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BRITAIN & NORTHERN IRELAND

A large photograph of a wind farm. In the foreground, a gravel path leads towards a large white wind turbine. In the background, several other wind turbines are visible against a bright blue sky with scattered white clouds. The ground is covered in green grass and some low-lying vegetation.

Vietnam

Renewable Energy Business Opportunities

31 March 2021

Note to Readers

Disclaimer

The Foreign, Commonwealth & Development Office (FCDO)'s ASEAN Prosperity Fund team has commissioned this series of reports to Ernst & Young LLP (EYLLP) where EYLLP has undertaken a market study for six countries in ASEAN. Noted that Indonesia version was initially written by Tetra Tech ES Inc in 2019 then updated by EYLLP in 2021. The summary of the findings are included in this report (hereafter "report"). This report is only for general information. It doesn't intend to provide or should not be considered for accounting, tax or other professional advice. On any specific matter, reference should be made to the appropriate advisor.

The report highlights key findings on the research performed, key information available or address matters. This study relied on a combination of research sources (e.g., reports, presentations and new articles) and local knowledge, we have not verified the accuracy, reliability or completeness of such information or sources. With respect to market estimates referenced throughout the report, there will usually be differences between estimated and actual results, because events and circumstances frequently do not occur as expected and those differences may be material.

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Abbreviation & Acronyms

Acronym	Description
ASEAN	Association of Southeast Asian Nations
AECID	Spanish Agency for International Development Cooperation
ADB	Asian Development Bank
ACT	Avoided cost tariff
AGC	Automatic generation control
AIT	Advance Information Technologies
AMI	Advanced metering infrastructure
AMR	Automatic meter reading
Asiapetro	Asia Petroleum Energy
BESS	Battery energy storage system
BNEF	Bloomberg New Energy Finance
BIPV	Building integrated photovoltaics
BOT	Build-operate-transfer
BOS	Balance of system equipment
BKHB	Bach Khoa A Chau Hoa Binh
CAGR	Compounded annual growth rate
CFMCC	China First Metallurgical Group Co. Ltd.
COD	Commercial operation date
CPC	Central Power Corporation
CSMC	Commission for the Management of State Capital at Enterprises
CIP	Copenhagen Infrastructure Partners
CLP	Curtailable Load Program
CGIF	Credit Guarantee and Investment Facility
CHP	Combined heat and power
DFAT	Australian Department for Foreign Affairs and Trade
DGIS	Netherlands Ministry of Foreign Affairs
DPI	Vietnam Department of Planning and Investment
DIT	UK Department for International Trade
DPPA	Direct power purchase agreement

Acronym	Description
DR	Demand response
DRMS	Demand response management system
DSM	National Demand-Side Management
DHD	Da Nhim-Ham Thuan-Da Mi Hydro Power
EVN	Vietnam Electricity
ERAV	Electricity Regulatory Authority of Vietnam
EREA	Electricity and Renewable Energy Authority
ESMAP	World Bank's Energy Sector Management Assistant Program
EPC	Engineering, procurement and construction
EVNNT	The National Power Transmission Corporation
EVNEPTC	Electricity Power Trading Company
FS	Feasibility study
FiT	Feed-in-tariff
FDI	Foreign direct investment
FSPV	Floating solar photovoltaics
GW	Gigawatt
GDP	Gross domestic product
GreenID	Green Innovation and Development Centre
GEC	Gia Lai Hydropower
GENCO	Generating company
GE	General Electric
GWEC	Global Wind Energy Council
GHG	Greenhouse gases
HNPC	Hanoi Power Corporation
HCMCPC	Ho Chi Minh City Power Corporation
ha	Hectare
IC	Investment certificate
IPP	Independent power producer
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency

Acronym	Description
IEA	International Energy Agency
IPO	Initial public offering
ICT	Information and communications technology
JSC	Joint Stock Company
kV	Kilovolt
LCOE	Levelised costs of energy
LEAP	Leading Asia's Private Sector Infrastructure Fund
MW	Megawatt
MWh	Megawatt hours
MWp	Megawatts-peak
MVA	Megavolt amperes
MOIT	Vietnam Ministry of Industry and Trade
MOF	Vietnam Ministry of Finance
MPI	Vietnam Ministry of Planning and Investment
MONRE	Vietnam Ministry of Natural Resources and Environment
NLDC	National Load Dispatch Centre
NPC	North Power Corporation
NPDP	National Power Development Plan
OTS	Open operator training system
ODI	Overseas direct investment
O&M	Operations and maintenance
PV	Photovoltaics
PPA	Power purchase agreement
PDP	Power Development Plan
PPC	Provincial People's Committees
PVN	Petro Vietnam
PIDG	Private Infrastructure Development Group
PFS	Pre-feasibility study

Acronym	Description
RE	Renewable energy
REDP	Renewable Energy Development Project
RPDP	Revised Power Development Plan
SOE	State-owned enterprise
SPC	South Power Corporation
SEACEF	Southeast Asia Clean Energy Facility
SECO	Swiss State Secretariat for Economic Affairs
TW	Terawatt
TWh	Terawatt hours
TTC	Thanh Thanh Cong
TEPCO	Tokyo Electric Power Company
TVHB	Tri Viet Hoa Binh
USTDA	U.S. Trade and Development Agency
USAID	United States Agency for International Development
UKAid	UK Department for International Development
US\$	US dollars
UK	United Kingdom
US	United States
UKEF	UK Export Finance
VND	Vietnamese dong
VAT	Value-added tax
Vinacomin	Vietnam National Coal Mineral Industries Holding Corporation
VCGM	Vietnam Competitive Generation Market
VWEM	Vietnam Electricity Wholesale market
VREM	Vietnam Electricity Retail Market
VEDRP	Voluntary Emergency Demand Response Program
WTE	Waste-to-energy

Executive Summary

Socio-economic landscape of Vietnam

Vietnam is a country with a rapidly growing economy. Since 1986, a series of economic and political reforms have been implemented by the government under “Doi Moi.”

Gross domestic product (GDP) per capita is expected to have increased to US\$3,503 in 2020 from a mere US\$121 in 1990. Vietnam has been one of the most dynamic emerging markets. The country maintained an average GDP growth rate of 5.6% over the last three years (2018-2020) versus an average of 0.14% in Asia-Pacific. With the COVID-19 pandemic kept under control, Vietnam’s economy registered a GDP growth rate of 2.9% for 2020, the highest amongst its Southeast Asian peers.

Overview of power sector

The Vietnamese government has implemented various initiatives to increase the electrification rate as well as to enhance the efficiency of the power market. According to World Bank, Vietnam was able to electrify 96% of its households by 2005 and 100% by 2015.¹

At present, the state-owned enterprise, Vietnam Electricity (EVN), still has control of the power market and notably still holds a monopoly on transmission and distribution. Prior to the implementation of Decision No. 13/2020/QĐ-TTg in April 2020, EVN was the sole offtaker for all electricity generated in Vietnam. With Decision No. 13, eligible rooftop solar projects are now able to sell portions of or all the power generated to other entities off-grid, opening the way for further competition in the electricity market. This ties in with a roadmap to transform the Vietnamese electricity market that was issued in 2013, with the market expected to transition to a competitive market from 2023.

The electricity demand in Vietnam is projected to increase two-fold from 2020 to 2030. To sustain the growing demand, new plants are being built, including coal-fired power plants.

Besides fossil fuels, hydropower is also an important part of the electricity supply in Vietnam, accounting for 33% of the total installed capacity as of 2019 and ranked first in terms of hydro installed capacity in Southeast Asia. According to Vietnam Energy

Outlook 2019, until 2019, the medium and large hydroelectric power sources (20GW capacity potential) had been almost fully utilised. The small hydropower resource has a potential of 6.7GW, with more than 3GW already in operation. Through various incentives, the government is actively looking to diversify its renewable energy sources outside of hydro through solar, wind and biomass.

Renewable energy market

Vietnam has an abundance of renewable energy resources with high solar irradiation and large wind potential. Solar power played almost no part in Vietnam’s energy mix in 2017. To speed up the technology’s adoption, the government offered that year to pay developers a feed-in tariff (FiT).

An FiT of US\$9.35 cents/kWh for solar projects reaching commercial operations date (COD) by June 2019. As a result, 2019 witnessed a surge in Vietnam’s solar PV market, with an increase in capacity from 100MW in 2018 to 4.5GW in 2019, making it the largest solar market in Southeast Asia. There surge in capacity has also continued in 2020, despite the pandemic with over cumulative solar capacity reaching over 16GW in 2020 for utility scale and rooftop solar plants. The surge in solar installation in 2019 and 2020 also drove the contribution of renewable energy (excluding medium and large hydroelectric power sources) to the generation capacity, from 7% in 2018 to 15% in 2019 and to over 34% in 2020.

In February 2020, the Vietnamese government issued Decision No. 329/QĐ-BCT to set priority orders for approving the inclusion of new power and energy projects in the master plans. It is promulgated in this decision that wind, waste-to-energy (WTE) and biomass will have higher priority over solar in upcoming years. The rationale behind this initiative is to maintain a balance in the country’s energy mix, after witnessing an over-subscription of solar PV projects in 2019.

Upgradation of the national power grid system is also a priority of the Vietnamese government. Grid overload and curtailment happened when too many solar projects came online in the second quarter of 2019 to meet the cut-off date for preferential FiT rates. To address some of these curtailment issues, investments in grid capacity are also planned.

¹World Bank - Databank. According to EVN data, electrification rate as of October 2019 is 99.47%, <https://www.evn.com.vn/d6/news/EVN-voi-su-menh-hien-thuc-hoa-muc-tieu-thap-sang-moi-mien-To-quoc-6-12-24501.aspx>.

Regulations and issues

The government has adopted a pro-investor approach in the power sector with no foreign ownership limit and no local content requirement in renewables power generation. Compared with countries having foreign ownership limits, such as the Philippines, Vietnam has managed to draw a lot of attraction from foreign investors, especially regional companies from Thailand and the Philippines. However, bankability of power purchase agreements (PPAs) is still a big challenge for project financing. Changes in regulations are expected to happen in the Vietnam renewable energy sector in 2020 and 2021.

The Ministry of Industrial and Trade (MOIT) is currently designing an auction regime with a pilot auction to be conducted in 2020. A draft version of the national Power Development Plan (PDP8) for the period of 2021-2030 with a vision up to 2045 has been released in February 2021.¹ The draft PDP8 propose more ambitious targets for renewable energy as compared to the earlier version of the PDP (PDP7 2011-2030).

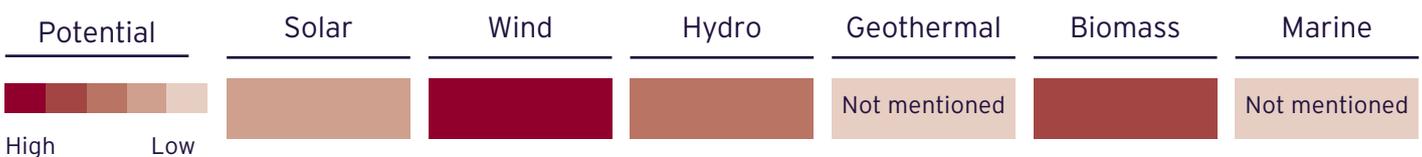
Conclusion

At the moment, Vietnam's renewable energy sector is still at a nascent stage and remains largely untapped. For example, the installed wind generation capacity is a mere 630MW and biomass power generation level is still negligible (570MW). This offers significant opportunities for early investors looking to gain a foothold for future developments as the market matures and some of the existing uncertainties are ironed out.

Market values for renewable energy projects

The total market value for renewable energy is estimated at US\$36 billion between 2021-2025, based on an analysis of Vietnam's energy policies, masterplan and current market conditions.

Priority orders for approving the inclusion of renewable energy project in Vietnam's National Master Plan



Source: MOIT - On principles and order of priority for the adjustment and addition of power projects into plans (Decision No. 329/QĐ-BCT) (Jan 2020). http://vepg.vn/wp-content/uploads/2020/02/329-QĐ-C4%90-BCT_EN.pdf.

Estimated market value of renewable energy and related projects (US\$ million, 2021-2025)

Technology	Market size	Foreign share in market size
Onshore and nearshore wind	19,402	12,165
Offshore wind	9,965	5,979
Biomass	3,115	869
Small hydro	2,880	513
Utility-scale and rooftop solar PV	624	362
Total	35,986	20,888

Source: EY Research

¹ Vietnam Energy Online - Approving the content of PDP VIII (Nov 2019). <http://nanluongvietnam.vn/news/en/policy-planning/approving-the-content-of-pdp-viii.html>.

1. About The Study

Background

The UK has provided leadership in addressing the challenges of climate change and in supporting the shift toward a low-carbon economy across the world. Since the Paris agreement on climate change in 2016, the world has been undergoing a transition toward low-carbon technologies. This represents opportunities for UK companies, which have wide-ranging expertise in policy and regulation, and technological know-how in research, innovation, manufacturing, engineering and renewable energy technologies.

Purpose of study

A greater understanding of the ASEAN renewable energy market would support UK companies in tapping the opportunities, particularly for the export of UK low-carbon capabilities. This study provides an overview of the power market in Vietnam and details of the renewable energy market, including major government policies and programs, ownership and financing. Market opportunities for foreign investments are then assessed and identified.

Study approach

This study analyses the power market in Vietnam across the following types of renewable energy: solar PV, wind (onshore and offshore), hydropower, geothermal, bioenergy (biomass, biogas and biofuels), marine, electricity networks and storage (smart grid and battery storage).

However, there is no utilisation of geothermal energy and marine energy in Vietnam as of January 2021. There is also a lack of a specific regulatory framework for the development of these two types of renewable energy in Vietnam. Therefore, only solar, wind, hydro and biomass are covered in this report.

Market size estimation

The size of the renewable energy market in Vietnam was assessed between 2021-2025 and further broken down by technology type, supply chain value added and foreign/domestic share.



Step 1: Estimating the value of the market



Installed capacity (2021-2025)

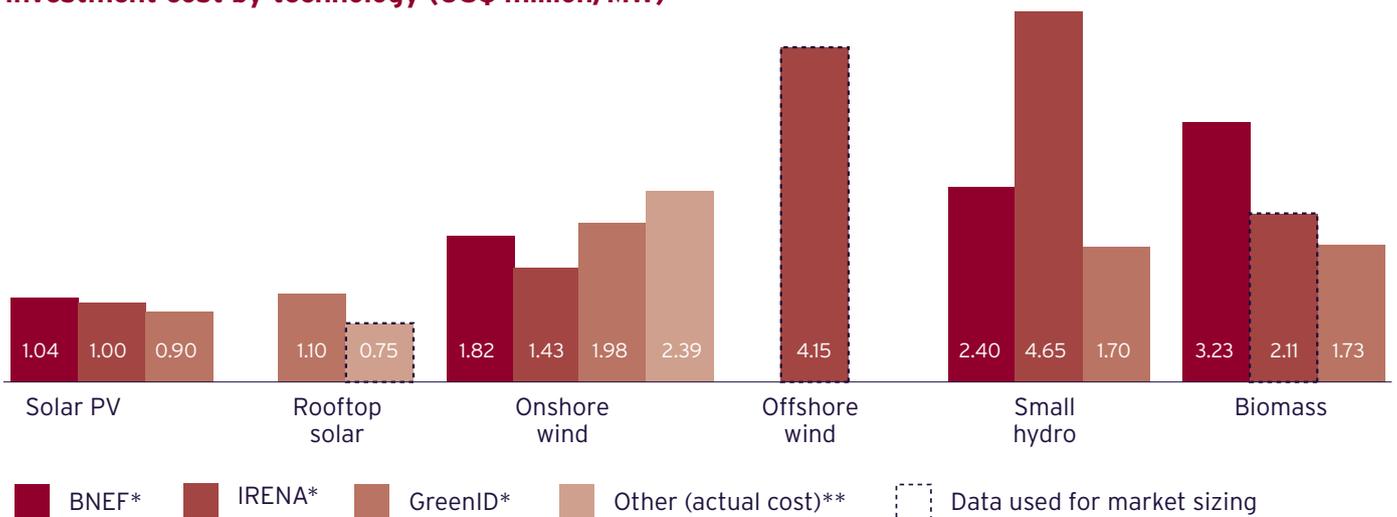
The size of the market has been estimated based on reviews of Vietnam’s national energy master plans in order to determine the planned and expected installed generating capacity to be added between 2021-2025.

Vietnam’s government does not disclose its procurement plan or list of awarded projects periodically. The government sets a target for renewables’ installed capacity in the national power development plan (PDP) and the latest one was issued four years ago, in March 2016. A draft of PDP 8 has been released in February 2021 that sets out renewable energy targets until 2045. These targets have been used as an estimate of the generation capacity in 2021-2025.

Project cost

Project costs are determined based on estimates of levelised costs of energy (LCOE) or actual project costs, where information is available. Sources used include research agencies such as Bloomberg New Energy Finance (BNEF), International Renewable Energy Agency (IRENA) and Green Innovation and Development Centre (GreenID).¹

Investment cost by technology (US\$ million/MW)



Sources: BNEF, IRENA, GreenID, EY research.

Note: (*) BNEF data is the average of low case and high case as of 2H2019. IRENA data is the average of investment cost in 2018 and in 2025. GreenID data is the projected investment cost for the period of 2020-25 in Vietnam, projected by GreenID based on actual investment costs in the country.

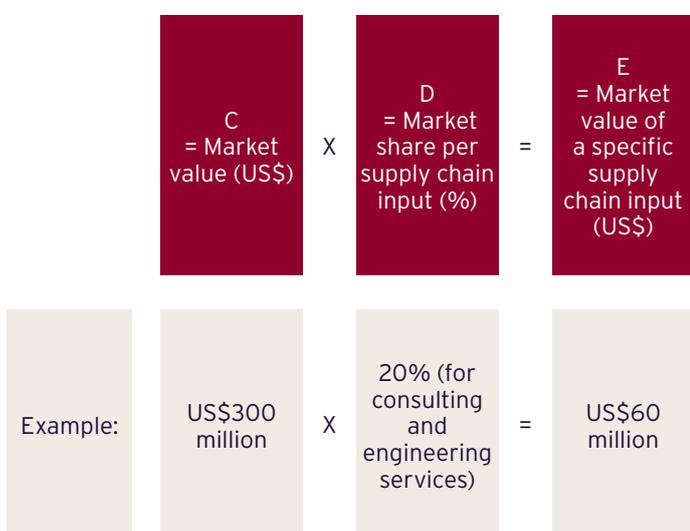
(**) Actual cost for rooftop solar is the current market rate taken from Vu Phong solar - a leading developer in rooftop solar developer in Vietnam. Actual cost for onshore wind is the investment cost of Cong Ly near-shore wind farm - Phase 1 (16MW) which started operation in 2013.

¹ The GreenID’s research report on investment cost per technology in Vietnam can be accessed through the following link: http://en.greenidvietnam.org.vn/app/webroot/upload/admin/files/060618_GreenID_Study%20on%20future%20power%20sources.pdf.



Step 2: Estimating the market value for each supply chain input

The cost breakdown by supply chain input was assessed using data from market sources (e.g., our knowledge of local markets) and research sources (e.g., IRENA and Tetra Tech report for Indonesia market).



Exchange rate

Where otherwise stated, the exchange rate used in this report is the rate announced by State Bank of Vietnam on 9 March 2021:

US\$1 = VND23,200

Opportunities for UK companies

This study then identifies top business opportunities for UK companies by analysing their strengths and weaknesses, current market positioning and mapping these against the respective markets and supply chain components.

Sources of information

This study relied on a combination of research sources (e.g., reports, presentations, news articles) and knowledge of the local markets from our local teams. A list of references, including publications, presentations and articles for this study, is provided at the end of this report.

Step 3: Estimating the foreign market share of each supply

The contributions from foreign and domestic businesses for each supply chain input were allocated based on our knowledge of local market and available data.



2. Country Energy Industry Background

2.1 Socio-Economic Landscape

Vietnam is the easternmost country on the Indochina Peninsula in Southeast Asia, bordered by China, Laos and Cambodia. With a population of 97 million in 2020, Vietnam is the world's 15th most populous country and the third most populous country in Southeast Asia, after Indonesia (273 million) and the Philippines (110 million).

The country is divided into 58 provinces and five municipalities. The two largest cities in Vietnam are Hanoi and Ho Chi Minh City. Hanoi, located in the north, is the capital of Vietnam where the central government is located. Meanwhile, Ho Chi Minh City in the south is the business hub of the country.

Vietnam – country overview



Population (2020): 97 million

GDP (nominal, 2020): US\$341 billion

Real annual GDP growth (2016-2020): 6.1%

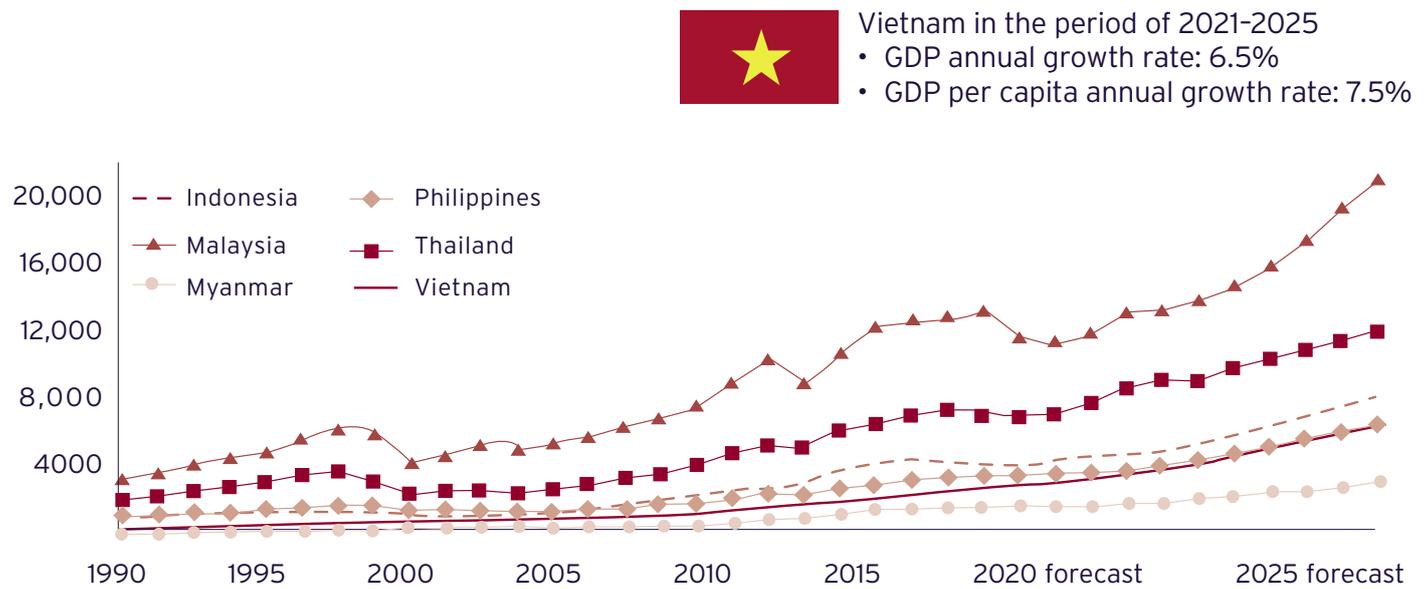
Source: Oxford Economics.

Vietnam has been one of the most dynamic and fastest-growing emerging markets in Asia, maintaining an average GDP growth rate of 5.6% over the last three years (2018-2020). A series of economic and political reforms implemented by the government since 1986 helped transform the country. GDP per capita is expected to have risen to US\$3,503 in 2020 from a mere US\$121 in 1990.

Vietnam's GDP per capita is ranked 6th in Southeast Asia after Singapore, Brunei, Malaysia, Thailand and Indonesia as of 2020. In the mid term (2021-2025), it is projected that the Vietnamese economy will keep growing at an average pace of 6.5% annually. The GDP per capita is forecasted to grow 7.5% annually to US\$5,422 in 2025.

With the COVID-19 pandemic kept under control, Vietnam's economy registered a GDP growth rate of 2.9% for 2020, the highest amongst its Southeast Asian peers.

Figure 2.1: GDP Per Capita in Select Southeast Asian Countries (Nominal US\$, 1990-2025 Forecast)



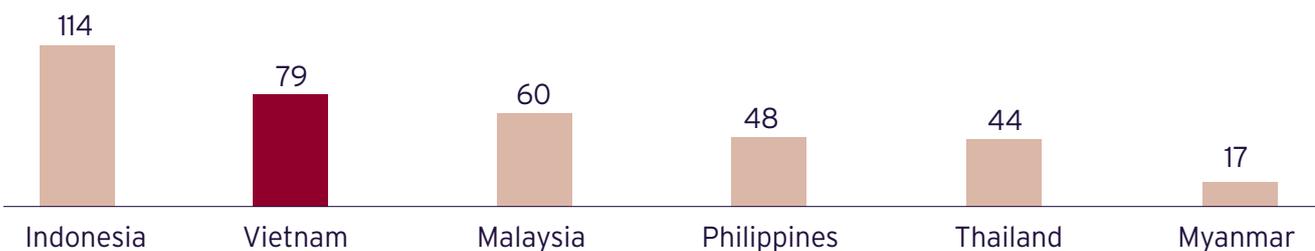
Source: Oxford Economics

Foreign direct investment (FDI) plays an important role in the Vietnamese economy. During the period of 2014-2019, Vietnam attracted a total of US\$79 billion of net FDI inflows, with Korea, China and Japan being the major counterparts. The country has also become Samsung’s largest overseas production base. Until 2020, Samsung alone has invested US\$17 billion in the country. It is reported

that Samsung Vietnam’s combined revenue reached US\$66 billion in 2019, accounting for approximately 20% of the country’s GDP in 2019.¹

As of 2020, the UK has 378 projects in Vietnam, with a total registered investment of US\$3.6 billion, ranked 15th amongst all countries and territories.²

Figure 2.2: Accumulative Net Inflows of FDI Between 2014 and 2019 (US\$ billion)



Source: World Bank – Databank

¹Using GDP data from Oxford Economics (Vietnam’s GDP in nominal US\$ in 2019): US\$327 billion. <http://hanoitimes.vn/samsung-vietnam-generates-us43-billion-in-profits-in-2019-311239.html>.
² Not including investment from tax heavens belonging to British overseas territories such as British Virgin Islands and Cayman Islands. Accumulative registered investment from these two tax heavens amount to US\$29 billion as of 2020. General Statistics Office of Vietnam (GSO). <https://pxweb.gso.gov.vn:443/sq/12a4cf21-a67d-4e72-9ceb-9d464de51d39>.

2.2 Key Government Stakeholders

Regulators

Policies in the power sector in Vietnam are created through exchanges and processes within and between the Government, the National Assembly and the provincial authorities. Overall, the MOIT has the most influence on the power sector.

The list of key regulators is summarised in the table below.

Table 2.1: Key Regulators in The Power Sector

Agency	Key roles relevant to the power sector
Government of Vietnam	<ul style="list-style-type: none"> The Prime Minister's office is responsible for approving policies and regulations for the power sector
MOIT	<ul style="list-style-type: none"> MOIT oversees all aspects of the energy industry, including electricity, renewable energy, coal, oil and gas. The MOIT formulates reform initiatives and the national electricity development plans (subject to approval by the Prime Minister) and supervises their implementation
Electricity Regulatory Authority of Vietnam (ERAV)	<ul style="list-style-type: none"> ERAV, an entity under the MOIT, assists in developing regulations on the operation of a competitive power market, assessing wholesale and retail electricity tariffs as well as fees for transmission and distribution functions
Electricity and Renewable Energy Authority (EREA)	<ul style="list-style-type: none"> EREA, under MOIT, deals with renewable energy planning and provincial electricity development planning. EREA has authority and responsibility for regulating FITs for renewable energy
Provincial People's Committees (PPCs)	<ul style="list-style-type: none"> The PPCs formulate local electricity development plans and submit them to the people's council and to the MOIT for approval. The people's committee also monitors the implementation of approved local electricity development plans Within the scope of their powers, the people's committees also monitor the implementation of approved local electricity development plans (e.g., ground clearance, population relocation and resettlement, payment of compensation for loss of land and property). They also grant electricity activity licences to organisations and individuals engaged in small-scale electricity activities within their jurisdiction

Source: EY research.

The Ministry of Finance (MOF), Ministry of Planning and Investment (MPI) and Ministry of Natural Resources and Environment (MONRE) are also influential in energy sector policymaking because certain decisions that have implications

for public resources, such as large investments, energy prices and environmental impact assessments fall under their purview.

State-owned enterprises

State-owned Enterprises (SOEs) have considerable influence on the power sector in Vietnam with EVN having majority control across the value chain (from power generation to transmission and distribution). As of January 2021, with the implementation of Decision No. 13/2020/QĐ-TTg in April 2020, EVN is now

no longer the sole offtaker for all electricity generated in Vietnam. Decision No. 13 stipulates that eligible rooftop solar projects may sell portions of or all the power generated to other entities off-grid, opening the way for further competition in the electricity market.¹

Table 2.2: State-Owned Enterprises in Power Sector

Agency	Key roles
EVN	<ul style="list-style-type: none"> • EVN was formed in 1995 and is the major actor across all value chains of the electricity market in Vietnam • EVN is tasked to meet the basic electricity demand for Vietnam's socio-economic development and ensure progress on power generation and transmission projects assigned in the power master plan • Following are the units formed under EVN: <ul style="list-style-type: none"> • Generation segment: EVN parent company directly runs its own power plants with generation capacity of 10,540MW as of 2018. Under EVN, there are three power generation companies, namely GENCO 1, GENCO 2 and GENCO 3. EVN's combined generation capacity amounted to 28,169MW in 2018, accounting for 58% of Vietnam's generation capacity • Transmission segment: The National Power Transmission Corporation (EVNNPT) under EVN is the sole transmission operator in Vietnam. EVNNPT is in charge of all investments and maintenance of electrical networks, including smart grids • Distribution and supply segment: Electricity distribution and supply is exclusively operated by five subsidiaries of EVN, namely North Power Corporation (NPC), Central Power Corporation (CPC), South Power Corporation (SPC), Hanoi Power Corporation (HNPC) and Ho Chi Minh City Power Corporation (HCMCPC). The Electricity Power Trading Company under EVN (EVNEPTC) is currently the single buyer purchasing all generated electricity. EVNEPTC, in turn, resells electricity through distribution grids to the five PCs to retail to end consumers • System and market operator: National Load Dispatch Centre (NLDC) under EVN manages operation of the national power system and runs the Vietnam power market
Petro Vietnam (PVN)	<ul style="list-style-type: none"> • PVN is the Vietnam National Oil and Gas Group. PV Power under PVN is the second largest electricity provider in Vietnam • As of December 2018, PV power owns 13 active power plants, including gas-fired, coal and hydropower, with a total capacity of 5,019MW. The company is also diversifying into renewables with Phu Qui wind power plant under construction²
Vietnam National Coal Mineral Industries Holding Corporation (Vinacomin)	<ul style="list-style-type: none"> • Vinacomin is Vietnam's largest state-owned mining company • As of November 2019, Vinacomin Power under Vinacomin owns six coal thermal power plants and one hydropower plant, with a total capacity of 1,735MW. Vinacomin Power also invests in three other thermal power plants with a minor stake³

Source: EY research.

¹ Lexology - Silver Lining for Solar - Vietnam Approves New Incentives and Feed-In-Tariff. <https://www.lexology.com/library/detail.aspx?g=20f9a241-9d39-4e46-aaff-dbf12a25eaf>.

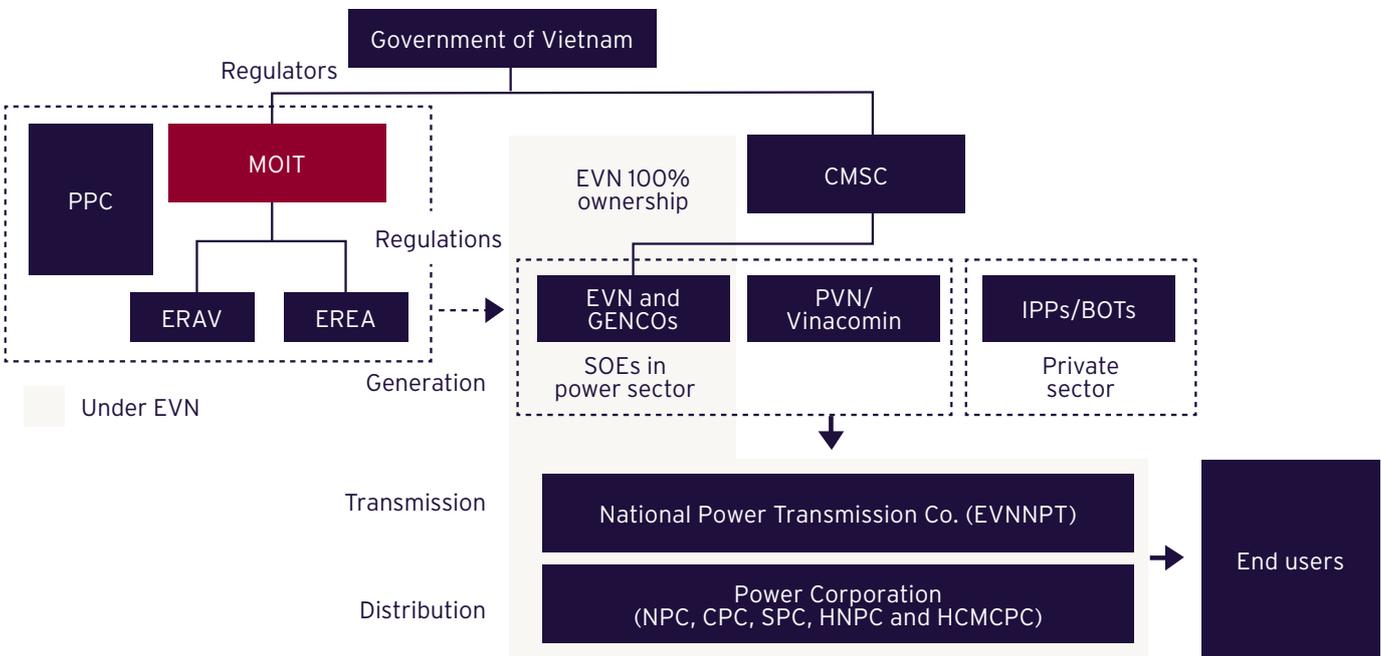
² PV Power - annual report 2018. <https://www.pvpower.vn/wp-content/uploads/2019/04/190411-bao-cao-thuong-nien-pow-2018-final.pdf>.

³ Vinacomin Power - annual report 2018 and Vinacomin press release. <http://www.dienluctk.vn/dMedia/files/da484c658bf1859814530d4771e0e1ec.pdf>, <http://www.vinacomin.vn/tin-tuc-vinacomin/tong-cong-ty-dien-luc-ky-niem-10-nam-thanh-lap-201911011637539638.htm>.

Vietnam is conducting the equitisation and privatisation of its SOEs to improve their business efficiency. Since November 2018, ownership of these companies has been transferred from MOIT to the

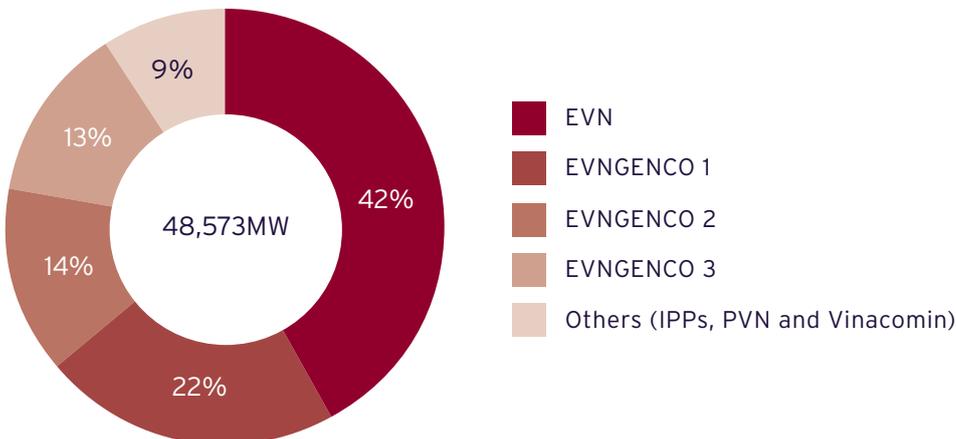
Commission for the Management of State Capital at Enterprises (CMSC). CMSC is the key government agency in charge of managing the Vietnamese government’s stakes in Vietnam’s SOEs.

Figure 2.3: Institutional Set-Up for The Power Sector in Vietnam



MOIT - Smart grids in Viet Nam - market development, frameworks and project examples (Jul 2019). https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2019/190722-iv-vietnam-04.pdf?__blob=publicationFile&v=3.

Figure 2.4: Power Generation by Players (% , 2018)



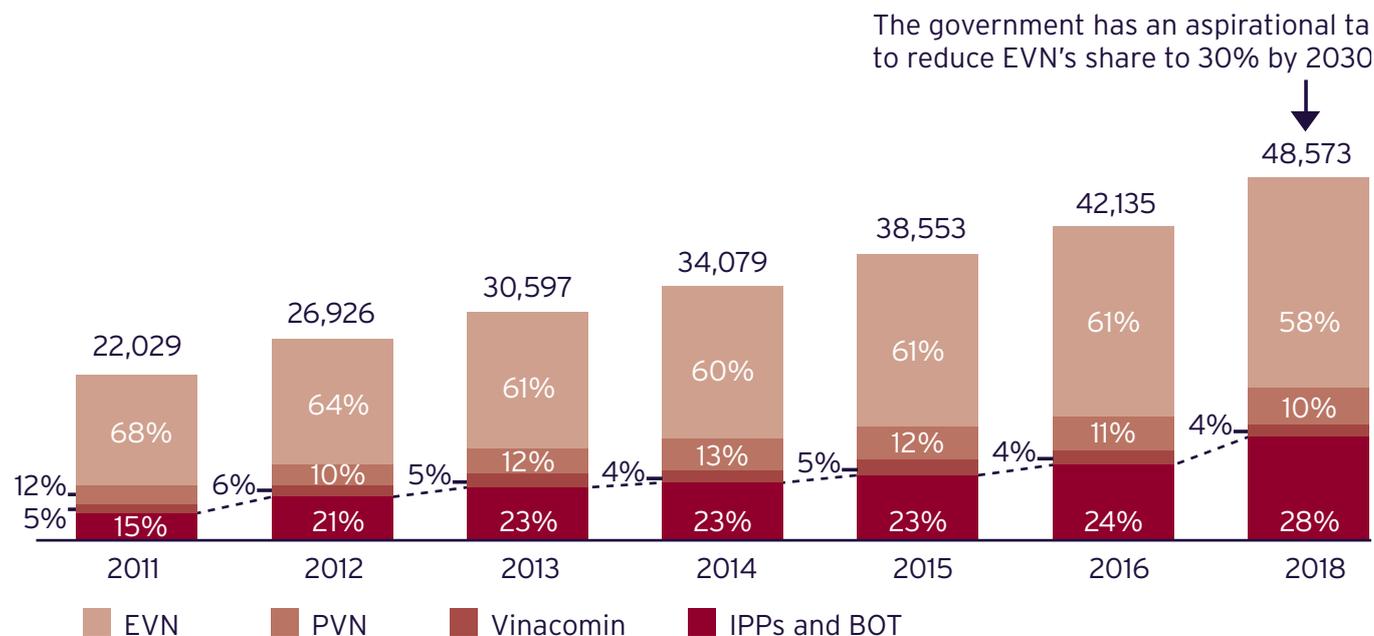
Source: EVN - annual report 2018 (Jan 2021). <https://en.evn.com.vn/userfile/User/huongbtt/files/2021/1/EVNAnnualReport2018.pdf>.

2.3 Other Key Stakeholders

Other than the SOEs mentioned above, electricity in Vietnam is also generated by independent power producers (IPPs) and build-operate-transfer (BOT) projects.

IPPs started entering the generation in the year 2000 with 452MW.¹ Together with reforms implemented by the government, the contribution of IPPs and BOT to the country's generation capacity has increased over the years. In contrast, EVN's share decreased from 68% in 2011 to 58% in 2018. The government is aiming to reduce EVN's share to 30% by 2030.²

Figure 2.5: Installed Capacity by Ownership in Vietnam (MW, 2011-2018)*



Sources: EVN annual reports, World Bank.

<https://www.evn.com.vn/c3/pages-c/Bao-cao-thuong-nien-2-50.aspx>.

(*) EVN annual report 2017 does not disclose nation's installed capacity as of December 2017.

Figure 2.6: Examples of IPPs in The Power Sector in Vietnam (Non-Exhaustive)

Developer Type	Examples
Local developers	<ul style="list-style-type: none"> TTC The Blue Circle Geleximco BIM Group REE Corporation Cong Ly Construction Tan Hoan Cau Company Vietracimex Trungnam Group Hung Hai Group
Foreign developers	<ul style="list-style-type: none"> ACWA Power AES AC Energy German Asean Power Gulf Energy Infracore Asia KEPCO Marubeni Corporation Nexif Energy Sumitomo Corporation

¹ Asian Development Bank (ADB) - Assessment of power sector reforms in Viet Nam (Sep 2015). <https://www.adb.org/sites/default/files/institutional-document/173769/vie-power-sector-reforms.pdf>.

² World Bank - Vietnam - maximizing finance for development in the energy sector (Dec 2018). <http://documents.worldbank.org/curated/en/290361547820276005/pdf/133788-WP-OUO-9-Vietnam-Energy-MFD-Report-ENG-for-printing.pdf>.

2.4 Overview of Power Market

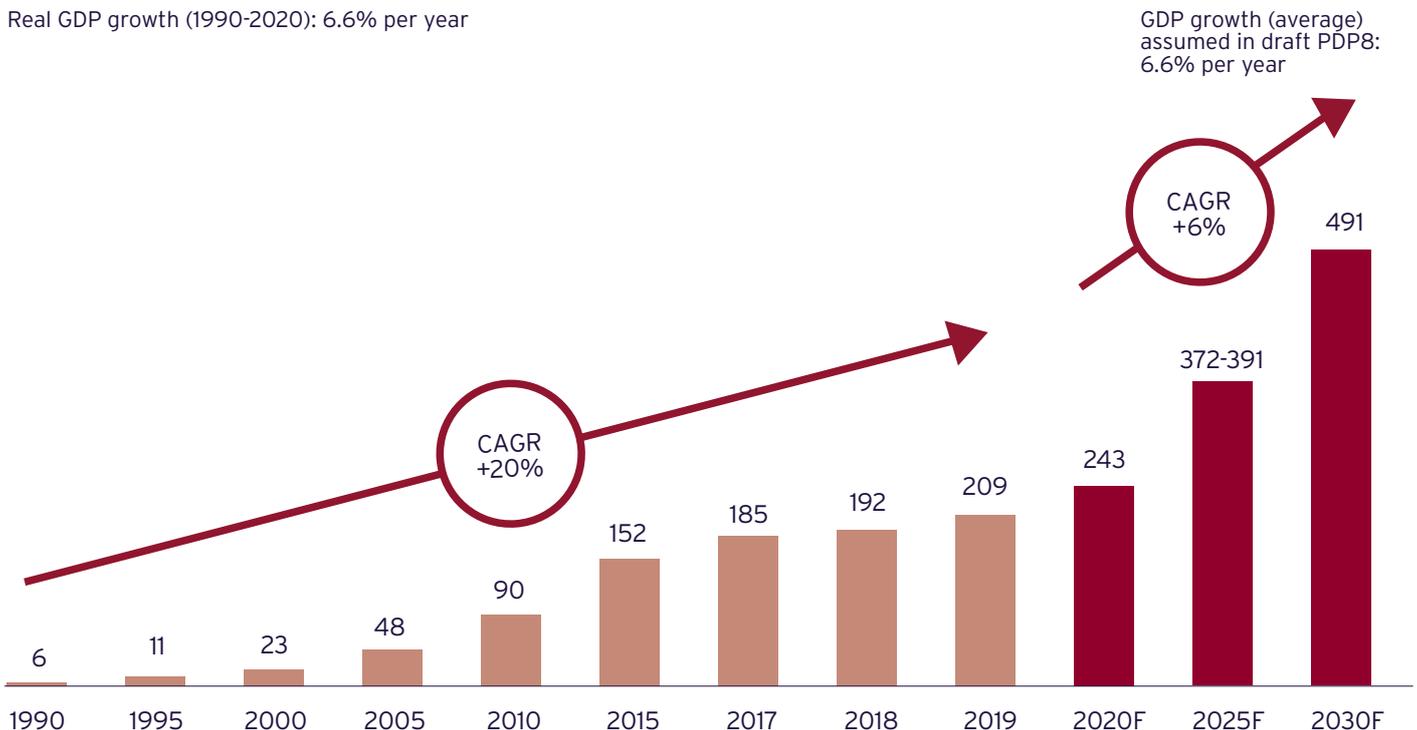
Electricity demand

Due to vibrant economic growth, the electricity demand in Vietnam has been rising rapidly. A 20% compounded annual growth rate (CAGR) in demand from 1990 to 2020 has resulted in the doubling of electricity consumption every 3 and a half years.

In the draft PDP8 issued in February 2021, the Institute of Energy projected electricity demand to be in the range of 372TWh-391TWh in 2025 and 491TWh in 2030. This translates to an annual growth of 7% in electricity demand from 2021 to 2030. These projections were made with the assumption that the Vietnamese economy will grow at an average annual rate of 6.6% in the period of 2021-2030.

Figure 2.7: Electricity Consumption in Vietnam (TWh, 1990-2030)

Real GDP growth (1990-2020): 6.6% per year



Sources: Lexology, Draft PDP8, EY research.

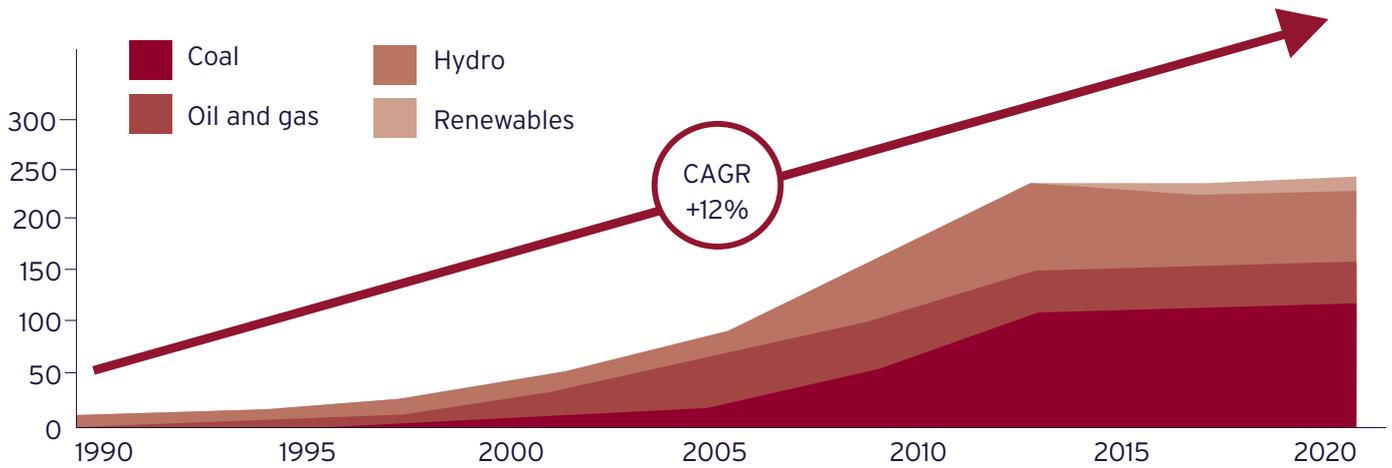
<https://policy.asiapacificenergy.org/sites/default/files/PDP%207%20revised%20Decision%20428-QD-TTg%20dated%2018%20March%202016-ENG.pdf>

Electricity supply

Vietnam has hugely increased its output of electricity since 1990 to meet the growing demand. The annual increase during the 1990-2020 period was 12%, in line with the annual growth rate of

GDP. Coal, hydropower and natural gas are the most important energy sources for electricity production.

Figure 2.8: Electricity Generation in Vietnam by Sources (TWh, 1990-2020)

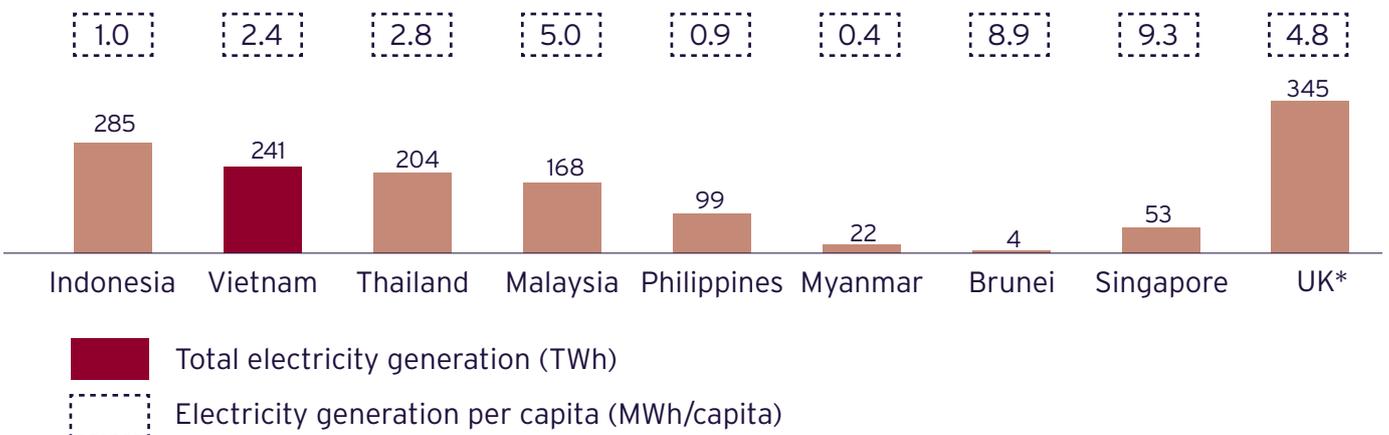


Source: International Energy Agency (IEA), EVN quarterly press releases.

Being the third populous country in Southeast Asia, Vietnam ranked second after Indonesia in the region in terms of electricity generation and fifth in terms of electricity generation per capita. Compared with more advanced economies such

as the UK or Singapore, Vietnam’s electricity generation per capita is relatively low, indicating potential demand for power generation in the upcoming years.

Figure 2.9: Total Electricity Generation and Electricity Generation Per Capita (2018)



Sources: International Energy Agency, World Bank - Databank.

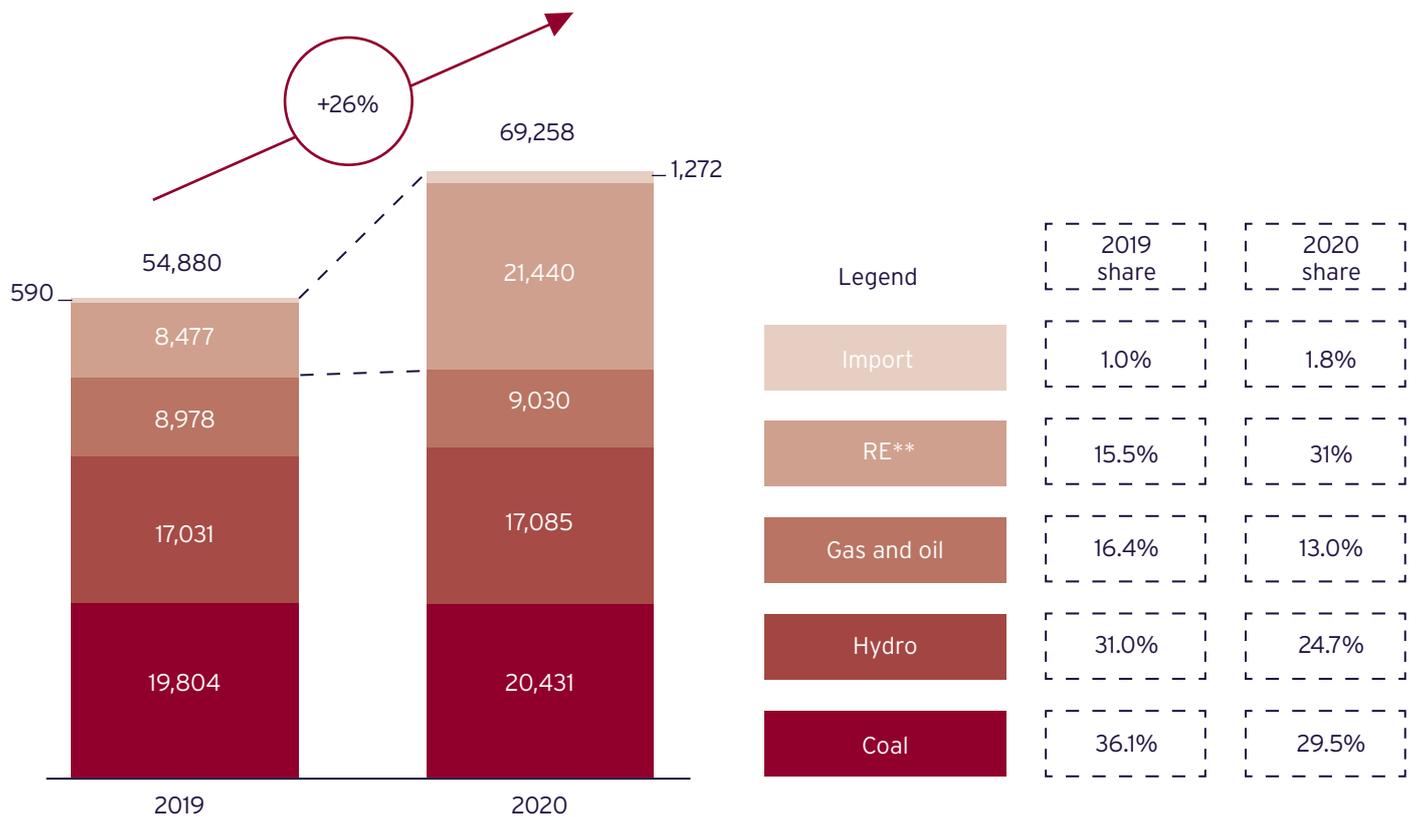
(*) Data for UK is as of 2019.

Capacity mix

In 2020, the total installed generation capacity in Vietnam is 69,258MW with coal and hydropower being the major sources of power generation. 2020 saw a further rise in the installation of renewable energy, especially solar PV. From 2019 to 2020, the total installed capacity increased by 26% from 54,880MW to 69,258MW. Renewable energy alone

contributed 12,963MW, accounting for 90% of the total capacity added. It should be noted that medium and large hydropower is not classified as renewable energy in Vietnam. As of 2020, the total installed solar has exceeded 16GW translating to a yearly addition of more than 10GW.

Figure 2.10: Installed Capacity by Technology (MW, 2019-2020)



Sources: EVN annual report 2018, EREA Renewable energy in Vietnam presentation dated 23 Feb 2021, EVN press release, Draft PDP8, EY research.
 Note: (*) 2019 data is estimated based on government's disclosure of the status of power plants in the pipeline.
 (**) Renewable energy in Vietnam includes solar, wind, biomass and small hydro.

Draft National Power Development Plan 2021-2030 (PDP8)

Vietnam’s most recent National Power Development Plan (NPDP) is the National Power Development Plan VIII (PDP8), with a draft version released in February 2021. PDP8 presents a master plan for power source development for the period between 2021 and 2030.

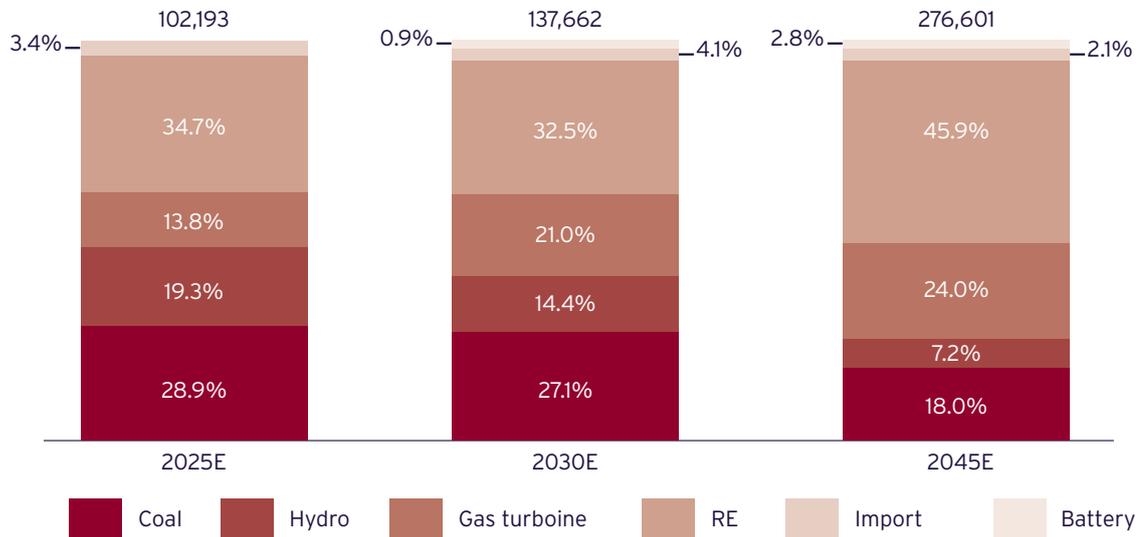
The PDP8 represents a continuation from the previous PDP, the Revised National Power Development Plan 2016-2030 (RPDP7), which was approved by the Prime Minister in March 2016. It presented a master plan for power source development for the period between 2016 and 2030. The targets unveiled in the PDP8 represent a sharp divergence from the existing coal-centric model.

To meet the growing demand for electricity in Vietnam, the government targeted to increase the total installed generation capacity to 102,193MW by 2025 and 137,662MW by 2030, nearly two-fold the current capacity.

Out of the overall increase in total installed capacity, the draft PDP8 aims for renewables to play a more significant role in Vietnam’s overall installed capacity mix.

The goal is for renewable energy (excluding large and medium hydropower) to comprise 32% of total installed capacity by 2030 and, eventually, 46% of the total installed capacity by 2045. The contribution of coal will be reduced from the 29.5% of the overall capacity mix to 18.0% by 2045.

Figure 2.11: Draft PDP8’s Targets for Share of Power Generation Sources (% , MW)



Source: Draft PDP8.

Comparison of the Draft PDP8 and the amended RPDP7

The draft PDP8 sets more ambitious targets for renewable energy over the period until 2030. The installed capacity of renewable energy in draft PDP8 has increased to almost 32% in 2030 compared to the RPDP7 target of 16.3%. Over the same period, the installed capacity of coal-fired plants is expected to

decrease from 42% in RPDP7 to 27% in draft PDP8. About 18GW of coal-fired power plants are expected to be delayed. In addition, the proportion of gas-fired powerplants of total installed capacity in 2030 has increased to 21% in draft PDP8 from 14% in RPDP7.¹

¹ Reuters - Vietnam abandons plan for first nuclear power plants (Nov 2016). <https://www.reuters.com/article/us-vietnam-politics-nuclearpower/vietnam-abandons-plan-for-first-nuclear-power-plants-idUSKBN13H0VO>.

Implementation progress of RPDP7

In a report released in June 2019 (Decision No. 58/BC-BCT), MOIT projected that the total capacity of power sources operationalised by 2030 is expected to be about 120,320MW, which is 10,000MW less than what was provided in RPDP7 (129,500MW).

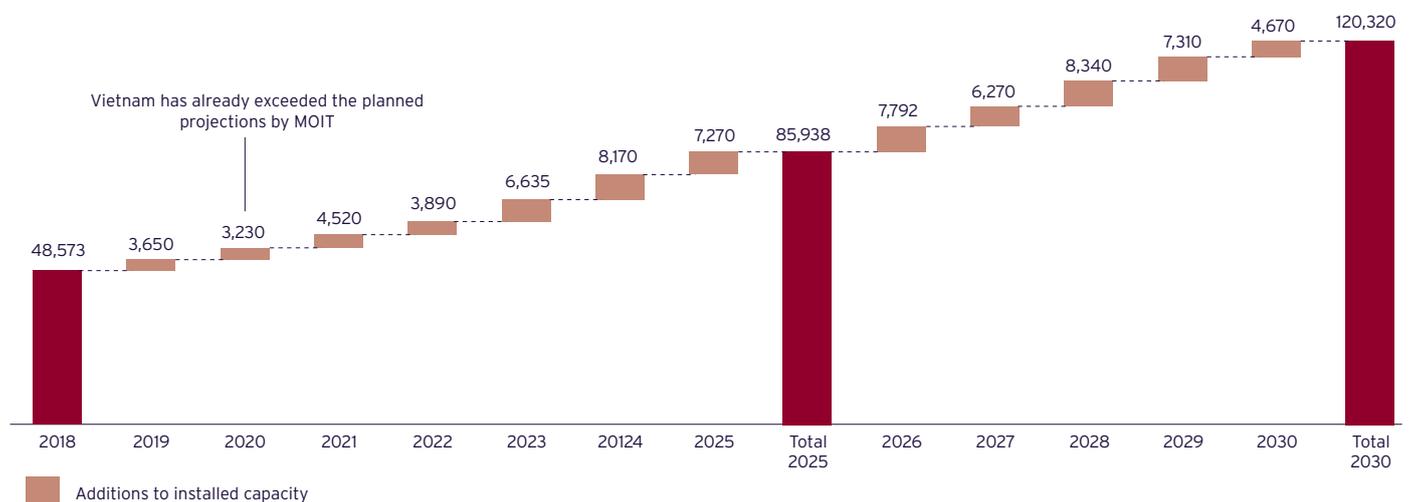
The key reason for this lower projection is the delay in the setting up of thermal projects in RPDP7's project pipeline. For example, Lot B and Blue Whale gas projects are delayed by nine months to one year; and Kien Giang 1 and 2 thermal power projects are delayed beyond 2030, failing to be completed in the period of 2021-2025 as scheduled. O Mon III project is delayed until 2025.

In addition, in November 2016, Vietnam's National Assembly voted to abandon its nuclear plants which were targeted to be built by 2030.¹

With the new draft PDP8, the Vietnamese government has now set the direction for a substantially more ambitious expansion in total installed capacity and the use of renewables in the national energy mix. The PDP8 has been released for public consultation in February 2021 and is expected to be released officially in mid-to late 2021. Vietnam has already exceeded the targets set above with cumulative solar installations exceeding 16GW by the end of 2020.

The delay in setting up thermal power plants in the period of 2018-2022 (mainly in the south) will lead to a supply deficiency in the period of 2021-2025. This may create favorable conditions for more renewable energy projects to be approved into the national PDP to cover the short term shortage amount.

Figure 2.12: MOIT's Projected Installed Capacity Per Year for All Types of Technology (MW, June 2019)



Source: MOIT - On the implementation progress of power projects in the revised Power Development Plan 7 (Decision No. 58/BC-BCT). http://vepg.vn/wp-content/uploads/2019/06/MOIT_Report_58_BC_BCT.pdf.

¹ Reuters - Vietnam abandons plan for first nuclear power plants (Nov 2016). <https://www.reuters.com/article/us-vietnam-politics-nuclearpower/vietnam-abandons-plan-for-first-nuclear-power-plants-idUSKBN13H0VO>.

Electricity distribution

Electrification

Vietnam has made significant progress in electrification. From 78% in 2001, the household electrification rate increased to 96% by 2005 and 100% by 2015.¹

Grid network

Currently, the distribution of power plants in Vietnam is heavily influenced by its natural geography and energy reserves. In the north, hydro and coal power plants dominate while in the south, gas represents the major power source. As such, there is a mismatch between demand and supply capability by region. There is surplus capacity in the north while there is a low reserve margin in the south. To enable power exchange between regions, a 500kV North-South transmission line was constructed in 1994. The second line was completed in late 2005. These two lines are now

serving as the backbone for the power system of Vietnam. Presently, the load ability of the 500kV transmission line is 3,500MW for the South-Central region's section and 1,800MW for the North-Central region's section.

The current law on electricity stipulates that the power transmission field should be a state monopoly, so opportunities for the private sector, including foreign companies, in providing equipment to EVN are currently limited.

However, at present, grid congestion is a massive challenge requiring a redesign of the grid strategy. Earlier, grid planning was focused on serving massive coal complexes but it now has to service a diverse set of renewable power plants in solar and wind. The government may consider letting private sector to invest in the national grid system in collaboration with EVN to be able to upgrade the network in a short time.²

Figure 2.13: Electrification Rate in Select Southeast Asian Countries (% , 2020)



Sources: DOE (Oct 2020), EVN, Indonesia – ESDM (Nov 2019), World Bank – DataBank.

Note: *Data for the Philippines is of 2020. **Data for Vietnam, Indonesia and Myanmar are as of 2019. Data for other countries is from World Bank - DataBank (2018),

https://www.doe.gov.ph/sites/default/files/pdf/electric_power/37th_epira_report_october_2020.pdf.

<https://www.evn.com.vn/d6/news/EVN-voi-su-menh-hien-thuc-hoa-muc-tieu-thap-sang-moi-mien-To-quoc-6-12-24501.aspx>.

<https://www.esdm.go.id/en/media-center/news-archives/growing-by-3-per-year-electrification-ratio-in-3rd-quarter-reaches-9886>.

¹ World Bank - DataBank. According to EVN data, electrification rate as of October 2019 is 99.47%. <https://www.evn.com.vn/d6/news/EVN-voi-su-menh-hien-thuc-hoa-muc-tieu-thap-sang-moi-mien-To-quoc-6-12-24501.aspx>.

² Vietnam News - Provinces, experts call for allowing private capital in power grid construction (August 2019). <https://vietnamnews.vn/economy/523926/provinces-experts-call-for-allowing-private-capital-in-power-grid-construction.html>.

2.5 Major Government Policies and Programme

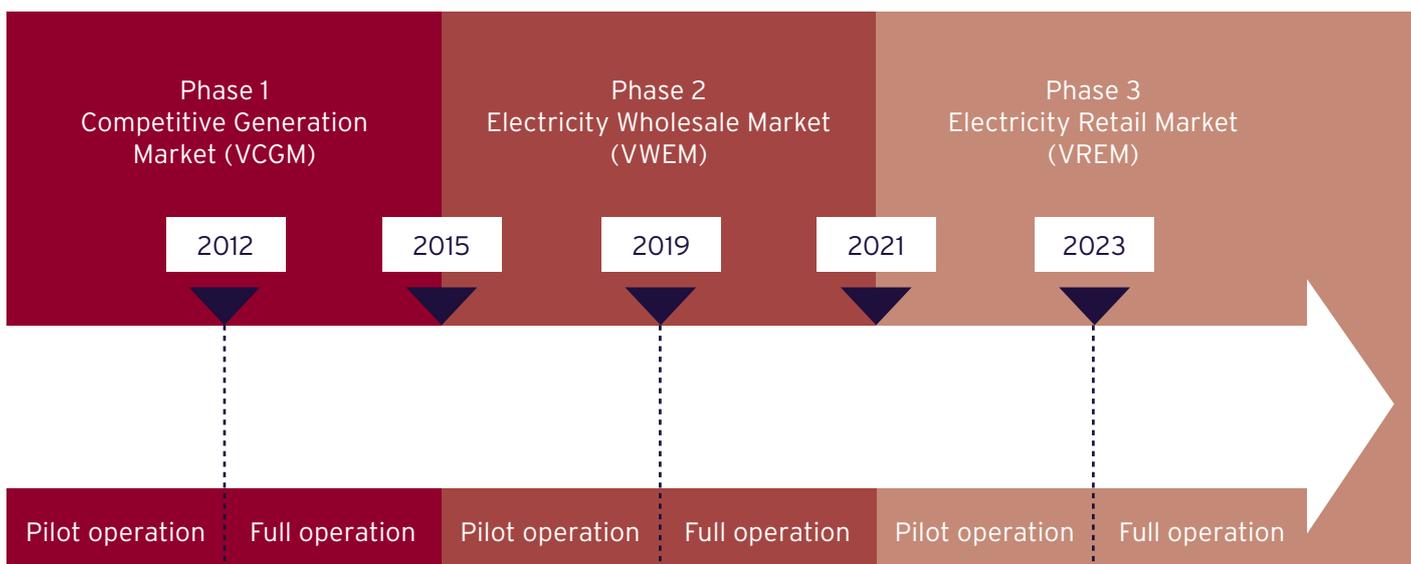
The Vietnamese government has implemented various initiatives to increase the efficiency of the power sector.

The power sector reform began in earnest with the approval of the 2004 Electricity Law. This law provides the guiding framework for developing a competitive electricity market, which requires the unbundling of the sector by breaking up the vertically integrated, state-owned power utility EVN. The law also directs electricity tariff reforms to move prices toward cost-reflectiveness to attract private investment in order to ensure sustainable sector development, reduce subsidies and promote demand-side energy efficiency.

Formulation of a competitive market

Vietnam has a clear roadmap for power reform that starts with a single buyer for power, then proceeds to a competitive wholesale market and finally moves toward a competitive retail market. The current roadmap for the EVN market was approved through Decision No. 63/2013/QD-TTg issued in 2013. This roadmap stipulates that the Vietnamese electricity market will be transformed through three key stages of Competitive Generation Market (VCGM), Electricity Wholesale Market (VWEM) and Electricity Retail Market (VREM).



Figure 2.14: Roadmap of Power Sector Reforms Per Decision No. 63/2013/QĐ-TTg

- VCGM: Generating units sell electricity to a single buyer (EVN) via a bilateral agreement in spot electricity market
- VWEM: Electricity retailers and major end users purchase electricity from generating units and electricity wholesalers via a bilateral agreement in spot electricity market
- VREM: Distribution company activities are split into (i) network management and operation and (ii) retailing to end users, giving end users the freedom to choose their suppliers

Source: EY research.

In July 2011, the pilot VCGM was launched. In July 2012, it became fully operational with EVNGENCOs and IPPs competing in a power pool to sell to the single buyer – the Electricity Power Trading Company. The roadmap targets a pilot competitive VWEM starting in 2015. However, only in 2018 was the pilot VWEM launched. Since January 2019, VWEM has officially come into operation.

Even though there were some delays in the implementation of the electricity market reform in Vietnam, the country is transforming its electricity market to become more competitive and efficient.

As of 2018, 90 power plants directly participated in the competitive generation market, with a total installed capacity of 23,054MW, accounting for 52.6% of the installed capacity of the whole system. However, these power plants are only required to sell 10% of their electricity generated through the VCGM and the balance remains contracted with EVN under PPAs.

Figure 2.15: Structure of Power Market in Southeast Asian Countries (2020)

Sources: IRENA – Southeast Asia Renewable Energy Market Analysis (2018), Singapore's Energy Market Authority (EMA), EY research. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_Market_Southeast_Asia_2018.pdf.

Note (*): According to Singapore's EMA, the electricity futures market enables the entry of independent electricity retailers and facilitates new business models. As of January 2021, all households in Singapore can freely choose their electricity provider.

Gradual hike in power price

Retail tariffs in Vietnam are heavily subsidised and considered to be amongst the lowest in Southeast Asia. The retail tariffs below cost-recovery levels have challenged EVN's financial position. To improve the creditworthiness of EVN, EVNNPT and EVN's other subsidiaries, an electricity price increase is necessary.

In fact, the power retail price in Vietnam has increased 97% in the past 10 years, from VND949/

kWh (US\$4.1 cents) in 2009 to VND1,864/kWh (US\$8 cents) in March 2019. A gradual hike is also expected in the future.

According to estimates from the World Bank,¹ to achieve full cost-recovery, average electricity tariffs have to be increased to US\$12 cents/kWh by 2020. The current tariff level is still much lower than this threshold.

Figure 2.16: Average End User Electricity Price (2009-2019, US\$ cents/kWh)

Source: MOIT.

¹ World Bank - Vietnam - maximizing finance for development in the energy sector (Dec 2018). <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/897271548259738578/vietnam-maximizing-finance-for-development-in-the-energy-sector>.

Privatisation of power plants

Government plan

The Vietnamese government already had plans to privatise SOEs in the power sector to increase their efficiency. These SOEs include EVN's subsidiaries, PV Power and Vinacomin Power.

By 2020, government ownership after the privatisation of these companies is targeted to be reduced from 100% to below 51%. By 2030, it is envisaged that EVNGENCO will be fully privatised with EVN retaining the ownership of strategic generation assets alone (such as the multipurpose hydropower plants).

Implementation progress

In January 2018, PV Power conducted a successful initial public offering, auctioning a 16% share in the company. As of January 2021, PVN owns 79.94% share of PV power, followed by financial investors such as PYN Fund Management (2.47%) and Norges Bank (1.27%).

However, it will take a long time for the government to complete the privatisation of big EVNGENCOs in Vietnam due to their size, their high leverage, strong forex exposure and unfavorable short term prospects.

In February 2018, EVNGENCO 3 was listed on Ho Chi Minh City Stock Exchange under the equitisation plan approved by the Prime Minister as per Decision No. 2100/QĐ-TTg dated 27 December 2017. However, the EVNGENCO 3 Initial Public Offering (IPO) auction was not well-received by investors. EVNGENCO 3 only managed to sell 2.8% of the 12.8% shares offered through the IPO.

According to disclosures by EVN, four foreign investors from India, Thailand, South Korea and the Middle East registered to buy 36% of the charter capital to become Genco 3's strategic investors. However, as of January 2021, no deal has yet been closed. EVN still owns 99.19% share of EVNGENCO 3. Foreign investors do not seem keen on investing in a large-cap power corporation like the EVNGENCOs and it may be easier to sell shares of individual power plants due to accessibility of information disclosure and fewer risks.

The IPOs of EVNGENCO 1 and 2 were expected to occur in 2019. However, perhaps linked to the failure of EVNGENCO 3's IPO, the IPOs of the two remaining EVNGENCOs did not take place. On 21 January 2021, EVNGENCO2 held an IPO road show in HCMC announcing the company's intention to list 581.45 million shares or 48.9875% of its charter capital on the Ho Chi Minh City Stock Exchange. At a starting auction price of VND24,520 (US\$1.06) per share, EVNGENCO2 would be priced at an implied valuation of US\$1.26 billion.



3. Renewable Energy Market Characteristics

3.1 Major Government Policies and Programme

Potential of renewables in Vietnam

Vietnam has an abundance of renewable energy resources with high solar irradiation and large wind potential. There have been various research conducted by different international organisations together with the Vietnamese government to measure the potential of renewables in Vietnam. The government's estimate shown below for solar potential was the result of an assessment conducted in 2014 in collaboration with Spanish Agency for International Development Cooperation (AECID).

The AECID and MOIT report titled "*Solar radiation and potential mapping*," estimates a potential of 85GW for select provinces where solar PV could technically produce 109TWh/year. The onshore wind resource assessment was conducted in 2015 with the support of World Bank's Energy Sector Management Assistant Program (ESMAP), which estimated a potential of 27GW.

Table 3.1: Vietnam's Technical Potential for Renewable Energy - Estimates from Difference Sources

	Solar	Wind	Hydro (small)	Geothermal	Bioenergy	Marine
EVN estimate	85GW	27GW*	>7GW	340GW	>3,000MW	100MW-200MW
USAID	85GW	27GW*	Not available			

Sources: EVN - *Implementation of photovoltaic projects in Vietnam (Jul 2019)*, USAID-NREL - *Exploring Renewable Energy Opportunities in Select South-east Asian Countries (Jun 2019)*.

https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2019/190722-iv-vietnam-06.pdf?__blob=publicationFile&v=2, <https://www.nrel.gov/docs/fy19osti/71814.pdf>.

Note: (*) Only for onshore wind. This research did not estimate the potential for offshore wind.

(**) USAID data provides the technical potential for LCOE of less than US\$150/MWh, for both onshore and offshore.

Estimating potential of renewables is a highly complex process and the results often vary, depending on the assumption and scenarios chosen to be used as inputs in each assessment. In general, these estimates should be interpreted with great caution and careful consideration of the assumptions made.

There is a big gap between the potential estimated by USAID-NREL and the government. However, through all of these estimates, Vietnam undoubtedly has abundant renewable resources which are untapped at the moment. As of 2020, renewable energy (excluding mid and large hydropower projects) totaled 21.4GW of installed capacity in Vietnam.

Government's target for renewables set in draft PDP8

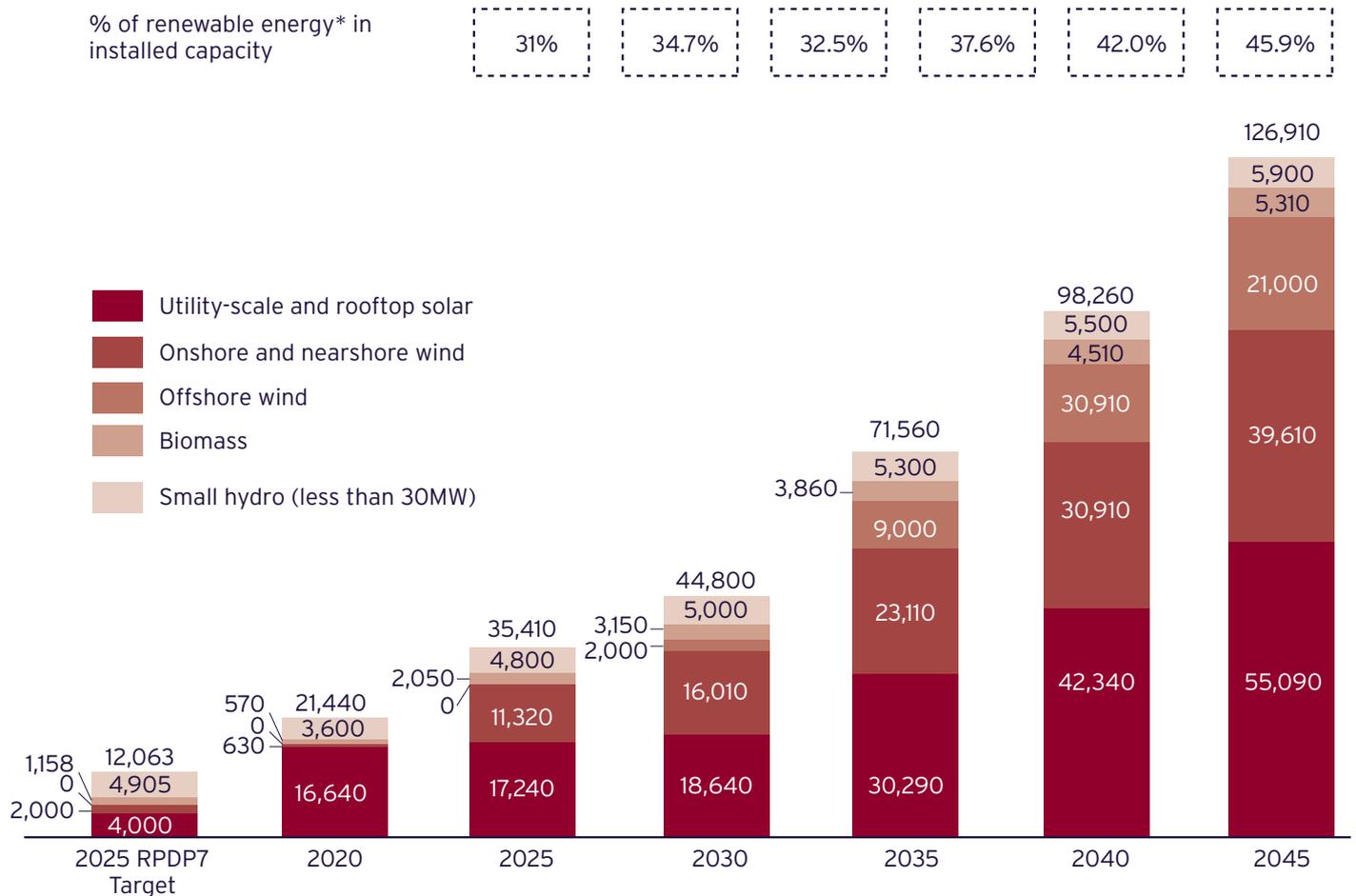
The PDP8 reinforces the Vietnamese Government's current view on placing renewable energy sources as a priority for the future of the national electricity mix.

It stipulates that the total installed capacity of wind power plants should increase to 4,800MW by 2025 and increase to 5,000MW by 2030; solar power capacity would increase to 17G.2W by 2025 and 18.6GW by 2030; small hydropower capacity would increase to 4.8GW by 2025 and to 5GW by 2030; and biomass capacity would increase to 2GW by 2025 and 3.1GW by 2030.

The goal is for renewable energy (excluding large and medium hydropower) to hit a target of comprising 32% of the total installed capacity by 2030 and eventually comprise 46% of the total installed capacity by 2045.

In February 2021, a draft PDP8 has been released for public consultation. The final PDP8 is expected to be finalised before the end of 2021.

Figure 3.1: Renewables Installed Capacity for 2020 and Targets Set for 2025 and 2030 in Draft PDP8 (MW)**



Sources: Draft PDP8, EY research.

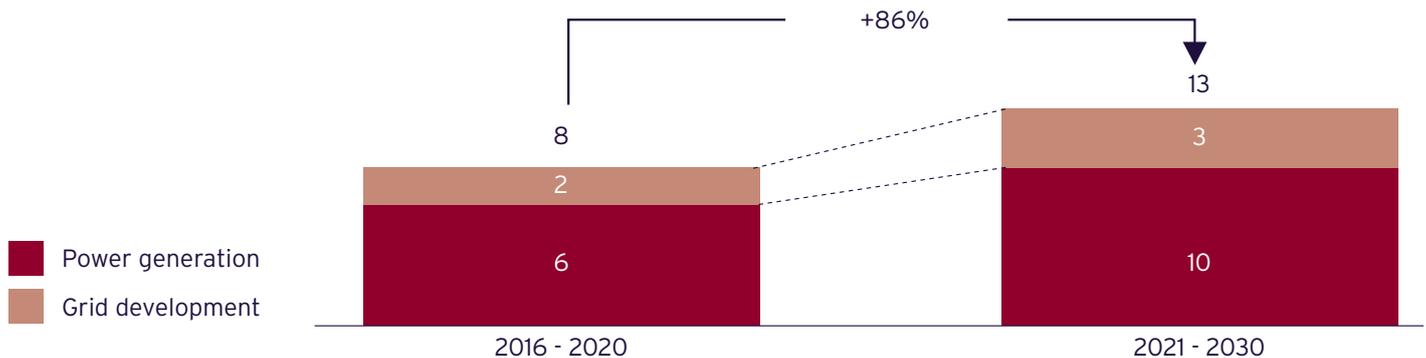
Note: (*) Mid and large hydropower projects are not considered to be renewable energy sources in Vietnam’s PDP.

Government's and companies' spending plans and timelines

In RPDP7, the government projected that funding requirements for investment in power generation and grid expansion (excluding BOT-driven projects) in the period of 2016-2030 will be VND3,206,652 billion (US\$138.6 billion), divided into two phases as follows:

- 2016-2020 period: VND858,660 billion (US\$37.1 billion, US\$7.4 billion/year on average), of which 75% will be spent for power sources and 25% for grid development
- 2021-2030 period: VND2,347,989 billion (US\$101.5 billion, over US\$10 billion/year on average), of which 74% will be for power sources and 26% for grid development

The draft PDP8 has replaced the RPDP7 with more ambitious spending plans. Specifically, for the 2021-2030 period, the total amount of investment in power generation and grid expansion has been increased from US\$101.5 billion to US\$128.3 billion, over US\$12.8 billion/year on average. Out of the US\$128.3 billion, 74% will be for power sources and 26% for grid development. This translates into a 86% increase in the targeted annual spending plan from the 2016-2020 period.

Figure 3.2: Annual Government Spending Plan in Power Sector (US\$ billion)

Sources: RPDP7, EY research.

<https://policy.asiapacificenergy.org/sites/default/files/PDP%207%20revised%20Decision%20428-QD-TTg%20dated%2018%20March%202016-ENG.pdf>

The World Bank had previously estimated that around US\$2.3-2.9 billion is required annually from 2020-2025 for renewable energy to achieve

the government's objects set in RPDP7. Around US\$27-33 billion will be required for the whole period from 2016-2030.

Table 3.2: Historic Investments Trends and Forecast Investment Needs for Renewable Energy (US\$ billion)*

Historic period 2011-2015	Forecast period			Total investment required
	2016-2020	2020-2025	2025-2030	2016-2030
0.1	1.1-1.3	2.3-2.9	2.0-2.5	27-33

Source: The World Bank – Vietnam - maximizing finance for development in the energy sector (Dec 2018).

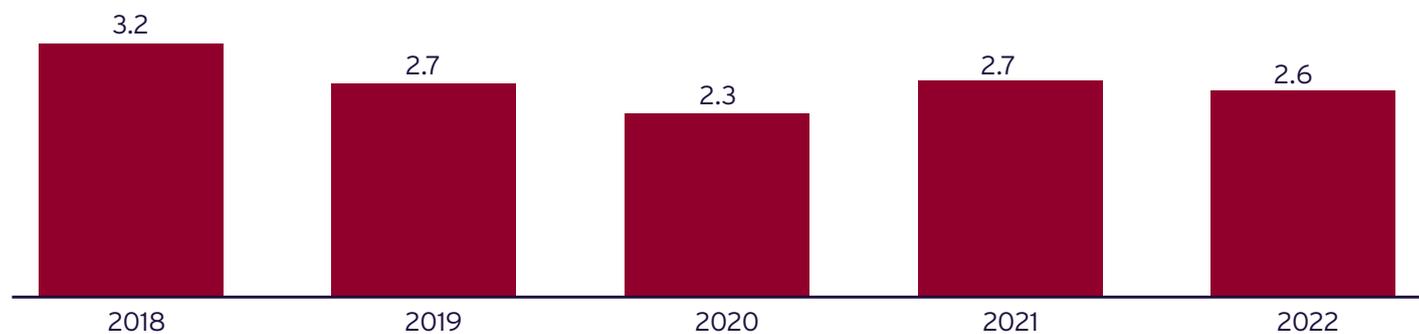
<http://documents.worldbank.org/curated/en/290361547820276005/pdf/133788-WP-OUO-9-Vietnam-Energy-MFD-Report-ENG-for-printing.pdf>

Note (*): World Bank calculations based on data from RPDP7, EVN and MOIT. A range of future investment requirements was calculated based on low, medium and high electricity demand forecasts in RPDP7.

EVN will continue to play an important role and will be responsible for about 30% of the total investment requirements until 2030, being fully responsible for all transmission and distribution investments via its subsidiaries (National Power Transmission Corporation and the five power corporations in distribution).

During the period of 2018-2022, EVN debt-financing requirements, which include new debt-to-finance capex as well as maturing debt-to-refinance existing debt, are estimated to be around US\$2.3-US\$3.2 billion annually.

Figure 3.3: EVN's Debt-Financing Requirements (US\$ billion)



Source: EVN. Extracted from *The World Bank – Vietnam - maximizing finance for development in the energy sector (Dec 2018)*.
<http://documents.worldbank.org/curated/en/290361547820276005/pdf/133788-WP-OUO-9-Vietnam-Energy-MFD-Report-ENG-for-printing.pdf>.

Vietnam's renewable energy sector has also attracted interest from foreign developers and financial investors with many companies investing heavily in the Vietnamese market.

In January 2021, Vietnam-based Thanh Thanh Cong (TTC) Group invested \$291 million in an onshore and offshore wind power project, with a combined total capacity of 150MW. TTC plans to expand the projects to 200MW in the next phase.

Also in January 2021, Southeast Asia Clean Energy Facility (SEACEF), a clean energy-focused fund managed by Singapore-based fund management company Clime Capital invested in Levanta Renewables, a Vietnam-focused renewable energy company headquartered in Singapore. The fund raised US\$10 million from US and UK-based philanthropic organisations, such as Bloomberg Philanthropies, to support the development of 3 early-stage onshore wind power projects with a combined capacity of up to 330MW.

In February 2019, the World Bank's International Finance Corporation (IFC) invested US\$75 million in the listed green bond issued by AC Energy, a Philippines company under Ayala Corporation. IFC noted that its subscription was dedicated to selected solar PV and wind projects in Vietnam, particularly its equity stake in solar project developer Gia Lai Electricity Joint Stock Company.

One of Thailand's largest power developers, B. Grimm Power Public Company, has partnered with the Vietnamese conglomerate Xuan Cau to build a 420MW solar park as part of its plan to invest US\$1.8 billion into wind farms across the country.

In 2018, The Thai company Superblock Pcl. disclosed that the company plans to invest US\$1.76 billion to install 700MW of wind farms in Vietnam. In the initial period, it will spend US\$651.84 million in the construction of three onshore wind power plants in the southern provinces of Bac Lieu, Soc Trang and Ca Mau, with capacities of 142MW, 98MW and 100MW, respectively. These plants are expected to commence operations in 2020.

Sources: IJGlobal, EY research.

<https://ijglobal.com/articles/152608/seacef-taps-into-vietnam-winds>.

<https://ijglobal.com/articles/152647/ttc-group-builds-vietnam-winds>.

List of regulations

Key regulations in effect in the renewables market are summarised below.

Table 3.3: List of Major Regulations Regulating Renewables Market in Vietnam

Type ¹	Description	Year	Description
All	Electricity Law No. 28/2004/QH11	2004	Electricity law
	Circular No. 43/2013/TT-BCT	2013	Regulations on procedures for formulation, assessment and approval to electricity development planning
All	Decision No. 2068/QĐ-TTg	2015	Development strategy of renewable energy of Vietnam by 2030 with a vision to 2050
All	Decision No. 428/2016/QĐ-TTg	2016	RPDP
All	Circular No. 25/2016/TT-BCT	2016	Electricity transmission system
Solar	Circular No. 16/2017/TT-BCT	2017	<i>Regulations on project development and standardised PPAs for solar power projects</i>
Solar	Decision No.13/2020/QĐ-TTg	2020	Mechanism for encouragement of development of solar power in Vietnam (effective from 22 May 2020)
Solar	Circular No. 18/2020/TT-BCT	2020	Regulations for rooftop project development and electricity prices
Wind	Decision No. 37/2011/QĐ-TTg	2011	Support mechanism for wind power project
Wind	Circular No. 96/2012/TT-BCT	2012	Financial mechanism to support electricity price for grid-connected wind power projects
Wind	Circular No. 32/2012/TT-BCT	2012	Implementation of wind power projects and the standardised PPA
Wind	Circular No. 96/2012/TT-BCT	2012	Guiding the financial mechanism to support electricity price for grid-connected wind power projects
Wind	Circular No. 06/2013/TT-BCT	2013	Process and procedures for preparation, validation and approval of wind power development planning
Wind	Decision No. 39/2018/QĐ-TTg	2018	Amending Decision No. 37
Wind	Circular No. 02/2019/TT-BCT	2019	Regulations on wind power project development and standard PPA
Wind	Document No.693/TTg-CN	2020	Issued by Prime Minister requesting the inclusion and focus on wind power projects into electricity development planning
Solid waste	Decision No. 31/2014/QĐ-TTg	2014	Support mechanism for the development of power generation projects using solid waste in Vietnam
Solid waste	Circular No. 32/2015/TT-BCT	2015	Regulations on project development and standardised PPA for power generation projects using solid wastes
Biomass	Decision No. 24/2014/QĐ-TTg	2014	Support mechanism for the development of biomass power projects in Vietnam
Biomass	Circular No. 44/2015/TT-BCT	2015	Avoided cost tariffs (ACT) and standardised PPAs applicable to biomass power projects
Biomass	Decision No. 08/2020/QĐ-TTg	2020	Amending Decision 24 dated 24 March 2014 on support mechanisms for the development of biomass power projects in Vietnam
Small Hydro	Circular No. 32/2014/TT-BCT	2014	Procedures on establishment and application of ACT schedule and promulgation of PPA to small hydropower plants
Small Hydro	Circular No. 06/2016/TT-BCT	2016	Amending Circular No. 32

Source: EY research.

¹ Type of technologies impacted by the regulation.

Pricing policies

FiT

FiT is a popular policy tool for jump-starting growth in renewables, whereby the government pays a long-term and mutually agreed rate to IPPs to develop renewable energies.

Renewable energies typically have higher initial capital costs/MW than fossil fuels such as coal. Therefore, FiTs have historically been viewed as an important mechanism for inducing investment in nascent renewable sectors.

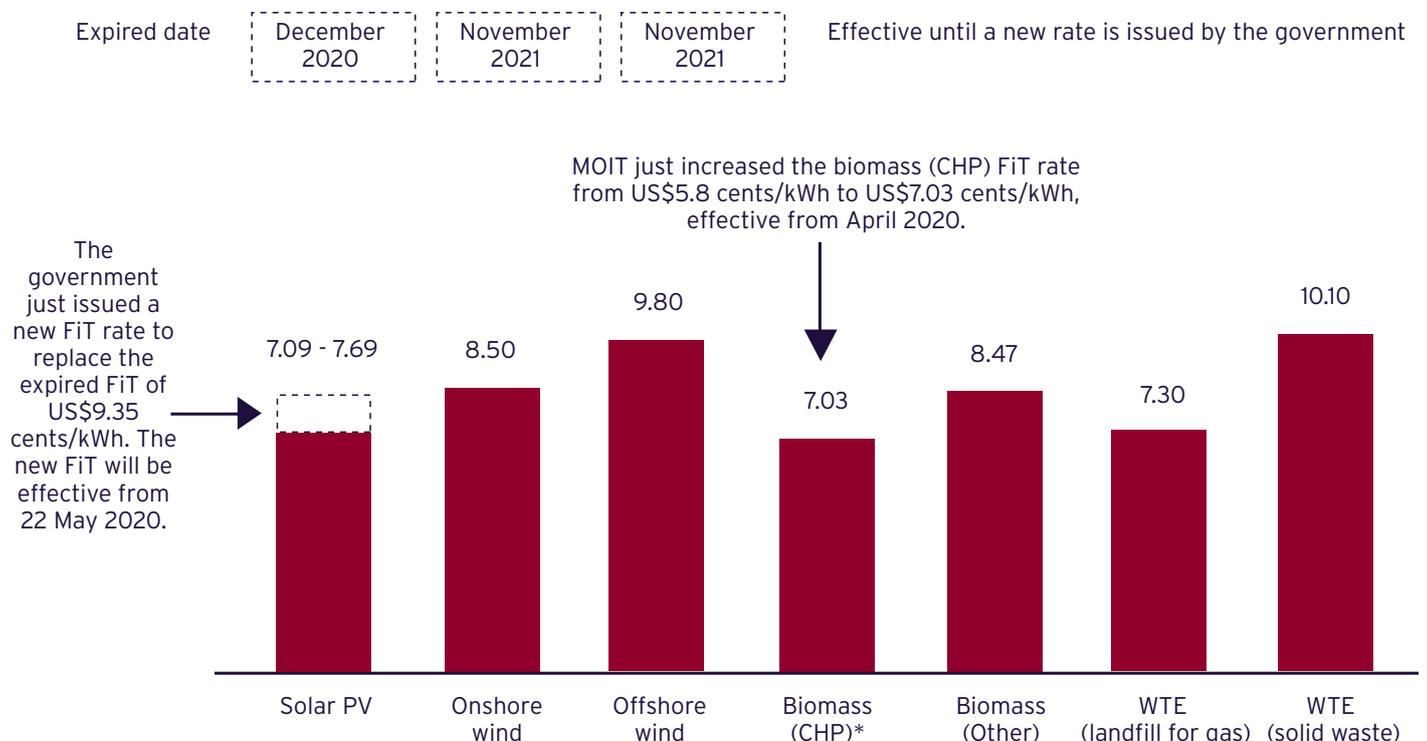
In Vietnam, FiT is currently set for solar, wind, biomass and WTE with a contract length of 20 years.

In April 2020, the Vietnamese government issued a new solar FiT to replace the expired FiT of US\$9.35 cents/kWh for all types of solar PV. According to the new decision (Decision No. 13/2020/QĐ-TTg),

new solar FiT rates differ by technology. The FiT rate for ground-mounted solar is US\$7.09 cents/kWh, for floating solar, US\$7.69 cents/kWh and for rooftop solar, US\$8.38 cents/kWh. Please refer to Chapter 4 for more information.

Meanwhile, avoided cost tariff (ACT) is applied for small hydro. MOIT determines and issues ACT for these technologies annually. Details of ACT for small hydro will be mentioned in more details in Chapter 6. The government is targeting to transition to competitive bidding and is planning to hold a pilot auction for solar sometime in 2021. As of March 2021, details of the pilot auction have yet to be released.

Figure 3.4: FiTs for Different Renewables Technologies in Vietnam (US\$ cents/kWh)



Source: EY research.

(*) CHP: Combined heat and power.

Recent developments on direct PPA mechanisms

In January 2020, MOIT submitted Proposal No. 544 to the Prime Minister along with a new draft decision on approval of the pilot program on direct power purchase agreement (DPPA) mechanisms between renewable energy developers and private power buyers.

The draft DPPA decision proposes DPPA mechanism for off-site renewable energy projects in Vietnam with a proposed pilot program at a scale ranging between 400MW and 1,000MW.

Under Decision No. 13, for the first time, the Vietnamese government has allowed for sale of energy generated to a non-EVN entity. The decision provides a clear basis for a direct PPA between the rooftop energy producer and an non-EVN buyer.

Investment incentives

The Vietnamese government offers various incentives to encourage the development of renewable energy. These incentives are stipulated in *Approving Vietnam's Renewable Energy Development Strategy up to 2030 with an Outlook to 2050* (Decision No. 2068 issued in 2015) and are summarised in the below table.

Table 3.4: Incentives for Renewable Energy Projects

Category	Incentives
Import duty	Exemption for: <ul style="list-style-type: none"> • Goods imported to form fixed assets • Project materials, components and semi-finished products that cannot be domestically manufactured
Corporate income tax	<ul style="list-style-type: none"> • Exemption for the first four years • 50% reduction for the following nine years • Preferred tax rate of 10% for the first 15 years
Land lease	• Exemption ranging from 14 years to the entire project lifecycle depending on the project location

Sources: Prime Minister of Vietnam - *Approving the Viet Nam's renewable energy development strategy up to 2030 with an outlook to 2050* (Decision No. 2068/QD-TTg) (Nov 2015), EY research.

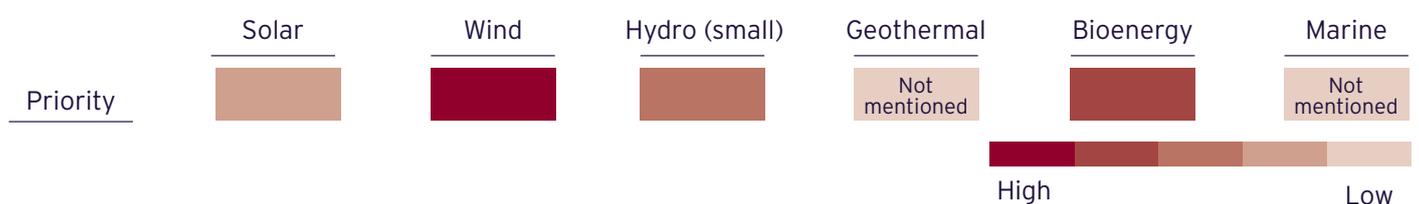
https://www.mzv.cz/public/1b/a6/7a/1810646_1462225_Strategy_on_Renewable_Energy_Decision_2068_ENG_2015_11_25.pdf.

Priority of renewable energy projects

In February 2020, the Vietnamese government issued Decision No. 329/QD-BCT to set priority orders for approving the inclusion of new power and energy projects in the master plans. It is promulgated in this decision that wind, WTE and biomass will be given higher priority over solar in the upcoming years.

Due to the preferential tariff rate set for solar PV until June 2019, Vietnam has seen an over-subscription of solar projects. The country has far exceeded the target set for solar PV in 2020. This explains the lower priority accorded to newly proposed solar power projects.

Table 3.5: Priority Orders for Approving the Inclusion of Renewable Energy Projects in Vietnam's National Master Plan



Source: MOIT - *On principles and order of priority for the adjustment and addition of power projects into plans* (Decision No. 329/QD-BCT.) (Jan 2020) http://vepg.vn/wp-content/uploads/2020/02/329-Q%C4%90-BCT_EN.pdf.

3.2 Overview of Vietnam Renewables Market

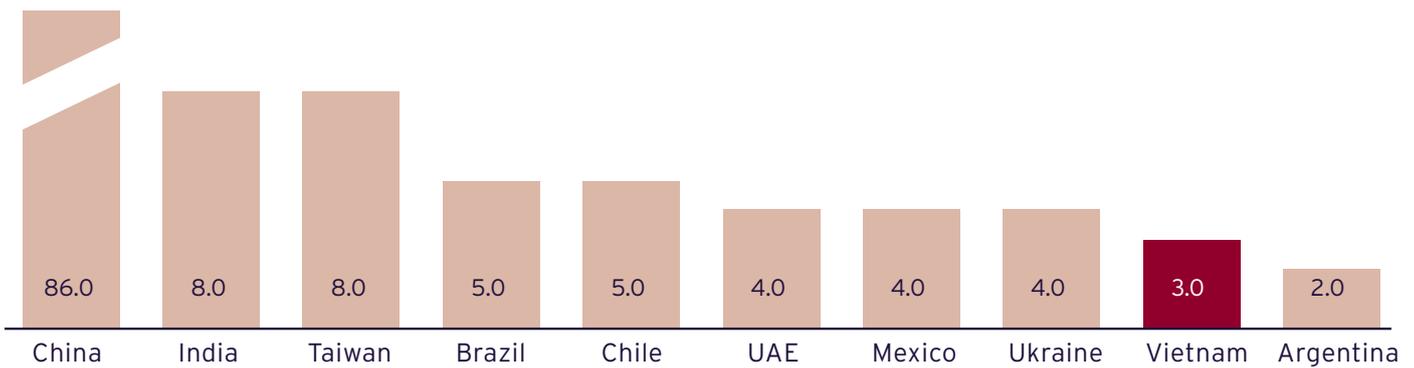
Investment conditions

The period 2019-2020 witnessed a steady advancement for Vietnam in the world renewables map. Globally in terms of investment conditions for clean energy as measured by the Climatescope-BNEF ranking, Vietnam advanced from 22nd place in 2019 to rank 19th in 2020. The ranking covered 108

developing countries. In Southeast Asia, Philippines has the highest rank (12th), followed by Vietnam (19th) and Thailand (30th).

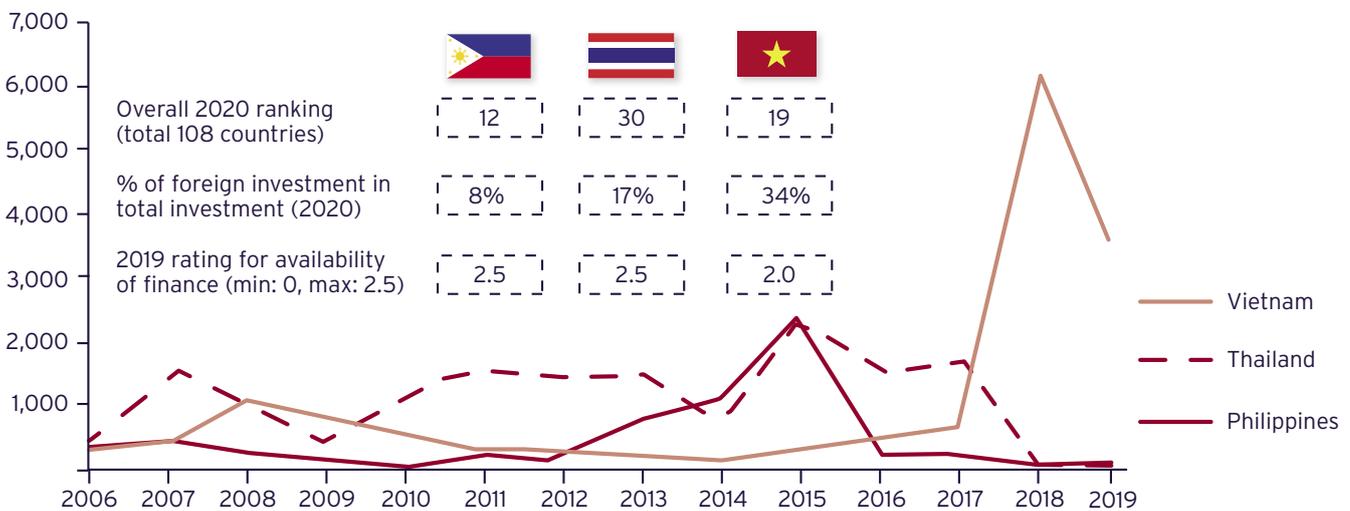
BNEF also estimates that around 38% of investment in renewables in Vietnam is from foreign investment, much higher than Thailand and the Philippines.

Figure 3.5: Top 10 Emerging Markets for Clean Energy Asset Finance (US\$ billion, 2019)



Sources: BNEF – Climatescope 2020, EY research.
<https://global-climatescope.org/assets/data/reports/climatescope-2020-report-en.pdf>

Figure 3.6: Climatescope’s ranking and clean energy asset finance in select Southeast Asian countries (US\$ billion, 2020)



Sources: BNEF - Climatescope 2020 and BNEF – Country profiles, EY research.
<https://global-climatescope.org/assets/data/reports/climatescope-2020-report-en.pdf>
<https://global-climatescope.org/results/vn#clean-energy-investment>
<https://global-climatescope.org/results/ph>
<https://global-climatescope.org/results/TH>

Market entry for foreign investors

To enter Vietnam's renewables market, foreign investors have options such as greenfield investment, partnering with a local player or acquiring stakes in existing companies in Vietnam.

For example, in 2016, IFC and Armstrong Asset Management jointly invested in Vietnam's Gia Lai Hydropower (GEC) – a subsidiary of Thanh Cong Group – and acquired 36% at GEC. GEC is one of Vietnam's largest private hydropower plants with 84.4MW of installed capacity in 2016. After the investment of IFC and Armstrong, GEC diversified its portfolio to solar and wind with a target of having 1,136MW of installed capacity by 2022.

In a similar move, in August 2019, Philippine energy developer AboitizPower acquired Mekong wind farm from Armstrong Asset Management at US\$46 million to enter the Vietnam wind market.

Regional companies from Thailand and Philippines have been quite active in Vietnam. The major players include Gulf Energy Development Public Company Limited (Thailand), Super Energy (Thailand), B. Grimm Power (Thailand), AC Energy (Philippines) and Hitachi Zosen (Japan).

Table 3.6: Examples of Acquisitions Conducted by Foreign Investors in Vietnam (As of January 2021)

Year	Target	Investor	Types	Country of investor	Total capacity	Investment (US\$ million)
2020	Tan Chau Solar PV Plant	Bright Green Power Co. Ltd.	Solar	Thailand	50MW	47
2020	Phong Dien 2 Solar PV Plant	Gunkul Engineering	Solar	Thailand	50MW	40
2020	Dam Nai Wind Farm	Scatec Solar	Wind	Norway	39.4MW	65
2020	Tri Viet 1 Solar Power Plant Project, Bach Khoa A Chau 1 Solar (Tay Ninh Province)	Bright Green Power Co. Ltd.	Solar	Thailand	60MW	60
2020	Thinh Long Phu Yen Solar Power Joint Stock Company (JSC)	Super Energy Corporation	Solar	Thailand	50MW	51
2019	Mekong Wind Pte. Ltd. (Ninh Thuan Province)	Aboitiz Power Corporation	Wind	Philippines	39.4MW	46
2019	Mekong Project (Ben Tre Province)	Gulf International Holding	Wind, Solar	Thailand	310MW (near-shore wind), 30MW (solar)	7
2019	HBRE Phu Yen and HBRE Gia Lai	Super Energy Corporation	Wind	Thailand	250MW	18
2018	Sinenergy Ninh Thuan I Solar Power Plant	Super Energy Corporation	Solar	Thailand	300MW	4
2018	Phu Yen TTP JSC	B. Grimm Renewable Power	Solar	Thailand	257MW	35
2018	Coc San	TEPCO	Hydro	Japan	29.7MW	NA
2016	Bitexco Power Corp	ORIX, Venture Management Pvt. Ltd.	Hydro	Japan, Singapore	1GW	50

Sources: Capital IQ, IJGlobal, Mergermarket.

A player which is backed up by the UK government – InfraCo Asia – has also been quite active in Vietnam’s renewable energy market.

InfraCo Asia is currently funded by three members of the Private Infrastructure Development Group (PIDG), the Australian Department of Foreign Affairs and Trade (DFAT), the Swiss State Secretariat for Economic Affairs (SECO) and the UK Department for International Development (UKAid). InfraCo Asia funds high risk infrastructure development activities by taking an equity stake with a focus on socially responsible and commercially viable infrastructure projects. At the appropriate time, either as close as possible to financial close and/or commercial operation, it aims to exit each project.

In Vietnam, InfraCo Asia acquired 33.4% of the stake at the 29.7MW Coc San run of river hydro plant in 2012 at US\$7.5 million when the project was at risk of being abandoned. The company has successfully restructured the project and completed the sale of its interest in the hydro plant to Japanese utility Tokyo Electric Power Company (TEPCO). In the solar segment, InfraCo Asia took a minority stake in the 168MW Ninh Thuan solar power project and partnered with Singapore-based Sunseap to develop it. The project started operation in 2019.

InfraCo Asia has also assigned Infunde Development – its exclusive developer in Southeast Asia (excluding Myanmar) – to launch and develop several projects in Vietnam, including the 143MW Huc wind power project in Quang Tri province and the Ninh Tay project in Ninh Thuan Province.

Table 3.7: InfraCo Asia’s Projects in Vietnam (As of January 2021)

Year	Project	InfraCo’s equity (US\$ million)	Capacity	Co-investors
2019	Eco Solar Project (Khanh Hoa province)	NA	4MWp (solar)	Infunde Development*
2019	Huc Wind Power (Quang Tri Province)	6 (development capital)*	143MW (wind)	Infunde Development*
2018	Ninh Thuan Solar Power	10.6	168MW (solar)	Sunseap
2017	Ninh Tay Project (Ninh Thuan Province)	N.A.	30MW (wind), 50MW (solar)	Infunde Development, TSV (a Vietnamese developer)
2012	Coc San hydro plant	7.5	29.7MW (hydro)	Nexif Energy, Colben Energy Holdings and two Vietnamese investors

Source: EY research.

Note: (*) Infunde Development is an exclusive developer for InfraCo Asia in Southeast Asia and we consider projects developed by Infunde Development as InfraCo Asia’s projects.

3.3 Cost and Technical Considerations

Levelised Cost of Electricity (LCOE)

Under favorable conditions, the LCOE of renewable energy such as solar PV, wind and hydro can have similar generation cost compared with traditional fossil fuels such as coal, oil and gas. This creates a strong foundation for renewable projects to continue to take off in Vietnam, especially when the LCOE for key renewables such as solar and wind is projected to decrease in the coming years.

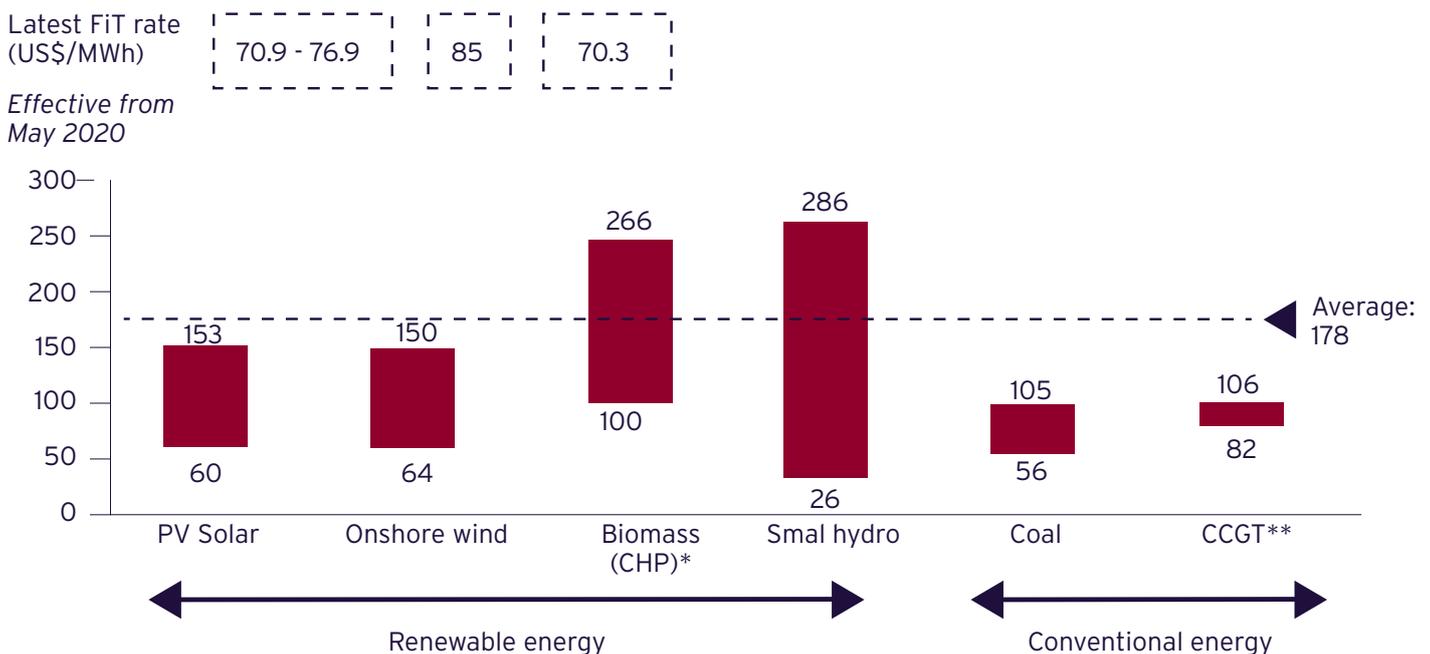
It should be noted that the current FiT rate for biomass projects is lower than the FiT rates for other types of technologies as well as biomass LCOE. This explains why there has not been much investment into this segment in the last few years.

Project cost

Due to the unavailability of actual project cost, data from several research companies and organisations have been used to triangulate the investment cost required for the power sector in Vietnam. Data across sources are quite consistent for solar and wind. Hydro and biomass see the biggest variances due to a wide range of data provided by IRENA and BNEF. It should be noted that data from IRENA is the global average data, so it may not reflect correctly the amount of investment required to produce electricity in Vietnam.

In October 2017, GreenID Vietnam, a non-profit organisation, published a report titled Analysis of future generation capacity scenarios for Vietnam. GreenID interviewed people and collected actual investment-cost related data from the renewable energy projects that are currently operating in Vietnam. This can be considered as an useful source of information regarding capital investment in the country.

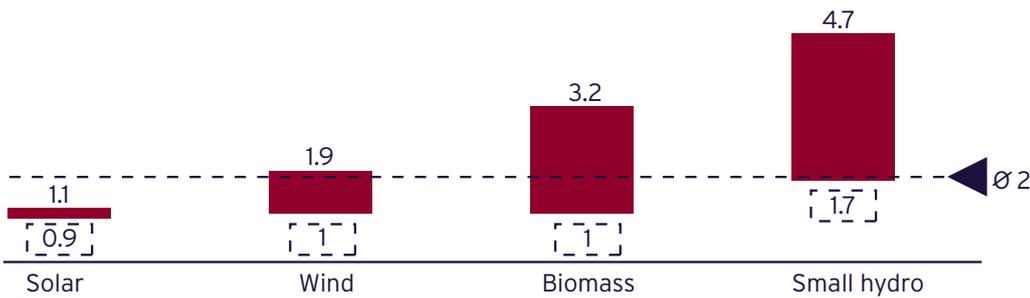
Figure 3.7: LCOE for Power Projects in Vietnam (US\$/MWh, 2019)



Source: EY research based on propriety databases.

Note: (*) CHP = Combined heat & power, (***) CCGT = Combined cycle gas turbine.

Figure 3.8: Capital Investment Required for Renewable Energy Projects in Vietnam (US\$ million, MW)



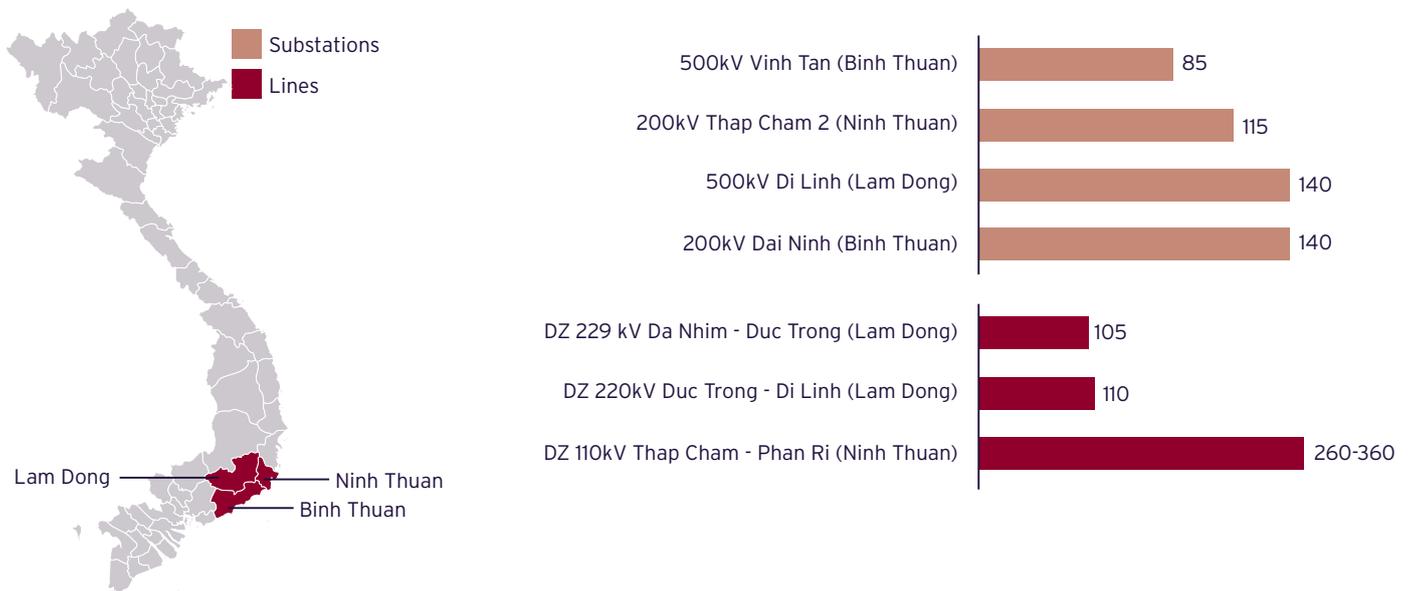
Source: EY research based on various sources.

Grid overload and curtailment

Concentration of investment in certain provinces has led to grid overload and therefore curtailment. As many as 81 solar projects that started operation in the second quarter of 2019 immediately overloaded power grids, especially in southeast coastal provinces of Binh Thuan and Ninh Thuan with the highest solar radiation in Vietnam. According to disclosures from EVN, the 110kV line in Ninh Thuan Province in June operated at 260%-360%

beyond safe capacity. Such grid overload has led to curtailment – the restriction of power delivery from power plants. With power transmission lines underdeveloped in many areas, EVN has often restricted power delivery from generators to prevent grid overload – in some cases to 60% of a plant’s full capacity – and only pays for the electricity fed to the grid, as stipulated by its current FiT scheme.¹

Figure 3.9: Safe Capacity Utilisation in Certain Substations and Lines (% , July 2019)



Sources: EVN, Vnexpress.

¹Vnexpress - New solar plants overload Vietnam national grid (Jul 2019). <https://e.vnexpress.net/infographics/economy/new-solar-plants-overload-vietnam-national-grid-3950184.html>.

3.4 Project Development Cycle

Procurement method

In general, procurement methods across all renewables technologies are quite similar in Vietnam, with basic principals promulgated in Circular No. 43/2013/TT-BCT issued in 2013.

Circular No. 43 stipulates that only projects included in NPDP or PPDP are permitted to be facilitated and connected to the national electricity system. For the remaining, investors will need to apply for inclusion of the project in the NPDP or PPDP.

As the Vietnamese government followed a fossil fuel-centric approach in RPDP7 2016-2030, the majority of projects in the pipeline listed in RPDP7

are thermal power plants. Only five biomass projects specified for the period of 2016-2018 were added as a proposal from investors prior to the issuance of RPDP7. All other annual government targets for renewables are displayed as a lump sum number without any detailed project pipeline being listed. At present, the current draft PDP8 does not provide a specific list of projects.

This implies that in most cases, investors will need to take initiatives to make a proposal for an investment in renewables in Vietnam. The government opened investment opportunities to all players, including foreign investors.

Table 3.8: Project Procurement Method in Power Sector for All Types of Technologies in Vietnam

Included in PDP or not	Appointment method	Legal basis
No	Bottom-up approach: Investors to prepare investment proposal and request for the inclusion of the project into RPDP (for small projects ≤50MW) or NPDP (for large projects >50MW).	Circular No. 43/2013/TT-BCT dated 31 December 2013 on content, sequence, procedures for formulation, assessment, approval and adjustment to electricity development planning:
Yes	Top-down approach – direct selection: Once the project gets included in PDP/NPDP/PPDP, investors submit the document to the Department of Planning and Investment (DPI) to request a decision on investment, for a project, which is roughly equivalent to a permit to develop the project. DPI submits the document to the PPC or the MPI depending on the project scale.	Article 14 outlines that only electrical projects within the list of projects in the newly approved plan are permitted to get connected to the national electricity system. Investment in any electricity generation and grid development project under planning not yet supplemented or adjusted shall not be facilitated.

Sources: MOIT - Regulations on content, sequence, procedures for formulation, assessment, approval and adjustment to electricity development planning (Circular No. 43/2013/TT-BCT) (Dec 2013), EY research.

<https://vanbanphapluat.co/circular-no-43-2013-tt-bct-assessment-approval-and-adjustment-to-electricity-development-planning>.

Following the expiry of the FiT scheme, MOIT has recommended a competitive bidding framework for solar power pricing going forward and is expected to put forward revised regulations in the first quarter of 2021. As per information on EVN website, EVN is not accepting new applications for rooftop solar projects in the interim.

Based on available information, MOIT and EVN are developing the framework for a pilot auction. EVN is tasked to find a suitable site. The pilot solar auction

plan is being supported by World Bank's Global Infrastructure Facility through a funding support of US\$1.5 million.¹ MOIT's options for a competitive framework currently under consideration range from competitive bidding for projects already in the masterplans, competitive bidding for substation connections to competitive bidding for specific projects.

¹"World Bank and GIF Support the Government of Vietnam to Mobilize Private Investment in Solar Pilot Auction Program", World Bank, 18 December 2019, <https://www.worldbank.org/en/news/press-release/2019/12/18/world-bank-and-gif-support-the-government-of-vietnam-to-mobilize-private-investment-in-solar-pilot-auction-program>.

Overview of renewables development project

The project development process is complex and a rapid entry into the Vietnam market may require partnering with an existing developer who has experience.

With the implementation of Decision No. 13/2020/QĐ-TTg in April 2020, EVN is now no longer the sole offtaker for all electricity generated in Vietnam. Decision No. 13 stipulates that eligible rooftop solar projects may sell portions of or all the power generated to other entities off-grid, opening the way for further competition in the electricity market.

The project development process up to PPA signing takes at least 6-8 months. Additionally, milestone payments are required to cover a number of costs, including but not limited to, legal and technical and financial advisory fees, land clearance costs, land compensation costs and local consultant.

The finalisation of the engineering, procurement and construction (EPC) and debt-financing arrangements to reach Financial Close may take at least an additional 3-6 months following PPA signing.

Current renewables projects are developed under the FiT scheme. With solar FiT and wind FiT being phased out by 2021, Vietnam is aiming to move to an auction-based system. The government plans to have the pilot auction launched in 2020. As of March 2020, the structure and process for auction in Vietnam is still being developed and will be clarified by MOIT during the period of 2020-2021.



Table 3.9: Timeline and Key Milestones for Projects under FiT Regime

Estimated timing	Month 1-3	Month 4-5	Month 6-8	
Milestone	PFS and Land Development Rights approval by province	MOIT approval of project	FS (Basic Design) approval by MOIT	PPA signing
Description	<ul style="list-style-type: none"> • Commencement of pre-feasibility study (PFS) • Report on land compensation • PFS completed* 	<ul style="list-style-type: none"> • Start of Feasibility study (FS) • Inclusion in the national power plan for projects over 50MW • Site swept for underground munitions • Land compensation process commences • Land compensation paid to government • Detailed discussion on PPA terms with EVN • EVN assess grid interconnection costs • Site design commences • Tender for EPC • Environmental permit application • Investment certificate (IC) issued • IC performance bond deposited 	<ul style="list-style-type: none"> • Site design to be completed • Environmental permit approval • EPC bid proposal due • Construction permit lodged • FS completed 	<ul style="list-style-type: none"> • Land compensation process complete • Construction permit approval received • PPA signed • EPC evaluated and term sheet agreed

In case the project has not been included in PDP.

(*) For biomass project, PFS is conducted after the project is added to the PDP.

Please note that the actual timeline may depend on a variety of factors, e.g., type of technology, the requirement for inclusion to PDP and land clearance process.

Source: EY research.

3.5 Ownership

Procurement method

In electricity generation, 100% foreign ownership is possible for all types of renewables, but a local partner will help de-risk the project, given the policies and lengthy procedures.

Even though some high-profile, foreign-invested thermal power projects have been implemented in cooperation with the government under the BOT umbrella, it does not appear that the government will offer this kind of treatment for renewable energy projects at large (except, perhaps, for very prominent ones). Therefore, it is expected that most projects will have to be carried out as independent power projects. The main implication of this is that there will be little room for investors to negotiate special terms or incentives or obtain government guarantees.

The transmission and distribution of electricity is not yet open to foreign investors. EVN and its subsidiaries still play a monopolistic role in these areas.

3.6 Financing

Source of financing

Domestic banks

Domestic banks have, in general, limited capacity to appraise credits for non-recourse project financing for greenfield renewable energy projects. They favor corporate finance solutions to borrowers who can demonstrate an existing asset base. Hence, most of the loans extended to renewable energy projects in the past couple of years required corporate support from the developers, at least until COD of the project. They also mostly provide financing in VND, the local currency. Interest rates in VND range from 9%-11% per annum and the tenure does not generally exceed 10 to 15 years.

There are examples of “on-lending”, whereby US\$ liquidity is provided by an international lender to a Vietnamese bank, which on-lends the US\$ liquidity to borrowers. In September 2019 and Japan International Cooperation Bank entered into a credit package of US\$200 million to finance capital for solar and wind power projects in Vietnam. The term of the loan is up to 14 years, in accordance with the demand for loans to invest in green energy projects in Vietnam.

It should be noted that credit institutions in Vietnam can only provide short term loans denominated in foreign currencies if the borrower has sufficient sources of foreign currency revenue for the loan (Circular No. 31/2016 by State bank of Vietnam). Renewable energy projects that only have sources of income in VND would not qualify for foreign loan scheme from local banks as per the circular.

International and bilateral financing institutions

The bankability issues associated with the PPA for renewable energy projects have been discouraging international banks from financing renewable energy projects in Vietnam. Please refer to Appendix 2 for an overview of the key risks associated with the PPA for international lenders.

The DPPA program being explored for solar PV projects (please refer to Section 3.1) may allow international lenders to participate in the financing of these projects that would rely on a offtake contract with a corporate client rather than a PPA with EVN.

Another important source of renewable energy financing to date (especially small hydropower) is the international and bilateral financing institutions. The financing mechanism for these institutions typically follows an “on-lending” modality, under which loan financing institutions lent to Ministry of Finance, which then on-lends the loans to SOEs, such as EVN. In most cases, Ministry of Finance will on-lend through commercial banks, which are then responsible for collecting repayments and bearing the associated risks. The modality of renewable energy financing from international and bilateral financing institutions usually requires a sovereign debt guarantee, which the government is now reluctant to provide due to the public debt ceiling.

A successful example of financing for renewables project from an international donor is World Bank’s Renewable Energy Development Project (REDP). REDP committed US\$200 million to private investors to finance 19 small hydropower projects (up to 30MW), with a total capacity of 300MW in Vietnam. There have been no payment defaults by the small hydropower projects. Commercial banks charged margins to cover their costs/risks in line with commercial practice and no payment defaults by private investors to the lending banks have been reported. In addition, as a result of the knowledge and capacity created by the REDP, participating banks subsequently financed an additional 1,500MW of private-sector-financed small hydropower projects outside of the REDP lending envelope.¹

Financial investors (equity funds, infrastructure funds, etc.)

There are several equity funds operating in the renewables sector in Vietnam such as Dragon Capital, Mekong Capital and VinaCapital.

The active international equity funds in Vietnam include Armstrong asset management, climate fund manager and ADB’s LEAP. For example, Armstrong asset management invested in the 40MW Dam Nai wind farm together with TSV, a Vietnamese partner.

Self-funding by large corporates and conglomerates

There are several large domestic corporates and conglomerates involved in the infrastructure and energy sectors, including REE, Bitexco, HAGL, Thanh Cong - TCC/GEC, Bim Group and Hung Loc Phat. In the past, these conglomerates have mostly focused their investments on small hydropower, but they are now looking more closely at investment opportunities in solar and wind. The boom in solar PV experienced in the last two years was mostly driven by domestic players and funded out of the equity and corporate loans provided by domestic banks.

EPC contractor financing

To circumvent the need for project financing, some EPC contractors have extended “Supplier Financing” solutions to solar PV projects, whereby payments under the EPC contract are due within 1-2 years following COD, allowing the developers to seek project financing once the asset is completed.

¹ World Bank report - Vietnam - maximizing finance for development in the energy sector (December 2018). <http://documents.worldbank.org/curated/en/290361547820276005/pdf/133788-WP-OUO-9-Vietnam-Energy-MFD-Report-ENG-for-printing.pdf>.

Green bonds

A green bond is similar to other types of bonds. However, the funds raised by the issuer are specifically for green projects, which are environment-friendly and priorities climate concerns. Renewable energy is one of the main sectors that stand to benefit from the issuance of green bonds.

The first green bond was issued by the European Investment Bank and the World Bank in 2007 to finance their environmental projects. However, Vietnam only recently entered this space in

February 2019 when the government's Decree 163 regulating the issuance of corporate bonds took effect. Decree 163 covers green bonds and creates more channels for capital mobilisation for environmental protection instead of solely relying on traditional financing from banks.

In January 2020, the first green bond in Vietnam was issued, guaranteed by Credit Guarantee and Investment Facility (CGIF), a trust fund of ADB, for a 150MW solar farm in Vietnam. The structure of this deal is summarised below.

Table 3.10: An Example of Bond Issued for a Solar Project

US\$140 million loan for a 150MW solar farm developed by a local player (January 2020)	
Project name	Hong Phong 1A (qualified for an FiT rate of US\$9.35 cents/kWh)
Project sponsor	Vietracimex
Lender	AD.B, Dutch Bank ING
Deal structure	<ul style="list-style-type: none"> VND bond provided by ADB's trust fund CGIF: five-year tranche sized at VND400 billion (US\$17.3 million) and a 15-year tranche sized at VND2,150 billion (US\$93 million) Amortising loan of US\$30 million with a seven-year tenor provided by ING
Debt-to-equity ratio	75:25
Roles	<ul style="list-style-type: none"> ING – sole international adviser Vietcombank Securities Company – bond issuance agent Freshfields Bruckhaus Deringer – legal Mott MacDonald – technical

Sources: IJGlobal, EY research.

<https://ijglobal.com/articles/145170/details-emerge-on-local-bond-loan-for-vietnam-solar>.

Table 3.11: An Example of Corporate Loan for a Solar Project

US\$37.8 million loan for a 50MW solar farm developed by a foreign developer (January 2020)	
Project name	Thanh Cong Industrial Zone 2 solar PV project (qualified for an FiT rate of US\$9.35 cents/kWh)
Project sponsor	Thanh Cong Group (a Vietnamese conglomerate, 10%), Gulf Energy Development (a Thai developer, 90%)
Lender	ADB A loan – US\$11.3 million
Deal structure	<ul style="list-style-type: none"> • ADB B loan – US\$18.9 million (funded by Bangkok Bank – US\$6.3 million, Siam Commercial Bank – US\$6.3 million, Standard Chartered Bank – US\$6.3 million) • Leading Asia's Private Infrastructure Fund (LEAP) – US\$7.6 million • The B loan's tenor is 15 years, while ADB has stretched the A loan's tenor to 17 years
Debt-to-equity ratio	73:27
Roles	<p>Sponsors' advisers on the project financing include:</p> <ul style="list-style-type: none"> • Baker McKenzie – legal • Artelia – construction technical • Alectris – operations and maintenance technical • Aon – insurance <p>Lenders' advisers include:</p> <ul style="list-style-type: none"> • Allen & Overy – legal • Poyry – technical • Environmental Resource Management (ERM) – environment • Marsh – insurance

Sources: IJGlobal, EY research.

<https://ijglobal.com/articles/145139/vietnam-solar-project-financing-signs>.

Challenges for renewables financing in Vietnam

Bankability of PPA

International investors (equity and debt) are keen to support energy projects in Vietnam and could serve an effective role in satisfying the demand for financing as the local capital market develops. However, financing for renewable energy remains an area of concern for developers. Limitations in MOIT's standard PPAs affect the bankability of projects with international lenders.

One of the main drivers determining whether a project is bankable (for international investors) is the risk allocation provided in the contractual documentation. The general perception is that the government is trying to reallocate certain risks within the control of the government to the private sector.

In detail, the standard PPA in Vietnam does not properly address several elements that may hinder investment in renewable energy in Vietnam: a lack of governmental guarantees or support to EVN as the sole offtaker, the existence in the PPA of a number of cases where the offtaker is not obliged to purchase power and a lack of provision for protecting the energy producer against changes in the taxation or applicable laws. (see Appendix 2 for more details of issues regarding the standard PPA in Vietnam).

Decision No. 13 allows rooftop generators to sell directly to non-EVN entities. This has significantly opened up the rooftop solar segment and resulted in a surge in rooftop solar capacity in 2020.

Under Circular 18, the MOIT has removed EVN's offtake obligation to purchase the entire power output generated from solar power projects. This is expected to create some contractual uncertainty for a developer noting there is no deemed capacity payments under the PPA and other risks related to curtailment in Vietnam.

Some local and international developers with renewable licenses and relationships with local authorities still manage to raise financing and technical support through local and foreign banks. However, to scale up and raise sufficient finance to achieve renewables targets, developing a bankable PPA is critical for the Vietnamese government.

Liquidity and capability of local banks

Many local banks are unfamiliar with energy projects, particularly renewable energy. This makes it difficult for them to assess credit risks and to price loans accordingly.

Domestic commercial and development banks provide local currency debt to projects in the electricity sector, typically on a corporate basis rather than a non-recourse project finance basis. Local bank financing is also relatively short term and expensive.

In addition to that, the single borrower limit of 15% of a bank's equity capital constrains lending for many of the banks. Lending is also constrained by sector concentration limits set by banks for prudential purposes.

Others

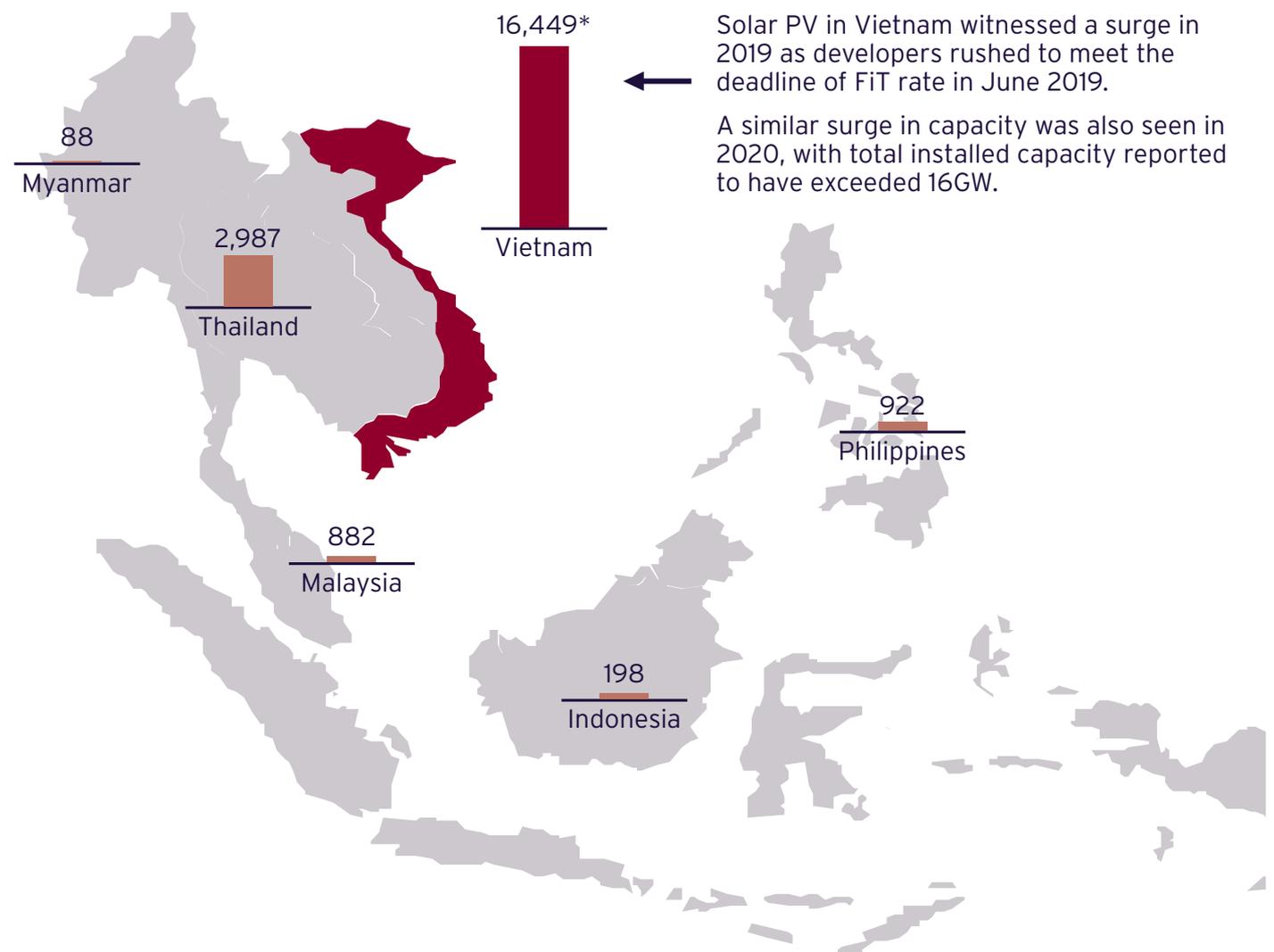
Each type of technology may face different challenges in looking for project financing. For example, the success of a biomass energy project is highly dependent on the availability of biomass supply and location of the plants. Therefore, ensuring a stable biomass supply will help increase the chances of securing loans from financial institutions.

4. Market Conditions for Solar Photovoltaics (PV) Development

Vietnam has expansive solar resources that could be used to successfully develop the solar energy sector, including both solar PV as well as solar thermal applications for hot water and commercial process heat generation. Current scientific estimates of the overall solar resources in Vietnam state an average of

4 kWh/m²/day to 5 kWh/m²/day in most regions of Southern and Central Vietnam. These solar irradiation levels for Vietnam are comparable to most countries in the region, including developed solar markets such as China and Thailand.

Figure 4.1 Installed Capacity for Utility-Scale and Rooftop Solar Power Generation in Southeast Asia (MW, 2019)

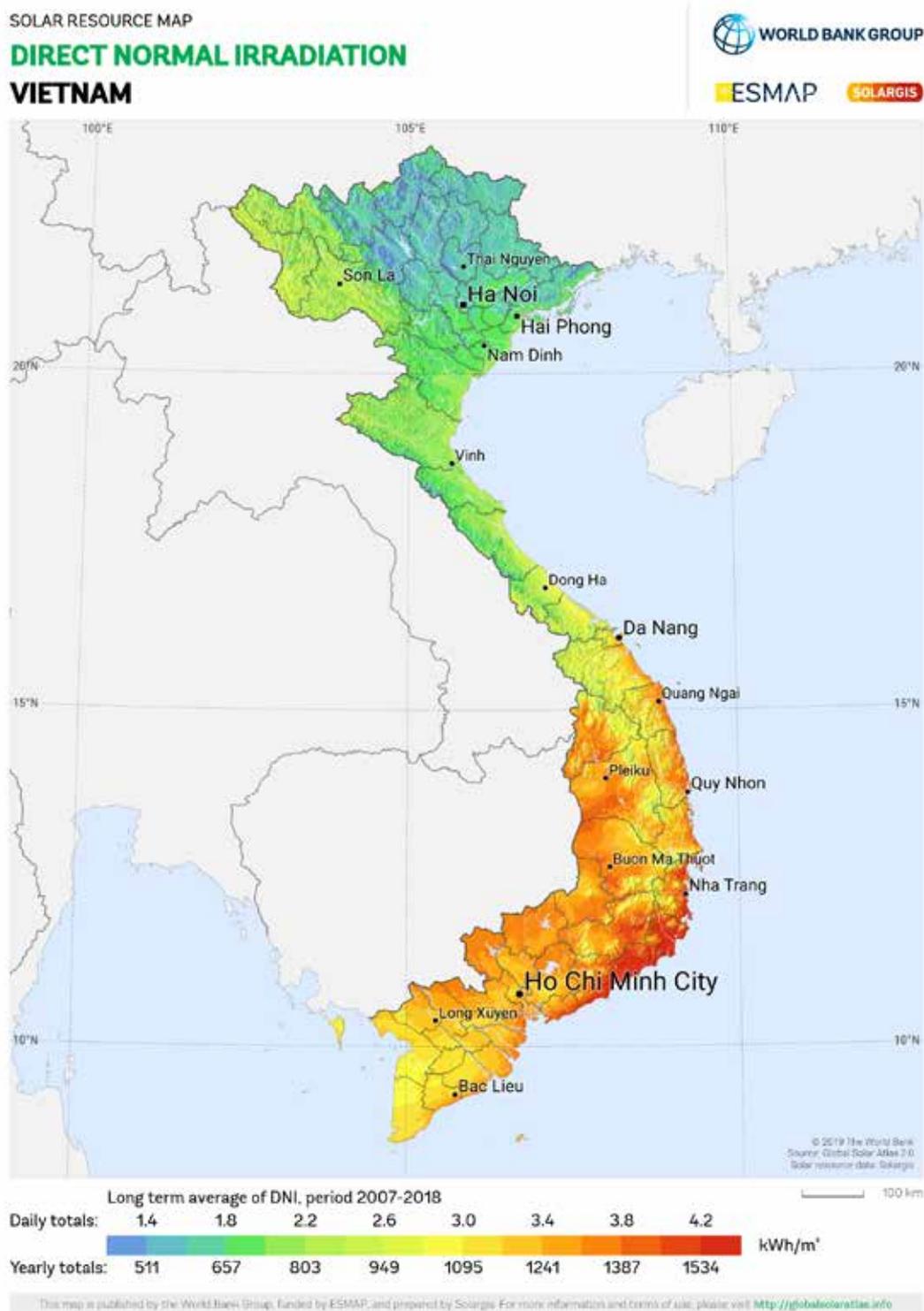


Source: IRENA (July 2020).

<https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020>.

Note: (*) Data for Vietnam represents installed capacity as of 2020.

Figure 4.2: Solar Irradiation Across Vietnam



Sources: Global Atlas © 2019 The World Bank, Global Solar Atlas 2.0.

Solar resource data: Solargis.

¹GIZ report - Framework assessment for the promotion of solar energy in Vietnam (May 2015). <http://gizenergy.org.vn/media/app/media/Framework%20Assessment%20for%20the%20Promotion%20of%20Solar%20Energy%20in%20Vietnam.pdf>.

4.1 Utility-Scale Solar PV

Overview

Solar power played almost no part in Vietnam's energy mix in 2017. To speed the technology's adoption, the government offered that year to pay suppliers a healthy FiT of US\$9.35 cents/kWh for projects reaching COD no later than June 2019. As a result, the first half of 2019 witnessed a surge in Vietnam's solar power market from less than

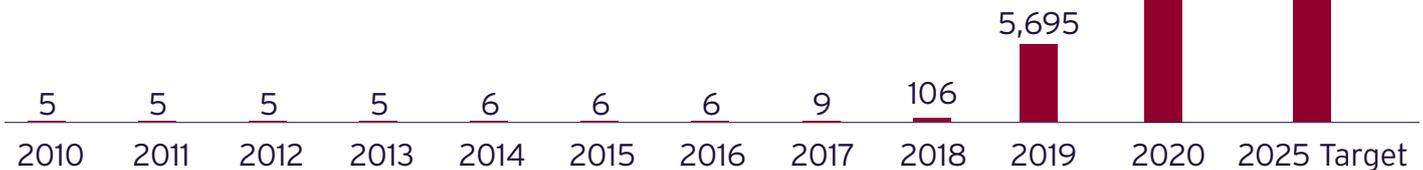
100MW in 2018 to 4.2GW as of June 2019 and 4.5GW for the whole year, making Vietnam the largest solar market in Southeast Asia.

By the end of 2020, installed capacity for utility-scale solar PV stood at 6,860MW. This represents an increase in 2.3GW of capacity, or an increase of 50% over 2019.

Figure 4.3: Solar PV Accumulated Installed Capacity by 2021 (MW)

In both 2019 and 2020, solar PV in Vietnam witnessed a surge in supply coming online to the grid. A similar surge in capacity was also seen in 2020, with total installed capacity reported to have exceeded 16GW.

About 9GW of these additions is reported to be from rooftop solar.



Source: Draft PDP8, IRENA 2019 Statistics, PV Tech.

<https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020>,

<https://www.pv-tech.org/news/vietnam-rooftop-solar-records-major-boom-as-more-than-9gw-installed-in-2020>

Figure 4.4: Number of Projects Added to National PDP and Number of Projects Waiting for Approval as of December 2019¹



Source: MOIT press release.

<https://www.evn.com.vn/d6/news/De-nang-luong-tai-cao-Viet-Nam-phat-trien-ben-vung-141-17-24715.aspx>.

As of December 2019, 135 solar farms with a combined capacity of 8.9GW were added to the national power plan, with already operational plants producing almost 4.5GW. Another 260 plants with 28.3GW total capacity are pending approval.²

The FiT scheme issued in 2017 for solar was already expired from July 2019. Therefore, under Official Letter No. 9608/BCT-DL dated 16 December 2019, the MOIT requested that the PPCs and EVN temporarily suspend proposing new applications for inclusion in the master plans under the FiT mechanism, until a new FiT mechanism has been issued.

Effective May 2020, Decision 13 provided new rules for encouraging solar power projects. Decision 13 provided new FiT rates for grid connected power projects. Under the new rules, projects who received in principle approval before 23 November 2019, and who achieved commercial operations from 1 July 2019 to 31 December 2020 are eligible to receive the new FiT. At the end of 2020, about 1.5GW of ground mounted solar projects is expected to have been added to the grid.³

¹Baker Mckenzie - Updates to Vietnam's Draft Decision on Solar Power (Jan 2020). <https://www.bakermckenzie.com/en/insight/publications/2020/01/updates-to-vietnam-draft-decision-on-solar-power>.

²The Vietnamese government does not disclose list of projects which have received approval for inclusion in the national power development plan. Therefore, latest data regarding solar power development in Vietnam is gathered both through official government data and local news article.

³PV Tech News - Vietnam rooftop solar records major boom as more than 9GW installed in 2020 (Jan 2021). <https://www.pv-tech.org/news/vietnam-rooftop-solar-records-major-boom-as-more-than-9gw-installed-in-2020#:~:text=Throughout%202020%20rooftop%20solar%20installations,upward%20in%20the%20past%20day>.

In February 2020, the Vietnamese government issued Decision No. 329/QD-BCT to set priority orders for approving the inclusion of new power and energy projects in the master plans. It is promulgated in this decision that wind, WTE and biomass will have higher priority over solar in upcoming years. The rationale behind this initiative is to maintain a balance in the country's energy mix, after witnessing an over-subscription of solar PV projects in 2019.

That means investors in solar PV may need to consider partnering with local developers who already got investment approvals for solar projects or acquiring existing solar plants to enter the Vietnam market in the short term.

Floating Solar PV (FSPV)

Potential of FSPV in Vietnam

Majority of utility-scale solar PV in Vietnam is ground-mounted. However, floating solar farms are fast gaining popularity. FSPV is being used increasingly to reduce the need for land (around 1.5 hectares of land are required for 1MWp of installed capacity in Vietnam) and to facilitate co-location with a hydropower plant, thereby improve dispatch of variable renewable energy.

Although the EPC costs of FSPV are currently estimated to be about 10-20% higher than ground-mounted plants owing to limited competition in equipment production and the need for expensive anchoring structures, these additional costs are partially offset by a 10-12% increase in energy production thanks to the cooling effect and reduction in dust caused by the surrounding water.¹

Vietnam has nine hydropower dams of a size greater than 100MW. Two of them, (Tri An Lake and Thac Mo) meet the requirements that solar irradiation should be at least 4 kWh/m²/day and no more than 20% of the reservoir should be covered. These two dams have a combined potential of 4.5GW.

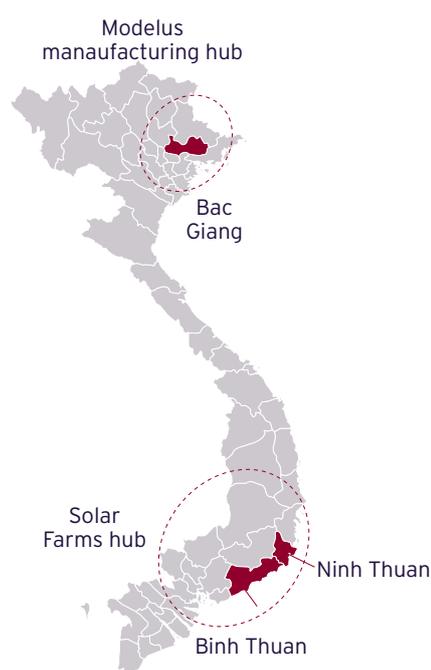
Installed capacity

In May 2019, 47.5MW Da Mi floating solar farm - the largest FSPV in Southeast Asia started operations.² Da Mi floating solar farm also received a loan of US\$37 million from the Asian Development Bank (ADB) and the Canadian Climate Fund. This is one of the first renewable projects that ADB has financed on a non-sovereign basis without the Government of Vietnam's guarantee. Da Mi floating solar farm is developed by DHD - a subsidiary of EVNGENCO 1.

Vietnam's manufacturing capability for modules

Big players from the United States and China, including First Solar, JA Solar Group, Trina Solar and Bowerway Group as well as local manufacturers such as SolarBK, are ramping up their manufacturing facilities in Vietnam to embrace the boom in solar PV projects across the country.

Bac Giang province in the North (located near the border with China) is currently home to at least 5.2GW of solar PV module manufacturing capacity. In 2019, 10GW of panels were manufactured in Vietnam, representing 8% of the global market.³



¹World Bank Group, ESMAP and SERIS - Where sun meets water: floating solar market report (Oct 2018). <https://www.worldbank.org/en/topic/energy/publication/where-sun-meets-water#:~:text=As%20of%20September%202018%2C%20that,at%20the%20end%20of%202017.>

²Vietnam Business Forum (Jul 2019). https://www.amchamvietnam.com/wp-content/uploads/2019/08/MVEP-2.0_finaL_ENG-9-Aug.pdf.

³International Energy Agency - Solar PV module shipments by country of origin, 2012-2019 (May 2020). [https://www.iea.org/data-and-statistics/charts/solar-pv-module-shipments-by-country-of-origin-2012-2019.](https://www.iea.org/data-and-statistics/charts/solar-pv-module-shipments-by-country-of-origin-2012-2019)

Regulatory treatment

Project in renewables in Vietnam are all eligible for investment incentives mentioned in the Prime Minister Decision "Approving the Vietnam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050" (Decision No. 2068 issued in 2015).

Both utility-scale solar PV and rooftop solar are governed by Decision No. 13/2020/QĐ-TTg on mechanism for encouragement of Development of Solar Power in Vietnam and Circular No. 16/2017/TT-BCT on project development and standardised PPAs for solar power projects.

Please refer to chapter: 3 for more details on regulations governing renewables market in Vietnam.

Pricing

On 6 April 2020, the government issued Decision No.13/2020/QĐ-TTg on mechanisms for the development of solar power projects in Vietnam. According to the new decision, new solar FiT rates differ by technology and are lower than the previous FiT. The new FiT rate is effective from 22 May 2020.

Table 4.1: Solar FiT

Year	Tariff rate (US\$ cents/kWh)		Tariff type	Required COD	Market size (US\$ million)
2017	All types	9.35	20 year FiT	30 June 2019	Regulations
2020	Floating solar	7.69	20 year FiT	31 December 2020	Decision No.13/2020/QĐ-TTg
	Ground-mounted solar	7.09			

Source: EY research.

 Expired  The new FiT which will be effective from 22 May 2020

It should be noted that this new FiT will only be applicable to solar farms:

- For which investment approvals have been issued before 23 November 2019
- Which will achieve their COD between 1 July 2019 until 31 December 2020

The MOIT has determined that there could be a total of 36 solar farms, with a total accumulated capacity of about 2,988.9MW, which would potentially be eligible for the new FiTs.

Regarding Ninh Thuan Province, the new decision continues recognising the special policy for this province by allowing limited solar power projects with the total accumulated capacity cap of 2,000MW achieving the actual COD before 1 January 2021 to be eligible for the extended FiT of US\$9.35 cents/kWh.

The decision leaves alternative tariff mechanisms for other solar projects that are unresolved. Many other projects are still pending final approval for inclusion in the master plans. Certain other solar projects are already in the master plans but failed to obtain investment approvals before 23 November 2019.

MOIT has proposed to the government that a definite transition to a competitive, open and transparent bidding mechanism should be formulated and implemented.

The World Bank is assisting the Vietnamese government in introducing an auction scheme for future ground-mounted solar project development. The auction is expected to be implemented in 2021.

PPA terms

PPA's duration is up to 20 years.

Model PPA for solar PV is specified in Circular No. 18/2020/TT-BCT effective 31 August 2020. Circular 18 replaces the earlier Circular No. 16/2017/TT-BCT.

Refer to chapter: 3 - Financing section and appendix 2 on issues with model PPA in Vietnam for more details.

Procurement method

Refer to chapter: 3 - Project development cycle section for more details.

Key decision makers

MOIT and the prime minister are the key decision makers for large projects with installed capacity of more than 50MW.

PPCs are the key decision makers for small projects with installed capacity from 50MW and below.

The project developer is the key decision maker for all equipment and services procured during the project development period.

Refer to chapter: 3 - Project development cycle section for more details.

Land and permitting

Because Vietnam is a country of tropical lowlands, hills and densely forested highlands with level land covering no more than 20% of its geography, there are competing demands for land that impact solar PV deployment. Land usage is presented in the land master plan led by the provinces. Currently, the land master plan is not synchronised with the generation master plan. As the deployment of solar is land-intensive, land availability and land planning are challenging when developing solar generation.

In addition to that, current regulation stipulates that a long-term land-use area must not exceed 1.2 ha/1MWp.

Financing

The equity ratio of grid-connected solar power projects must not be less than 20% of the total investment.

The current PPA terms reduce the possibility of IPPs to access US\$ project financing as international lenders have until now not been comfortable with the risk allocation under the PPA.

Local banks are generally comfortable with the PPA and EVN's risks and are willing to finance the solar PV projects. However, currently, local banks are not providing finance to solar PV projects under a non-recourse project financing scheme and typically require a completion guarantee from the developer.

This has limited interest among international IPPs developers. A large proportion of the 4.5GW of installed solar capacity is owned by local developers and was financed out of equity and or corporate loans.

Refer to chapter: 3 - Financing section for more details.

Foreign ownership restrictions

No

Local content requirements

No

Major foreign developers or equipment and service providers

Regional companies (from Thailand, Philippines and China) are very active in the Vietnam's solar market.

Developers include: B. Grimm, Super Energy, Bright Green Power, Gulf International Holding, Sermsang Power, Sunseap and AC Energy.

EPC contractors include: Power Construction Corporation of China (Hong Phong 1 A and 1 B project), JGC Corporation (Krong Pa project, TTC 1 and 2 projects - total 190MW), Waaree Energies (49.5MW project in Khanh Hoa province).

Solar module providers include: Jinko Solar (supplied 351MW of solar modules to Hong Phong 1A and 1B projects), Sharp Energy Solutions (49MW project in Quang Ngai province, 48MW in Hue province, 98MW projects in Binh Thuan province and Long An province).

Examples of current and upcoming projects

Table 4.2 : Financing Structure for Current Projects

Transaction name	Finance type	Investment (US\$ million)	Sponsors	SPV	Financial close date	Debt or equity
Thuan Nam	Undisclosed	518.6	Trung Nam Group	Trung Nam Group	4/1/2020	-
Hong Phong 1A Solar PV Plant (195MW) additional facility 2020	Project finance	187	Vietracimex	Hong Phong 1	1/24/2020	75:25
Acquisition of 99.94% in Sungrow Power's Vietnamese Solar Portfolio (60MW)	Corporate finance	60.6	Bright Green Power	Tri Viet Hoa Binh (TVHB) and Bach Khoa A Chau Hoa Binh (BKHB)	2/4/2020	50:50
Da Mi Floating Solar PV Plant (47.5MW)	Public sector finance	52.86	EVN	Da Nhim-Ham Thuan-Da Mi Hydro Power (DHD) Joint Stock Company	10/1/2019	70:30
TTCIZ-2 Solar PV Plant (50MW)	Project finance	51.5	TTC Group, Gulf Energy Development	Gulf Tay Ninh 2 Joint Stock Company (TTC02)	1/22/2020	73:27
Constant Energy Singapore (150MW) Additional Facility	Project finance	15	Constant Energy, Olympus Capital Asia	Constant Energy Singapore Holding	1/31/2020	100:0

Sources: Institute for Energy Economics and Financial Analysis (IEFA), IJGlobal, EY research.

The table below highlights some opportunities for UK companies. This list is non-exhaustive. Please refer to chapter: 9 for further details and insight.

Table 4.3: Upcoming Solar Projects (As of January 2021)*

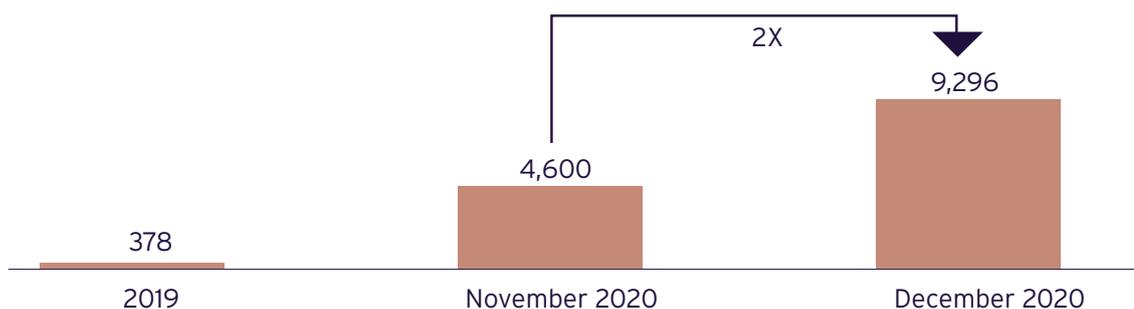
Project name	Location	Capacity (MW)	Investor	SPV	Status	Year online
B.Grimm Viet Nam Solar Power Project (Phu Yen Project)	Phu Yen	257	B.Grimm Renewable Power 2	Phu Yen TTP Joint Stock Company (Phu Yen JSC)	Announced	-
Genco3 Ninh Thuan Solar PV Park	Ninh Thuan	350	EVN Power Generation Corporation 3	-	Announced	2021
Ham Thuan Floating Solar PV Park	Binh Thuan	300	EVN	Da Nhim-Ham Thuan-Da Mi Hydropower JSC	Permitting	2021
Xuan Thien Thuan Solar PV Park	Ninh Thuan	240	Xuan Thien Co. Ltd.	-	Under construction	2020
Hoang Son Solar PV Project	Ninh Thuan	62	My Son I Solar Power Co. Ltd.	-	Under construction	2020

Sources: GlobalData, IJGlobal, Inframation, EY research.

Note (*): As the current FiT scheme for solar tariffs has expired, there are few projects in the pipeline at present. It is expected that once the rules for auction are revealed, the pipeline will be re-activated

4.2 Rooftop Solar

Figure 4.5: Actual Installed Capacity - Rooftop Solar (MWp)



Sources: BNEF, IEEFA, MOIT, EY research.

<https://about.bnef.com/blog/vietnam-was-likely-the-third-largest-solar-market-in-2020/>.

<https://ieefa.org/ieefa-vietnams-extraordinary-rooftop-solar-success-deals-another-blow-to-the-remaining-coal-pipeline/>.

MOIT has launched a program incentivising the development of rooftop solar power in Vietnam (approved by the MOIT under Decision No. 2023/QD-BCT on 5 July 2019) to encourage organisations and individuals to invest in rooftop solar power with the target of 100,000 systems (1000MWp) to be installed and put into operation by the end of 2025.

Under Decision 13, effective 22 May 2020, rooftop solar projects are considered as projects which are directly or indirectly connected to the grid and have a capacity of 1MW or less and with a voltage of 35kV or less. Decision 13 also set the FiT rate for rooftop solar as VND 1,943 per kWh (equivalent to US\$ 8.38 cents/kWh). This new FiT is proposed for rooftop solar systems which achieve the COD between 1 July 2019 and 31 December 2020.

According to the MOIT's report, there were 19,378 rooftop solar systems, with a total capacity of 318MWp installed nationwide by the end of November 2019, with a focus on the southern region of Vietnam. As of January 2021, there are 101,000 rooftop solar systems installed, with a total capacity of 9,296MWp¹.

Post expiry of the FiT, it is expected that a competitive bidding scheme will be introduced. The purchase price of electricity from rooftop solar systems achieving COD post 2021 has not yet been set. Pending clarify, it is understood that EVN is not accepting requests for connection and signing PPAs for rooftop solar projects.²

Given that the tariff for future purchases has not been announced, the draft PDP8 does not set a specific target for rooftop solar capacity by 2025. The draft PDP8 forecasts modest additions in solar capacity (utility scale and rooftop) until 2025.

Regulatory treatment for rooftop solar

Projects in renewables in Vietnam receive investment incentives mentioned in the Prime Minister Decision Approving Vietnam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050 (Decision No. 2068 issued in 2015). Rooftop projects are also governed by Circular 18 (Circular No. 18/2020/TT-BCT) and Decision 13 (Decision No. 13/2020/QD-TTg), which have replaced earlier decisions.

Decision 13 allowed energy generated from rooftop solar systems to be sold to other entities off grid, thus making EVN no longer the sole electricity offtaker. The move is expected to offer greater flexibility for rooftop solar developers and also shows the governments commitment to develop a more competitive electricity market.

Please refer to chapter: 3 for more details on regulations governing renewables market in Vietnam.

¹BNEF - Vietnam Was Likely the Third-Largest Solar Market in 2020 (Jan 2021). <https://about.bnef.com/blog/vietnam-was-likely-the-third-largest-solar-market-in-2020/>.

²EVN - Press release on rooftop solar PV development after 31 December 2020 (Dec 2020). <https://en.evn.com.vn/d6/news/Press-release-on-rooftop-solar-PV-development-after-31-December-2020-66-142-2111.aspx>.

Pricing

Rooftop solar projects not exceeding 1MW which achieve COD between 1 July 2019 and 31 December 2020 would be eligible for FiT rate of VND 1.943 per kWh (USD\$8.38 cents/kWh). The tariff post December 2020 has not yet been announced.

Procurement method

Procurement is done on a business-to-consumer or business-to-business basis. Under current regulations, all individuals and organisations have the right to participate in the development of the solar power system. For projects with a capacity of less than 1MW organisations and individuals only need to register the grid with the provincial electricity company (under EVN). The content of the application includes the expected electrical capacity, specifications of solar cells and parameters of the grid-connected.

After completing the application, EVN will go to the venues to check and decide whether the venue and the installation of a rooftop solar system are qualified or not to sign a contract to purchase electricity. EVN will provide and help consumers install two-way electric meters for net-metering.

Key decision makers

MOIT, EVN are PPCs are the key decision makers for the installation of rooftop solar systems.

Financing

In July 2019, the MOIT officially launched the program to promote the development of rooftop solar power in Vietnam. Individuals and organisations can get financial support of VND3 million (US\$129) per 1 kWp and up to VND9 million (US\$388) to install rooftop solar systems. The program is active until 2021.

EVN will set-up a software system, ensuring that all people who installed the solar power system and have signed the PPA will be invoiced, thereby receiving support money.

Vietnamese banks also provide loans for the installation of rooftop solar systems. For example, by June 2019, HD Bank has granted loans for multiple rooftop solar projects, with a total amount up to VND280 billion (US\$12 million).¹

Foreign Ownership Restrictions

No

Local Content Requirements

No

Estimated market size

For rooftop solar, a large increase in capacity addition has been seen in 2020 due to the favourable FiT rate with the current installed capacity at 9,583 MW. However, there is some ambiguity on the FiT rate for future projects.

Based on the draft PDP8, the combined additions for utility-scale and rooftop solar is expected to be 600MW by 2025.

Assumptions for project costs come from Bloomberg New Energy Finance (BNEF) estimates for the Vietnam market in the second half of 2019. Project cost composition is triangulated from different sources, including IRENA and Tetra Tech.

Assumptions for a foreign and domestic share of the market come from estimated involvement of foreign companies in each component of the supply chain.

¹Ho Chi Minh Development Joint Stock Commercial Bank - Introduction of HDBank. http://vepg.vn/wp-content/uploads/2019/09/08_Ch%C6%B0%C6%A1ng-tr%C3%ACnh-cho-vay-v%E1%BB%91n-d%E1%BB%B1-%C3%A1n-%C4%91i%E1%BB%87n-m%E1%BA%B7t-tr%E1%BB%9D1_HD-Bank_EN.pdf.

Table 4.4: Estimated Market Size - Utility-Scale and Rooftop Solar PV (2021-2025)

Technology	2020 installed capacity (MW)	2025 installed capacity (MW)	Additions (2021-2025)	Project cost (US\$ million/MW)	Market size (US\$ million)
Solar PV	16,640	17,240	600	1,040	624

Sources: BNEF, Draft PDP8, PV Tech, EY research.

Table 4.5: Supply Chain and Financing Analysis of Utility-Scale and Rooftop Solar PV (%)

	Share in cost (%)	Domestic (%)*	Foreign (%)
Project developer or sponsor	10%	8%	2%
Consulting engineering	5%	4%	1%
Engineering design	5%	3%	3%
Major electromechanical equipment	60%	15%	45%
Balance of system equipment (BOS)	15%	8%	8%
Construction	5%	5%	0%
Total	100%	42%	58%

Sources: Tetra Tech, IRENA, EY research.

Note: (*) Assume that local content only accounts for 25% in major electromechanical equipment, 50% in engineering design and BOS, 80% in consulting engineering, project developer or sponsor and 100% of construction

Table 4.6: Supply Chain and Financing Market Value Analysis of Utility-Scale and Rooftop Solar PV (US\$ million)

	Estimated market size	Domestic share	Foreign share
Project developer or sponsor	62	50	12
Consulting engineering	31	25	6
Engineering design	31	19	19
Major electromechanical equipment	374	94	281
Balance of system equipment	94	50	50
Construction	31	31	0
Total	624	262	362

Sources: Tetra Tech, IRENA, EY research.

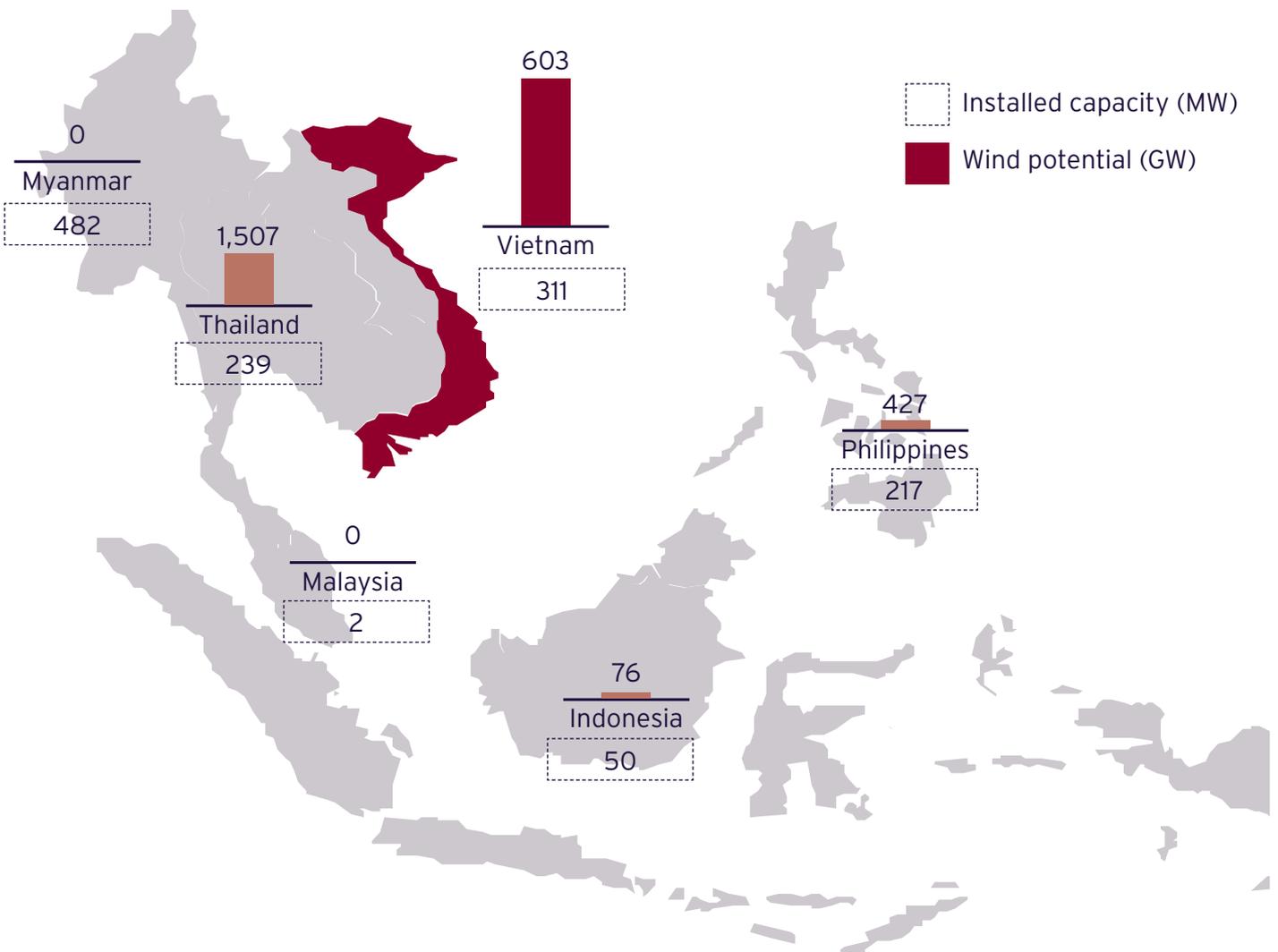
Note: (*) Assume that local content only accounts for 25% in major electromechanical equipment, 50% in engineering design and BOS, 80% in consulting engineering, project developer or sponsor and 100% of construction

5. Market Conditions for Wind Power Development

Located in the monsoon climate zone and shaped by its 3,000km long coastline, Vietnam has a lot of potentials to develop wind power generation. In the PDD8, the Vietnamese government has set a target for wind power generation capacity to be 11,320MW in 2025 and 16,010MW in 2030.

The current FiT scheme with preferential tariff rates of US\$8.5 cents/kWh to US\$9.8 cents/kWh will expire in November 2020. This may create a ramp-up in wind installed capacity by the cut-off date; similar to what happened with solar PV in the first half of 2019.

Figure 5.1: Installed Capacity and Potential Capacity for Wind Power Generation in Southeast Asia (2019)



Source: IRENA – Renewable Energy Statistics (Jul 2020), PDP8, USAID-NREL (Jun 2019).
<https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020>.
<https://www.nrel.gov/docs/fy19osti/71814.pdf>.

Note (*): Data for Vietnam represents installed capacity as of 2020.

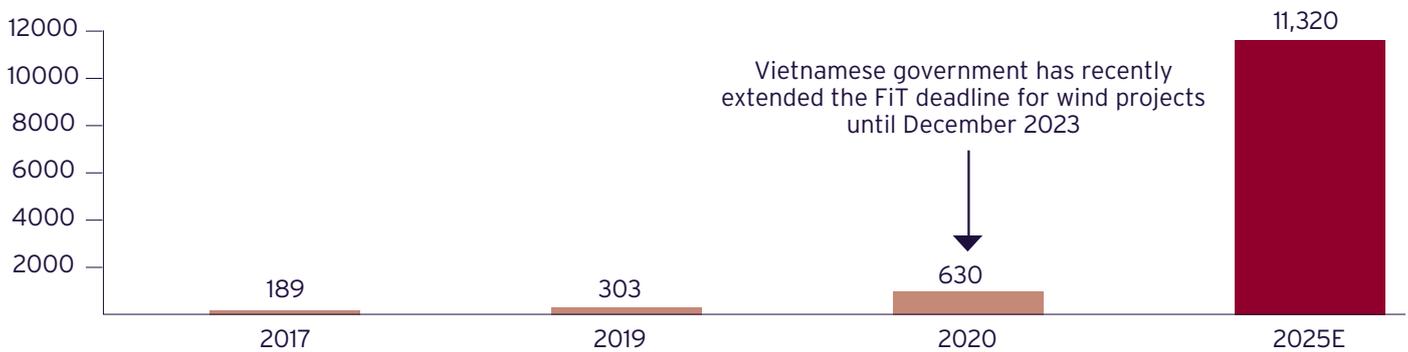
5.1 Onshore Wind

The draft PDP8 has articulated a desire to reduce the reliance on thermal sources and renewable energy, particularly wind, to play an important role in energy generation compared to the RPDP7. Wind power will account for 12% of the total installed capacity in 2025 and 13% of the total installed capacity in 2030.

The government has set a target of 11,300MW for onshore and nearshore wind by 2025 from the ~630MW capacity in 2020.

According to a report from the Institute of Energy, as of October 2019, there are 60 projects with 4,600MW already added to the national PDP and 77 proposed projects, with a total capacity of 10,300MW are waiting for the government's approval.¹ As of June 2020, the Vietnamese government has formally approved about 7GW of new wind projects translating to an expected pipeline of nearly 12GW by 2025. As per news reports, about 91 onshore and offshore wind projects have been approved. The approved 12GW will be used as inputs for market sizing calculations with the assumption that all approved projects will start operation by 2025.

Figure 5.2: Installed Capacity and Target by 2025 - Onshore and Nearshore Wind (MW)



Sources: Institute of Energy, MOIT - *Where next for renewable energy?* (Sep 2019), EY research.

<https://moit.gov.vn/web/web-portal-ministry-of-industry-and-trade/tin-chi-tiet/-/chi-tiet/where-next-for-renewable-energy--16729-1305.html>

<http://www.ievn.com.vn/tin-tuc/Cac-Muc-tieu-Phat-trien-Ben-vung-Cap-nhat-Tinh-hinh-Dien-Gio-tai-Viet-Nam-thang-102019-1-1396.aspx>

¹ Viet Nang Luong (Institute of Energy) - Sustainable Development Goals - Updated Wind Power Situation in Vietnam. <http://www.ievn.com.vn/tin-tuc/Cac-Muc-tieu-Phat-trien-Ben-vung-Cap-nhat-Tinh-hinh-Dien-Gio-tai-Viet-Nam-thang-102019-1-1396.aspx>.

Regulatory treatment

Projects in renewables in Vietnam are all eligible for investment incentives mentioned in the Prime Minister Decision *Approving the Vietnam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050* (Decision No. 2068 issued in 2015).

Wind projects are also governed by Circular No. 02/2019/TT-BCT on project development and standardised PPAs for wind power projects.

Project applications by investors must include one year of wind measurement data. The domestic wind energy supply chain is limited and the development cycle is likely to be lengthy with long-lead times for several equipment and supplies.

Please refer to chapter 3 for more details on regulations governing renewables market in Vietnam.

Pricing

Current FiT applies to projects that start commercial operation by 1 November 2021 and for an operational term of 20 years. In October 2020, the MOIT instructed provinces and cities nationwide to temporarily stop accepting proposals for new wind power projects due to concerns of over-expansion. Although the FiT for wind was introduced in 2011, it was generally considered not attractive enough except for the best wind sites and only 303MW of wind generation is operational as of 2019. It is anticipated that the revised and increased FiT introduced in 2018 will now spur the development of the market.

For wind power projects set to be in operation before November 1 2021, Vietnam's current FITs is fixed at US\$8.5 cents/kWh for onshore and US\$9.8 cents/kWh for offshore wind.

Table 5.1: Wind FiT

Year	Tariff rate (US\$ cents/kWh)		Tariff type	Required COD	Regulations
2011	All types	7.8	20 year FiT	30 June 2019	Decision No. 37/2011/QD-TTg
2018	Onshore	8.5	20 year FiT	1 November 2021	Decision No. 39/2018/QD-TTg*
	Offshore**	9.8			
2020	Onshore	7.02	20 year FiT	Nov 21- Dec 22	Document No. 2491/BCT-DL Document No.693/TTg-CN Document No.8159/BCT-DL
	Onshore	6.81		Jan - Dec 23	
	Offshore**	8.47		Nov 21- Dec 22	
	Offshore**	8.21		Jan - Dec 23	

Source: EY research

Note: (*) Projects which started operations before the issuance of Decision No. 39/2018/QD-TTg benefit from the increased tariff for the remaining term of their signed PPA. (**) Near-shore wind projects such as Cong Ly Wind Project in Bac Lieu Province, Mekong Wind in Ben Tre Province are receiving FiT for Offshore at US\$9.8 cents/kWh

PPA terms

Model PPA for wind PV is specified in Circular No. 02/2019/TT-BCT.

Refer to chapter 3: Financing section and appendix 2 on issues with model PPA in Vietnam for more details.

Procurement method

Refer to chapter 3: Project development cycle section for more details.

Key decision makers

MOIT and the Prime Minister are the key decision makers for large projects with installed capacity of more than 50MW.

PPCs are the key decision makers for small projects with installed capacity from 50MW and below.

The project developer is the key decision maker for all equipment and services procured during the project development period.

Refer to chapter 3: Project development cycle section for more details.

Land and permitting

The land clearance and compensation task might take years with a high risk

of increasing costs. Developing a near-shore project can be an option to avoid the complexity of land clearance.

The rate of land used with the term of wind power projects shall not exceed 0.5 ha/MW. The temporary land-use area of wind power projects is less than 0.7 ha/MW)

Financing

Wind energy projects typically require significant capital investment and as a result, are often financed with a significant portion of debt capital.

Similar to the financing constraints facing the solar market, the current PPA terms reduce the possibility of IPPs to access US\$ project financing as international lenders have not been comfortable with the risk allocation under the PPA.

Local banks are generally comfortable with the PPA and EVN's risks and are willing to finance wind projects. However, currently, local banks are not providing finance to wind projects under a non-recourse project financing scheme and typically require a completion guarantee from the developer.

This has so far limited the interest among international wind IPPs developers. Domestic developers have focused on the solar market, which is considered easier to develop than wind.

Foreign ownership restrictions

No

Local content requirements

No

Major foreign developers or equipment and service providers

Developers include: Aboitiz Power, Gulf International, Super Energy, EAB, ST International and Banpu Power.

EPC contractors include: Vestas (50MW Tra Vinh Intertidal project), Pöyry (90MW wind project in Soc Trang province), Modern Energy Management (150MW intertidal wind project).

Wind turbine suppliers include: Vestas, GE, Fuhrländer and Siemens Gamesa.

Estimated market size

Inputs for capacity additions of onshore wind projects come from MOIT and Institute of Energy's disclosures.¹ As per data from MOIT, 2021, MOIT has added 78 wind projects to the PDP with a total capacity of 4,800MW, 11 projects are operational with a total capacity of 377MW and 31 projects have signed PPA with a total capacity of 1,662MW and are expected to reach COD by 2021.² In addition, 91 projects with a total capacity of 7GW have also been approved. These planned capacity additions have been used as inputs for the market assessment. Assumptions for project costs come from BNEF's estimates for the Vietnam market in the second half of 2019. Project cost composition is triangulated from different sources, including IRENA and Tetra Tech.

Assumptions for a foreign and domestic share of the market come from the estimated involvement of foreign companies in each component of the supply chain.

Table 5.2: Estimated Market Size - Onshore Wind (2021-2025)

Technology	2020 installed capacity (MW)	2025 installed capacity (MW)	Additions (2021-2025)	Project cost (US\$ million/MW)	Market size (US\$ million)
Solar PV	630	11,320	10,690	1.815	19,402

Sources: BNEF, EY research.

¹MOIT - Where next for renewable energy? (Sep 2019). <http://moit.gov.vn/web/web-portal-ministry-of-industry-and-trade/tin-chi-tiet/-/chi-tiet/where-next-for-renewable-energy--16729-1305.html>, <http://www.ievn.com.vn/tin-tuc/Cac-Muc-tieu-Phat-trien-Ben-vung-Cap-nhat-Tinh-hinh-Dien-Gio-tai-Viet-Nam-thang-10-2019-1-1396.aspx>.

²MOIT - On request and proposal for extending the Feed-in tariffs mechanism for wind power in Decision No. 39 (Document No. 2491/BCT-DL) (Apr 2020). http://vepg.vn/wp-content/uploads/2020/05/2491_BCT_DL_Wind_FIT_Extension.pdf

Table 5.3: Supply Chain and Financing Analysis of Onshore Wind (%)

	Share in cost (%)	Domestic (%)*	Foreign (%)
Project developer or sponsor	10%	6%	4%
Development cost	3%	2%	1%
Balance of plant (transformer, transmission line, etc.)	22%	4%	18%
Major electromechanical equipment (wind turbines and blades)	45%	5%	41%
Towers	10%	10%	0%
Construction	10%	10%	0%
Total	100%	37%	63%

Sources: Tetra Tech, IRENA, EY research.

Note: (*) Assume that local content accounts for 10% of Major electromechanical equipment, 20% of Balance of plant, 60% of project developer or sponsor, 80% of development cost and 100% for Towers and Construction

Table 5.4: Supply Chain and Financing Market Value Analysis of Onshore Wind (US\$ million)

	Share in cost (%)	Domestic (%)*	Foreign (%)
Project developer or sponsor	1,940	1,164	776
Development cost	582	466	116
Balance of plant (transformer, transmission line, etc.)	4,269	854	3,415
Major electromechanical equipment (wind turbine and blades)	8,731	873	7,858
Towers	1,940	1,940	0
Construction	1,940	1,940	0
Total	19,402	7,237	12,165

Sources: BNEF, Tetra Tech, IRENA, EY research.

Projects in operations

Table 5.5: Onshore Wind Projects in Operations (As of January 2021)

No.	Project name	Province	Investor	SPV	Capacity (MW)	Investment (US\$ million)	COD	Note
1	Binh Thuan wind power plant	Binh Thuan	Vietnam Renewable Energy Joint Stock Company	Vietnam Renewable Energy JSC	60	Undisclosed	2009	Fuhrlander AG turbines
2	Tuy Phong	Binh Thuan	REVN	Thuan Binh Wind Power JSC	30	45	2011	Fuhrländer turbines
3	Phu Quy	Binh Thuan	PV Power	-	6	15	Jan 2013	N.A
4	Bac Lieu wind farm	Bac Lieu	Cong Ly Ltd	Cong Ly Construction-Trade-Tourism Ltd	99.2	95	2013/2016	GE wind turbines
5	Phu Lac	Binh Thuan	Thuan Binh Wind Power JSC	Thuan Binh Wind Power JSC	24	40	Nov 2016	Vestas turbines
6	Huong Linh 2	Quang Tri	Tan Hoan Cau	Tan Hoan Cau JSC	30	63	2017	Vestas turbines
7	Dam Nai (phase I,II)*	Ninh Thuan	SN Power AS	-	39.4	75	2018	Gamesa turbines
8	Tay Nguyen (Central Highland) wind farm	Dak Lak	HBRE Wind Power Solution Company (HBRE)	-	28.8	77.7	2019	GE turbines
9	Mui Dinh	Ninh Thuan	BRE Singapore Pte Ltd	-	37.6	57	Apr 2019	Enercon turbines
10	Trung Nam wind farm	Ninh Thuan	Trung Nam Group	-	129	172.58	2020	-
11	Quang Tri 1 and 2 wind farm	Quang Tri	Quang Tri TNC Joint Stock Company	Quang Tri TNC JSC	60	114.8	2020	Vestas turbines

Total:
544MW

Sources: GlobalData, GWEC, GIZ, Inframation, IJGlobal, Reuters, MOIT Letter No.: 2491/BCT-DL, EY research.



Upcoming projects

The table below highlights some opportunities for UK companies. This list is non-exhaustive. Please refer to chapter 9 for further details and insight.

Table 5.6: Upcoming Wind Projects (As of January 2021)

Project name	Location	Capacity (MW)	Investor	SPV	Status	Year online
Undisclosed	Offshore (Binh Dinh)	2,000 (over 3 phases)	PNE Group	-	Announced	2024
Nexif Ben Tre Onshore Wind Farm	Ben Tre	80	Nexif and RH International (Singapore) Corporation	-	Announced	2022
AIT/Mainstream Ben Tre Offshore Wind Farm	Ben Tre	500 (over 2 phases)	Mainstream Renewable Power and Advance Information Technologies (AIT)	-	Announced	2023
La Gan Offshore Wind Farm	Binh Thuan	3,500 (over 2 phases)	Copenhagen Infrastructure Partners (CIP), Asia Petroleum Energy (Asiapetro) and Novasia Energy	La Gan Wind Power Development Corporation	Announced	2020 - 2030
Phu Cuong Wind Farm	Near-shore (Soc Trang)	800	GE Financial Services; Mainstream Renewable Power Ltd.; Phu Cuong Group	-	Permitting	-
Mekong Wind Farm	Near-shore (Ben Tre)	310	Gulf Energy Development PCL; Thanh Cong Group	Mekong Wind Power JSC	Permitting	2021
Pu Chu	Gia Lai	200	TSV-The Blue Circle (JV)	TSV JSC	Announced	2020
Cu' An	Gia Lai	200	TSV-The Blue Circle (JV)	TSV JSC	Announced	2020
Bai Dinh Wind Project	Ninh Binh	180	Tan Hoan Cau Corp	-	Permitting	2021
Ben Tre Wind Farm	Ben Tre	125	Marshal Global Renewable Power Pvt. Ltd.	-	Permitting	2021
Hanbanram Wind Project	Ninh Thuan	117	LandVille Energy Co. Ltd.	-	Permitting	2020
Ben Tre 7	Ben Tre	110	Ecotech Vietnam Technology Investment and Trading	-	Permitting	2020
Kong Yang	Gia Lai	103	TSV-The Blue Circle (JV)	TSV JSC	Announced	2020

Sources: GlobalData, IJGlobal, Inframation, EY research.

5.2 Offshore Wind

As of March 2020, there is no offshore wind project officially included in Vietnam's power development plan (near-shore projects such as Cong Ly Wind in Bac Lieu Province or Mekong Wind in Ben Tre is considered as onshore projects in this report). As per MOIT's letter dated 9 April 2020, the MOIT has also received documents from 3 provinces (Binh Thuan, Ba Ria - Vung Tau and Ben Tre), requesting the inclusion of 3 offshore wind power projects with the total capacity of 4,900 MW in the PDP. Numerous provinces allow investors to survey and research offshore wind power projects with the total registered capacity of approx. 18,000 MW. The draft PDP8 does not forecast any offshore capacity between 2021 - 2025.

There is currently a FiT for offshore wind that is slightly higher than for onshore wind. In practice, to date most "offshore wind" development projects in Vietnam are "near-shore" developments, for which land development rights are easier to obtain than for onshore wind. As of now, the "offshore wind" market is still in its infancy. Contrary to the UK market, for example, an offshore wind project is responsible for the development and financing of the interconnection to EVN grid.

For the purpose of calculating market sizing for offshore wind projects, proposed Thang Long project in Binh Thuan province is considered. This is the world's largest proposed offshore project and is receiving support from the Vietnamese government. This special treatment is only applied to offshore wind market sizing.

In June 2019, 3.4GW Thang Long offshore wind project has received a site survey license to survey an area covering 2,800km² located 20km-50km off the Binh Thuan Province. The owner of the project is Enterprize Energy.

The Thang Long project will be developed in five 600MW phases and one 400MW phase. The first 600MW phase is expected to be operational in late 2022, early 2023. The remaining 600MW phases are scheduled to be commissioned by 2026.

Market sizing for offshore wind in Vietnam is calculated with the assumptions that 2,400MW will be completed through Thang Long project by 2025.

Regulatory treatment

Refer to Regulatory treatment in 4.1 Onshore wind

Pricing

Refer to Pricing in 4.1 Onshore wind

PPA terms

Refer to PPA terms in 4.1 Onshore wind

Procurement method

Refer to chapter 3: Project development cycle section for more details.

Key decision makers

Refer to Key decision makers in 4.1 Onshore wind

Land and permitting

Refer to Land and permitting in 4.1 Onshore wind

Financing

Refer to Financing in 4.1 Onshore wind

Foreign Ownership Restrictions

No

Local Content Requirements

No

Estimated market size

The draft PDP8 does not forecast any offshore wind capacity until 2025. The Global Wind Energy Council (GWEC) estimates that offshore wind capacity is likely to reach around 2GW by 2025 and 5.2GW by 2030.¹ Inputs for capacity additions of offshore wind projects come from disclosures on Thang Long project. The potential opportunity could be much more if the wind sector experiences the same surge as the solar sector. Assumptions for project costs come from IRENA for the period of 2018-2025. Project cost composition is taken from IRENA's report on wind power's cost analysis (Jun 2012).²

Assumptions for a foreign and domestic share of the market come from the estimated involvement of foreign companies in each component of the supply chain.

¹Global offshore wind report 2020", GWEC.

²IRENA - Renewable Energy Cost Analysis - Wind Power (Jun 2012). <https://www.irena.org/publications/2012/Jun/Renewable-Energy-Cost-Analysis---Wind-Power>.

Table 5.7: Estimated Market Size - Offshore Wind (2021-2025)

Technology	2020 Installed capacity (MW)	2025 Installed capacity (MW)	Additions (2021-2025)	Project cost (US\$ million/MW)	Market size (US\$ million)
Offshore wind	0	2,400	2,400	4.152	9,965

Sources: IRENA, EY research.

Table 5.8: Supply Chain and Financing Analysis of Offshore Wind (%)

	Share in cost (%)	Domestic (%)*	Foreign (%)
Turbine systems	51%	0%	51%
Foundation & installation	27%	27%	0%
Others (array cabling, transmission)	22%	13%	9%
Total	100%	34%	66%

Sources: IRENA, EY research.

Note: (*) Assume that local content accounts for 100% for Foundation & installation, 40% of Others. 100% turbine systems are imported.

Table 5.9: Supply Chain and Financing Market Value Analysis of Offshore Wind (US\$ million)

	Estimated market size	Domestic share	Foreign share
Turbine systems	5,082	0	5,082
Foundation and installation	2,691	2,690	0
Others (array cabling, transmission)	2,192	1,295	897
Total	9,965	3,986	5,979

Sources: IRENA, EY research.

6. Market Conditions for Hydropower Development

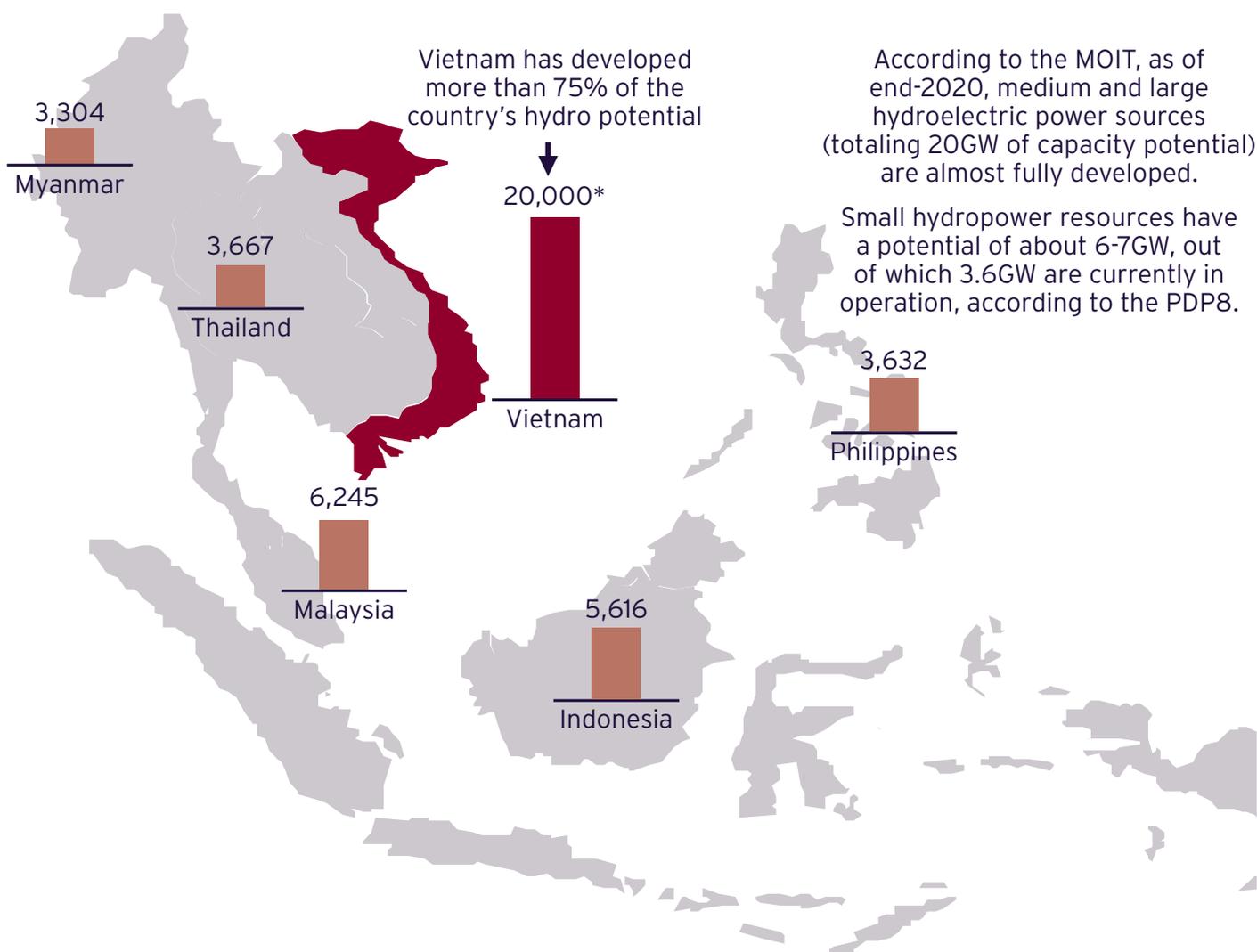
Hydropower has been a major contributor to power security in Vietnam for many years, accounting for 30% of the total installed capacity in Vietnam in 2020.

Due to its impact on the environment, local socio-economics and the fast growth in the development of solar and wind power, hydropower is currently not a high priority in Vietnam's PDP.

In the newly released PDP8, MOIT has released targets to reduce the projected share of hydropower generation to 24% in 2025 and 18% in 2030.

In a press release in November 2019, MOIT disclosed that more than 470 small and cascade hydropower plants with combined installed capacity of 2,059MW were removed from PDP7. MOIT also rejected another 213 potential projects because of environmental and efficiency concerns, according to locally published reports.¹

Figure 6.1: Installed Capacity for Hydropower Generation in Southeast Asia (MW, 2019)



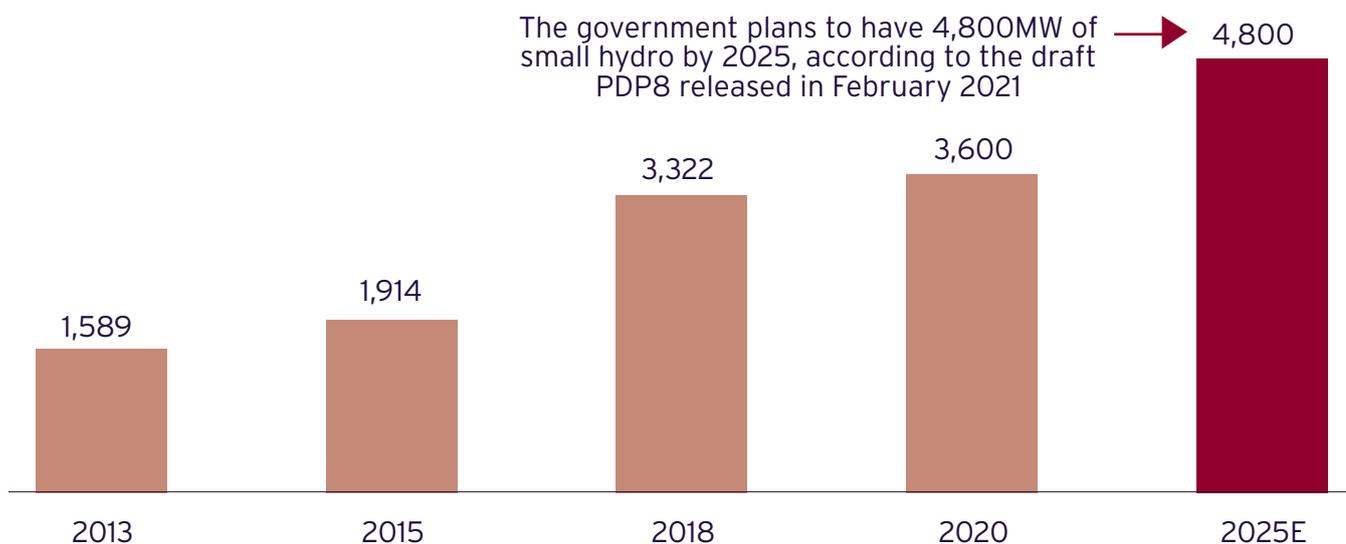
Sources: IRENA – Renewable Energy Statistics (Jul 2020), MOIT (2020).

<https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020>.

<https://thuvienphapluat.vn/cong-van/Tai-nguyen-Moi-truong/Cong-van-1931-BCT-DL-2020-xem-xet-bo-sung-quy-hoach-du-an-dien-gio-438654.aspx..>

Note (*): Data for Vietnam represents installed capacity as of 2020.

¹ Baodatu - Removing more than 470 small hydropower projects from planning (Nov 2019). <https://baodautu.vn/loi-hon-470-du-an-thuy-dien-nho-khoi-quy-hoach-d110348.html>.

Figure 6.2: Installed Capacity for 2020 and Target Set by The Government for 2025 - Small Hydro (MW)

Sources: EVN - annual report 2012-2013 (Jan 2014), GIZ (2016), MOIT (2020), Draft PDP8, Vietnam Energy Outlook (2019), EY research.
<https://en.evn.com.vn/d6/news/Annual-Report-2012-2013-6-13-82.aspx>.
<https://www.vcci.com.vn/bo-cong-thuong-loai-hang-tram-thuy-dien-nho-ra-khoi-quy-hoach>.
<https://vietnam.um.dk/~media/vietnam/documents/content%20english/english%20layout%20file%20full%202810.pdf?la=en>.

Regulations

Projects in renewables in Vietnam are all eligible for investment incentives mentioned in the Prime Minister Decision 'Approving Vietnam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050' (Decision No. 2068 issued in 2015). Small hydro (or hydropower plant with a capacity of up to 30MW) is being governed through Circular No. 32 dated 9 October 2014 and Circular No. 06/2016/TT-BCT on ACT mechanisms for small hydropower projects in Vietnam and the respective model ACT PPA.

It should be noted that in October 2019, MOIT released a draft circular amending Circular No. 32 and Circular No. 06.

In relation to cascade hydropower plants with a combined capacity of up to 60MW on the same river, the MOIT proposes (under the draft circular) removing ACT eligibility for those plants and only allowing single plants of up to 30MW each to be eligible for the ACT mechanism.

The draft circular also proposes removing the option of ACT risk-sharing mechanisms for parties to ACT PPAs in relation to the floor price of 90% and the ceiling price of 110% applicable up to 12 years in order to address market risks from annual ACT adjustments, together with other amendments relating to the methods and input components of determining ACT tariff structures.

See chapter three for more information regarding regulations for hydro and renewables in general.

Pricing

For small hydropower projects which are not co-generation projects, an avoided cost tariff (ACT) applies.

Table 6.1: Small Hydro's Avoided Cost Tariff in 2020 (US\$ cents/kWh)

Region	Dry season			Rainy season			Surplus amount*
	Peak	Normal	Off-peak	Peak	Normal	Off-peak	
North	3.127	3.127	3.123	3.028	3.032	3.024	1.512
Central	3.140	3.140	3.140	3.045	3.049	3.041	1.520
South	3.226	3.226	3.222	3.131	3.131	3.127	1.563
Capacity or price							8.321

Sources: ERAV - Avoidable Cost Price List 2020 (Decision No. 4036/QĐ-BCT) (December 2019).

http://www.erav.vn/userfile/User/trungnla/files/2020/10/QĐ_4036_QĐ_BCT%20nam%202019%20ve%20bieu%20gia%20chi%20phi%20tranh%20duoc%20nam%202020.pdf.

Note: (*) Surplus amount includes all electrical power produced during rainy season exceeds electrical power with load factor 0.85 in rainy season. Please refer to Article 2, Circular No. 32 for more details.

The avoidable cost refers to the cost for producing 1 kWh of generation capacity from a power plant with the highest generation cost in the national electricity system and this cost is avoidable if the buyer purchases 1 kWh from an alternative small hydropower plant.

Circular No. 32 stipulates that the ACT will separate the water resources tax and forest environment service charges which the power buyer will pay the small hydropower plant. Meanwhile, the power buying time is flexible following peak and off-peak hours during the dry and rainy seasons.

According to Circular No. 32, EVN - the buyer - must buy-up power from small hydropower plants - the sellers (in the event that the sellers need to sell-up their power) under a 20-year contract which can be extended under an agreement between the buyer and the seller. ACT is paid in VND and is not indexed to the exchange rate quoted in US dollars like in other FITs.

Procurement method

Other than a direct selection from the government for project awarding, companies can make an investment proposal and request the government to add projects into PDP in case the projects are not in PDP.

Key decision makers

MOIT and the Provincial People Committee (PPC)

Financing

The Electricity Law has provisions for the Vietnam Development Bank to provide up to 70% of low-interest financing for renewable projects in mountainous areas. The majority of small hydropower projects are located in mountainous areas of Vietnam and therefore are eligible for this investment incentive.

Foreign ownership restrictions

No

Local content requirements

No

Major foreign developers or equipment and service providers

Due to the long history of hydropower in Vietnam, majority of hydropower developers in Vietnam are local companies (EVN, GEC and Hung Hai Corporation). The presence of foreign investors are mainly seen through acquisition of existing projects (InfraCo. Asia, TEPCO and Nexif Energy).

Equipment providers include: GE, Toshiba, Nissho Iwai, Sumitomo and Japan AE Power.

Estimated market size

Based on various public sources, Vietnam's potential for medium and large hydro projects has mostly been utilised while under 30% of small hydro potential is developed. Inputs for capacity additions of the small hydropower projects come from the government's target that is set in the draft PDP8.

Assumptions for project costs come from BNEF's estimates for the Vietnam market in the second half of 2019. Project cost composition is triangulated from different sources, including IRENA and Tetra Tech.

Assumptions for a foreign and domestic share of the market come from the estimated involvement of foreign companies in each component of the supply chain.



Table 6.2: Estimated Market Size - Small Hydro (2021-2025)

Technology	2020 installed capacity (MW)	2025 installed capacity (MW)	Additions (2021-2025)	Project cost (US\$ million/MW)	Market size (US\$ million)
Offshore wind	3,600	4,800	1,200	2.400	2,880

Sources: IRENA, EY research.

Table 6.3: Supply Chain and Financing Analysis of Small Hydro (%)

	Share in cost	Domestic*	Foreign
Project developer or sponsor	2%	2%	0%
Consulting or engineering study and design	4%	3%	1%
Civil works	63%	63%	0%
Major electromechanical equipment	17%	0%	17%
Balance of system equipment	11%	11%	0%
Transmission line	3%	3%	0%
Total	100%	82%	18%

Sources: Tetra Tech, IRENA, EY research.

Note: (*) Assume that local content only accounts for 20% in major electromechanical equipment, engineering design, consulting engineering; 50% in project developer or sponsor and 80% of balance of system equipment

Table 6.4: Supply Chain and Financing Market Value Analysis of Small Hydro (US\$ million)

	Estimated market size	Domestic share	Foreign share
Project developer or sponsor	58	58	0
Consulting or engineering study and design	115	86	29
Civil works	1,814	1,814	0
Major electromechanical equipment	484	0	484
Balance of system equipment	323	323	0
Transmission line	86	86	0
Total	2,880	2,367	513

Sources: BNEF, Tetra Tech, IRENA, EY research.

Upcoming projects

The table below highlights some opportunities for UK companies. This list is non-exhaustive. Please refer to chapter nine for further details and insight.

Table 6.5: Upcoming Small Hydropower Projects (As of January 2021)

Project name	Location	Capacity (MW)	Investor/SPV	Status	Year online
Nam Rom	Dien Bien	6	-	Permitting	-
Tra linh 2	Quang Nam	27	Ngoc Linh Hydropower	Announced	-
Dak Mi 1A	Kon Tum	11	Quang Doc Kon Tum JSC	Permitting	-
Trung Xuan	Thanh Hoa	10.5	Thanh Binh Co Ltd	Permitting	-
Hang Dong B	-	20	-	Permitting	-
Nam Long HPP	Dak Nong	9	Dak Nong Power Investment and Management JSC	Permitting	2021
Dong Mit HPP	Binh Dinh	9.4	-	Permitting	2022
Rao Trang 3	Thua Thien-Hue	13	-	Permitting	-
Tra Khuc 2	Quang Ngai	30	-	Announced	-
Nam Ban 3	Lai Chau	22	Nam Ban 3 Power Investment & Development Co Ltd	Permitting	-
Chu Va 2	Lai Chau	14	-	Permitting	-
Muong Nhe 2	Dien Bien	16	-	Permitting	-
Muong Tung	Dien Bien	10	-	Permitting	-
Nam Ngam	Dien Bien	3.2	-	Permitting	-
De Bau	Dien Bien	3	-	Permitting	-
Mo Phi 1	Dien Bien	6.2	-	Permitting	-
Phi Linh	Dien Bien	16	-	Permitting	-
Hang Dong A	-	16	Xuan Thien Ninh Binh Co Ltd	Permitting	-
Tak Le	Quang Nam	11.6	-	Announced	-
Luoc Lah	Quang Nam	11	-	Announced	-
Tra Leng	Quang Nam	30	-	Announced	-
Nam Nhe 2	Dien Bien	16	-	Permitting	-
Hua Chang 2	Lai Chau	77	-	Permitting	-
Song Ma 2	Dien Bien	21	-	Permitting	-
Ta Pao Ho	Lai Chau	10	-	Permitting	-
Nam Nghe	Lai Chau	7.5	Northern Power Corporation	Permitting	-
Tung Chung	Lao Cai	10.12	-	Permitting	-
Ta Loi 1	Lao Cai	15	Investment Corporation and Transport Infrastructure	Announced	-

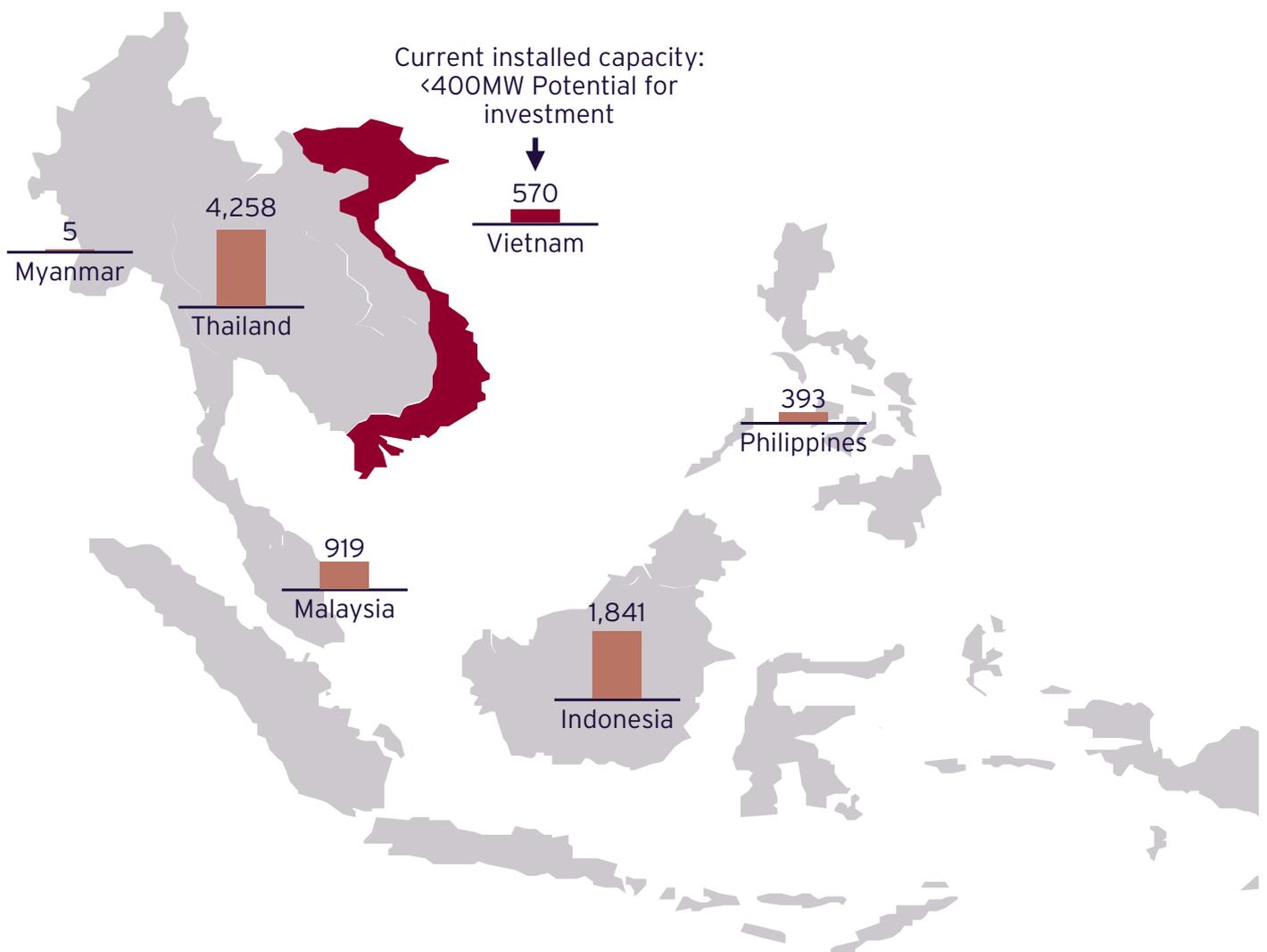
Sources: GlobalData, EY research.

7. Market Conditions for Bioenergy Power Development

Compared to other countries in Southeast Asia, Vietnam's current installed capacity for bioenergy is quite low, at only 570MW. Meanwhile, Thailand has 4GW and Indonesia has 1.8GW.

Almost all bioenergy generation in Vietnam comes from biomass plants with bagasse as the key fuel. Several small-scale WTE projects have been added to Vietnam's current PDP.

Figure 7.1: Installed Capacity for Bioenergy Generation in Southeast Asia (MW, 2019)



Sources: IRENA – Renewable Energy Statistics (Jul 2020), PDP8.
<https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020>.

Note (*): Data for Vietnam represents installed capacity as of 2020.

7.1 Biomass

As an agricultural country, Vietnam has very good biomass energy potential and has set a target of having a combined capacity of 3,150MW by 2030 through the PDP8. Major biomass resources include rice husk from paddy milling stations, bagasse from sugar factories, coffee husk from coffee processing plants in the Central Highlands and wood chip from wood processing industries.

The PDP8 states that 570MW of biomass capacity is currently installed, without providing further detail. From the most recent publicly available sources, we understand that the majority of biomass plants in Vietnam use bagasse as the key fuel source. As of June 2019, there are 38 sugar mills in Vietnam that are using biomass for electricity and heat production, with a total capacity of 352MW. Among them, only eight plants are grid-connected, with a total capacity of 82.51MW (22.4%).¹ This could be explained by the fact that for a long time the FIT for biomass is much lower than solar and wind and not attractive enough and that developers opt for biomass instead for self-consumption.

7.2 Biogas

Pig waste is a by-product of pork production, an important source of protein in Vietnam.

Pork represents more than 72.6 % of meat produced in the country and provides a livelihood for more than four million people working on small farms. The country's improving standards of living and lifestyle changes have driven the increase in demand for meat with pork production reaching 3.8 million tons in 2018.² The draft PDP8 does not set a specific target for biogas.

The growing Vietnamese pig production industry and the waste produced as a result of it has put further strain on the environment, adding to the country's greenhouse gas (GHG) emissions. To manage the impacts of the expanding pig industry, the Vietnamese government, in collaboration with international organisations such as Dutch non-profit organisation SNV, has been promoting the installation of biogas digesters to harvest methane from pig waste.

About the "Vietnam Biogas Program"

- Year founded: 2003 by SNV (with funding from the Netherlands government)
- Objective: Effectively exploit biogas technologies and develop a commercially viable biogas sector in Vietnam. SNV provides technical assistance to the implementer of the Vietnam Biogas Program, the Department of Livestock Production under Vietnam's Ministry of Agricultural and Rural Development (MARD)

Since its inception until March 2017, the Vietnam Biogas Program has:

- Facilitated the construction of 158,500 domestic biogas digesters, resulting in access to a clean, renewable and reliable source of energy for more than 790,000 rural individuals across 55 provinces and cities of Vietnam
- Created more than 2,500 new jobs in rural Vietnam
- Trained nearly 1,700 biogas masons and supported 355 biogas construction team leaders in establishing biogas businesses
- Provided pre-installation training to 164,525 households and provided training on post-installation and use of bio-slurry to 161,397 households
- Reduced around 800,000 tons of CO2 equivalent per year

Sources: SNV, EY research.

¹GGGI report - Sweetening the Deal for Biomass Energy in Vietnam's Sugar Industry (Nov 2018). <https://gggi.org/site/assets/uploads/2018/12/Biomass-report-10.12.pdf>.

²General Statistics Office Of Vietnam. <https://pxweb.gso.gov.vn:443/sq/eb0a5e51-4999-40fd-abf8-cea2f331ab6c>.

7.3 Waste-To-Energy (WTE)

As of end 2020, there is 10MW of installed capacity in the WTE sector.

The draft PDP8 does not set a specific target for WTE sector.

As of February 2019, two plants (Hau Giang and Phu Tho waste power plants) were added to the national power development plan. It is expected that this sector will gain momentum in the coming years given that currently almost 76% of Vietnam's municipal solid waste is sent to landfills.

The Hau Giang Waste Power Plant project that is located in Hau Giang province has a capacity of 12MW, of which, 1 capacity of 6MW was put into operation in 2019 and phase two of 6MW will be put into operation in 2024.

The Phu Tho Waste Power Plant Project in Tram Than Commune, Phu Ninh District, Phu Tho Province has a capacity of 18MW, of which, phase one of 9MW will be put into operation in 2020 and phase two capacity of 9MW will be put into operation in 2026.

Table 7.1: Examples of Active WTE Projects (As of January 2021)

Plant name	Investor	Capacity (MW)	Location	COD
Go Cat	Hydraulic and Machine Co. Ltd	2.4	Ho Chi Minh City	2017
Nam Son	URENCO & Hitachi Zosen Company - Japan	2	Hanoi	2017
Can Tho	EB Can Tho Environmental Energy & China Everbright	7.5	Can Tho	2018

Source: EY research.

Regulatory treatment

Projects in renewables in Vietnam are all eligible for investment incentives mentioned in the Prime Minister Decision 'Approving Vietnam's Renewable Energy Development Strategy up to 2030 with an outlook to 2050' (Decision No. 2068/QĐ-TTg issued in 2015). The Bioenergy segment is also being regulated through Decision No. 24/2014/QĐ-TTg, Circular No. 44/2015/TT-BCT, Decision No. 31/2014/QĐ-TTg and Circular No. 32/2015/TT-BCT.

See chapter three for more details.

Pricing

According to the MOIT, there are about 10 combined heat and power (CHP) biomass power projects operating in Vietnam. Most of these are active in utilising bagasse from sugar mills for self-consumption and were established before the issuance of Decision No. 24 on 24 March 2014 regarding FiT for biomass projects in Vietnam. However, throughout Decision No. 24's approximately six-year implementation, no other grid-connected biomass power projects have been constructed or operated. This could be explained by the unattractive FiT rate issued in 2014 for biomass CHP at US\$5.8 cents/kWh versus a FiT rate of US\$9.35 cents/kWh for solar or US\$8.5 cents/kWh for onshore wind.

On 5 March 2020, the Prime Minister of Vietnam issued Decision No. 08 to amend Decision No. 24 on support mechanisms for the development of biomass power projects in Vietnam. Effective from 25 April 2020, Decision No. 08, among other revisions, increases FiT for biomass power projects from US\$5.8 cents/kWh to US\$7.03 cents/kWh.

Under Decision No. 08, tariffs at the delivery point are increased as follows:

- For CHP biomass power projects: US\$7.03 cents/kWh (exclusive of value-added tax (VAT))
- For other biomass energy projects: US\$8.47 cents/kWh (exclusive of VAT)

The proposed FiT shall be adjusted in accordance with the fluctuation of the VND/US\$ exchange rate on the date of issuance of the relevant invoice. The proposed FiT is to be applied throughout the PPA term of 20 years from the COD.

Figure 7.2: Current Tariff Rate for Biomass as of April 2020 (US\$ cents/kWh)



Source: EY research.

PPA terms

The current PPA is specified in Decision No. 24 and Circular No. 44 for biomass. Decision No. 31 and Circular No. 32 for WTE (Refer chapter three for more details).

Procurement method

Other than a direct selection from the government for project awarding, companies can make an investment proposal and request the government to add projects into PDP in case the projects are not in PDP.

Key decision makers

MOIT and the Provincial People Committee (PPC).

Major foreign developers or equipment and service providers

The current size of the biomass or WTE market in Vietnam is still very small. Therefore, the presence of foreign developers and contractors in the market is still limited.

Developers include: Hitachi Zosen, Trisun Green, KPC and Keppel.

EPC contractors include: China First Metallurgical Group Co. Ltd. (CFMCC) and China Tianying Inc.

Estimated market size

Below market sizing estimation is only for biomass and it does not include biofuels or WTE resources. Inputs for capacity additions of biomass projects come from the government's targets set in the PDP8.

Assumptions for project costs come from IRENA's estimates. Project cost composition is triangulated from different sources, including IRENA and Tetra Tech.

Assumptions for a foreign and domestic share of the market come from the estimated involvement of foreign companies in each component of the supply chain.

Table 7.2: Estimated Market Size - Biomass (2021-2025)

Technology	2020 installed capacity (MW)	2025 installed capacity (MW)	Additions (2021-2025)	Project cost (US\$ million/MW)	Market size (US\$ million)
Biomass	570	2,050	1,480	2.105	3,115

Source: Draft PDP8, EY research.

Table 7.3 : Supply Chain and Financing Analysis of Biomass (%)

	Share in cost	Domestic*	Foreign
Civil works	17%	17%	0%
Major electromechanical equipment	70%	35%	35%
Transmission line	3%	3%	0%
Pre-construction by developer (permit, land acquisition, etc.)	5%	5%	0%
Pre-construction by consultant (study and engineering design)	5%	5%	0%
Total	100%	65%	35%

Sources: Tetra Tech, IRENA, EY research.

Note: (*) Assume that local content accounts for 100% in civil works, transmission line, pre-construction work

Table 7.4: Supply Chain and Financing Market Value Analysis of Biomass (US\$ million)

	Estimated market size	Domestic share	Foreign share
Civil works	530	530	0
Major electromechanical equipment	2,180	1,090	1,090
Transmission line	93	93	0
Pre-construction by developer (permit, land acquisition, etc.)	156	156	0
Pre-construction by consultant (study and engineering design)	156	156	0
Total	3,115	2,025	1,090

Sources: Tetra Tech, IRENA, EY research.

Upcoming projects

The table below highlights some opportunities for UK companies. This list is non-exhaustive. Please refer to chapter nine for further details and insight.

Table 7.5: Upcoming Bioenergy Projects (As of January 2021)

Project name	Location	Capacity (MW)	Investor	SPV	Status	Year online
Que Son Biomass Power Plant	Quang Nam	12		-	Announced	-
Vietnam Waste Solution Landfill Power Plant	HCMC	12	Vietnam Waste Solution	-	Announced	-
Quang Binh Biomass Power Plant	Quang Binh	100	Dohwa Engineering Co. Ltd.	Hoang Gia Biomass Energy Investment JSC	Announced	2020
Trisun Green WTE Plant	HCMC	66	Trisun Green Energy Corp.	Trisun Energy Vietnam	Permitting	-
Hitachi Ho Chi Minh WTE Plant	HCMC	20	Hitachi Zosen Corp	-	Announced	-
Keppel Ho Chi Minh WTE Plant	HCMC	20	Keppel Seghers Pte. Ltd.	-	Announced	-
Citra Gasification Power Plant	Ha Noi	12	PT Citra Metro Jaya Energi	-	Permitting	-
Luong Dien Waste to Energy Power Plant	Hai Duong	9	Au Viet Resource and Environment JSC; United Expert Investment Ltd.	-	Permitting	2020

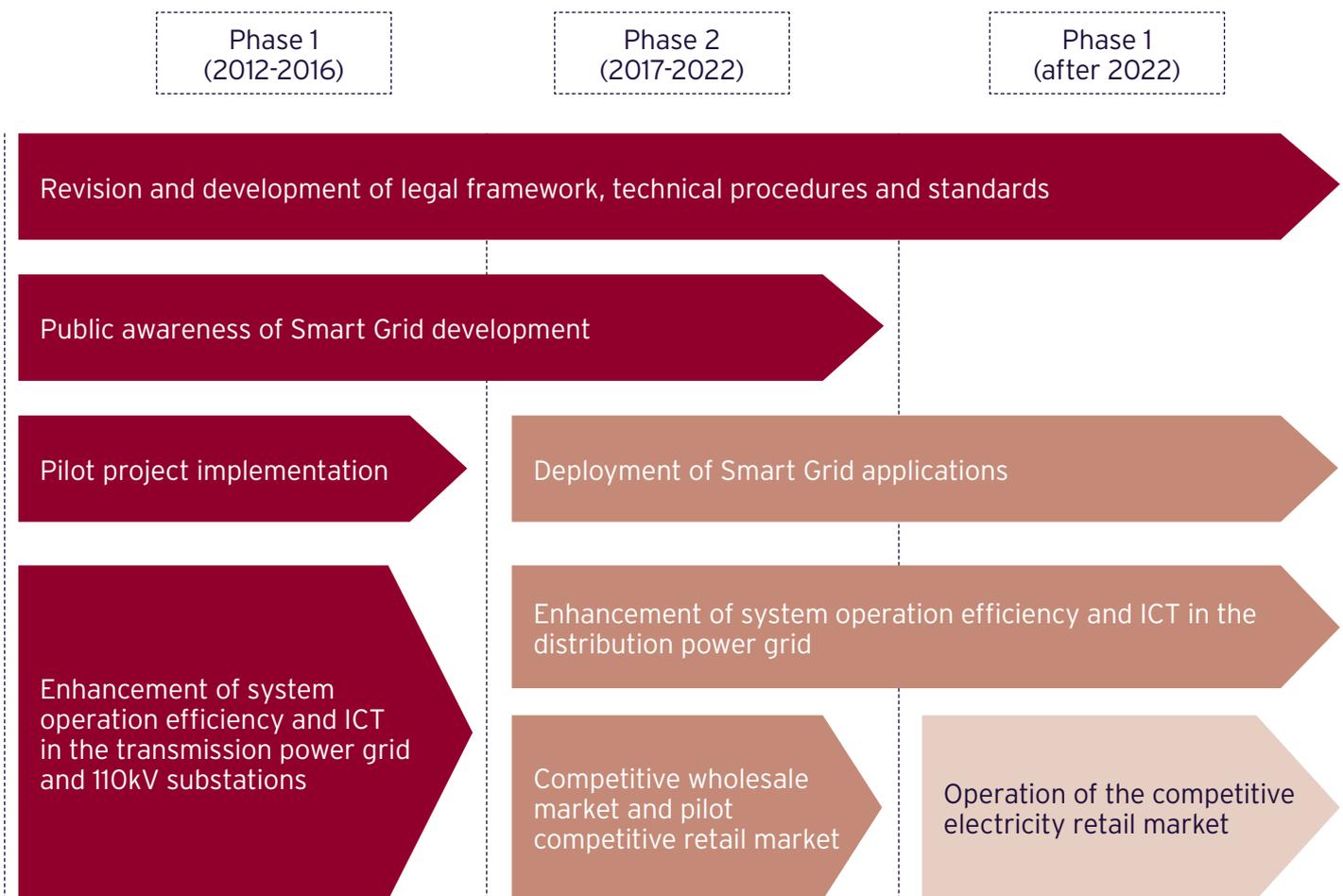
Sources: GlobalData, VietnamPlus, VUFO-NGO Resource Centre, EY research.

8. Market Conditions for Electrical Networks and Storage

Smart grid systems

The Government of Vietnam issued Decision No.1670/QĐ-TTg covering the development of intelligent power grids in Vietnam (in short: Smart Grid Road Map) on 8 November 2012. The roadmap aims to increase the quality and reliability of power supply as well as to improve the effective use of electricity.

Figure 8.1: Smart Grid Road Map in Vietnam



Source: Prime Minister - Approving the scheme on development of intelligent power grid in Vietnam (Decision No. 1670/QĐ-TTg) (8 November 2012). <https://vanbanphapluat.co/decision-no-1670-qd-ttg-approving-the-scheme-on-development-of-intelligent>.

As indicated in the Smart Grid Roadmap, implementation of smart grid systems is just at the pilot stage. Key results as of 2019 are summarised below:

- New SCADA/EMS system is equipped in National Load Dispatch Center in 2016. Activated functions include state estimator, automatic generation control (AGC) and an open operator training system (OTS)
- SCADA connection as of March 2019¹:
 - A big power plant (over 30MW): 99% connected (4% temporally lost connection)
 - 500kV substation: 100% connected
 - 220kV substation: 100% connected
 - 110kV substation: 96% connected
- Remote metering as of December 2018¹:
 - 99.7% power plants
 - 100% substations
 - 35.6% customer meters

Transmission grid control systems

EVNHCMC has conducted a pilot on Demand Response (DR), where a few commercial and industrial customers participated through a Curtailable Load Program (CLP) and a Voluntary Emergency Demand Response Program (VEDRP), including the pilot operation of a demand response management system (DRMS) software.

The Decision No. 279/QĐ-TTg dated 8 March 2018 regulates the National Demand-Side Management (DSM) program for the 2018-2020 period. So far, only EVN Hanoi reported that some customers are participating in a pilot DSM project.

Advanced metering infrastructure (AMI)

AMI and smart meters have very limited deployment in Vietnam with AMI being installed in a few hundred households at some of the power corporations.

Most power corporations are successfully deploying automatic meter reading (AMR) to most of their customers. Most of them have the target of covering 100% of customers with AMR within the next one to two years.

Battery energy storage system (BESS)

Vietnam had no BESS as of June 2019. A feasibility study of using advanced energy storage technology to solve issues of Vietnamese power system when share of renewable energy increase has been started under the sponsorship of USTDA (U.S. Trade and Development Agency).

As of March 2021, the study has yet to be published. However, the Vietnam National Load Dispatch Center (NLDC) disclosed that the first BESS project might start in 2-5 years.

EVN's investment plan to upgrade the national grid network

As mentioned in Chapter 3, EVN will need to spend US\$3 billion annually to implement grid system upgrade as stipulated in RPDP7.

The draft PDP8 released in February 2021 has supplanted the RPDP7 with more ambitious spending plans. Specifically, for the 2021-2030 period, the total amount of investment in power generation and grid expansion has been increased from US\$101.5 billion to US\$128.3 billion, over US\$12.8 billion/year on average. Out of the US\$128.3 billion, 74% will be for power sources and 26% for grid development. This translates into a 86% increase in the targeted annual spending plan from the 2016-2020 period.

¹MOIT - Smart grids in Viet Nam - market development, frameworks and project examples (Jul 2019). https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2019/190722-iv-vietnam-04.pdf?__blob=publicationFile&v=3.

In the previous RPDP7, the government targeted to expand the 220kV and 500kV transmission grid in the national electricity system to guarantee the power transmission from power centers to load centers in safe, reliable and cost-saving manners. At the same time, small-scale renewable power sources were to be established and connected to distribution grids, thus contributing to reduced power losses. While all

transmission is owned by the EVN, the curtailments issues experienced in the solar boom may lead to investments by the private sector in new lines together with storage solutions.

The draft PDP 8 is oriented to further the development of the 220KV transmission grid to solve overcapacity issues that has been occurring in recent years with the soaring use of renewable energy.

Draft PDP8:

- Large increase in proposed capital expenditure for the expansion of the grid system in the period of 2021 - 2045 compared with the RPDP7

RPDP7: Master plan for the development of power grids

- The 500kV transmission grid shall be built for electricity transmission from large power centers to load centers, ensuring ongoing connections among regional power systems and power exchanges with other countries in the region
- The 220kV transmission grid shall be constructed using the double-circuit structure; transformer stations in heavy-load density areas and shall be properly designed for flexible operations
- Considerations shall be taken into the construction of GIS, 220/22kV, underground and fully automated transformer stations in load centers. The smart grid technologies shall be applied in the power transmission process

Figure 8.2: 500kV Transformers (kMVA) to be Built Up to 2045

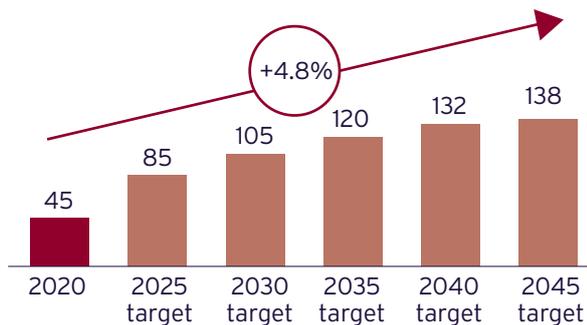


Figure 8.3: 220kV Transformers (kMVA) to be Built Up to 2045

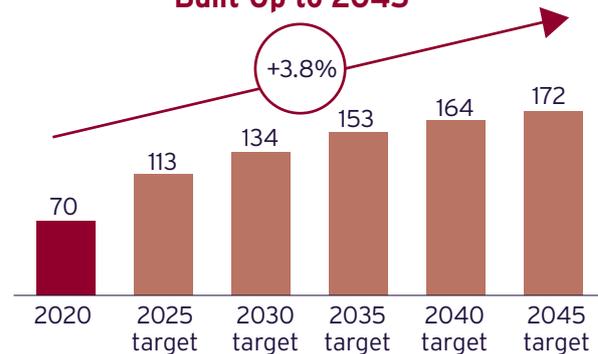


Figure 8.4: 500kV Lines (k km) to be Built Up to 2045



Figure 8.5: 220kV Lines (k km) to be Built Up to 2045



Estimated market size

The below market sizing estimation is only for transformers at 220kV and 550kV substations. Inputs for required transformers are taken from the government's disclosure in the draft PDP8.

In Decision No. 38/2020/QĐ-TTg, the government announced a list of high-tech sectors / products that would be encouraged for development. Battery storage systems and other renewable energy technologies such as tidal and marine are included in the list. This Decision takes effect from February 15, 2021 and replaces Decision No. 66/2014 / QĐ-TTg dated November 25, 2014.

As of 2018, Vietnam has 23,000MVA of 500kV transformers and 53,000MVA of 220kV transformers. According to the draft PDP8, the government is targeting an additional 40,000MVA of 500kV transformers and 43,000MVA of 220kV transformers by 2025. Please refer to Figures 8.1 and 8.2 for more details.

The assumptions for transformers cost come from the actual market rate of ABB - a leading electrical equipment provider in Vietnam. It is estimated that one 250MVA transformer costs US\$1.5 million, which translates to US\$6,000 per 1MVA.

Table 8.1: Estimated Market Size - Transformers at 220kV and 550kV Substations (2021-2025)

Equipment	MVA of transformers to be added (2021-2025)	Cost per 1MVA (US\$ million)	Market size (US\$ million)
Transformer	83,000	0.006	498

Source: EY research.



9. Top Business Opportunity Areas for UK Companies

This section identifies areas where UK renewable energy capabilities match the needs of the Vietnamese market. The largest market segments identified are also the segments where there is existing presence of foreign companies. Hence, UK companies would also need to consider innovative ideas to be competitive in the local market.

UK companies can invest in Vietnam in several ways such as by establishing a new enterprise, acquiring or investing in an existing enterprise, setting up a local branch or representative office,

licensing or franchising models or through direct contractual arrangements. UK companies will need to consider several factors such as nature, quantum and time horizon of the proposed investment, prevalence of any foreign ownership restrictions in the relevant sector, potential value addition of a local Vietnamese partner and tax implications such as VAT and foreign contractor tax. The legal basis and compliance requirements for UK companies are set out in the Vietnamese Investment Law 2014 and Enterprise Law 2014.



9.1 Existing Players in Vietnam

The market for thermal generation is dominated by few players as shown below.

Table 9.1: Installed Capacity by Ownership in Vietnam (December 2018)

Companies	Capacity (MW)	%
EVN	28,169	58%
PVN	5,019	10%
Vinacomin	1,735	4%
IPPs and BOT	13,650	28%
Total	48,573	100%

Source: EVN - annual report 2018 (Jan 2021).
<https://en.evn.com.vn/userfile/User/huongbtt/files/2021/1/EVNAnnualReport2018.pdf>.

The IPP market has a presence of local players as shown below but also include foreign developers like Sembcorp, Sojitz, AES and China Investment Corporation.

Figure 9.1: Major Domestic Players in the Renewable Energy Sector in Vietnam*

<p>REE Corp. - Listed company</p> <p>2000MW</p> <ul style="list-style-type: none"> Hydropower plants (1034MW) Wind and solar energy plants (1,080MW) - owning indirectly through Thuan Binh Wind power JSC** 	<p>Thanh Cong Group (TTC)</p> <p>700MW</p> <ul style="list-style-type: none"> 19 mid & small hydropower plants (80MW) 7 Biomass plants (89MW) at sugar mills 500MW of solar power in operation as of February 2020
<p>Bitexco Group - Private company</p> <p>1,138MW</p> <ul style="list-style-type: none"> 18 hydropower plants (1GW) 138MW of solar power 	<p>Others:</p> <ul style="list-style-type: none"> Hung Hai Group BIM Group Trungnam Group Thuong Mai

Source: EY analysis.

Note (*): Data is estimated by EY based on companies' disclosures as of February 2020. Estimates includes installed capacity for upcoming projects.

(**) REE is the largest shareholders at Thuan Binh Wind Power, currently owns 49.1% share at the company. Thuan Binh Wind Power used to be a subsidiary of EVN.

The renewables market is pretty fragmented and has seen interest from several domestic and international developers. There appears to not be any single developer who has a dominant share in the market. The landscape includes domestic developers like AMI Renewable Energy and Bac Phuong as well as international developers like

Sunseap Group (Singapore), B. Grimm (Thailand), Gulf International Holding (Thailand) and Jinko Solar (China). Despite some of the challenges in the sector, particularly in the PPAs and grid connectivity, the sector remains attractive to foreign investors and developers.

9.2 Business Opportunities for UK Companies

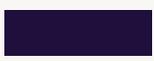
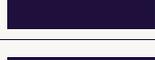
The top three most attractive sectors for value addition in the short term appear to be in onshore wind, offshore wind and solar.

In UK DIT's assessment, the strongest capability for UK companies is in services (such as consulting, design and engineering) for the development of

renewable energy projects. In terms of sectors, offshore wind and waste are the sectors with extensive UK expertise.

The subsequent sections describe UK capabilities across these sectors and other key sectors identified in Vietnam.

Table 9.2: Summary of Business Opportunities for UK Companies

Sectors	UK expertise ⁵				Estimated opportunities (US\$ million)		
	Pre-development ¹	Detailed design and development ²	Construction, installation and commissioning ³	Operations and maintenance (O&M) ⁴	Estimated market potential	Foreign potential share	UK potential
Solar					624	362	125
Wind					19,402	12,165	1,164
Small hydro					9,965	5,979	5,481
Bioenergy ⁶					2,880	513	513
Geothermal					3,115	869	467 - 869
Electrical networks including storage					***	***	***

 Competitive or world-leading  Capable but not world-leading or the most competitive  Little to no capability

Sources: UK DIT Capability Statement: Renewable Energy (2020). EY research.

The above analysis is based on the review of the information provided by the FCDO. We understand that in 2017, DIT carried out an extensive assessment of UK renewable energy capabilities across different sectors and identified areas of significant

export potential. The estimated market potential and foreign potential is as determined in previous chapters. The potential UK share of the opportunity is then determined. The subsequent sections explore the sectors in greater detail.

¹Pre-development includes all pre-development activities of the project such as strategy, policy development, resource assessments, site surveys, site selection, licensing and consents, grid connection assessments, preliminary environmental impact assessment, other professional services and so on.

²Detailed design and development includes activities related to specific projects such as FEED studies, procurement plan, site specific studies like seabed studies and wind speed studies. It also includes ancillary project development activities such as financing, construction and installation.

³Commissioning includes activities related to the actual engineering and build of the project until full commercial operations is achieved

⁴O&M includes routine or periodic maintenance, project inspections and reviews. Professional services during O&M period can include activities such as insurance, audit, tax and independent engineer on projects.

⁵Note: Colors indicate the strength of UK expertise: green = competitive or world-leading; amber = capable but not world-leading or the most competitive; red = little to no capability. Further, UK expertise in green financing spans both sector and stages and are hence not separately identified

*** In certain sectors, the market in Vietnam is at a relatively nascent stage and pipeline for projects is not available. The opportunities in the sector may develop in upcoming years and could materialise into significant opportunities in future

Solar

Despite large-scale capacity additions in 2019 (exceeding the 2025 national target), solar is likely to remain a priority sector for Vietnam and is viewed as an attractive market segment for investment from overseas investors. UK capabilities in solar are primarily through overseas direct investments (ODI) where UK developers develop, own and operate medium to large-scale projects (>50MW) and integrated hybrid solutions with energy storage and mini-grid options where a generation system such as rooftop solar can be integrated with battery storage to create stand-alone island systems - an attractive proposition for remote rural areas. Ability to participate will be driven by the competitiveness of UK companies when compared to local or other overseas participants. UK companies are also adept at providing a range of professional services, including the design of policy or incentive structures for solar projects, general technical design, engineering and PMC services. The UK has limited capabilities on supplying BOP equipment such as inverters, cables, panel frames and bespoke building integrated photovoltaics (BIPV) panels. The UK does not have expertise in manufacturing solar panels.

A number of UK companies such as Lightsource, Solarcentury and Proinso have the capabilities to develop large utility-scale power plants. Developers such as Solar Securities and British Solar Group which largely have domestic and regional experience may consider venturing into new markets.

Given the overall maturity of solar PV, particularly manufacturing capabilities of other countries, opportunities for UK export are limited in large-scale PV projects (>50MW), unless mandated by export finance requirements (20% in UKEF). The potential can go up to 34% for smaller projects (in the range of 2.25MW). Considering the overall estimated market potential for the sector in Vietnam and the potential opportunities for foreign companies (and areas where UK companies have strong expertise), the estimated opportunity for UK companies is estimated to be around US\$125 million.

As Vietnam phases out FiT, UK companies can find partners with sponsors who have projects approved in the masterplan already or target the solar auction program that will follow.

Wind

Vietnam is considered to have one of the best wind resources in ASEAN especially in the near-shore, offshore and coastal onshore regions. With limited capacity in the domestic market, there are opportunities across the entire project value chain for UK companies. Existing foreign participants in the market primarily consist of European, Chinese, Korean or US contractors.

Offshore: The UK is in the unique position of being the world leader in offshore wind and having the valuable experience and expertise to support overseas markets. UK expertise includes policy development, project development (consultancy, engineering, consenting, surveying, unexploded ordinance and due diligence), installation, equipment supply (except turbine nacelles), O&M and any specialist offshore legal and insurance advisory services. Although there is considerable domestic experience in development, UK companies are not known to invest and own projects overseas. It is estimated that UK companies can potentially export up to 55% of the capex requirements for an offshore wind farm (of a typical 400MW wind farm) and can support through the value chain of the project from site studies and feasibility studies (Atkins, Arup and Mott Macdonald), site development (BiFab, Offshore Structures Britain OS(B), Smulders Projects UK, Harland and Wolff, WD Close, Wiltons and FoundOcean), equipment supply (CS Wind, Siemens Gamesa Renewables Mitsubishi Vestas Offshore Wind (MVOW), Tekmar) to implementation (Seajacks, MPI, DeepOcean, Global Marine, SMD, Ecosse Subsea, Modus, Houlder and Canyon Offshore).¹

Onshore: Onshore is a mature technology and able to compete on price in many markets internationally. The UK has leading manufacturers (Gaia Wind, BritWind) exporting small scale turbines and are also active in component supply to larger turbine manufacturers. The most attractive segment in Vietnam for UK companies will be in the project development and financing stage during the pre-construction and construction phases. A moderate strength is estimated for UK export potential in areas such as grid integration, component supply and turbine towers. While ODI potential is limited, UK companies have potential in the export of professional services and providing assistance to local developers in securing finance for new projects. Professional services constitute a relatively small portion of the overall investment.

The outlook for the wind sector in Vietnam remains bullish and a number of projects are expected in the short to mid term. The development process for wind projects in Vietnam appears to be relatively complex and is estimated to take between two to four years with approvals required from a number of provincial and/or national authorities.² Given the complex permitting procedures, masterplan inclusion and approvals and land acquisition, UK companies could consider targeting the expected opportunities in partnership with local companies who have a sound understanding of the local regulatory landscape. Considering the overall estimated market potential for the sector in Vietnam and the potential opportunities for foreign companies (and areas where UK companies have strong expertise), the estimated opportunity for UK companies could be up to US\$1.2 billion for onshore wind and US\$5.5 billion for offshore wind.

¹ UK DIT Capability Statement: Renewable Energy (2020).

² For instance, foreign investors require an investment registration certificate and it is common practice to establish project companies at the feasibility study stage itself.

Small hydro

The UK has strong expertise across the value chain for small-scale hydro. Generally, UK involvement overseas is limited to various consulting and engineering activities and has not been typically involved in end-to-end development of large-scale projects. In small-hydro, the UK excels at large-scale design and technical engineering, efficient and reliable technology for small-scale hydro through companies such as Gilkes, intake screens, electrical systems and financing support through UKEF.¹

Though UK solutions may appear slightly more expensive when compared to other markets, coupled with direct lending support, the UK offering for small - medium scale hydro is strong. It has the capability to deliver up to 35% of project costs comprising of consultancy, civil engineering and systems.¹ Considering the approach be more selective in further development of small hydropower projects and the potential opportunities for foreign companies (and areas where UK companies have strong expertise), the estimated opportunity for UK companies is US\$513 million.

Bioenergy

Being an agrarian economy, there is immense potential for biomass in Vietnam. Biomass and biogas potential has been primarily focused in rural areas. Although, the UK has expertise in anaerobic digestion with capability to meet 40% of project costs, the competitiveness of UK products in Vietnam would need further investigation. There is a strong local market created as an outcome of the Vietnam Biogas Program which was founded in 2003 by SNV with funding from the Netherlands Ministry of Foreign Affairs (DGIS). The program aimed to effectively exploit biogas technologies and develop a commercially viable biogas sector in Vietnam.²

The WTE sector is gaining traction in Vietnam. With an estimated potential of around 320MW, the WTE sector is an unexplored opportunity for UK companies in Vietnam. Foreign companies like Keppel, Trisun and Hitachi are already exploring this sector and have invested in upcoming WTE plants in Vietnam. Companies such as Virindor, Bioenergy Infrastructure Group, FCC and Aggreko Plc Group have successfully constructed and operated WTE systems in the UK. It is estimated that UK companies are capable of supporting around 15% of project value of a typical 250,000 ton p.a. WTE plant with experience in design, engineering and construction services applicable to all types of WTE facilities.¹

UK expertise in this sector lies in design and implementation of the policy and incentive structure required to make WTE facilities economically viable, include the design, build and operation for anaerobic digestion and WTE facilities and the supply of waste collection vehicles. Further, the UK has limited ODI potential given that majority of the developers investing in the UK across the waste sector are foreign companies.

Considering the overall estimated market potential for the sector in Vietnam and the potential opportunities for foreign companies (and areas where UK companies have strong expertise), the estimated opportunity for UK companies is could range from US\$467 million to US\$869 million.

¹ UK DIT Capability Statement: Renewable Energy (2020).

² SNV - Vietnam Biogas Programme. <https://snv.org/project/vietnam-biogas-programme>.

Electrical networks

The transition of the power sector with greater contribution from renewables is a challenge for the national grid. The grid needs to ensure that there is sufficient capacity to absorb additional renewable capacity as well as ensure that electricity supply is reliable. The Vietnamese government in its Decision No. 1670/QĐ-TTg, a roadmap for the development of intelligent power grids (smart grid road map). GIZ is currently supporting ERAV on smart grid development across three main areas such as legal, capacity development and technology corporation. The project is expected to be completed in 2021 and is likely to create a clear pathway for opportunities in this sector.¹

The UK has considerable design and delivery experience, both in traditional transmission and distribution systems as well as in off-grid and mini-grid systems where small-scale distributed generation such as rooftop solar can be integrated with energy storage solutions to provide reliable supply on a self-sufficient basis. Specific areas of UK expertise include consultancy services, technical services (e.g., Network analysis, standards, codes and specific equipment manufacture), general design, engineering and construction, protection and control systems and monitoring.² As the Vietnamese market gains traction, opportunities are expected for companies like Schneider Electric UK, Bowers Electricals, Siemens UK, Babcock, Lucy Electric and so on.

Electrical networks and BESS

A number of UK companies operate in the BESS market, primarily in the UK and Europe. Given the challenges with the existing national grids with the increasing share of renewables in the system and the related intermittency, energy storage is a sector that can be of importance in Vietnam in the future. Vietnam has recently commissioned a feasibility study with GE to examine the feasibility of deploying advanced storage technologies in the country. This new study will provide potential solutions to EVN and NLDC to address some of the grid related challenges. Recommendations and analysis from the study will help EVN and NLDC determine how much battery energy storage and/or related transmission devices (FACTS or others) to employ and where on the system to deploy it. UK companies can closely monitor this sub-sector and participate in early engagement with EVN and private generators to further explore specific opportunities.

Green financing

Green finance is defined as funding any means of reducing carbon emission or raising resource efficiency. Green funding in itself is not generally considered as an export but as an enabler for the development of RE projects. Lack of coordinated efforts, limited capacity of governments and local banks and underdeveloped capital markets have been some of the barriers for development of green financing. While no green bond has been issued in Vietnam to date, MOF has been looking to promote the issuances of green bonds. In 2016, MOF implemented a trial program with the pilot issuance of green bonds in order to prepare for official issuances in the future. The UK is well placed to support and can potentially enable projects that would not otherwise happen, particularly in emerging markets.

While the funding itself is not considered as export, the associated services such as legal, accounting and insurance, which could be around 1-2% of the project value is considered as export and is a domain where UK companies excel.²

¹GIZ Energy Support Programme - Plans for Viet Nam's smart grid development in 2019. <http://gizenergy.org.vn/en/article/plans-viet-nams-smart-grid-development-2019>.

²UK DIT Capability Statement: Renewable Energy (2020).

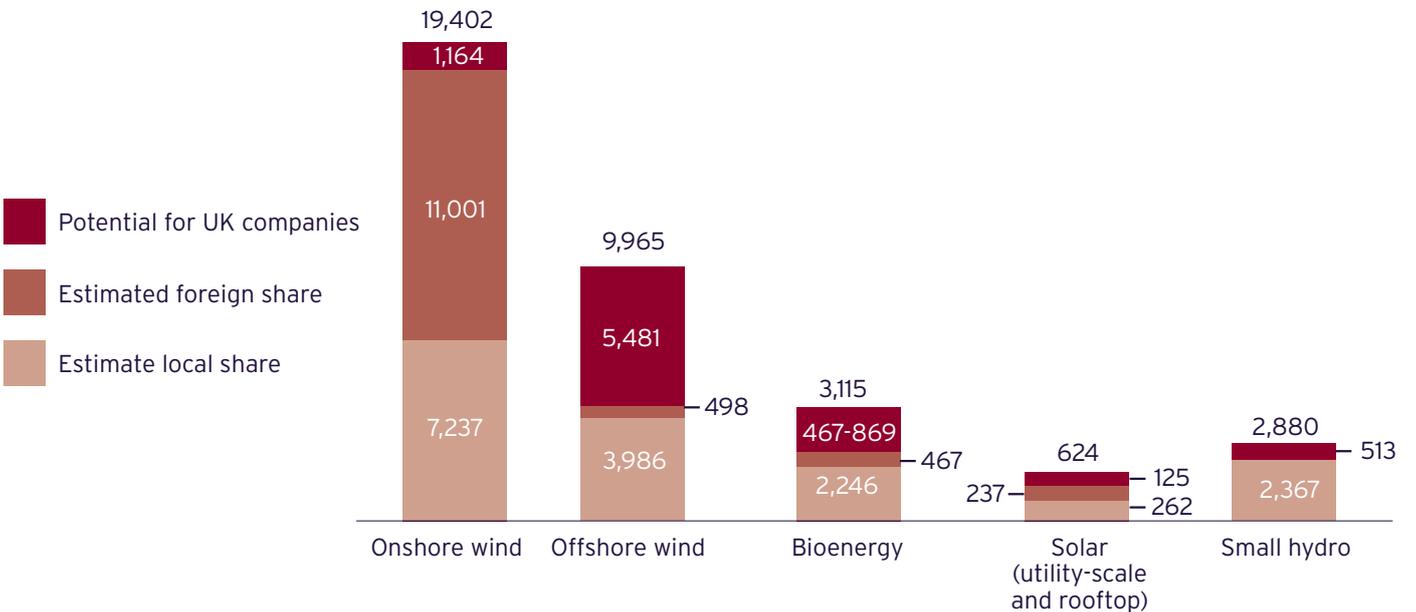
Other sectors

In the other sectors, UK expertise lies in providing consulting services, design, finance and limited construction support, project management and supervision. In DIT’s assessment, in largely mature sectors, UK companies would need to be highly price competitive ¹. As liquidity is constrained in the domestic market, there is a need to tap into international sources of finance. Vietnam has been able to attract over US\$3 billion in FDI investment in renewables in 2019 and this figure is likely to grow further.² UK companies may explore opportunities where collaboration with UKEF could unlock opportunities for investment, finance and associated services.

Summary of Vietnam market opportunity

The renewable energy opportunity in Vietnam is estimated to be in excess of US\$36 billion across solar, wind, hydro and waste sectors. The largest opportunity for UK companies is in the wind sector given the strongest alignment with UK expertise.

Figure 9.2: Market Opportunity for Renewables Investment in Vietnam (US\$ million)



*Sorted in descending order of market opportunity
Source: EY research.

In summary, although there is considerable potential for UK companies in the renewable energy sector in Vietnam, UK companies will need to compete with other foreign companies and demonstrate competitiveness to be able to realise the export opportunity.

Through its network of officers deployed in Vietnam and UK-based trade advisors, the DIT can support UK companies wishing to expand into Vietnam. The DIT helps businesses export and grow into overseas markets by providing pragmatic advice, contacts and insight into the overseas market. UK companies can leverage the UK’s existing knowledge of doing business and providing strategic assistance to Vietnam while developing their market entry strategy. Interested parties are encouraged to reach out to the DIT at DIT.Vietnam@fcdo.gov.uk.

¹ UK DIT Capability Statement: Renewable Energy (2020).
² BNEF – Climatescope 2020. <https://global-climatescope.org/assets/data/reports/climatescope-2020-report-en.pdf>.

9.3 Upcoming Renewable Projects

In Vietnam, RE projects need to be included in the government's masterplan to be eligible for FiT. To be included in the masterplan, projects need to be fairly developed and studies like feasibility study, preliminary approvals, land allocation are already underway. Hence, it can be argued that participation post masterplan approval might be already too late for UK companies.

By the time projects are awarded, it is expected that developers would have some clarity on suppliers and financiers making participation relatively more difficult. For already awarded projects, UK companies can still pursue financing opportunities and ancillary professional services (e.g., audit, tax, legal services and financing).

Some opportunities are highlighted in the following table.

Table 9.3: Upcoming Projects in Vietnam (Non-Exhaustive)

No	Project	Capacity (MW)	Target COD date	Technology	Status	Foreign service potential
1	Nam Ban 3 HPP	22	-	Hydro	Permitting. Turbine manufactures identified to be Andritz Hydro GmbH	Financing, insurance and other professional services
2	Thien Tan 3 solar power plant	300	2021	Solar	Expected to be developed in phases	Financing, insurance and other professional services
3	Ham Thuan Floating Solar PV Park	300	2021	Solar	Permitting	Financing, insurance and other professional services
4	Ke Ga Offshore Wind Power Project	3,400	2023	Wind	Announced	Financing, insurance, equipment supply and other professional services
5	GELEX 2 and 3 Wind Farm	30 each	2021	Wind	Permitting	Financing, insurance and other professional services
6	Vietnam Waste Solution Landfill Power Plant	12	-	-	Announced	Financing, insurance, equipment supply and other professional services

Sources: GlobalData; RPDP7.

Please refer to Appendix 4 for a consolidated list of upcoming projects. Specific projects expected to come online in 2022 and beyond are yet to be announced. In January 2020, Vietnam has issued new rules for masterplan approval for power projects which sets out priority for approving new generation projects.¹ Under the new rules, wind power, WTE power project, biomass and small hydropower projects are likely to be prioritised. The latest masterplan is expected in 2020.

In addition, UK companies may explore the pilot DPPA program for solar PV which has been launched in January 2020. Approximately 150MW to 300MW is expected to be awarded under this program with the expected COD to be March 2021.²

The DPPA program may be expected to attract international financing as the Model PPA with EVN would not apply and instead the project would enter a contract for difference with the corporate offtaker. It would increase interest from international developers, including from the UK. The DPPA program may also allow UK companies with operations in Vietnam to meet their green procurement policies.

UK companies have greater value addition potential in market making activities during the initial deal preparation stage. For ease of doing business in Vietnam, it maybe prudent for foreign companies to form partnerships with local companies, who will be able to navigate the complex regulatory framework in Vietnam.

¹Baker McKenzie Alert - Vietnam's new policies for approving proposed power and energy projects in the master plan (Jan 2020). <https://www.bakermckenzie.com/-/media/files/insight/publications/2020/01/baker-mckenzie-client-alert-vietnam-new-policies-power-and-energy-projects-jan-2020.pdf?la=en>.

²ERAV - Vietnam wind power development plan: grid, DPPA and renewable energy planning (Jun 2019). <https://gwec.net/wp-content/uploads/2019/06/1.-Mr-Nguyen-The-Huu-Grid-ERAV-REnewable-Energy-Development-Plan.pdf>.

9.4 Top Companies Ready to Export

UK expertise lies in providing services with differentiating experience in hydropower, biomass and wind energy sectors as shown in the figure below.¹ Consulting firms are able to provide advisory

services across all technologies. British consulting companies like Mott Macdonald and Atkins already have a presence in Vietnam.

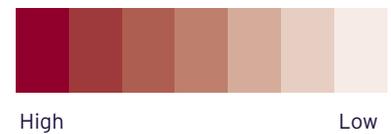
Table 9.4: Summary of UK Expertise Across Sectors and Services (Number of Companies)

Service area /sector	Solar PV	Wind	Hydroelectric	Geothermal	Bioenergy	Marine	Storage of smart grid
Consulting	Dark Red	Dark Red	Dark Red	Light Brown	Dark Red	Dark Red	Dark Red
Manufacturing	Light Brown	Light Brown	Light Brown	Lightest Brown	Light Brown	Light Brown	Light Brown
EPC services	Dark Red	Dark Red	Dark Red	Light Brown	Dark Red	Dark Red	Dark Red
O&M services	Light Brown	Dark Red	Dark Red	Light Brown	Dark Red	Light Brown	Dark Red

Sources: UK Tetra Tech, EY analysis.

Note: A company maybe active across multiple sectors and services and hence would appear in more than one segment above.

The above heat map indicates the presence of UK companies in the various renewable sectors and service areas, with a darker shade indicating higher presence (in terms of number of companies) and vice versa.



¹UK FCDO Low-carbon energy study (Mar 2017).

The table below identifies some companies in the renewable energy sectors (based on the information compiled by the FCDO) who have the potential to participate in RE projects in Vietnam. Appendix 1 includes the long list of identified companies. The table below is non-exhaustive and is intended to be for illustrative purposes only. Companies identified

in the below table should not be considered to be exclusive in respective sectors or as the only companies with export potential.

Further engagement would be needed to assess if Vietnam is a target market for the identified UK companies.

Table 9.5: UK Companies Involved in Renewable Energy and Green Financing (Non-Exhaustive)

Company name	Description	Sector	Expertise
RES group	Independent renewable energy company with over 16GW portfolio and the expertise to develop, engineer, construct, finance and operate projects.	Wind, solar, storage, electrical networks	Development, O&M
Aggreko Plc Group	Engineering and construction firm specialising in wind (planning and infrastructure, construction, pre-commissioning, testing and commissioning and O&M for both on- and offshore facilities), battery storage for solar PV (design and build) and biogas (employing new technology).	Wind, energy storage, biogas	EPC and O&M
Gaia Wind	Turbine manufacturer capable to perform at wind speeds between 3.5m/s-25m/s.	Wind (Onshore)	Manufacturer
CWind	Constructs, commissions, operates and maintains large-scale offshore wind projects and offers range of services, including pre-project planning and cable installation, blade repair, subsea surveys, power cable storage, training, inspection and maintenance.	Wind (Offshore)	Project design and planning, EPC and O&M
EDS HV Group	Designs, connects, tests, commissions and operates onshore and offshore wind projects.	Wind	EPC and O&M
Lyndex	Designer and manufacturer of waste recycling machinery.	Waste	Manufacturer
TNEI	Specialist energy consultancy, combining power systems analysis, renewables integration, environmental services and noise assessment.	Solar, wind and energy storage	Professional services
PROINSO UK Ltd	Integrates and distribute solar PV products, supplying such components as inverters, modules, structures and complete balance of system. Also develops a wide range of rooftop and ground-mount structures (PROINSO PV rack).	Solar	Developer, EPC
ROMAG	Manufactures solar panel kits that can fit to any roof.	Solar	Manufacturer

Table 9.5: UK Companies Involved in Renewable Energy and Green Financing (continued)

Company name	Description	Sector	Expertise
Gilbert Gilkes & Gordon Ltd.	Manufactures hydro turbines with capacities up to 20MW. Exports to over 85 countries.	Small hydro	Manufacturer
PlanET Biogas UK	Provides biogas services in planning, new construction, re-powering, technical (remote maintenance, support for CHP units, on-site replacement and advisories on new technologies), biological (operations stability and substrate treatment) and biomethane.	Biomass or biogas	Professional services
PM PROJEN	Engineering design and project management firm focusing on the design and building of anaerobic digestion, biogas, biomass and liquid biofuels plants.	Biomass or biogas	Professional services
Organics Group plc	Provides services in landfill gas extraction and utilisation, anaerobic digestion, refuse-derived fuel and advanced thermal processing (pyrolysis and gasification).	Biomass or biogas	
Agrivert	Develops and operates organic waste treatment facilities.	Biomass (anaerobic digestion)	EPC and O&M
Bioenergy Infrastructure Group	Has one of the UK's largest portfolios of biomass and WTE facilities.	Biomass	Developer
Organics group	Primarily an EPC contractor. Provides services in landfill gas extraction and utilisation, anaerobic digestion, refuse-derived fuel and advanced thermal processing (pyrolysis and gasification).	Biogas or WTE	EPC, manufacturer
Arup	Technical advisory firm providing engineering services and consulting across renewable energy sectors, electrical networks and energy efficiency.	All renewable sectors	Professional services
Atkins	Technical advisory firm providing engineering services and consulting across renewable energy sectors, electrical networks and energy efficiency.	All renewable sectors	Professional services

Note: The above table is non-exhaustive and is intended to be for illustrative purposes only. Companies identified in the above table should not be considered to be exclusive in respective sectors or as the only companies with export potential. Appendix 1 identifies a long list of UK companies active in the renewable energy space.

Source: EY analysis based on UK DIT Capability Statement: Renewable Energy (2020).

Appendix

Appendix 1: UK Low-Carbon Capabilities

The UK has strong capabilities in many low-carbon and resource-efficient services, technologies and processes that have the potential for export. Leveraging past work prepared by Carbon Trust (2013 and 2018), the UK's strongest low-carbon services are in the areas of financial, legal, policy,

architectural design, engineering design and environmental consulting. In energy technologies, processes and operations and maintenance, UK energy industries encompass solar PV, wind, hydro, geothermal, bioenergy, marine and energy storage and smart grid.

UK Companies Involved in Renewable Energy and Green Financing

Company	Sector	Service area	Description
Absolute Energy Capital	Solar PV, hydroelectric	Finance	<ul style="list-style-type: none"> Independent investment platform focused on renewable energy Offers investment/co-investment opportunities, as well as business development potential to industrial and financial clients Develops and deploys market-based solutions for rural electrification and energy efficiency
Acropora Capital	Solar PV, green finance	EPC, finance	<ul style="list-style-type: none"> Investment and development company that develops renewable energy projects, primarily in the Middle East and Africa Specialises in fundraising for the development, construction, operation and maintenance of developed assets and provides access to desirable markets, which are otherwise difficult to enter
Adrian Laycock	Hydroelectric	Consulting, EPC	<ul style="list-style-type: none"> Plans, designs and constructs small and micro-hydropower schemes, with sizes ranging from 50kW to 1MW or more Specialises in micro-hydropower in environmentally sensitive areas
Advanced Pump and Hydro Systems Ltd.	Hydroelectric, bioenergy	Manufacturing	<ul style="list-style-type: none"> Provides advice and solutions for hydropower projects, from the initial idea through to commissioning and generation Uses new, innovative, cost-effective technologies such as plastic generator screws and low-head Kaplan turbines Exclusive UK and Ireland agents for Bombas iDeal, which offers a wide range of pump products and Wangen Pumps, which manufacture progressive cavity pumps
AES UK	Storage/smart grid	Manufacturing	<ul style="list-style-type: none"> Offers a world-class battery-based energy storage system, Advancion® Introduced the first grid-scale advanced battery in commercial power market service in 2008 Operates the largest fleet of battery-based storage assets in service today, working with customers to integrate energy storage into eight power markets globally
Aggreko Plc Group	Solar PV, wind, bioenergy, storage/smart grid	EPC	<ul style="list-style-type: none"> Engineering and construction firm specialising in wind (planning and infrastructure, construction, pre-commissioning, testing and commissioning and O&M for both onshore and offshore facilities), battery storage for solar PV (design and build) and biogas (employing new technology)
AquaFloat	Solar PV	Manufacturing	<ul style="list-style-type: none"> A 2018 start-up that has opened a 12MW manufacturing facility for floating solar systems in Brampton, Cumbria The production facility has been awarded ISO 9001:2015 and ISO 14001:2015 certification

Company	Sector	Service area	Description
Arup	Solar PV, wind, geothermal, bioenergy, storage/smart grid	Consulting, EPC	<ul style="list-style-type: none"> Independent firm of designers, planners, engineers, architects, consultants and technical specialists working across every aspect of the built environment, including offshore wind, solar, WTE, as well as hydrogen and electric cars
Atkins	Solar PV, wind, hydroelectric, bioenergy, marine	Consulting, EPC	<ul style="list-style-type: none"> Provides design, engineering and project management consultancies Produced the outline designs for breakwaters, turbine houses and ancillary works Supported the tender process by helping develop documents and reviewing responses and detailed designs for Tidal Lagoon Swansea Bay Plc, the power-generating tidal lagoon in Wales
Barclays	Green finance	Finance	<ul style="list-style-type: none"> Offers green loans to fund a range of environmental and sustainability projects in energy efficiency, renewable energy, green transport, sustainable food, agriculture and forestry, waste management and greenhouse gas emission reduction
Battery Energy Storage Solutions Ltd	Storage/smart grid	O&M, others	<ul style="list-style-type: none"> An energy storage company that owns and operates a portfolio of battery sites Provides a range of services from frequency balancing to reserve power
Belectric Solar and Battery GmbH	Solar PV, storage/smart grid	EPC, O&M	<ul style="list-style-type: none"> Develops and constructs utility-scale solar power plants and energy storage systems Offers battery energy storage systems and hybrid power solutions, which combines technologies to autarkic systems One of the largest O&M providers globally
Biffa Group	Bioenergy	O&M, others	<ul style="list-style-type: none"> One of the largest municipal, industrial and commercial waste management fleets in the UK Offers construction waste management, logistics waste solutions, recycling and hazardous waste management
Bioenergy Infrastructure Group	Bioenergy	EPC, O&M	<ul style="list-style-type: none"> Helped in establishing one of the UK's largest portfolios of biomass and WTE facilities Has over 100MW of operational and late-stage construction assets that will divert over 1 million tonnes per annum of waste from landfills
Border Hydro	Wind, hydroelectric	EPC, O&M	<ul style="list-style-type: none"> Designs, installs and maintains grid-connected and stand-alone wind turbines, a range of hydropower turbines and controllers and control panels
Cumulus Energy Storage Ltd	Storage/smart grid	Manufacturing	<ul style="list-style-type: none"> Manufacturer and developer of grid-level energy storage batteries with the lowest levelised cost of storage globally
CWind	Wind	EPC, O&M	<ul style="list-style-type: none"> Constructs, commissions, operates and maintains large-scale offshore wind projects, including technician and engineering support, training and inspection and maintenance
Deep Sea Electronics	Solar PV, hydroelectric, marine	Manufacturing	<ul style="list-style-type: none"> Electronics manufacturer of control solutions Provides gensets for solar and marine applications and mains decoupling relays suitable for hydropower applications

Company	Sector	Service area	Description
Doosan Babcock	Bioenergy	Manufacturing	<ul style="list-style-type: none"> Equipment manufacturer specialising in biomass co-firing and conversion, including fuel handling and milling, dedicated burners and combustion systems and integrated steam turbine retrofitting
Dulas Ltd	Solar PV, wind, hydroelectric, storage/smart grid	Consulting, EPC, O&M	<ul style="list-style-type: none"> Renewable energy consultancy and installation on energy storage for industrial solar, hydropower and wind applications Provides services, including planning and application support, site design, through to project management, installation, O&M and long-term service optimisation
Eaton Electrical	Solar PV, wind, marine, storage/smart grid	Consulting, manufacturing	<ul style="list-style-type: none"> Power management company with 2016 sales of US\$19.7 billion Provides research, development and implementation of energy-efficient solutions Is a leading supplier of products and services for renewable energy distribution and automation and offers programmable logic controllers to regulate PV power plants worldwide
EcoMachines Ventures	Storage/smart grid	Finance, others	<ul style="list-style-type: none"> Invests in technology companies that are working to meet energy demand and make the supply of energy secure and stable Focus on innovative proprietary technologies, energy efficiency and smart tech
EDS HV Group	Wind	EPC, O&M	<ul style="list-style-type: none"> Designs, connects, tests, commissions and operates onshore and offshore wind projects Provides services, including installation, fault management, advisories, high voltage (HV) safety, asset management and commissioning
Ellergreen Hydro Ltd	Hydroelectric	Consulting, EPC	<ul style="list-style-type: none"> Provides feasibility studies, design & consenting, construction and project management Constructs and operate its own schemes and community-owned schemes
Engie	Solar PV, wind, bioenergy, storage/smart grid	EPC, O&M	<ul style="list-style-type: none"> Energy services firm that sources and supplies green gas (sourced from generation plants that produce biogas from anaerobic digestion or landfill waste gas) Designs and installs battery storage solutions for small and large businesses
EPS UK	Storage/smart grid	EPC, O&M	<ul style="list-style-type: none"> Offers a broad range of services, including switchgear and circuit breaker design, rapid prototyping, 3D printing, finite element analysis based design improvement and contract computer aided design (CAD) services Provides services, including design of low-voltage automation products, design of medium-voltage equipment (up to 72.5kV) and transformer condition monitoring
FCC Environment Ltd	Wind, bioenergy	O&M	<ul style="list-style-type: none"> Operates waste to energy facilities and makes use of existing sites around the UK, such as reclaimed areas of landfills, to build small wind turbines
Fichtner Consulting Engineers Ltd	Solar PV, wind, hydroelectric, geothermal, marine, storage/smart grid	Consulting, EPC, others	<ul style="list-style-type: none"> Specialises in the due diligence, procurement and engineering of renewable energy technologies throughout all project phases, from feasibility studies through to full operation Evaluates the impacts and optimises the design of renewable energy projects

Company	Sector	Service area	Description
Flexitricity	Storage/smart grid	Consulting	<ul style="list-style-type: none"> Created the first demand response portfolio in Great Britain Pioneered open-market aggregated demand-side services for electricity system balancing Provides aggregated short term operating reserve (STOR) and frequency control by demand management (FCDM), foot room and demand turn-up, post-fault dispatch for distribution networks, demand-side smart frequency control and balancing mechanism access for demand-side assets
Geothermal Engineering	Geothermal	EPC	<ul style="list-style-type: none"> Geothermal engineering and construction company that is developing the UK's first large-scale geothermal energy plan in Cornwall
Gilbert Gilkes & Gordon Ltd	Hydroelectric	Manufacturing	<ul style="list-style-type: none"> Manufactures hydropower turbines with capacities up to 20MW Exports to over 85 countries Has supplied over 6,700 hydroelectric turbines worldwide
Glen Hydro	Hydroelectric	Consulting, EPC	<ul style="list-style-type: none"> Developers and consultants who design, install, operate and own hydroelectric schemes Advise on the economic viability and technical feasibility of watercourse as a hydropower investment Focus on developments over 100kW and up to 2MW in capacity
Green Highland	Hydroelectric	Consulting, EPC, O&M, finance	<ul style="list-style-type: none"> Independent hydropower project developer, operator and owner Offers services, including potential identification, design and licensing, O&M, financing and construction/commissioning
Green Investment Group	Green finance	Finance	<ul style="list-style-type: none"> Part of the Macquarie Group Offers a full suite of financial services, including development funding, financial close, construction phase equity and debt and asset financing across both established (offshore wind, onshore wind, solar, hydro, inter-connectors, waste and biomass) and emerging technologies through all stages of the project lifecycle: development, construction and operations
Hallidays Hydropower Ltd.	Hydroelectric	Consulting, O&M	<ul style="list-style-type: none"> Global hydropower consultants specialising in the delivery and maintenance of low-head, fish-friendly, run-of-river hydropower schemes Services are provided from concept through feasibility, design, licensing, installation and commissioning
Hotspur Geothermal	Geothermal	EPC	<ul style="list-style-type: none"> Develops and constructs geothermal projects, focusing on large-scale projects, typically over 10MW, as well as smaller-scale direct use heat and power projects Offers services, including potential resource identification, exploration and drilling and advancing projects to development Is targeting geothermal development in Indonesia
HSBC Bank	Green finance	Finance	<ul style="list-style-type: none"> Launched a range of new green finance products for UK businesses – from small and medium enterprises to large corporations –, including a green loan, green revolving credit facility and a green hire, purchase, lease and asset account as part of HSBC's commitment to providing £76 billion in sustainable financing and investment by 2025
Hydroplan	Hydroelectric	Consulting, O&M	<ul style="list-style-type: none"> Offers hydropower consulting, in-house design, due diligence, hydropower scheme operations and maintenance, survey services, feasibility studies, hydro/dam engineering, tunnelling and HV electrical
JDR Cables	Wind, marine	Consulting, EPC	<ul style="list-style-type: none"> Develops inter-array submarine electric cables for offshore wind, wave and tidal energy projects Offers front-end engineering and design, project implementation, product engineering and installation and asset management

Company	Sector	Service area	Description
Kingspan	Solar PV	Consulting, EPC	<ul style="list-style-type: none"> Provides evacuated tube collectors and flat plate solar panel technologies, consulting and engineering studies and solar thermal system servicing
M.A.M. Contracting	Hydroelectric	EPC	<ul style="list-style-type: none"> Provides engineering and construction on hydroelectric schemes
MannPower	Hydroelectric	EPC, O&M	<ul style="list-style-type: none"> UK's first supplier of Archimedean screw hydropower turbines Provides feasibility and design studies, detailed project plans, construction and installation, commissioning and remote management
MHI Vestas Offshore Wind	Wind	Manufacturing	<ul style="list-style-type: none"> Manufactures offshore wind turbine blades and offers operations and maintenance and project management services Offers the world's largest commercially proven rotor (174 meters)
MLM Group	Wind, bioenergy, marine	Consulting, EPC	<ul style="list-style-type: none"> Privately-owned engineering, environmental and building control consultancy Provides full design services for WTE plants Provides design services in biomass, wind farms and wave generation
Moixa	Storage/smart grid	Manufacturing	<ul style="list-style-type: none"> Provides smart grid batteries and smart battery hardware and GridShare software to facilitate smart energy storage and sharing Specialises in batteries for solar storage
Mott MacDonald	Solar PV, wind, hydroelectric, geothermal, bioenergy and marine, storage/smart grid	Consulting, EPC, finance	<ul style="list-style-type: none"> Experienced in all types of renewable energy generation and power transmission and distribution technologies
N-ERGY Limited	Solar PV, wind, storage/smart grid	EPC, O&M	<ul style="list-style-type: none"> Experienced in the design, development, operation and maintenance of solar plants and wind farms In the area of energy storage, provides battery maintenance
NOJA Power	Storage/smart grid	Manufacturing, EPC	<ul style="list-style-type: none"> Provides medium-voltage reclosers and related products to the international market Has installed more than 50,000 NOJA Power OSM series Automatic Circuit Reclosers in 87 countries
Open Energi	Storage/smart grid	Consulting	<ul style="list-style-type: none"> Offers specialist consultancy services in decentralised, digitalised energy management to help businesses assess and value project opportunities Developed Dynamic Demand 2.0 software that dispatches assets for capacity reserve schemes in line with market obligations, by minimising costs and maximising income opportunities during peak periods by reducing consumption or dispatching generation assets in response to price signals
Orbital Marine Power	Marine	Manufacturing	<ul style="list-style-type: none"> Pioneered floating tidal stream turbines in Orkney, Scotland Developed Orbital O2 turbine representing a move toward commercial operation Is developing tidal arrays at Lashy Sound, Orkney

Company	Sector	Service area	Description
Organics Group plc	Solar PV, wind, bioenergy	EPC, O&M	<ul style="list-style-type: none"> Provides services in landfill gas extraction and utilisation, anaerobic digestion, refuse-derived fuel and advanced thermal processing (pyrolysis and gasification) Constructed three biogas plants in Indonesia Environmental protection services cover enclosed low-emission flare systems, thermal ammonia removal systems, odour control, wastewater treatment and soil decontamination Develops and operates solar PV, wind, biogas and biodiesel projects
Osbit	Wind	Manufacturing	<ul style="list-style-type: none"> Provides design, manufacturing, integration and support services for floating offshore wind plants Is supplying its MaXccess T-18 access system for Japan's first offshore wind farm to allow engineers' safe access to the 2MW downwind floating turbine and the 66kV floating substation, which are situated in deep and rough waters, 20km off the coast of Japan
OXTO Energy	Storage/smart grid	Manufacturing	<ul style="list-style-type: none"> Has developed an innovative flywheel energy storage system to enable a sustainable, low-carbon future Flywheel, designed to work alongside renewable technologies such as wind and solar, allows an intermittent renewable generation to continue generating, even when the energy is not necessarily required, with excess energy stored in OXTO's steel flywheels and then released when demand increases
Pegasus Group	Solar PV, wind, hydroelectric, bioenergy, marine	Consulting, others	<ul style="list-style-type: none"> Experienced in solar power, on- and offshore wind (turbine schemes, from single turbines to wind farms), bioenergy (biomass, from small to commercial scale), tidal power, energy from waste, anaerobic digestion and hydropower Offers services, including site assessment and feasibility studies, environmental impact assessments and mitigation design
Peter Brotherhood	Bioenergy	Manufacturing	<ul style="list-style-type: none"> Designs, manufactures and services steam turbines and turbine generator sets up to 40MW applicable for biomass powerplants and WTE plants Has installed thousands of steam turbines in more than 140 countries The only producer in the UK for steam turbines with outputs up to 40MW
Plan B Management Solutions	Bioenergy	Consulting, EPC	<ul style="list-style-type: none"> Environmental management consultancy providing management and technical support services to the waste management industry Offers services, including procurement, interim project and data management, procurement and work programming
PlanET Biogas UK	Bioenergy	O&M	<ul style="list-style-type: none"> Provides biogas services in planning, new construction, re-powering, technical (remote maintenance, support for CHP units, on-site replacement and advisories on new technologies), biological (operations stability and substrate treatment) and biomethane
PM PROJEN	Bioenergy	Consulting, EPC	<ul style="list-style-type: none"> Engineering design and project management firm focusing on the design and building of anaerobic digestion, biogas, biomass and liquid biofuels plants Installed the UK's first large-scale biodiesel plant
PROINSO UK Ltd	Solar PV	EPC, O&M	<ul style="list-style-type: none"> Integrates and distributes solar PV products, supplying such components as inverters, modules, structures and complete balance of system Develops a wide range of rooftop and ground-mount structures (PROINSO PV Rack) Project development services range from identifying project sites to contracting, construction and O&M Offers full support for engineering, procurement and management

Company	Sector	Service area	Description
Pure Energy Professionals Ltd.	Solar PV, wind, bioenergy and marine	Finance	<ul style="list-style-type: none"> Helps create, finance and build new renewable energy businesses Project services offered include co-development, financing, procurement and construction management, operations and asset management, acquisitions/disposal, power purchase agreements and green credit marketing Specialises in joint ventures in the wind, solar, biomass and marine energy
Ramboll	Solar PV, wind, hydroelectric, geothermal, bioenergy and marine	Consulting and EPC	<ul style="list-style-type: none"> Engineering and consulting firm Has been involved in more than 20 solar heating projects in 10 countries, with a total of more than 200,000m Has completed wind projects in 21 countries in offshore wind and 60 countries onshore Optimises power stations, designs, monitors and assures the quality of investments, both retrofits and new plants Specialises in seismic, geological and geophysical studies and investigations, including modelling and reservoir hydraulic calculations and evaluation Establishes major modern anaerobic digestion (biomass) and biogas facilities using a variety of feedstocks and has delivered over 60 biomass power, heat and CHP facilities using a full spectrum of fuel types Is working on a 10MW tidal test array from concept study to detailed design for both foundation design and installation methodology
ROMAG	Solar PV	Manufacturing	<ul style="list-style-type: none"> Manufactures solar panel kits that can be fitted to almost any roof Offers a new lightweight and most efficient PV panel, the RSM 6 (60), for roof mounting
Siemens Gamesa UK	Wind, storage/ smart grid	Manufacturing	<ul style="list-style-type: none"> A leading supplier of wind power solutions (on- and offshore wind turbines) Installed products and technology in more than 90 countries, with a total capacity base of over 89GW Offers hybrid power solutions to allow for the integration of one or more renewable power generation assets with tailored energy storage systems - heat or battery storage
SIMEC Atlantis Energy	Marine	Manufacturing and O&M	<ul style="list-style-type: none"> Designs, supplies and maintains tidal turbines and subsea connection equipment Has more than 1,000MW of tidal stream marine projects in various stages of development As lead developer, works with consortiums to secure development rights for marine power projects. Is the majority owner of MeyGen, the world's largest tidal stream energy project Has a formal agreement with GE to share resources for the ongoing development of utility-scale tidal energy generation and associated energy storage solutions
Suez Environment UK	Bioenergy	Consulting and O&M	<ul style="list-style-type: none"> Part of the Suez Group Handles over 10 million tonnes of waste in the UK Makes a significant and growing contribution to the circular economy and sustainability by recovering value from these waste materials Provides waste auditing and site assessments and recycling and recovery services

Company	Sector	Service area	Description
Tidal Lagoon Power plc	Marine	EPC and O&M	<ul style="list-style-type: none"> Develops, constructs and operates tidal lagoon power plants in the UK and internationally Is currently developing a national fleet of six tidal lagoons to meet up to 8% of UK electricity demand, or power for around 30% of UK homes, as well as moving on a number of potential projects overseas
TLS Hydro	Hydroelectric	EPC and O&M	<ul style="list-style-type: none"> Develops, constructs and operates hydropower sites Renovates older sites which are no longer operational
TNEI	Solar PV, wind, Storage or smart grid	Consulting	<ul style="list-style-type: none"> Specialist energy consultancy, combining power systems analysis, renewables integration, environmental services and noise assessment Works in distributed renewable generation and the integration of low-carbon technology Provides a range of technical services, from GIS to civil engineering and energy market analysis
Trade Link Solutions	Hydroelectric	Finance	<ul style="list-style-type: none"> Offers financial and commercial advice in accrediting renewable generation plants, trading electricity, hydropower generation and feasibility studies
UKSOL Ltd	Solar PV	Manufacturing	<ul style="list-style-type: none"> Produces high-quality solar PV modules that come with a 30-year British warranty Provides procurement and global support Exports into over 39 countries Has installed 2MW solar panels on a factory rooftop in Manila, Philippines and 300kW modules on a new office block in Ho Chi Minh city
Veolia UK	Bioenergy	O&M and others	<ul style="list-style-type: none"> Provides a comprehensive range of waste, water and energy management services, including commercial waste collection, hazardous waste collection and treatment and low-carbon heating for districts and communities
Viridor (Pennon Group)	Bioenergy	O&M	<ul style="list-style-type: none"> Has 300+ advanced recycling, energy recovery and landfill diversion facilities and 10 energy recovery facilities that maximise resource efficiency for non-recyclable waste One of the UK's largest independent power generators from waste, with 274 megawatts (MW) of operating capacity from ERFs, anaerobic digestion, solar and landfill gas (including joint ventures), exporting 1.5 terawatt hours of power during the 2018/19
Xero Energy Limited	Storage/smart grid	Consulting and O&M	<ul style="list-style-type: none"> Independent transmission and distribution industry expert with expertise in micro-grids, private wire systems and smart grids, from small domestic systems through to higher-voltage distribution networks and transmission Offers a broad range of expert services, including engineering, technical, commercial and regulatory expertise on-grid and electrical systems
Zenobe Energy	Storage/smart grid	Others	<ul style="list-style-type: none"> Works with network infrastructure companies such as power grids Identifies innovative ways to reduce or eliminate reinforcement expenditure, increase reliability and improve the environment for customers through energy storage Delivers large-scale projects which transform returns for investors and benefits for consumers



Appendix 2: Bankability Issues Surrounding the Standard PPA in Vietnam

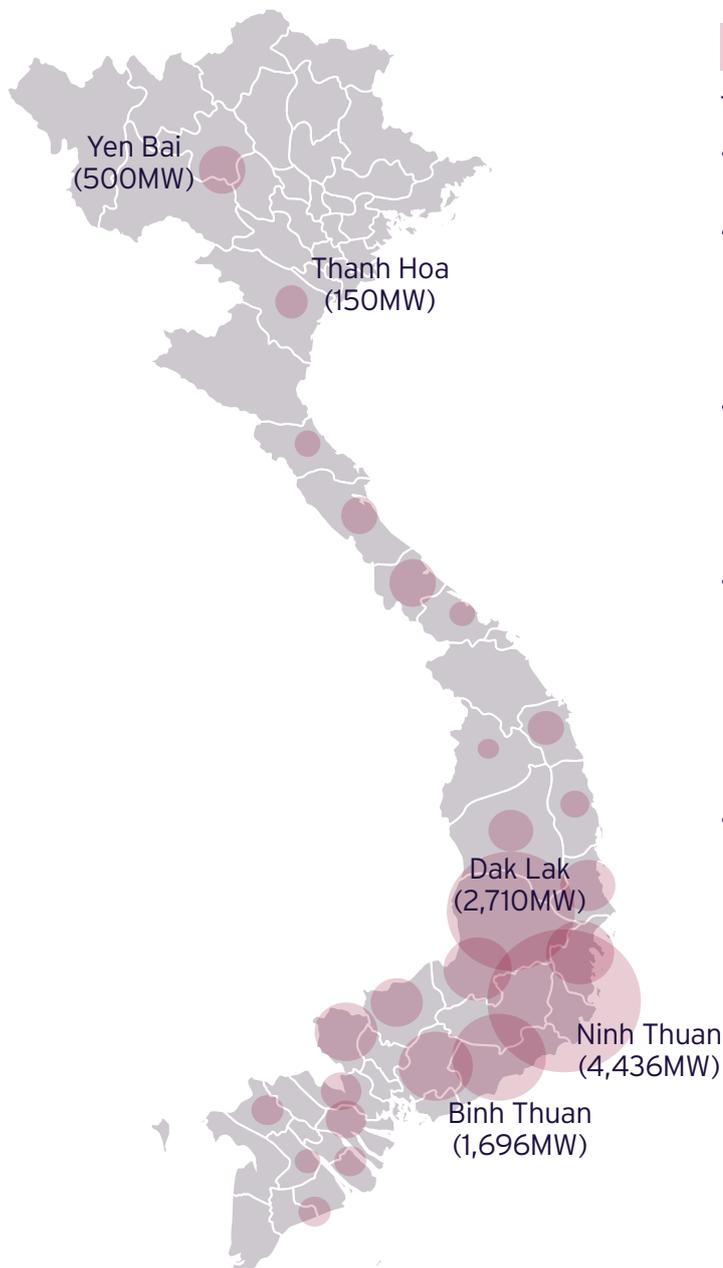
Renewable energy generators and EVN must negotiate and conclude their PPAs on the basis of the standard agreement forms provided by law. The MOIT has issued such forms for each of the small hydro, wind, biomass and solid waste power projects. It is preparing the draft form for solar power. While the parties can agree on additional provisions to the standard form PPA, they cannot vary the “basic contents.” However, the standard forms contain terms that increase costs and risks for investors and hence reduce bankability.

Some key points for concern are:

- Offtaker obligations and government guarantees: there are no “take or pay” provisions governing compensation if EVN, as the sole offtaker, fails to take electricity (by its own failure to cooperate or otherwise). EVN’s obligations are not guaranteed by the government, exposing projects to EVN payment risk. EVN is rated BB by Fitch, in line with the sovereign rating. Under Circular 18, the new template PPA no longer requires EVN to contractually agree to purchase yield from the solar farm
- Change in law: there are no specific provisions for a specific change in law
- Commissioning risk: in order to qualify for the FiT, the project would need to achieve the COD by the FiT’s deadline, without any allowance for commissioning delays attributable to EVN
- Force majeure: EVN’s obligations are suspended in a number of force majeure circumstances, as well as interruptions and outages due to grid overhauls and maintenance by EVN
- Termination payments: in the event of EVN’s default, there are no specific provisions regarding the calculation of damages, which are therefore governed by the Vietnamese law. Damages are calculated by the court and may not fully compensate the investors
- Currency fluctuations: the FiT is payable in Vietnamese dong, only adjusted annually based on the State Bank of Vietnam’s VND/US\$ exchange rate, presenting a risk for repayment of US\$ denominated debt. Further, the Standard Solar PPA does not contain an indexation clause to protect investors against increased costs or inflation
- Dispute resolution: the governing law is the Vietnamese law and the Vietnamese courts have exclusive jurisdiction. There is a provision for international arbitration

Appendix 3: Map of Renewable Energy Projects in Vietnam

Map of solar projects in Vietnam



Illustrative

 Registered capacity (MW)

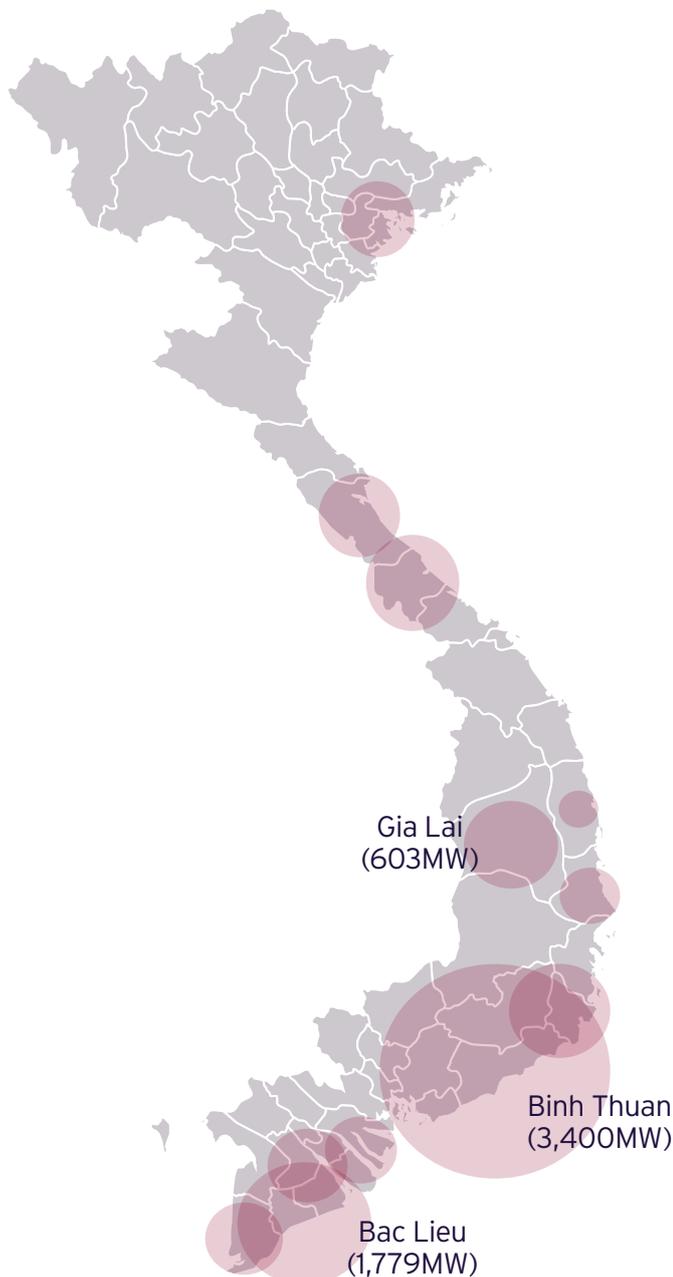
Total registered capacity in the database: 17,163MW

- 30 out of 63 provinces have solar projects in Vietnam
- Majority of utility-scale solar projects in Vietnam are located in South-Central and Southern regions of Vietnam. Total registered capacity in these two regions account for 91% of total registered capacity in Vietnam
- Three provinces Ninh Thuan, Dak Lak, Binh Thuan account for 52% of total registered capacity in Vietnam. These three provinces also have the highest level of solar irradiation in Vietnam
- Even though Yen Bai and Thanh Hoa (located in the Northern part and North-Central part of Vietnam) have lower solar irradiation compared to the provinces in the South, there are two floating solar projects proposed here to utilise the available water area and to serve the electricity demand within each province
- The project in Yen Bai province is a 500MW floating solar project at Thac Ba Lake, proposed by Solkiss - a Korean developer and is under permitting process. Thanh Hoa province has three solar projects, with a total capacity of 150MW, as of March 2020. The 30MW Yen Dinh floating solar project is already in operation from 2019

Note: This map illustrates the registered province-wise solar capacity in Vietnam. The registered capacity includes capacity already in operation and capacity in the pipeline (that have either been approved by the government or are still undergoing the permit process).

Source: EY research (based on data from GlobalData as of March 2020).

Map of wind projects in Vietnam



Illustrative

Registered capacity (MW)

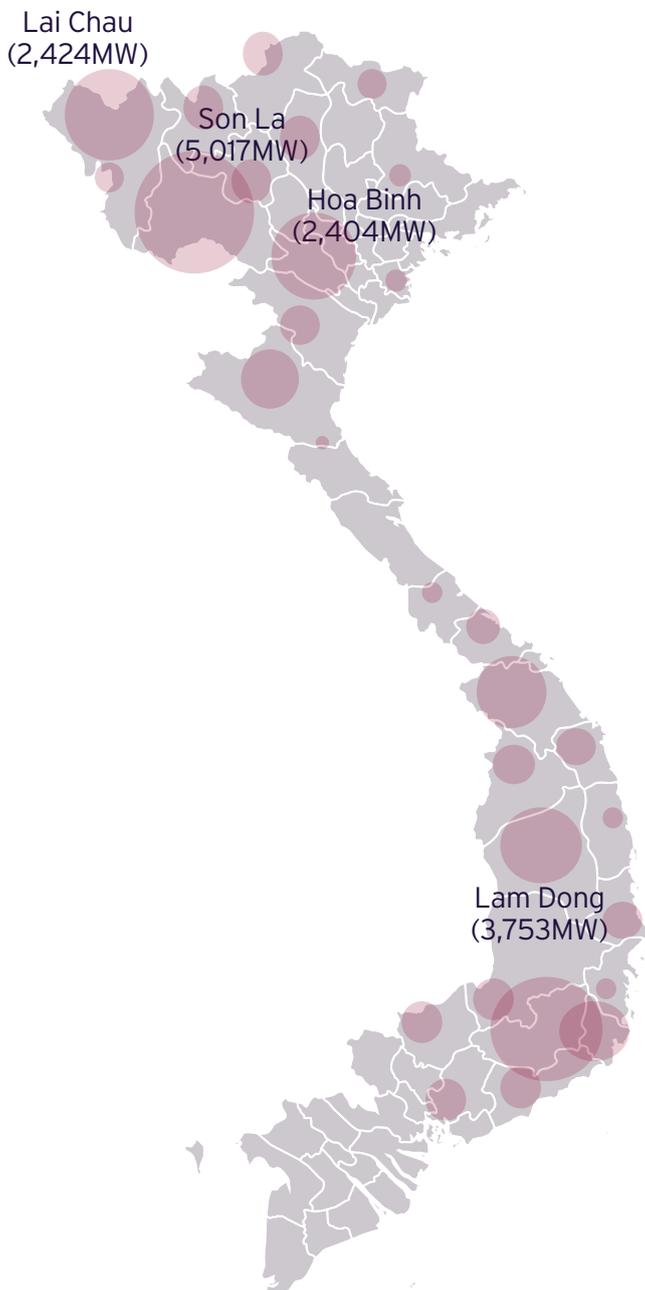
Total registered capacity in the database: 11,905MW

- 17 out of 63 provinces have wind projects in Vietnam
- Except Gia Lai province, all the provinces having wind projects are coastal. Including Gia Lai, all these provinces have favorable conditions to develop wind power plants
- Binh Thuan is currently having the largest wind registered capacity, even though there is just one project here, the Thang Long project. It is also the largest offshore wind project registered in Vietnam so far
- Provinces in Mekong Delta region such as Bac Lieu, Tra Vinh, Soc Trang and Ca Mau have ample intertidal areas, which are very suitable to develop near-shore wind projects. The first wind project in Vietnam - Cong Ly wind farm in Bac Lieu province has been developed in such an intertidal area
- Near-shore projects which have the advantage of shortened time in land clearance, are popular among wind developers in Vietnam. A total of 1,703MW of near-shore registered wind projects are there in Vietnam, accounting for 14% of total registered wind capacity in Vietnam

Note: This map illustrates the registered province-wise wind capacity in Vietnam. The registered capacity includes capacity already in operation and capacity in the pipeline (that have either been approved by the government or are still undergoing the permit process).

Source: EY research (based on data from GlobalData as of March 2020).

Map of hydropower projects in Vietnam



Illustrative

 Registered capacity (MW)

Total registered capacity in the database: 28,100MW

- 31 out of 63 provinces have hydropower projects in Vietnam
- A majority of hydropower projects in Vietnam are located in the mountainous areas in the North and Central Highland regions
- The Son La province has large hydropower projects such as the 2,400MW Son La hydropower project and the 1,200MW Dong Phu Yen hydropower project, which has the largest registered hydroelectric capacity in Vietnam. The Son La project is already in operation while the Dong Phu Yen project is still in the development phase with a target the target COD in the year 2028
- Lam Dong province has the second largest portfolio of hydropower projects in Vietnam with several large hydropower projects in the pipeline such as the Don Duong hydropower project (1200MW, COD: 2030) and Ninh Son hydropower project (1200MW, COD: 2028)

Note: This map illustrates the registered province-wise hydroelectric capacity in Vietnam. The registered capacity includes capacity already in operation and capacity in the pipeline (that have either been approved by the government or are still undergoing the permit process).

Source: EY research (based on data from GlobalData as of March 2020).

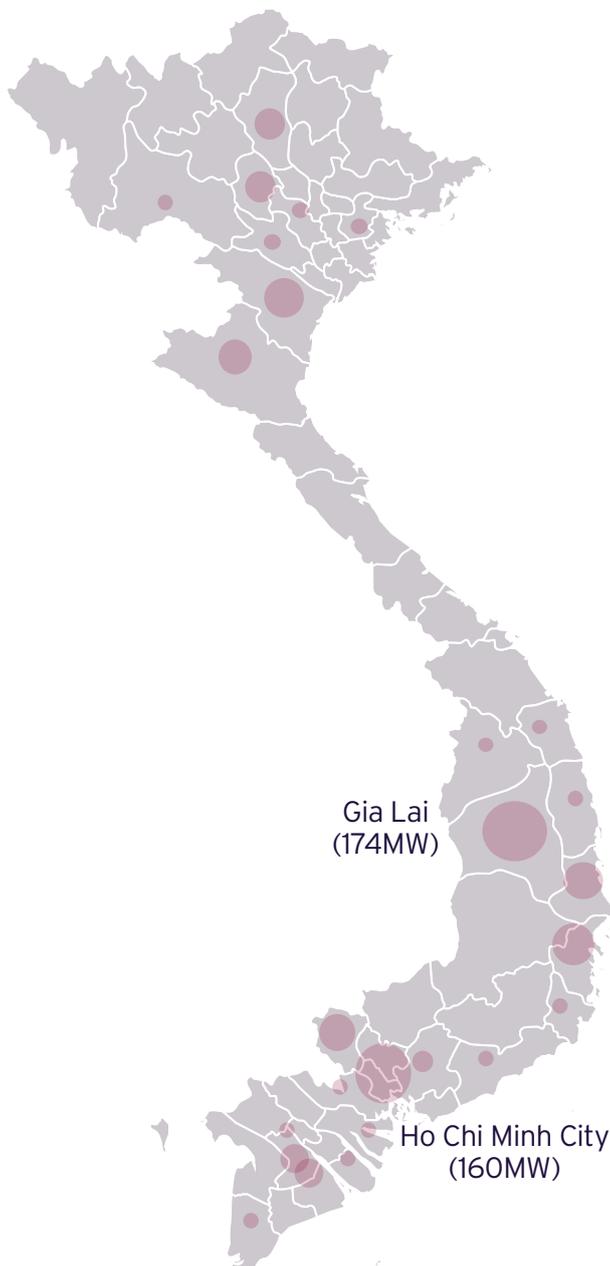
Map of bioenergy projects in Vietnam

Illustrative

 Registered capacity (MW)

Total registered capacity in the database: 832MW

- 29 out of 63 provinces have bioenergy projects in Vietnam
- A majority of these bioenergy projects are biomass plants built at sugar mills located across Vietnam
- Gia Lai province currently has the largest registered bioenergy capacity in Vietnam with two biomass projects already in operation: 135MW An Khe biomass plant owned by Quang Ngai Sugar and 35MW Cheo Reo biomass plant owned by Thanh Cong Group, a leading conglomerate with strong market position in sugarcane
- Ho Chi Minh City ranked second in terms of registered bioenergy capacity in Vietnam. Being the largest city in Vietnam, a majority of bioenergy plants in Ho Chi Minh City are WTE plants. However, as of March 2020, only the 2.4MW Go Cat WTE is active. Other projects are still under construction or undergoing the permit process



Note: This map illustrates the registered province-wise bioenergy capacity in Vietnam. The registered capacity includes capacity already in operation and capacity in the pipeline (that have either been approved by the government or are still undergoing the permit process).

Source: EY research (based on data from GlobalData as of March 2020).

Appendix 4: Upcoming Projects

The landscape for projects in the region is dynamically changing. Projects are not always developed through a structured procurement process but include a combination of unsolicited and sponsor-initiated projects. UK companies interested in the sector must actively engage in the market and market participants to explore leads and develop opportunities.

A consolidated summary of upcoming projects presented in each chapter is included in the following table. More detailed information is available for selected projects denoted with * in the table below.

Summary of upcoming projects

Project name	Sector	Location	Investor	Capacity (MW)	Status	Year online
B.Grimm Viet Nam Solar Power Project (Phu Yen Project)	Solar	Phu Yen	Phu Yen TTP JSC (Phu Yen JSC)	257	Announced	-
Genco3 Ninh Thuan Solar PV Park	Solar	Ninh Thuan	EVN Power Generation Corporation 3	350	Announced	2021
Ham Thuan Floating Solar PV Park*	Solar	Binh Thuan	Da Nhim-Ham Thuan-Da Mi Hydropower JSC	300	Permitting	2021
Xuan Thien Thuan Solar PV Park*	Solar	Ninh Thuan	Xuan Thien Co. Ltd.	240	Permitting	2020
Hoang Son Solar PV Project	Solar	Ninh Thuan	My Son I Solar Power Co. Ltd.	62	Permitting	2020
PNE wind farm*	Wind	Offshore (Binh Dinh)	PNE Group	2,000 (over 3 phases)	Announced	2024
Nexif Ben Tre Onshore Wind Farm	Wind	Ben Tre	Nexif and RH International (Singapore) Corporation	80	Announced	2022
AIT/Mainstream Ben Tre Offshore Wind Farm*	Wind	Ben Tre	Mainstream Renewable Power and Advance Information Technologies (AIT)	500 (over 2 phases)	Announced	2023
La Gan Offshore Wind Farm*	Wind	Binh Thuan	Copenhagen Infrastructure Partners (CIP), Asia Petroleum Energy (Asiapetro) and Novasia Energy	3,500 (over 2 phases)	Announced	2020 - 2030
Phu Cuong Wind Farm	Wind	Near-shore (Soc Trang)	GE Financial Services; Mainstream Renewable Power Ltd.; Phu Cuong Group	800	Permitting	-
Mekong Wind Farm	Wind	Near-shore (Ben Tre)	Gulf Energy Development PCL; Thanh Cong Group	310	Permitting	2021
Pu Chu*	Wind	Gia Lai	TSV-The Blue Circle (JV)	200	Announced	2020
Cu' An	Wind	Gia Lai	TSV-The Blue Circle (JV)	200	Announced	2020

Source: Based on information available in various databases.

Please note independent verification has not been completed to verify the accuracy of third party sources.

*Detailed information on project included in the Appendix

Project name	Sector	Location	Investor	Capacity (MW)	Status	Year online
Bai Dinh Wind Project	Wind	Ninh Binh	Tan Hoan Cau Corp	180	Permitting	2021
Ben Tre Wind Farm	Wind	Ben Tre	Marshal Global Renewable Power Pvt. Ltd.	125	Permitting	2021
Hanbanram Wind Project	Wind	Ninh Thuan	LandVille Energy Co. Ltd.	117	Permitting	2020
Ben Tre 7	Wind	Ben Tre	Ecotech	110	Permitting	2020
Kong Yang	Wind	Gia Lai	TSV-The Blue Circle (JV)	103	Announced	2020
Nam Rom	Small hydro	Dien Bien	-	6	Permitting	-
Tra linh 2*	Small hydro	Quang Nam	Ngoc Linh Hydropower	27	Announced	-
Dak Mi 1A*	Small hydro	Kon Tum	Quang Doc Kon Tum JSC	11	Permitting	-
Trung Xuan	Small hydro	Thanh Hoa	Thanh Binh Co Ltd	10.5	Permitting	-
Hang Dong B*	Small hydro	-	-	20	Permitting	-
Nam Long HPP	Small hydro	Dak Nong	Dak Nong Power Investment and Management JSC	9	Permitting	2021
Dong Mit HPP*	Small hydro	Binh Dinh	-	9.4	Permitting	2022
Rao Trang 3*	Small hydro	Thua Thien-Hue	-	13	Permitting	-
Tra Khuc 2	Small hydro	Quang Ngai	-	30	Announced	-
Nam Ban 3	Small hydro	Lai Chau	Nam Ban 3 Power Investment & Development Co Ltd	22	Permitting	-
Chu Va 2	Small hydro	Lai Chau	-	14	Permitting	-
Muong Nhe 2	Small hydro	Dien Bien	-	16	Permitting	-
Muong Tung*	Small hydro	Dien Bien	-	10	Permitting	-
Nam Ngam	Small hydro	Dien Bien	-	3.2	Permitting	-
De Bau	Small hydro	Dien Bien	-	3	Permitting	-
Mo Phi 1	Small hydro	Dien Bien	-	6.2	Permitting	-

Source: Based on information available in various databases.

Please note independent verification has not been completed to verify the accuracy of third party sources.

*Detailed information on project included in the Appendix

Detailed project information (continued)

Project name	Sector	Location	Investor	Capacity (MW)	Status	Year online
Phi Linh*	Small hydro	Dien Bien	-	16	Permitting	-
Hang Dong A*	Small hydro	-	Xuan Thien Ninh Binh Co Ltd	16	Permitting	-
Tak Le	Small hydro	Quang Nam	-	11.6	Announced	-
Luoc Lah	Small hydro	Quang Nam	-	11	Announced	-
Tra Leng	Small hydro	Quang Nam	-	30	Announced	-
Nam Nhe 2	Small hydro	Dien Bien	-	16	Permitting	-
Hua Chang 2	Small hydro	Lai Chau	-	77	Permitting	-
Song Ma 2	Small hydro	Dien Bien	-	21	Permitting	-
Ta Pao Ho	Small hydro	Lai Chau	-	10	Permitting	-
Nam Nghe	Small hydro	Lai Chau	Northern Power Corporation	7.5	Permitting	-
Tung Chung	Small hydro	Lao Cai	-	10.12	Permitting	-
Ta Loi 1	Small hydro	Lao Cai	Investment Corporation and Transport Infrastructure	15	Announced	-
Que Son Biomass Power Plant	Bioenergy	Quang Nam		12	Announced	-
Vietnam Waste Solution Landfill Power Plant*	Bioenergy	HCMC	Vietnam Waste Solution	12	Announced	-
Quang Binh Biomass Power Plant	Bioenergy	Quang Binh	Dohwa Engineering Co. Ltd.	100	Announced	2020
Trisun Green WTE Plant	Bioenergy	HCMC	Trisun Green Energy Corp.	66	Permitting	N.A.
Hitachi Ho Chi Minh WTE Plant*	Bioenergy	HCMC	Hitachi Zosen Corp	20	Announced	N.A.
Keppel Ho Chi Minh WTE Plant*	Bioenergy	HCMC	Keppel Seghers Pte. Ltd.	20	Announced	N.A.
Citra Gasification Power Plant*	Bioenergy	Ha Noi	PT Citra Metro Jaya Energi	12	Permitting	N.A.

Source: Based on information available in various databases.

Please note independent verification has not been completed to verify the accuracy of third party sources.

*Detailed information on project included in the Appendix

Project name	Ham Thuan Floating Solar PV Park
Project type	Solar PV
Installed capacity	300MW
Project location	Binh Thuan, Vietnam
Developer	Da Nhim-Ham Thuan-Da Mi Hydropower Joint Stock Company JSC
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Public
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	Da Nhim-Ham Thuan-Da Mi Hydropower Joint Stock Company was involved in Da Mi Floating Solar PV Park. This is a floating solar power plant on Da Mi reservoir, located at La Ngau commune, Tanh Linh district and La Da commune, Ham Thuan Bac district, with a capacity of 47.50MW. The project was developed in two stages of capacity 20.50MW and 27MW each.
Other stakeholders	Asian Development Bank has provided finance for this project.
Notes	<ul style="list-style-type: none"> • This project is likely to be deployed at the Ham Thuan Hydroelectric Power Complex • Da Nhim - Ham Thuan Hydro Power Plant operates as a subsidiary of Electricity of Vietnam (EVN) • Total capex for the project: US\$476.292 million
Business opportunities	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Information sources	GlobalData

Detailed project information (continued)

Project name	Xuan Thien Thuan Solar PV Park
Project type	Solar PV
Installed capacity	240MW (Park I: 150MW and Park II: 90MW)
Project location	Ninh Thuan, Vietnam
Developer	Xuan Thien Co. Ltd.
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Private
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	Ingeteam Corporacion SA has supplied a 220kV plant substation, string combiner boxes, SCADA system and the power plant controller (PPC) for the project.
Notes	<ul style="list-style-type: none"> • The AC capacity of the plant: 200MW • Type of mounting: ground-mounted • Type of installation: utility-scale
Business opportunities	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Information sources	GlobalData

Project name	PNE
Project type	Offshore wind power plant
Installed capacity	2,000MW (Phase 1: 700MW, phase 2: 650MW and phase 3: 650MW)
Project location	Phu Cat and Phu My, Binh Dinh province, Vietnam
Developer	PNE Group
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	Technical survey to commence in 2021
Any other issues	-
Developer track record	This is the first renewable project for PNE AG in Vietnam
Other stakeholders	-
Notes	<ul style="list-style-type: none"> • PNE is targeting to start the pilot phase 1 in 2024 • Total capex for the project: US\$4.8 billion
Business opportunities	<ul style="list-style-type: none"> • Financing, insurance and other professional services • PNE plans to install 154-166 wind turbines for the project
Information sources	IJGlobal

Detailed project information (continued)

Project name	AIT/Mainstream Ben Tre Offshore Wind Farm
Project type	Offshore wind power plant
Installed capacity	500MW
Project location	Ben Tre, Vietnam
Developer	Mainstream Renewable Power and Advance Information Technologies (AIT)
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	<ul style="list-style-type: none"> Received site survey license in 2020 Under consideration - permitting stage. Applied for inclusion in the Power Development Plan (PDP) 8
PPA offtaker	-
Feasibility study	Completed
Other studies	-
Any other issues	-
Developer track record	<ul style="list-style-type: none"> Mainstream Renewable Power has previously partnered with Vietnam-based Phu Cuong Group through a joint venture for the 1.4GW Phu Cuong Soc Trang wind project in Soc Tran province, Vietnam. The project has 2 phases, with phase 1 targeting 400MW of production and phase 2 targeting 1GW AIT is fairly new to the renewable energy development business in Vietnam. Currently, AIT has a pipeline under development totaling 200 MW (50 MW solar and 150 MW onshore wind) which have received approval from the MOIT to be included in the national PDP
Other stakeholders	-
Notes	<ul style="list-style-type: none"> Plans to reach financial close and commence construction by 2023/24, and reach COD by 2025/26
Business opportunities	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Information sources	<ul style="list-style-type: none"> IJGlobal Mainstream Renewable Power website - https://www.mainstreamrp.com/insights/Agreement-with-AIT-to-co-develop-500-mw-offshore-wind-project/

Project name	La Gan Offshore Wind Farm
Project type	Offshore wind power plant
Installed capacity	3,500MW (Phase 1: 600MW and phase 2: 3,000MW)
Project location	Binh Thuan, Vietnam
Developer	Copenhagen Infrastructure Partners (CIP), Asiapetro and Novasia
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Copenhagen Infrastructure New Markets Fund I (CI NMF I), a fund focusing on greenfield renewable energy infrastructure projects, will invest in the project
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	Environmental and Social Impact Assessment- https://www.niras.com/projects/la-gan-offshore-wind-farm-in-vietnam/
Any other issues	-
Developer track record	CIP was the lead sponsor for Taiwan's 600MW Changfang & Xidao offshore wind project. This remains CIP's only wind project in Asia
Other stakeholders	Floating LiDAR contract awarded to AXYS Technologies; local subcontractors including Petrosetco, the Vietnam Coast Guard and Rynan Technologies engaged to install advanced equipment for wind and wave measurement off the coast of Binh Thuan
Notes	<ul style="list-style-type: none"> Total capex for the project: US\$10 billion
Business opportunities	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Information sources	<ul style="list-style-type: none"> IJGlobal NIRAS website - https://www.niras.com/projects/la-gan-offshore-wind-farm-in-vietnam/ Viet Nam News - https://vietnamnews.vn/economy/804044/site-investigation-contracts-signed-for-35-gw-offshore-wind-power-plant.html CIP website - https://cippartners.dk/investments/

Detailed project information (continued)

Project name	Pu Chu
Project type	Wind power plant
Installed capacity	200MW
Project location	Kong Yang- Gia Lai, Vietnam
Developer	The Blue Circle Pte. Ltd. as IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Private
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	-
Any other issues	-
Developer track record	The Blue Circle Pte. Ltd. was involved in Dam Nai Project in the Ninh Thuan province of Vietnam. The project has a total capacity of 39.375MW. The project sits along the Highway One and consists of 933 hectares of agricultural land where a 100 metre meteorological mast had been erected by The Blue Circle in May 2015.
Other stakeholders	TSV JSC served as the financial player.
Notes	<ul style="list-style-type: none"> • The Blue Circle Pte. Ltd. served as a developer IPP • TSV JSC served as the financial player with equity offerings • Total capex for the project: US\$473.60 million
Business opportunities	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Information sources	GlobalData

Project name	Bai Dinh Wind Project
Project type	Wind power plant
Installed capacity	180MW
Project location	Bai Dinh- Ninh Binh, Vietnam
Developer	Tan Hoan Cau Corp
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Private
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	Tan Hoan Cau Corp was involved in Huong Linh 2 Wind Farm, an extension of Phu Lac Wind Power Plant
Other stakeholders	Financing, insurance and other professional services; limited equipment supply if suppliers are not yet identified
Notes	Total capex for the project: US\$426.24 million
Business opportunities	-
Information sources	GlobalData

Detailed project information (continued)

Project name	Tra linh 2
Project type	Small hydro
Installed capacity	27MW
Project location	Quang Nam, Vietnam
Developer	Ngoc Linh Hydropower as IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	-
Notes	<ul style="list-style-type: none">• Total capex of US\$37.2 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Project name	Dak Mi 1A
Project type	Small hydro
Installed capacity	11MW
Project location	Kon Tum, Vietnam
Developer	Quang Duc Kon Tum JSC as IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	Quang Duc Kon Tum JSC is also currently building an 84MW hydro project, the Dak Mi 1, in Kon Tum province at a cost of US\$84 million. The project is at present suspended due to a modification of the original design from 49MW to 84MW
Other stakeholders	-
Notes	Total capex of US\$11.3 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Detailed project information (continued)

Project name	Trung Xuan HPP
Project type	Small hydro
Installed capacity	10.5MW
Project location	Thanh Hoa, Vietnam
Developer	Thanh Binh Co Ltd as IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	According to GlobalData, the developer has only one project in the pipeline - Trung Xuan HPP
Other stakeholders	FLOVEL Energy Private Limited is supplying 2 x 5.25MW Kaplan turbines and generators for the project
Notes	<ul style="list-style-type: none"> Investment plan has been approved the People's Committee of Thanh Hoa province as of 2017 Total capex of US\$10.8 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Project name	Hang Dong B
Project type	Small hydro
Installed capacity	20MW
Project location	Undisclosed
Developer	Undisclosed
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	FLOVEL Energy Private Limited is supplying 2 x 10MW Francis turbines and generators for the project
Notes	Total capex of US\$20.7 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Detailed project information (continued)

Project name	Dong Mit HPP
Project type	Small hydro
Installed capacity	9.4MW
Project location	Binh Dinh, Vietnam
Developer	Undisclosed
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	FLOVEL Energy Private Limited is supplying 2 x 4.726MW Kaplan turbines and generators for the project
Notes	<ul style="list-style-type: none"> • Expected to come online in 2022 • Total capex of US\$9.7 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Project name	Rao Trang 3
Project type	Small hydro
Installed capacity	13MW
Project location	Thua Thien-Hue, Vietnam
Developer	Rao Trang 3 Hydroelectric Joint Stock Company
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	Truong Son Construction Consulting Limited Company is providing consulting services
Notes	Total capex of US\$12.5 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Detailed project information (continued)

Project name	Muong Tung
Project type	Small hydro
Installed capacity	10MW
Project location	Muong Cha - Dien Bien, Vietnam
Developer	-
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	-
Notes	Total capex of US\$10.35 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Project name	Phi Linh
Project type	Small hydro
Installed capacity	16MW
Project location	Dien Bien, Vietnam
Developer	-
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	-
Other stakeholders	Song Da 505 - main construction contractor of the project
Notes	Total capex for the project is US\$16.56 million.
Business opportunities	-
Information sources	GlobalData

Detailed project information (continued)

Project name	Hang Dong A
Project type	Small hydro
Installed capacity	16MW
Project location	Undisclosed
Developer	Xuan Thien Ninh Binh Co Ltd as IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - permitting stage
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	-
Developer track record	According to GlobalData, the developer has only one project in the pipeline - Hang Dong A
Other stakeholders	Andritz Hydro to supply 2x8 MW Pelton turbines
Notes	Total capex of US\$16.5 million is fixed for the project development
Business opportunities	Professional services
Information sources	GlobalData

Project name	Vietnam Waste Solution Landfill Power Plant
Project type	Bioenergy
Installed capacity	12MW
Project location	Ho Chi Minh City, Vietnam
Developer	Vietnam Waste Solutions is the owner of the plant
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	Private
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	-
Any other issues	-
Developer track record	Vietnam Waste Company Limited (VWS) is a wholly owned subsidiary of California Waste Solution (CWS), headquartered in California, USA. The company was established to provide waste treatment services to Vietnam. Vietnam Waste Co. Ltd. is responsible for the design, construction and operation of the Da Phuoc Waste Treatment Complex (DPIWMF). DPIWMF was built in Da Phuoc commune, Binh Chanh district, Ho Chi Minh City, Vietnam. Total investment in this project is over US\$100 million. Financial resources from CWS, US and Vietnamese banks
Other stakeholders	-
Notes	The project will be developed at a total investment of around US\$27.50 million
Business opportunities	<ul style="list-style-type: none"> • Financing, insurance and other professional services • Limited equipment supply if suppliers are not yet identified
Information sources	<ul style="list-style-type: none"> • GlobalData • Vietnam Waste Solutions Limited website - www.vnwaste.com/

Detailed project information (continued)

Project name	Citra Gasification Power Plant
Project type	Bioenergy
Installed capacity	12MW
Project location	Ha Noi, Vietnam
Developer	<ul style="list-style-type: none"> • Owner - PT Citra Metro Jaya Energi • Developer - EQTEC
PPA status	PT Citra was expected to secure PPA by Q3 2018
Tariff	-
Financing	Financing is in process
Financing sources	Private
Permits	PT Citra was expected to secure all the permits by Q3 2018
PPA offtaker	-
Feasibility study	Under consideration - permitting stage
Other studies	-
Any other issues	Since 2018, the project has not made progress
Developer track record	<ul style="list-style-type: none"> • PT Citra Metro Jaya Energi (PT CMJE) - it is an experience power plant developer and investment company with long-standing experiences throughout Indonesia. CMJE is an affiliate of Regions20 Asia-Pacific on WTE project for the majority sub-national and cities from Africa and ASEAN. Together with its German technology partner, CMJE has successfully co-developed an innovative gasification model community solid waste suitable for community waste in Indonesia and Vietnam to generate hi-calorie energy. The two-stage gasification technology has been registered as CMJE patent • EQTEC - Ireland-headed EQTEC plc (formerly REACT Energy plc) is a technology solution company for waste gasification to energy projects. Its gasification technology used in projects, including Movialsa biomass gasification plant, Karlovo & Heat Biomass EOOD, Syngas Italy, Belisce I Project and Polygen project. The company provides operation and management services to clean energy projects
Other stakeholders	GE Jenbacher GmbH & Co. OHG - engine supplier
Notes	<ul style="list-style-type: none"> • Total capex for the project is US\$42.58 million • PT CMJE (owner of the project) engaged EQTEC as the developer of the project on EPC contract in 2018 • The value of the contract was between EUR20 million (US\$23.4m) and EUR22 million • CITRA was responsible for obtaining the permits, licences and authorisations (PLA), PPA and feedstock agreements for the 12MW project expected to be obtained during Q3 2018 • Feedstock agreements would incorporate EQTEC's specification for refuse-derived fuel (RDF), a fuel produced from various types of wastes, such as MSW, industrial wastes or commercial wastes and is the primary feedstock for EQTEC's UK project pipeline
Business opportunities	<ul style="list-style-type: none"> • Financing, insurance and other professional services • Limited equipment supply if suppliers are not yet identified
Information sources	<ul style="list-style-type: none"> • GlobalData • Waste Management World • Bioenergy International • INDOVIN

Project name	Hitachi Ho Chi Minh WTE Plant
Project type	Bioenergy
Installed capacity	20MW
Project location	Ho Chi Minh City, Vietnam
Developer	Hitachi Zosen Corp as an IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	
Any other issues	-
Developer track record	<p>Hitachi Zosen Corp (Hitz) is an industrial and engineering company, based in Osaka, Japan. It designs, constructs and operates refuse incineration and recycling facilities, pressure vessels, marine diesel engines and press machines and other process machines</p> <p>The project in Ho Chi Minh City is part of a company plan to launch the operation of such facilities in emerging countries suffering from electricity shortages. The generated electricity, to be purchased by local utilities, will be enough to meet the power demand of nearly 10,000 homes</p>
Other stakeholders	
Notes	Total capex for the project is US\$100 million
Business opportunities	Professional services
Information sources	GlobalData

Detailed project information (continued)

Project name	Keppel Ho Chi Minh WTE Plant
Project type	Bioenergy
Installed capacity	20MW
Project location	Ho Chi Minh City, Vietnam
Developer	Keppel Seghers Pte. Ltd. as an IPP
PPA status	-
Tariff	-
Financing	Financing is in process
Financing sources	-
Permits	Under consideration - announced stage
PPA offtaker	-
Feasibility study	Under consideration - announced stage
Other studies	
Any other issues	-
Developer track record	Keppel Seghers Pte. Ltd. (Keppel Seghers), a subsidiary of Keppel Infrastructure Holdings Pte. Ltd., is an environmental technology solutions provider, based in Singapore. The company offers waste management, wastewater treatment, water reuse, desalination and off-gas treatment services. It has operations in Europe, Asia-Pacific, North and South America and the Middle East and Africa
Other stakeholders	-
Notes	Total capex for the project is US\$150 million
Business opportunities	-
Information sources	GlobalData

Appendix 5: Major foreign developers or equipment and service providers

Company	Incorporated / headquartered	Description	Prominent sectors
B. Grimm Group	Bangkok, Thailand	<ul style="list-style-type: none"> B. Grimm Group operates power generation, cooling, healthcare, lifestyle, transport, manufacturing, and real estate businesses. The company operates power plants in Thailand and Vietnam For more information: https://www.bgrimmpower.com/en 	<ul style="list-style-type: none"> Solar developer
Sermsang Power	Bangkok, Thailand	<ul style="list-style-type: none"> Sermsang Power Corporation Public Company Limited operates in the renewable energy business - through solar farm and rooftop, and wind farm projects in Asia. The company also provides investment and consultancy services For more information: https://www.sermsang.com/home 	<ul style="list-style-type: none"> Solar developer
Sunseap	Singapore	<ul style="list-style-type: none"> Sunseap Group Pte. Ltd. provides clean energy solutions for residential and commercial customers in Singapore. The company specializes in solar PPA, offsite clean energy supply, EPC and O&M solar PV solutions, demand-side management, energy efficiency, and more services For more information: https://www.sunseap.com/SG/ 	<ul style="list-style-type: none"> Solar developer
AC Energy	Philippines	<ul style="list-style-type: none"> AC Energy formerly known as Michigan Power Inc is an operating subsidiary of Philippines-based Ayala Corp. The company develops and operates power generation facilities that generate power using solar, wind, and mini-hydro energy For more information: https://www.acenergy.com.ph/ 	<ul style="list-style-type: none"> Solar developer
Power Construction Corporation of China	Beijing, People's Republic of China (PRC)	<ul style="list-style-type: none"> Power Construction Corporation of China, Ltd, an operating subsidiary of Power Construction Corporation of China provides electric utility line construction services. The company engages in hydropower engineering, water works engineering, thermal power engineering, new energy engineering, and other projects. Power Construction China also operates property development For more information: http://pr.powerchina.cn/g315.aspx 	<ul style="list-style-type: none"> Solar EPC contractor
Waaree Energies	Mumbai, India	<ul style="list-style-type: none"> Waaree Energies Private Limited designs, installs, and supplies semiconductors For more information: https://www.waaree.com/ 	<ul style="list-style-type: none"> Solar EPC contractor

Sources: Bloomberg, Capital IQ, IJGlobal, company websites, EY research.

Appendix 5: Major foreign developers or equipment and service providers (continued)

Company	Incorporated / headquartered	Description	Prominent sectors
JGC Corporation	Yokohama, Japan	<ul style="list-style-type: none"> JGC Holdings Corporation, formerly known as JGC Corporation, operates in Japan and internationally. The company provides engineering, procurement, and construction services for plants and facilities. The company is involved in the design, procurement, construction, and performance test services of plant and machinery, and also manufactures and distributes chemicals and catalyst products. The company also provides environment, energy and resources, and social science consulting services For more information: https://www.jgc.com/en/ 	<ul style="list-style-type: none"> Solar EPC contractor
Jinko Solar	Shangrao, China	<ul style="list-style-type: none"> Jinko Solar Co., Ltd. manufactures photovoltaic products. The company develops, manufactures, and markets crystalline ingots, wafers, cells, mono-crystalline photovoltaic panels, and multi-crystalline photovoltaic panels For more information: http://www.jinkosolar.com/ 	<ul style="list-style-type: none"> Solar module provider
Sharp Energy Solutions	Yao, Japan	<ul style="list-style-type: none"> Sharp Energy Solutions Corporation, an operating subsidiary of Sharp Corporation engages in distribution and sale of photovoltaic systems For more information: https://www.sharp-sesj.co.jp/en/ 	<ul style="list-style-type: none"> Solar module provider
Gulf Energy	Bangkok, Thailand	<ul style="list-style-type: none"> Gulf Energy produces and sells electricity, steam, and cold water to public and private clients in Thailand and internationally. The company operates in three segments: power, consulting, and infrastructure For more information: https://www.gulf.co.th/en/ 	<ul style="list-style-type: none"> Wind developer
Aboitiz Power	Taguig City, the Philippines	<ul style="list-style-type: none"> Aboitiz Power Corporation, a subsidiary of Aboitiz Equity Ventures, engages in the power generation, distribution, and retail business in the Philippines. The company operates hydropower, geothermal, solar, coal, and oil power plants. It sells its electricity through bilateral contracts as well as the Wholesale Electricity Spot market. The company also distributes electricity and has interests in various distribution utilities. In addition, it is involved in the retail of electricity to various industries For more information: https://aboitizpower.com/ 	<ul style="list-style-type: none"> Wind developer

Sources: Bloomberg, Capital IQ, IJGlobal, company websites, EY research.

Company	Incorporated / headquartered	Description	Prominent sectors
Samtan Co. Ltd (ST International)	Seoul, South Korea	<ul style="list-style-type: none"> ST International, formerly known as Samcheok Coal Development Co. is an operating subsidiary of Samchully Co., Ltd. which engages in the exploration, production, transportation, and shipping of mineral resources in South Korea and internationally. The company also produces and exports thermal coal. In Indonesia, the company produces crude palm oil and operates an independent thermal coal power plant in West Indonesia. Further, it holds interests in exploration licenses in Mongolia For more information: http://www.samtan.co.kr/eng/company/company01.php 	<ul style="list-style-type: none"> Wind developer
Banpu Power	Bangkok, Thailand	<ul style="list-style-type: none"> Banpu Power Public Company Limited, an operating subsidiary of Banpu Public Company Limited engages in the power business in Asia. The company invests in power and renewable energy projects, as well as other industrial areas; and produces and sells solar, wind, and coal power. The company is also involved in the production and sale of steam; and power trading activity For more information: https://www.banpupower.com/ 	<ul style="list-style-type: none"> Wind developer
Vestas	Aarhus, Denmark	<ul style="list-style-type: none"> Vestas Wind Systems A/S designs, manufactures, installs, and services wind turbines worldwide For more information: https://www.vestas.com/ 	<ul style="list-style-type: none"> Wind EPC contractor Wind turbine supplier
Pöyry	Vantaa, Finland	<ul style="list-style-type: none"> B. Grimm Group operates power generation, cooling, healthcare, lifestyle, transport, manufacturing, and real estate businesses. The company operates power plants in Thailand and Vietnam For more information: https://www.bgrimmpower.com/en 	<ul style="list-style-type: none"> Wind EPC contractor
Modern Energy Management	Bangkok, Thailand and Singapore	<ul style="list-style-type: none"> Modern Energy Management advises on commercial, financial, and project risk management for the development, construction and operation of investment grade renewable energy projects in emerging markets For more information: http://modernenergy.management/ 	<ul style="list-style-type: none"> Wind EPC contractor

Sources: Bloomberg, Capital IQ, IJGlobal, company websites, EY research.

Appendix 5: Major foreign developers or equipment and service providers (continued)

Company	Incorporated / headquartered	Description	Prominent sectors
General Electric (GE)	Boston, United States	<ul style="list-style-type: none"> General Electric Company is a globally diversified technology and financial services company. The Company's products and services include aircraft engines, power generation, water processing, and household appliances to medical imaging, business and consumer financing, and industrial products For more information: https://www.ge.com/renewableenergy/home 	<ul style="list-style-type: none"> Wind turbine supplier Hydro equipment provider
Siemens Gamesa	Zamudio, Spain	<ul style="list-style-type: none"> Siemens Gamesa Renewable Energy, S.A., formerly known as Gamesa Corporación Tecnológica, Sociedad Anónima is an operating subsidiary of Siemens Energy Global GmbH & Co. KG. which supplies wind power solutions worldwide For more information: https://www.siemensgamesa.com/en-int 	<ul style="list-style-type: none"> Wind turbine supplier
Sumitomo	Tokyo, Japan	<ul style="list-style-type: none"> Sumitomo Corporation is a general trading company. The Company imports and exports a wide variety of goods such as metals, machinery, chemicals, fuel, food products, and textiles. Sumitomo also operates real estate, construction, shipping, insurance, finance, and, leasing businesses For more information: https://www.sumitomocorp.com/en/jp/business/case/group/electric-power 	<ul style="list-style-type: none"> Hydro equipment provider
Toshiba	Tokyo, Japan	<ul style="list-style-type: none"> Toshiba Corporation manufactures and markets electrical and electronic products. The company's products include digital products such as PCs and televisions, NAND flash memories, and system LSIs (large-scale integrated), as well as social infrastructures such as power generators, medical equipment, and home appliances For more information: https://www.toshiba-energy.com/en/renewable-energy/product/ 	<ul style="list-style-type: none"> Hydro equipment provider
Nissho Iwai	Tokyo, Japan	<ul style="list-style-type: none"> Nissho Iwai Corporation merged into Nichimen Corporation to form Nissho Iwai-Nichimen Corporation. The company imported and exported a wide variety of products including metals, machinery, fuel, textiles, lumber, chemicals, and food For more information: https://www.sojitz.com/history/en/company/nisshoiwai/ 	<ul style="list-style-type: none"> Hydro equipment provider

Sources: Bloomberg, Capital IQ, IJGlobal, company websites, EY research.

Company	Incorporated / headquartered	Description	Prominent sectors
Hitachi Zosen	Osaka, Japan	<ul style="list-style-type: none"> Hitachi Zosen Corporation develops, manufactures, and sells environmental equipment and facilities including garbage incinerators and industrial waste processing facilities, plants, ships, steel structures, and industrial machinery For more information: https://www.hitachizosen.co.jp/english 	<ul style="list-style-type: none"> Biomass or WTE developer
Trisun Green	Houston, Texas	<ul style="list-style-type: none"> KCP Limited is a diversified company with interests in heavy engineering, sugar, cement, hydel-power, information technology, and biotechnology For more information: http://kcp.vn/profile/?lang=en 	<ul style="list-style-type: none"> Biomass or WTE developer
KCP	Chennai, India	<ul style="list-style-type: none"> B. Grimm Group operates power generation, cooling, healthcare, lifestyle, transport, manufacturing, and real estate businesses. The company operates power plants in Thailand and Vietnam For more information: https://www.bgrimmpower.com/en 	<ul style="list-style-type: none"> Biomass or WTE developer
Keppel	Singapore	<ul style="list-style-type: none"> Keppel Seghers Engineering Singapore Pte. Ltd. provides environmental technology solutions. The company offers various solutions including consultancy, design and engineering, technology, construction, operations, and maintenance of facilities For more information: http://www.keppelseghers.com/en/technology-and-solutions/ 	<ul style="list-style-type: none"> Biomass or WTE developer
China First Metallurgical Group Co. Ltd. (CFMCC)	Wuhan, China	<ul style="list-style-type: none"> China First Metallurgical Group Co Ltd., an operating subsidiary of Metallurgical Corporation of China Ltd. provides engineering construction services. The company constructs steel structure buildings, roads, municipal infrastructures, and other buildings. The company also operates real estate development and equipment manufacturing businesses For more information: http://www.mcc.com.cn/mccen/about_mcc/about_mcc60/index.html 	<ul style="list-style-type: none"> Biomass or WTE developer
China Tianying Inc	Nantong, People's Republic of China (PRC)	<ul style="list-style-type: none"> China Tianying Inc. offers environmental engineering services. The company provides sludge treatment, kitchen waste treatment, hazardous waste treatment, construction waste treatment, sewage treatment, landfill gas development, and other businesses. The company also operates investment, house loans, and other businesses For more information: https://www.ctyi.com.cn/en/about.html 	<ul style="list-style-type: none"> Biomass or WTE developer

Sources: Bloomberg, Capital IQ, IJGlobal, company websites, EY research.

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