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Pathways to Paris: Association of Southeast Asian Nations

Executive Summary

Technology and Policy Options to Reduce GHG Emissions

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Main Takeaways

- For the Paris Agreement process, the Association of Southeast Asian Nations (ASEAN) countries pledge to reduce their emissions through 2030 and introduce numerous policies to fulfill their pledges. This report offers a discussion of policy instruments and technologies in the energy sector that can assist ASEAN countries' in achieving their emission mitigation targets.
- The ASEAN countries face the challenge of reducing GHG emissions while at the same time expanding energy supply to meet the needs of their rapidly developing economies. In aggregate the ASEAN region is making good progress towards its Paris goals but still requires additional action to sufficiently decrease emissions from its current trajectory.
- Under the unconditional pledges, the ASEAN region faces an emissions gap (i.e., the needed reduction to meet the Paris pledges) of around 400 $MtCO_2e$, which indicates that the ASEAN region will have to reduce emissions by 11% by 2030 relative to its current trajectory. Under the conditional (i.e., subject to more ambitious global efforts and technology and financial transfers) pledges, the emissions gap is about 900 $MtCO_2e$, which indicates a needed reduction of 24% by 2030.
- Individually, while some countries are projected to be close to or to even over-achieve their goals for 2030, others need substantial additional efforts. However, there are many policy and technology options to reduce the emissions gap.
- Carbon pricing through taxes or cap-and-trade systems tends to be the most cost-effective option but can be politically challenging to implement. Other policy instruments are therefore needed to promote clean technology (e.g., support to natural gas infrastructure development for countries with large coal use and renewable energy auctions for all ASEAN countries).
- While wind and solar generation provide attractive options for lowering emissions, a switch from coal to natural gas promotes lower-carbon power generation and enables higher penetration of intermittent renewables by serving as backup capacity.
- Our country-specific analysis for Indonesia and Vietnam shows that emission reduction goals are achievable at a manageable cost. For an economy-wide policy, the GDP cost of meeting unconditional pledges in Indonesia and Vietnam is only 0.03% and 0.008%, respectively, relative to GDP in a business-as-usual scenario in 2030.
- Our assessment is unique in providing a gap analysis that consistently covers all ASEAN countries. We provide all input data and tools used in our analysis in an open source format. We hope the open source format will enhance the capacity of ASEAN economies to analyze their pathways to meeting their emission mitigation goals.

Executive Summary

Context

The world is facing a serious threat from global climate change. In the Paris Agreement, 195 nations have agreed to national greenhouse gas (GHG) emission reductions as a first step toward limiting the global temperature rise to less than 2 degrees Celsius (C) relative to the pre-industrial temperature. Reaching this goal will require a transformation of the global energy system over several decades. The Association of Southeast Asian Nations (ASEAN) countries face the challenge of reducing GHG emissions while at the same time expanding energy supply to meet the needs of their rapidly developing economies. To help them address this challenge, we use a variety of analytical tools—including country-specific, economy-wide models for selected countries—to understand the ASEAN countries' emissions trajectory in both business-as-usual and climate policy scenarios. We also offer a discussion of policy instruments and technologies in the energy sector that can assist ASEAN countries in achieving their emission mitigation targets. This assessment is enhanced by collaboration with representatives of the ASEAN Centre for Energy (ACE). By maintaining an open dialogue on the data and policies incorporated in our projections and by providing all input data and tools used in our analysis in an open source format, we hope to enhance the capacity of ASEAN economies to analyze their pathways to meeting their energy, electrification, and emissions goals.

Limiting global temperature rise to 2 degrees Celsius will require a transformation of the global energy system.

The ASEAN region is an important contributor to global development. In 2015, its population accounted for about 9% of the global population and about 6% of global gross domestic product (GDP) measured at purchasing power parity. In terms of GHG emissions from energy, industry, transportation, agriculture and final consumption (i.e., all sources excluding land use), the ASEAN region's global share in 2010 was about 5%. While eventually emission reductions will need to come from all sectors of the economy, the energy sector offers a significant opportunity to obtain reductions using available technology and policy solutions at a relatively low cost.

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The ASEAN region is projected to have high growth in energy demand—nearly a 100% increase in total primary energy consumption from 2015 to 2030—due to its growing population and economy. Moving to lower-carbon or no-carbon energy (e.g., natural gas, wind, and solar) today will ease the task of reducing GHG emissions in the future.

In the Paris Agreement process, each country determines its own contribution to reduce GHG emissions to mitigate climate change. There is no mechanism to force a country to take on a certain target. Countries are free to choose the stringency of their emission mitigation targets and they may or may not specify the mechanisms to achieve the targets. Countries' pledges (called Nationally Determined Contributions, or NDCs) have various types of targets, such as (1) a reduction in emissions relative to a business-as-usual (BAU) projection, (2) a reduction in emissions relative to some historic year, (3) a reduction in emissions intensity (i.e., the ratio of emissions to GDP), (4) a targeted level or percentage of renewable energy, (5) a reduction in deforestation or an increase in a forest cover of a country, and (6) sector-specific targets such as efficiency improvements. Many countries also provide two stringencies of emission mitigation targets in their NDCs: unconditional (i.e., what a country is planning to do regardless of

actions by other countries) and conditional (i.e., unconditional targets plus additional mitigation actions by a country if specific conditions are satisfied, such as a global climate accord, financial assistance, or technology transfers).

Emissions Pathways

This report provides a projection of the ASEAN countries' future emissions trajectory and maps their NDC targets relative to their historic and estimated future emissions. In 2030, the estimated ASEAN Baseline (No Climate Policy) scenario emissions are 3,679 million tonnes of CO_2-equivalent ($MtCO_2e$), and the unconditional emissions target is 3,265 $MtCO_2e$. Consequently, the emissions gap (the volume of reductions to be achieved under a specific target) is 415 $MtCO_2e$, which indicates that, in aggregate, the ASEAN region will have to reduce its emissions by 11% relative to the Baseline scenario to meet its countries' unconditional NDC pledges. Under the conditional emissions target (2,781 $MtCO_2e$), the emissions gap is 899 $MtCO_2e$, which indicates a needed reduction of 24% relative to the Baseline scenario emissions.

Investments in generation from natural gas or in wind and solar in power generation would pave the way for more aggressive emission reductions in the future.

Achievement of NDC goals will be affected by the type of power generation added in each country. For example, investments in coal power plants (without carbon capture and storage, CCS) would lock-in substantial carbon emissions associated with coal use while investments in generation from natural gas—which has a lower carbon intensity than coal—or investments in wind and solar with zero carbon emissions in power generation would pave the way for more aggressive emission reductions in the future. At the same time, coal power in many countries is the cheapest and most reliable energy option, and therefore an attractive path to expand access to energy.

High efficiency, low emission (HELE) coal plants provide an option for lower carbon emissions and significantly reduced (to the level of natural gas plants) emissions of sulphur dioxide (SO_2), nitrogen oxides (NOx) and particular matter (PM). However, if carbon emission reduction goals after 2030 are substantially increased in the ASEAN countries, then further reduction of carbon emissions would require CCS. The current progress on CCS development is rather slow (with only a few power plants at a commercial scale) and the ultimate fate of coal will depend on the cost of investing in CCS versus abandoning or converting the generating assets.

Policy Options

Policy frameworks are the key to determine a nation's ability to incentivize the deployment of new technologies, attract private capital, internalize externalities (such as the health effects of air pollution), modernize electricity transmission and distribution, and expand access to energy. These policies can range from broader policies like energy price reforms and energy subsidy reduction to technology-specific policies like renewable portfolio standards, feed-in tariffs and renewable energy auctions. Carbon pricing through taxes or quantity controls with tradeable units both leave the allocation of resources to the market and can thereby equalize abatement costs across all covered entities, avoiding technology-picking and offering superior cost-effectiveness over alternative instruments.

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Other types of instruments—such as price support measures and fiscal subsidies—can be successful in building coalitions of support, and have also been confirmed through opinion surveys to be more popular with the public. Weak administrative capacities, legal challenges, and unclear mandates can undermine or delay the practical implementation of the instruments which promise to be the most effective and efficient in theory, as shown in the operation of complex policy instruments such as an emissions trading scheme (ETS; see case study of the European Union ETS in Section 7.3.1). Likewise, the legal frameworks protecting foreign and domestic investors in, or owners of, low-carbon technology assets and infrastructure can be a greater determinant of the success of renewable energy or energy efficiency support measures than the design and implementation of those measures themselves.

Currently, electricity market designs are again facing substantial pressure to transform. The emergence of disruptive technologies, such as distributed energy resources and digitalization, coupled with ever more stringent environmental policy requirements, are fundamentally changing the landscape in which energy markets operate. When considering their policy framework, ASEAN economies need to begin by thinking about how the design of their electricity market will advance their energy security and climate goals. Design of electricity markets, for instance, needs to facilitate the integration of distributed or centralized resources contributing to the efficient provision of electricity services and attainment of other public objectives.

To successfully integrate growing shares of variable renewable energy sources, electricity market design has to ensure proper incentives for adequate reserve and balancing capacity through capacity markets or other mechanisms. A comprehensive and efficient system of market-determined prices and regulated charges needs to reflect energy-related services (such as electric energy, operating reserves, firm capacity, and ramp-up capability) and network-related services (such as network connection, voltage control, power quality, network constraint management, and energy loss reduction). Market interconnections with other countries/regions provide the potential to make more efficient choices, better integrate intermittent and distributed resources, and enhance system reliability and resilience.

Another important feature of many electricity markets with substantial repercussions for climate change mitigation is price supports for conventional energy, such as fossil fuel subsidies. The reduction and eventual elimination of energy subsidies leads to the correction or removal of distortions in costs and prices that inform the decisions of producers, investors, and consumers. In many cases, energy subsidies prolong the life of older technologies and energy-intensive methods of production while often undermining the credit worthiness of utilities. Subsidy removal reduces the strain on fiscal resources and potentially leads to their improved allocation.

The ASEAN countries list in their NDCs numerous plans, policies, and strategies as their means to achieve their emissions reduction goals. Because the ASEAN countries represent a wide variety of economies in terms of their level of development and institutional capacity, their choice of policy instruments for GHG emission mitigation depends on administrative and technical capacities to introduce and enforce a particular policy, political support for the desired stringency of emission reductions, and willingness to accept the associated economic cost. Currently, the climate and energy policy portfolios of most ASEAN countries are dominated by a patchwork of energy savings measures and targeted support for renewable energy, embed-

ded in broader—and in many cases aspirational—mitigation strategies. While these policies have shown some positive effects, they are not always cost-effective, nor do they yet have the scalability to set in motion a broad transition towards a lower-carbon future. Our analysis shows that ASEAN nations have the opportunity to achieve greater GHG reduction gains, at relatively low cost, through better policy coordination, stronger policy signals, and the introduction of new technologies.

No ASEAN member nation has implemented a carbon price to date, but interest in this highly cost-effective and scalable policy option is growing, with at least one ASEAN country (Singapore) already planning adoption of a carbon tax in the near term. For the ASEAN countries with more advanced administrative and technical capacities, we therefore recommend carbon pricing through taxes or quantity controls with tradeable emission permits because they offer the greatest economic efficiency benefits. These instruments are particularly suitable for countries with substantial experience with market-based mechanisms and competitive electricity markets. International experience with such markets is extensive (for an overview of experience, see Section 7.3 of the report), and capacity building initiatives and guidance on their design and implementation are readily accessible from a variety of sources, some of which are already active in several ASEAN countries (e.g., the World Bank Partnership for Market Readiness). As deployment of carbon pricing instruments in the region has been halting, it should therefore be a priority of future policy development for economically more advanced ASEAN countries. Singapore's adoption of a legislative basis for introduction of a carbon tax in 2019 will set a useful near term example for neighboring ASEAN countries to study.

For countries that are still in the process of advancing their institutional capacities, we recommend an initial focus on technology-specific policies such as renewable portfolio standards, feed-in tariffs and renewable energy auctions. Feed-in tariffs are already in place in several ASEAN countries—such as Indonesia, Malaysia, and Thailand—and renewable energy auctions are gaining more widespread use. Such support measures can be more successful in building coalitions of support for ambitious climate policies, and also in creating the domestic supply chains and know-how needed for robust markets in clean technology.

At a later stage, however, such targeted support measures should be reviewed and, where political will and institutional capacities allow, gradually phased out as more cost-effective mitigation instruments, such as carbon pricing, are introduced and scaled up. Recent reductions in fossil fuel subsidies across the ASEAN region have shown that political support can be mustered for policy reforms that may increase energy prices. At the same time, thoughtful implementation of policy changes is critical. The political backlash against sudden electricity cost increases due to feed-in tariffs in the Philippines led to the elimination of feed-in tariffs for a majority of renewable energy project types in 2017. The Philippines example shows how politically sensitive energy prices remain and reveals the obstacles governments must overcome to introduce policies affecting energy prices.

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In the medium-term, natural gas offers a viable option for lowering emissions in countries that have substantial share of coal generation (e.g., Indonesia, Malaysia, The Philippines, and Vietnam). To realize the potential of natural gas, policy options include a support to natural gas infrastructure development and loosening or removing price rigidities. An important component of a national gas strategy is allowing more private participation in supply, transportation, and marketing of natural gas, including third-party access to natural gas infrastructure. An early experience by other countries that promote natural gas use (e.g., Mexico, China, and Egypt) illustrates the need for natural gas pricing reforms that reflect the market fundamentals and promote competition, thereby enhancing new supplies that ultimately lower the costs.

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In any country, a policy package with one clear core policy instrument and complementary planning, market and regulatory instruments (which share a common objective with the core instrument) is often critical to secure investment decisions and implement and execute projects. A coherent, targeted policy package performs differently than a combination of various core policy instruments with different objectives. In terms of assembling policy portfolios, this difference should be clearly recognized.

Because different policy objectives require their own policy instruments, we recommend that policies adopted to promote climate mitigation should avoid the simultaneous pursuit of other policy objectives, such as development, labor, or industrial policy goals. Combining policy instruments can lower overall efficiency due to adverse interactions and trade-offs.

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We therefore recommend establishing a clear and transparent policy mix that allows for periodic policy review and adjustments. In many cases, pilot programs (1–2 years) can serve to fine-tune policy design and prepare economic actors for policy compliance; thereafter, however, policies with long time horizons (5 years or more) are recommended to provide planning and investment certainty to market participants. These long-term policies should contribute to overarching mitigation strategies and should be accompanied by robust planning processes to ensure consistency across instruments as well as to establish the supporting institutional and regulatory frameworks.

Substantial progress towards emission mitigation goals can be achieved by modernization of electricity market design and a reduction and eventual elimination of fossil fuel subsidies. Although fossil fuel prices in most ASEAN countries fluctuate based on prices in international markets, they remain regulated and are not fully liberalized (e.g., natural gas in Myanmar and Thailand, gasoline and diesel in Vietnam and Indonesia). As electricity demand is growing rapidly in most ASEAN countries, a reform in electricity subsidies (both for residential use and for certain type of fuels like natural gas) will be a key issue despite the associated political difficulties. Subsidy removal reduces the strain on fiscal resources and potentially leads to their improved allocation. We therefore recommend continuation of recent efforts at subsidy removal (e.g., experiences with removing subsidies for gasoline and diesel in Indonesia and Malaysia, reform of CNG and LPG pricing in Thailand, and changes in electricity pricing in Vietnam), combined with creation of targeted support to low-income consumers.

Technology Options

Numerous technology options are available for GHG emission mitigation. We categorize the most promising options into three clusters. In *Tier I* we include options related to building or retrofitting power plants to provide lower-carbon generation options than the current fleet. The options vary by their capital-intensity, maturity and scale and include the development of wind, solar, natural gas, hydro, geothermal, and waste technologies. Thus, for many ASEAN countries, this tier means moving away from unabated coal-based generation. While wind and solar generation provide better options in terms of lowering carbon emissions, natural gas also has a substantial role both as a fuel with a lower carbon content than coal and as a technology that allows a higher penetration of intermittent renewables by serving as a backup capacity to provide reliability for the electricity system.

In *Tier II* we group the technology options that lead to improved efficiency (more-efficient turbines, digitalization, etc.), both on the production and on the consumption of electric power. The options in *Tier III* relate to technologies that enhance market and network organization (e.g., enabling distributed generation, time-of-the-day pricing, etc.), and include options for improved integration of renewables (e.g., new transmission lines, virtual power plants, microgrids, tools for better citing and forecasting of wind and solar farms to maximize their utilization).

Despite substantial progress in bringing down costs of certain types of low-carbon power generation, the considerable uncertainty about the future costs of different technologies and the challenges for their integration to the system necessitates a flexible approach. We recommend that policy makers incentivize emission reductions from all sources of energy rather than favor any particular technology.

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Most ASEAN nations are at the beginning stage of introducing new technologies for emissions reduction. As countries update their NDCs, this is an opportunity to create frameworks that encourage the adoption of these technologies to improve the efficiency of the power sector and reduce emissions. For example, as wind and solar options become more competitive, they offer a valuable option for emission reduction. The ASEAN countries are still at low levels of penetration of intermittent renewables, and therefore, their integration into the power system is currently relatively simple. ASEAN nations can learn from others how to avoid the challenges of higher levels of renewables penetration by directing policy makers, regulators, market and network operators, utilities, and other players to plan and prepare for the integration of higher shares of non-dispatchable technologies such as wind and solar. The experience of countries with large shares of renewables (e.g., Germany, Denmark, Belgium, and Portugal) provides valuable guidance for understanding challenges and opportunities of intermittent generation sources.

While coal power is the cheapest and most reliable energy option in many ASEAN countries, natural gas provides a viable alternative in order to reduce GHG emissions and local air pollutants. Some ASEAN nations are only beginning to introduce natural gas as a fuel choice in their economies by developing access to LNG, piped gas, or domestic supply. We have seen this trend grow in China, Japan, Korea, and Taiwan, as well as more recently in Malaysia and Pakistan. However, because future emission reduction targets (for the period beyond the current Paris pledges) are likely to be more aggressive, we also recommend exploring options

for nuclear and CCS technologies, keeping in mind that these capital-intensive projects require longer planning timelines and extensive government support.

We also recommend a wider use of technologies that enable energy efficiency improvements, both in the construction of more efficient power plants and through the use of digital technology to improve existing supply- and demand-side processes. Decision-makers should monitor the latest advances in technologies that enhance market and network organization (e.g., enabling distributed generation, time-of-the-day pricing, etc.) and consider options for the improved integration of renewables. These technology options are highly under-utilized in the ASEAN context and provide opportunities for regulators and policymakers.

We emphasize that other technologies may become more attractive in the future. Possible options include energy storage as well as the production of hydrogen with renewable power and its consequent use for energy needs. Therefore, we recommend monitoring technological progress and adjusting the options under consideration as new technologies become more economically feasible. At the same time, decision makers should be able to perform an objective evaluation of the prospects of the advanced technologies rather than rely on potentially over-optimistic promises of sellers of new technological options.

The scale of the required transformation in the ASEAN region as a whole can be illustrated with a hypothetical example of removing coal-based generation from the electricity mix. While we do not advocate for a complete replacement of coal-based generation in a short period of time, the impact of technology choice can be dramatized by our illustrative example showing the magnitude of a potential change. Depending on the natural gas capacity factor, replacing all coal-based generation with natural gas by 2030 corresponds to about 1,000–1,500 new 100MW natural gas turbines in the ASEAN countries. Depending on the wind generation capacity factor, replacing all coal-based generation with 4MW wind turbines corresponds to about 30,000–45,000 new wind turbines in the ASEAN region. Furthermore, replacing all coal generation with wind displaces 764 $MtCO_2$, which falls short of achieving the ASEAN region's conditional targets (a needed reduction of 899 $MtCO_2e$) but is sufficient to achieve its unconditional targets (a needed reduction of 415 $MtCO_2e$). These illustrative estimates convey that, while in many cases actions targeting only the power generation sector will not be sufficient for meeting a nation's Paris Agreement goals, major shifts in choice of generating technology move the ASEAN countries significantly toward their emission reduction goals. Mitigation action most likely will employ a set of different options in different sectors of the economy rather than achieve all emission reductions exclusively in the power generation sector through replacing or improving an entire generation fleet.

Deep Dive: Indonesia and Vietnam

This report also provides additional focus on Indonesia and Vietnam through MIT-developed economy-wide models. Our detailed analysis leads us to the conclusion that reductions in GHG emissions to meet their respective NDC unconditional targets are achievable at a manageable cost. For an economy-wide policy, the GDP cost in Indonesia and Vietnam is only 0.03% and 0.008%, respectively, relative to GDP in the BAU (No Policy) scenario in 2030. Deviations from this most efficient policy (i.e., moving from economy-wide coverage to sector

specific policies) increase the costs. For example, an ETS applied to only the energy-intensive industries induces "emissions leakage"—an increase in activity and GHG emissions in the uncovered sectors—and thus requires a higher carbon price (roughly 3 times larger in Indonesia and 3 to 7 times larger in Vietnam) than would an economy-wide ETS.

The most costly simulated impacts arise from meeting conditional targets using an ETS with coverage of only energy-intensive industries. In Indonesia, this scenario decreases electricity generation in 2030 relative to the BAU by nearly 25% while in Vietnam electricity generation decreases 27.6%. The key insight from these simulations is that the sectoral coverage of climate policy should be a broad as possible. This can be achieved by either including as many sectors as possible in the ETS, or linking non-ETS sectors to included sectors by allowing domestic offset credits to be surrendered in lieu of ETS permits (see the case studies on the European Union ETS and the Western Climate Intiative in sections 7.3.1 and 7.3.3).

Digitalization measures can support the dual-pursuit of development and climate policy goals. We estimate up to a $1.8 billion (0.1%) increase in GDP and 14.6 TWh (2.6%) increase in electricity generation in Indonesia, and up to a $1.7 billion (0.3%) increase in GDP and 8.7 TWh (2.4%) increase in generation in Vietnam, in 2030 relative to scenarios without the use of digitalization technologies.

Policy Recommendations for Indonesia

We recommend further strengthening of Indonesia's existing policy portfolio, including more ambitious targets for low-carbon generation and coordination of policies in the power sector with policies in the other sectors of the Indonesian economy. Such coordination calls for better inter-agency cooperation. A newly formed Directorate General of Climate Change, operating under the auspices of the Ministry of Environment and Forestry, can work alongside the Ministry of National Development Planning to implement the National Action Plan for Greenhouse Gas Reduction, a presidential decree of 2011, which sets out a cross-sectoral framework for Indonesia's climate strategy.

Currently, emissions from rainforest and peatland loss still dominate the country's emissions profile. Going forward, however, emissions growth will shift to the energy sectors, where robust economic growth has also resulted in a steep increase in energy demand, seeing electricity demand, for instance, almost double over the last decade.

Planned expansion of coal-fired electricity generation, in particular, will pose a substantial challenge for achievement of Indonesia's pledged mitigation targets, although it aligns with the strategic objective of achieving greater energy security. For future policy design, this poses a twofold challenge. To be effective at curbing emissions, Indonesia's instrument portfolio will have to both address the substantial emissions from land use, land use change and forestry, and require shifting the further expansion of electricity generation towards Indonesia's abundant domestic renewable resources.

Timing is also a critical factor: as Indonesia progresses with its planned expansion of electricity generation capacity, it faces a considerable risk of long-term carbon lock-in. As it implements

the Electricity Supply Business Plan for 2016–2025, which anticipates the addition of 80 GW in generating capacity over the course of a decade, any new fossil-fueled generation capacity will continue to emit over the considerable useful economic life of these assets.

Mitigation actions in seven key areas outlined in the government plans should be enhanced: sustainable peat land management; reducing the deforestation and land degradation rate; developing carbon sequestration projects in forestry and agriculture; promoting energy efficiency; developing alternative and renewable energy sources; reducing solid and liquid waste; and shifting to low-emission transportation mode.

In the area of land use, land use change, and deforestation, cooperation with international donors has resulted in a temporary moratorium on new forestry licenses and peatland development. A "One Map Initiative" aimed at developing a unified forestry mapping system has the potential to greatly increase transparency on emissions from deforestation. In the transportation sector, whose emissions are likewise growing at a rapid pace, several pilot and demonstration projects seek to expand use of public transportation and improve urban transportation infrastructure.

As Indonesia considers options to further strengthen its existing policy portfolio, it has a unique opportunity to accelerate the shift from continued growth of fossil fuels in electricity generation, heating, and transport to renewable energy sources. While Indonesia enjoys abundant domestic reserves of hard and brown coal, it is also richly endowed with untapped renewable energy potential, especially in biomass, geothermal, hydropower, solar, and tidal energy. Not only will substitution of fossil resources with renewable energy be essential to achieve mitigation objectives, it will also mobilize important additional benefits, such as reduced air and water pollution as well as associated health impacts.

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A stronger policy portfolio might be translated into more ambitious targets for renewable energy deployment in Indonesia's national energy strategy. Rapidly falling technology costs make a much more aggressive expansion trajectory for renewable energy economically viable. A transition away from the established fossil fuel sector will face resistance and necessitate careful planning to avoid social hardship, but opportunities for strong growth, employment and innovation also exist along the renewable energy supply chain. Overall, the net benefits of a transition will outweigh costs. But accelerating growth in renewable energy use will require coordinated action along multiple levels.

Renewable energy auctions are a proven instrument to cost-effectively scale up growth of renewable energy while retaining control over the pace and cost of the transition (for an overview of international experience with renewable energy auctions, see Section 7.1.2 of the report). Increased reliance on renewable energy auctions needs to be complemented by forward-looking infrastructure planning to ensure grid integration of new and variable generation capacities, including in remote areas with small, isolated grids. International cooperation and policy learning can help build technical capacity and inform future reforms of Indonesia's electricity market with a view to better managing an evolving electricity mix.

Emissions are also rapidly growing in the transport and residential sectors. Carefully managed to minimize land use impacts, expanded use of biofuels can play a considerable role in reducing the emissions intensity of these sectors. Continued use of targeted energy efficiency measures (e.g., Energy Management Regulation 14/2012 of the Indonesia's Ministry of Energy

and Mineral Resources requires energy efficiency plans and periodic energy audits for entities consuming more that 6000 tonnes of oil equivalent per year) offer a useful way to curb emissions growth, but can suffer from low cost-effectiveness and have unintended effects. Over time, Indonesia should therefore consider instituting a price on carbon to leverage this policy's ability to scale up abatement at least cost across all sectors, create a more even playing field between carbon-intensive and renewable technologies, and potentially leverage carbon finance from third countries through offset projects or international linkage of carbon pricing policies. Indonesia already has a good track record of international carbon market participation under the Clean Development Mechanism (CDM) of the Kyoto Protocol and, more recently, the bilateral Joint Crediting Mechanism (JCM) with Japan.

Rather than relying on public expenditures, as many current measures do, carbon pricing could also be a source of much-needed revenue for public budgets. It is also vitally important that Indonesia continue initial efforts under the current administration to reform fossil fuel subsidies, which continue to bind a significant share of the public budget. Although a weakening currency and rising fossil fuel prices make it harder to sustain the recent pace of reform, further subsidy reductions will likewise reduce the strain on public budgets. Combined with carbon pricing revenue, this will allow Indonesia to allocate greater financial resources for strategic investment in innovation and infrastructure development, which will be key for further growth of renewable energy in electricity generation and electrification of transport.

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More generally, institutional and regulatory challenges, including fragmented governance structures involving a large number of government actors, have been identified as barriers to effective translation of national commitments to the regional and local level). While the creation of the Directorate General of Climate Change marks a useful first step, further integration and mainstreaming of climate policy priorities across all levels of government is recommended.

Policy Recommendations for Vietnam

Our policy recommendations for Vietnam focus on bringing down its energy intensity, which is the highest among major East Asian economies, and shifting future growth in electricity generation capacity to renewables and natural gas. Strengthening and better enforcement of existing policies on energy efficiency and renewable energy, continued energy price reform and restructuring of the power sector, and, prospectively, introduction of a carbon price are all suited to advance decarbonization of the power sector.

Emissions growth in Vietnam is primarily driven by the energy sector. Despite an already high electrification rate, electricity demand is expected to quadruple from 2010 to 2030 driven by industrial demand growth. Much of this electricity generation is projected to come from coal, of which the country possesses ample domestic reserves. Agriculture, while still an important source of emissions, is declining in relative importance, and industry and waste each contribute only a small share of the country's emissions.

Policy recommendations therefore focus on ensuring that new electricity generation capacity is based on renewable energy and natural gas rather than coal and, especially in the short

term, curbing energy demand growth as a way to buy time for fuel switching in the electricity sector. Opportunities for both are ample, with significant low cost potential documented for energy efficiency improvements in households and industry, and attractive conditions for solar and on- and offshore wind energy deployment. Ongoing construction of LNG import terminals will also allow increased use of natural gas in electricity generation.

Vietnam already has a robust foundation for climate policy in place. As a country with centralized, top-down decision-making structures, Vietnam relies on 5-and 10-year planning cycles. Three strategic frameworks guide its policies on climate change mitigation: a National Climate Change Strategy, a National Green Growth Strategy, and a National Strategy on Environment Protection. In 2012, Vietnam adopted a National Action Plan on Climate Change for the period 2012–2020, which sets out objectives and a large number of specific programmes and projects.

Aside from shortfalls in the effective implementation and enforcement of existing rules, an important challenge has been that centrally determined electricity prices are fixed at low, albeit progressive, levels. Although the government has commendably announced a phase-out of fossil fuel subsidies by 2020, the block electricity tariffs set by the government are not fully reflective of marginal generation costs and therefore amount to an implicit price support. Not only does this reduce the incentive for energy conservation, it also provides insufficient cost-recovery and return on investment in the power sector.

In 2015, Vietnam adopted a Renewable Energy Strategy for 2030, with targets that represent a declining share of renewables in electricity generation to reflect the faster expansion anticipated for generation from coal and natural gas. This Strategy is largely consistent with the latest iteration of the National Power Development Plan (2016–2030), which envisions the addition of 77 new coal-fired power generation plants by 2030. Several support mechanisms incentivize electricity generation from renewable sources, including feed-in tariffs, net metering, and compensation based on avoided cost, complemented by grid codes, standardized power purchase agreements, and incentives related to corporate income tax, import duties, and land use.

Although these policies have helped open the electricity sector for private investment, it continues to be dominated by a state-owned enterprise, Electricity Vietnam (EVN). Private investors, which already face greater financial risk and capital constraints than the state-owned EVN, also struggle with fixed electricity rates that are too low to cover capital costs for new investments or recover operating costs for existing power generation. Prices for coal—which is mined by another state-owned enterprise, the Vietnamese National Coal and Mineral Industries Group—are also regulated by the government and, although linked to the international market, are considered low.

Taken together, low prices for electricity and coal, modest and unevenly enforced incentives, and an electricity market that creates barriers to private sector entry dampen prospects for energy efficiency improvements and rapid growth in renewable energy generation. With earlier plans to develop nuclear power suspended for reasons of cost, and remaining hydroelectric potential at risk due to climate change, decarbonization of the Vietnamese power sector will rely on natural gas and, increasingly, solar, wind and biomass. Aside from reduced externalities, the latter three also offer the benefit of improved energy security through independence from

energy imports. Existing policies provide a solid basis for their promotion, but the effectiveness of this policy framework could be enhanced with more ambitious targets and strengthened institutional capacities to ensure rigorous enforcement.

Importantly, continued restructuring of the power sector can be an important enabler of scaled-up investment in clean energy technologies. As the ongoing power sector reforms spur a transition from an electricity market design with state monopolies and centrally controlled prices to a competitive electricity market in which market dynamics determine prices, renewable energy sources, natural gas, and energy efficiency investments will become more cost competitive. Greater competition will also reduce emissions through operational and efficiency gains, as inefficient and emissions intensive coal fired plants see less frequent dispatch or exit the market.

Leveraging the signaling effect of prices that more accurately reflect underlying cost also requires thinking about carbon pricing over time. In a competitive electricity market, a carbon price will further strengthen the merit of lower-carbon technologies relative to coal, for instance by promoting fuel switching from coal to gas. Vietnam already announced in 2012 that it would launch a national emissions trading system for carbon covering all major emitting sectors. For the carbon price to be effective, however, continued privatization of state-owned enterprises and deregulation of electricity tariffs will be critical to foster responsiveness to market signals. Ultimately, a carbon price will also help channel private sector finance to low-carbon investments, helping overcome another major barrier for mitigation efforts faced in Vietnam.

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International Experiences

The ASEAN countries can learn from positive and negatives experiences with emission reduction policy mechanisms in other regions of the world. We offer a detailed exploration of the lessons learned worldwide from employing policies to promote renewable energy, such as feed-in tariffs and renewable energy auctions. We also summarize the experience with standards, regulations, and carbon pricing systems in other regions.

While feed-in tariffs were initially a popular instrument to develop wind and solar projects, renewable energy auctions have become a more established tool in the portfolio of clean energy support instruments. By fostering strong competition, they have contributed to low project cost bids. Time will tell whether these bids come at the expense of low realization rates. Concerns about the financial feasibility of some projects, difficulties in securing financing, and issues with access to transmission infrastructure help explain relatively low realization rates for certain projects in Brazil, Mexico and Argentina. At this point, it is too early to tell if the experience of these initial projects is indicative of future challenges or if the realization rates will be improved with more maturity in this policy instrument. The example of auctions illustrates the value of studying international policy experiences.

Overall, we recommend that ASEAN policy makers carefully survey the lessons learned in other regions with emission reduction policies, and apply best practices by tailoring these policies to local conditions. But there are also some overarching recommendations we can infer from international experience. Given the emissions gap identified in this report, ASEAN countries will invariably have to strengthen existing and adopt additional policy instruments to achieve their NDCs. Both

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practical and theoretical arguments justify adopting a mix of different policies to build capacity, foster policy support, and start the gradual transformation process of the economy.

Already, ASEAN countries have leveraged many of the benefits of a diverse instrument portfolio. At the same time, experience shows that coexistence of multiple policy instruments can result in negative policy interactions, increasing the economic cost of achieving climate targets. By favoring specific technologies, targeted policies may also miss valuable abatement opportunities. Over time, as ASEAN countries strengthen their technical capacities and explore more ambitious goals for future NDC cycles, we therefore recommend they focus on economy-wide carbon pricing as a central pillar of their mitigation strategies and better harmonization of existing policies until they achieve that goal.

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