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Bridging the implementation gap for climate mitigation in ASEAN: a comprehensive capacity-building framework

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Abstract

Purpose – The paper systematically examines the capacity building needs of energy and climate stakeholders in the Association of Southeast Asian Nations (ASEAN). It looks at conditions and opportunities for improvements in institutional, organisational, technological, innovation and financing capacities. This paper provides a guide to concrete capacity building programs and implementations to accelerate the implementation of National Determined Contributions (NDCs) and low-carbon energy transition in the ASEAN region.

Design/methodology/approach – This paper proposes a comprehensive capacity-building framework, drawing on transition management theory and the interactive systems framework for capacity building. The assessment is based on interviews with representatives of the ministry responsible for energy policy and the ministry responsible for climate policy in each ASEAN country, as well as a survey among a broader set of Southeast Asian energy and climate experts from academia, think tanks and international development partners.

Findings – The paper identifies the priority areas for capacity building for each ASEAN country and the region as a whole. Each country has a unique set of needs and priorities. At the regional level, the widest capacity gaps were observed in institutional capacity, technical capacity, human resources capacity, financing capacity and the capacity to develop policy and legislation. Specific gaps for capacity building are discussed in delivering strategic areas of energy transition, such as electrification of transportation, development of the green supply chain, deploying renewable energy, energy efficiency, strengthening finance and investment and reducing dependencies on fossil fuels.

Originality/value – This paper helps fill the gap for detailed capacity needs analysis and facilitates long-term plans/strategies and their implementation. The insights help to increase ASEAN energy and climate

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stakeholders' understanding of the interaction between energy and climate, therefore enhanced capability in developing more effective action maps and intervention points in achieving NDCs and sustainable development goals.

Keywords NDC implementation, Capacity building, Climate mitigation, Low carbon development, Energy transition, Long-term strategy, Net zero

Paper type Research paper

1. Introduction

In line with the Paris Agreement to limit global warming to 1.5° above pre-industrial levels, the ASEAN member states have set unconditional and conditional Nationally Determined Contribution (NDC) targets (Veng, Suryadi, Pranadi, & Shani, 2020). Nine out of ten ASEAN member states have also committed to net zero targets (ACE, 2022). Aligning with the 1.5°C target requires technology diffusion and sector transformations on a large scale and at a high speed, often in the form of the immediate introduction of low emissions technologies rather than marginal efficiency improvements (Kuramochi *et al.*, 2017). The majority of Southeast Asian countries regard renewable energy deployment, electrification of transport, and sustainable urban development as the main areas for reducing GHG emissions (Amponin & Evans, 2016; Lau, 2022). Several decarbonization technologies and measures require a high level of technical competence, institutional capacity, and effective coordination across different sectoral agencies (Khosla, Sagar, & Mathur, 2017).

Moreover, the ASEAN countries face energy security and affordability challenges due to a lack of technical capability, human capacity, supply chain capacity in the clean energy sector, and access to finance (Gunningham, 2013; UNFCCC, 2020). The path dependence of the countries with significant fossil fuel production or large fossil fuel reserves, mainly Indonesia and Vietnam, constitutes a major hurdle to improving energy sector efficiency throughout the value chain, including production, transmission, distribution, and end-use (Aris & Jørgensen, 2020). To overcome the barriers to a low carbon transition in ASEAN, it is paramount to improve local capacities, by developing the skills of stakeholders in government, industry, the private sector, and society (Overland *et al.*, 2021).

Cambodia, Indonesia, Lao PDR, Myanmar, Thailand, and Vietnam have made parts of their NDCs conditional upon international support and assistance. To enhance the cost-effectiveness of climate change mitigation and to facilitate, expedite, and enhance technology development and transfer, capacity building and access to financial resources will be decisive (Amarjargal *et al.*, 2020).

No systematic analysis has been published on the barriers, capacity development needs, and enabling environments for NDC implementation and energy transition in the ASEAN countries. The sparse analysis that has been published in this field either focuses on other parts of the world or is global in scope. UNDP (2016) conducted a survey among 72 respondents representing 58 developing countries and identified the common needs for capacity development/technical support to support the implementation of their NDCs. The top four needs identified were: (1) mobilization of resources for NDC implementation, (2) development of concrete NDC implementation plans, (3) improvement of the information base and monitoring systems, and (4) building institutional structures and coordination mechanisms. Khan, Mfitumukiza, and Huq (2020) mapped the capacity needs of Cambodia, Indonesia, Lao PDR, Malaysia, and Vietnam in the energy, building, transport and other sectors. They used capacity building categories derived from the Paris Agreement, including education, training and public awareness, institutional capacity building, research, and technology development. However, these broad capacity categories are of limited use to guide concrete capacity building programs and implementation. More specific and detailed capacity needs analysis is required as a basis for actual bilateral and multilateral technical assistance. This paper aims to fill this gap.

Decarbonization pathways are characterized by high levels of uncertainty, multiple dimensions, interactions across different spatial and policy levels, and the involvement of a multitude of actors (Klinsky & Sagar, 2022). In response to this uncertainty and complexity, we take a systematic approach to examining stakeholders' capacity needs across the climate and energy space in the ASEAN countries by: (1) bringing together transition management theory and the Interactive Systems Framework for capacity building; (2) laying the foundation for balancing the interests of various Southeast Asian energy and climate stakeholders to identify potential intervention points; (3) increasing awareness about the interactions between climate and energy policies; and (4) identifying gaps and mismatches in expectations at various levels, in ministries in the ASEAN member states, at the level of ASEAN as a regional organization, and between member states and international organizations.

Section 2 outlines our analytical framework, along with a typology of capacity types used in our analysis. Section 3 presents our methodology. In Section 4, capacity needs at the system level to implement NDCs as identified by our interview and survey respondents are highlighted. In Section 5, we dive into focus areas for climate mitigation, and detailed action points for capacity building at the delivery level to achieve strategic low carbon development goals.

2. Linking the transition management and interactive systems framework for capacity building

In this study, we bring together the Transition Management framework and the Interactive Systems Framework (ISF), endeavouring to identify tools, systems, and processes that can link long-term goals and strategies with shorter-term actionable elements to address energy transition and climate issues. The combined frameworks and their interrelationship are illustrated in Figure 1.

2.1 Transition management

Within the multi-level perspectives literature, Transition Management has been widely applied by policymakers and practitioners to manage complex system-level transitions, such

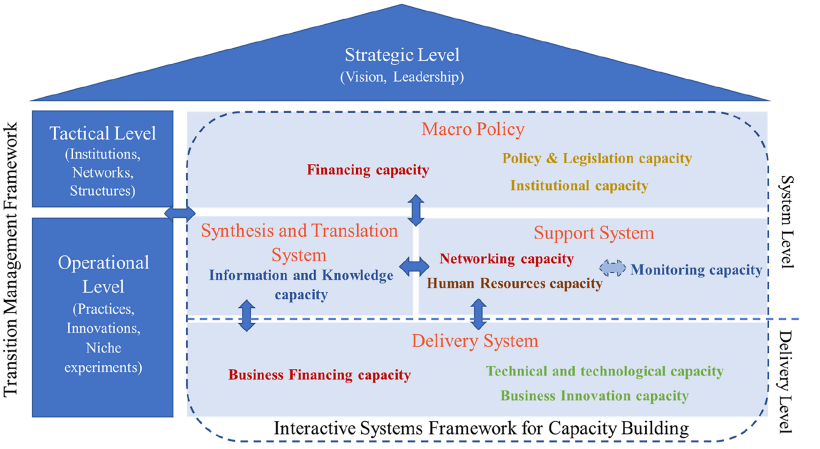

Figure 1.
Illustration of an integrated interactive systems framework and transition management framework

Source(s): Authors' own work

as clean energy transition, low carbon development, and the promotion of circular and sustainable economies (Loorbach, 2010; Morrissey, Mirosa, & Abbott, 2014).

As an approach to governance (Wittmayer & Loorbach, 2016), Transition Management can help address the complexity of climate and energy policy. These are reflected in four dimensions:

(1) Temporal – taking an intergenerational perspective.

(2) Spatial – a system-level approach that interconnects multiple systems, levels, and actors.

(3) Innovative – a focus on niche experiments and innovation, involving technology, policy, business models, and culture; learning by doing and doing by learning.

(4) Multi-actor – bringing together frontrunners from all domains to develop shared understandings of complex and multidisciplinary transition challenges.

2.2 Interactive systems framework (ISF)

The Interactive Systems Framework (ISF) can be used to understand functions and relationships relevant to dissemination and implementation, and aiding communication among key stakeholders in a system (Wandersman *et al.*, 2008). The ISF describes three interacting components that correspond mainly to the *tactical* and *operational* levels of the Transition Management framework, as illustrated in Figure 1. These include a synthesis and translation system, a support system, and a delivery system, underpinned by general implementation capacity and innovation-specific capacity to deliver desired outcomes (Katz & Wandersman, 2016).

Both system-level capacities and delivery-level capacities are critical for successful dissemination and implementation of climate mitigation strategies and initiatives. The interaction between these two levels is to be effectively monitored and harmonized to enable system change and to achieve climate and low carbon development goals. Positive feedback loops between them can be created through strengthening collective vision and common goals, and effective communications among different level of actors, coherent actions to bridge long-term strategies, policy formation, and implementation. This will in turn further enhance capacities at both levels, and improve the overall environment for low carbon infrastructure development, skills and knowledge building, sustainable finance flow, and regional and international collaboration.

In the context of delivering a low-carbon transition in the ASEAN region, innovation-specific capacity building can involve providing information about an innovation, choosing which innovations to use, innovation training, and providing technical assistance to ensure the successful implementation and operation, and its sustainability. These can be innovations in technology, policy, planning, market mechanisms, financing, supply chains, business models, or social behaviours, for instance relating to the supply, transmission, distribution, and end use of energy.

2.3 Capacity building in a sustainable development context

Capacity building, as an overarching concept and core process, enables deeper cooperation and co-ordination among various stakeholders and agencies, fostering sustainable development in the ASEAN region (Humphrey, Mardini, & O'Dwyer, 2024). As stipulated in Article 11 of the Paris Agreement, the key to success is to promote ownership of the capacity building process by the recipient countries themselves.

Three levels of capacity building concepts are widely accepted in the development studies: individual, organizational, and societal/systemic. At the individual level, capacity

building refers to the process of changing attitudes and behaviours, typically through training and building knowledge and skills, information sharing and public engagement. At the organizational level, capacity building involves strengthening performance and function by developing mandates, tools, guidelines, and management information systems that facilitate organizational change. At the system level, capacity building is concerned with the overall policy, economic, regulatory, and accountability frameworks and the overall enabling environment within which organizations and individuals operate (World Bank, 2009).

In this study, we draw on the framework for capacity gaps and needs employed by UNDESA (2019, p. 5), adding specific focus areas such as business innovation capacity and networking capacity, as highlighted by interview respondents. Networking capacity facilitates integration between different levels and effective coordination between macro policy environment, synthesis and translation system, support system and implementation system for dissemination and implementation. System-level capacities represent the overall ecosystem and enabling environment. When supported by adequate institutional capacities, these can lead to broader system effects and impact green path development. By contrast, a lack of human resources can impede the development of all other capacities, resulting in policy and decision-making failure. Delivery-level capacities are associated with successful implementation of climate mitigation strategies and initiatives through technical and technological capacity, business innovation capacity and business financing capacity. The capacity building elements and key measurements are illustrated in Table 1.

3. Methods

The data creation and collection process are outlined in Figure 2. To investigate the capacity needs of ASEAN energy and climate stakeholders to implement NDCs at national and regional levels in Southeast Asia, we carried out a literature review to identify recent trends in research on NDCs and regional needs relating to NDCs. This served to inform the design of the interview and survey questionnaires. We then selected representatives of the ministries in charge of energy and the ministries in charge of environment and/or climate change to conduct a series of structured interviews. Key interview questions are listed in Appendix 1. Priority areas revealed through the interview process were explored in a survey among a broader range of energy and climate stakeholders in each ASEAN country. All interviewees and survey respondents are serious and highly experienced experts on energy or climate issues in their countries. Figure 3 shows the distribution of survey respondents by role.

The interview and survey questionnaires covered three levels (strategic, tactical, and operational) of the Transition Management framework. Questions mostly revolved around strategic energy and climate-related goals and priorities, longer-term aspirations and outlook, energy transition and NDC implementation, and associated needs in technology, finance, and capacity. Lack of capacity emerged as the major factor holding back NDC implementation and effectiveness.

Semi-structured qualitative interviews were held with senior officials at the director level within the ministries, mostly the ministries in charge of Energy and ministries in charge of Environment. A list of interviewees by country and by ministry/department is summarized in Table A2 in Appendix 2. They were conducted in English through online Zoom meetings between May and July 2021. Each interview ranged between 45 minutes and 1.5 hours in length and was transcribed and summarized. Some respondents from the Philippines, Singapore, and Thailand submitted written responses to the interview questionnaire. The survey covered a wider range of stakeholders at the national and regional levels, including government officials, think tanks, universities, international development agencies, financiers and investors, and was administered via the Qualtrics online platform. The link to the survey questionnaire was sent by email to a list of stakeholders in July 2021 and was

Capacity type	Description	Key measurements
	System level capacity	
System level capacity	System capacity is concerned with the overall policy, economic, regulatory and accountability frameworks and the overall enabling environment within which organizations and individuals operate (World Bank, 2009)	
Institutional	The capability of an institution to set and achieve social and economic goals, through knowledge, skills, systems, and institutions, but also attitude and behavior (UNDP, 2009)	
Institutional capacity	Capability to form institutional structure, initiate institutional reform, including governance structures, central and local coordination, and external partnerships to create enabling environment for NDC implementation, horizontal (multi-sector) and vertical (national and local) collaboration	- improving the enabling environment for the private sector - enhancing climate-related institutional, financial and policy reforms - developing institutional structures or strengthening existing institutional structures
Policy and legislation capacity	The capacity to assimilate and experiment with novel ideas and practices, and make efficient and strategic decision to support its goals and priorities (Bryan, 2016; Foo, 2015)	- creating a favorable policy environment for the private sector - policy support for long term strategy implementation - enhancing climate-related policy reform - translating NDCs into concrete policies and programs
Financing capacity	The capacities needed to address financing gaps through resource mobilization and strengthened public and private finance processes. This may include access to capital, via public or private channels, the ability to raise taxes, but also having land and property resources (Kuzemko & Britton, 2020)	- developing a climate fiscal framework - establishing sustainable finance mechanism(s) in priority sectors - innovative financing to attract private sector finance
Organizational	The internal structure, policies and procedures that determine an organization's effectiveness and facilitate learning process, at the individual and organizational levels (UNDP, 2009; Merrick, 2001)	
Human resource capacity	Skill and knowledge sharing and transfer, integrated planning practices and coordinated actions, that bring a collection of individuals together and put the benefits of the enabling environment into action. This also includes technical and managerial skills/abilities, leadership and the need for sensitizing policy makers/decision makers to support the NDC implementation	- developing energy sector planning and long-term strategy - estimating NDC implementation costs - developing NDC implementation plans-translating NDCs into concrete policies, programs, and projects

(*continued*)

Table 1.
Capacity building elements and key measurements

Capacity type	Description	Key measurements
Networking capacity	Cooperation between ministries and cross sectors, as well as cooperation between different institutional levels, e.g. between the federal or central government and the regional, provincial, or local governments. They also require the cooperation between the government and many private sectors, businesses or other non-governmental organizations (Willems & Baumert, 2003)	- enhancing coordinated efforts between ministries - strengthening public-private sector cooperation - facilitating peer-to-peer learning among countries based on similar NDC contexts
Monitoring capacity	Transparent and efficient systems and processes to monitor the progress of sustainable capacity development and improvement, including data collection/availability and transparency, data information systems/monitoring platforms and quality of reporting/progress monitoring, including carbon monitoring, GHG inventories etc.	- strengthening data collection structures - enhancing monitoring and transparency systems - Carbon Monitoring, GHG inventories
Knowledge and information capacity	Information generation, knowledge sharing, and peer-to-peer learning among countries	- building awareness and ownership of NDCs at the national level - developing/improving the information base
	Delivery level capacity	
Delivery level capacity	Capacities to carry out activities that are necessary to implement actions or programs. These activities may be undertaken by individuals, organizations or coalitions, which all have varying levels of capacity to implement the innovation (Flaspohler, Lesesne, Puddy, Smith, & Wandersman, 2012)	
Technology and innovation	Capacities to support and manage technological change and to guide and coordinate the overall process of technology development/adaption and deployment to meet development imperatives through technical, policy and financing capacity (UNDESA, 2016; Chaudhary, Sagar, & Mathur, 2012)	
Technical and technological capacity	Technical skills, areas for technical assistance and capacity building, technology development for NDC implementation, including energy sector specific capabilities	- strengthening technical inputs to key ministries and stakeholders - facilitating technical assistance and capacity building - promoting technology transfer and development
Business innovation capacity	Production and use of new products, services or processes (ways of doing things) over long periods of time (Wilkinson, 2016), including the capability to develop and scale up business models and financing	- innovative business models for low carbon development, including renewable energy and energy efficiency business models and financing
Business financing capacity	The ability to raise external funding or acquire public and private finances to support its innovation activities (World Bank, 2015)	- innovative business models - innovative financing for low carbon development
	Personnel capacity	
Personnel capacity	The skills, instincts, abilities, knowledge and experience are needed to perform and execute mandates, to problem-solve and innovate to carry out intended objectives	

Table 1.

Source(s): Table by authors

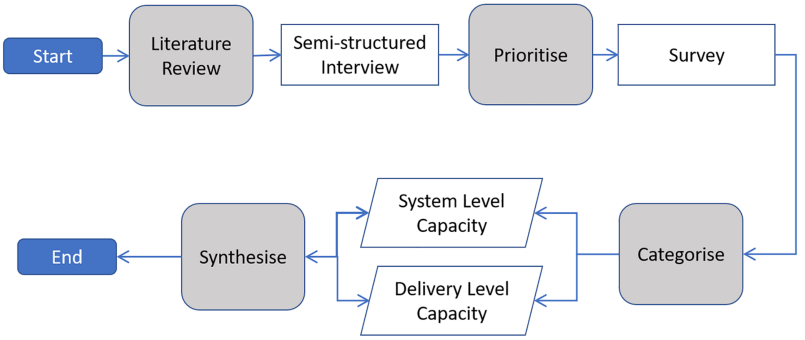

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Figure 2. Data creation and collection process to inform ASEAN capacity needs

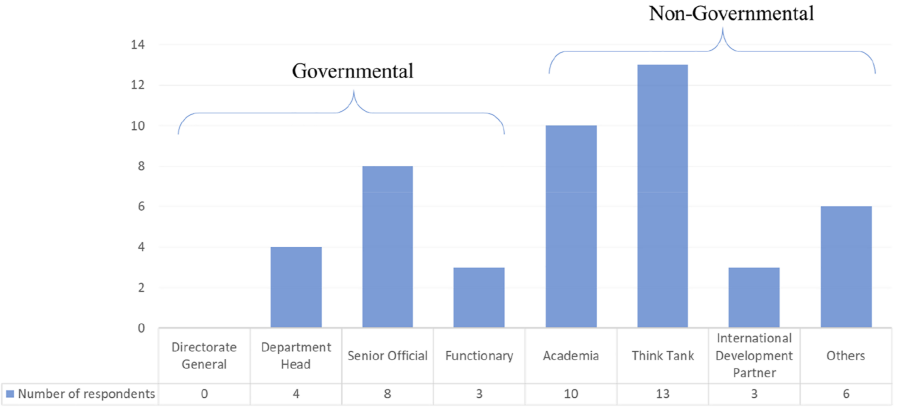

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Figure 3. Distribution of survey respondents by role

also accessible via the ASEAN Centre for Energy (ACE) website and social media platforms until August 2021. The survey questionnaire had 37 questions in total and the response time ranged from 20 to 50 mins.

As illustrated in Figure 4, a total of 20 interviews were conducted and 47 completed survey responses were received from nine ASEAN member states. Twenty-seven survey responses were received from energy experts and 21 from climate experts, while 11 and 9 interviews were conducted with energy and climate change stakeholders respectively. The capacity needs of ASEAN member states were parsed and compiled from the survey and interview responses in accordance with the major capacity categories identified in Table 1. The capacity areas where each country has greatest needs was calculated based on the survey responses. The results are shown in Figure 5.

4. System-level capacity building needs to implement NDCs in ASEAN

The spider diagrams presented in Figure 5 illustrate the priority areas for capacity building identified by survey respondents from each country (excluding Brunei Darussalam), and for the ASEAN region as a whole. The diagrams represent each country's relative strength in each capacity category based on the survey data. The methodology for developing the spider

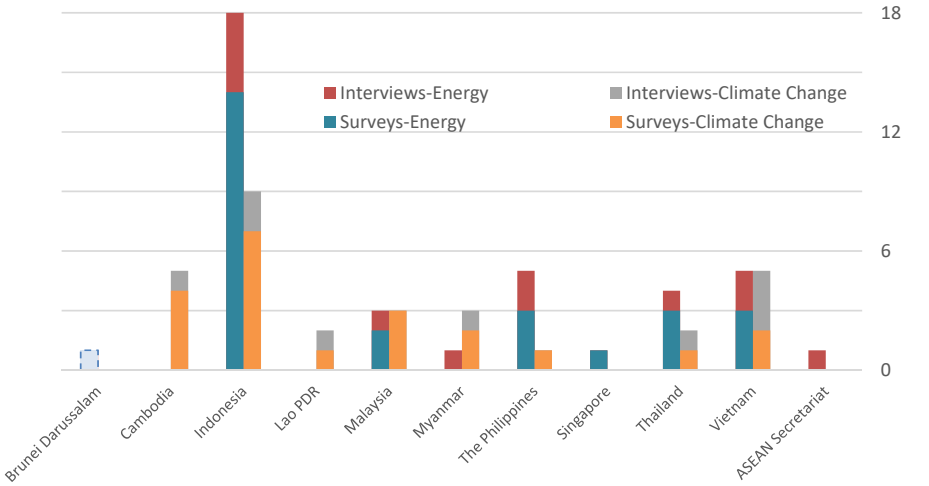


Figure 4.
Distribution of interviewees and survey respondents by field and country

Source(s): Authors' own work

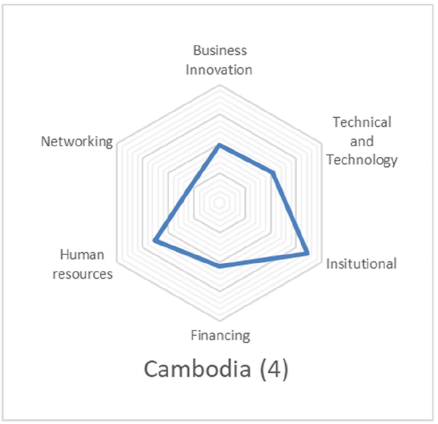
diagrams and a heatmap table of relative strength by each capacity category at the country level and the ASEAN level is presented in Table A3 and Table A4 respectively in Appendix 3. Monitoring capacity, and knowledge and information capacity were considered to be important aspects of NDC implementation by respondents, yet were less prominent in interview and survey responses compared to other capacity needs. We therefore excluded them from Figure 5.

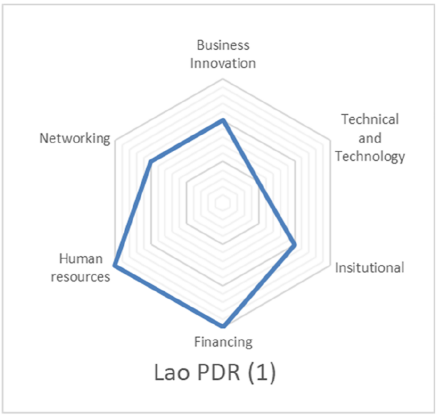
Economic and political factors, such as socio-economic strategy and development, energy security, and international commitments, were cited by the interviewees as the most influential factors in forming energy and climate change strategies in the ASEAN countries. At the implementation level, the spider diagrams indicate that each country has a unique set of capacity needs and priorities in realizing national climate mitigation strategies and development plans. At the ASEAN level, the widest capacity gaps were observed in institutional capacity, technical and technological capacity, human resources capacity, financing capacity, and the capacity to develop policy and legislation.

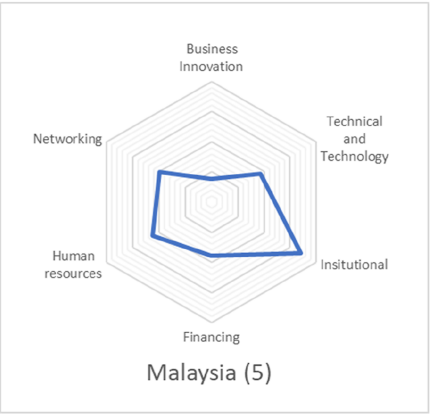
4.1 Institutional capacity

Institutional capacity is the category with the highest average score, rated by respondents from Cambodia, Indonesia, Malaysia, and Singapore as the top capacity development need. Within this category, interviewees and survey respondents identified two distinct areas for institutional capacity building to help achieve NDC targets. Firstly, relating to climate policy, institutional capacity is associated with adequate and efficient institutional structure and process, effective coordination of all relevant line ministries and associated stakeholders, and the capability to develop institutional arrangements. Secondly, it also relates to leadership and authority of climate governance and legislation to design and implement climate policies and measures, as well as monitoring, reporting and review, and awareness raising among the general public.

Effective implementation of policies and measures requires strong capacity in specific policy areas with their own sets of expertise and institutional arrangements, including the energy, transport, agriculture, and forestry sectors, and general economic policies.







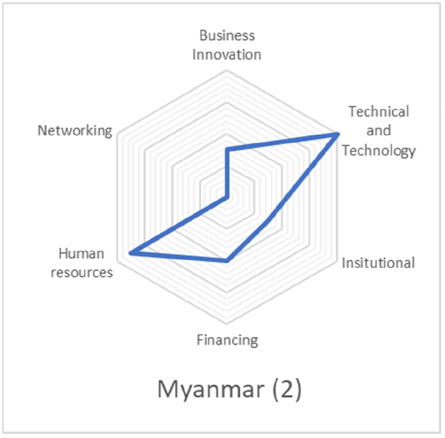


Figure 5.
Spider diagrams by capacity category at the country level (excluding Brunei Darussalam) and at the ASEAN level

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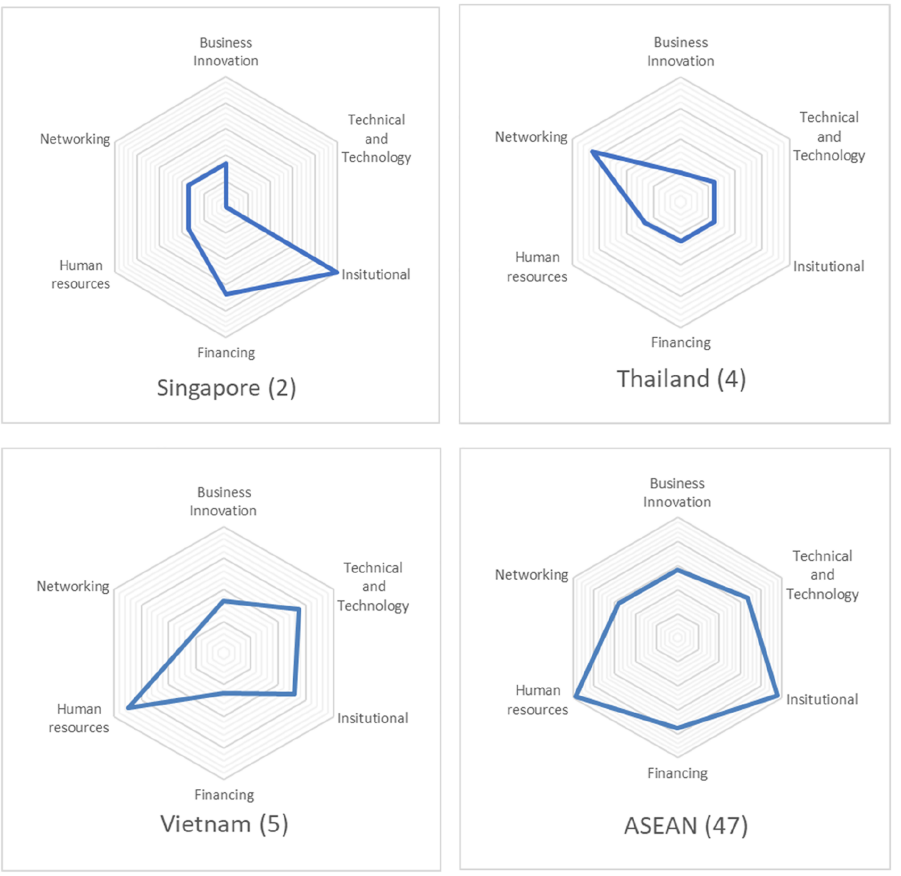

Note(s): Greater distance from the center of each diagram suggests greater need to build capacity. The number of respondents is indicated in the parentheses next to the country names

Source(s): Authors' own work

Figure 5.

Monitoring, reporting, review, and enforcement also require strong statistical and judiciary systems. To achieve both sectoral and climate goals, an integrated policy approach can help to achieve a better coherence of measures across sectors, improved consistency of policy instruments, and enhanced cooperation between all actors involved in the process of both policy formulation and implementation (Domorenok, Graziano, & Polverari, 2021).

4.2 Organizational capacity

The capacity for central coordination and ensuring accountability is needed to deliver the NDC commitments, including adequate institutional arrangements and mechanisms for implementation, as well as individual skills and capabilities. The human resources capacity gap was highlighted by respondents from Lao PDR, Indonesia, Myanmar, the Philippines, and Vietnam, particularly in energy-sector planning and long-term strategy, as well as the

strengthening of technical and managerial skills/abilities in ministries. The need to develop NDC implementation plans and estimate NDC implementation costs was also highlighted by respondents from Indonesia, Myanmar, the Philippines, and Vietnam. All these will enable the governments to mainstream NDC commitments and targets into existing development plans, strategies, and budgets.

The networking capacity gap is mostly related to the need to enhance coordination between ministries, and strengthening public-private sector cooperation, as highlighted by respondents from Indonesia, Lao PDR, Malaysia, and Thailand. Indonesia, Malaysia, Thailand, and Vietnam also mentioned the capacity development need in facilitating peer-to-peer learning among countries. These capacities will help to promote knowledge exchange and transparency and create a space for dialogue and improved coordination across ministries and the public and private sectors, thus increasing buy-in from private stakeholders, subnational authorities, and civil society.

4.3 Financing capacity

The interview and survey respondents stated that climate finance is necessary to support a multitude of mitigation and adaptation efforts. They also acknowledged that there remains a continued dependency on public funds for NDC implementation, although most NDC options are intended to be implemented fully or partially by the private sector. Currently, public entities are the main sources of climate finance in ASEAN, including funds provided by governments and their agencies, climate funds, and development finance institutions. The current gap in private sector finance relates to the enabling environment and policies to encourage the private sector to operate in the climate change space, and how to translate these opportunities into viable business models at both sectoral and project level. Most of the ASEAN countries also reiterated the importance of international support and technical assistance for innovative financing for renewable energy and energy efficiency from international development and financing agencies and donors.

Many respondents also expressed concerns about the high investment and operating costs of some proposed measures and actions in their NDC plans, such as the cost of technologies and infrastructure in the energy sector. These are resulted from high-perceived risk in low-carbon and green project financing due to the uncertainty of returns and the long-span horizon of the green investment period, weak local financial markets, the inability of attracting sustainable finance, and a lack of climate-related standards and disclosures. For example, typical lending interest rates for renewable energy projects for high-risk countries (e.g. Indonesia, Vietnam, and the Philippines), range between 5–8% for US dollar-denominated loans from local or foreign banks, compared to below 5% in low risk perceived countries (Halimatussadiah *et al.*, 2022). To overcome these barriers requires appropriate incentive mechanisms and adequate policy support from governments to de-risk renewable energy and energy efficiency investments.

4.4 Long-term capacity building and international support

Capacity at various levels, including local participation and initiatives, energy and climate planning and management, and policymaking, are important to enable the successful implementation of climate change actions (Hofman & van der Gaast, 2019). The execution of climate change actions requires short term capacity strengthening for governments, industries, as well as the forward-looking long-term capacity building in the country, through education and training for effective climate change actions, and climate-resilient national and sectoral planning. Capacity and institutional frameworks that can enhance the synthesis of relevant information and knowledge, and the provision of technical support and guidance to countries, are also necessary to attract international financing. This will have a

direct impact on the type and pace of technology development and physical infrastructure that determine the path of the transition.

Aligning international efforts with the needs and priorities of individual countries is critical to achieve more effective allocation of human and capital resources in an assistance effort. International organizations should be aware of the importance of acknowledging country and place-specific factors in each recipient country, and the ability to adapt and bring international experience and best practices to better suit the local context. On the other hand, many lessons can be learned beyond the individual country level, and regional collaboration is essential to address common challenges in the low carbon development journey (Aris, Zawawi, & Jørgensen, 2020).

5. Strategic areas to deliver on climate mitigation

The survey respondents highlighted a number of strategic focus areas to achieve the current NDC targets and longer-term climate and sustainable development goals, including deploying EVs and green supply chain, renewable energy, energy efficiency, strengthening private sector investment, and reducing dependencies on fossil fuels.

(1) *Electrification of Transport and Green Supply Chain:* There are multiple reasons and benefits for promoting the electrification of transport among ASEAN member states, ranging from emissions reduction for human and environmental health, to energy security, to economic development. As a result, a number of member states, including Indonesia, the Philippines, Singapore, Thailand, and Vietnam, have been exploring the potential to develop EV industries and local supply chains to reduce costs and increase the availability and competitiveness of these technologies.

(2) *Deploying Renewable Energy at Speed and Scale:* It is widely acknowledged by respondents that to accelerate the clean energy transition, countries need to stimulate investment in renewable energy, storage and firming technology, reduce import dependency and increase supply diversity, and moderate demand by reducing the energy intensity of the economy. It is necessary to secure the delivery of energy in the long term and fulfil national emissions reduction commitments for climate change mitigation. The respondents also expressed an interest in developing energy technology supply chains, including emerging new technologies, such as hydrogen, carbon capture, utilization and storage, and smart grids.

(3) *Energy Efficiency Standards and Building Codes:* Energy efficiency standards, minimum energy performance standards (MEPS), and building codes are considered as "no-regret option". They are critical measures to enable ASEAN member states to meet their targets and policies for energy efficiency, as residential and commercial sectors consume a total share of 30% of the final energy consumption matching industrial and transport sectors (ACE, 2018).

(4) *Reducing Dependencies on Fossil Fuels:* Whilst expectations for increases in clean energy investment run high, 40% of the respondents believed that fossil fuel investment from domestic sources is also likely to increase. Despite the international effort to phase out coal fired generations in the ASEAN region, 17.9 GW of new coal-fired power plants are in the pipeline to be built in Indonesia, Lao PDR, Vietnam, Philippines, and Thailand (Global Energy Monitor, 2024). This may also imply that meeting the growing energy demand in these countries in the near term is likely to include highly efficient and low-emission fossil fuel generation technologies, co-firing, as well as carbon capture, utilization, and storage (Phoumin, Kimura, & Arima, 2021).

Successful implementation of these strategic areas will require countries to strengthen capacities associated with the delivery system of the capacity building framework, not only in technical and technological capacity but also in business innovation capacity and financing capacity, supported by conducive institutional and policy environment. Suggestions in relation to strengthening the institutional environment, improving the technological and innovation capacity, and strengthening private sector investment and business models are summarized in the following sections.

5.1 Strengthening institutional environment

To deliver on climate mitigation, our data highlight the importance of institutionalizing climate targets and clean energy targets and measures as part of the country's regulatory framework to ensure accountability and avoid political dynamics (such as changes of leadership or departmental restructuring). The consistent policy is critical to project developers and investors as this will significantly impact the evaluation and risk profile of projects. A stop-start or boom-bust policy environment will spook international and domestic investors, and significantly slow down the clean energy deployment and the pace of the low carbon transition.

An overall conducive policy environment needs to be stable and non-distortive, to promote climate-smart trade, green infrastructure, flexible yet fair labour markets, and non-tariff measures and low (or zero) tariffs on climate-smart goods, combined with a right balance of R&D and research strategy, innovation policies, data and AI policies, intellectual property and patent strategies (ADB, 2023). Further, improving the system-level capacity involves strengthening policies, programs, and institutional structures, as well as industry awareness and capacities in sectors such as clean energy, supply chain and manufacturing, transport, buildings (commercial and residential), and industries. This includes policy and legislations for strengthening emission standards in line with international standards and best practices, such as vehicle and fuel emission standards for both passenger and freight vehicles, energy efficiency standards and building codes, coal-fired power plant emission and technical efficiency standards.

Renewable energy legislation, pro-renewable energy governance reform, and general conditions for investors are identified as three key factors for attracting capital and investment in ASEAN (Vakulchuk, Overland, & Suryadi, 2023). Strong policy and institutional environments to foster clean energy technology and project development may imply an adequate target for renewable energy, paired with incentive mechanisms and right procurement and pricing strategies, streamlined regulatory framework and enhanced permitting agency capacity can significantly help scale and replicate clean energy investments and installations (Do *et al.*, 2021; Halimatussadiah *et al.*, 2024). Adequate planning, administration, and project development capacities, and a skilled clean energy workforce are also critical to promote widespread implementation of large-scale grid-connected renewable energy projects (CEET, 2023).

5.2 Improving technological and innovation capacity

Technical and technological capacity needs were considered to be the main needs by respondents from Cambodia, Myanmar, the Philippines, and Vietnam. Technical and technological capacity is critical to the development of clean energy infrastructure and their supply chain, such as wind and solar, nuclear, high efficiency power grids, energy storage, and electric vehicles (EVs), and to attract sustainable finance to support the transition to a clean economy. Through more collaborations with private sector partners, and educational and research institutions, governments could prioritize the upskilling and reskilling of the energy workforce to enable more rapid knowledge transfer to grasp clean energy

technologies and applications, their implementation, operation and maintenance, as well as their market and policy environment. Technical and technological capacity needs to be improved at all levels, from targeted training programs to industry and government, to more investments in tertiary and vocational education in engineering, STEM, digital technologies to develop a future-ready workforce, as well as state-of-art R&D capability.

Business innovation capacity may relate to technological innovation, service and delivery innovation, social innovation, as well as financial innovation, including innovative renewable energy and energy efficiency business models. These innovation capacities will help to enable wider participation from the private sector in project development and sustainable investment to support deeper decarbonization (Gui & MacGill, 2018). Business innovation capacity will also need to connect and contribute to the ongoing institutional development, and thus form a positive feedback loop in enhancing both the system-level capacity and the delivery system capacity to better implement the climate mitigation strategies.

For example, electrification of transport and green supply chain will necessitate a multidimensional approach to industrialisation, trade, investment, and integration in the regional and global value chains (Prakash, 2023), supported by adequate strategic planning and institutional and organizational capacity at the system level. Delivery-level capacity relates to the ability to attract technology partners, mobilize skilled and digitally-enabled workers, and develop manufacturing capacity to achieve economies of scale and economic competitiveness. Business innovation capability is also required in attracting large-scale investment in developing supply chain, manufacturing capacity, public EV charging infrastructure, as well as acquiring a sufficient level of EV customers to support the market growth.

To foster energy efficiency projects and activities, business innovation activities and human resources capacities are to be strengthened to provide new services and business models, in the provision of energy consultation and assessment, energy performance monitoring, testing and inspection, energy auditing and certification services. These new service providers can gradually build their technical expertise, servicing different classes of customers in industrial, commercial, and residential sectors, and overcome the barriers of high upfront capital costs and technology selection (Lütken & Zhu, 2020). Business reporting by the public sector, large state companies, or large corporations also play an important role, particularly associated with corporate social responsibility (CSR) or environmental, social, and governance (ESG). These champions will help to build the need for energy efficiency related services and capabilities in accelerating the implementation of energy efficiency measures, and influence policy-making and institutional development of the energy efficiency eco-system.

5.3 Strengthening private sector investment and business models

The majority of low carbon infrastructure development in ASEAN are expected to rely on private sector investments from domestic or international sources. Some of the enabling conditions to increase private sector investment would revolve around a level playing field for the private sector, streamlining the clean energy project framework and targeted financial intervention. Incentives such as priority sector lending and preferential interest rates can facilitate financing to increase clean energy project deal flow liquidity and funding supply, and enable commercial banks to prolong the loan tenor. Risk mitigation instruments may include convertible loans/grants for feasibility and environmental studies upgrades to meet international lenders' standards and reducing project transaction costs.

The system-level support, including adequate energy policies and legal regulations are indispensable for innovative business models to sustain and flourish. For example, a study

found that during their trial period of peer-to-peer trading in Thailand, there was a need for deregulation at the start of the program to allow private investors to enter the market (Junlakarn, Kokchang, & Audomvongseree, 2022). More consumer-centric decentralized models may include an electricity export scheme, microgrid or minigrid, and peer-to-peer (P2P) trading which has been able to attract a wider range of project developers and electricity customers, thus accelerating the clean energy transition. The system-level capacity can also facilitate new organizational forms, such as public-private partnerships (PPP), cooperatives, and community organizations (Pinilla-De La Cruz, Rabetino, & Kantola, 2021). This will in turn help address barriers to private sector financing by reducing risks and transaction costs and increase confidence from financiers and third-party investors (Gui, Diesendorf, & MacGill, 2017). There have been positive experiences in renewable energy and energy efficiency business model innovation in several ASEAN member states, and wider learnings to be facilitated among countries in the region.

To reduce the dependency on coal and fossil fuels in the region, innovative financing, technical and technological capacity, policy and legislation capacity are to be strengthened. The strengthened system-level capacity is essential to support emission reduction measures, and enable actions in enhancing emission standards and reduce the dispatch and use of coal for existing plants, long term planning for sustainable energy and climate, requirements for domestic industry to incorporate emission and sustainability criteria and strategies, public awareness-raising around climate change, and enhanced political will. This will consequently help to improve capacities at the delivery level, in implementing technical and technological solutions, assisted technology development and transfer from developed countries, as well as attracting more international and domestic investments in the clean energy sector.

6. Conclusion

Through a transition management and capacity building lens, we have examined capacity needs and strategic focus areas for capacity building in the energy-climate space to achieve energy transition and climate goals in the ASEAN countries. The categorization and identification of capacity needs help to understand more systematically capacity gaps at both the delivery level and the system level in the ASEAN countries. This is critical to allow effective policy and decision making, national and sectoral planning, and enable actions and implementation. This will in turn strengthen the system-level capacity and the delivery-level capacity and realize synergies between these two levels to create a conducive environment for the private sector to flourish, and improve cross-sectoral cooperation in energy, transport, built-environment, and industry etc.

The institutional, technical, and economic challenges in decarbonization and NDC implementation need to be urgently addressed and capacities to be strengthened to support the implementation of the regional the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025 and beyond. They include the high costs of renewable energy, lack of energy efficiency and demand side technologies and approaches, the political influence of the fossil fuel industry and fossil fuel subsidies, the lack of grid infrastructure, and the lack of inter-ministerial and cross-sectoral coordination. The development of implementation and action plans to mitigate these deficiencies will rely on a high level of technical capacity, adequate institutional and organizational capacities, technology and innovation capacities. System-level capacities need to be supported by appropriate regulatory arrangements and policy incentives that can foster the diffusion of low carbon development, innovation in clean energy technology, and the mobilization of private investment and international cooperation.

Each country is taking a different approach to climate action and low carbon transition, determined by the specific country context, market conditions, and socio-economic situation,

yet many face similar challenges. Cross-learning, appropriate standardization, and collective wisdom and knowledge sharing among the ASEAN member states can help to improve capacities at all levels, including governments, industries, public and private sectors, and the wider society.

Capacities need to be further developed to improve the regional connectivity, resource sharing, economic efficiency, and mutual learning. This will help to facilitate regional collaboration to establish the ASEAN climate fund, ASEAN carbon market, regional grid integration and power trading, and regional energy efficiency standards for more rapid clean energy transition. This will also rely on coordination and collaboration among stakeholders at all levels, including national and local governments, the private sector, the broader society, and international development agencies.

We hope that this study will facilitate mutual learning among ASEAN countries for more effective NDC implementation and net zero energy transition, and a better understanding of the conditions for raising ambitions in line with the Paris Agreement. We also hope that it will be useful for external actors who wish to help strengthen the capacities of the ASEAN countries to implement their NDCs. Future work can go on to identify key intervention points and detailed action maps.

References

ACE (2018). Mapping of green building codes and building energy efficiency in ASEAN: Towards guidelines on ASEAN green building codes.

ACE (2022). ASEAN energy in 2022: Outlook report. Available from: https://aseanenergy.org/asean-energy-in-2022/

ADB (2023). *ASEAN and global value chains locking in resilience and sustainability*. Metro Manila: Asian Development Bank. doi: 10.22617/SPR230100-2.

Amarjargal, B., Ebro, H., Nylander, J., & Duggal, V.K. (2020). *Achieving nationally determined contributions through market mechanisms in Asia and the pacific*. Manila: Asian Development Bank.

Amponin, J. A., & Evans, J. W. (2016). *Assessing the intended nationally determined contributions of ADB developing members*. Manila: Asian Development Bank.

Aris, H., & Jørgensen, B. N. (2020). ASEAN power grid 20 years after: An overview of its progress and achievements. *IOP Conference Series: Earth and Environmental Science*, *463*(1), 012055. doi: 10.1088/1755-1315/463/1/012055.

Aris, H., Zawawi, I. S. M., & Jørgensen, B. N. (2020). The Philippines' and Singapore's journeys towards liberalised electricity supply industries—takeaways for Malaysia. *Energies*, *13*(14), 3514. doi: 10.3390/en13143514.

Bryan, T. K. (2016). Capacity for climate change planning: Assessing metropolitan responses in the United States. *Journal of Environmental Planning and Management*, *59*(4), 573–586. doi: 10.1080/09640568.2015.1030499.

CEET (2023). Best practices for variable renewable energy (VRE) integration. Council of Engineers for the Energy Transition (CEET) Issue Brief. December, 2023. Available from: https://www.unsdsn.org/resources/best-practices-for-variable-renewable-energy-vre-integration/

Chaudhary, A., Sagar, A. D., & Mathur, A. (2012). Innovating for energy efficiency: A perspective from India. *Innovation and Development*, *2*(1), 45–66. doi: 10.1080/2157930x.2012.667212.

Do, T. B., Burke, P. J., Nguyen, H. N., Overland, I., Suryadi, B., Swandaru, A., & Yurnaidi, Z. (2021). Vietnam's solar and wind power success: Policy implications for the other ASEAN countries. *Energy for Sustainable Development*, *65*, 1–11, doi: 10.1016/j.esd.2021.09.002.

Domorenok, E., Graziano, P., & Polverari, L. (2021). Introduction: Policy integration and institutional capacity: Theoretical, conceptual and empirical challenges. *Policy and Society*, *40*(1), 1–18. doi: 10.1080/14494035.2021.1902058.

Flaspohler, P., Lesesne, C. A., Puddy, R. W., Smith, E., & Wandersman, A. (2012). Advances in bridging research and practice: Introduction to the second special issue on the interactive system framework for dissemination and implementation. *American Journal of Community Psychology*, *50*(3-4), 271–281. doi: 10.1007/s10464-012-9545-3.

Foo, R. (2015). Barriers to building institutional capacity in the Malaysian housing development sector. *International Journal of Housing Policy*, *15*(4), 436–60. doi: 10.1080/14616718.2015.1057428.

Global Energy Monitor (2024). Global coal plant tracker, 2024 Global Energy Monitor, Covina, CA. Available from: https://globalenergymonitor.org/projects/global-coal-plant-tracker/

Gui, E. M., & MacGill, I. (2018). Typology of future clean energy communities: An exploratory structure, opportunities, and challenges. *Energy Research and Social Science*, *35*, 94–107. doi: 10.1016/j.erss.2017.10.019.

Gui, E. M., Diesendorf, M., & MacGill, I. (2017). Distributed energy infrastructure paradigm: Community microgrids in a New Institutional Economics context. *Renewable and Sustainable Energy Reviews*, *72*, 1355–1365. doi: 10.1016/j.rser.2016.10.047.

Gunningham, N. (2013). Managing the energy trilemma: The case of Indonesia. *Energy Policy*, *54*, 184–193. doi: 10.1016/j.enpol.2012.11.018.

Halimatussadiah, A., Kruger, W., Wagner, F., Afifi, F., Lufti, R., & Kitzing, L. (2024). The country of perpetual potential: Why is it so difficult to procure renewable energy in Indonesia?. *Renewable and Sustainable Energy Reviews*, *201*, 114627. doi: 10.1016/j.rser.2024.114627.

Halimatussadiah, A., Sonobe, T., Azhgaliyeva, D., Utama, N. A., Riefky, T., & Maulia, R.F. (2022). Regional cooperation for financing renewable energy in Southeast Asia. T20 policy brief task force 3 governing climate targets. *Energy Transition, and Environmental Protection*. Available from: https://www.lpem.org/think-t20-policy-brief-lpem-feb-ui/

Hofman, E., & Van der Gaast, W. (2019). Enhancing ambition levels in nationally determined contributions—learning from technology needs assessments. *WIREs Energy and Environment*, *8*(2019), e311. doi: 10.1002/wene.311.

Humphrey, C., Mardini, P., & O'Dwyer, B. (2024). Reshaping an issue-based field: Assessing the impact of the international federation of accountants (IFAC) on the global development aid agenda. *Accounting, Auditing and Accountability Journal*, Vol. ahead-of-print No. ahead-of-print. doi: 10.1108/AAAJ-06-2023-6520.

Junlakarn, S., Kokchang, P., & Audomvongseree, K. (2022). Drivers and challenges of peer-to-peer energy trading development in Thailand. *Energies*, *15*(3), 1229. doi: 10.3390/en15031229.

Katz, J., & Wandersman, A. (2016). Technical assistance to enhance prevention capacity: A research synthesis of the evidence base. *Prevention Science*, *17*(4), 417–28. doi: 10.1007/s11121-016-0636-5.

Khan, M., Mfitumukiza, D., & Huq, S. (2020). Capacity building for implementation of nationally determined contributions under the Paris Agreement. *Climate Policy*, *20*(4), 499–510. doi: 10.1080/14693062.2019.1675577.

Khosla, R., Sagar, A., & Mathur, A. (2017). Deploying low-carbon technologies in developing countries: A view from India's buildings sector. *Environmental Policy and Governance*, *27*(2), 149–162. doi: 10.1002/eet.1750.

Klinsky, S., & Sagar, A. D. (2022). The why, what and how of capacity building: Some explorations. *Climate Policy*, *22*(5), 549–556. doi: 10.1080/14693062.2022.2065059.

Kuramochi, T., Höhne, N., Schaeffer, M., Cantzler, J., Hare, B., Deng, Y., . . . Blok, K. (2017). Ten key short-term sectoral benchmarks to limit warming to 1.5°C. *Climate Policy*, *18*(3), 287–305. doi: 10.1080/14693062.2017.1397495.

Lau, H. C. (2022). Decarbonization roadmaps for ASEAN and their implications. *Energy Reports*, *8*, 6000–6022. doi: 10.1016/j.egyr.2022.04.047.

Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. *Governance*, *23*(1), 161–183. doi: 10.1111/j.1468-0491.2009.01471.x.

Lütken, S., & Zhu, X. (2020). Incorporating energy service companies in nationally determined contributions. In *The potential of ESCOs for meeting the climate goals in the Paris Agreement*. Copenhagen Centre on Energy Efficiency. Available from: https://c2e2.unepccc.org/kms_object/incorporating-energy-service-companies-in-nationally-determined-contributions-the-potential-of-escos-for-meeting-the-climate-goals-in-the-paris-agreement/

Merrick, L. J. (2001). Sustainable organizational capacity building: Is organizational learning a key?. *International Journal of Human Resource Management*, *12*(1), 91–98. doi: 10.1080/713769590.

Morrissey, J. E., Mirosa, M., & Abbott, M. (2014). Identifying transition capacity for agri-food regimes: Application of the multi-level perspective for strategic mapping. *Journal of Environmental Policy and Planning*, *16*(2), 281–301. doi: 10.1080/1523908X.2013.845521.

Overland, I., Sagbakken, H. F., Chan, H. Y., Merdekawati, M., Suryadi, B., Utama, N. A., & Vakulchuk, R. (2021). The ASEAN climate and energy paradox. *Energy and Climate Change*, *2*, 100019. doi: 10.1016/j.egycc.2020.100019.

Phoumin, H., Kimura, F., & Arima, J. (2021). ASEAN's energy transition towards cleaner energy system: Energy modelling scenarios and policy implications. *Sustainability*, *13*(5), 2819. doi: 10.3390/su13052819.

Pinilla-De La Cruz, G. A., Rabetino, R., & Kantola, J. (2021). Unveiling the shades of partnerships for the energy transition and sustainable development: Connecting public–private partnerships and emerging hybrid schemes. *Sustainable Development*, (5), 10991719, 2022.

Prakash, A. (2023). *Connectivity plans in Indo-Pacific: Infrastructure for expanded supply chains and resilient growth*. ERIA Research Project Report 2022 No. 19. Jakarta: Economic Research Institute for ASEAN and East Asia.

UNDESA (2016) Strengthening technology facilitation and capacity building in a post-2015 setting: Understanding the issues, 2016 Development Cooperation Forum Policy Briefs.

UNDESA (2019). Review of capacity development gaps, needs, and priorities. Capacity Development for 2030 Agenda Implementation.

UNDP (2009). Capacity development: A UNDP primer.

UNDP (2016). Developing country support needs for the implementation of nationally determined contributions (NDCs).

UNFCCC (2020). Technical assessment of climate finance in Southeast Asia.

Vakulchuk, R., Overland, I., & Suryadi, B. (2023). ASEAN's energy transition: How to attract more investment in renewable energy. *Energy, Ecology, and Environment*, *8*(1), 1–16. doi: 10.1007/s40974-022-00261-6.

Veng, V., Suryadi, B., Pranadi, A. D., & Shani, N. (2020). A review of renewable energy development and its policy under nationally determined contributions in ASEAN. *International Journal of Smart Grid and Clean Energy*, *9*(1), 149–161. doi: 10.12720/sgce.9.1.149-161.

Wandersman, A., Duffy, J., Flaspohler, P., Noonan, R., Lubell, K., Stillman, L., … Saul, J. (2008). Bridging the gap between prevention research and practice: The interactive systems framework for dissemination and implementation. *American Journal of Community Psychology*, *41*(3-4), 171–181. doi: 10.1007/s10464-008-9174-z.

Wilkinson, D. (2016). Innovation capacity: How to develop it in your organisation. *Oxford Review*. Available from: https://oxford-review.com/

Willems, S., & Baumert, K. (2003). *Institutional capacity and climate actions*. Paris: OECD and IEA.

Wittmayer, J., & Loorbach, D. (2016). Governing transitions in cities: Fostering alternative ideas, practices, and social relations through transition management. In D. Loorbach, J. Wittmayer, H. Shiroyama, J. Fujino, & M. Mizuguchi (Eds), *Governance of Urban Substantiality Transitions: European and Asian Experiences* (pp. 13–32). Tokyo: Springer.

World Bank (2009). Defining capacity is complex. Available from: lencd.org/learning

World Bank (2015). *Financing business innovation: A review of external sources of funding for innovative businesses and public policies to support them*. World Bank Group. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/652201468151787487/financing-business-innovation-review-of-external-sources-of-funding-for-innovative-businesses-and-public-policies-to-support-them

Appendix 1

ASEAN energy-climate needs assessment project: Stakeholder interview questionnaire

Objective and purpose

This study endeavours to fill some of the present knowledge gaps in the decision-making process and its institutional context in relation to energy and climate change policies and actions in ASEAN, particularly to support the implementation of NDCs.

This research will take a systematic approach to examine stakeholder needs to bridge gaps between current conditions and NDCs, and between NDCs and Paris Agreement (2 C or 1.5 C) from the institutional, political, economic, social, environmental, technical, and financial perspective, considering strategies and plans of national/regional energy blueprint, market conditions, and socio-economic situations of each member state. The output could lead us (and other stakeholders) in designing crucial "on-point" activities in addressing those needs (and gaps). Key interview questions are listed in Table A1.

Participation is completely voluntary, and individual contributions will only be reported in aggregate form unless individuals explicitly agree to be identified. Individual contributions can be withdrawn at any point up until the initial report on July 16, 2021.

No.	Topics and questions	Remarks
	National priorities and goals	
1	What are national strategic objectives and goals in the energy and climate change programme and policy planning? Which of factors (political, economic, social, environmental, ecological, technical, financial) are most influential?	
2	What key economic development opportunities do you see associated with the post-COVID recovery in the next 5–10 years?	
	(Nationally determined contributions) NDC implementation	
3	Is there any NDC implementation roadmap/plan, including its monitoring and evaluation system, established in <your country>? If yes, how well is it?	
4	Are you on track to achieve the NDC targets? How confident are you in meeting the NDC targets? Any learnings from the experience, biggest challenges so far?	
5	How well the current energy policies and instruments support the implementation of the current NDCs set?	
6	*What challenges have been encountered in developing clean energy and energy efficiency in your country? What needs to be done to make it more effective?*	[For stakeholders with energy background]
7	*What are some of the positives and negatives of the current NDCs target on the energy sector you are aware of in <your country>?*	[For stakeholders with energy background]
8	*What enabling conditions (e.g. policies, market instruments) may be most effective that can help < your country > to achieve the current NDC target, and potentially enhance the future ambition?*	[For stakeholders with energy background]
9	Are there any specific capacity gaps and needs for implementing the mitigation components of NDC that were highlighted in the energy sector? What particular capacity supports < your country > will need to implement and strengthen the current NDCs, for example	
10	What does an NDC financing structure and plan look like, what are the funding sources for NDC implementation, and when should they be used?	[For stakeholders with finance background]
11	How do you engage with and incentivise private sector/non-state actors' support?	
12	Where are the key opportunities for strengthening climate action in the short and medium term in <your country>? Where are the key opportunities for regional collaboration at the ASEAN level?	

Table A1.
Interview questions

Note(s): Country specific questions in *italic*
Source(s): Table by authors

Appendix 2
ASEAN energy-climate needs assessment: a summary of interview participants (by country and ministry)

Country		Ministry	Department/ Directorate	Date	Position	Written response	Climate or energy (C/E)
Cambodia	1	General Secretariat of National Council for Sustainable Development (UNFCCC Focal Points)		28/ 06/ 2021	Director		C
Lao PDR	2	Ministry of Natural Resource and Environment	Department of Climate Change	02/ 06/ 2021	Deputy Director General		C
Indonesia	3	Ministry of Environment and Forestry	Directorate of Climate Change Mitigation	28/ 06/ 2021		1	C
	4	Ministry of Environment and Forestry	Directorate General of Climate Change Control	25/ 06/ 2021	Section Head		C
	5	Ministry of Energy and Mineral Resources	Directorate of Energy Conservation	24/ 04/ 2021	Technical Officer		E
	6	Ministry of Energy and Mineral Resources (MEMR)	Directorate General of Electricity	27/ 04/ 2021	Advisor to the MEMR on Environment		E
	7	Ministry of Energy and Mineral Resources	Directorate of Various New and Renewable Energy	21/ 06/ 2021	Director		E
	8	Ministry of Energy and Mineral Resources	Directorate of New Renewable Energy and Energy Conservation	25/ 06/ 2021	Section Head		E
Malaysia	9	Sustainable Energy Development Authority Malaysia	Strategic Planning Division	25/ 06/ 2021	Director		C

(*continued*)

Table A2.
A list of interviewees by country, ministry, department, and position

Country		Ministry	Department/ Directorate	Date	Position	Written response	Climate or energy (C/E)
Myanmar	10	Ministry of Natural Resources and Environmental Conservation	Climate Change Division	1/ 07/ 2021	Director		C
	11	Ministry of Electricity and Energy	Department of Electric Power Planning	6/ 07/ 2021		1	E
Philippines	12	Department of Energy	Energy Utilization Management Bureau	28/ 05/ 2021	Director		E
	13	Department of Energy		1/ 07/ 2021	Senior Undersecretary/ SOE Leader	1	E
Thailand	14	Ministry of Natural Resources and Environment (UNFCCC Focal points)	Climate Change Management and Coordination Division	29/ 06/ 2021		1	C
	15	Energy Forecast and Information Technology Center	Energy Policy and Planning Office	1/ 07/ 2021	Director		E
Vietnam	16	Ministry of Industry and Trade	Energy Saving and Sustainable Development Department	9/ 06/ 2021			C
	17	Ministry of Natural Resources and Environment	Department of Climate Change	6/ 05/ 2021			C
	18	Ministry of Planning and Investment	Dept. of Science, Education, Natural Resources and Environment	14/ 05/ 2021	Deputy Director General		C
	19	ASEAN Council of Petroleum (ASCOPE)		14/ 06/ 2021		1	E
	20	Ministry of Industry and Trade	Electricity and Renewable Energy Authority	7/ 06/ 2021	Deputy Director		E
ASEAN Secretariat	21	ASEAN Secretariat	Energy and Mineral Division	9/ 07/ 2021	Assistant Director		E

Table A2.

Source(s): Table by authors

Appendix 3
The methodology for developing the spider diagrams at the country level and the ASEAN level

The spider diagrams displayed in Figure 5 were developed based on two key survey questions related to capacity needs. Survey questions and their multiple choices in Column A, capacity categories assigned most relevant to specified choice in Column C are listed in Table A3. Both questions are forced multiple-choice questions with a minimum of 3 choices and a maximum of 5 choices allowed. The percentage of each choice in Column A under each question is calculated against the total choice counts of that question. For example, if there is a choice count of 7 for "Strengthen technical inputs to key ministries and stakeholders" chosen by survey respondents in one country, and a total choice count of 50 for Q1 for that country, the Choice count in Percentage in Column B will be 14%. This percentage then will be assigned to the technical and technological capacity category and the human resources capacity category. Based on the total percentage gained in each capacity category by country, we draw their relative strength in Figure 5. A heatmap is presented in Table A4 to illustrate the relative strength of each capacity category at the country level and the ASEAN level. The relative strength by each capacity category at the ASEAN level is developed based on the aggregated relative strength by all ASEAN countries, excluding Brunei Darussalam.

Column A Survey questions related to capacity needs	Column B Choice count in percentage (for illustration)	Column C Capacity categories assigned most relevant to the survey entry choice	Column D Capacity categories code assigned
Q1. What needs to happen in your country to meet your unconditional and conditional NDC target? (select top 5)	100%		
Strengthen technical inputs to key ministries and stakeholders	11%	Technical and technological, Human resources	TH
Facilitate technical assistance and capacity building	9%	Technical and technological	T
Improve enabling environment for private sector	9%	Institutional, Business innovation	IB
Promote technology transfer and development	10%	Technical and technological	T
Enhance climate-related institutional, policy and financial reforms	11%	Institutional, Financing	IF
Develop a climate fiscal framework	8%	Financing	F
Establish sustainable finance mechanism(s) in priority sectors	8%	Financing	F
Strengthen existing institutional and data collection structures	9%	Institutional, Monitoring	IM
Enhance monitoring and transparency systems	6%	Monitoring	M
Enhance coordinated efforts between ministries	11%	Networking	N
Strengthen public-private sector cooperation	7%	Networking	N
Q2. What capacity development is needed for your country to meet the NDC target? (Select top 5)	100%		

(*continued*)

Table A3. Survey questions and their multiple choices, and capacity categories assigned for developing the spider diagrams

Column A Survey questions related to capacity needs	Column B Choice count in percentage (for illustration)	Column C Capacity categories assigned most relevant to the survey entry choice	Column D Capacity categories code assigned
Estimating NDC implementation costs	6%	Human resources	H
Developing NDC implementation plans	7%	Technical and Technological, Human resources	TH
Translating NDCs into concrete policies, programs, and projects	17%	Institutional, Human resources	IH
Carbon Monitoring, GHG inventories, and developing/ improving information base	14%	Monitoring	M
Building institutional structures and coordination mechanisms	8%	Institutional	I
Building awareness and ownership of NDCs at the national level	7%	Knowledge	K
Facilitating peer-to-peer learning among countries based on similar NDC contexts	5%	Knowledge, Networking	KN
Energy sector planning and long-term strategy	14%	Human Resources	H
Innovative Renewable energy and energy efficiency business model and financing	15%	Business innovation, Financing	BF
Cross-sectoral coordination and integration, such as energy-transport, energy-forestry etc.	8%	Networking	N

Note(s): B: Business Innovation capacity
F: Financing capacity
H: Human Resources and Leadership capacity
I: Institutional capacity (including Policy and legislation capacity)
K: Knowledge and information capacity
M: Monitoring and reporting capacity
N: Networking capacity
T: Technical and Technological capacity

Source(s): Table by authors

Table A3.

	Business Innovation	Technical and Technological	Institutional	Financing	Human resources	Networking
Cambodia	0.39	0.42	0.69	0.43	0.51	0.22
Indonesia	0.38	0.26	0.55	0.46	0.44	0.35
Lao PDR	0.40	0.20	0.40	0.60	0.60	0.40
Malaysia	0.15	0.37	0.68	0.36	0.45	0.40
Myanmar	0.30	0.80	0.30	0.40	0.70	0.00
The Philippines	0.36	0.52	0.41	0.36	0.91	0.26
Singapore	0.33	0.00	1.00	0.67	0.33	0.33
Thailand	0.19	0.25	0.25	0.25	0.26	0.65
Vietnam	0.33	0.55	0.52	0.25	0.69	0.23
ASEAN	0.32	0.37	0.53	0.42	0.54	0.32

Source(s): Table by authors

Table A4.
A heatmap of relative strength by capacity category at the country level (excluding Brunei Darussalam) and the ASEAN level

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