increase or decrease in technological progress. Then, the effects of these shocks on CO_2 emissions are traced out over a twelve-year horizon.

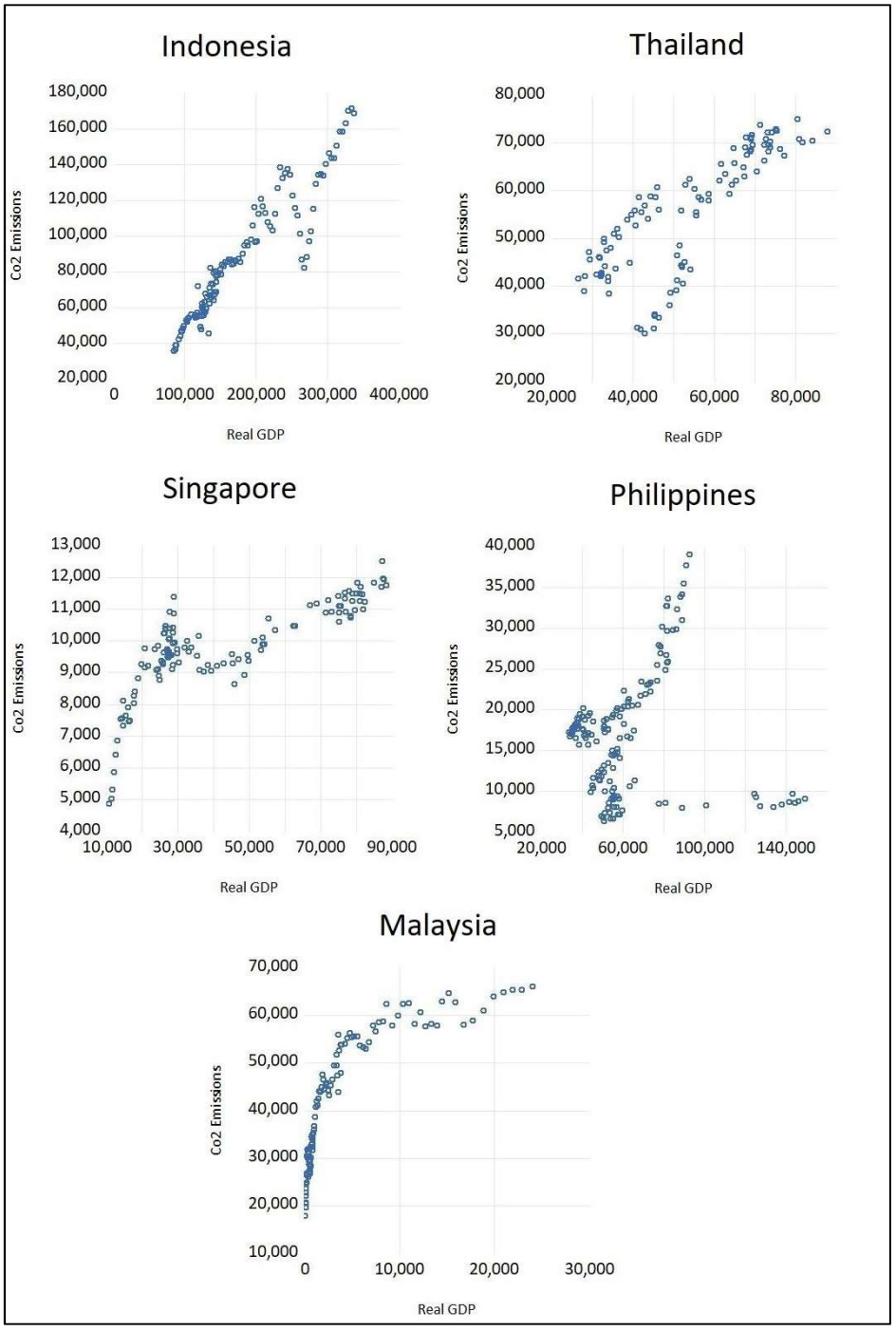
The findings presented below are in line with established economic theories. In particular, for the five countries for which data was available, the energy consumption and economic growth nexus was studied, as well as the economic growth and CO_2 emissions nexus.[1] Some theories suggest that an increase in energy consumption leads to economic growth. Other theories indicate that if economic growth induces an increase in energy demand, then the challenge is to reduce this energy demand through market-oriented policies (in a similar spirit as the EU Emissions Trading System) and/or government regulation (such as CO_2 emission cap). Further, economic theory indicates that an increase in the number of patent applications based on environmental-related technologies tends to reduce CO_2 emissions.[2]

We start by focusing on some stylized facts about the relationship between GDP and CO_2 emissions in the ASEAN-5 countries, as shown in Figure 2. These five scatterplots have different sample periods according to the data availability in each country. In each scatterplot, we have GDP on the horizontal axis, whereas CO_2 emissions are represented on the vertical axis.

[1] The nexus between energy consumption and economic growth theories in the literature has been tested by hypotheses such as the "Growth Hypothesis", the "Conservation Hypothesis", or "Feedback Hypothesis", where such empirical support of the nexus is found, or the "Neutrality Hypothesis" where there is no support for the nexus. The economic theory on the relation between economic growth and the environment is referred to as the Environmental Kuznets Curve and the variants of this hypothesis.

[2] As defined by OECD, the environmental-related technologies relate to all those technologies that include environmental management, water-related adaptation, and climate change mitigation.

Figure 2: Scatterplots of the GDP and CO_2 emissions for the ASEAN-5 countries



Source: Authors' calculations based on CEIC database, OECD, IEA and World Bank data.

Notes: The scatterplots above are based on quarterly data. The sample periods are as follows: Indonesia, 1990:Q1-2018:Q4; Thailand, 1993:Q1-2018:Q4; Singapore, 1980:Q1-2018:Q4; Philippines, 1981:Q1-2018:Q4; Malaysia, 1992:Q2-2018:Q4. In each country, CO_2 emissions are measured in Kt, whereas the real GDP is expressed in US$ and deflated by the GDP deflator.

At a first visual inspection, it emerges that for all countries there is a positive relationship between economic growth and CO_2 emissions. However, this positive relationship is linear in certain cases and non-linear in others. For example, we observe a positive linear relationship for Indonesia, Thailand and partly for the Philippines.[3] This would suggest that, in these three countries over the last three decades, GDP and CO_2 have grown hand in hand. In contrast, Singapore and Malaysia show a non-linear relationship, i.e. they have decoupled economic and emissions growth. This would indicate that, in these three countries, GDP and CO_2 have not grown at the same pace in the last three decades. In the empirical analysis that we present below, we quantitatively assess this relationship, together with the other variables of our model.

INDONESIA

- In Indonesia, there is a long-run relation between energy consumption and economic growth. GDP is positively associated with energy consumption, i.e., increases in energy consumption are associated with higher GDP; or a higher GDP is associated with higher energy consumption. The contribution of non-renewable energy consumption is greater than renewables in relation to GDP. In particular, between 1992 and 2018 the average share between fossil-fuel consumption and total energy consumption was approximately 96%.
- There is also a long-run relationship between GDP, CO_2 emissions and patents. CO_2 emissions vary directly with GDP and inversely with patents. This implies that an increase in the number of patents is associated with a decrease in CO_2 emissions and vice-versa, suggesting that technological progress plays an important role in reducing CO_2 emissions. In Indonesia, an increase in GDP is accompanied by an increase in CO_2 emissions. Therefore, in this country, there is a positive link between economic growth and pollution. On the other hand, the negative relationship between CO_2 emissions and the number of patents suggests that policymakers should prioritize the adoption of environmental-related technologies in order to reduce carbon emissions.
- In the short run, a change in renewable energy consumption causes a change in CO_2 emissions. This relationship is inverse, i.e., an increase in renewable energy consumption causes a decrease in CO_2 emissions. The policy recommendation for Indonesia would be to increase the renewable energy production at a low cost. This, in turn, would stimulate an increase in renewable energy consumption and lower CO_2 emissions.

One of the findings from the simulation analysis shows that a positive shock (i.e. a notable increase) in the number of patents leads to significant decline in CO_2 emissions. Although this effect lasts less than two quarters, it seems promising. Policymakers could incentivize the

[3] Figure 2 shows that Indonesia has the highest GDP and the largest amount of CO2 emissions among the ASEAN-5 countries

development of patents based on environmental-related technologies, which, in turn, may lead to a persistent reduction in CO_2 emissions for this country.

THAILAND

- In Thailand, a long-run positive relationship is found between GDP and energy consumption. GDP is positively associated with energy consumption, i.e., increases in energy consumption are associated with a higher GDP; or a higher GDP is associated with higher energy consumption.
- We identify a second long-run relationship between GDP, CO_2 emissions and patents. CO_2 emissions vary directly with GDP and inversely with patents. For Thailand, we find a positive link between economic growth and CO_2 emissions. A decline in CO_2 emissions with an increase in patents suggests that policymakers should prioritize the adoption of non-fossil fuel technologies in order to reduce carbon emissions.
- In the short run, we find that an increase in GDP leads to an increase in CO_2 emissions.

The simulation analysis revealed that a positive shock to GDP leads to an increase in CO_2 emissions. This indicates that an increase in economic activity leads to higher CO_2 emissions. As a policy implication, Thailand would need to increase the renewable energy production at a low cost. This, in turn, would stimulate an increase in renewable energy consumption and lower CO_2 emissions.

SINGAPORE

- In Singapore, there is a long-run relationship between GDP and energy consumption. GDP is positively associated with energy consumption. This means that increases in energy consumption are associated with a higher GDP; or a higher GDP is associated with higher energy consumption.
- There is a second long-run relationship between CO_2 emissions, GDP and renewables. An increase in GDP is accompanied by an increase in CO_2 emissions, and an increase in renewables is accompanied by a decrease in CO_2 emissions.
- Short run results show that a change to renewable energy consumption causes a change in CO_2 emissions and the relationship is inverse, i.e., an increase in renewable energy consumption causes CO_2 emissions to decrease.

These simulations provide two main findings. First, a positive shock to non-renewable energy consumption leads to a sustained increase in CO_2 emissions. Secondly, a positive shock to the number of patents leads to a significant decline in CO_2 emissions, an effect that lasts just under two quarters. This result seems promising. Policymakers could incentivize the

developments of patents based on environmental-related technologies, which, in turn, may lead to a persistent reduction in CO_2 emissions.

PHILIPPINES

- In the Philippines, there is a long-run relationship between GDP and energy consumption. GDP is positively associated with energy consumption. This result implies that increases in energy consumption are associated with a higher GDP, or a higher GDP is associated with higher energy consumption.
- In the long-run, CO_2 emissions vary inversely with GDP.
- In the short run, changes in GDP cause a change in CO_2 emissions and the relationship is direct, i.e., an increase in GDP leads to an increase in CO_2 emissions. Furthermore, changes in GDP cause a change in patents and the relationship is direct, i.e., an increase in GDP leads to an increase in patents.

There are several findings from the simulation analysis. First, a positive shock to non-renewable energy consumption leads to an increase in CO_2 emissions. Second, a positive shock to renewable energy consumption induces a decrease in CO_2 emissions. Third, a positive shock to GDP leads to an increase in CO_2 emissions. An appropriate policy response, which would keep economic growth constant and reduce CO_2 emissions, would be to increase renewable energy production at a low cost. This, in turn, would stimulate an increase in renewable energy consumption and lower CO_2 emissions.

MALAYSIA

- In Malaysia, there is a single long-run relationship between energy consumption (renewables and non-renewables), GDP, CO_2 emissions and patents. This result is quite different from the other four countries since we identify one, rather than two separate, long-run relationships between all variables. In the other four countries, there are two long-run relationships among variables: (1) energy consumption and GDP; and (2) CO_2 emission and GDP (and patents in certain cases). Here, there is only one long-run relationship, between energy consumption, GDP, CO_2 emissions and patents.
- Short-run results show that changes in GDP cause changes in energy consumption of non-renewables and the relation is direct, i.e., an increase in GDP causes an increase in non-renewable energy consumption.

One finding from the simulation analysis shows that a positive shock (i.e., a notable increase) to the number of patents leads to a significant decline in CO_2 emissions. This effect lasts just over two quarters. This result seems promising. Policymakers could incentivize the

development of patents based on environmental-related technologies which in turn, may lead to a persistent reduction in CO_2 emissions.

To conclude, there are some commonalities in terms of relationships between the variables for ASEAN-5 countries. For example, a positive association between economic growth and energy consumption, as well as the prevalence of a positive relationship between economic growth and CO_2 emissions. On the other hand, it should be noted that, if each country seeks to maintain the goal of sustained economic growth, the energy transition path would be different according to the specific characteristics of each economy. From a policy perspective, the ASEAN-5 countries could incentivize non-fossil fuel energy production and patents based on environmental-related technologies with the objective of reducing CO_2 emissions. In particular, given that Indonesia has the highest CO_2 emissions among the ASEAN-5 countries, the adoption of the above-mentioned polices in Indonesia would help the entire region to significantly reduce carbon emissions and, thus, to meet the climate change goals. To avoid an economic slowdown, Indonesian policymakers could stimulate their economy by increasing R&D expenditure.

ASEAN Energy-Climate Plan in 2025

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The earlier sections looked at COVID-19 Recovery in Southeast Asia and explored the potential of innovative energy-related policies to increase the deployment of clean energy technologies to reducing CO_2 emissions. In this section, we examine two kinds of institutional setup that would promote greater innovation and uptake of clean energy technologies. Firstly, the national and regional institutions should embrace energy-climate integration and multilateral energy trade. We see a need to improve the coherence between the energy sector and climate change ambitions in the regional energy plan broadly. Secondly, another perspective is the large-scale incorporation of renewable energy in the power grids. The International Energy Agency estimated that US$3 trillion is to be invested in renewable energy and efficiency measures in Southeast Asia between 2017 and 2040 for a clean energy transition. Finally, we strongly recommend that the developed countries cooperate to close the USD$1 trillion dollars gap for energy transition every year for the next three years.[4] ASEAN needs to think of a region-wide transformational policy approach to energy transition.

Recognizing Window of Opportunity for Energy-Climate Integration

The ASEAN Plan of Action for Energy Cooperation (APAEC) aims to achieve a renewable energy target of 23% by 2025, which is a significant increase from the 13.9% in 2018. Its achievement to date has been limited by underperforming institutions responsible for implementing APAEC. It can run the risk of being largely rhetorical, outcompeted by other national priorities, and plagued by unchallenged visions and simplified models. The APAEC is considered a capacity building plan but one that does not make material commitments, especially in the area of renewable energies. The most material commitment relates to infrastructure development and policy development while others include general monitoring and actor networking. The APAEC 2016-2020 mentions “climate” eight times while the next iteration (2021-2025) mentions it 24 times. “Decarbonization” is not even mentioned in the first document but it is used 8 times in the second document. The 2021-2025 plan took the existing efforts further by framing energy efficiency as a significant contribution to addressing climate issues. In addition, clean coal technology has emerged as the region’s primary response to energy transition. With the 2021-2025 plan now specifying activities for exchanging information between the climate and energy sectors, the dialogue and deliberation could build the political momentum and technical capacity for setting ambitious targets on renewables and emission in the next iteration of APAEC post 2025.

ASEAN dialogue partners and organizations have a critical role to play to create enabling conditions for major transformative energy changes in ASEAN. Being the secretariat of APAEC, the ASEAN Centre for Energy can provide better modelling of pathways for energy transition.

[4] International Energy Agency (2021) *Sustainable Recovery Tracker*, October 2021. https://www.iea.org/reports/sustainable-recovery-tracker/key-findings

The models would help justify what and by how much should the developed countries invest. This can then be followed by a multi-level, multi-stakeholder dialogue that actively includes the civil society and think tank for raising the climate pledges in the Nationally Determined Contributions.

Tipping the Balance of Renewable Energy Trade

Multilateral trading will further unlock the benefits of a regional power grid, which include greater economies of scale, better access to diverse energy resources, and increased stability of energy supply. The shift from bilateral to multilateral trading will depend critically on the political will to reform ASEAN institutions. Policy makers may like to consider three energy-trade models that differ from each other in the level of regional integration. First is a harmonized bilateral trade model, which involves a set of standardized bilateral contract templates, a standard wheeling charge methodology (intermediary country transmitting power from one country to another), and a "regional coordinator" institution to manage transactions. The bilateral trade model with a regional coordinator would allow an individual ASEAN country to enter into bilateral agreements with any other country even if they do not share a border. Second, the development of a secondary trading model that involves creating a regional power market that is separate from the national market and system operations. This model would also require a central clearing party, as well as a regional market operator (to collect information on demand and supply). There may also be the need for a central clearing party to collect and distribute payments from one country to another. Lastly, a primary trading model could replace the national markets with a fully integrated regional market through market restructuring. There would be no national or local markets, just a regional one. The role of institutions is essentially the same, but their overall responsibilities would increase significantly under this model. Most AMS may not choose to implement primary trading quickly, as this would involve developing a fully integrated regional market that necessitates the completion of a regional grid infrastructure, accompanying institutions, harmonized grid codes, and a supranational regional market coordinator and authority. Beyond the power grid on mainland Southeast Asia, an interesting development involving the supply of renewable energy to the region via underwater cables has every potential to be scaled up. The first stop is Singapore and Indonesia. Brunei and the Philippines could well be serviced if the operating models are proven to be commercially viable and financially supported by governments.

Inviting Future Investments from ASEAN Partners

ASEAN's key dialogue partners including the United Kingdom, Japan and the European Union (EU) has the money, the technologies, and the policy experience for decarbonization. ASEAN countries on the other hand are willing to receive these where the climate interests and development needs can be met. Japan is investing US$10 billion in renewable and carbon

capture technologies. A €10 million programme for disaster management from the EU was well-received. Given that the United Kingdom (UK) has US$52 billion worth of bilateral trade with ASEAN, Southeast Asian countries could build on the existing ties and welcome technical and financial assistance especially in the areas of offshore wind and hydrogen production. The UK has an ASEAN Low Carbon Energy Programme that delivers a £15 million assistance programme to facilitate green finance and energy efficiency. With its formal admission as ASEAN's 11th Dialogue Partner in August 2021, the UK is expected to do more to create enabling conditions for major transformative energy changes in ASEAN.

Just Transitions and Job Creation

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Earlier sections focused on the governance and policy infrastructure needed for the region's post-pandemic recovery and low-carbon energy transition. A key aspect of meeting these challenges lies in ensuring that capacities for building a sustainable and resilient ASEAN are raised across the region. As Southeast Asia makes use of national and regional energy transition opportunities, social justice emerges as a key concern including in the creation of quality jobs and decent work under the Just Transition (JT) commitments of the Paris Agreement.

The principles of energy justice (see Text Box 1) call for transitions to address energy poverty and access, ensure appropriate and reliable forms of energy security at local and national levels, deliver environmental sustainability, identify past injustices, and ensure that existing injustices are not prolonged or replicated.

Text Box 1: Energy Justice[5]

Distributional:	equal and equitable distribution of benefits and burdens related to energy production and consumption
Procedural:	equal and meaningful participation of all stakeholders in energy decisions
Recognition:	acknowledgement of distinct and diverse identities and histories of people in affected communities, including forms of exclusion, in relation to the energy system

Under the Paris Agreement, and as one step to meet these broader energy justice principles, governments have committed to a "just transition of the workforce and the creation of decent work and quality jobs", a commitment also actioned as a key work area of the UNFCCC "improved forum" on the impact of the implementation of response measures. The UNFCCC Secretariat advises that job creation has both quantitative and qualitative aspects, the former focusing on the *number* of jobs affected and created, and the latter on the *quality* of jobs created or transformed. Just transitions across the energy system will therefore require policy action in three key areas: support for and reskilling of workers currently in fossil fuel energy

[5] For more on the principles of energy justice, see Setyowati, A. B. (2021) Mitigating inequality with emissions? Exploring energy justice and financing transitions to low carbon energy in Indonesia, *Energy Research & Social Science,* 71, pp. 1-10. https://doi.org/10.1016/j.erss.2020.101817; Elliott, L. and Setyowati, A. B. (2020) Toward a socially just transition to low carbon development: the case of Indonesia, *Asian Affairs,* 51 (4), p. 875-94.

sectors; decent jobs in the renewable energy sector; and the creation of sustainable jobs in sectors affected by energy transitions.

The International Labour Organization's (ILO) Decent Work Agenda [6] provides a useful framework for job creation and labour market transitions under the JT expectations of the Paris Agreement. Jobs must recognize fundamental employment rights, protect workers from health and safety hazards and risks, and enhance social protection mechanisms that safeguard workers from the negative impacts of economic restructuring. They must ensure social dialogue that enables workers to be informed and heard, expand employment opportunities for women and for groups marginalized in the informal economies, address employment inequalities in existing energy sectors, and avoid reproducing those inequalities in new energy sectors.

Just Transitions and Job Creation in the Renewable Energy Sector

Job creation in the renewable energy sector is key to the decent work demands of a just energy transition. With a collective target of obtaining 23% of its primary energy from renewables by 2050, AMS should be well placed to take advantage of the transition to renewable energy production and consumption. Employment in sectors with strong green jobs potential – such as electricity generation, gas, steam and air conditioning supply – currently sits at only 0.5% of the ASEAN workforce according to the ILO, although the International Renewable Energy Agency (IRENA) calculates that in 2016 ASEAN accounted for more than 6% of the 10.3 million people employed globally in the renewable energy sector. Data from IRENA's 2019 Renewable Energy and Jobs Annual Review shows that employment profiles vary across the region. Malaysia has the largest solar photovoltaic workforce in ASEAN. The Philippines is the region's biggest employer in the wind energy sector and Vietnam accounts for 6% of global jobs in hydropower (although, as we note below and in Text Box 3, hydropower itself can come with social and environmental challenges as a renewable energy sector).

ASEAN countries face some challenges in implementing the decent work and quality jobs expectations that define Just Transitions under the Paris Agreement. First, two non-fossil fuel energy sectors that account for the highest proportion of the region's renewable energy jobs – liquid biofuels (53%) and large-scale hydropower (19%) – can have significant environmental and social consequences, including negative impacts on biodiversity and terrestrial ecosystem services, loss of soil fertility, fragmentation of riverine habitats, displacement of local communities and diversion of land away from food crops [see text box 3].

[6] International Labour Organisation (2015) The global framework for just transitions and job creation also includes the new ILO Climate Action for Jobs Initiative (established in 2020) and the Energy and Jobs Platform initiated by the International Renewable Energy Agency under the umbrella of SDG7 Technical Advisory Group.

The second challenge arises in ensuring that workers have the necessary skills to support decent work and quality jobs. In turn, this relies on understanding better where job creation opportunities will arise along renewable energy supply chains. This mix of jobs - equipment manufacturing, construction and installation, and operations and maintenance, as well as those in administration, project planning and development - differs across sectors. The liquid biofuels sector relies on high levels of employment in planting and harvesting of feedstock and much lower levels in processing facilities, though the latter are better paid and require higher technical skills. In hydropower, by contrast, IRENA calculates that 75% of jobs globally are in operations and maintenance, a figure that we might expect to see replicated in ASEAN. Much of the available labour market data for ASEAN focuses on formal on-grid renewable energy sectors. There is a paucity of clear data on the flow-on employment impacts of job creation in on-grid renewables as well as on job impacts of the deployment of off-grid energy production such as decentralized renewable energy (DRE) mini-grids and stand-alone solar home systems (SHS).

Text Box 2: Gender and socially inclusive just transitions

Energy transitions must include gender-sensitive measures to ensure that outcomes are both inclusive and equitable. Studies in Southeast Asia demonstrate that community engagement in energy transitions will not automatically lead to fairer outcomes as the interventions often reinforce inequalities and further marginalize women and vulnerable groups (Fathoni et al 2021; Hill et al 2017). As one example, access to clean cooking technology is predicted to reach 59% of the population by 2030, but the remainder will still be reliant on biomass fuel (IEA 2017). Traditional household gender roles mean that women will be most affected by the health consequences of indoor pollution associated with biomass cooking and the time burden involved in collecting firewood. There is also ample evidence that energy transitions could disproportionally affect women in job creation. IRENA shows that while women occupy a larger share of jobs in renewable energy compared with the oil and gas sector, they still account for only 32% of the fulltime workforce in renewable energy. Within that workforce, women are more likely to hold administrative positions rather than jobs requiring technical expertise. In Myanmar, Laos, Cambodia, the Philippines and Indonesia, more women than men are in informal employment, making them more vulnerable to job insecurity (ILO 2018). The barriers inhibiting women from the renewable energy workforce and decision-making processes include cultural and social norms, unequal asset ownership and limited access to knowledge skills and training opportunities.

A third challenge arises because job creation in renewable energy sectors will need to account for and overcome high levels of informal and vulnerable employment [see text box 2]. The

ILO calculates that across ASEAN more than 47% of employment can be classified as vulnerable with workers more likely to experience low job and income security and less coverage by social protection systems and employment regulation. The vulnerable employment sector is highest in Lao PDR with 83% of workers falling into this category. More than 50% of workers in Myanmar, Vietnam, Cambodia and Thailand are considered vulnerable. Brunei Darussalam and Singapore lie at the other end of the scale with less than 10% of workers defined as vulnerable, mainly because of those countries' minimal reliance on agricultural sectors.

Text Box 3: Renewable energy challenges in rural areas

An authentically sustainable renewable energy project needs to take into account the risks of irreversible ecological and socioeconomic damage if it is to meet the conditions of a "just transition". Yet popular rural energy solutions such as large-scale hydropower dams require vast land clearing and forest destruction, the takeover and flooding of (usually indigenous) lands and natural habitats, and community displacement (Ansar et al 2014). Wind energy and tidal barrages can affect coastal community territories and fishing grounds, and impact coastal hydrology and fish movements. Large-scale solar farms can also result in indigenous land loss, land clearing and smallholder and subsistence farming land takeovers as land prices soar, leading to local food insecurity (Smith 2018; Lu et al 2020). Difficulties in accessing rural areas results in high infrastructure transport and maintenance costs. Inadequate training for local repairs means damaged equipment is left abandoned and unused. The safe disposal of highly toxic and unrecyclable materials in areas that often do not have basic rubbish and sewage systems is another problem (Shellenberger 2018). Hybrid renewable energy systems combining micro-hydro equipment with small-scale solar installations and training of local communities have proven effective for small communities off the main grid yet even then coal or diesel-powered generators are still required at times of low rainfall or high cloud cover.

From a policy perspective, individual ASEAN countries and ASEAN as a regional organization, can take further steps to commit to the Just Transition provisions of the Paris Agreement and to implement energy transition policies in a way that recognizes the importance of social justice principles. Policies should ensure that decarbonization and energy transition programmes create quality jobs and ensure decent work. Such policies should highlight social inclusion, gender empowerment and sustainable rural development as three key performance indicators of the success of decarbonization and renewable energy transitions. This requires taking into account the financial, technical and logistical limitations of vulnerable communities, including rural communities, to ensure that renewable energy transitions are just, feasible and inclusive.

Conclusion

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This policy report has examined the opportunities and challenges for AMS in the low-carbon energy transition. The diversity across ASEAN makes it challenging to compare directly and draw overarching region-wide conclusions. This report has, therefore, utilized inter-regional and international analyses to highlight the varying levels of ambition and the constraints shaping climate policies in the AMS. Looking ahead, there is an opportunity for ASEAN to play a key role in facilitating its member states to realize their Paris Agreement goals.

With rapidly growing economies, the region is making a more significant contribution to global emissions. This has increased the need for a more holistic or balanced approach in ensuring greener, low-carbon developments. Effective cross-ministerial coordination within each country would greatly facilitate energy planning in alignment with climate change mitigation plans. Furthermore, it is essential to increase the renewable energy share in the overall power supply and to implement energy efficiency programmes to ensure long-term sustainable energy transition. By decreasing the capacity of coal-fired power plants and adding more renewables into the energy mix, this can further strengthen each country's ongoing mitigation efforts. The installation of renewable energy facilities should be accelerated to a rate that will enable the replacement of coal power completely.

The Intergovernmental Panel on Climate Change (IPCC) Working Group 1 Report on the Physical Science Basis of the Sixth Assessment published in August 2021 highlights that there must be no new coal plants built after 2021 (IPCC, 2021). It notes that the 38 members of the Organisation for Economic Cooperation and Development (OECD) must phase out existing coal by the end of the decade, and all other countries must do so by 2040. In order to keep global temperature increase to below 2°C or even 1.5°C, all new fossil fuel exploration and production must cease. The report also recommends that fossil fuel subsidies be channelled into renewable energy. Further, solar and wind capacity should quadruple and renewable energy investments should triple by 2030 in order for the world to maintain a net zero trajectory by mid-century. These policy recommendations have yet to be translated into goals for ASEAN, but the region must play its part in tackling global climate change.

Otherwise, the emissions impact from coal and other fossil fuel-based resources will continue to undermine the growth in renewable and clean energy across the region, particularly as energy demand is still growing. It should also be recognized that the effects of climate change, such as droughts, can impact the power systems of the AMS and their long-term energy security. This is especially true for countries like Laos that are highly dependent on hydropower where water quantity and quality are also affected by climate change, and therefore the amount of electricity being produced.[7]

[7] See, for example, Sivongxay, A., Greiner, R. and Garnett, S. T. (2017) Livelihood impacts of hydropower projects on downstream communities in central Laos and mitigation measures, *Water Resources and Rural Development*, 9. pp. 46-55. and Soukhaphon, A., Baird, I. G., and Hogan, Z. S. (2021) The Impacts of Hydropower Dams in the Mekong River Basin: A Review, *Water* 13(3), 265. https://www.mdpi.com/2073-4441/13/3/265

It is also crucial to create an enabling environment to facilitate renewable energy deployment in the short term. This could be done through government support – for example, by subsidizing initial investments, providing tax incentives and de-risking investments through power purchase agreements or feed-in-tariffs (FiTs). A level playing field is required for renewable energy to compete fairly with fossil fuels in the long term. The powerful indirect influence of the subsidy of fossil fuels has to be addressed. A long-term commitment, such as those in Long-term Emission Reduction Strategies, should be appropriately designed to complement the relatively mid-term Nationally Determined Contributions (NDCs).

Among AMS, important co-operation areas may include facilitating collective carbon mitigation efforts in the regional energy and forest sectors. This could be tackled through the establishment of carbon trading mechanisms by leveraging each country's strength in terms of trade (or goods they are efficiently producing).[8] All these trends point towards a need to capitalize on the recent positive momentum among the AMS in addressing climate change's current and future challenges and minimizing its impact on the region's future prosperity (Bain & Company, 2020). Presently, there are discussions about establishing an ASEAN Power Grid, which would initially connect the region on cross-border bilateral terms. It would eventually expand to sub-regional and local levels to fully integrate a Southeast Asian power grid system. As mentioned above, it is vital to co-develop institutions within the region whilst building the infrastructure. For example, ASEAN is working with the International Energy Agency (IEA) to establish a multilateral power trade system with clear actions to develop cross border trading system in the region (IEA, 2019).

Consideration of energy demand is as important as securing clean energy sources that are socially just and support global environmental commitments that each country has made. One of the main challenges in the region is the provision of equitable energy access to vulnerable groups and energy-poor communities. The regional sustainable energy transition framework can benefit from allowing avenues for local and community stakeholders to participate directly in the decision-making process of the energy transition projects. While it is important to have technological and market-driven solutions, it is also crucial to consider the human and environmental aspects of the sustainable energy transition.

Alongside achieving regional and national targets to address climate change, government activities should also holistically address the direct energy realities and socio-economic needs of the marginalized communities and off-grid rural areas. For example, AMS should explore ways to better integrate the climate change and biodiversity agendas, and their combined social impacts.[9] Women and indigenous people are likely to be very important in creating localized energy solutions. Finally, AMS can encourage more community-based approaches and engagement towards long-term sustainable energy transition.

[8] See, for example Green finance report published as part of the UK-Singapore COP26 Universities Network policy reports.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026880/Green_Finance_COP26_Universities_Network_Policy_Report.pdf

[9] See, for example, the IPBES-IPCC Co-Sponsored Workshop Report on Biodiversity and Climate Change published on 10 June 2021, and the Nature-based climate solutions report published as part of the UK-Singapore COP26 Universities Network policy reports.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026882/Nature-based_Solutions_COP26_Universities_Network_Policy_Report.pdf

Finally, ASEAN can play a role to catalyze the low-carbon energy transition in the region by promoting cross-regional dialogues while bringing together member states and various non-state actors to agree on mutual areas of focus and influence across the energy and climate policies. ASEAN Governments have a vital role to play to ensure the long-term success of the Paris Agreement, particularly given their emissions trajectories now and in the future. Amid their economic recoveries from COVID-19, it will be essential to develop a clear understanding of how this has and will continue to affect their experiences in meeting, enhancing and implementing their NDCs and ensuring their continuous sustainable energy transition.

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