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Vietnam's solar and wind power success: Policy implications for the other ASEAN countries

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ABSTRACT

This study analyzes the factors that have facilitated Vietnam's recent rapid solar and wind power expansion and draws policy insights for other member states of the Association of Southeast Asian Nations (ASEAN). A policy-mix analysis focusing on targets, incentive instruments, enabling regulations, and policy implementation is carried out, informed by semi-structured interviews with 20 Vietnamese experts during the period January–March 2021. A comparative analysis between Vietnam and the other ASEAN countries provides policy insights. Generous feed-in tariffs are found to have been a key driver, with income tax and land lease payment exemptions also being important. The main barriers include a high level of policy uncertainty and an underprepared transmission grid. Vietnam's case indicates that a strong price signal and a supportive investment environment can pave the way for rapid solar and wind power uptake. Another key lesson is that early preparation of transmission systems for solar and wind electricity is needed to maximize the potential for expanding the use of these technologies.

Introduction

The Association of Southeast Asian Nations (ASEAN) has a population of around 650 million people. Its electricity consumption has been projected to more than double between 2018 and 2040, reaching about 2000 TWh per annum (ASEAN Centre for Energy, 2020). Electricity generation in ASEAN is dominated by fossil fuels, with natural gas and coal accounting for around 78% of the total in 2018. ASEAN's "aspirational target" is to expand the share of renewables in the total primary energy supply (excluding traditional biomass) to 23% by 2025 (ASEAN Centre for Energy, 2020). However, on the current trajectory, this target is likely to be missed (International Renewable Energy Agency, 2018).

Since 2019, Vietnam has emerged as the leader in solar and wind electricity adoption in the ASEAN area. The country overtook Thailand and had the largest installed solar and wind capacity in 2019. Vietnam's total capacity of solar photovoltaic (PV) reached about 16,500 megawatts (MW) by the end of 2020 (International Renewable Energy Agency, 2021). This far surpassed the original 2020 target of 850 MW (Government of Vietnam, 2016) and is even approaching the tentative target of 18,600 MW of installed solar power capacity by 2030 that appears in the draft version of Vietnam's Power Development Plan 8 (Vietnam Energy Institute, 2021). More than 100,000 rooftop solar PV systems were installed in Vietnam in 2019 and 2020, an extraordinary achievement (Electricity of Vietnam, 2020). While most of the ASEAN countries share similar opportunities, they have yet to experience the rapid progress in solar and wind development seen in Vietnam (Fig. 1).

Vietnam's solar and wind electricity generation rose from 4.7 TWh in 2019 to 9.5 TWh in 2020. This equaled a 1.98 percentage point increase in the share of total electricity generation (BP, 2021) (Fig. 2). The rate of increase in the solar plus wind share of the electricity mix in Vietnam in 2020 was much faster than that achieved in the broader Asia-Pacific region or the world as a whole. Elsewhere in ASEAN, Malaysia, Singapore, and Indonesia saw smaller increases, while the solar plus wind share of the electricity mix actually declined in Thailand and the Philippines due to relatively stagnant uptake of these renewables and rapid growth in use of other electricity sources. These countries have set renewable energy targets and applied policy instruments such as feed-in tariffs, but with mixed success.

While solar PV has seen the greatest expansion in Vietnam, installed wind power capacity has also grown quickly. Installed wind power

Abbreviations: ASEAN, Association of Southeast Asian Nations; ENV, Electricity of Vietnam; FIT, feed-in tariff; GW, gigawatt; GWh, gigawatt hour; LCOE, levelized cost of electricity; MW, megawatt; MWh, megawatt hour; MOIT, Ministry of Trade and Industry; NDC, Nationally Determined Contribution; PV, photovoltaic; REZ, renewable energy zone; RPS, renewable portfolio standard; TW, terawatt; TWh, terawatt hour; W, watt.

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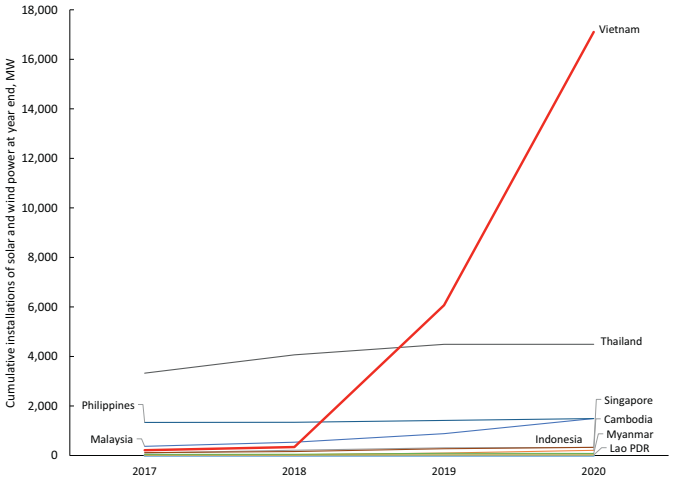

Fig. 1. ASEAN total solar plus wind power capacity, 2017–2020.
Source: International Renewable Energy Agency (2021). The figure shows cumulative installations at year end. Brunei Darussalam has a small level and is not labelled.

capacity reached 600 MW by the end of 2020, behind only Thailand (1507 MW) among the ASEAN countries. In 2020, Vietnam's annual wind power capacity growth rate was 70%, while the other ASEAN countries did not expand their wind capacity (International Renewable Energy Agency, 2021). Vietnam has the most ambitious wind power development plan in ASEAN, with a tentative target of 11,800 MW of wind power capacity by 2025 (Vietnam Ministry of Industry and Trade, 2020). The targets of Thailand and the Philippines are about 3000 MW by 2036 (Climate Scorecard, 2020) and 2378 MW by 2030 (Philippines Department of Energy, 2011), respectively. Vietnam's cumulative solar and wind power installed capacity was 176 W per capita in 2020, the highest among the ASEAN countries (Fig. 3). Understanding the underlying drivers of Vietnam's success could help the other ASEAN countries to formulate suitable policies for boosting the use of these renewable energy technologies.

This paper investigates Vietnam's recent solar and wind energy development and seeks to answer two questions: 1) How did Vietnam manage to accelerate its solar and wind power adoption? 2) What policy insights emerge for the other ASEAN member states? A policy-mix analysis framework is used to address the first question, while a comparative analysis between Vietnam and the other ASEAN countries is performed to answer the second. Semi-structured interviews were conducted with 20 experts from government agencies, academia, private sector, and civil society in Vietnam to inform the analysis. To our knowledge, this is the first paper to investigate policy lessons from Vietnam's initial success in adopting solar and wind power for other countries in the ASEAN region.

The paper finds that generous feed-in tariffs and income tax and land lease payment exemptions have been key drivers for Vietnam's solar and wind development success. Other factors include political and social support and a supportive investment environment. A key conclusion is that the other ASEAN countries could consider following Vietnam's lead by focusing on the domestic benefits of solar and wind power development in prioritizing the adoption of these renewables. These domestic benefits include access to low-cost new electricity sources and a reduction in local pollution, among others. Early preparation in terms of electricity transmission and distribution and also energy storage would enable ASEAN to better benefit from transitioning to intermittent but increasingly cost-effective sources of electricity in the form of solar and wind power.

Literature review

There is a sizeable literature on solar and wind development policies. Ambitious targets and economic incentives such as feed-in tariffs (FITs), tax exemptions, and investment subsidies have been found to be key drivers in the initial stages of solar and wind power development (Bechberger & Reiche, 2004; Kilinc-Ata, 2016; Best & Burke, 2018; Thapar, Sharma, & Verma, 2018; Burke et al., 2019; Do, Burke, Baldwin, & Nguyen, 2020). Other policy instruments such as renewable portfolio standards and reverse auctions also play important roles (Burke & Do, 2020). Renewable energy laws have also been a common enabler in early-moving countries such as China, Germany, and the United Kingdom (de Castro et al., 2019). Government policies are crucial for renewables development given the capital-intensive nature and risk exposure of these projects and the high level of government participation in the electricity sector (Urmee & Harries, 2009; Burke & Do, 2020).

The ASEAN countries have applied various policy instruments to promote solar and wind uptake. The most common tool is the use of FITs (ASEAN Centre for Energy and China Renewable Energy Engineering Institute, 2018). Reverse auctions have also recently come into use in countries such as Indonesia, Malaysia, the Philippines, and Thailand (REN21, 2020). Considerable efforts to improve the investment environment, including specifically for renewables, have helped Thailand, the Philippines, and Vietnam to rank among the top 40 countries in terms of their investment environments for renewable energy (EY, 2020). Each ASEAN country has a target to expand the use of solar and wind power (ASEAN Centre for Energy, 2020).

Despite progress in some countries, ASEAN's success in solar and wind uptake has been mixed. Solar and wind power uptake has recently

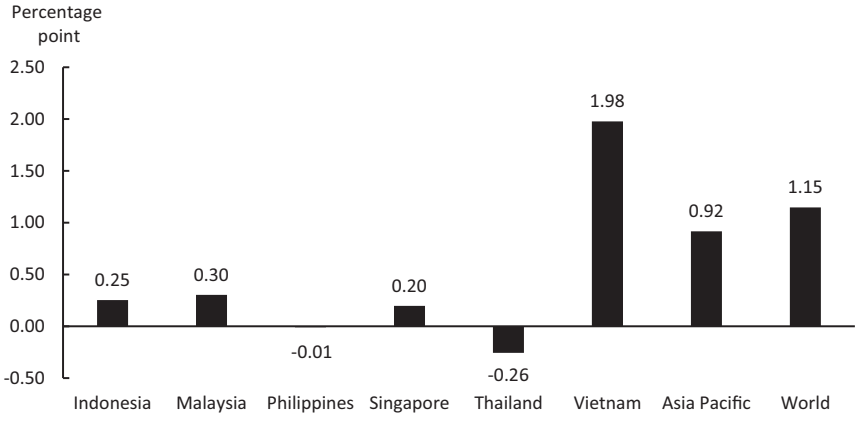

Fig. 2. Change in the solar plus wind share of electricity generation in key ASEAN countries, 2020.
Source: BP (2021).

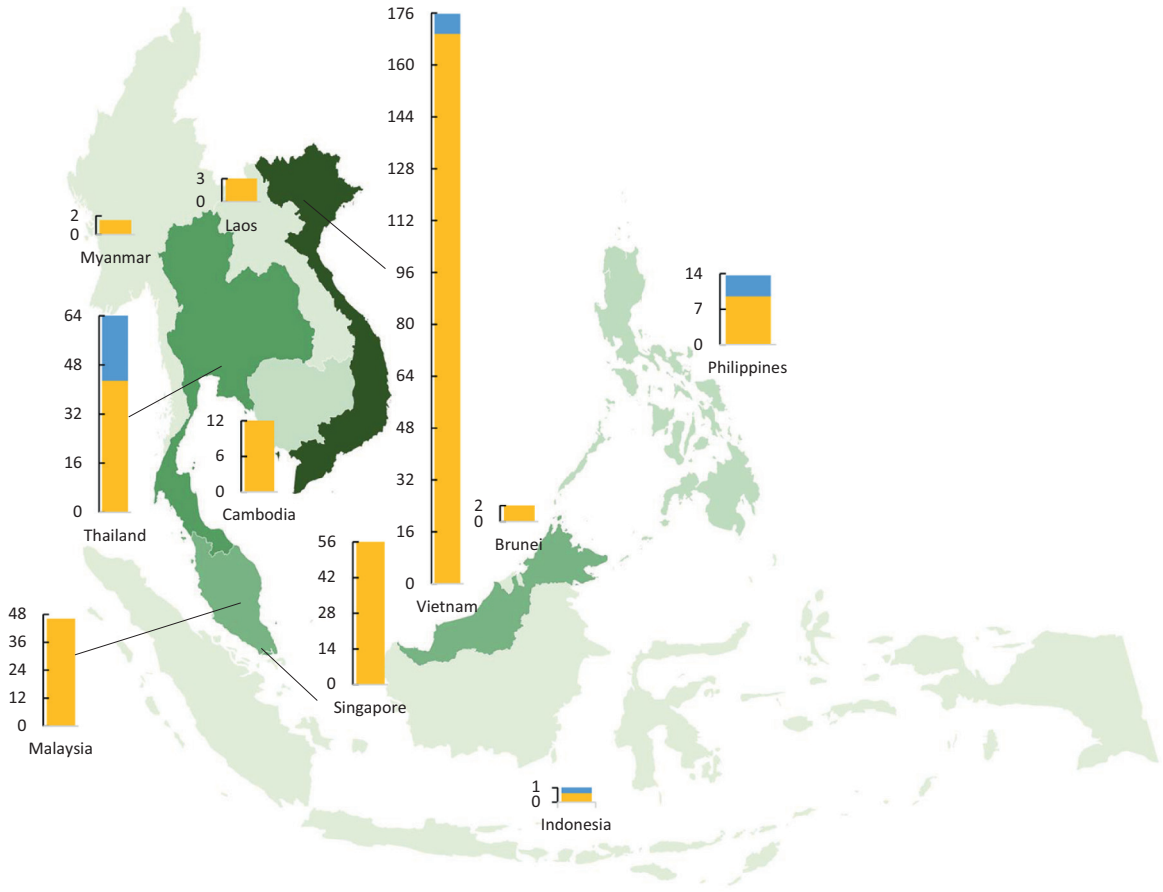

Fig. 3. ASEAN total cumulative installed solar and wind power capacity per capita in 2020 (W).
Source: International Renewable Energy Agency (2021); Worldometer (2021).

stalled in Thailand and the Philippines, the earlier pioneers in the region (International Renewable Energy Agency, 2021). Despite introducing FITs in 2008, the solar and wind share of the electricity mix in Indonesia remained below 1% as of 2020 (BP, 2021). Solar and wind power shares have also remained very low in the other ASEAN countries such as Malaysia and Singapore (BP, 2021).

Comparative studies on solar and wind development policies among the ASEAN countries have been relatively limited. Some have analyzed individual countries (for example, Tongsopit, 2015; Setyawati, 2020; Vaka, Walvekar, Rasheed, & Khalid, 2020) or have reviewed ASEAN progress, but without detailed analysis of the policy reasons for the mixed progress (Erdiwansyah, Mamat, Sani, Khoerunnisa, & Kadarohman, 2019; Malahayati, 2020). Earlier comparative analyses of the ASEAN countries by the ASEAN Centre for Energy and China Renewable Energy Engineering Institute (2018) focused only on FITs. Do et al. (2020) studied solar power development in Vietnam but without a focus on wind power or specific lessons for the other ASEAN countries. The current paper thus makes an important contribution to the literature given that solar and wind have the potential to contribute a growing share of the energy mixes of the ASEAN countries over coming decades.

Materials and methods

A policy-mix analysis framework (Rogge & Reichardt, 2016) is employed to carry out a comprehensive analysis of policy instruments applied in selected ASEAN countries. The analysis focuses on targets, incentive instruments, enabling regulations, and policy implementation of relevance to solar and wind adoption. Incentive instruments that have been applied in Vietnam, such as FITs and tax exemptions, are central to the focus. Key elements of FITs, including rates and eligibility windows, are assessed.

The study is based on expert consultations that are complemented by secondary data, providing an update on and broadening of an earlier analysis of solar power development in Vietnam by Do et al. (2020). Semi-structured interviews were conducted with 20 experts in Hanoi: 5 from government agencies, 6 from academia, 4 from industry, and 5 from non-governmental organizations. While there is no rigid rule on the number of interviews required for qualitative research, 20 is a typical minimum (Schreier, 2018). The number of interviewees from each stakeholder group was determined based on respondents' availability and willingness to participate, aiming for a balanced representation of stakeholders. The paper also uses secondary data on regulations and policies and energy statistics from government agencies and international organizations such as the ASEAN Centre for Energy, International Energy Agency, International Renewable Energy Agency, and BP.

Invitations for interviews were sent to 28 experts who were randomly selected from a list of Vietnamese experts on energy and climate change administered by the Ministry of Natural Resources and Environment. Of the 28 invitees, 8 did not respond. The response rate was thus 71%. The interviews were carried out in Vietnamese between January and March 2021.

Semi-structured interviews were employed because they enable open discussions on a set of questions about a topic of interest (Roulston & Choi, 2018). They are particularly suitable for gathering information with balanced breadth and depth, and when interviewees are from different stakeholder groups. Such interviews have been applied in prior energy-focused research in the Vietnamese context (Zimmer,

Jakob, & Steckel, 2015; Do et al., 2020). The key interview questions for this study were as follows:

1. In your opinion, why did the Vietnamese government prioritize solar and wind power development?
2. What do you think about Vietnam's solar and wind power targets?
3. What do you think about Vietnam's feed-in tariffs for solar and wind power?
4. What were the other supporting factors for solar and wind power development in Vietnam?
5. What do you think about the potential use of other instruments, such as reverse auctions and renewable portfolio standards, in Vietnam?
6. What lessons can be learned from Vietnam's solar and wind power development?

Vietnamese cultural and social norms were taken into account when designing the interviews (Do & Bennett, 2010). As Vietnamese people tend to prefer personal conversations to virtual interviews, face-to-face meetings were the principal mode, with Zoom and phone interview formats being offered as alternatives. The list of questions was sent to the interviewees in advance so that they had time to think their answers over. Key study findings were subsequently shared with the participants for their input to ensure interpretation accuracy and policy relevance. The interviewees were also asked about concerns they might have with respect to Vietnam's solar and wind boom. All interviewees' statements were transcribed, and those mentioned by over 50% of the respondents and supported by secondary data sources were brought forward for further analysis. The personal and institutional details of the interviewees remain confidential.

To achieve policy insights for the other ASEAN member states, a comparative analysis between Vietnam and the other ASEAN countries was conducted (Burke et al., 2019). The analysis focuses on the following dimensions: political and social support, national policy, incentive instruments, fiscal instruments, overall investment attractiveness, and supporting regulations (International Renewable Energy Agency, 2018). Indonesia, Malaysia, the Philippines, and Thailand were the focus of this analysis on account of their size and importance in terms of the ASEAN renewable energy target (Erdiwansyah et al., 2019). They also each have roughly similar socioeconomic development statuses with Vietnam or are more developed.[1] Policy and other features unique to Vietnam were also further investigated to help to understand the causes of Vietnam's outperformance as well as any shortcomings in Vietnam's approach.

Drivers of Vietnam's solar and wind power expansion

Underlying drivers

According to the expert interviewees, the government's commitment to energy availability was the most important motivation for Vietnam's solar and wind policies (Fig. 4). This is similar to the findings of Do et al. (2020). The Prime Minister's consistent message has been to not let electricity shortages happen given the importance of electricity to socioeconomic development (Dang & La, 2019). Solar and wind have emerged as increasingly viable options for capacity expansion because of their rapid cost reductions and the relatively short construction time for new power plants, especially for solar power.

Public demand for clean air was identified by the interviewees as the second-most important driver. They pointed out that advanced monitoring technologies have helped to facilitate growing public awareness about air pollution, as one can now easily check air pollution levels in real-time using widely available smart phone applications. Civil society has also played a growing role in voicing concerns about worsening air pollution. This has contributed to rising resistance to new coal power projects, particularly at the provincial level (Do et al., 2020).

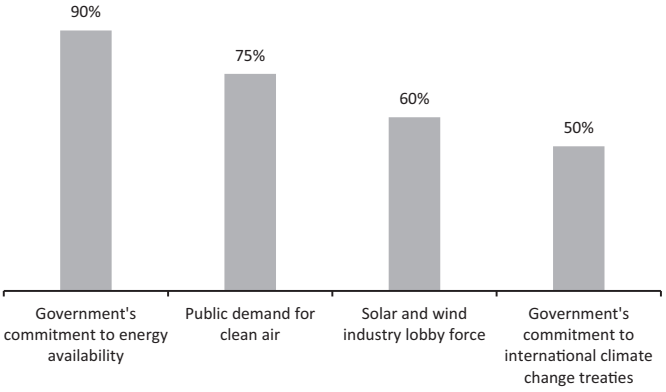

Fig. 4. Key drivers of Vietnam's solar and wind policy (% of respondents).
Source: Expert interviews. Interviewees were given various options from which to select. They could select more than one driver and could also volunteer new ideas. Those selected by 50% or more of the respondents were reported as key drivers.

Notably, the interviewees reported that the emerging lobbying power of the solar and wind industry has been a relevant factor. As Vietnam is a potentially lucrative market, mergers and acquisitions of solar and wind projects have been on the rise, with the key investors coming from Thailand, Singapore, and the Philippines (Apricum, 2020). While the fossil fuel industry remains powerful (Dorband, Jakob, & Steckel, 2020), its influence has begun to wane because of public concerns about its negative environmental and health impacts and the government's anti-corruption campaigns targeting the industry (Do et al., 2020).

The government's commitment to international climate change treaties has also been a driver of solar and wind policy development. In 2020, Vietnam adjusted its nationally determined contribution (NDC) to commit to reducing greenhouse gas emissions by 9% or 27% in 2030 relative to business as usual without and with international assistance, respectively (Government of Vietnam, 2020). For the energy sector, targets are for emissions reductions of 5.5% (unconditional) and 11.2% (conditional) below business as usual.

Feed-in tariffs

The interviewed experts all believed that generous solar FITs have been the proximate driver of solar PV adoption. The first FIT was launched in 2017 by Prime Ministerial Decision 11/2017/QD-TTg (Government of Vietnam, 2017). Solar power projects—both utility scale and rooftop—that started operation prior to 30 June 2019 can sell their electricity to state-owned Vietnam Electricity and its subsidiaries at a FIT of US$93.5/MWh for 20 years.

In April 2020, the Prime Minister issued Decision 13/2020/QD-TTg to usher in reduced FITs of US$83.8/MWh for new rooftop solar projects, US$70.9/MWh for new ground-mounted solar PV, and US$76.9/MWh for new floating solar projects. Projects that entered commercial operation by 31 December 2020 were eligible, with the FITs being applicable to electricity generated over the next 20 years. As of early 2021, the next stage of the FIT program has yet to be decided.

Vietnam's solar PV FITs have been generous. Lee et al. (2020) estimated that the average LCOE for solar PV in Vietnam in areas excluding protected areas, water bodies, forested areas, agricultural areas, urban areas, and areas with slopes greater than 5% was around US$87.5/MWh in 2018. With a reduction rate of 13% per annum (International Renewable Energy Agency, 2019), these LCOEs would be about US$76/MWh in 2019 and US$66/MWh in 2020. Therefore, FITs of US$93.5/MWh before June 2019 and US$70.9–US$83.8 per MWh thereafter

[1] In 2020 the GDP per capita (PPP terms, current international US$) of Indonesia was 12,073; Malaysia 27,887; the Philippines 8390; Thailand 18,236; and Vietnam 8651 (World Bank, 2021a, 2021b).

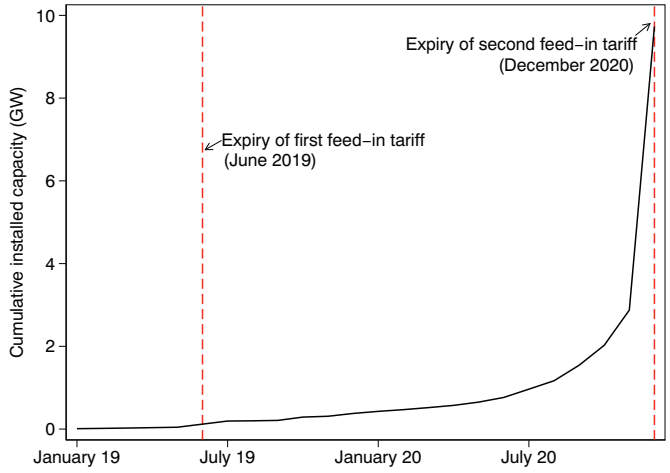

Fig. 5. Vietnam's cumulative rooftop solar installations by month, 2019–2020.
Source: Vietnam Energy Partnership Group (2020).

have been attractive, especially given that project developers have focused on the best available sites in the south of the country. The expiry of the two FITs created booms in solar PV installations as market participants rushed to capitalize on the opportunity (Fig. 5). Almost 7 GW of rooftop solar PV was installed in December 2020 alone, a remarkable achievement (Vietnam Energy Partnership Group, 2020).

The FITs for wind power have been less immediately effective. The first FIT for onshore wind was issued in 2011 through Decision 37/2011/TTg-QD of the Prime Minister, with the FIT set at US$78/MWh. Only about 100 MW was installed between 2011 and 2018 under this FIT. In 2018, the FIT for onshore wind increased to US $85/MWh, and a new FIT for offshore wind of US$98/MWh was introduced under Decision 39/2018/TTg-QD of the Prime Minister. As of the end of 2020, installed wind power capacity had reached 600 MW, of which 100 MW was offshore (Prime Minister, 2021). One of the reasons why short-run booms have been seen for solar but not wind is that solar projects are quicker to implement. This is particularly the case for rooftop solar.

According to our expert respondents, Vietnam's wind FITs have also been less generous than its solar FITs. Onshore wind power projects have higher installed costs—about US$2000/MW relative to US $1100/MW for solar (Lee et al., 2020)—and longer project periods. The average LCOE for onshore wind in Vietnam was about US$93/MWh in 2018 (Lee et al., 2020). With an annual reduction rate of 9%, the onshore wind LCOE could be estimated to be about US $84.6/MWh in 2019 and US$77/MWh in 2020. Similarly, the LCOE for offshore wind is about US$174/MWh in 2021 and US$100/MWh in 2028 (World Bank, 2020a). This indicates a gap between the LCOE and the current offshore wind FIT.

The three-year eligibility window for the current wind FIT was assessed by our interviewees as being too narrow, especially for offshore wind projects. Wind power projects require significant planning and capital expenditure, with a lengthy approval process. It can take several years to build a wind farm, with longer average construction times for offshore projects. Uncertainty about the FIT for new projects that are completed beyond a three-year horizon can be crippling for investment.

Tax and land lease incentives

According to our respondents, tax and land lease exemptions have also been key factors. Both solar and wind developers have been exempted from corporate income tax for the first four years of operation. Income tax will be reduced by 50% in the following nine years and then by 10% until the 15th year of operation. Imported equipment has also been exempted from import tariffs. Some utility-scale solar and wind projects have received land lease payment exemptions ranging from 14 years to the entire project lifespan, depending on the location (Do et al., 2020). Funding from all sources, including foreign investors, has been allowed.

Enabling regulations

Two key legal documents providing a foundation for solar and wind uptake are the Government's National Strategy on Renewable Energy Development 2015 and the Party's Resolution 55/NQ-TW on the Orientation for National Energy Development 2020 (Government of Vietnam, 2015; Vietnam Political Bureau, 2020). The former was the first to highlight the importance of solar and wind power in achieving socioeconomic development targets and the use of economic instruments such as FITs. The latter reemphasized the need to prioritize solar and wind amid debates over these intermittent energy sources.

Regulations have also been revised to enable private sector investment. While the Electricity Law and the Investment Law have been considered for amendment, the Prime Minister issued an ad hoc directive in 2020 to allow the private sector to invest in transmission lines to connect their plants and other local projects to the main grid (Nang Luong Vietnam, 2020). Under Prime Minister Decision 13/2020/QD-TTg, rooftop solar generators can now also sell electricity to non-Electricity of Vietnam (EVN) buyers, although details of how this can be done are still being developed by the Ministry of Trade and Industry (MOIT). Tentatively, utility-scale solar plants will be able to sell to final consumers either via EVN-managed transmission lines with surcharges paid to EVN or directly using their own power lines. This is part of the wholesale electricity market reforms that are currently underway in Vietnam.

Targets

Vietnam's 2020 targets for solar and wind were 850 MW and 800 MW, respectively (Government of Vietnam, 2016). Our interviewees believed that the targets were useful, despite lacking ambition. They also believed that a higher wind target could have boosted wind uptake. For solar PV, the target was initially relevant but quickly became redundant when Vietnam's installation rate soared beyond the targeted level.

Vietnam's government is considering increasing the nation's solar and wind capacity targets. According to the draft Power Development Plan 8 of February 2021, solar and wind capacity will reach 18.6 GW and 18 GW by 2030, respectively, accounting for about 26% of the total electricity generation capacity (Vietnam Energy Institute, 2021). The tentative targets are more ambitious than the existing formal targets in Power Development Plan 7 of about 12 GW and 6 GW for solar and wind, respectively, by 2030, equal to about 14% of the total target for power generation capacity (Government of Vietnam, 2016). However, the solar target is redundantly low, as Vietnam's solar power capacity is already almost at the target level.

Our interviewees believed that Vietnam's targets could be more ambitious. In only two years, 2019 and 2020, Vietnam's solar PV capacity increased by over 16 GW. The country's underlying potential for both solar and wind power is massive, with economic potentials of 2847 GW and 311 GW, respectively, at sites with an LCOE of less than US $150/MWh as of 2018 (Lee et al., 2020). The potential for utility-scale PV plants within 10 km of the existing power grid alone is estimated to be about 48 GW (Teske, Morris, & Nagrath, 2019). There is great scope for a much more sizeable transition to these new and clean energy types.

Policy implementation

According to our expert interviewees, significant effort has gone into facilitating solar policy implementation in Vietnam. Prime Ministerial

Table 1
List of solar power regulations.

No.	Year	Regulations	Issued by	Contents
1.	2017	Decision 11/QĐ-TTg	Prime Minister	Support mechanisms for the development of solar power projects in Vietnam
2.	2017	Circular 16/TT-BCT	MOIT	Regulation on project development and standard power purchasing agreement for solar power projects
3.	2018	Document 5113/EVN-KD	EVN	Guidance for grid connection for rooftop solar PV projects
4.	2019	Decision 02/QĐ-TTg	Prime Minister	Amending and supplementing some articles of Decision 11/2017/QD-TTg
5.	2019	Circular 05/TT-BCT	MOIT	Amending and supplementing some articles of Circular No. 16/2017/TT-BCT
6.	2019	Document 1532/EVN-KD	EVN	Guidance for the implementation of rooftop solar PV projects
7.	2019	Document 3450/EVN-KD	EVN	Guidance for the settlement of outstanding issues on rooftop solar power
8.	2019	Decision 2023/QĐ-BCT	MOIT	Approval of the rooftop solar PV promotion program
9.	2020	Decision 13/QĐ-TTg	Prime Minister	Mechanisms to promote the development of solar power projects in Vietnam
10.	2020	Circular 18/TT-BCT	MOIT	Regulation on project development and standardized power purchasing agreements for solar power projects
11.	2020	Circular 21/TT-BCT	MOIT	Regulation on the application process and requirements for the issuance of electricity generation licenses
12.	2020	Document 7088/BCT-ĐL	MOIT	Guidance for the development of rooftop power

Source: Compiled by the authors from Vietnamese government documents.

decisions relating to the sector were made and subsequently detailed in MOIT circulars and EVN technical guidance documents. Provincial People's Committees have also issued regulations to facilitate project siting and land clearance. Vietnam's provinces viewed the booming solar PV industry as providing economic opportunities and moved to simplify administrative procedures in order to attract investment.

Wind power policy implementation, however, has been less smooth and has been affected by inadequate enabling regulations, particularly for offshore wind. Marine planning and regulations on connections from offshore wind farms to onshore grids have also not been developed. Having multiple government agencies involved in offshore wind licensing has posed challenges, and poor transport infrastructure has hindered the supply of heavy and cumbersome wind turbines and towers. A lack of financing for capital-intensive offshore wind projects has also been a barrier.

Due to the under-capacity of transmission grids, the MOIT and EVN have been reluctant to issue further policies to promote wind power. By February 2021, only seven wind power regulations had been issued, compared to 12 for solar power (Tables 1 and 2). In particular, EVN has yet to issue a technical guidance for wind power. Consequently, the provinces have been unenthusiastic about following up with enabling guidances for land clearance for wind power projects. The experts also noted that wind farms appear to receive more aesthetic objections than solar farms. Public resistance to wind power due to aesthetic reasons has been a significant barrier to its development in other countries (Chen, Ponta, & Lago, 2011; Sæþórsdóttir & Ólafsdóttir, 2020).

According to our interviewees, decision-making processes for solar and wind power have been fairly open and adaptive in Vietnam. Key documents such as Power Development Plan 8, which sets out detailed targets and tasks for the electricity sector for the period 2021–2030, have been made available in draft form for public comment (Vietnam Energy Institute, 2021). The MOIT's regular policy reviews and feedback channels (such as business forums) have provided input for policy revisions.

The government has displayed some adaptiveness in response to challenges and feedback. In 2020, for example, it moved to clarify the definition of rooftop solar to exclude systems that are not genuine rooftop-mounted systems. Exemptions to FIT expiry dates were also provided for already-approved solar power projects in solar-rich Ninh Thuận province when they did not meet the first FIT deadline on 30 June 2019 in terms of project completion. These projects remain eligible for the rate of US$93.5/MWh until the provincial cap of 2 GW has been reached (Nang Luong Vietnam, 2018). This change was intended to support project developers who had experienced technical and administrative delays. Similarly, the government is considering extending the wind FITs until the end of 2023 in light of the COVID-19 pandemic and the challenges that have arisen as a result.

Policy insights for the other ASEAN countries

The common enabling factors for solar and wind uptake in Vietnam include political and social support, incentive instruments, supporting regulations, and overall investment attractiveness (Urmee & Harries, 2009; Gabriel, Kirkwood, Walton, & Rose, 2016; International Renewable Energy Agency, 2018). This section discusses the relevant lessons from Vietnam's case for the other ASEAN countries in terms of both what has worked and what has not.

Drivers of solar PV and wind power in ASEAN

The ASEAN countries have significant solar and wind power potential. The resource base for solar and onshore wind power at sites with a levelized cost of electricity (LCOE) of less than US$150/MWh as of 2018 has been estimated to exceed 31 TW (Lee et al., 2020). This is about 130 times ASEAN's total installed electricity generation capacity (234 GW) as of 2017 (ASEAN Centre for Energy, 2020). Thailand has the highest technical solar PV potential (over 10.5 TW), followed by Myanmar (7.7 TW), Cambodia (3.2 TW), and Vietnam (2.8 TW).

Table 2
List of wind power regulations.

No.	Year	Regulations	Issued by	Contents
1.	2011	Decision 37/2011/QĐ-TTg	Prime Minster	The mechanism supporting the development of wind power projects in Vietnam
2.	2012	Circular 32/2012/TT-BCT	MOIT	Regulation on the implementation of wind power project development and the standardized power purchase agreement for wind power projects
3.	2012	Circular 96/2012/TT-BTC	MOIT	Guidelines for the financial mechanism to support the electric price for wind power projects
4.	2013	Circular 06/2013/TT-BCT	MOIT	Regulation on the content, process and procedures for the preparation, validation, and approval of wind power development planning
5.	2018	Decision 39/2018/QĐ-TTg	Prime Minister	Amendment and supplementation of some articles of Decision 37/2011/QĐ-TTg
6.	2019	Circular 02/2019/TT-BCT	MOIT	Regulation on wind power project development and power purchase agreements (to replace Circular 32/2012/TT-BCT and Circular 06/2013/TT-BCT)
7.	2021	Decree 11/2021/ND-CP	Government	Assignment of rights over seabed leasing

Source: Compiled by the authors from Vietnamese government documents.

Table 3
Features of Vietnam's solar and wind policy framework compared with those of selected other ASEAN countries.
Sources: International Renewable Energy Agency (2017a, 2017b, 2018); REN21 (2020); EY (2020); International Energy Agency (2021); World Bank (2019c).

	Indonesia	Malaysia	Philippines	Thailand	Vietnam
1. Strong political and social support	N	N	N	N	Y
2. FITs for new projects in 2019	Y Capped*	N	N	Y US$57/MWh	Y US$93.5/MWh
3. Gross metering	N	N	N	N	Y
4. Land lease exemptions	N	N	N	N	Y
5. Reverse auctions	Y	Y	Y	Y	N
6. An enabling investment environment^	N	N	Y	Y	Y
7. Low fossil fuel subsidies	N	N	N	N	Y
8. Solar/wind equipment recycling regulations	N	N	N	N	Y

Note: Y represents the presence of policy. N indicates an absence of policy or lack of a strong policy.
* The Indonesian FIT is capped at 85% of regional average generation cost in some regions.
^ Based on appearance in the EY (2020) top 40 list.

Myanmar, Vietnam, and Thailand are the three top countries in terms of onshore wind power potentials with 0.5 TW, 0.3 TW, and 0.2 TW, respectively (Lee et al., 2020). Vietnam and the Philippines' technical offshore wind potentials within 200 km of the coast are estimated at 0.21 TW and 0.16 TW respectively (World Bank, 2019a). Research suggests that ASEAN countries could achieve up to a 97% solar and wind share in their electricity mix with support of off-river pumped hydro energy storage at an LCOE of US$55–115/MWh based on 2020 technology costs (Lu, Blakers, Stocks, & Do, 2021).

One lesson from the Vietnamese case is that other ASEAN member states may seek to follow Vietnam in focusing on domestic drivers to publicly motivate the adoption of solar and wind power. These include the local health benefits associated with zero-emission electricity generation. Similar to Vietnam, the other ASEAN countries are facing serious air pollution from the combustion of fossil fuels and other factors. The annual number of premature deaths associated with air pollution in ASEAN is projected to rise from 450,000 in 2018 to more than 650,000 by 2040 if the current fossil fuel-reliant trajectory continues (International Energy Agency, 2019). Outdoor air pollution is already estimated to reduce average life expectancy by about 2 years in Indonesia, 1.7 years in Malaysia, and 1 year in Thailand (Energy Policy Institute at the University of Chicago, 2020). Focusing on the local air quality benefits of solar and wind power can help build political and public support.

There are many other potential motivations for pursuing solar and wind power in ASEAN. These energy sources offer a new industry that can help ASEAN pursue a greener post-pandemic recovery. Solar power offers an opportunity to generate revenue from otherwise underutilized spaces, such as rooftops and degraded land. Combining solar or wind power with farming can also increase the returns generated on agricultural land. Investments in solar and wind power also reduce the stranded asset risks associated with fossil fuel assets. It has been estimated that ASEAN could save about US$26 billion on fuel costs by achieving its 23% renewable energy target by 2025 (ASEAN Centre for Energy, 2020).

The ASEAN countries could also use broader motivations to motivate solar and wind uptake. As one of the world's most vulnerable regions to climate change, ASEAN is estimated to be on track to experience a mean sea level rise of as much as 70 cm, a decline of up to 50% of rice yield potential, and a loss of 6.7% of annual GDP by 2100 (Overland et al., 2017; ASEAN, 2020). Transitions to solar and wind energy would contribute to mitigating these impacts. Another potential driver is improving the positions of the ASEAN countries on the international stage (Overland et al., 2021). There are also opportunities for ASEAN to demonstrate a pioneering role, setting an example for other countries.

Positive lessons from Vietnam's case

Eight important characteristics of Vietnam's solar and wind power development are strong political and social support, high FITs, gross metering, land lease exemptions, an absence of reverse auctions, an enabling investment environment, fossil fuel subsidy reform, and regulations on solar and wind equipment recycling. These are summarized in Table 3, with Vietnam's situation compared with those of Indonesia, Malaysia, the Philippines, and Thailand. The following discussion focuses on each feature in turn.[2]

Strong political and social support

Strong political and public support has been a characteristic of Vietnam's solar and wind development. Vietnamese policymakers have shown interest in developing new and greener economic sectors (Zimmer et al., 2015; Do et al., 2020) and have put a policy framework in place to do so. This has unleashed interest in renewables on the part of private businesses.

FITs for new projects

Vietnam's case shows that relatively high FITs can generate strong interest in the expansion of renewable electricity generation. Thailand and Malaysia started solar power FITs in 2007 and 2011, respectively—much earlier than Vietnam. However, in recent times the FITs in these countries have been less generous than those in Vietnam. The rooftop FIT in Thailand in 2019 was only about US$57/MWh (Pugnatorius, 2019) . Before ending in 2016, Malaysia's solar FITs were subject to strict conditions, including a maximum eligible installed capacity of 30 MW and annual reductions in the available FIT rates for new projects based on government-set quotas (ASEAN Centre for Energy and China Renewable Energy Engineering Institute, 2018). Indonesia's utility-scale solar FITs have been capped at 85% of the regional average cost of electricity generation in locations where the regional average cost is greater than the national average generation cost. In some areas, the potentially negotiated FIT is low. Uncertainty also abounds in terms of grid access and project success (Burke et al., 2019).

Gross metering

Vietnam uses gross metering for rooftop solar PV producers rather than net metering as in Indonesia, Malaysia, the Philippines, and Thailand (Rehman et al., 2020). Vietnam actually intended to apply net metering in late 2017 but switched to gross metering in early 2019 after realizing that net metering was making it difficult for tax agencies to calculate taxes and causing delays in EVN signing power purchase agreements (Rodl and Partner, 2019). The switch from net to gross metering demonstrated policy flexibility when pursuing industry development, with the need for policy settings that suit the local

[2] Vietnam's average LCOEs for solar and onshore wind were US$87/MWh and US$92/MWh respectively as of 2018 (Lee et al., 2020). These are lower than for other ASEAN countries other than that the solar LCOEs of Vietnam and Thailand were similar. Vietnam's technical potential for solar and wind at sites with an LCOE under US$150/MWh are higher than those of Indonesia, Malaysia, and the Philippines (Lee et al., 2020). This is largely attributed to natural endowment advantages and so not included in this policy analysis.

context. However, this does not mean that gross metering is always the best fit in all contexts.

Land lease exemptions

Land lease exemptions have been another important measure in Vietnam. While the other ASEAN countries apply income tax exemptions for renewables projects (International Renewable Energy Agency, 2018), only Vietnam has used land lease exemptions broadly. To do this, strong support from local governments has been needed, as they are often in charge of collecting land lease revenue. Recent reforms toward more decentralization in Vietnamese administrative systems have tended to increase local governments' roles in energy policymaking. However, this approach involves a subsidy for land, which can lead to inefficient resource allocation. As a result, the approach is not generally recommended. It is possible to have rapid solar and wind expansion without such an input subsidy, as demonstrated by Vietnam's rooftop solar boom.

Reverse auctions

One interesting point is that Vietnam has been relatively cautious in applying reverse auctions, despite them being popular in the region and further afield. The advantage of reverse auctions is that they can help achieve cost reductions for the procurer. For example, in Indonesia, reverse auction prices for floating solar projects came in as low as US $36.8/MWh in recent auctions (PV Magazine, 2021). However, careful preparation is needed to ensure a reverse auction model that is a good fit in the local institutional context. The transparent and professional management of auction processes is critical. It is fair to say that Vietnam would not have experienced such runaway growth in solar PV installations if reverse auctions had been the only procurement mechanism. This is because it is unlikely that the government would have procured such large quantities of new power generation capacity so quickly through auctions. The use of reverse auctions for future renewables procurement is under ongoing consideration in Vietnam.

Enabling investment environment

Vietnam has also strived for a favorable overall investment environment, including for renewable energy. Unlike Indonesia and Malaysia, it does not impose local content requirements as a condition for preferential FITs (Guild, 2019; SEDA, 2019). This reduces technology costs. The country's ease of doing business rank has also improved from 99th place in 2013 to 70th in 2020 (World Bank, 2020b). Since 2019, Vietnam has been among the top 40 markets in the world in terms of attractiveness for renewable energy investment and deployment (EY, 2020). To a large extent, the conditions that make a country attractive for investment are similar across sectors, with a key pre-requisite being a supportive business environment that does not lead to cost escalation.

Low fossil fuel subsidies

Fossil fuel subsidies per capita in 2019 in Vietnam equaled only US$3 compared with US$8 in Thailand, US$57 in Malaysia, and US$71 in Indonesia (International Energy Agency, 2021). Vietnam has also been doing relatively well with respect to the pace of fossil fuel subsidy reductions. Its annual reduction in fossil fuel subsidies in 2019 was 56%, while those of Thailand, Indonesia, and Malaysia were 50%, 43%, and 12%, respectively (International Energy Agency, 2021).

Equipment recycling regulations

Regulations on solar and wind equipment recycling are another key feature of the Vietnamese case. The revised Law on Environmental Protection stipulates that producers and importers of solar and wind equipment are responsible for end-of-life recycling and need to either organize recycling or pay a premium to the (already functional) Vietnam Environmental Protection Fund. The details of the mechanism are due to be specified in a government decree in 2021. By addressing public concerns about potential negative impacts, recycling regulations help make solar and wind even more socially acceptable.

Room for improvement

Despite its success, Vietnam's renewables policy framework has not been flawless. A notable limitation has been the use of short FIT windows with high levels of uncertainty over the FIT regime for new projects in the post-expiration period of any particular FIT regime. This has led to installation rushes to meet FIT deadlines rather than the smooth development of the industry. Uncertainty increases financing and project costs and introduces difficulties for national electricity sector planning and grid development (Nghiep and Thi, 2020). Smoother and more predictable processes would be preferable. There is also a need to strengthen the bankability of PPAs by reducing off-take risks (Do et al., 2020). Vietnam's strong solar uptake is unlikely to continue in 2021 unless clarity over the FIT or any alternative incentive or procurement regime is established.

A major issue in Vietnam is the inadequacy of its transmission grid. Sudden solar booms in provinces such as Ninh Thuận and Bình Thuận led to the curtailment of output. About 365 GWh of solar output was curtailed in 2020 (Vnexpress, 2021), and EVN has announced that it may have to reduce solar output in 2021 to balance supply and demand. Now that solar PV has entered the mainstream, it is important that transmission planning starts to catch up to ensure that cheap and emission-free electricity can be easily transmitted to major demand centers. The power grid needs to be updated and managed much more flexibly in order to better suit the intermittency of solar and wind. Electricity distribution networks also need to be prepared for the full integration of rooftop solar output.

Inadequate attention has been paid to energy storage policy, grid planning and investment for intermittent renewables, and system stability issues (Merdekawati, Suryadi, Wiratama, & Supendic, 2021). A decline in electricity demand in some periods during the COVID-19 slowdown exacerbated problems arising from this issue in some parts of the country (Vnexpress, 2021). Considering the reintroduction of net metering for rooftop systems and the use of clear tax calculation guidelines is one option to incentivize self-consumption and reduce the excess supply issue for solar power. Time-of-day price flexibility is also becoming an increasingly important priority.

There are other opportunities for Vietnam and the other ASEAN countries. A quantity-focused mechanism in the form of a renewable portfolio standard (RPS) is an option to guide the way toward high levels of renewable energy use and to reduce uncertainty (Burke & Do, 2020). A mandatory RPS could also encourage the national electricity utility to develop a more renewables-oriented transmission planning and wind and solar integration approach. An RPS approach has been at the heart of solar and wind expansion in some other countries including Australia (Best, Burke, & Nishitateno, 2019).

Solar and wind power projects have occasionally been approved to be sited on forest land or other high-value conservation areas in Vietnam (Kinhtemoitruong, 2020). While the areas are often relatively small (around 10–20 ha for each project), the cumulative impact could turn out to be significant. This poses risks of biodiversity loss, soil erosion, and floods in downstream areas. Severe flooding in central Vietnam in late 2020, exacerbated by deforestation, provided a reminder of the importance of maintaining forest cover (Dan, 2020). Stricter regulations on the siting of solar and wind projects would help address this issue. Projects should not be sited in high-value conservation areas.

Other considerations

Land availability will become a growing issue as more large-scale utility solar and onshore wind farms are built. Floating solar projects could be encouraged given the large surface areas of waterbodies in

many ASEAN countries (World Bank, 2019b), including those of hydropower dams. The successful development of the rooftop sector is also a priority. The more panels that are placed on rooftops, the smaller the need for utility-scale installations. Significant offshore wind endowments in countries such as Vietnam and the Philippines (World Bank, 2019a) also provide opportunities to ease pressure on land.

Vietnam and other ASEAN member states could also consider adopting a renewable energy zone (REZ) approach (Do et al., 2020). This would facilitate transmission investment and planning and the management of curtailment risks, with the focus being on adequately linking the best solar and wind sites to the grid. Solar and wind parks are a potential option within REZs. This would involve a government agency selecting and preparing project sites and then inviting competitive bidding for solar and wind power projects at these sites (World Bank, 2019c). This approach has been used in India.

Carbon pricing would further enable solar and wind uptake. Carbon pricing works by making fossil fuel options more expensive, creating incentives for transitioning to low-emission electricity options such as solar and wind. In November 2020, Vietnam's National Assembly passed a revised Law on Environmental Protection that legalizes an emissions trading scheme (Do, 2020). The law will take effect on January 1, 2022, although scheme development and implementation will take time. There are opportunities for the ASEAN countries to follow Vietnam's case or the example of Singapore, which has a carbon tax. Thailand and Indonesia have been considering emissions trading schemes (World Bank, 2021a, 2021b).

Vietnam and the other ASEAN countries could also further reform fossil fuel subsidies. Removing fossil fuel subsidies in ASEAN's electricity sector would not only provide a boost to non-fossil energy but also potentially free up about US$8.3 billion per year (International Energy Agency, 2021). This sizeable resource could instead be used for the development of transmission lines or for other priorities. The COVID-19 recovery period is an ideal time for such reforms given the reduction in international fossil fuel prices and the need for efficiency-enhancing public investments.

Setting more ambitious greenhouse gas emission reduction targets would also help the ASEAN countries to speed up the transition to renewable energy. ASEAN's NDCs under the Paris Agreement have been modest (Overland et al., 2021). While some ASEAN countries have recently presented enhanced targets in their updated NDCs (Yurnaidia et al., 2021), the targets are still insufficiently ambitious to achieve the goals of the Paris Agreement (CarbonBrief, 2021). Better coordination between climate change and energy planning agencies would also be useful (Vakulchuk et al., 2020). However, entrenched fossil fuel industries and a pipeline of potential coal projects in many of the ASEAN countries will remain significant challenges (ASEAN Centre for Energy, 2020; Jakob, Flachsland, Christoph Steckel, & Urpelainen, 2020).

Who pays the costs of solar and wind procurement may influence the uptake of renewables. In Vietnam, retail prices are regulated and cost pass-through in the form of higher electricity prices is not permitted. Instead, costs are absorbed in an opaque way—including via EVN reducing its profit and the government foregoing some income tax revenue. Electricity affordability for consumers has not been compromised. Public support for solar and wind might have been lower had they led to higher retail electricity prices.

While Vietnam's lessons are relevant for all other ASEAN countries, they are particularly applicable to Cambodia, Indonesia, Laos, and Myanmar. The energy sectors of these countries are at a crossroads, with sizeable solar and wind potential and rapidly growing electricity demand. Like Vietnam, they each have (near) single-buyer wholesale electricity market structures and heavy use of the power purchase agreement model (International Renewable Energy Agency, 2018). With retail tariffs that are regulated by national governments, the countries could also pursue approaches that avoid placing upward direct pressure on electricity prices.

Conclusions

Vietnam has orchestrated the first stage of its solar and wind power development using FITs and a supportive overall investment environment. Government incentives and enabling policies that have boosted energy availability while avoiding upward pressure on electricity prices have gained public support. Renewables take-off got going when solar and wind technology costs reached a sufficiently low level, significantly below the levels from a decade or so earlier. FITs have attracted powerful responses from businesses and have enabled the rapid development of the industry, especially in the case of solar. Vietnam's case sets an example of how the government, the industry, and the public can work together toward a greener growth model.

Generous FITs, together with income and land lease payment exemptions, are key aspects of the Vietnamese policy framework. Underlying drivers include the government's determination to ensure a sufficient local electricity supply to cope with the increasing power demand and public demand for local environmental quality. The emerging lobbying power of the solar and wind industry has made it increasingly capable of influencing policy settings. Climate policy has also played a role in facilitating the adoption and implementation of low-carbon initiatives such as FITs.

Vietnam's success confirms that the solar and wind sector can grow rapidly in a developing country context when suitable financial and institutional conditions are in place. The key lessons from Vietnam's experience are the importance of price signals, an adequate degree of government prioritization and support, and an attractive investment environment.

There is of course room to improve on Vietnam's approach. A more stable and foreseeable FIT regime would reduce investment uncertainty and associated financing costs and help smoothen the industry's expansion path. Better electricity system planning and a greater focus on system flexibility and energy storage would also help facilitate more efficient integration of solar and wind into the electricity system and avoid the need to curtail intermittent energy sources.

The ASEAN countries could learn much from Vietnam's initial experience. Strong government commitment to renewables development and an open investment environment are prerequisites to strong industry growth. Attractive FITs could be used at early stages to spur uptake before countries switch to greater use of reverse auctions to bring down costs, as Vietnam is considering. Other policies, such as the use of an RPS, carbon pricing, and fossil fuel subsidy reductions, would also facilitate solar and wind uptake (and are policy options for Vietnam also). Wholesale electricity market reforms, including direct power purchase mechanisms (business-to-business), would further enable the transition. Investment in transmission grids and the development of REZs would likewise be a sensible post-COVID-19 recovery government intervention. Stable policies and public acceptance are needed to nurture this promising emerging industry.

Now is an opportune time for ASEAN to engage in preparing for solar and wind uptake. Rapid cost reductions and maturing global supply chains mean that significant diffusion of these renewable energy technologies will occur sooner or later. Advance preparation could help the other ASEAN countries mitigate some of the challenges that Vietnam has experienced, such as grid overload and the need for renewables curtailment.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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