

Socialist Republic of Vietnam

Data Collection Survey on Power Sector in Vietnam

Final Report

February 2021

Japan International Cooperation Agency (JICA)

TEPCO Power Grid, Inc. (TEPCO PG)

Tokyo Electric Power Company Holdings, Inc. (TEPCO HD)

Tokyo Electric Power Services Co., Ltd (TEPSCO)

Mitsubishi Research Institute, Inc. (MRI)

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Abbreviations

Abbreviation	Word
ADB	Asian Development Bank
AFD	Agence Française de Développement
AGC	Automatic Generation Control
ASEAN	Association of Southeast Asian Nations
BAU	Business as usual
BCC	Business Corporate Contract
BLT	Build, Lease & Transfer
BOO	Build, Own & Operation
BOT	Build, Operation & Transfer
BT	Build, & Transfer
BTL	Build, Transfer & Lease
BTO	Build, Transfer & Operation
BUR	Biennial Update Report
CF	Cash Flow
CfD	Contract for Difference
CPC	Central Power Corporation
DANIDA	Danish International Development Agency
DEPP	Danish Energy Partnership Programme in Viet Nam
DFR	Draft Final Report
DPPA	Direct Power Purchase Agreement
DR	Demand Response
DSM	Demand Side Management
DTG	Direct Trading Generator
ECA	Export Credit Agency
EDC	Economic load Dispatching Control
EESD	Department of Energy Efficiency and Sustainable Development
EMS	Energy Management System
EPTC	Electric Power Trading Company
ERAV	Electricity Regulatory Authority of Vietnam
EREA	Electricity & Renewable Energy Authority
EU	European Union
EVN	Vietnam Electricity
EVNNT	National Power Transmission Corporation
FIRR	Financial Internal Rate of Return
FIT	Feed-in Tariff
FR	Final Report
FS	Feasibility Study
GDE	General Directorate for Energy
GDP	Gross Domestic Product
GENCO	Generation Company
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GMS	Greater Mekong Subregion
GPS	Global Positioning System
GSO	General Statistics Office
HCMC	Ho Chi Minh City
HNPC	Hanoi Power Corporation
ICR	Inception Report

Abbreviation	Word
IE	Institute of Energy
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
INDC	Intended Nationally Determined Contribution
IP	Industrial Processes
IPP	Independent Power Producer
IPT	Independent Power Transmission
IRP	Integrated Resource Planning
JBIC	Japan Bank for International Cooperation
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company
JUSEP	Japan-U.S. Strategic Energy Partnership
KfW	Kreditanstalt für Wiederaufbau
LC	Large Customer
LEEC	Law on Energy Efficiency and Conservation
LFC	Load Frequency Control
LIBOR	London Interbank Offered Rate
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land Use Change and Forestry
METI	Ministry of Economy, Trade and Industry
MM	Man-Month
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MRV	Monitoring, Reporting and Verification
NDC	Nationally Determined Contribution
NLDC	National Load Dispatch Center
NPC	Northern Power Corporation
NPT	National Power Transmission Corporation
ODA	Official Development Assistance
O&M	Operation and Maintenance
PC	Power Corporation
PCS	Power Conditioning System
PDP	Power Development Planning
PECC	Power Engineering Consulting Joint Stock Company
PMB	Project Management Board
PMU	Phasor Measurement Unit
PPA	Power Purchase Agreement
PPC	Provincial's Party Committee
PPP	Public Private Partnership
PSPP	Pumped Storage Power Plant
REDS	Renewable Energy Development Strategy
RoE	Return on Equity
RPS	Renewables Portfolio Standard
SCADA	Supervisory Control and Data Acquisition
SGREEE	Smart Grids for Renewable Energy and Energy Efficiency
SMO	System market Operator
SMHP	Strategic Multipurpose Hydropower Plant

Abbreviation	Word
SPC	Southern Power Corporation
SPC	Special Purpose Company
SPP	Solar Power Plant
SP-RCC	Support Program to Respond to Climate Change
TA	Technical Assistance
TC	Technical Cooperation
TEPCO	Tokyo Electric Power Company
TOR	Terms of Reference
TWG	Technical Working Group
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollar
USTDA	U.S. Trade & Development Agency
VCGM	Vietnam Competitive Generation Market
VCRM	Vietnam Competitive Retail Market
VEIC	Vietnam Energy Information Center
VEIS	Vietnam Energy Information System
VEPG	Vietnam Energy Partnership Group
VGF	Viability Gap Funding
VGGS	Vietnam Green Growth Strategy
VLEEP	Vietnam Low Emissions Energy Program
VND	Vietnam Dong
VNEEP	Vietnam Energy Efficiency Programme
VWEM	Vietnam Wholesale Electricity Market
WACC	Weighted Average Cost of Capital
WB	World Bank
WPP	Wind Power Plant

Chapter 1. Introduction

1.1 Background to the Survey

In South Vietnam, the introduction of solar and wind power generation of about 5 GW each has been approved, and it is expected that the introduction of renewable energy will proceed rapidly. An urgent issue is to solve the supply-demand imbalance between the north and south based on the future increase in power supply in the southern region and the power deficit in the northern region. In addition, there is a concern that the introduction of a large amount of renewable energy will cause instability in the system, so urgent examination and the implement of countermeasures is required. Specifically, an examination of the feasibility of measures such as system enhancement, stabilization systems/operational improvements, and the installation of storage batteries is envisaged.

1.2 Purpose of the Survey

This survey comprehensively collects information necessary for examining the direction of medium- to long-term assistance for Vietnam in the power sector. In particular, it will consolidate and prioritize possible support measures from the perspectives of private sector partnerships such as overseas investment and loans, ODA loans, and technical assistance. In addition, it aims to examine the details of cooperation programs for which assistance can be provided in the short term.

1.3 Area in Which to Conduct the Survey

The whole of Vietnam.

1.4 Conducting Organizations in the Partner Country

Ministry of Industry and Trade: MOIT

Institute of Energy: IE

Electricity Regulatory Authority of Vietnam: ERAV

Electricity & Renewable Energy Authority: EREA

Vietnam Electricity: EVN

National Power Transmission Corporation: EVNNPT

Power Corporations: PCs (if necessary)

Chapter 2. Power Sector in Vietnam

2.1 Power Development Policy and relevant Key Legal Systems

2.1.1 Power Development Plan (PDP)

In Vietnam, the Law on Planning passed on November 24th, 2017 and took effect on January 1st, 2019. It prescribes the formulation of a sector-wise national plan. Power Development Plans (PDP) have been formulated every few years in Vietnam based on the assumptions regarding future electricity demand, presenting a medium-term plan for the next 10 years and a long-term plan for the next 20 years (the latest plan covers 25 years). In 1981, the plan was known as the Master Plan (MP), but since the 5th Master Plan, formulated in 2001, it has been given the name PDP.

MOIT is the entity responsible for the development of PDPs. In the past, it was MOIT's General Directorate for Energy (GDE), but the responsibility has been transferred to EREA due to the reorganization of MOIT.

For the PDP development, IE, an extra-departmental organization of MOIT, is designated as a consultant to lead the formulation of the draft plan. The draft of the PDP developed by IE is submitted to MOIT after reflecting comments from stakeholders such as EVN, PVN, and VINACOMIN. With the initiative taken by MOIT, a council consisting of relevant government agencies, regulatory bodies, local people's committees, and MOIT, etc., is formed and the plan reviewed. Finally, the plan is submitted to the Prime Minister.

The former Soviet Union provided support for the formulation of MP1 to IE, and Vietnam has subsequently received support from Japan for the formulation of MP4, PDP6 and PDP7. PDP8, which is scheduled to be drafted in 2020, is due to be developed mainly by IE, but international partners such as WB, USAID, and the Danish government are providing support through the provision of analysis tools.¹

Table 2-1 History of Power Development Plan

Name	Publication	Planning period		Support from other countries in planning
		Power development plan	Vision	
MP1	-	1981 - 1990	Up to 2000	Developed jointly by IE and the former Soviet Union
MP2	-	1986 - 1995	Up to 2005	-
MP3	-	1991 - 2000	Up to 2010	-
MP4	-	1996 - 2005	Up to 2015	Japan supported IE
PDP5	Published June 2001 (No: 95/2001/QD-TTg) Revised March 2003 (No: 40/2003/QD-TTg)	2001 - 2010	Up to 2020	-
PDP6	Published July 2007 (No. 110/2007/QD-TTg)	2006 - 2015	Up to 2025	Japan supported IE
PDP7	Published July 2011 (No. 1208/2011/QD-TTg) Revised December 2013 (No. 2414/QD-TTg) Revised again in March 2016 (No. 428 _ QD-TTg)	2011 - 2020	Up to 2030	Japan supported IE
PDP8	Scheduled to release within 2021	2021 - 2030	Up to 2045	-

¹ http://vepg.vn/wp-content/uploads/2019/09/VEPG_TWG1_3rd_Meeting_Report_15-03-2019.pdf

(Source: JICA survey team-prepared with reference to NEDO "Basic Project for International Technology and System Demonstration Project for Efficient Use of Energy Coal Project (Basic Survey on Efficient Coal Utilization System in Vietnam)")

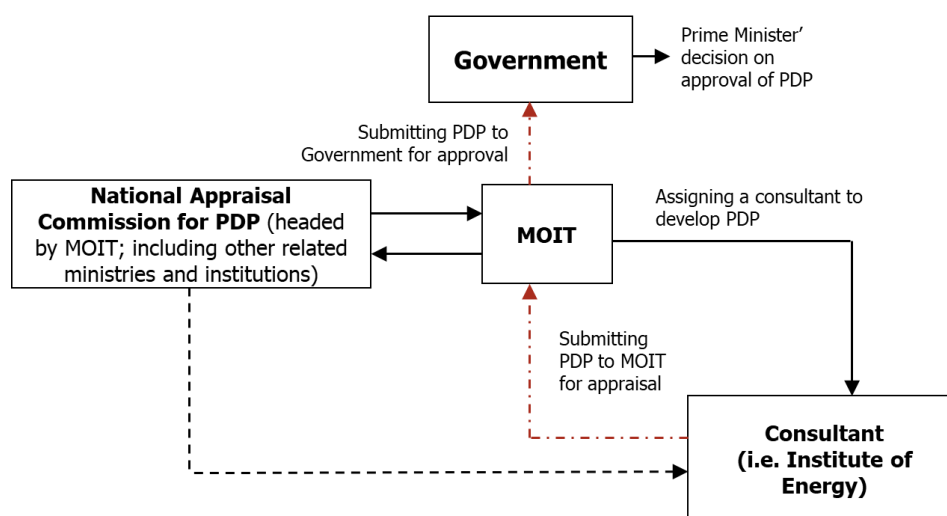


Figure 2-1 PDP development flow

(Source: JICA survey team-created with reference to The First Mekong Energy and Ecology Network (MEE-Net) "Vietnam Electricity Sector - an Introduction -" http://probeinternational.org/library/wp-content/uploads/2011/08/Country-Profile_Vietnam-Energy-Industry.ppt)

The PDP contains a development plan for large-scale power plants (more than 50 MW of installed capacity) and power transmission networks (220 kV or more) based on a mid- to long-term electricity demand forecast. Development plans for small-scale power plants (50 MW or less of installed capacity) and transmission networks (110 kV or less) plans are included in provincial and municipal power development plans.

The procedure for including specific projects in the PDP is described in Circular No. 43/2013/TT-BCT.

Table 2-2 Inclusion of the project in the power development plan

Item	Details
Key Content	The proposal for inclusion of the project in the national/provincial/municipal PDP includes the following main content: 1. Legal basis and the rationale for inclusion of the project in the plan. 2. Scale, progress and main specifications of the project need to be included in the plan. 3. Evaluation of the potential impacts of the project on the provincial/regional power grid. 4. Comprehensive solutions for power source/regional power grid to be adjusted to ensure power supply. 5. Evaluation of socio-economic benefits of the project to be included. 6. Conclusions and recommendations.
Stakeholders	<ul style="list-style-type: none"> Prime Minister: for projects with an installed capacity of > 50 MW or connected to transmission grid. Upon request by the MOIT, the Prime Minister will issue the acceptance for inclusion of the project in the national PDP. MOIT: for projects with an installed capacity of ≤ 50MW or connected to distribution grid. Upon request by the Provincial/Municipal People’s Committee, MOIT will issue the acceptance for inclusion of the project in the provincial/municipal PDP.
Procedures Applied	Procedures for accepting the inclusion of the project in the national PDP 1. The Investor will send a dossier requesting inclusion of the project in the plan to EREA for appraisal. 2. Within five (5) working days from the receipt of the dossier, EREA will issue a written request for additional information if the dossier is not complete or valid. 3. EREA will be responsible for appraising the dossier requesting the project’s inclusion in the plan within ninety (90) working days from the receipt of the complete set of valid

Item	Details
	<p>documentation.</p> <p>4. Within fifteen (15) working days from completing the project's inclusion in the plan, EREA will be responsible for drafting the submission letter and reporting to the MOIT for consideration and subsequent submission for the Prime Minister's approval.</p> <p>Procedures for accepting the inclusion of the project in the provincial/municipal PDP</p> <p>1. The Investor will send a dossier requesting inclusion of the project in the plan to DOIT for consideration and reporting to the Provincial/Municipal People's Committee, who will then send documentation to EREA for appraisal and subsequent reporting to the Minister of Industry and Trade for final approval.</p> <p>2. Within five (5) working days from the receipt of the dossier, EREA will issue a written request for additional information if the dossier is not complete or valid.</p> <p>3. Within forty-five (45) working days from the receipt of the complete set of valid documentation, EREA will appraise the dossier requesting the project's inclusion in the plan before submitting it for the approval by the Minister of Industry and Trade.</p>
Documents to be submitted by the Investor	<p>The dossier requesting inclusion of the project in the national PDP consists of:</p> <ol style="list-style-type: none"> 1. Letter from the Investor on the rationale for project inclusion in the plan. 2. Five sets of the proposal for project inclusion in the plan. 3. Written agreement of Provincial/Municipal People's Committee on the location of the power plant which is proposed to be included. 4. Proven evidence of the Investor's financial capacity and technical experience, and other documents (if necessary). <p>The dossier requesting inclusion of the project in the provincial PDP consists of:</p> <ol style="list-style-type: none"> 1. Submission letter requesting the project's inclusion in the plan of the Provincial/Municipal People's Committee. 2. Five (5) sets of the proposal for the project's inclusion in the plan. 3. Opinions of the Provincial Power Company, District People's Committee and relevant provincial departments/units.
Estimated Time	<ul style="list-style-type: none"> • From forty-five (45) - sixty (60) days for the preparation of inclusion in planning report. • Approx. one hundred and ten (110) working days for project inclusion in the national PDP. • Approx. fifty (50) working days for project inclusion in the provincial/municipal PDP.
Costs	<ul style="list-style-type: none"> • Subject to contract between Investor and consulting company for the preparation of the necessary documents requesting inclusion of the project in the relevant plan. • No fee is applied for appraisal and approval of inclusion in planning.

(Source: Directive No. 43 of 2013 and GIZ "Development Guidelines for grid-connected power generation projects using solid waste in Vietnam" <http://gizenergy.org.vn/media/app/media/2017%2011%2020%20W2E-ENG-Final.compressed.pdf>)

The period covered by the PDP will be the next 10 years, with a long-term vision of 25 years ahead. In the conventional PDP the vision covered the next 20 years, but in PDP8, the vision is 5 years longer than that of the conventional PDP.

The following is the proposed content of the PDP8 under Ref. 1264/QD-TTg.

Table 2-3 Proposed content of PDP 8

<p>- Volume I: General report, including 18 chapters:</p> <p>Chapter I: Existing status of the national power system</p> <p>Chapter II: Implementation results of the Power Development Plan in the period 2011 -2020</p> <p>Chapter III: Overview of socioeconomic situation in Vietnam</p> <p>Chapter IV: Criteria and input parameters for plan development</p> <p>Chapter V: Power saving and efficient use in power development</p> <p>Chapter VI: Power demand forecast</p> <p>Chapter VII: Primary energy for power generation</p> <p>Chapter VIII: Renewable energy for power generation</p> <p>Chapter IX: Power source development program</p> <p>Chapter X: Power grid development program</p> <p>Chapter XI: Regional power interconnection</p>

Chapter XII: Rural electricity development orientation Chapter XIII: Load dispatching and communications in Vietnam's power system Chapter XIV: National power development investment program Chapter XV: Assessment of socio-economic effectiveness of the national power development program Chapter XVI: Environmental protection and sustainable development mechanism in national power development Chapter XVII: Summary of land use demand for power work Chapter XVIII: Implementation mechanisms and solutions for the Plan Conclusion and Recommendations
- Volume II: The appendices present input parameters and load forecast calculation results, calculation results for power source and power grid development programs, and calculation results for financial and economic analysis.
- Volume III: Geographic drawings of the national power system in the planning period.

(Source: Ref. 1264/QD-TTg)

As of December 2020, PDP8 will be release in 2021.

2.1.2 Electricity Act

Under Resolution No. 51/2001/QH 10, issued in December 2004, the Electricity Act became effective on July 1, 2005. The Act contains provisions related to power development planning and investment, power saving, electricity markets, the rights and obligations of related organizations and individuals to implement or use electricity, the protection of power equipment and facilities, and the securing of power-related safety. In the Act, EVN is exclusively responsible for constructing and managing transmission facilities. Due to the recent expansion of solar power generation facilities in Vietnam, discussions on a private investment mechanism for transmission business led by MOIT have been undertaken.

2.2 Relevant Legal Framework for Private Investment in the Power Sector

(1) Investment Law

In Vietnam, the liberalization of economic activities using private capital, including foreign capital, began in 1992, when the revision of the Constitution (Doi Moi) took place. Following the revision, the 1996 Law on Foreign Investment in Vietnam (No. 52 L/CTN/DT), which specifies the types of and requirements for foreign capital participation, was enacted. Moreover, the Law on Domestic Investment Promotion (No. 03/1998/QH 10), enacted in 1998, provides legal protection for private investment and encourages private capital participation in business sectors.

As mentioned above, there were different laws and regulations for domestic capital and foreign capital originally, but the Investment Law (No. 59/2005/QH 11), enacted in 2005, unified the laws and regulations for private capital participation.

In 2014, the revised Investment Law (No. 67/2014/QH 13) was enacted, and institutional revisions were made to promote further participation of private capital, including foreign capital, by reducing the number of sectors where entry is not permitted or is permitted with conditions. A minor revision of the Investment Law was made in 2016. The establishment and revision of the Investment Law is summarized in Table 2-4.

Table 2-4 Establishment and revision of the Investment Law

Year	Enactment and revision of laws
1996	The Law on Foreign Investment in Vietnam (No. 52 - L/CTN)
1998	The Law on Domestic Investment Promotion (No. 03/1998/QH 10)
2000	Supplementary provisions and amendment of No. 52 - L/CTN (No. 18/2000/QH 10)
2005	Supplementary provisions of No. 52 - L/CTN and No. 18/2000/QH 10; Replacing Act for No. 03/1998/QH 10 (No. 59/2005/QH 11) (Effective from July 1, 2006)
2014	The Investment Act on Investment Activities in Vietnam and Overseas Investment Activities outside Vietnam (No. 67/2014/QH 13) (Effective from July 1, 2015) - Regardless of the nationality of investors, the Act has been applied to investment and management activities in Vietnam.
2016	Amendment Act on Article 6 and Appendix 4 of the Investment Act (No. 03/2016/QH 14)

(Source: JICA survey team based on JETRO website "regulations on foreign capital", https://www.jetro.go.jp/world/asia/vn/invest_02.html)

The current law on investment consists of 5 chapters: Chapter I General Provisions, Chapter II Investment Guarantees, Chapter III Investment Incentives and Support, Chapter IV Investment Activities in Vietnam, and Chapter V State Management of Foreign Investment.

Article 16 of Chapter 3 lists preferential investment industries, trades and geographical areas (Table 2-5), and clean and renewable energy is included as one of the areas. The following benefits are available for identified areas for all or certain periods of an investment project.

- (a) Application of a lower rate of corporate income tax than the normal tax rate for a definite period or for the whole duration of implementation of the investment project, and exemption from and reduction of corporate income tax
- (b) Exemption from import duty in respect of goods imported to form fixed assets, raw materials, supplies and components for implementation of an investment project
- (c) Exemption from and reduction of land rent, land use fees and land use tax

Objects entitled to investment incentives are as follows:

- (a) Investment projects in the preferential investment industries and trades prescribed in article 16.1 of this Law
- (b) Investment projects located in preferential investment geographical areas prescribed in article 16.2 of this Law
- (c) Projects with a scale of capital being 6,000 billion Dong or more, of which at least 6,000 billion Dong is disbursed for a period of three years from the date of issuance of the IRC or the date of the decision on the investment policy
- (d) Investment projects located in rural areas and employing 500 employees or more

(dd) High-tech enterprises, and scientific and technological enterprises or organizations

Table 2-5 Preferential investment industries and trades

- (a) High-tech activities, industrial products which support high-tech; and research and development activities;
- (b) Production of new materials, new energy, clean energy or renewable energy; production of products with an added value of 30% or more, and energy-saving products;**
- (c) Production of electronics, prioritized mechanical products, agricultural machinery, automobiles, automobile parts; and shipbuilding;
- (d) Production of industrial products which support [production of] garments and textiles or leather products and the products prescribed in paragraph (c) of this clause.
- (dd) Production of products in information technology, software and digital content [products];
- (e) Breeding, growing and processing agricultural, forestry and aquaculture products; afforestation and protection of forests; salt production; fishing and fishing logistics, creation of plant and animal varieties and production of products of biological technology;
- (g) Collection, processing, reprocessing or reuse of refuse;
- (h) Investment in development and operation, and management of infrastructure facilities; and development of public transportation in urban areas;
- (i) Pre-school education, general education, and vocational education;
- (k) Medical consultation and treatment; production of medicines, raw materials for production of medicines, principal medicines, essential medicines and medicines for the prevention and treatment of social diseases, vaccines, medical biological products, medicines from pharmaceutical materials, oriental medicines; and scientific research in relation to technology of preparation or biological technology for production of new medicines;
- (l) Investment in facilities for training and competition in sports or physical practice for disabled people or for professional sportsmen; and protection and promotion of the value of cultural heritage;
- (m) Investment in centers for geriatrics, psychiatry or treatment of patients exposed to Agent Orange, and centers for care of the old, disabled, orphans or street children without support;
- (n) People's credit funds, and micro-financial institutions.

(Source: Prepared by JICA survey team based on Law on Investment)

(2) Business forms for investment with foreign investment capital

The general forms of entry and investment in Vietnam with foreign investment capital can be categorized as follows:

Table 2-6 Forms of entry and investment with foreign investment capital in Vietnam

Forms of entry and investment	Details
(1) New establishment (100% or joint venture)	<ul style="list-style-type: none"> Foreign investment capital is wholly owned or a company is established as a joint venture with a Vietnamese company (government and private sector) or individual. Both single or multiple foreign investments are eligible. 100% foreign ownership is allowed in many service sectors, but some service sectors (transportation, etc.) still do not allow 100% foreign ownership.
(2) Investment in existing economic organizations (purchase of shares or equity, additional investment)	<ul style="list-style-type: none"> Following the provisions of the Law on Investment, Law on Securities and other related laws. The investment ratio of foreign capital in a public company is applied when sectors have specific provisions, but if sectors do not have specific provisions on the ratio, the ratio is limited to 49% at the maximum.
(3) Business Cooperation Agreement (BCC)	<ul style="list-style-type: none"> A form of investment in which a Vietnamese company and foreign capital share profits and assets liabilities in a contractual relationship without establishing a corporate entity. BCC is used to invest in projects that are carried out in a short period of time, specified projects regulated by the government such as telecommunications, or joint projects such as exploration and exploitation of oil and other natural resources.
(4) Public-Private Partnership (PPP) Agreement	<ul style="list-style-type: none"> PPP is concluded between foreign capital and Vietnamese government agencies. Depending on when and how infrastructure facilities are constructed, and transferred to the Vietnamese government, there are 7 types of contracts: <ul style="list-style-type: none"> ➤ BOT (Build-Operate-Transfer) ➤ BTO (Build-Transfer-Operate) ➤ BT (Build-Transfer) ➤ BOO (Build-Own-Operate) ➤ BTL (Build-Lease-Transfer) ➤ BLT (Build-Transfer-Lease) ➤ O&M (operation and maintenance). Foreign capital establishes a company to implement the project. PPP is used to carry out projects related to the development, improvement, expansion, management, operation, and provision of services for roads, ports, airports, railways, bridges, water supplies, electricity, and other infrastructure.
(5) Establishment of branches and representative offices	<ul style="list-style-type: none"> Establishment of branch offices by law firms, accounting firms, banks, etc. Representative offices are for market research, information gathering, and management of consignment processing and are not allowed to engage in any business activity.
(6) Other (consignment processing, etc.)	<ul style="list-style-type: none"> There are two types of consignment processing: the method of purchasing the product with processing fees (gratuitous processing method) and the method of receiving the product with raw material costs plus processing fees (charged processing method). Other types of business include construction and installation work contracts, in which business is carried out based on a contract with the client by obtaining a construction license for each project; technology transfer contracts, in which patents and know-how are provided and compensation is received; agency and distributor contracts, which are sold through distributors in Vietnam; and franchise contracts with operators in Vietnam.

(Source: Vietnam Investment Act 2014 (No. 67/2014/QH 13) and JBIC "Investment climate in Vietnam" https://www.jbic.go.jp/wp-content/uploads/page/2017/11/58694/inv_VietNam08.pdf)

(3) Institutional framework for Public-Private Partnerships (PPP)

When foreign investment capital participates in infrastructure development projects in Vietnam, including in power sector projects, participation under PPP contracts is commonly used. As an institutional framework for PPP, Decree No. 108/2009/ND-CP, entitled "Investment in the form of build-operate-transfer, build-transfer-operate or build-transfer contract", was enacted in 2009. This was amended to Decree No. 15/2015/ND-CP, entitled "Investment in the Form of Public – Private Partnerships", in 2015.

Table 2-7 PPP-related institutional framework

Year	Related law
2009	Investment in the form of build-operate-transfer, build-transfer-operate or build-transfer contract (Decree No. 108/2009/ND-CP)
2010	Promulgation of the Regulations on Pilot Public-Private Partnership Investment (Decision No. 71/2010/QD-TTg)
2015	Investment in the Form of Public – Private Partnerships (No. 15/2015/ND-CP)

(Source: JICA survey team)

Decree No. 15/2015/ND-CP indicates projects that are eligible for PPP, and the construction and operation of power plants and transmission lines is included (Table 2-8). As shown in (4) of Table 2-6, there are various types of PPP contracts, such as BOT (Build-Operation-Transfer), but in any case, the ownership of infrastructure assets formed under PPP contracts is ultimately transferred to government agencies and state-owned enterprises in Vietnam.

In Vietnam, foreign investment capital has been entering the power generation business for some time, but many of such investments are based on BOT contracts. Other power generation facilities operated by state-owned enterprises such as VINACOMIN and those using domestic capital are called IPP (Independent Power Producers) in Vietnam.

Table 2-8 Projects encouraged to use PPP-type investment

a.	Transportation;
b.	Public lighting, water supply, drainage, wastewater treatment and waste collection;
c.	Power plants, and power transmission lines;
d.	Parks; houses, yards for cars, vehicles, machinery and equipment, cemeteries;
e.	Offices of state agencies, public housing, social housing, and resettlement housing;
f.	Health, education, training, vocational training, sport; travel, science and technology, hydro-meteorology, IT applications;
g.	Commercial infrastructure, urban areas, economic zones, industrial parks, industrial clusters, information technology parks, high-tech technical infrastructure, incubator facilities, technical facilities, and working areas to support small and medium enterprises;
h.	Agriculture and Rural Development, services associated with production, processing, and consumption of agricultural products;
i.	Other areas as decided by the Prime Minister.

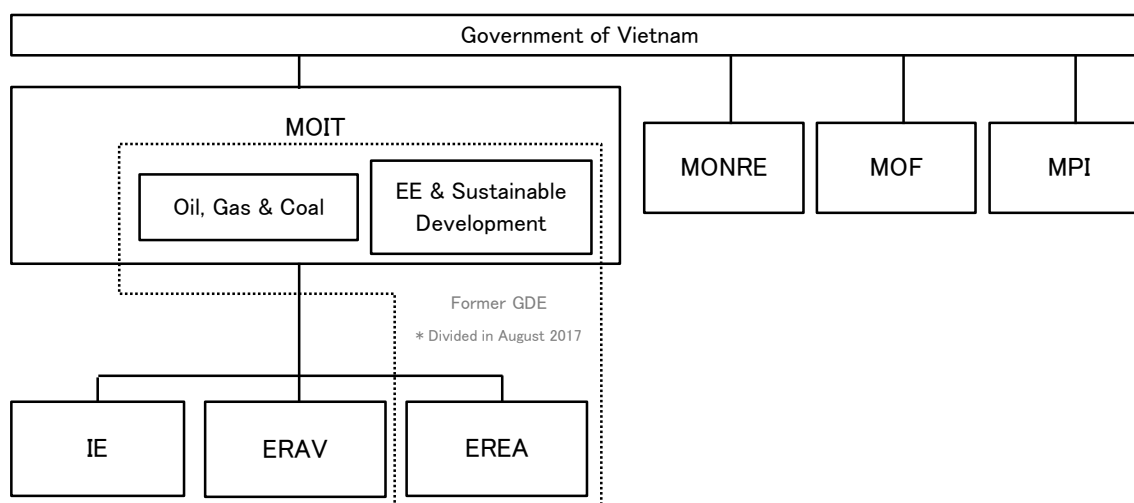
(Source: JICA survey team based on JETRO "Comparison of Revised PPP Regulations"
https://www.jetro.go.jp/ext_images/_Reports/4_PPPkiteikaiteihikaku.pdf)

2.3 Government and Regulatory agencies and Companies related to Electric Power Sector

(1) Government and Regulatory agencies related to Vietnam's electric power sector

In Vietnam, the Ministry of Industry and Trade (MOIT) is the government agency responsible for electricity and energy, including the formulation of energy policies and plans. Organizations under the direct control of MOIT include the Institute of Energy (IE), Electricity Regulatory Authority of Vietnam (ERAV), and the Electricity and Renewable Energy Authority (EREA).

The General Department of Energy (GDE), formerly an internal organization of MOIT, was established in November 2011 as an organization that manages, and provides recommendations and support for, the energy industry (electric power, nuclear power, oil, coal, renewable energy, energy conservation). It was established by a Prime Ministerial Ordinance in May (Decision No.50/2011/QD-TTg). As a result of the reorganization of MOIT announced in August 2017, it was divided into three organizations: the Renewable Energy Authority (EREA), the Energy Efficiency and Sustainable Development Department, and the Oil, Gas and Coal Department (Decree No.98/2017/ND-CP). Aside from MOIT, ministries responsible for energy-related operations include the Ministry of Finance (MOF), which manages the national finances and overseas loans; the Ministry of Planning and Investment (MPI), which manages the national investment plan; and the Ministry of Natural Resources and Environment (MONRE), which is responsible for the formulation of environment-related regulations.



(Source: JICA Survey Team)

Figure 2-2 Organizational structure of Government and Regulatory agencies related to Vietnam's Electric Power Sector

(a) Ministry of Industry and Trade (MOIT)

The current Ministry of Industry and Trade (MOIT) was established in 2007 by integrating the former Ministry of Trade and the former Ministry of Industry. In addition to formulating, implementing and supervising laws and regulations, strategic plans, and master plans for the industries under their jurisdiction, they are also responsible for permitting and approving related regulations and investment projects. The MOIT is also responsible for energy policy, and the planning and licensing of electricity tariffs.

(b) Institute of Energy (IE)

The Institute of Energy (IE) is an organization under the direct control of the MOIT. It is a research institute specializing in the energy field. It is in charge of energy field research analysis and examination, and policy drafting. IE is also in charge of formulating PDP, PDP revisions, and long-

term demand forecasts. Various drafts are submitted to, and approved by, MOIT. IE is currently developing the next power development plan, PDP8.

(c) Electricity Regulatory Authority of Vietnam (ERAV)

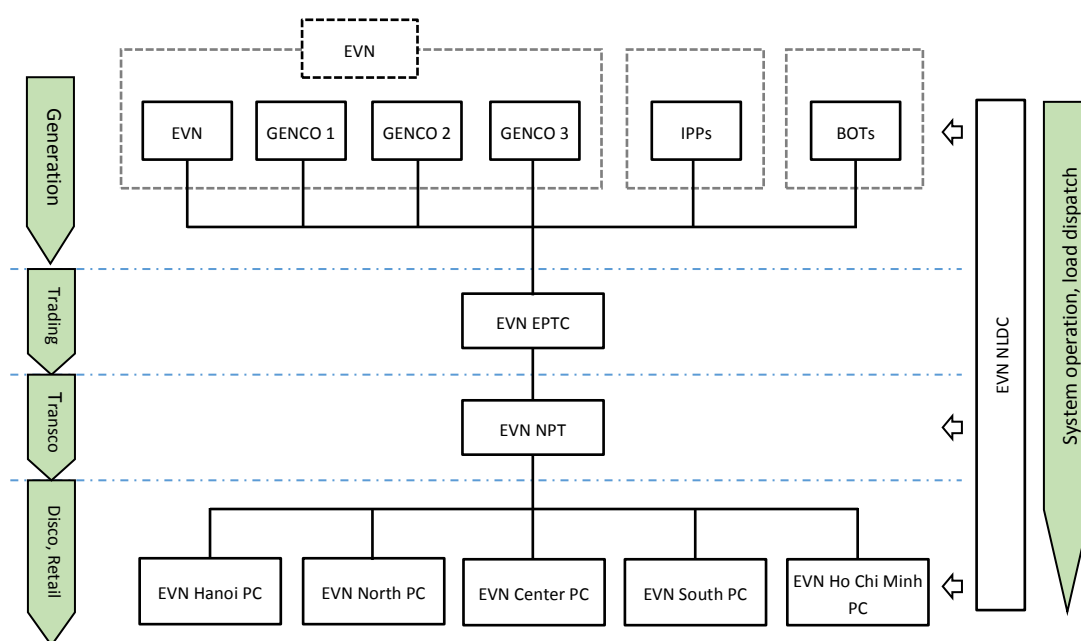
The Electricity Regulatory Authority of Vietnam (ERAV) is an organization under the direct control of MOIT that is responsible for the formulation and implementation of regulations related to electricity. Its main business is the issuance of electricity business licenses, setting of electricity tariffs, and maintenance and monitoring of the electricity market. ERAV is an internal organization of MOIT, and various regulations and electricity tariffs are approved by MOIT, which is a higher-level organization than ERAV.

(d) Electricity and Renewable Energy Authority (EREA)

The Electricity and Renewable Energy Authority (EREA) is an organization under the direct control of MOIT that develops policies, systems and regulations related to renewable energy and conducts business reviews of renewable energy power projects, such as solar and wind power generation. It is also in charge of the FIT system for renewable energy. EREA is an internal organization of MOIT, and various systems formulated by EREA are approved by MOIT. MOIT approval is required for large-scale renewable energy power generation projects exceeding 10 MW.

(2) Companies related to Electric power sector

The current Vietnamese power business is divided into and operated according to (1) power generation, (2) grid operation, (3) transmission, and (4) distribution and retail. Each power business is operated by Vietnam Electric Power Company EVN and operating companies under EVN, but the “power generation” business is also open to companies other than EVN. Vietnam's electricity sector reform started in 2005 following the promulgation of the 2004 Electricity Law (No. 28/2004 / QH11). The purpose of sector reform was to respond to the large increase in power demand against the background of economic growth, and to optimize the electricity tariff to properly allocate the funds necessary for maintaining and expanding the power system. In line with the progress of sector reform, EVN merged four regional power transmission companies into one power transmission company (NPT) in 2008. In the same year, a power trading company (EPTC) was established under EVN as a single buyer (SB) in the electricity market. The following year, EVN was legally separated from the traditional vertically integrated company and turned into a holding company. In 2010, the 11 regional distribution companies were reorganized into five EVN-affiliated power companies: Northern PC, Hanoi PC, Central PC, HCMC PC, and Southern PC. In 2012, three power generation companies (GENCO-1, -2, and -3) were established.

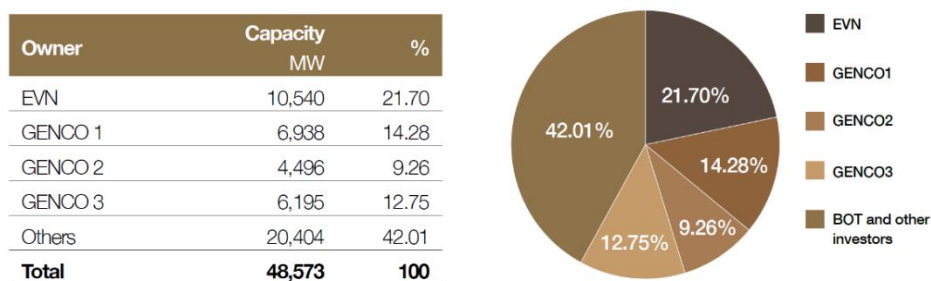


(Source: JICA Survey Team)

Figure 2-3 Organizational structure of Vietnam's electric power sector

(a) Power Generation Companies

Power generation companies in Vietnam are roughly divided into power plants directly under EVN and EVN subsidiaries, and the power plants of IPP and BOT operators. Genco (Power Generation Corporation) -1, -2, and -3 were split off from EVN in 2012 as 100% EVN independent profit companies. Power plants owned by EVN are allocated to Gencos except for power plants that are important in terms of energy security. In the first stage of privatization of the power generation business, Genco-3 shares were made public in 2018 and it was privatized. The remaining Genco-1, and -2 will be privatized in the future. Petro Vietnam Power Corporation and Vinacomin Power are considered to be the three major power generation IPP operators, along with EVN. In the field of solar power projects, which have been increasing rapidly this year, the Japanese companies of Sharp Energy Solutions, Idemitsu Group and Fujiwara have entered the power generation business. According to the EVN Annual Report 2018, the EVN Group owns about 58% of the total power generation capacity (directly: 21.7%, Gencos: 36.3%), with 42% owned by other companies.



(Source: EVN Annual Report 2018)

Figure 2-4 Installed Capacity Portfolio

Table 2-9 shows the major power plants in 2018, including EVN Group power plants and major IPP power plants.

Table 2-9 List of major Power Plants in Vietnam

Type	Plant	Installed Capacity [MW]	Owner	
Hydro	Tri An	420	EVN	
	Hoa Binh	1,920	EVN	
	Ialy	720	EVN	
	Se San 3	260	EVN	
	Tuyen Quang	342	EVN	
	Se San 4	360	EVN	
	Pleikrong	100	EVN	
	Son La	2,400	EVN	
	Ban Chat	220	EVN	
	Lai Chau	1,200	EVN	
	Huoi Quang	520	EVN	
	Ban Ve	320	Genco1	
	Dai Ninh	300	Genco1	
	Song Tranh 2	190	Genco1	
	Dong Nai 3	180	Genco1	
	Dong Nai 4	340	Genco1	
	Da Nhim + Song Pha	168	Genco1	
	Da Nhim extension	45	Genco1	
	Ham Thuan	300	Genco1	
	Da Mi	175	Genco1	
	Quang Tri	64	Genco2	
	An Khe - Kanak	173	Genco2	
	Song Bung 4	156	Genco2	
	Trung Son	260	Genco2	
	Thac Mo	225	Genco2	
	A Vuong	210	Genco2	
	Song Ba Ha	220	Genco2	
	Song Bung 2	100	Genco2	
	Buon Kuop	280	Genco3	
	Buon Tua Srah	86	Genco3	
	Srepok 3	220	Genco3	
	Thac Ba	120	Genco3	
	Vinh Son	66	Genco3	
	Song Hinh	70	Genco3	
	Nam Chien	200	PV Power	
	Nam Cat	3	PV Power	
	Ngoi Hut 1	8	PV Power	
	Hua Na	180	PV Power	
	Song Tranh 3	62	PV Power	
	Dak Drinh	125	PV Power	
	Dong Nai 5	150	Vinacomin	
	Hydro Total	13,459		
	Coal	Thai Binh	600	EVN
Vinh Tan 4		1,200	EVN	
Uong Bi extension 1		300	Genco1	
Uong Bi extension 2		330	Genco1	
Quang Ninh 1		600	Genco1	
Quang Ninh 2		600	Genco1	
Nghi Son 1		600	Genco1	
Duyen Hai 1		1,245	Genco1	
Duyen Hai 3		1,245	Genco1	
Pha Lai 1		440	Genco2	
Pha Lai 2		600	Genco2	
Hai Phong 1		600	Genco2	
Hai Phong 2		600	Genco2	
Ninh Binh		100	Genco3	
Vinh Tan 2		1,244	Genco3	
Mong Duong 1		1,080	Genco3	
Vung Ang 1		1,200	PV Power	
Na Duong		110	Vinacomin	
Cao Ngan		115	Vinacomin	
Son Dong		220	Vinacomin	
Mao Khe (Dong Trieu)		440	Vinacomin	
Cam Pha 1&2		670	Vinacomin	
Nong Son		30	Vinacomin	
Coal Total		14,169		
Gas		Thu Duc	113	EVN
		Can Tho	155	Genco2
		Phu My 2.1	945	Genco3
		Phu My 1	1,118	Genco3
		Phu My 4	477	Genco3
		Ba Ria	389	Genco3
		Ca Mau 1	750	PV Power
		Ca Mau 2	750	PV Power
		Nhon Trach 1	450	PV Power
	Nhon Trach 2	750	PV Power	
	Gas Total	5,897		
	Oil	Thu Duc	165	EVN
		Can Tho(S4)	33	Genco2
O Mon 1		660	Genco2	
Oil Total		858		
Total		34,383		

(Source: Prepared by JICA Survey Team based on EVN and various materials)

In EVN, the Corporate Planning Department conducts annual demand forecasting and development planning. The Investment Management Department manages the overall investment plan and the progress of large projects. For the actual construction stage, the Hydropower Project Management Board (HPMB) is responsible for hydropower plants, and the PMB, under the power generation subsidiary (GENCO), is responsible for thermal power plants. After the start of operations at a hydropower plant, the operation and maintenance work is taken over by an EVN subsidiary company.

(b) Power System Operators

The National Load Dispatch Center (NLDC) is an organization under the direct control of EVN that is responsible for grid operation throughout Vietnam. It functions as a power market operator (SMO). In particular, power plants with a capacity of 30 MW or more are required to have AGC (Automatic Generation Control) functions, and NLDC uses AGC to perform direct online generation dispatching control. For solar power generation, NLDC makes an hourly total PV generation output estimation on

the day before, based on the generation plans (available generation capacity) submitted by each power plant, since all the PV generation output should basically be purchased. However, the actual PV generation output depends on the weather conditions of the day, so PV generation will be consequent upon this. If system congestion occurs on the day, NLDC will calculate the amount of curtailment required at each PV power plant based on the actual generation outputs and dispatch generation reduction commands to the related PV power stations via AGC. The power generation market (VCGM), which began operation in 2011, and the wholesale power market (VWEM) are operated by NLDC.

(c) Transmission Companies

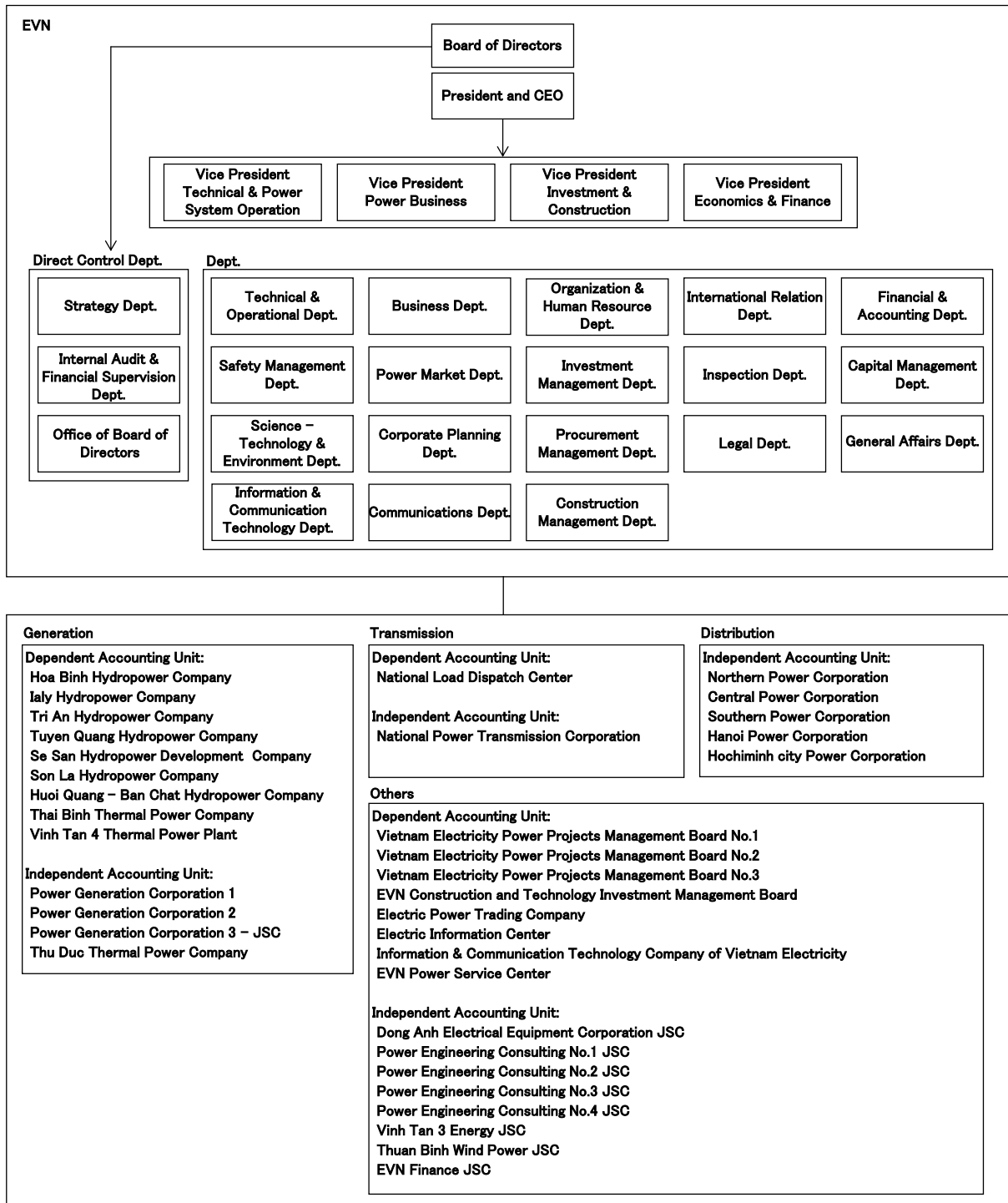
The National Power Transmission Corporation (NPT) is an EVN 100% independent profit company, established in April 2008. It exclusively operates the transmission network throughout Vietnam. NPT consists of four power transmission companies (PTC) and three project management boards (PMB), and it operates and maintains 220-500kV transmission and transformation facilities. For transmission line and substation expansion plans, IE formulates its master plan as part of the PDP, but the EVN NPT's planning department cooperates with the EVN planning department to review annual expansion plans for 220kV or higher. Three NPT PMBs (Northern PMB, Central PMB and Southern PMB) supervise the construction work. The four NPT PTCs also carry out Operation & Maintenance for transmission and substation facilities owned and operated by local power companies (PC).

(d) Distribution and Retail Companies

Power Corporation (PC) is a 100% EVN independent profit company, which is divided into five companies by region. It manages the Operation & Maintenance of power transmission and distribution facilities of 110kV or less. Each PC supplies power directly to the consumer, or sells it to the consumer through another power distribution company (Local Distribution Unit). For rooftop solar power generation, which has been promoted by the government in recent years, a PC accepts grid connection applications and PPA contracts from project owners.

(e) Trading Companies

Electric Power Trading Company (EPTC) is an organization responsible for electric power trading, and it is under the direct control of EVN. The Vietnam electric power market has started operation of the second stage, the wholesale electric power market (VWEM), but in reality, the EPTC continues to be a single buyer, with generation charges, wheeling charges and retail tariffs traded via EPTC.



(Source: EVN Annual Report 2018)

Figure 2-5 Organizational Structure of EVN Group

Chapter 3. Current Status and Outlook of the Power Sector in Vietnam

3.1 Vietnam Power Sector Roadmap

The roadmap and targets for the power sector in Vietnam are shown below.

Table 3-1 Vietnam Power Sector Roadmap and Targets

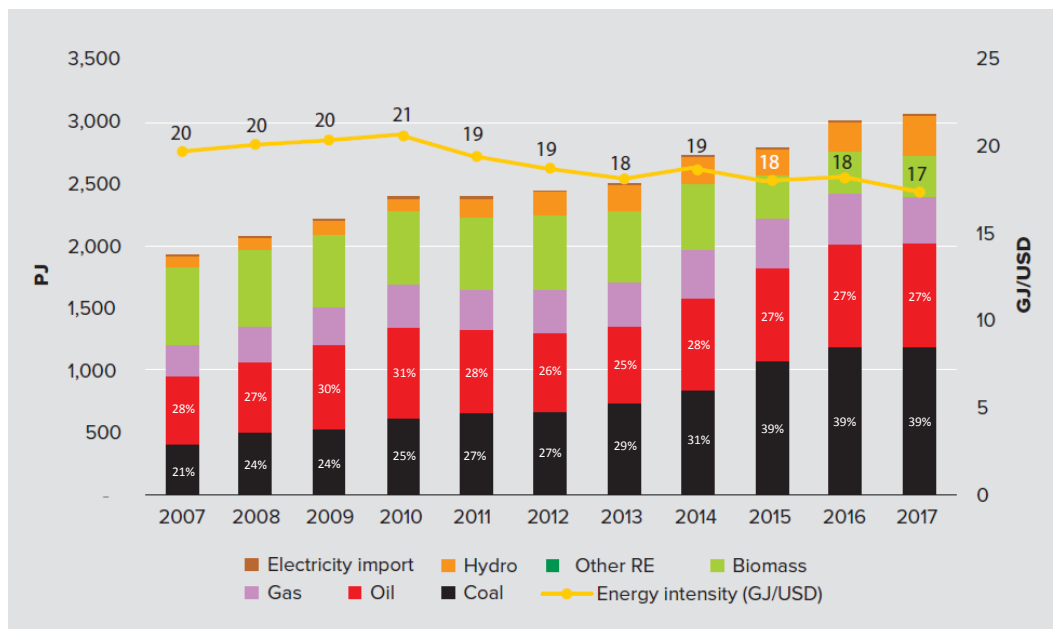
	- 2015	2016	2017	2018	2019	2020	2021	2022	2023 -
PDP development		● Mar. 2016 Revised PDP7 release			Middle to end- 2020 PDP 8 IE => MOIT submission	●	● 2021 PDP8 release (scheduled)		
Solar FIT			FIT phase 1 (PM Dec. No.11/ 2017)		FIT phase 2 (MOIT Circ. No.402/ 2019)		After 2021 Under consideration		
Solar auction						Preparation and demonstration (scheduled)		Demonstration start not determined	
Wind FIT	FIT phase 1 (PM Dec. No. 37/ 2011)			FIT phase 2 (PM Dec. No. 39/ 2018)			After Nov. 2021 Under consideration		
Wind auction				Demonstration preparation				Demonstration (scheduled)	
DPPA						2020 PM approval (scheduled)		Demonstration (scheduled)	
Generation market (VCGM)	● 2011 Trial operation started 2012 Full-scale operation started								
Wholesale market (VWEM)	○ 2015 Scheduled trial operation	● 2016 Start trial operation	○ 2017 Scheduled full-scale operation		● 2019 Start full-scale operation (According to ERAV)				
Retail market (VCRM)							● 2021 Start of operation (scheduled)		
NDC Target	● Sep. 2015 INDC Submission	● Nov. 2016 Ratification of the Paris Agreement				● Jul. 2020 Revised NDC			

Note: The study on PDP8 is being carried out by IE and PDP8 will be release in 2021.
The feed-in tariff will be replaced with a solar auction mechanism after the end of Feed-in Tariff phase 2; however, the feed-in tariff will continue to apply only for rooftop solar power projects.
Trial operations for the retail market are scheduled to start in 2021 as originally planned, but full-scale operation of the wholesale market is 2 years behind the original schedule, so it is likely to be delayed.
(Source: JICA survey team)

3.2 Primary Energy Supply/Demand Situation

3.2.1 Primary Energy Supply

The primary energy supply trends in Vietnam are shown below.

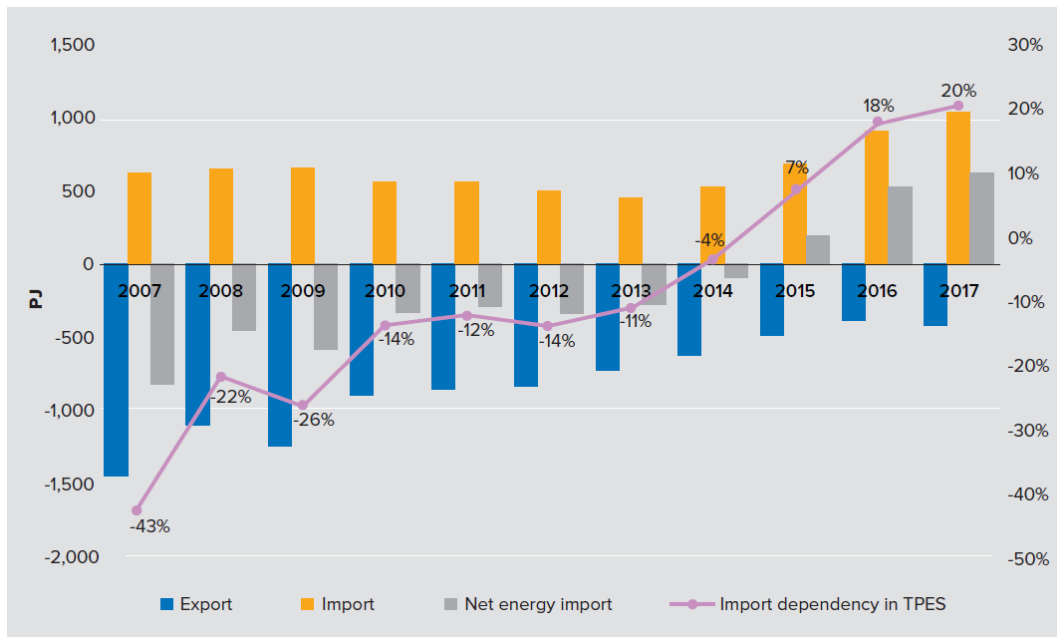


(Source: Vietnam Energy Outlook Report 2019, November 2019)

Figure 3-1 Trends in Primary Energy Supply

Looking at the trends from 2007 to 2017, the average annual increase rate is 4.7%. While hydropower and coal supplies have increased, biomass supplies have decreased. In 2017, coal accounted for about 39% and oil accounted for about 27%. Supply from renewable energy, such as solar and wind power, was very small.

The primary energy import/export trends in Vietnam are shown below.



(Source: Vietnam Energy Outlook Report 2019, November 2019)

Figure 3-2 Trends in Primary Energy Imports/Exports

In 2007, a large amount of primary energy was exported, but due to rising energy demand and shrinking domestic production, imports have exceeded exports since 2015. Since then, the share of imports in the total primary energy supply has increased, reaching 20% in 2017.

3.2.2 Energy Policy

(1) Long-term national energy development strategy

Vietnam's long-term national energy development strategy looking towards 2020 was approved in 2007 along with 2050 Vision (PM Decision No.1855/QD-TTg). The strategy contains the following policy objectives:

- Ensure national energy security;
- Supply sufficiently high-quality energy for socioeconomic development;
- Exploit and manage domestic primary energy resources efficiently;
- Diversify energy investments and business models;
- Establish and develop a competitive energy market;
- Promote new and renewable energy sources; and
- Develop energy resources effectively and sustainably with consideration for environmental protection.

(2) Energy Plan

With regard to energy planning, MOIT formulates separate development master plans for power and renewable energies.

(a) National Power Development Master Plan (PDP)

The PDP is formulated every 10 years for the following 10 years, with a further prospect of 10 subsequent years. The PDP is revised 5 years after its start. The latest PDP is the revised PDP7 (which

the government approved on March 18, 2016) for the period from 2016 to 2030. The revised PDP7 highlights Renewable Energy, including accelerated hydropower development, to the maximum extent (10.8GW for small-, medium- and large-scale hydropower including pumped storage (2.4GW), 5.9GW for wind power, 11.2GW for solar power, and 2.1% of total generation for biomass power by 2030). LNG imports equivalent to 19GW of power generation are planned for by 2030, coal-fired power considering domestic development promotion is planned to be 55.3GW by 2030, and nuclear power is expected to make up 5.7% of total generation. Finally, power imports from neighboring countries are envisaged, with a focus on ASEAN and GMS (Greater Mekong Sub-region) countries.

The Institute of Energy is currently working on PDP8, which will be the next power development plan. According to the notification (No. 693/TTg-CN) issued by the Prime Minister to the MOIT on June 9, 2020, the PDP8 was to be proposed to the Prime Minister by October 31, 2020. However, due to the rapid increase in the number of new power projects, such as wind power and LNG-fired power plants, the formulation of PDP8 is still underway (as of December 2020).

(b) Renewable Energy Development Plan

The Renewable Energy Development Plan was approved in December 2015 (Decision No. 2068/QD-TTg, dated November 25, 2015, of the Prime Minister), and it is designed for measures through 2030 and the 2050 concept for industrial development, living standards' improvement and environmental protection regarding efforts to promote the introduction of renewable energy.

Small-scale hydropower, biomass-based power, wind power and solar power have been positioned; the introduction plan is as follows.

Table 3-2 Introduction amounts in Renewable Energy Development Plan
(Billion kWh)

	2015	2020	2030	2050
Small-scale hydropower	56	90	96	--
Biomass-based power	0.6	7.8	37	85
Wind power	0.18	2.5	16	53
Solar power	0.01	1.4	35.4	210

In this strategy, the hydropower generation amount has been raised to 96TWh in 2030, from 56TWh in 2015. Wind power is expected to supply 2.5TWh by 2020 (1% of the total power supply), 16TWh (2.7% of the total) by 2030, and 53TWh by 2050 (5% of the total), from 180GWh in 2015. Solar power is expected to be increased to 35.4TWh (6% of the total) by 2030, and 210TWh (20% of the total) by 2050, from 1.4TWh in 2020.

Pumped storage is also planned to be 2,400MW by 2030, and 8,000MW by 2050.

In addition, the development plan includes a policy serving as an introduction mechanism for Renewable Energy, which sets the purchase price giving incentives for investment, purchases a total volume from an electric power company (such as a Feed-in-Tariff law), and determines the relevant systems and rules for the power generation business.

(3) Various policies related to energy and climate change

Energy policy and climate change policy are very closely related, and the various policies related to them are summarized as follows.

Table 3-3 Various Policies related to Energy and Climate Change

Name	Content
Law on Energy Efficiency and Conservation (LEEC) ²	Promoting energy efficiency and conservation activities through regulations, standards and incentives.
Electricity Law and Amendment of Electricity Law ³	Prescribing electricity development planning and investment, electricity saving, electricity markets and other rules.
Vietnam Green Growth Strategy (VGGS) ⁴	Introducing GHG reduction targets aiming to reducing fossil fuel usage and promote renewable energy.
Law on Environment Protection ⁵	Promoting clean and renewable energy; environmental protection fees; environmental protection funds; strategic environmental assessments.
Renewable Energy Development Strategy (REDS) ⁶	Setting RE targets in energy and power sectors; supporting schemes for RE development (Feed-in tariff (FIT); Renewable Portfolio Standard (RPS), Net-metering etc.
National Program on Energy Efficiency and Conservation for the period 2019-2030 (VNEEP3) ⁷	Setting targets to reduce final energy consumption compared to the business-as-usual baseline.
Intended Nationally Determined Contributions (INDCs)	Submitted to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC).
The revised National Power Development Plan (revised PDP7) ⁸	Reducing the amount of coal power plants compared to PDP7, enhancing security and implementing innovations for new power plants.

(Source: created by JICA Survey Team based on the Vietnam Energy Outlook Report 2019)

² Law No. 50/2010/QH12

³ Law No. 28/2004/QH11 and Law No. 24/2012/QH13

⁴ Prime Minister Decision 1393/2012/QD-TTg

⁵ Law No. 55/2014/QH13

⁶ Prime Minister Decision No. 2068/2015/QD-TTg

⁷ Prime Minister Decision No. 280/2019/QD-TTg

⁸ Prime Minister Decision No. 428/2016/QD-TTg

The target values related to energy and climate change mentioned in these various policies are shown below.

Table 3-4 Target Values in these various Policies

Target	2020	2025	2030	2050
Renewable energy				
RE share in primary energy supply (REDS)	31%		32%	44%
RE share in total electricity generation (REDS)	38%* 4% excl. hydro		32%* 15% excl. hydro	43%* 33% excl. hydro
Energy efficiency as compared to business-as-usual				
Final energy demand saving (VNEEP3)		5-7%	8-10%	
GHG emission reduction as compared to business-as-usual				
Green growth strategy (VGGS)	10-20%		20-30%	
Intended Nationally Determined Contributions (INDCs)			8% (unconditional) 25% (conditional)	
REDS (energy sector)	5%		25%	45%

* Including small and large hydro power, wind power, solar power, biomass, biogas and geothermal energy

(Source: Vietnam Energy Outlook Report 2019, November 2019)

In 2030, final energy demand will be reduced by 8-10% as compared to BAU, and GHG emissions in the energy sector will be reduced by 25% as compared to BAU. In order to achieve these targets, it is essential to increase the efficiency of energy use and actively introduce renewable energy.

3.3 GHG Emissions Projections

In September 2015, the government of Vietnam submitted its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, and it was officially determined as its contribution (NDC) when Vietnam signed the Paris Agreement in November 2016 as it ratified the Paris Agreement. NDCs are submitted every five years to the UNFCCC secretariat, therefore, in July 2020, the government of Vietnam submitted an updated version of the NDC to the UNFCCC.

According to Vietnam’s NDC submitted in 2015, with domestic resources, Vietnam will reduce GHG emissions by 8% compared to the Business as Usual (BAU) scenario by 2030, and this 8% contribution could be increased to 25% with international support. In the updated NDC submitted in 2020, the base year was changed to 2014 from 2010, and the reduction target was raised to reduce GHG emissions by 9% compared to the BAU scenario by 2030 with its own domestic resources, and to reduce GHG emissions by 27% with international support through bilateral as well as multilateral cooperation and the implementation of new mechanisms under the Paris Agreement. The NDC in Vietnam has identified 2 options, adaptation and mitigation, with implementation periods from 2021 to 2030.

BAU scenarios by sector through 2030 in the updated NDC are shown in the following Table. Under the BAU scenario, GHG emissions would be about 1.8 times higher in 2020 about 2.5 times in 2025, and about 3.2 times higher in 2030 as compared with the total emissions in 2014. The energy sector accounts for the largest share of the total and has the largest growth rate.

Table 3-5 GHG emissions in BAU Scenario from 2014 to 2030

	2014	2020	2025	2030
Energy	171.6	347.5	500.7	678.4
Agriculture	89.8	104.5	109.2	112.1
LULUCF	-37.5	-35.4	-37.9	-49.2
Waste	21.5	31.3	38.1	46.3
IP	38.6	80.5	116.1	140.3
Total	284.0	528.4	726.2	927.9

Note: Units are MtCO_{2e}, LULUCF: Land Use, Land Use Change and Forestry, IP: Industrial Processes

(Source: “The Socialist Republic of Viet Nam: Updated Nationally Determined Contribution (NDC)”)

The GHG emission reduction targets specified in the updated NDC are shown in the following Table. “Conditional” refers to cases in which Vietnam receives international support. Of the four sectors targeted for GHG emissions reduction, the energy sector accounts for a large share, both unconditionally and conditionally.

Table 3-6 GHG reduction targets for 2030 (ratio to BAU)

Sector	Unconditional contribution		Conditional contribution		Unconditional contribution & Conditional contribution	
	Goal (%)	GHG reduction (MtCO _{2e})	Goal (%)	GHG reduction (MtCO _{2e})	Goal (%)	GHG reduction (MtCO _{2e})
Energy	5.5	51.5	11.2	104.3	16.7	155.8
Agriculture	0.7	6.8	2.8	25.8	3.5	32.6
LULUCF	1.0	9.3	1.3	11.9	2.3	21.2
Waste	1.0	9.1	2.6	24.0	3.6	33.1
IP	0.8	7.2	0.1	0.8	0.9	8.0
Total	9.0	83.9	18.0	166.8	27.0	250.8

(Source: “The Socialist Republic of Viet Nam: Updated Nationally Determined Contribution (NDC)”)

In Vietnam, the Ministry of Natural Resources and Environment (MONRE) is in charge of developing the NDC and it is reviewing and updating it with the support of other international partners such as UNDP and GIZ. The environmental division of MOIT is in charge of GHG reduction in the energy sector.

During an interview with MONRE in 2019, it was stated that since the submission of INDC in 2015, the introduction of renewable energy has progressed rapidly and the composition of energy sources has changed from the original plan; therefore, the government of Vietnam desires to raise the GHG reduction target. As this comment, the GHG reduction target, especially the target of the energy sector, has significantly raised in the updated NDC as compared to the NDC submitted in 2015.

In the revised PDP7 approved in 2016, it was expected that domestic electricity demand would be met by domestic fossil fuels. However, the Paris Agreement of 2016 requires all nations, including developing countries, to slash GHG emissions, and Vietnam became an importer of primary energy in 2015 due to a sharp increase in demand and a decline in primary energy production. As a result, attempts are being made to suppress the development of power sources derived from fossil fuels, particularly coal-fired power generation. In the updated NDC, there are comments on power sources in Vietnam as follows; maximise hydro-power; prioritise wind and solar power development in line with the ability to ensure system safety at reasonable prices; maximise the exploitation of co-generated biomass sources, gradually making gas power an important source of power supply and supporting the regulatory system; develop coal-fired power at an appropriate level with large-capacity, high-efficiency turbines using advanced technologies such as the ultrasupercritical technology or more.

3.3.1 Actual GHG emissions

The second biennial updated report (BUR) was submitted by the Vietnamese government to the UNFCCC in 2017. A comparison of GHG emissions in 2013 from all 5 sectors, i.e. the energy, industrial process, agriculture, LULUCF, and waste sectors, indicates that the energy sector has the largest GHG emissions (151.4 Mt CO₂e), accounting for about 58% of the total including LULUCF, followed by the agriculture sector (89.4 Mt CO₂e), the industrial processes sector (31.8 Mt CO₂e), the waste sector (20.7 Mt CO₂e), and the LULUCF sector (-34.2 Mt CO₂e).

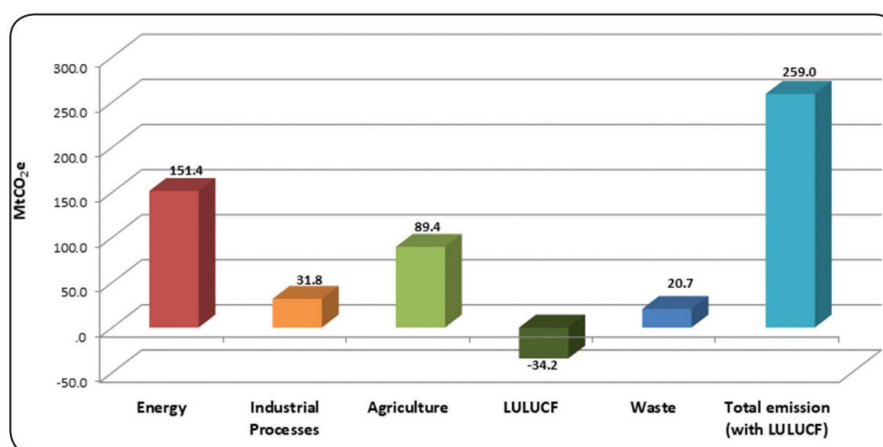


Figure 3-3 GHG emissions by sector in 2013

(Source: MONRE "THE SECOND BIENNIAL UPDATED REPORT OF VIETNAM TO THE UNFCCC")

Comparing GHG emissions over time in 1994, 2000, 2010, and 2013, GHG emissions more than doubled over 9 years, from 103.8 Mt CO₂e in 1994 to 259.0 Mt CO₂e in 2013. A comparison by sector shows that GHG emissions in the energy sector have increased the most rapidly, from 25.6 Mt CO₂e in 1994 to 151.4 Mt CO₂e in 2013, a 6 fold increase over 9 years.

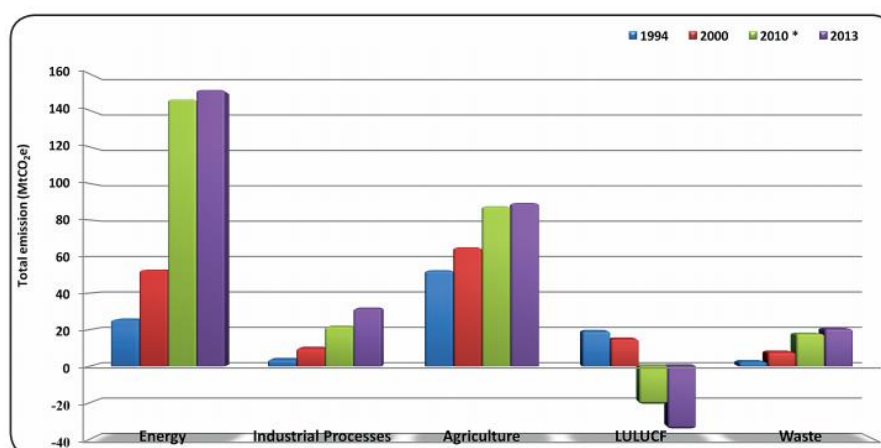


Figure 3-4 Trends in GHG emissions by sector

(Source: MONRE "THE SECOND BIENNIAL UPDATED REPORT OF VIETNAM TO THE UNFCCC")

3.3.2 Financial and technical assistance needed to achieve NDC

The BUR1, submitted by the Vietnamese government to the UNFCCC in 2014, and the BUR2, submitted in 2017, described the need for financial and technical assistance related to climate change.

(1) Financial support

According to the Vietnamese government, it is estimated that about US \$3.2 billion will be needed for the implementation period from 2021 to 2030 to achieve the NDC's target of unconditional contribution (i.e. NDC submitted in 2015). It also estimates that an additional US \$17.9 billion of international assistance would be required to achieve the goal of conditional contribution to achieve the reduction goal of the NDC submitted in 2015.

To date, Vietnam has received bilateral and multilateral assistance from international partners in implementing its climate change measures from a variety of sources, including technical assistance, grants and preferential loans. Financial support for climate change from agencies through the Climate Change Program Loan (SP-RCC: Support Program to Respond to Climate Change) is shown in Table 3-7. Since the updated version of NDC does not include specific data of financial support through the SPR-CC, those data were referred from the NDC submitted in 2015.

Table 3-7 Financial support through the SPR-CC

Donors	POLICY MATRIX FOR THE YEAR OF:								
	2008-2009	2010	2011	2012	2013	2014	2015	2016	2017
LOAN									
JICA	US\$ 110 million	US\$ 110 million	US\$ 153 million	US\$ 100 million			US\$ 100 million	US\$ 100 million	
AFD	EUR 20 million	EUR 20 million	EUR 20 million	EUR 20 million	EUR 20 million				US\$ 50 million
WB		US\$ 70 million	US\$ 70 million	US\$ 70 million				US\$ 90 million	US\$ 90 million
KEXIM			US\$ 30 million	US\$ 20 million	US\$ 10 million				
GRANT									
CIDA			AUS\$ 4.45 million						
AusAID/DFAT			AUS\$ 8 million	AUS\$ 6 million					

(Source: MONRE "THE SECOND BIENNIAL UPDATED REPORT OF VIETNAM TO THE UNFCCC")

(2) Technical assistance

In a technical report on the NDC in 2015, the required technologies are listed by following sectors: energy, transport, agriculture, forestry, and waste management.

The technologies for achieving the GHG emission reduction targets set in Vietnam’s NDC are shown in Table 3-8. Renewable energy, including biomass power generation, small hydropower generation, wind power generation, biogas power generation, supercritical thermoelectric technology, and solar power generation, is listed in the technologies to achieve the NDC targets.

Table 3-8 Technologies to be applied for achievement of the NDC

Sector	Technology
Energy	<ul style="list-style-type: none"> • Using high performance household air conditioners • Using high performance refrigerators • Using energy-saving lighting • Using solar water heaters • Transforming the technology of cement production • Technological innovation in the production of bricks • Using high-performance air conditioning in commercial services • Developing biomass electricity • Developing small hydropower • Developing wind power • Developing biogas • Developing supercritical thermoelectricity technology • Developing solar power

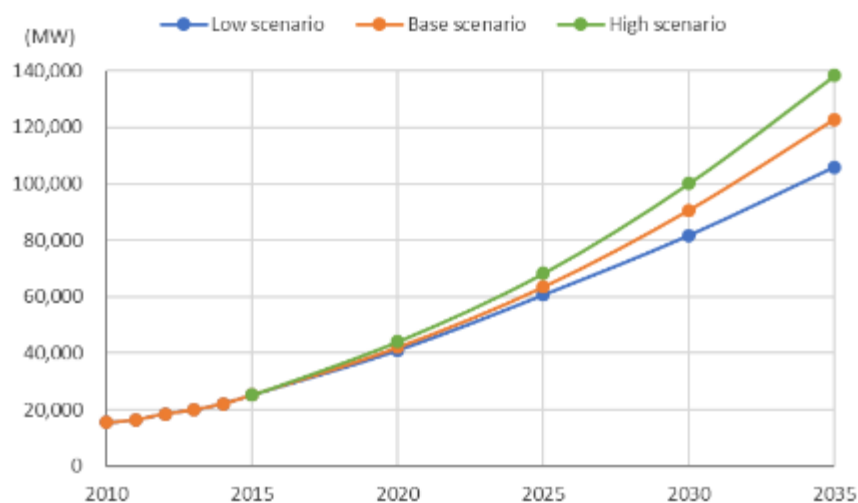
(Source: MONRE "THE SECOND BIENNIAL UPDATED REPORT OF VIETNAM TO THE UNFCCC")

3.4 Current Status and Outlook for Power Development

MOIT commissioned IE to formulate PDP8 as a revision of the revised PDP7 (approved by the Prime Minister on March 18, 2016: 428/QD-TTg). As of December 2020, PDP8 will be release in 2021.

3.4.1 Demand Forecast

The demand forecast in the revised PDP7 is shown below.



(Source: Revised PDP7, March 2016)

Figure 3-5 Demand Forecast in the revised PDP7

The annual growth rate from 2010 to 2015 is 10.4%.

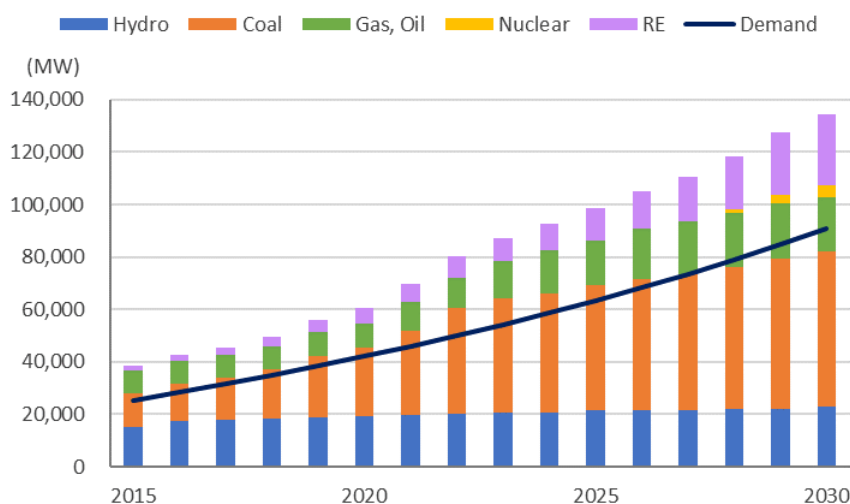
Demand growth from 2015 to 2030 is assumed to be 7.0% per year in the Base Scenario and 7.5% per year in the High Scenario.

PDP8 is currently being revised, but according to IE expectations as of December 2019, the demand forecast in PDP8 is not expected to differ greatly from the revised PDP7. However, demand by 2020 is expected to decrease slightly compared to the forecast.

3.4.2 Supply and Demand Situation in the revised Version of PDP7

The power source configuration and supply and demand situation in the revised PDP7 are shown below.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Demand	25.3	28.3	31.5	34.8	38.4	42.1	45.9	50.0	54.3	58.8	63.5	68.3	73.5	78.9	84.7	90.7
Hydro	15.1	17.3	17.8	18.3	18.7	19.2	19.7	20.0	20.7	20.7	21.5	21.6	21.6	21.9	22.2	23.0
Coal	12.9	14.2	16.1	18.9	23.7	26.0	32.4	40.3	43.6	45.4	47.9	49.9	51.9	54.3	57.3	59.1
Gas, Oil	8.7	8.7	8.7	8.7	8.7	9.5	11.0	11.7	14.0	16.2	17.0	19.2	20.0	20.7	20.7	20.7
RE	2.0	2.3	2.7	3.7	4.7	5.7	6.8	8.0	9.0	10.2	12.0	14.1	17.1	20.3	23.6	27.2
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.5	4.6
Total	38.7	42.5	45.2	49.6	55.8	60.4	69.8	80.1	87.3	92.5	98.4	104.9	110.5	118.4	127.4	134.6



(Source: Prepared by JICA Survey Team based on revised PDP7)

Figure 3-6 Supply and Demand Situation in the revised PDP7⁹

Looking at the relationship between the installed capacity of generation facilities and the maximum demand, the installed capacity of generation facilities is more than 1.4 times⁹ the maximum demand, and it is planned to have sufficient supply capacity. In 2022 and 2023 in particular, it is more than 1.6 times, and if the facilities start operation as planned, the supply capacity will be at a slight surplus.

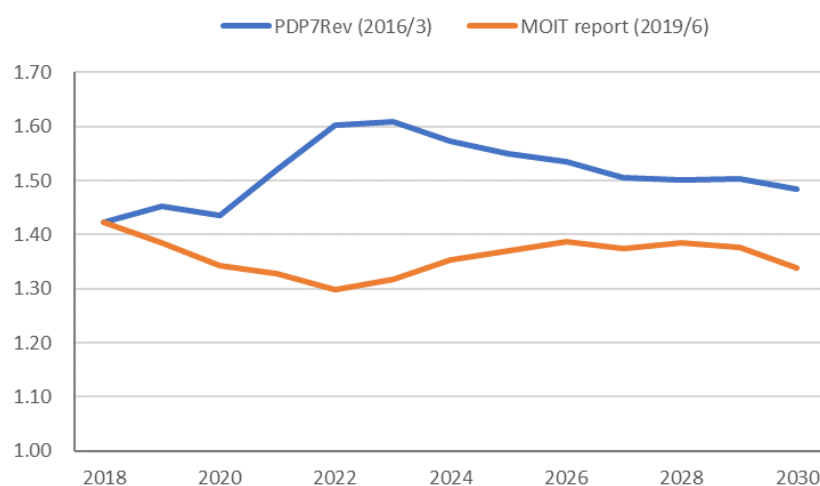
The amount of renewable energy increases gradually, growing especially after 2025, and will have reached 20% of the total by 2030. However, the utilization rate of renewable energy is assumed to be 19% for solar power and 23% for wind power, with the amount of generated energy not increasing as much as the installed capacity, so the composition ratio in 2030 is approximately 9%.

⁹ Renewable energy (RE) includes small hydropower of 10MW or less.

3.4.3 Current Status for Power Development Plan

As of June 4, 2019, MOIT has reported the current status and future prospects of the power development plan in the revised PDP7. According to this report, construction of the power plants proposed in the revised PDP7 has been greatly delayed. Based on the current power development plan, the ratio of installed capacity with the demand in the Base Scenario is as follows.

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Demand	(GW)	34.8	38.4	42.1	45.9	50.0	54.3	58.8	63.5	68.3	73.5	78.9	84.7	90.7
PDP7 Rev (2016/3)	(GW)	49.6	55.8	60.4	69.8	80.1	87.3	92.5	98.4	104.9	110.5	118.4	127.4	134.6
	Rate	1.42	1.45	1.43	1.52	1.60	1.61	1.57	1.55	1.53	1.50	1.50	1.50	1.48
MOIT report (2019/6)	(GW)	49.6	53.2	56.5	61.0	64.9	71.5	79.7	86.9	94.7	101.0	109.3	116.7	121.3
	Rate	1.42	1.39	1.34	1.33	1.30	1.32	1.35	1.37	1.39	1.37	1.39	1.38	1.34



(Source: Prepared by JICA Survey Team based on revised PDP7 and MOIT report)

Figure 3-7 Outlook for Power Development Plan

In the revised PDP7, in 2022 and 2023 there was about 1.6 times' the installed capacity with respect to demand, and it was expected that sufficient supply capacity could be secured. However, construction of many power generation facilities has been delayed, and according to the MOIT report in June 2019, the installed capacity in the same period can only secure about 1.3 times' the demand. For this reason, there is a high possibility of power shortages in 2022 and 2023. In addition, there are concerns about shortages of fuel (coal and gas) for power generation. Because the existing power generation facilities cannot secure sufficient fuel, it is reported that there are concerns about the occurrence of power shortages even in 2020.

3.5 Status and Prospects of Renewable Energy Penetration

3.5.1 Regulations related to Renewable Energy

The government of Vietnam has set policies and regulations for promoting renewable energy based on the revised PDP7, and has introduced a feed-in tariff (FIT) mechanism, a net metering scheme, tax incentives, etc. In addition, an auction mechanism for solar and wind power and a renewable portfolio standard mechanism have been under consideration.

Table 3-9 Major renewable energy promotion policies and regulations in Vietnam

Policies/regulations		Details
FIT mechanism		<ul style="list-style-type: none"> FIT mechanism has been implemented for solar, wind, biomass, waste, and small hydro power generation, which can be sold to EVN at a fixed price for 20 years. The next FIT mechanism for solar is reviewed regularly.
Net metering scheme		<ul style="list-style-type: none"> Consumers who purchase electricity from the grid and can generate electricity from renewable sources can use the net metering system.
RPS		<ul style="list-style-type: none"> MOIT is considering the introduction of regulations for the minimum ratio of electricity generation and purchase from renewable power sources on an annual basis for power generators and power distributors. However, it is unclear whether such regulations will be introduced.
Preferential tax system	1. Preferential corporate income tax treatment	<ul style="list-style-type: none"> The exemption to corporate income tax is applied to new renewable energy power generation projects.
	2. Preferential import tax treatment	<ul style="list-style-type: none"> In the renewable generation business, the import tax is exempted for goods that are fixed assets and imported for use in the business.
	3. Exemption to and reduction of land rent	<ul style="list-style-type: none"> Grid-connected renewable power plants, transmission lines, and substations are exempted from, and have reduced, land rents in accordance with current laws and regulations applicable to investment projects

(Source: Survey team-prepared based on various materials)

(1) Support mechanism for solar power projects

(a) FIT mechanism

Under Decision No. 11/2017/QĐ-TTg of the Prime Minister, the Vietnamese government introduced FIT phase 1 for solar power generation, and a flat purchase price (9.35 US\$/kWh) was set for power plants that started operation by June 30, 2019, with a valid period of 20 years (applications currently closed).

When the FIT phase 1 expired on June 30, 2019, the Government of Vietnam decided to extend the FIT period by 2 years, in phase 2 of the FIT, and set new purchase prices for power plants starting operation from July 1, 2019 to June 30, 2021. The MOIT submitted a proposal to the Prime Minister to set different purchase prices (6.67 - 10.87 US\$/kWh) for each region depending on where the solar power facilities are to be installed (all 63 provinces of Vietnam are divided into 4 regions) and for each type of power generation technology, including ground-mounted solar power, rooftop solar power, and floating solar power. However, at the end of July 2019, MOIT was reportedly requested by the Prime Minister to resubmit the proposal. In the plan, purchase prices were set low in the southern region, where solar radiation is advantageous, and set high in the northern region, where solar radiation is inferior. Therefore, it is assumed that the introduction of solar power was leveled among regions in order to mitigate the effects on electricity systems caused by the uneven penetration of solar power.

In Notice No. 402 of 2019, dated November 22, 2019 (No. 402/TB-VPCP), the Prime Minister signed phase 2 of the Solar FIT. According to the Notice, in accordance with the Prime Minister's Decision No. 11 of 2017, a uniform purchase price throughout the country was set for solar power plants that started operation on or after July 1, 2019. The purchase prices are 7.09 US\$/kWh for ground-mounted solar projects, 7.69 US\$/kWh for floating solar projects, and 9.35 US\$/kWh for rooftop solar projects and are fixed for 20 years. The price for rooftop solar plants remains the same as FIT phase 1. However, FIT phase 2 is applicable only to projects which already have an agreed power purchase agreement

(PPA) and will start operation by the end of 2020. For projects that have not yet agreed a PPA, or for new projects, FIT will not be applied, and prices will be determined via their purchase prices through a competitive auction mechanism. The government of Vietnam aims to create a competitive environment for power generation through the auction system and to reduce power generation costs. It is noted that the mechanism to promote the social and economic development of Ninh Thuan Province, located in south central Vietnam, from 2018 to 2023 was set under Resolution No. 115/NQ-CP. Therefore, as an exception, the province intends to accept FIT until the upper limit of 2,000 MW or until the end of 2020, whichever is earlier.

According to an interview with EREA conducted by the survey team in late November 2019, rooftop photovoltaic power generation was divided into medium and low voltage according to the voltage class of the distribution lines connected, and low-voltage rooftop solar power was to set at a higher purchase price than the medium voltage.

Based on the above-mentioned circumstances, the FIT phase 2 was officially announced under the Prime Minister's Decision No. 13 dated April 6, 2020 (Decision No. 13/2020/DQ-TTg). The purchase price of 7.09 USc/kWh for ground-mounted solar projects and 7.69 USc/kWh for floating solar projects will be applied for 20 years to projects which have attained decision on investment policy issued by competent authorities before November 23, 2019 and started operation between July 1, 2019 and December 31, 2020. As for rooftop solar power projects, the purchase price was reduced to 8.38 USc/kWh and will be applied for 20 years to projects which start operating between July 1, 2019 and December 31, 2020.

According the Notice issued by MOIT (No. 18/2020/TT-BCT) on July 17, 2020, solar projects in Ninh Thuan province are applicable to the above-mentioned incentivized measures of Resolution No. 115/2018/NQ-CP, and 9.35 USc/kWh will be applied for 20 years for the projects which start operation by January 1, 2021, before the cumulative capacity in Ninh Thuan province reaches 2,000 MW. After the cumulative capacity exceeds 2,000 MW, the purchase price indicated in Decision No. 13/2020/DQ-TTg will be applied to the solar projects in Ninh Thuan province.

Table 3-10 Purchase prices for solar FIT Phase 1 and Phase 2

	Phase 1: COD before June 30, 2019 (No. 11/2017/QD-TTg)	Phase 2 update: COD from July 1, 2019 to December 31, 2020 (No. 13/2020/QD-TTg)
Ground-mounted solar power projects	2,156 VND/kWh (9.35 USc/kWh)	1,664 VND/kWh (7.09USc/kWh)
Floating solar power projects	2,156 VND/kWh (9.35 USc/kWh)	1,783 VND/kWh (7.69 USc/kWh)
Rooftop solar power projects	2,156 VND/kWh (9.35 USc/kWh)	1,943 VND/kWh (8.38 USc/kWh)

(Source: Prime Minister Decision No. 11 of 2017, Prime Minister Decision No. 13 of 2020)

(b) Auction mechanism

As mentioned above, the FIT system for solar PV in Vietnam is expected to shift to an auction mechanism gradually. ADB and WB provide support for the EREA on solar auctioning; WB assists in the design of the auction scheme and ADB assists in the demonstration of auctioning.

According to WB's Terms of Reference (TOR), named "Advisory service for Vietnam: solar auction program design World Bank and global infrastructure facility support", WB support is planned to cover the following 4 tasks.

Table 3-11 TOR for the WB solar auctioning system

Tasks	Content
Task 1: Develop High Level Solar Auction Strategy	<ul style="list-style-type: none"> Support for MOIT, including relevant international experience, situation in Vietnam, and legal proposals

Tasks	Content
Task 2: Develop Specific Standard Auction Strategy	<ul style="list-style-type: none"> • Proposal of specific parameters to accept a project in the Standard Auction (i.e. land lease, grid interconnection agreement, environmental study etc.) • Proposal of frequency and size of Standard Auctions • Presenting specific roles and responsibilities of each stakeholder under Standard Auctions • Conduct one workshop with relevant stakeholders in Hanoi
Task 3: Develop Specific Solar Park Strategy	<ul style="list-style-type: none"> • Proposal of frequency of auctions and size of Solar Parks • Proposal of specific sites based on geospatial/grid interconnection analysis and discussions with the Provinces • Proposal of the Solar Park structure, with specific roles and responsibilities of each stakeholder • Conduct one workshop with relevant stakeholders in up to four relevant provinces
Task 4: Advise on Attractive Contractual/Procurement Framework for Solar Auction Program	<ul style="list-style-type: none"> • Advising on best practice contractual and procurement arrangements/tendering package to ensure the attraction of efficient domestic and international private investors to participate in the auction process and achieve the lowest bidding prices possible • Key areas for advice include: (i) Qualification Requirements; (ii) Winner Selection Process; and (iii) Seller’s Liabilities, etc.

(Source: World Bank "TERMS OF REFERENCE Advisory Service for Vietnam: Solar Auction Program Design World Bank and Global Infrastructure Facility Support" [https://www.devbusiness.com/NoticesAttachments/812c180f-341f-4ebc-a62d-2c1ac39df2d0%2399Optional%20TOR%20File%20\(3\).pdf](https://www.devbusiness.com/NoticesAttachments/812c180f-341f-4ebc-a62d-2c1ac39df2d0%2399Optional%20TOR%20File%20(3).pdf))

Under the FIT phase 1, the uniform purchase price caused concentrated construction of power plants in areas suitable for solar power generation, resulting in a shortage of transmission capacity. Therefore, it is assumed that the auction mechanism will aim to control the concentration of local power plant construction by determining the purchase price through auctioning. Rooftop solar power generation is expected to be excluded from auctioning and continue to apply the existing FIT mechanism.

The World Bank (WB) carried out a study on the investigation of the solar auction scheme in Vietnam. The report published in 2020 suggested several auction models and recommended that auctions at substation level and solar park level are appropriate for Viet Nam. Besides, the roles and responsibilities of each model have categorized in the report.

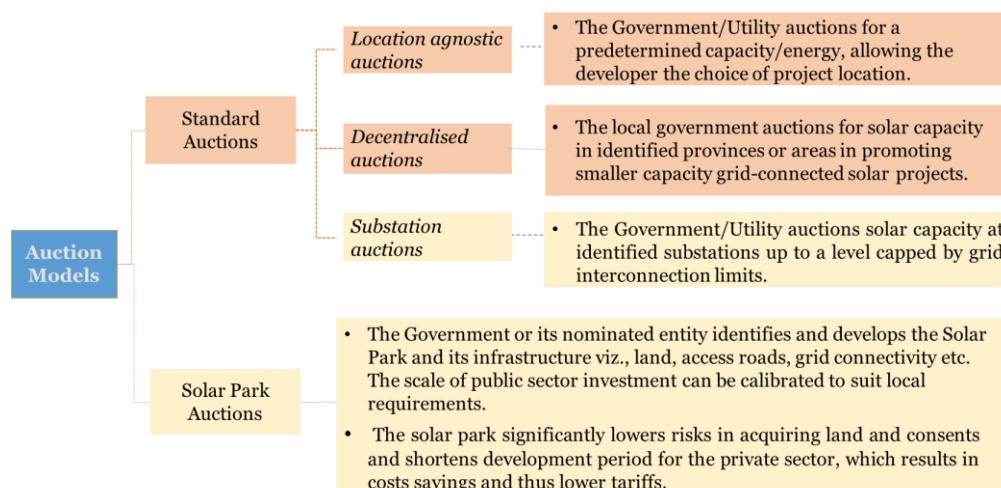


Figure 3-8 Solar auction models

(Source: WB “Vietnam: Solar Auction Strategy” <https://gwec.net/wp-content/uploads/2019/06/2.-Ky-Hong-Tran-World-Bank-Vietnam-Solar-Auction-Strategy.pdf>)

Table 3-12 Roles and responsibilities under substation-based competitive bidding

ROLE	RESPONSIBILITY	STAKEHOLDER(S)
Bidding selection committee	The committee (i) develops with the transaction advisors the bidding documentation and framework; and (ii) launches, implements, and concludes the IPP selection process.	MOIT and/or EVN leads the process with the support of EVN/MOIT and the PPC for the area in which each substation/solar park is located. PPCs must be fully involved, as the selection process leads to the approval of the investment license.
PPA signatory	The PPA signatory signs the PPA with the IPP and pays for the electricity provided by the IPP at the price determined through competitive bidding.	EVN, but this could change after the electricity market is fully in place; see Annex 1.
Selection of substations/ feeders and their capacity	Substations and feeders are selected as part of a larger technical study of the grid so as to ensure minimal VRE integration constraints are met and that suitable land is available around the substation.	EVN/NPT/Power Corporations (PCs), with the support of PPC and MOIT
Power plant owner	The plant owner is responsible for (i) financing, building, and operating the solar power plant; and in the case of substation-based competitive bidding: (ii) identifying land; and (iii) paying resettlement compensation.	IPP

Note: PPC: Provincial's Party Committee

(Source: WB "VIETNAM SOLAR COMPETITIVE BIDDING STRATEGY AND FRAMEWORK"

<http://documents1.worldbank.org/curated/en/949491579274083006/pdf/Vietnam-Solar-Competitive-Bidding-Strategy-and-Framework.pdf>)

Table 3-13 Roles and responsibilities under solar park competitive bidding

ROLE	RESPONSIBILITY	STAKEHOLDER(S)
Solar park land selection	The land selection must be aligned with the land master plan and with the goal of minimizing environmental and social impacts.	PPC with the support of MOIT and EVN
Land clearing for solar park	People on the selected land are compensated, and full ownership is transferred to the stakeholder.	PPC or EVN
Solar park agency	Technical development, financing, and construction of the infrastructure (fence and transmission line) and operation and maintenance (O&M).	public entity (PPC or EVN)

Note: PPC: Provincial's Party Committee

(Source: WB "VIETNAM SOLAR COMPETITIVE BIDDING STRATEGY AND FRAMEWORK"

<http://documents1.worldbank.org/curated/en/949491579274083006/pdf/Vietnam-Solar-Competitive-Bidding-Strategy-and-Framework.pdf>)

(c) Direct PPA

In conjunction with the auction mechanism, the direct power purchase agreement (DPPA) mechanism was proposed by USAID to ERAV. The DPPA is a long-term contract scheme in which off-takers (usually a commercial or industrial consumer) purchase electricity directly from renewable energy power producers (RE GENCO).

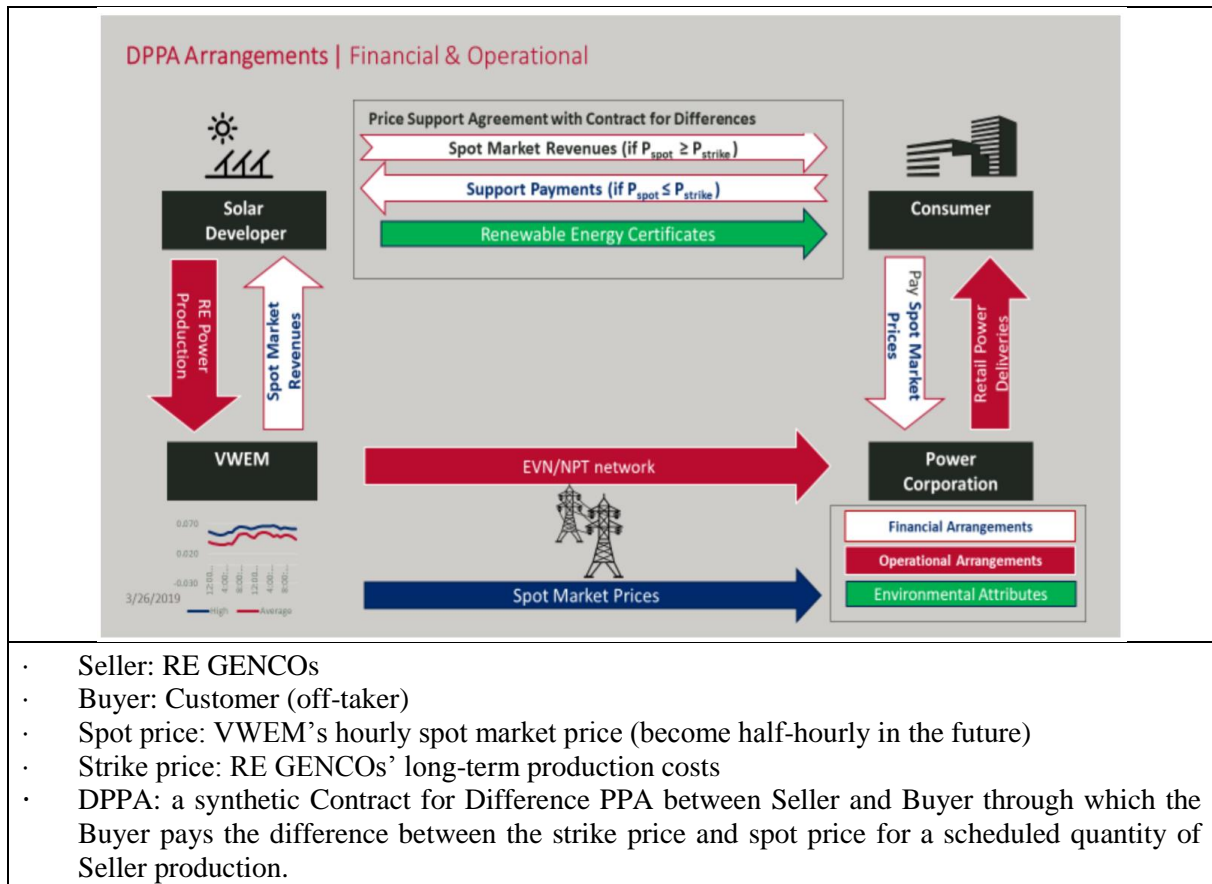


Figure 3-9 Overview of DPPA

(Source: Vietnam Low Emissions Energy Program "DPPA's for Vietnam: Pilot Design and Implementation Plan" http://vepg.vn/wp-content/uploads/2019/09/DPPA_Session123_V-LEEP_20190612_Eng-merged.pdf)

To illustrate the definition of, and explain the model of, a DPPA, the duration of a DPPA and the roles of buyers and sellers are shown below.

DPPA tenure:

- 10-20 years, with a mutually agreeable option to extend

Buyer (Consumer):

- Access to wholesale market for up to 100% of power consumption; pays at spot market prices
- DPPA fee: an additional charge for network costs and other extra costs of power sector agencies
- Pays (or be paid) to the Seller the difference between the strike price and spot price for a scheduled quantity of Seller's production
- Receive Renewable Energy Certificate from RE GENCO

Seller (RE GENCO):

- Sells 100% of generation into the wholesale market, receiving the spot market price
- Receives an hourly price support payment (equal to strike price minus spot market price) for scheduled quantities of generation as specified in the DPPA between Buyer and Seller

According to USAID, several projects will be launched as a demonstration program for DPPA. As of the end of September 2020, although the Vice-Minister of MOIT had received PM Notice No. 710/TTTg-CN dated June 11, 2020 concerning DPPA, USAID have not received MOIT's approval and thereby the demonstration project itself is expected to be delayed. According to USAID, MOIT

will make an announcement about the pilot DPPA program 15 days after the MOIT’s decision, and the DPPA website will be launched about 15 days after the MOIT decision and applications will be accepted. The application period is about 45 days, and the evaluation and selection are done in about 45 days after the deadline. About 270 days after MOIT selects the target project, commercial operation will begin and the demonstration program will continue for about 1 year.

Table 3-14 DPPA demonstration program

<ul style="list-style-type: none"> • Target: 400 – 1000 MW • Minimum Project size: Projects accepted into the DPPA Pilot Program shall have an installed capacity of no less than 30MW (for solar) • Pilot program location: <ul style="list-style-type: none"> ➢ Buyers shall be located in Southern Power Corp service area. ➢ Sellers shall be allowed to site projects at any location which best fits the projects criteria, while making best efforts to avoid areas currently considered “congested”. ➢ Projects accepted into the Pilot Program must be located in low congestion regions as determined by EVN. Proposed Timelines: • Timeline: <ul style="list-style-type: none"> ➢ Pilot Project Planning (May – Dec. 2019) <ul style="list-style-type: none"> ✧ MOIT Public Consultation ✧ First Action Plan agreed with ERAV ✧ Market preparation ➢ Legal Approval/ Invitation to Participate (Q4 2020) <ul style="list-style-type: none"> ✧ MOIT Decision *Pending* ✧ Pilot Program launched ➢ Project Selection (Q1 2021 – Q2 2021) <ul style="list-style-type: none"> ✧ Applications to MOIT submitted & evaluated ✧ Transaction agreements executed ✧ Operational capacity developed ➢ Project Implementation (Q4 2021 – Q2 2022) <ul style="list-style-type: none"> ✧ Financial Close ✧ Construction ✧ Commercial operation ✧ Monitoring and Evaluation

(Source: ERAV "VIETNAM WIND POWER DEVELOPMENT PLAN: GRID, DPPA AND RENEWABLE ENERGY PLANNING" <https://gwec.net/wp-content/uploads/2019/06/1.-Mr-Nguyen-The-Huu-Grid-ERAV-REnewable-Energy-Development-Plan.pdf>, VEPG “VEPG TWG3 5th Meeting” http://vepg.vn/wp-content/uploads/2020/11/VEPG_TWG3_5thMeeting_fin.pdf)

(d) Net metering scheme

For rooftop solar power generation, a net metering system was introduced in 2017. Decision No. 11 of the Prime Minister (No. 11/2017/QĐ-TTg) describes rooftop solar projects that started operation before June 30, 2019 and the provision was amended to direct transaction under Decision No. 02/2019/QĐ-TTg, applicable for projects that started operation after July 1, 2019.

Table 3-15 Net metering scheme

Item	Content
Target	<ul style="list-style-type: none"> • The net metering system can be used by consumers who purchase electricity from the national power system and, at the same time, can generate electricity from renewable energy sources for their own consumption.
Role	<ul style="list-style-type: none"> • Power distribution companies: Based on the net metering principle, they are responsible for concluding power purchase contracts with end consumers who have power facilities that use renewable power sources. • Ministry of Commerce and Industry: Introduce simplified connection procedures/procedures, evaluation methods, etc. • Electric Power Company: responsible for metering and calculating system owner surplus power and revenue.

Item	Content
Content	<p>Starting operation by June 30, 2019:</p> <ul style="list-style-type: none"> Net metering based on bi-directional metering (arranged by each state power company). Surplus power may be transferred from the current billing period to the next billing period. <p>Operation started on and after July 1, 2019:</p> <ul style="list-style-type: none"> Sellers pay directly for electricity received from the grid in accordance with current regulations. Purchasers pay the same price for the amount of electricity supplied to the grid from rooftop PV systems as they pay for grid-connected PV projects.
Price	<ul style="list-style-type: none"> 1,943 VND/kWh (8.38 USc/kWh) (Decision No. 13 of 2020, adjusted annually based on VND/USD exchange rate)

(Source: Decision No. 11 of 2017, Decision No. 2 of 2019, Decision No. 13 of 2020)

(2) Support mechanism for wind power projects

(a) FIT mechanism

Under Decision No. 39 of 2018 of the Prime Minister (Decision No. 39/2018/QD-TTg), flat purchase prices of 8.5 USc/kWh for onshore wind power and 9.8 USc/kWh for offshore wind power were set for power plants that started operation from November 1, 2018 to October 31, 2021. The purchase period is 20 years. Decision No. 39 of 2018 was adopted as a supplemental decision to No. 37 of 2011 (Decision No. 37/2011/QD-TTg). These were applied for projects that started operation before October 31, 2018 with a purchase price of 7.8 USc/kWh. The funding resources for the wind FIT, 1 USc/kWh, were covered by the Vietnam Fund of Environment Protection. However, according to an interview with the EREA, since the fund has run out, coverage from it has been completed.

Table 3-16 Purchase prices for wind FIT Phase 1 and Phase 2

	Phase 1: COD before October 31, 2018 (Decision No. 37/2011/QD-TTg)	Phase 2: COD after November 1, 2018 (Decision No. 39/2018/QD-TTg)	Proposed: COD after November 1, 2021 (Official Letter No. 8159/2020/BCT-DL)
Onshore wind power projects	1,614 VND/kWh (7.8 USc/kWh)	1,928 VND/kWh (8.5 USc/kWh)	7.02 USc/kWh
Offshore wind power projects	1,614 VND/kWh (7.8 USc/kWh)	2,223 VND/kWh (9.8 USc/kWh)	8.47 USc/kWh

(Source: Prime Ministerial Decision No. 37 of 2011, Prime Ministerial Decision No. 39 of 2018)

According to an interview with the EREA, the purchase prices for wind power projects were initially set at 7.8 USc/kWh regardless of whether they were onshore or offshore. However, since the expected capacity of the initial plan was not introduced, the purchase prices were set higher reflecting investors' opinions.

In April 2020, the MOIT proposed to the Prime Minister to extend the deadline for the application of the wind FIT in Prime Minister's Decision No. 39 of 2018 until December 31, 2023. Projects eligible for FIT must be operational by October 31, 2021, but wind projects take a lot of time to build, and there are construction delays in many projects due to COVID-19 and other factors. The proposal also suggests that wind power projects should adopt a competitive bidding mechanism after 2023.

According to the Official Letter No. 8159/BCT-DL dated October 28, 2020, MOIT has collected comments from other ministries regarding the FIT of wind power after November 1, 2021. The document proposes tariff of 7.02 USc/kWh for onshore wind power and 8.47 USc/kWh for offshore wind power for plants that began operation after November 1, 2021 and before December 31, 2023.

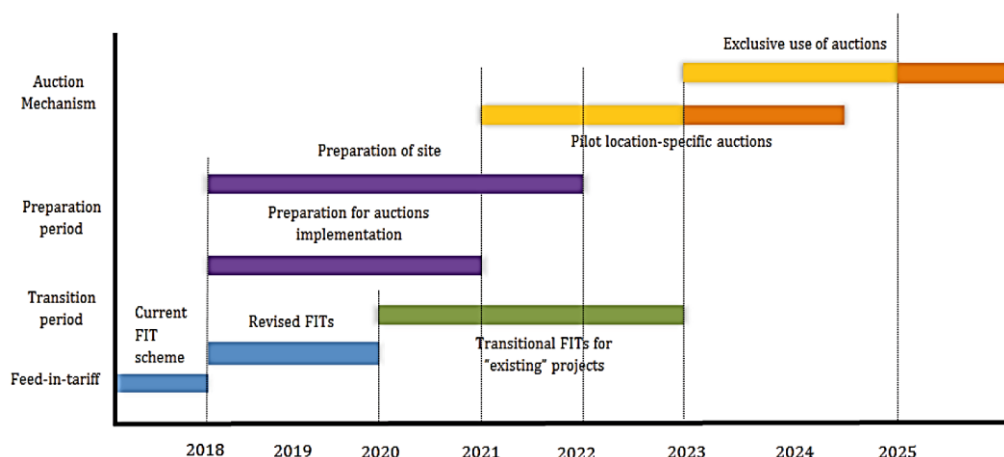
(b) Auction mechanism

Although no promotional mechanism has been decided for wind power projects after the FIT deadline of November 1, 2021, Decision No. 39 of 2018 of the Prime Minister indicates that wind power projects will also be moved to a bidding system.

In April 2020, the Ministry of Commerce and Industry submitted a proposal to the Prime Minister to extend the wind FIT until December 31, 2023, but the specifics have yet to be decided.

With regard to the auction mechanism for wind power projects, GIZ published a research report entitled "Assessing the Applicability of Wind Energy Auction for Vietnam - A Comprehensive Overview" in July 2018. The report recommends that the transition from FIT to auction mechanism for wind power projects should not be implemented immediately but should be carried out after the business environment is improved. The keys to the successful transition to the auction mechanism are (1) A sufficiently large national market size; (2) A high level of competition; (3) A mature market and policy framework; (4) Clarity about long-term market development. According to the report, the introduction of the auction is expected to begin after 2021, when the current FIT system expires. Financial support from international donors is needed before the bidding system can be fully implemented.

Table 3-17 Proposed timelines for Auction Implementation in Vietnam



(Source: MOIT/GIZ Energy Support Programme "Assessing the Applicability of Wind Energy Auction for Vietnam - A Comprehensive Overview")

The following recommendations have been stated for the preparation and implementation of the auction mechanism.

- Coordination with the design of solar PV auctions
- Detailed calibration of auction design for wind energy
- Selection/establishment of the managing Auction Agency
- Elaboration of training plan and training material for Auction Agency and other actors

Although recommendations for wind auctions were compiled by GIZ, ADB is providing support for EREA on the implementation of the demonstration.

(3) Other support mechanisms for renewable energy

(a) FIT mechanism for biomass and waste power projects

FIT for biomass power projects was introduced in 2014 under the Prime Minister's Decision No. 24/2014/QĐ-TTg. It applies a feed-in tariff of 5.8 USc/kWh for 20 years to power plants that start operating after May 2014. According to the Prime Minister's Decision 08/2020/QĐ-TTg dated March 5, 2020 which is an updated version of the Prime Minister's Decision in 2014, the purchase price of biomass power generation will be increased, and 7.03 USc/kWh will be applied from April 25, 2020. The FIT scheme for solid waste power projects was introduced in 2014 under the Prime Minister's Decision No. 31/2014/QĐ-TTg. The FIT for direct waste incineration of 10.05 USc/kWh and landfill combustion gas of 7.28 USc/kWh is applied for 20 years to power plants that start operation after May 2014.

Table 3-18 Purchase prices for biomass and waste

Power generation system	Purchase prices (US\$/kWh)	Period (Year)
Biomass power projects	5.8 (before April 24, 2020) 7.28 (after April 25, 2020)	20
Waste power projects	10.05 (direct incineration) 7.28 (combustion gas)	20

(Source: As of the end of December 2020, when the investigation team was formed, based on various materials)

(b) RPS mechanism

Under Decision No. 25 of 2015 of the Prime Minister, Vietnam's renewable energy development strategy through 2030 and the outlook through 2050 was approved and the Renewable Portfolio Standard (RPS) was proposed in the strategy. MOIT is under consideration for the introduction of a provision for the minimum rate of power generation and purchase from renewable power sources on an annual basis for power generator entities and distribution entities. MOIT will determine the minimum rate of power generation and purchase from renewable power sources every year.

Table 3-19 Minimum power generation and purchase rates set in RPS

Entities	Percentage
Power generation entities with more than 1,000 MW of installed capacity (excluding BOT invested sources)	The percentage of electricity generated from renewable power sources shall not be less than the following: <ul style="list-style-type: none"> • 2020: 3% • 2030: 10% • 2050: 20%
Power distribution entities that generate/purchase electricity from renewable sources	The percentage shall not be less than the following: <ul style="list-style-type: none"> • 2020: 5% • 2030: 10% • 2050: 20%

(Source: Prime Ministerial Decision No. 25 of 2015)

USAID provides support for the implementation of the RPS mechanism. In June 2019, the National Renewable Energy Laboratory (NREL), the U.S. Department of Energy's primary national laboratory for renewable energy, published the results of a study entitled "International Best Practices for Implementing and Designing Renewable Portfolio Standard (RPS) Policies" as part of the technical cooperation to improve the environment for renewable energy, in cooperation with the Vietnamese government, USAID, and the US Department of State. The objective is to examine the possibility of implementing RPS in Vietnam through an investigation of RPS cases in the United States, Mexico, China, South Korea, Australia, and the Philippines. However, the Vietnamese government's prospects concerning the implementation of RPS are not clear.

(c) Tax incentives

Major tax incentives for renewable energy in Vietnam include corporate income tax incentives, import tax incentives, and land rent exemptions and reductions.

Table 3-20 Tax incentives for renewable energy in Vietnam

Incentives	Details
Preferential corporate income tax treatment	<ul style="list-style-type: none"> • Income from new investment projects related to renewable energy projects is subject to a 10% reduction in corporate income tax for the first 15 years (The minimum corporate tax rate for ordinal companies in general is 20%). <p style="text-align: right;">(Source: Decree No: 218/2013/ND-CP)</p>
Preferential import tax treatment	<ul style="list-style-type: none"> • The import tax will be exempted when products that are fixed assets, raw materials or semi-finished products for renewable power generation projects are imported from abroad. <p style="text-align: right;">(Source: Decree No 4/2009/ND-CP)</p>

Land-rent exemption and mitigation	<ul style="list-style-type: none">• Grid-Connected renewable power plants, transmission lines, and substations will be exempted, and their land rent reduced, in accordance with current laws and regulations applicable to investment projects. (Source: Decision No. 25/2015/QD-TTga)
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3.5.2 Grid connection requirements for Renewable Energy

In Vietnam, the technical requirements for connecting power generation facilities to an electric power grid are stipulated in the electricity transmission grid code and distribution grid code, and requirements are also described for solar power generation and wind power generation.

(1) Solar and Wind power generation

The electricity transmission grid code (Circular No. 25/2016/TT-BCT) or distribution grid code (Circular No. 39/2015/TT-BCT) are applied to large-scale solar power projects with an output of 1 MWp or more, and all solar power generation and wind power generation, except rooftop types of less than 1 MWp. In addition, a project owner who intends to conduct a power generation business needs to obtain permission from MOIT as a power generation company and power generation project.

Table 3-21 Grid connection requirements for Solar and Wind power generation

Grid	Technical Requirements
Transmission	<p>High voltage - Ultra high voltage (220kV-500kV)</p> <ul style="list-style-type: none"> • Frequency: 49-51Hz (Free generation mode and Generating capacity control mode) • Minimum time to maintain power generation in proportion to frequency band <ul style="list-style-type: none"> - 47.5 - 48.0Hz: 10 min - 48.0 - 49.0Hz: 30 min - 49.0 - 51.0Hz: Must maintain continuous generation - 51.0 - 51.5Hz: 30 min - 51.5 - 52.0Hz: 1 min • Minimum time to maintain power generation in proportion to voltage range <ul style="list-style-type: none"> - -0.3pu : 0.15 sec - 0.3 - 0.9pu: $T=4 \times U-0.6$ sec (Upu: Actual voltage at connection point) - 0.9 - 1.1pu: Must maintain continuous generation - 1.1 - 1.15pu: 3 sec - 1.15 - 1.2pu: 0.5 sec • Output must be adjusted to dispatch level within 30 seconds. • The power factor at the interconnection point is maintained from 0.85 (reactive power generation mode) to 0.95 (reactive power receiving mode). • Total harmonic distortion at the connection point of less than 3%. • Negative phase sequence component of less than 1% of rated voltage. • Other areas conform to general requirements. <ul style="list-style-type: none"> - Install SCADA for remote monitoring and control. (More than 220 kV or 30 MW power generation facilities must be equipped with dual communication lines for SCADA.) - Install a circuit breaker that can de-energize the maximum short-circuit current (assumed up to the next 10 years) at the connection point. - Install an automatic frequency load shedding system. - Load fluctuation rate less than 10%.
Distribution	<p>High voltage - Medium voltage (1,000V-110kV)</p> <ul style="list-style-type: none"> • Frequency: 49-51Hz (Free generation mode and Generating capacity control mode) • Minimum time to maintain power generation corresponding to frequency and voltage is the same as that of the transmission system. • Output must be adjusted to dispatch level within 30 seconds. • The power factor at the interconnection point is maintained at 0.95. • Adjust voltage deviation to not more than ± 0.5 % of rated voltage within 2 minutes. • Negative phase sequence component of less than 1% of rated voltage. • Total harmonic distortion at the connection point of less than 3%. • Other areas conform to general requirements. <p>Low voltage (-1,000V)</p> <ul style="list-style-type: none"> • Total installed capacity of the solar power generation connecting low-voltage grid should not exceed 30% of installed capacity of that substation.

	<ul style="list-style-type: none"> • Under 3 kVA system is allowed to connect to 1-phase or 3-phase low voltage power grid. • 3 kVA to 100 kVA system (not exceeding 30% of installed capacity of the low-voltage substation to be connected) is allowed to connect to 3-phase low voltage power grid. • Maintain power generation in the range of frequency 49-51Hz and voltage 85-110%, and maintain power generation for 0.2 seconds when the voltage deviates from this range. • DC Current Injection of less than 0.5% • System of 10kVA or more is required to make an agreement with the Power distribution unit for requirements on protection system. • Other areas conform to general requirements.
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(Source: Circular No.25/2016/TT-BCT, Circular No.39/2015/TT-BCT)

(2) Rooftop solar power generation

For rooftop solar power generation with an output of less than 1 MWp, the project owner directly applies for a PPA and grid connection to EVN Power Corporation. EVN cannot refuse an application if there is no grid capacity limitation or technical requirement incompatibility. Owners are also exempt from obtaining permission as a power generation company. According to EVN's guidelines for the introduction of rooftop solar power generation (No.1532 / EVN-KD) published on March 27, 2019, the following requirements must be satisfied in order to connect power generation facilities to the distribution grid. Note that solar power generation that is not installed on the roof of a building, such as that which is ground-mounted or floating on water, even if the output is less than 1 MWp, is not covered by this regulation.

After confirming that the technical requirements are satisfied, a power purchase agreement is concluded with EVN, and a two-way electricity meter that can measure power purchases and sales is installed by EVN. The project owner can then connect the power generation facility to the grid to generate power. For rooftop solar power generation, a surplus purchase system (net metering system) is applied in which the generated power is basically consumed in the building and the surplus power is sold to an electric power company.

Table 3-22 Grid connection requirements for Rooftop Solar power generation

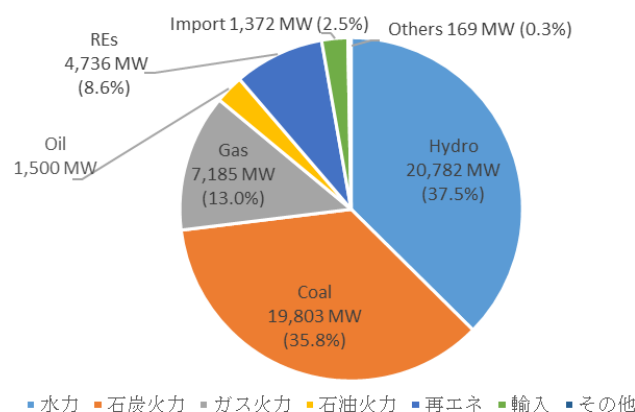
Grid	Technical Requirements
Distribution	<ul style="list-style-type: none"> • Maintain power generation in the range of frequency 49-51Hz and voltage 85-110%, and maintain power generation for 0.2 seconds when the voltage deviates from this range. • Phase imbalance of less than 5% • DC Current Injection of less than 0.5% • Voltage harmonic of less than 6.5% • Current harmonic of less than 12% (Capacity ≤ 50kW), or less than 20% (Capacity > 50kW) • The solar PV system must be automatically disconnected in the case of a power outage in the distribution grid or internal incident. • Facilities with an installed capacity of less than 3kWp are connected to the low voltage grid using single-phase or 3-phase. • Facilities with an installed capacity of more than 3kWp are connected to the low voltage grid using 3-phase. <p>* If there is no vacant capacity in the low voltage grid, it is possible to connect to the medium voltage grid, but it is necessary to satisfy the technical requirements of the power distribution grid (Circular No. 39/2015/TT-BCT). (Low voltage is less than 1,000V)</p>

(Source: Implementation Guideline for rooftop solar photovoltaic projects, No.:1532/EVN-KD)

3.5.3 Current Renewable Energy Development Situation and Associated Plans

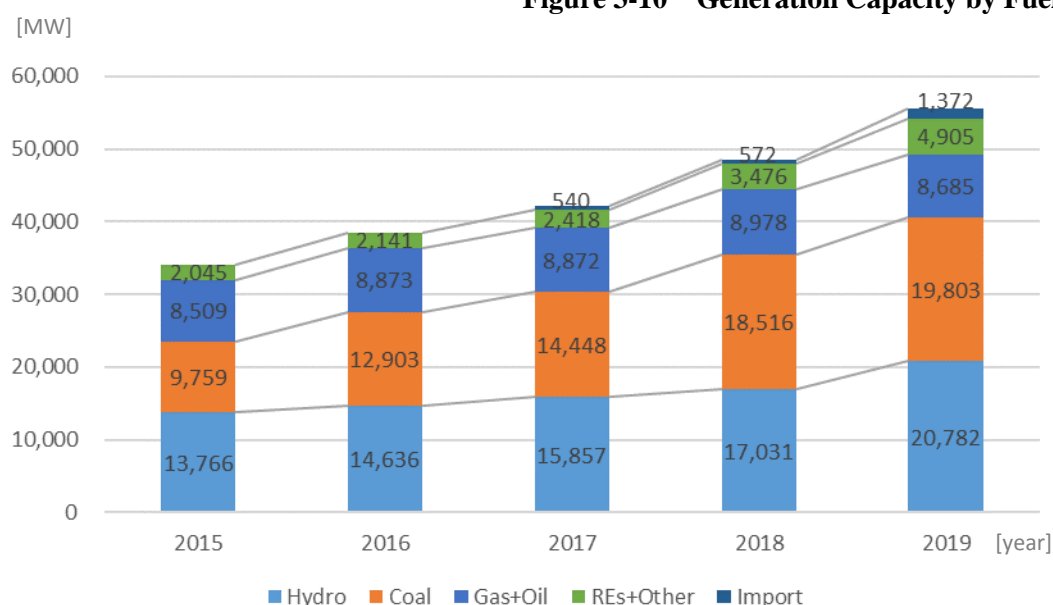
(1) Renewable Energy Development

The generation capacity in Vietnam was 54,175MW as of December 31, 2019 and it increased by 12.4% from the previous year, when it was 48,204MW. Both coal fired thermal power plants and hydro power plants accounted for more than 30%, and the capacity of renewable energy was only 8.6% of overall capacity. Generation capacity by fuel type is shown in the right figure, Figure 3-10. The trend of installed power generation capacity over the past five years is shown in Figure 3-11. In it, renewable energy includes small hydro, wind, solar and biomass.



(Source: EVN Annual Report 2018)

Figure 3-10 Generation Capacity by Fuel Type



(Source: EVN Annual Report 2019)

Figure 3-11 Changes in Generation Capacity

The recent development status of renewable energy is as follows.

Table 3-23 Recent Development Status of Renewable Energy

	2018.06		2018.12		2019.06		2019.12		2020.06		2020.12	
	No.	MW	No.	MW	No.	MW	No.	MW	No.	MW	No.	MW
Solar	0	0	2	84	82	4,464	84	4,752	89	5,092	136	8,598
Wind	5	234	5	234	6	271	8	330	11	468	12	550
Biomass	3	169	3	169	3	169	3	169	3	169	3	169
Total	8	403	10	487	91	4,904	95	5,251	103	5,728	151	9,316
Roof-top Solar		0		0		0		228		576		7,986

Note: Capacity at the end of each month

(Source: EVN NLDC)

(a) Wind power

In actual fact, the development of wind power in Vietnam started late, beginning in 2011. According to the Renewable Energy Master Plan, a total installed capacity of 11,623 MW is planned to be developed by 2030, but development has not progressed as expected. In October 2018, the Vietnamese government announced a Prime Minister's Decision (Decision No. 39/2018/QĐ-TTg) to increase the FIT price for wind power from 7.8 US\$/kWh to 8.5 US\$/kWh for onshore wind, and 9.8 US\$/kWh for offshore wind (20-year purchase period).

Eight wind plants have been developed since then, totaling 334.2MW (refer to Table 3-24 and Figure 3-12 below) as of November 2019. In recent years, wind power development by domestic and foreign companies has become more active, with 248 (44.9 GW) wind power projects. According to the letter (Dispatch No. 795/TTg-CN) issued on June 25, 2020, 91 new wind projects, of 6.9 GW, have been approved for development and added to the development list of the revised PDP7.

Table 3-24 List of current Wind Power Plants

No.	Plant	Capacity [MW]
1	Hướng Linh 2	30
2	Tây Nguyên	40
3	Trung Nam	40
4	Bạc Liêu	99.2
5	Đầm Nại	39
6	Mũi Dinh	32
7	Phú Lạc	24
8	Tuy Phong	30
Total		334.2



Figure 3-12 Location of Wind Power Plants

(b) Solar power

Under Decision No. 11/2017/QĐ-TTg of the Prime Minister, the Vietnamese government introduced FIT phase 1 for solar power generation, and a flat purchase price (9.35 US\$/kWh) was set for power plants that started operation by June 30, 2019, with a valid period of 20 years. Many projects have been registered due to the policy, and they are concentrated in central and southern Vietnam, where the amount of irradiation is large. As of June 10, 2018, 286 plant projects (19,300MWp) had been approved by MOIT, and 84 plants (4,493.7MW) had started operation by November 2019. Figure 3-13 shows the locations of each solar power plant.

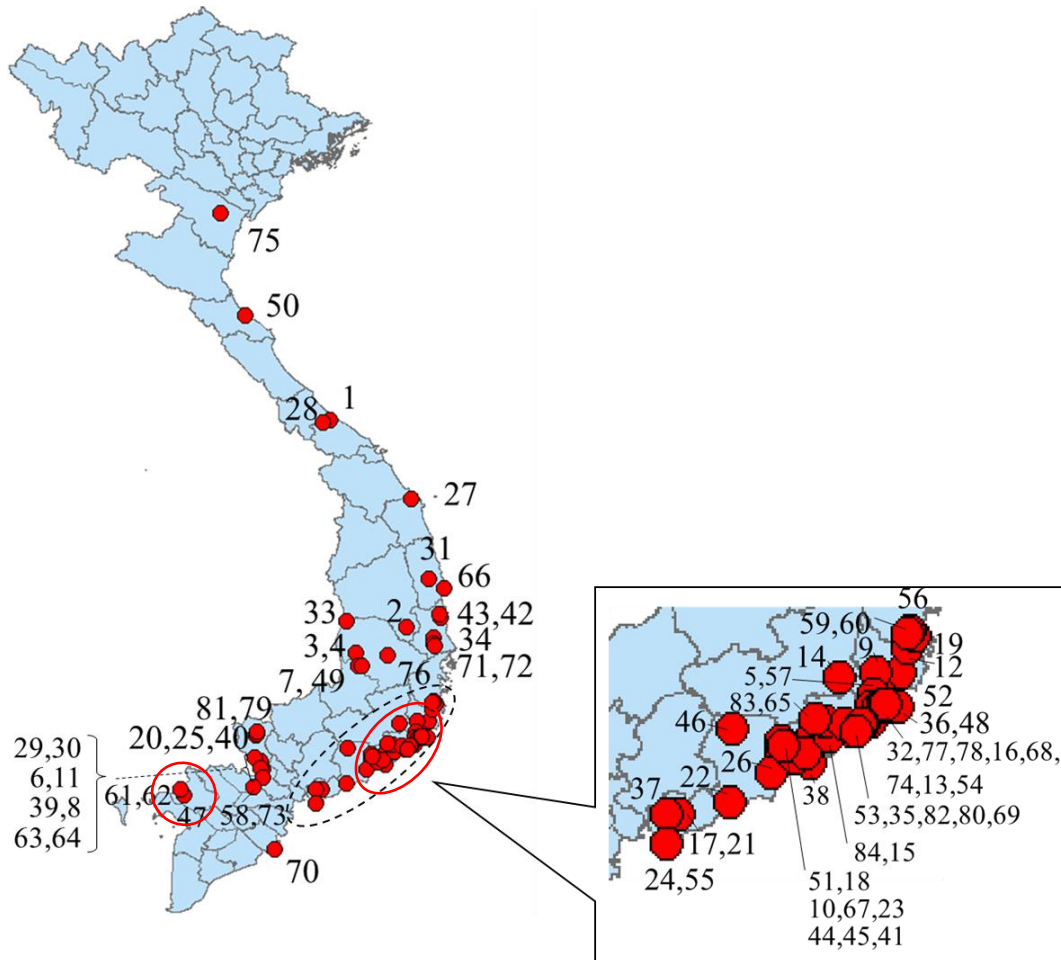
The FIT phase 1 expired on June 30, 2019, and the Government of Vietnam announced a decision by the Prime Minister (Decision No. 13/2020/QĐ-TTg) on April 6, 2020 for phase 2 of the FIT scheme, which will apply purchase prices of 7.09 US\$/kWh for Ground-mounted, 7.69 US\$/kWh for Floating, and 8.38 US\$/kWh for Rooftop for 20 years, for power plants that start operation between July 1, 2019 and December 31, 2020.

Table 3-25 List of current Solar Power Plants

No.	Plant	Capacity [MW]	No.	Plant	Capacity [MW]
1	Phong Điền	35	44	Hồng Phong 1A	150
2	Krông Pa	49	45	Hồng Phong 1B	100
3	Srepok 1	45	46	Ecoseido Tuy Phong	40
4	Quang Minh	45	47	Sao Mai	86
5	BP Solar 1	38	48	Ninh Phước 6.2	42
6	TTC số 1	49	49	Trúc Sơn	36
7	Cư Jút	50	50	Cầm Hòa	40.3
8	TTC Đức Huệ 1	39.5	51	Vĩnh Tân 2	34
9	Trung Nam	204	52	CMX	129
10	TTC-Hàm Phú 2	39.5	53	Vĩnh Hảo 6	40.7
11	TTC số 2	40.8	54	Thuận Nam 19	49
12	Sông Giang	40.3	55	Đá Bạc 4	40
13	BIM 2	201.6	56	ĐL Miền Trung	50
14	BIM 3	40.3	57	Mỹ Sơn HLV	40.3
15	Phong Phú	34	58	BCG Băng Dương	32.7
16	GELEX Ninh Thuận	40	59	Cam Lâm VN	40.3
17	Đá Bạc 2	48	60	KN Cam Lâm	40.3
18	Sông Lũy 1	39	61	Văn Giáo 2	40
19	AMI Khánh Hòa	42.5	62	Văn Giáo 1	40
20	Dầu Tiếng 1	150	63	Solar Park 1	40
21	Đá Bạc 3	40	64	Solar Park 2	40
22	Sơn Mỹ 3.1	40	65	Bình An	42.5
23	Đa Mi	38.3	66	Fujiwara	40.3
24	Đá Bạc	48	67	Thuận Minh 2	40.3
25	Dầu Tiếng 2	200	68	Nhị Hà	40.3
26	Hàm Kiệm	39.5	69	Hồ Bàu Ngự	50
27	Bình Nguyên	40	70	Trung Nam Trà Vinh	140
28	LIG Quảng Trị	40	71	Europlast Phú Yên	40.3
29	HCG	40.3	72	Thịnh Long AAA	40.3
30	HTG	40	73	GAIA	75
31	Cát Hiệp	39.9	74	Hacom Solar	42
32	Phước Hữu	50	75	Yên Định	29
33	Long Thành 1	45	76	BMT	24.2
34	Hòa Hội	214.1	77	BIM	24.2
35	Vĩnh Hảo 4	31.5	78	Phước Hữu Điện lực 1	28
36	Ninh Phước 6.1	7	79	Bách Khoa Á Châu	24.2
37	KCN Châu Đức	56.5	80	Vĩnh Hảo	29
38	Mũi Né	32.3	81	Trí Việt	24.2
39	Europlast Long An	40.3	82	VSP Bình Thuận II	30

No.	Plant	Capacity [MW]
40	Dầu Tiếng 3	60
41	Hồng Phong 4	44
42	Xuân Thọ 2	40.3
43	Xuân Thọ 1	40.3

No.	Plant	Capacity [MW]
83	Phan Lâm	30
84	Tuy Phong	11.5
Total		4493.7




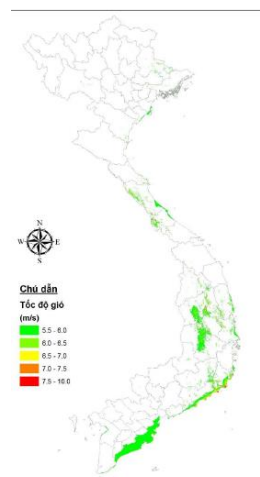
Note:  Area where solar power output curtailments have occurred as of November 2019

Figure 3-13 Location of Solar Power Plants

(2) Prospects for renewable energy development

The Renewable Energy Development Plan defines the policy up to 2030 and the concept for 2050 in terms of promoting the introduction of renewable energy sources for the purposes of developing industry, raising living standards and protecting the environment. It was approved on November 25, 2015 (see Table 3-2).

The theoretical potential for wind power plant development in Circular 06/2013/TT-BCT is shown in Figure 3-14. In IE’s estimation in the Master Plan for renewable energy sources, some areas that are not suitable for wind power development, such as residential land and secure areas, are excluded from the potential. It assumes a figure of 217GW (North: 12,564MW, Center: 131,103MW, South: 73,635MW). However, wind power development is behind schedule compared to the plan. IE estimated, based on the scenario and considering the current development progress, that wind power plants will be developed on the order of 1,469MW by 2020, 5,323MW (2025), 11,623MW (2030), and 19,023MW (2035).



(Source: Material from IE)

Figure 3-14 Wind Power Potential

The theoretical potential for solar power was calculated with the help of the World Bank. Figure 3-15 shows this potential. Although areas where solar power plants cannot technically be constructed are excluded, the available area is large, covering about 14% of the national land. Therefore, the technical development potential is huge, and it is assumed to be 1,677GW. The available area and capacity for developing solar power plants for each province are shown in Table 3-27.

Even in the conservative scenario, the estimated capacity of solar power plants will reach 4,634MWp in total by 2020, 13,604MWp (2025), 27,604MWp (2030), and 44,364MWp (2035).

These values are only the IE projections from previous studies, and the latest approved official figures will be updated in PDP8.

Table 3-26 Prospective Wind and Solar Power Development

	2020	2025	2030	2035
Wind [MW]	1,469	5,323	11,623	19,023
Solar [MWp]	4,634	13,604	27,604	44,364

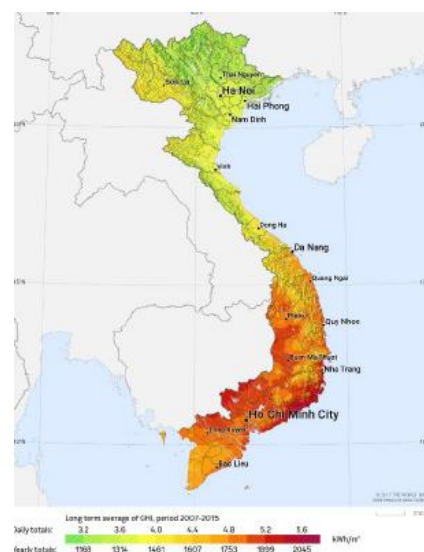
Note: based on the conservative scenario

(Source: Material from IE)

Table 3-27 Potential for Solar Power in each Province

STT	Tên tỉnh/thành phố	Diện tích (km2)	Tiềm năng kỹ thuật (MW)	STT	Tên tỉnh/thành phố	Diện tích (km2)	Tiềm năng kỹ thuật (MW)
1	Thành phố Cần Thơ	26.0	859	32	Tỉnh Khánh Hòa	393.7	12,991
2	Thành phố Đà Nẵng	4.4	144	33	Tỉnh Kiên Giang	242.5	8,002
3	Thành phố Hà Nội	43.3	1,429	34	Tỉnh Kon Tum	360.9	11,909
4	Thành phố Hải Phòng	16.6	549	35	Tỉnh Lai Châu	3,287.6	108,490
5	Thành phố Hồ Chí Minh	117.0	3,861	36	Tỉnh Lâm Đồng	885.7	29,228
6	Tỉnh An Giang	58.0	1,913	37	Tỉnh Lạng Sơn	2,226.1	73,462
7	Tỉnh Bà Rịa-Vũng Tàu	209.9	6,926	38	Tỉnh Lào Cai	1,731.3	57,132
8	Tỉnh Bắc Giang	699.1	23,069	39	Tỉnh Long An	724.4	23,904
9	Tỉnh Bắc Kạn	1,052.5	34,734	40	Tỉnh Nam Định	2.2	73
10	Tỉnh Bạc Liêu	38.5	1,271	41	Tỉnh Nghệ An	347.6	11,469
11	Tỉnh Bắc Ninh	13.8	454	42	Tỉnh Ninh Bình	28.2	932
12	Tỉnh Bến Tre	331.0	10,922	43	Tỉnh Ninh Thuận	644.3	21,262
13	Tỉnh Bình Định	264.1	8,714	44	Tỉnh Phú Thọ	844.9	27,882
14	Tỉnh Bình Dương	935.5	30,872	45	Tỉnh Phú Yên	1,245.9	41,113
15	Tỉnh Bình Phước	801.3	26,442	46	Tỉnh Quảng Bình	342.2	11,292
16	Tỉnh Bình Thuận	1,505.6	49,685	47	Tỉnh Quảng Nam	10.7	352
17	Tỉnh Cà Mau	81.9	2,702	48	Tỉnh Quảng Ngãi	98.4	3,246
18	Tỉnh Cao Bằng	1,303.0	42,998	49	Tỉnh Quảng Ninh	1,567.6	51,730
19	Tỉnh Đắk Lắk	3,564.3	117,621	50	Tỉnh Quảng Trị	553.8	18,276
20	Tỉnh Đắk Nông	1,790.8	59,097	51	Tỉnh Sóc Trăng	216.4	7,142
21	Tỉnh Điện Biên	2,542.6	83,907	52	Tỉnh Sơn La	2,348.8	77,512
22	Tỉnh Đồng Nai	1,421.3	46,904	53	Tỉnh Tây Ninh	1,524.1	50,295
23	Tỉnh Đồng Tháp	116.5	3,844	54	Tỉnh Thái Bình	7.3	241
24	Tỉnh Gia Lai	3,439.1	113,490	55	Tỉnh Thái Nguyên	893.3	29,479
25	Tỉnh Hà Giang	2,028.0	66,924	56	Tỉnh Thanh Hoá	1,983.9	65,468
26	Tỉnh Hà Nam	21.7	716	57	Tỉnh Thừa Thiên Huế	293.8	9,696
27	Tỉnh Hà Tĩnh	469.4	15,491	58	Tỉnh Tiền Giang	377.0	12,440
28	Tỉnh Hải Dương	44.5	1,469	59	Tỉnh Trà Vinh	143.8	4,747
29	Tỉnh Hậu Giang	156.1	5,152	60	Tỉnh Tuyên Quang	1,695.8	55,961
30	Tỉnh Hòa Bình	744.8	24,579	61	Tỉnh Vĩnh Long	58.1	1,917
31	Tỉnh Hưng Yên	12.1	400	62	Tỉnh Yên Bái	1,899.3	62,678
	Tổng				Tổng	50,832.2	1,677,461

(Source: Material from IE)

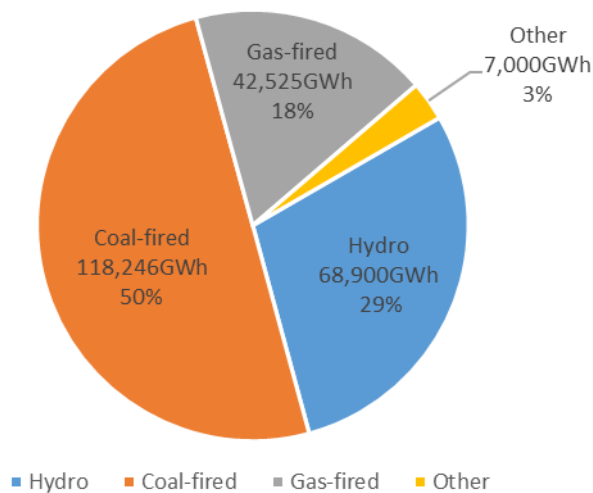


(Source: Material from IE)

Figure 3-15 Solar Power Potential

In February 2020, the Vietnamese government issued a resolution (No. 55-NQ/TW) on the direction of the national energy development strategy up to 2030 with a view to 2045, which sets out the direction of energy development in Vietnam after 2021, including the enhancement of the power system and the promotion of renewable energy. The policy states that the ratio of renewable energy to primary energy supply should be 15-20% by 2030 and 25-30% by 2045, and that greenhouse gas emissions from energy activities should be reduced by 15% by 2030 and 20% by 2045 from the general development scenario.

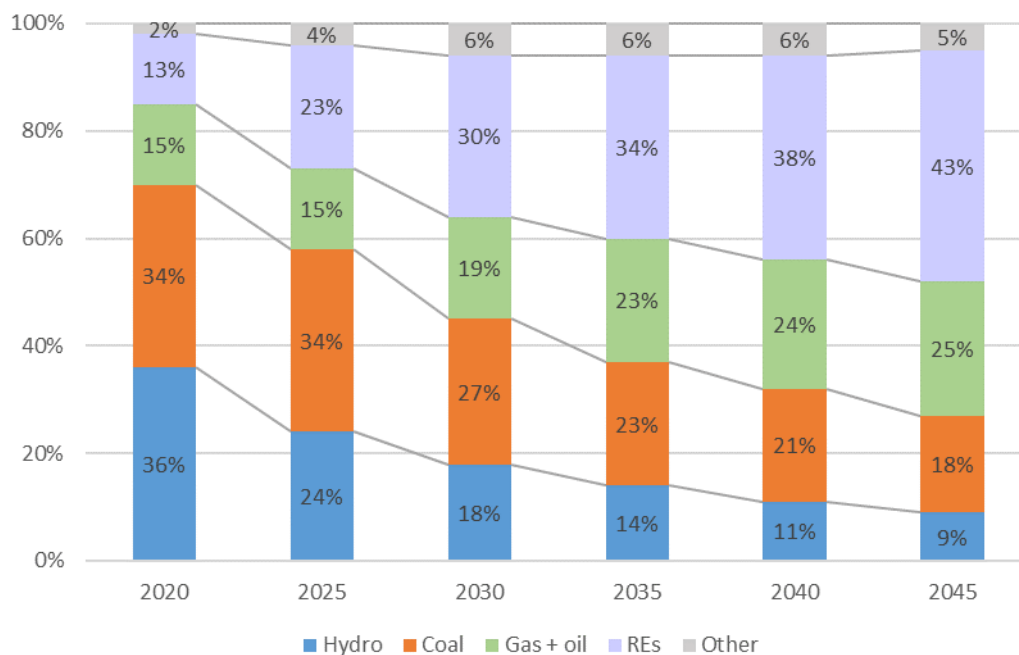
In Vietnam, coal-fired thermal power accounts for 36% of the power supply composition (2019) and is the main power source, accounting for 50% of the total power generated, as shown in Figure 3-16. While the revised PDP7 plans to increase coal-fired power generation to 55.3GW by 2030 to meet the growing demand, the resolution states that the main task and solution is to develop breakthrough mechanisms and policies to promote the development of renewable energy in order to replace fossil energy sources with renewable energy. For thermal power generation, gas is expected to gradually become an important power source in accordance with the policy of prioritizing the use of domestic gas resources, and taking into account the recent rise in international public opinion for coal-free power generation, the ratio of coal-fired power generation is expected to decline.



(Source: EVN Annual Report 2019)

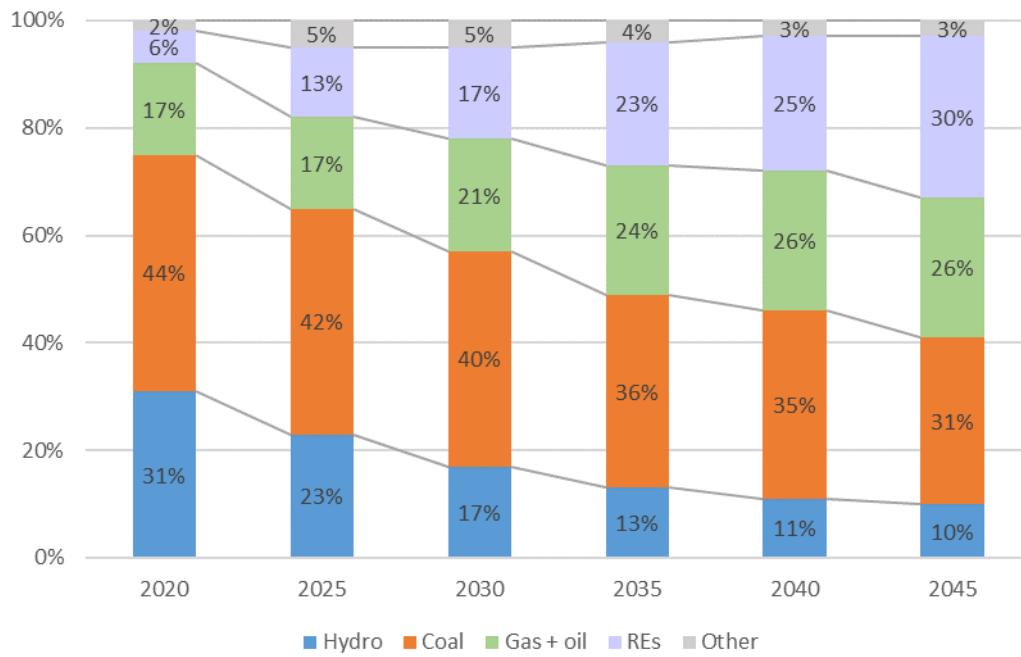
Figure 3-16 Power Production by Fuel Type 2019

The PDP8 workshop held in July 2020 discussed the composition of power sources by 2045, and as shown in Figure 3-17 and Figure 3-18, renewable energy sources are expected to account for a little less than half of the installed capacity and 30% of the electricity generated in 2045, so it is expected that renewable energy sources will continue to develop and become the main power source in Vietnam.



(Source: Report in PDP8 Workshop, July 2020)

Figure 3-17 Power Mix to 2045 (Installed Capacity)



(Source: Report in PDP8 Workshop, July 2020)

Figure 3-18 Power Mix to 2045 (Electricity generation)

3.6 Current Status of Power Transmission and Distribution System and Progress of Its Development

3.6.1 Current Status of Power Network System Development

The National Power Development Plan of Vietnam has been formulated every five years, and the latest PDP is the 7th National Power Development Plan (PDP7). PDP7 was formulated in July 2011 as a power development plan from 2011 to 2030, and it was revised on March 18, 2016. In the revised version, emphasis was placed on the development of renewable energy, but as mentioned above, the development of renewable energy, such as solar power, is progressing at a rate faster than expected.

From the end of 2018, IE started preparing to formulate the next PDP (PDP8). The following information is based on the information from the revised PDP7 and the system plan that was added or moved forward in response to the increase in renewable energy examined by EVN/PECC2 in accordance with MOIT's instructions in 2019.

Vietnam has a long territory, stretching from north to south, and there are 8 areas in the north and south, namely, the northwestern part of the north, the northeast, the Red River Delta, the central and northern areas in the central, the central southern part, the central highlands, the southeast of the southern part and the Mekong Delta. EVN divides Vietnam into the north of Ha Tinh province and Nghe An province in the north, Ha Tinh province to Dak Dong and Khan Hoa province in the middle, and the south in the south.

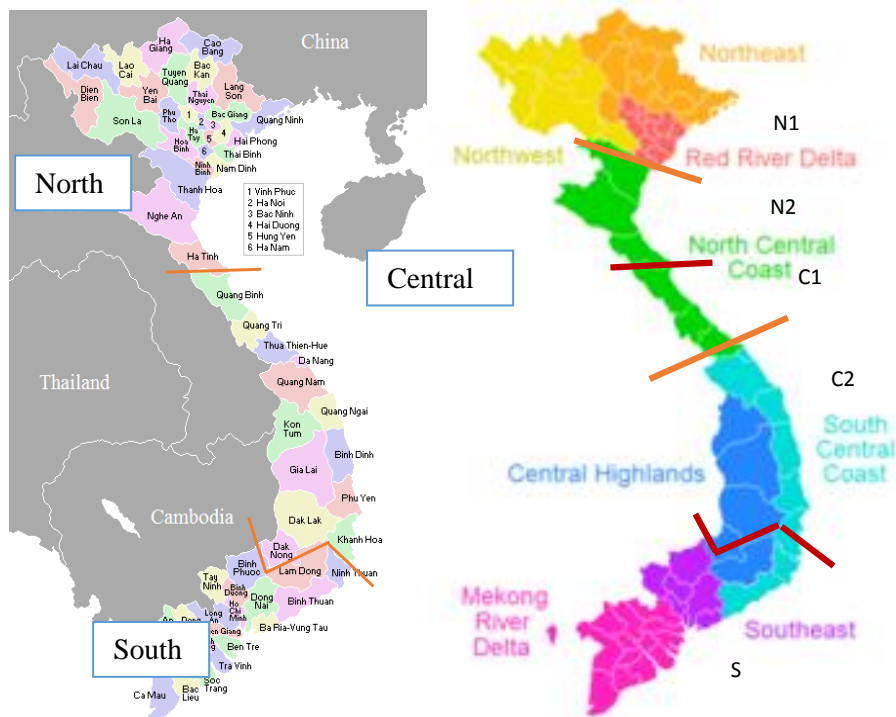
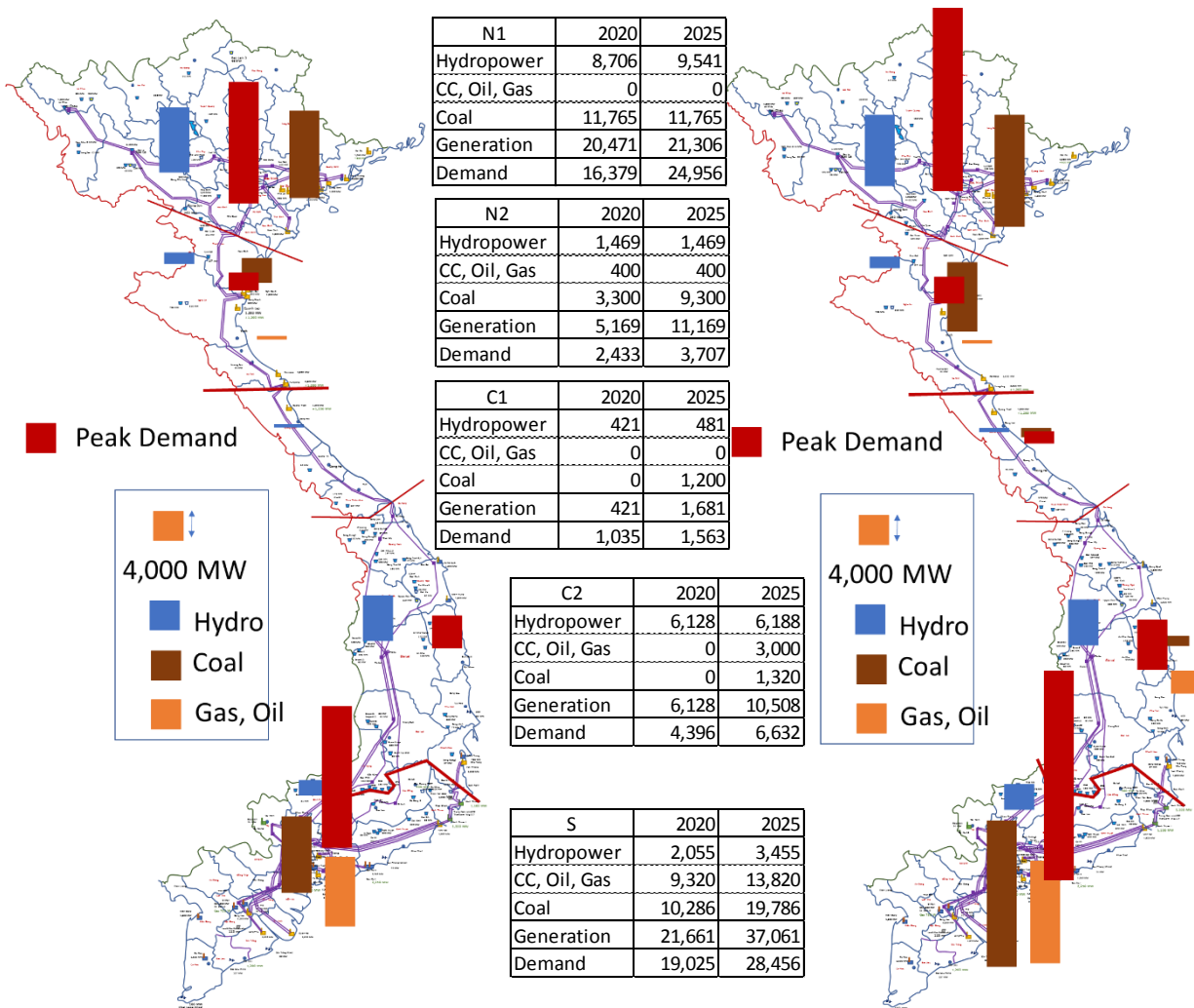


Figure 3-19 Regional divisions in Vietnam's power network system development plan

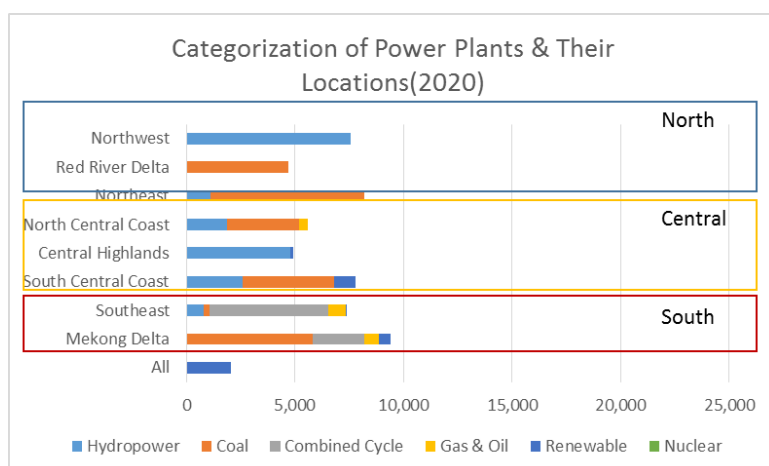
The north and central regions can be further divided into two regions based on the eight divisions. The northern part is divided into northern part 1, with a large share of hydropower and large power demand, and northern part 2, with a small power demand but a large amount of power generation, such as coal-fired power. In addition, the central part can be further divided into central part 1, of the north central coast, and central part 2, of the south central part of the coast.

The following figure shows the distribution of power generation capacity and maximum demand in Vietnam in 2020 and 2025, according to the revised PDP7 plan. Hydropower is distributed in north 1 and 2 in the middle, and coal-fired power is distributed in north 1 and 2, and the south. Gas fired power, combined cycle, and oil fired power are most common in the south. Power demand is concentrated in north 1, including Hanoi, and the south, including Ho Chi Minh City. In the south, the power generation capacity is small compared to the demand, and the power flow of the 500 kV system flows to the south. Power plants are planned to maintain a balance between power supply and demand in regions by installing coal-fired and gas combined cycle thermal power in the south. The below figure shows the regional distribution of power plants by power source type.

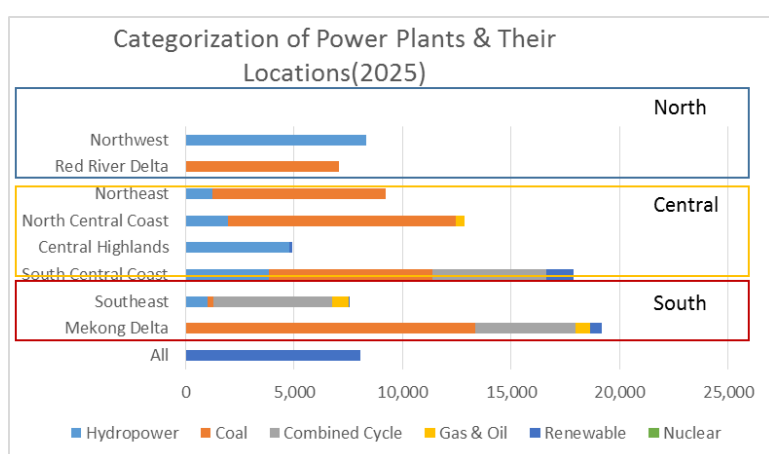


(Source: Prepared by the Study Team based on the revised version of PDP7)

Figure 3-20 Distribution of power plants in the revised version of PDP7 (left 2020, right 2025)



	Hydro power	Coal	Combin ed Cycle	Gas & Oil	Renewa ble	Nuclear
Northwest	7,580	0	0	0	0	0
Red River Delta	0	4,680	0	0	0	0
Northeast	1,126	7,085	0	0	0	0
North Central Coast	1,890	3,300	0	400	0	0
Central Highlands	4,798	0	0	0	110	0
South Central Coast	2,589	4,200	0	0	991	0
Southeast	796	282	5,471	774	24	0
Mekong Delta	0	5,804	2,382	693	511	0
All	0	0	0	0	2,060	0

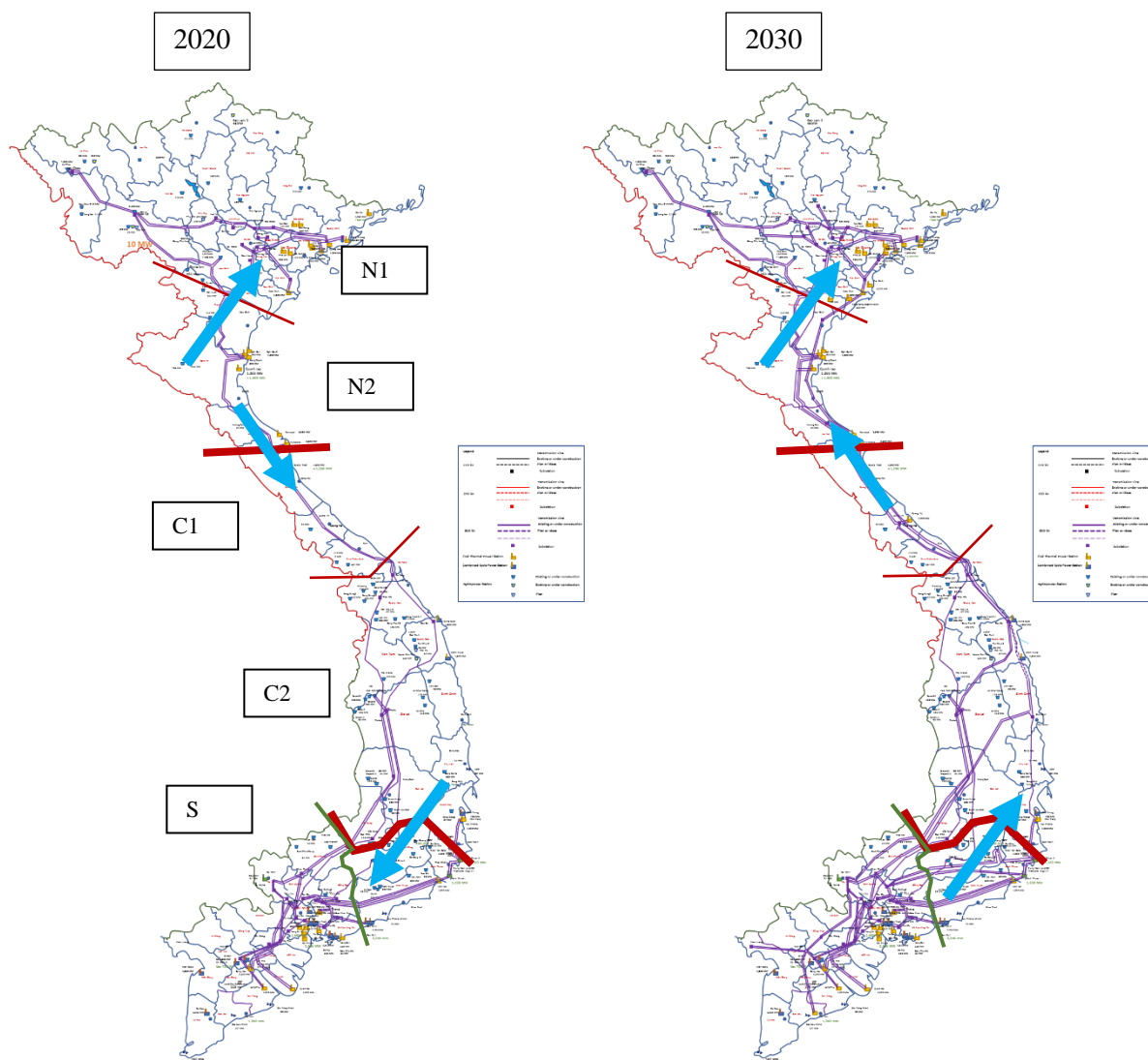


	Hydro power	Coal	Combin ed Cycle	Gas & Oil	Renewa ble	Nuclear
Northwest	8,310	0	0	0	0	0
Red River Delta	0	7,080	0	0	0	0
Northeast	1,231	7,980	0	0	0	0
North Central Coast	1,950	10,500	0	400	0	0
Central Highlands	4,798	0	0	0	110	0
South Central Coast	3,849	7,500	5,250	0	1,291	0
Southeast	996	282	5,471	774	24	0
Mekong Delta	0	13,324	4,632	693	511	0
All	0	0	0	0	8,050	0

(Source: Prepared by the Study Team based on the revised version of PDP7)

Figure 3-21 Regional distribution of power plants by power source type

Figure 6-4 shows the Vietnam 2020 and 2030 500kV systems in the revised PDP7 plan. Vietnam's backbone system is operated at voltages of 500 kV and 220 kV, and a 500 kV transmission system has been built in the north and south. Some areas in the north are supplied from China via three circuits of 220kV and four circuits of 110kV. They are supplied with power independently from the domestic system in Vietnam and are not shown in this figure. From the south, power is exported to Cambodia through a 220kV transmission line with double circuits. Vietnam also imports power from Laos via 220kV transmission lines, connected from the Xekaman 1 hydropower station in southern Laos to the 500kV Thanh My substation in central Vietnam, and from the Xekaman 3 hydropower station to the 500kV Pleiku 2 substation in central Vietnam.



Power flow assumes dry season

(Source: Prepared by the Study Team based on the revised version of PDP7)

Figure 3-22 Planning of 500 kV transmission lines according to revised PDP7

In the revised version of PDP7, nuclear power plants were planned, and they were supposed that 4,600 MW would be installed in Ninh Thuan province from 2028 to 2030. Therefore, new four circuits of 500kV transmission lines were planned from Ninh Thuan Province. Currently, 4,200MW of Vinh Tan coal-fired power plant is in operation, and four 500kV lines have been already constructed from Vinh Tan to substations near Ho Chi Minh City. Since hydropower plants are unevenly distributed in the north and central areas, the power flow of the 500kV system differs greatly between the rainy season when the hydropower plant output is large and the dry season. From the regional distribution of various power sources and the distribution of power demand, the necessary power transmission between each region is examined, and the number of 500kV transmission lines between each region is planned as follows.

Table 3-28 Number of 500kV transmission lines in the revised PDP7

Section	Year 2020	Year 2025	Year 2030
North 1- North 2	Double circuits	Four circuits	Five circuits
North 2- Central 1	Double circuits	Double circuits	Four circuits
Central 1- Central 2	Double circuits	Double circuits	Four circuits
Central 2 – South	Four circuits (Except for double circuits between Vinh Than-Van Phon)	Six circuits (Except for double circuits between Vinh Than-Van Phon)	Eight circuits
South (Central Highlands-South Central Coast) – South East	Four circuits (Except for four circuits between Vinh Than-HCM)	Six circuits (Except for four circuits between Vinh Than-HCM)	Fourteen circuits

3.6.2 Development of the Power Distribution Network

(1) Overview of Distribution Facilities

As mentioned in Chapter 2, there are 5 Power Corporations in the EVN. The company consists of 1. NPC(Northern Power Corporation), 2. SPC (Southern Power Corporation), 3. CPC (Central Power Corporation), 4. HCMC(Ho Chi Minh City Power Corporation), and 5. HNPC(Hanoi City Power Corporation). The distribution business is operated on a self-supporting accounting basis in each area. The outline of the facilities owned by each Power Corporation is as follows.

Table 3-29 Outline of Distribution Facilities

	HNPC	HCMC	NPC	CPC	SPC
Distribution Line Length [km]	110kV : 753 Medium and low voltage line : 36,840	110kV : 706 Medium and low voltage line : 18,885	110kV : 9,241 Medium and low voltage line : 216,487	110kV : 3,333 Medium and low voltage line : 70,845	110kV : 5,260 Medium and low voltage line : 152,632
Capacity of the Substation [MVA]	110kV : 4,905 Medium and low voltage line : 10,939	110kV : 6,331 Medium and low voltage line : 11,658	110kV : 18,369 Medium and low voltage line : 28,620	110kV : 4,604 Medium and low voltage line : 9,188	110kV : 14,590 Medium and low voltage line : 29,204

(Source: VIETNAM ELECTRICITY ANNUAL REPORT2017)

(2) Actual Duties of Power Corporations

The voltage classes in Vietnam are 220V, 380V, 440V, 6kV, 10kV, 15kV, 22kV, 35kV, 110kV, 220kV, and 500kV. In Vietnam, electric power is supplied from 220V low-voltage to 110kV high-voltage users through Power Corporations. Therefore, maintenance and operation of the 110kV system is carried out by Power Corporations in Vietnam.

The SPC and CPC, which were visited during this surveys, have supply areas in 21 provinces and 13 provinces, respectively. There are 21 Power Companies in SPC and 13 in CPC, each of which has its own supply area.

(3) Basic Approach to Formation of Distribution System

The basic concept underlying facility formation in a distribution system (110kV) is shown below.

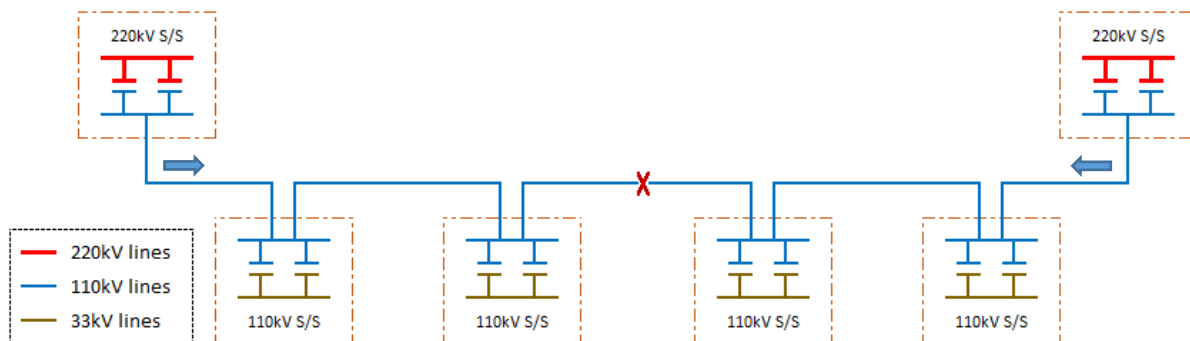


Figure 3-23 Basic facilities configuration in 110kV system

The 220/110 kV substations are connected by 110 kV transmission lines, and 2 to 4 110/33 kV substations are arranged between them. In normal operation, the interconnection is cut in the middle of the 110 kV transmission line¹⁰, and electric power is supplied from one 220/110 kV substation to two 110/33 kV substations. If an accident occurs on a 110 kV transmission line, it is possible to cut off the accident section and connect the cut section provided in the middle to supply power from the substations at both ends to the substations in front of the accident section. In the above configuration, if a transmission line accident occurs in the immediate vicinity of a 220/110 kV substation, the 220/110 kV substation on the opposite side will transmit power to 4 110/33 kV substations. Therefore, in order to transmit power without power failures even in the event of such an accident, transmission capacity equal to or more than the total value of the demand from the 4 110/33 kV substations is required.

A 110/33 kV substation is a base substation for supplying electric power to the customers in the vicinity. The capacity of the substation varies depending on its size, but on average it is about 50 MW. Therefore, in consideration of supplying power to 2 to 3 substations, 110 kV transmission lines are generally provided, with the lines capable of transmitting power of 100 to 150 MW.

The following shows the configuration of a 110 kV transmission line as described above when a solar power plant is connected. Depending on the amount of electricity generated by solar power plants, the flow of electricity is completely reversed during the daytime.

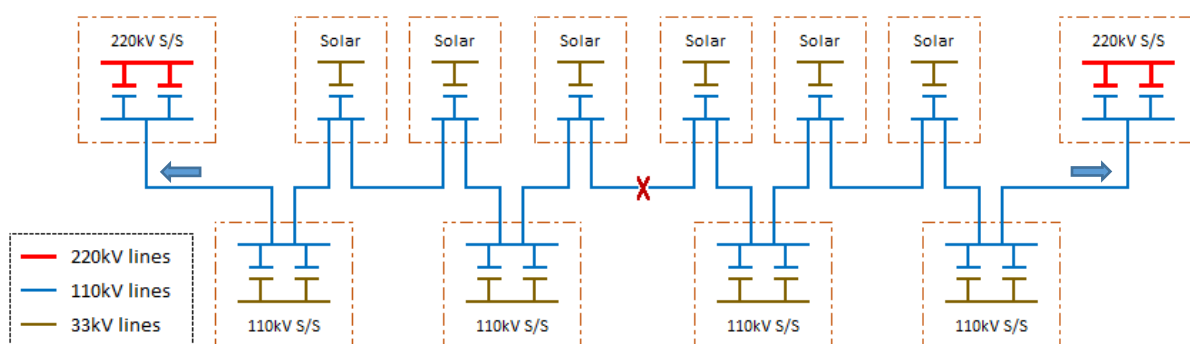


Figure 3-24 Structure of Facilities when Solar Power connected

Even if 3 solar power plants with a capacity of about 50 MW are connected to the same transmission line, the total output will be up to 150 MW, and since part of the generated output can be supplied to the customers in the vicinity, the power flowing into the 220/110 kV substation will be less than 150 MW, so transmission is considered possible. However, when four or more solar cells of the same capacity are connected, the transmission capacity is exceeded, and the possibility of output suppression increases.

¹⁰Actually, it is not cut in the middle of the transmission line, but the switch in one of the substations is cut.

3.6.3 Transmission and Distribution Network Development Plan Based on the Mass Introduction of Renewable Energy

Due to the massive installation of solar and wind power plants, which was not expected in PDP7, it is necessary to improve the power transmission and distribution network. In addition to PDP7, this section is reported according to the PECC2 report “Study on grid connection to generation capacity of solar and wind power plant projects” and information on PECC2 explanatory materials for October 2019. (Currently, EVN PECC2 is considering a new plan that assumes the latest situation following the above report.)

According to the revised PDP7 plan, the total amount of renewable energy development in Vietnam was 2,060MW by 2020, 5,990MW by 2021-2025, and 15,190MW by 2026-2030. However, according to the PECC2 report, the amount of solar power by 2020, which was planned as of June 2018, was 5,600MW and wind power was about 2,400MW (see Table 3-30), already exceeding the 2025 projection in the revised PDP7. The installations in Ninh Thuan Province and Binh Thuan Province cover about 2,600MW (47% of 5,600MW) of solar PV and about 1,300MW (55% of 2,400MW) of wind power. Renewable energy that is extremely unevenly distributed in these two provinces was also unexpected in the revised PDP7. The regional distribution of solar and wind power plants in Vietnam based on the PECC2 report is shown in the following figure.

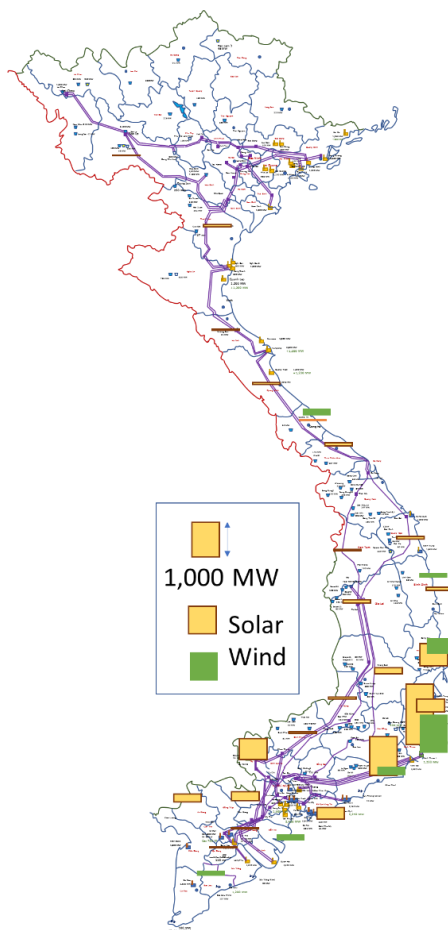


Figure 3-25 Regional distribution of solar and wind power plants based on PECC2 report

Table 3-30 Solar and Wind Power Planned in June 2018

No.	Province	SPP		WPP	Renewable energy
		(MWp)	(MW)	(MW)	(MW)
I	North	135.0	114.8	0.0	114.8
1	Thanh Hoa	75.0	63.8		63.8
2	Son La	10.0	8.5		8.5
3	Ha Static	50.0	42.5		42.5
II	Central	1785.1	1517.3	790.0	2307.3
1	Khanh Hoa	370.0	314.5		314.5
2	Phu Yen	659.0	560.2	450.0	1010.2
3	Dak Lak	206.8	175.8		175.8
4	Dak Nong	50.0	42.5		42.5
5	Gia Lai	98.0	83.3		83.3
6	Binh Dinh	99.5	84.6	130.0	214.6
7	Huế	85.0	72.3		72.3
8	Kon Tum	49.0	41.7		41.7
9	Quang Binh	49.5	42.1		42.1
10	Quang Tri	49.5	42.1	210.0	252.1
11	Quang Ngai	68.8	58.5		58.5
III	South	4640.2	3944.3	1614.0	5558.3
1	Binh Thuan	1129.5	960.1	928.0	1888.1
2	Ninh Thuan	1974.9	1678.7	394.0	2072.7
3	Tay Ninh	604.0	513.4		513.4
4	Long An	252.5	214.6		214.6
5	Vinh Long	49.3	41.9		41.9
6	An Giang	220.0	187		187
7	Hau Giang	29.0	24.7		24.7
8	Binh Phuoc	50.0	42.5		42.5
9	Ba Ria – Vung Tau	331.0	281.4		281.4
10	Bac Lieu			142.0	142.0
11	Ben Tre			150.0	150.0
	Total	6560.3	5576.7	2404.0	7980.7

(Source: PECC2 report)

In addition, the planned amount of solar power continues to increase, and according to the PECC2 explanatory document for October 2019, more than 10,000MW of solar power and more than 4,000MW of wind power is planned to be installed (Table 3-31).

Table 3-31 Solar and Wind Power Planned by early 2019

No.	Province	Solar Power		Wind Power	R.E. source
		(MWp)	(MW)	(MW)	(MW)
I	Northern Vietnam	353	300.1	0	300.1
1	Thanh Hoa	235	199.8	0	199.8
2	Son La	10	8.5	0	8.5
3	Ha Tinh	108	91.8	0	91.8
II	Central Vietnam	3202.9	2722.4	1125	3847.4
1	Khanh Hoa	550	467.5	0	467.5
2	Phu Yen	692.7	588.8	450	1038.8
3	Đak Lak	806.8	685.8	110	795.8
4	Đak Nong	106.3	90.4	0	90.4
5	Gia Lai	158	134.3	50	184.3
6	Binh Dinh	562	477.7	51	528.7
7	Hue	98	83.3	0	83.3
8	Kon Tum	61.3	52.1	0	52.1
9	Quang Binh	49.5	42.1	0	42.1
10	Quang Tri	49.5	42.1	464	506.1
11	Quang Ngai	68.8	58.5	0	58.5
III	Southern Vietnam	9737.8	8236.7	3031.5	11268.3
1	Binh Thuan	2591.4	2202.6	946.5	3149.1
2	Ninh Thuan	3874.7	3293.5	243.4	3536.9
3	Tay Ninh	945	803.3	0	803.3
4	Long An	452.5	384.6	0	384.6
5	Vinh Long	49.3	41.9	0	41.9
6	An Giang	321.6	273.4	0	273.4
7	Hau Giang	29	24.7	0	24.7
8	Binh Phuoc	850	722.5	0	722.5
9	BR – VT	411.9	350.1	4	354.1
10	Bac Lieu	0	0	401.2	401.2
11	Ben Tre	0	0	150	150
12	Lam Dong	47.5	0	98	98
13	Tra Vinh	165	140.3	126	266.3
14	Ca Mau	0	0	750	750
15	Soc Trang	0	0	312.4	312.4
	Total	13293.7	11259.2	4156.5	15415.8

(Source: PECC2 Report)

In order to transmit renewable energy concentrated in Ninh Thuan and Binh Thuan provinces, it is expected that a large number of new transmission lines from the provinces will be urgently needed. According to the PECC2 report, in 2019, 5,800 MW of renewable energy would actually be able to generate only 2,600 MW requiring the curtailment up to 3,200 MW due to 220 kV and 110 kV transmission capacity constraints.

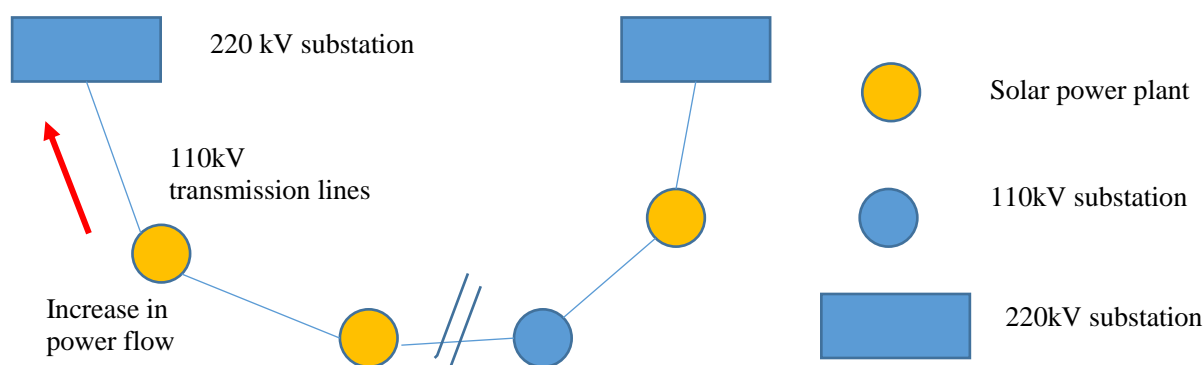


Figure 3-26 Schematic diagram of 110kV transmission line system connected to solar power plants

This transmission line capacity constraint includes not only the capacity of 220 kV and 110 kV systems to which renewable energy power plants are connected, but also the capacity of 500 kV systems. Figure 3-27 shows the 500kV system in southern Vietnam. By 2020, Binh Thuan province has Vinh Tan coal fired 4,200 MW (Vinh Tan II 1,200MW, I 1,200MW, IV 1,800MW) and Ham Thuan 300MW, and a total of 844 MW of hydropower including Dai Ninh 300MW, Da Mi 175MW. Four 500kV lines were constructed to transmit these generated power. (Red shaded section in the figure) Van Phong coal thermal power of 1,320 MW planned for 2022-2023 is also connected. The maximum demand in Binh Thuan Province is 400-600MW from 2020 to 2025, and the maximum demand in Ninh Thuan Province is 200-300MW from 2020 to 2025. The amount of power transmitted to Ho Chi Minh and the north-south system is about 4,000MW. Therefore, the four 500kV transmission lines in the shaded section of the figure are used for power transmission at existing or near-scheduled power plants. To transmit renewable energy installed in Binh Thuan and Ninh Thuan provinces, it is necessary to reinforce a new 500kV transmission line. (Blue shaded section in the figure)

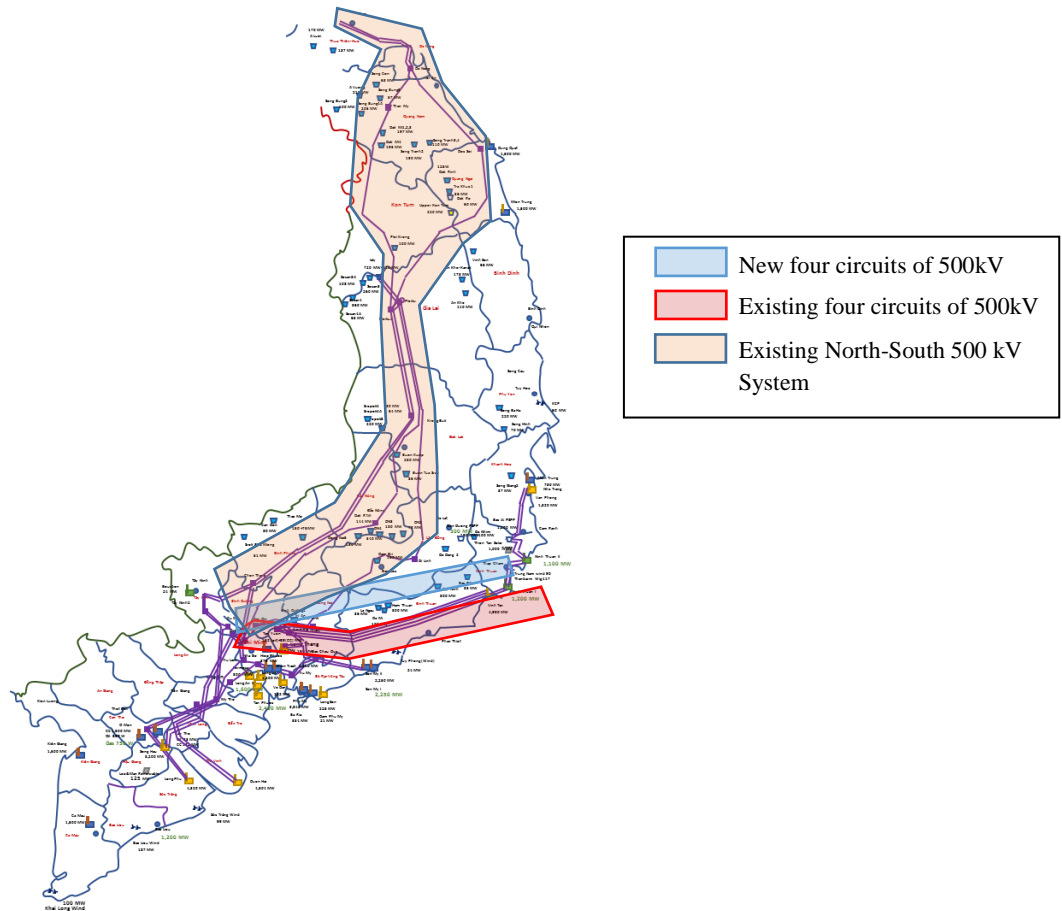


Figure 3-27 500kV system in southern Vietnam in 2020

The power generated by solar power plants is used for the following.

- Direct supply for daytime power demand
- Reducing gas and oil fired power to reduce fuel costs
- Reservoir-type hydropower savings to secure the amount of power generated (especially in the dry season)

Vietnam's power demand has peaks during the day and night, so the base power supply with little output fluctuation during the day and night maintains a constant output. It is thought that it will operate to ensure a balance between supply and demand by adjusting fluctuations in the output of solar power that generates electricity during the day time and stops at night. As mentioned above, gas and oil thermal power is concentrated in the south, and it is expected that these power plants will be reduced. The figure below shows the power source composition and distribution in the south, as well as the transmission route. (Red: Transmission line route)

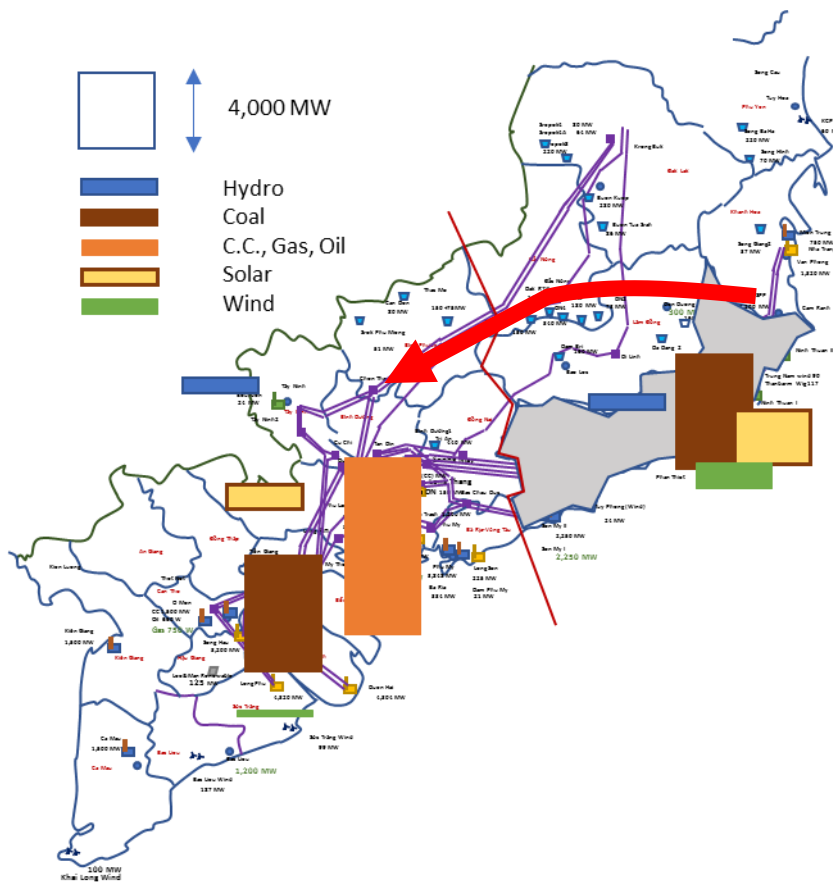


Figure 3-28 Southern power composition and distribution, and transmission routes

If it is preferable to save the amount of water stored in the northern and central hydropower stations during the daytime when solar power is used, such as during the dry season, as well as reduce gas-fired fuel in the south, it is also conceivable to suppress the output from hydropower during the daytime, when much solar power is generated.

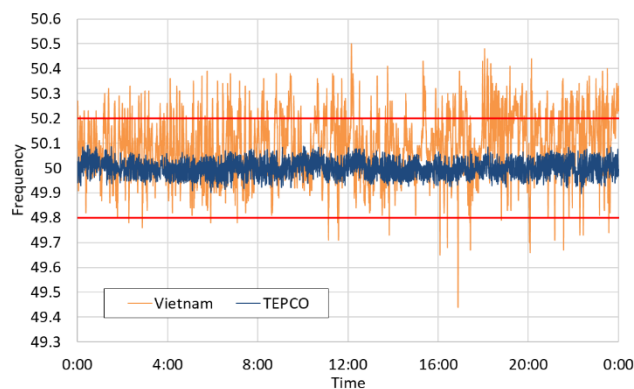
In this case as well, solar power can be sent to the north-south transmission line in Vietnam through the transmission route shown in the figure above, and it can be operated in conjunction with the northern and central hydropower generation.

3.7 Current Statuses of Power System Operation and Electricity Market

3.7.1 Current Status of Power System Operation

(1) Insufficient frequency control capacity

The system frequency in the Vietnam network recorded on 15 December 2015 is shown in Figure 3-29. The system frequency varied in the range of 49.5Hz and 50.5Hz. From this quite large frequency fluctuation, it is clear that the frequency control ability is insufficient in terms of capacity and control speed. The change in the system frequency may not cause any trouble for consumer appliances. According to the decision issued by the ministry office in August 2005, the system frequency is to be controlled within the range of 49.8Hz and 50.2Hz. However, actual frequencies often deviate from the range. In 2015, even though there was little renewable energy, such as PV and wind power stations, generating, the system frequency fluctuation continually exceeded the stipulated range. The system frequency control capacity and associated measures must surely be major issues in power system operation. The reasons for inappropriate frequency control are as follows:



(Source: NLDC)

Figure 3-29 System Frequency on 15 Dec. 2015

The system frequency control capacity and associated measures must surely be major issues in power system operation. The reasons for inappropriate frequency control are as follows:

- No regulations on frequency control capacity and response
- No reward and/or punishment concerning system frequency regulation
- Inappropriate droop characteristics and settings of governors applied for thermal power plants
- Governors for several hydro power plants have quite large dead bands and slow response characteristics due to aging
- Several thermal power plants block the governor function because the commissioning test of the governor function was not carried out
- Almost half of the generators have not been connected with AGC¹¹ in NLDC

Under these circumstances, when more and more renewable energy generation units are connected, the following are expected:

- The system frequency fluctuation may become larger
- The frequency fluctuation may cause customer appliances to suffer huge damage
- A widespread outage may happen

The Grid Code issued in 2015 stipulates that all generators of more than 30MW have to equip an AGC function and a governor function. All new thermal power stations installed after 2015 have these functions, but old thermal power stations located in the northern area have no responsibility for AGC or Governor applications and do not regulate the system frequency.

Referring to the new Circular (No.30/2019/TT-BCT), entered into force on January 3 2020, all generators, including renewable generators, connected to transmission lines more than or equal to 110kV have to adopt the AGC function, and all generators with a generation capacity of more than or equal to 10MW have to connect to the SCADA in NLDC.

Since the EMS/SCADA was replaced in NLDC and AGC was mounted in the EMS/SCADA in 2016, large-scale Strategic Multipurpose Hydropower Plants (SMHP) have conducted Load Frequency Control (LFC) by using the AGC function as the secondary frequency regulation. This means that SMHPs take on the role of system frequency regulation.

¹¹ Power plants with a capacity of 30 MW or more that have started operation since 2016 are required to have AGC (Automatic Generation Control) functions, and NLDC uses AGC to directly control the output of each power plant online. However, power plants that started operation before 2015 were not obliged to install AGC, so many power plants do not have AGC.

The AGC (client) has additional functions other than system frequency regulation, such as a generation curtailment function (transmission line congestion relief) for renewable energy power stations and an Economic Dispatching Control (EDC) function. NLDC plans to add a load shedding function to AGC in the future.

NLDC is enhancing the AGC function by studying system frequency control methods in other countries. Improvement in the system frequency fluctuation may be obtained via the AGC function enhancement.

There is no payment system for the system frequency regulation service. Therefore, since thermal and other power plants, except for SMHP, have no incentives regarding system frequency regulation, system frequency control will become more difficult if renewable energy power plants such as PV and wind continue to increase in installed numbers and generation capacity. In order to mitigate the adverse impacts, an ancillary market should be opened and sufficient frequency adjustment capacity should be secured.

(2) PV Generation Prediction System

Each renewable energy operator submits the next day's generation availability (typically a square shape rather than an upwardly convex parabola shape) to NLDC and the availability is used to formulate an overall demand and supply balance plan. However, all the actual generation output is fully purchased by a single buyer (as long as it does not exceed the system constraints), so the actual generation output depends on the weather conditions and is rather different from the availability. For this reason, NLDC uses a PV generation prediction system to predict the PV generation output every hour on the previous day based on the availability of each renewable energy generation company and weather forecast data, but prediction accuracy is an issue. NLDC was very interested in the data collection methods, PV generation prediction methods, and actual record analysis methods necessary for improving PV generation forecast accuracy, and requested to exchange opinions on these matters and the details of TEPCO's PV generation forecasting system.

It is not enough just to provide the prediction system software - it is necessary for EVN to accumulate data necessary for the prediction, gaining experience in this to improve the prediction accuracy. In order to realize improved predictions, technical assistance in data collection and data analysis methods is also required.

(3) Countermeasures for transmission line congestion in terms of power system operation

Most of the PV power plants are connected to 110kV transmission lines, but construction of transmission lines has not progressed in time due to the rapid expansion of PV power plants, so the power generated by PV power plants causes overloads on some 110kV transmission lines. In order to relieve these overloads, it is necessary to curtail the generation output of PV power plants. This curtailment of power generation output results in a loss of power generation opportunities and losses for PV power generation companies. Therefore, fundamental improvement by enhancing transmission facilities is desired.

At present, out of the 88 solar power plants that have started operation by June 2019, 24 power plants are subject to output curtailment due to congestion of transmission lines. Specifically, in Binh Thuan province, as an example, there is a transmission line to which 10 PV power stations are connected, and several 110kV transmission lines in the province are congested.

Congestion is not occurring on the 220kV transmission line network at present, but it is assumed that some congestion will occur there in the future according to the power flow calculation results.

AGC is used to suppress power generation output when a transmission line is congested. PV power plants agreed to install AGC in the consultation about grid connection and added the AGC function, so when congestion occurs, AGC in NLDC calculates the output suppression amount that is required to relieve the congestion and sends generation control signals based on the suppression amount to PV power plants, and each power plant suppresses its generation output according to the respective control signal assigned.

3.7.2 Power Market Development Status

(1) Power Market Development Roadmap

(a) Basic Policy

The basic policies for power market development are as follows.

- Improvement of competitive environment to pursue transparency, fairness and efficiency in power business activities.
- Provision of an attractive environment that encourages investors to participate in the power generation, distribution, wholesale and retail markets.
- The government owns the power transmission sector and regulatory authority, and manages the construction, operation and maintenance of large-scale power plants, which are particularly important from the socio-economic and security aspects.

(b) Roadmap

The roadmap for developing the electric power market is as follows. It was approved by the Prime Minister on November 8, 2013 (Decision No 63/2013 / QD-TTg).

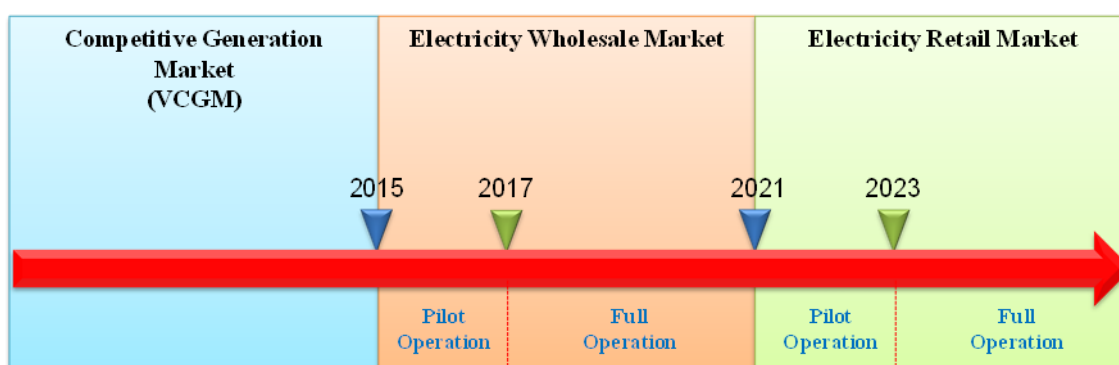


Figure 3-30 Roadmap for Power Market Development

At the time of approval (2013), the competitive market for the power generation sector (Vietnam Competitive Generation Market: VCGM) featured competition only for the power generation sector, but since 2015 the wholesale power market (Vietnam Wholesale Electricity Market: VWEM) has operated. Power generation companies are able to supply power by directly signing contracts with distribution companies and large consumers, and the distribution companies are also exposed to a competitive environment. From 2021, the retail sector will also be liberalized and customers will be able to freely choose their electricity supplier. For this reason, it is assumed that regulations on electricity tariffs will be abolished, and competition between electricity supply companies in electricity prices and services will appear.

(c) Power Market Development Status

There were plans to introduce a competitive market in Vietnam's power generation sector in 2009, but the implementation was delayed, and a competitive market (VCGM) was experimentally introduced in July 2011. From July 2012, GENCOs and IPPs started full-scale competitive market operation under the single buyer EPTC (Electric Power Trading Company) method.

In the roadmap shown above, the wholesale power market (VWEM) was scheduled to start in 2015. The VWEM roadmap was revised by Decision No. 8266 / QD-BCT, as follows:

- Preparation stage: the end of 2015
- Pilot (first stage): 2016
- Pilot (second stage): 2017 - 2018
- Full-scale operation: 2019

As per this modified roadmap, VWEM started trial operations in the pilot (first stage) on January 1, 2016, one year later than the original roadmap. The purpose of the trial operations is to identify problems for full-scale operation, and no actual transactions are conducted. Then, after the second stage of the pilot, full-scale operation of VWEM, in which all power plants except renewable energy power plants and SMHPs participated in the power market, began in 2019. Direct bilateral transactions

between a generation company and a distribution company are now at least systematically possible, and this situation is consistent with ADB's report, but full-scale operations do not appear to be as originally expected.

It is, therefore, doubtful that a retail market can be created as planned in 2021, and some support may be required, including revitalizing the wholesale market.

The status of assistance given to ERAV and EVN regarding the power market by each donor is as listed in Table 3-32.

Table 3-32 Assistance to ERAV and EVN regarding the power market

Donor	Assistance
VEPG TWG3 Chairman (ERAV, WB)	Appropriate energy market development Direct PPA mechanism development
USAID	Formulation of Direct PPA framework and regulations, capacity building
ADB	Electricity market institution design
DEPP (Denmark Energy Partnership Program)	Cooperation on electricity market operation
AFD	VWEM institution design and capacity building

(2) Power Generation Competitive Market (VCGM)

The basic concept of VCGM is shown below.

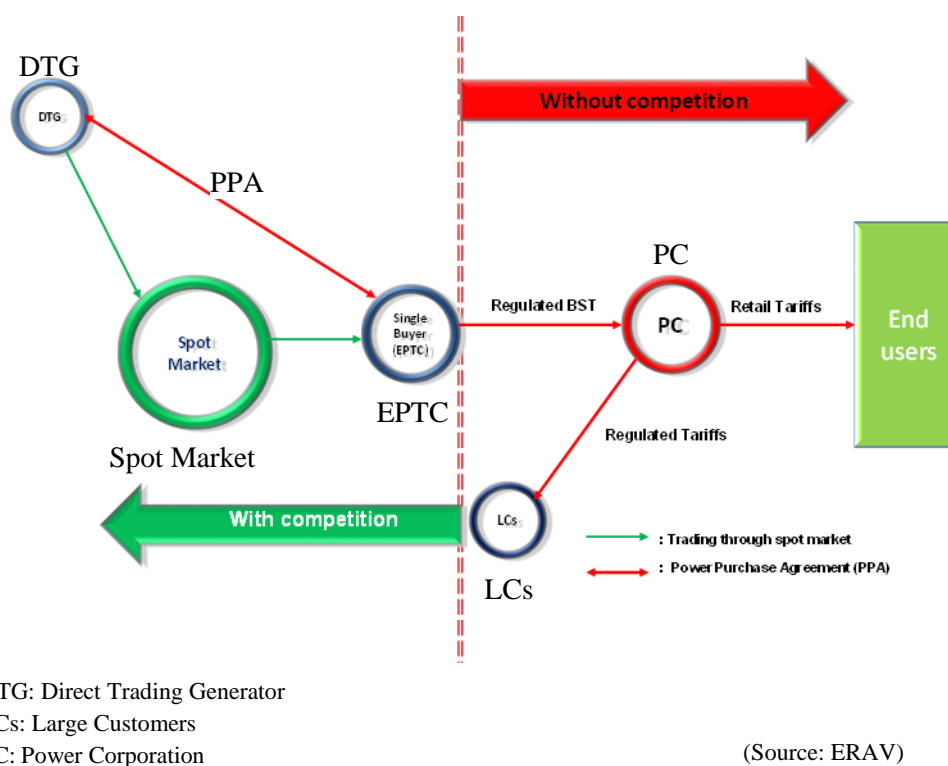


Figure 3-31 Basic Concept of VCGM

In VCGM, in order to compete in the power generation market, EPTC, a single buyer, concludes a PPA with each power generation company and procures electric power in relative transactions. EPTC also purchases electric power through the Spot Market and sells it wholesale to distribution companies at a given price. The Spot Market is operated by the Market Department of the National Load Dispatch Center (NLDC: A0).

The ratio of relative transactions to Spot Market transactions is determined by the government, and at the initial stage when the power generation market was established, relative transactions amounted to

95% of total power generation. This figure is now 80%, and it is planned to be 60% in the future. The price of a relative contract is decided between the power generation company and EPTC, and the price on the Spot Market is decided on a bidding basis.

As shown in the above figure, there is competition in the power generation sector, but in other sectors, transactions are conducted at a predetermined, regulated price. Participants in the competitive generation market (Direct Trading Generator, DTG) do not include all of the power generation facilities in Vietnam, but as of December 2015 covered 42% (62 locations, 14,952MW) of the total power generation facilities, and, in 2018, about 46% (81 locations, with 21 thermal power stations and 60 hydropower stations; 22,238 MW).

(3) Electric Power Wholesales Market (VWEM)

The Vietnam Wholesale Electricity Market (VWEM) conceptual design was approved by MOIT (Decision 6463 / QD-BCT) on July 22, 2014, and the detailed design was approved by MOIT on August 10, 2015 (Decision 8266 / QD-BCT).

The basic concept of VWEM is shown below.

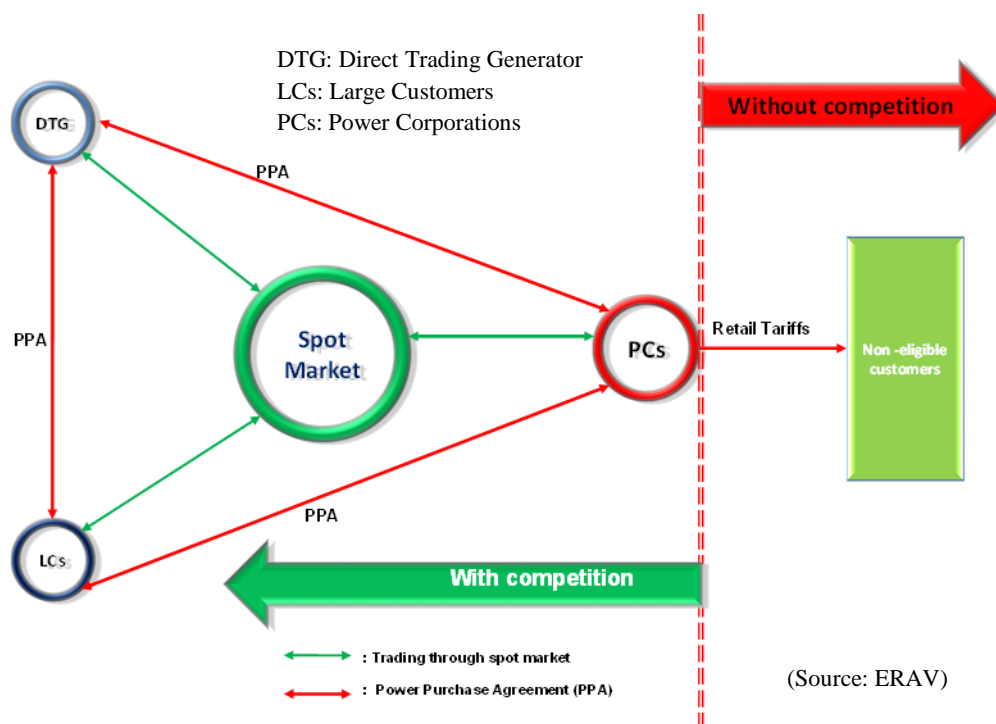


Figure 3-32 Basic Concept of VWEM

The VWEM started trial operations from January 1, 2016, and power plants other than renewable energy power plants and SMHP (Indirect Trading Generators) participated in the electric power market from January 1, 2019.

In VWEM, power distribution companies (PCs), power generation companies (DTG), and LCs (large customers) conclude a direct contract (PPA) with each other to procure power, and also procure power from the Spot market.

In VWEM, all power generation facilities of 30MW or more are obliged to participate in the power market. BOT generators and SMHP such as Hoa Binh Hydro, Son La Hydro, etc., which did not participate in VCGM, also join the VWEM through internal transactions in EVN.

According to Genco 1, all power plants except for floating solar (Da Mi) are currently participating in the wholesale market, and there are 6 wholesale market buyers (5 PC and EVN), but each of their

power plants sells wholesale to EVN (EPTC). Although it is possible to make direct contracts with the 5 PC as Genco 1, this has not yet been implemented.

In Genco 3, there is a case where part of a gas fired power plant (Phu My) is directly wholesaled to a distribution company in Ho Chi Minh.

(4) Developments in Power Market, including Demand and Supply Adjustment Market

According to the roadmap for power market development, which was approved by the prime minister on November 8, 2013, following the first-stage power generation market and the second-stage wholesale market, the trial operation of the third-stage retail market was scheduled to start operation from 2021, but the retail market was rescheduled to open in 2023, behind the original plan. A survey for the retail competition market has been conducted and reported to the prime minister, and it is currently awaiting a decision from the prime minister.

The ancillary market and capacity market, which are demand and supply adjustment markets, have not yet been established, and the plans for these have not yet been decided. For this reason, market participants are basically aiming for operations that will generate the most profit in the electricity market, and, unless they receive compensation, will not operate at an intermediate generation output in preparation for an output increase command in the event of a power shortage. There is no incentive to regulate the system frequency at this time.

In fact, frequency adjustment is currently done by SMHP, but no compensation is paid for these generators.

The content of the ancillary services covers frequency adjustment, operation reserve, spinning reserve, voltage adjustment, etc. Currently, contracts are made between EVN and specific power generation companies, but in the future the ancillary market will be opened and optimized in combination with the wholesale market. The ancillary service market will be similar to the PJM style in the United States. The capacity market is still at an early stage of investigation and will be considered in the future.

(5) Purchasing Conditions for Renewable Energy

The Feed In Tariff (FIT) in Vietnam does not guarantee that all power generation from PV power plants has to be purchased, and EVN is not obligated to purchase all the power generated, so there is no compensation from the government or EVN even if PV power generation is reduced to less than the maximum possible output due to insufficient transmission capacity. For this reason, congestion is a major business risk for PV power plants in areas where transmission lines are currently congested.

Chapter 4. Financial Conditions and Funding of EVN and EVNNPT

This study obtained information on the financial conditions and funding of EVN and its EVNNPT, which are the main players in the electric power sector in Vietnam. In this chapter, these data are analyzed to assess the companies' eligibility as loan borrowers.

In addition, this chapter contains an overview of the current payment process among business units within the EVN group, identifies issues to be addressed and discusses directions for improvement.

4.1 Financial Conditions of EVN and EVN NPT (Summary) and Issues Identified

(1) Overview

For both EVN consolidated and EVN NPT, the historical trend of their bottom line (final profit/loss) was affected by fluctuations in foreign exchange rates, but by removing this factor, both of them mostly achieved the target of ROE 3-5%, which was considered in the cost calculation for tariff setting. That is, their profitability has been rather stable, though not high enough.

The fact that ROE is referred to as the reward for these public utility businesses, not the WACC (Weighted Average Cost of Capital), which is an average of return on debt and return on equity weighted by the debt-equity ratio, implies that the cost of debt financing (interest payment) based on the actual borrowings of EVN and NPT is taken into account in cost calculations for tariff setting.

The equity ratio of EVN consolidated has been almost constant at around 30% and that of NPT has been gradually increasing, reaching almost 30% in FY2018. For both EVN and NPT, the equity part in the balance sheet mainly consists of "Share capital" and "Revaluation reserve", and gradual increase of "Share capital" can be observed so that their equity ratio remains stable around 30%. The EVN Finance officer, whom the JICA Survey Team interviewed in this study, explained that a 70%:30% debt-equity ratio is a standard for financing ODA projects, with an 80%:20% ratio for financing non-ODA projects. As a result of such financing policy, capital injection is assumed to be made continuously from the government to EVN as well as from EVN to NPT, which helped stabilizing their respective equity ratio.

One of the generally observed financial issues in the electric power sector is that the recovery of trade receivables stagnates and their remaining balance in accumulation becomes too high to reduce in the short term. Recent financial performance of EVN and NPT indicates that this issue has seen an improvement.

(2) Issues to Be Addressed

As discussed above, the financial performance of EVN consolidated and NPT, if the effect of forex gains/losses is disregarded, mostly achieved the target of ROE 3-5%, which is the precondition for the tariff regulation. In addition, interest payments are included in the cost calculation for tariff setting, based on the actual performance of loan borrowings. Based on the fact that EVN avoided increasing the costs of power supply per energy sales (VND/kWh) and attained a stable profit for three years from FY2015 to FY2017 despite that the retail electricity price were not raised during that period, EVN is supposed to have a certain capability of managing its costs to meet its financial conditions of the time. From the viewpoint of the loan provider, the risk of their failure to secure the necessary funds for interest payments due to negligence in the tariff regulation is relatively small.

However, in Vietnam, where the local commercial banks offer loans with an interest rate of 7-8%, the expected rate of return on equity financing for private investors should be higher than that. Officers of EVN and ERAV, whom the JICA Survey Team interviewed in the study, explained that the current target of ROE 3-5% is appropriate for a state-owned enterprise (SOE) that does not seek high profits, but there's space for arguing the appropriateness of this ROE target on a mid- or long-term basis.

4.2 Thoughts on Diversifying Modes of Fund Procurement (Promoting Non-sovereign Loans)

EVN's consolidated balance sheet and cash flow statement, as well as those of EVN NPT, demonstrate that both of them show a tendency to control their CAPEX and to reduce the procuring of new loans. While this trend may be applaudable in terms of enhancing the soundness of their balance sheet, the possibility of excessively restraining their CAPEX in terms of improving the quality of the electricity supply needs to be reviewed.

It is generally observed in countries where the growth of electricity demand has already reached maturity that the necessity of new CAPEX decreases, dependence on a net increase in loan financing for CAPEX declines, and the utility company becomes able to finance its CAPEX mostly with its own funds, which mainly consist of the depreciation of fixed assets. However, considering that the status of Vietnam's electric power sector is far behind this stage, the recent trend of restraining CAPEX by EVN and NPT appears to be rather unnatural.

In terms of the background to this, the Vietnamese government's policy of capping the balance of public debt at 65% of the country's GDP has made it difficult for EVN, as an SOE, to receive new foreign loans with a governmental guarantee (i.e. ODA loans). This may result in an excessive reduction of CAPEX that should have been expensed, delays in expanding the capacity of facilities that should have been made steadily on a long-term basis and, in the end, a negative effect on the stable supply of electricity.

Some local stakeholders who were interviewed in this study anticipated that the 65% ceiling would be relaxed, and the provision of new ODA loans would be made possible. Even in this case, however, it is also to be noted that such new ODA loans would be appropriated to more fundamental infrastructure with a higher priority, such as road transport, and the provision of ODA loans to the power sector, where private investment participation has already been made even if it's still limited, will continue to be restricted.

Considering such a situation, EVN (including NPT) will inevitably need to diversify its modes of fund procurement and explore fund procurement from funding sources other than ODA, such as non-sovereign loans.

As already discussed in this chapter, both EVN and NPT attain a financial soundness that would be the minimum requirement for a borrower, though some issues remain to be addressed. However, in order to judge whether EVN and NPT are sufficiently eligible to provide direct loans without governmental guarantee, certain discussion points that are described below may need to be made clear.

(1) Interest Rate

In providing a non-sovereign loan, the interest rate is determined considering the credit risk of the borrower (which, in this case, is EVN and NPT). Therefore, the interest rate generally tends to be higher than that of a sovereign loan (ODA), which is provided based on the credit risk of the government of the borrower country.

Whether the borrower has sufficient willingness and ability to pay the interest and principal needs to be reviewed. In the case of EVN and NPT, their ability to pay greatly depends on tariff regulations, and it must be confirmed whether such payment is assured through the tariff regulations. As discussed in the previous section, EVN and NPT have recovered the costs of supply, including the interest payments, with a certain stability under the current tariff regulations. However, there's still uncertainty in their credit risk because there's a certain space for policy intervention in tariff regulation matters.

With regard to this question, ERAV replied in the interview that even if the cost of debt servicing (i.e. interest payment) for EVN and NPT becomes higher due to the government's restriction on public debt, this cannot constitute a reason for declining their business plan, and that ERAV will approve the tariff so that the necessary costs of supply can be collected appropriately. To assure such direction, strengthening the autonomy of the regulatory body is vital.

(2) Loan Duration

Whereas a sovereign loan (ODA) can set a relatively long duration (in general, from 15 to 40 years), durations of non-sovereign loans tend to be shorter (in general, from 5 to 10 years). In the meanwhile,

duration of cost recovery for an infrastructure project is also determined taking into consideration the durability of facilities. For example, projects in thermal power generation and renewable power generation generally set the cost recovery duration at around 15 years, considering the durability of the machines and equipment that account for a large portion of their asset value. Projects in hydropower, transmission networks and distribution networks tend to set a longer cost recovery duration, considering the durability of structures (30-40 years) such as hydraulic dams and steel towers, which represent a large portion of their asset value. Providing a shorter-term loan may cause a mismatch with the cost recovery duration.

Some ideas for a possible solution to this are listed as follows. They need to be discussed in more detail, also taking into account consultations with the borrowers.

- Providing loans with longer durations, upon careful examination of the borrower's credit risk
- Providing loans with various durations within a project, considering the different cost recovery durations for each component, ranging from shorter-term loans (e.g. machines and equipment for substations) to longer-term loans (e.g. structures for transmission lines)
- Providing an opportunity to refinance with favorable terms on the condition that the borrower achieves certain conditions that are agreed beforehand

(3) Forex Risk Control

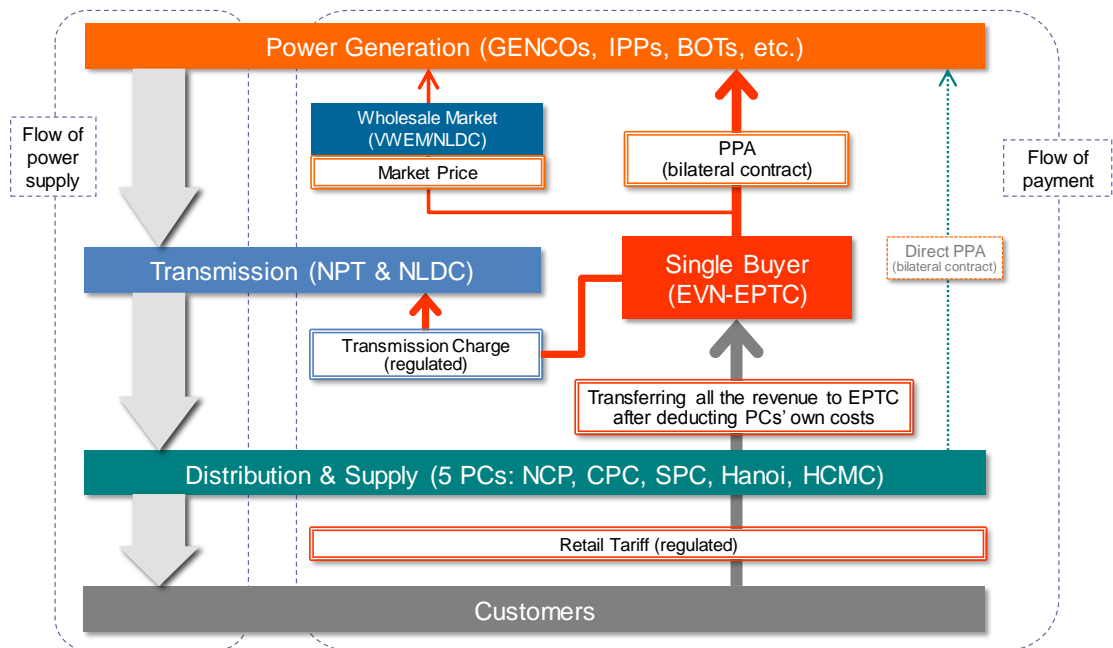
A common issue to be noted for both sovereign and non-sovereign loans is the forex risk for the borrower when a loan is provided in a foreign currency such as JPY or USD. The analysis of the financial statements of EVN and NPT confirmed that both companies rely heavily on foreign currency-denominated loans, which account for more than 70% of the interest-bearing debts for both of them. Unrealized forex gains/losses only affect the bottom line of income statement, but when the loan reaches maturity, the difference in forex rate between the time of procurement and time of maturity actually affects the cash flow.

The forex risk cannot be totally avoided as far as the major currency differs between the lender and the borrower. Some measures for mitigation can be considered, however, such as purchasing financial instruments for hedging currency risk and setting a reserve for absorbing the gains and losses deriving from forex. In the latter case, the costs for accumulating a certain amount of reserve can be allowed for inclusion in the cost calculation for tariff setting and, when a forex loss occurs in loan redemption, it will be offset by reversing the reserve. If a huge volume of reversal causes a decrease in the remaining balance below a certain level, the costs for accumulating the reserve will be recovered via the electricity tariff again. Key considerations for implementation are to integrate this process into the cost calculations for tariff setting and to set rules for avoiding arbitrary management of the reserve.

4.3 Analysis of Payment Flow within EVN Group and Discussion on Improvement

EVN group has promoted its organizational separation into power generation, transmission and distribution & retail business units, to motivate its managerial autonomy. However, despite the apparent progress in separation, the conventional process of centralized decision-making at EVN Headquarters still remains strong and the organizational reforms are still underway. The five distribution companies (PCs: Power Corporations) in particular, though they have already become stand-alone companies organizationally, still work as if they were simply a business unit directly under the control of EVN Headquarters. To support this discussion, the payment flow among business entities within the EVN group was analyzed in this study.

Figure 4-1 summarizes the current payment flow structure among entities within the EVN group. The downward arrows on the left of the figure indicate the power supply flow and the upward arrows on the right indicate the flow of payments.



(Source: Prepared by the JICA Survey Team based on the interview on EVN and ERAV)

Figure 4-1 Payment flow among entities within EVN group: Current structure

The electricity tariff that distribution companies (PCs) collect from their customers is transferred to the Electric Power Trading Company (EVN-EPTC) under EVN Headquarters, after subtracting the necessary costs for operating and managing the PCs' own power distribution assets. EPTC, as a single buyer, pays the cost of procuring power generation to power generation companies through bilateral PPA (Power Purchase Agreements) or market trades in VWEM (Vietnam Wholesale Electricity Market). EPTC also pay to NPT power transmission costs based on the transmission charges approved by the regulatory body, ERAV.

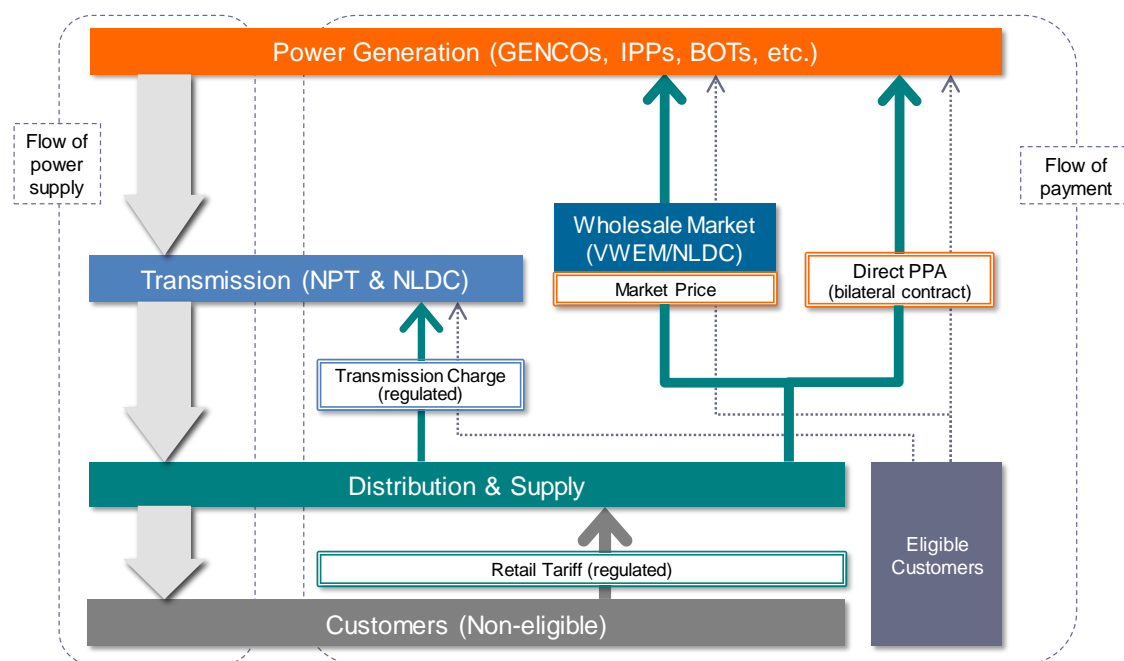
The amount of costs that PCs are allowed to deduct from the revenue is determined in advance based on their annual budget plan as approved by EVN Headquarters. Therefore, in terms of managerial administration, this payment flow is essentially the same as a process in which all the revenue is first transferred to EPTC and then a certain amount is allocated to PCs in accordance with their annual budget plan. Though PCs are institutionally allowed to conclude a PPA directly with generating companies and to procure power generation directly, this is still at the pilot stage and its trading volume is trivial.

Some reasons can be considered as to the existence of such a payment flow that is not greatly different from the structure of centralized control before the organizational separation. One reason is that only a few years have passed since the organizational separation of PCs and they do not yet have sufficient managerial resources as stand-alone entities to engage in contract and account settlement matters with power generation and transmission companies. Another reason may be that geographical conditions are significantly different among PCs and, compared to Hanoi PC and Ho Chi Minh City PC (whose franchise areas cover big cities only), PCs with franchise areas in rural regions are costlier in electricity supply and, as far as the universal tariff rates are applied throughout the country, a huge gap in financial conditions can occur among them if they are to pay generation and transmission costs on their own without subsidies.

Therefore, the centralized structure of payment still remains, meaning that the cost gaps deriving from the different geographical conditions are absorbed by the Headquarters (EPTC) and that PCs can recover the costs for operating their power distribution business stably.

Disregarding the fact that the organizational separation of PCs has been done and they are now stand-alone companies, the current payment flow structure can be justified as far as centralized decision-making works more effectively than distributed managerial administration. On the other hand, however, it has to be noted that the intention of EVN's organizational reforms has been to motivate PCs'

managerial autonomy and to shift to a structure of multiple-to-multiple transactions among PCs and power generation companies. Figure 4-2 illustrates this future direction in the same style as the previous diagram.



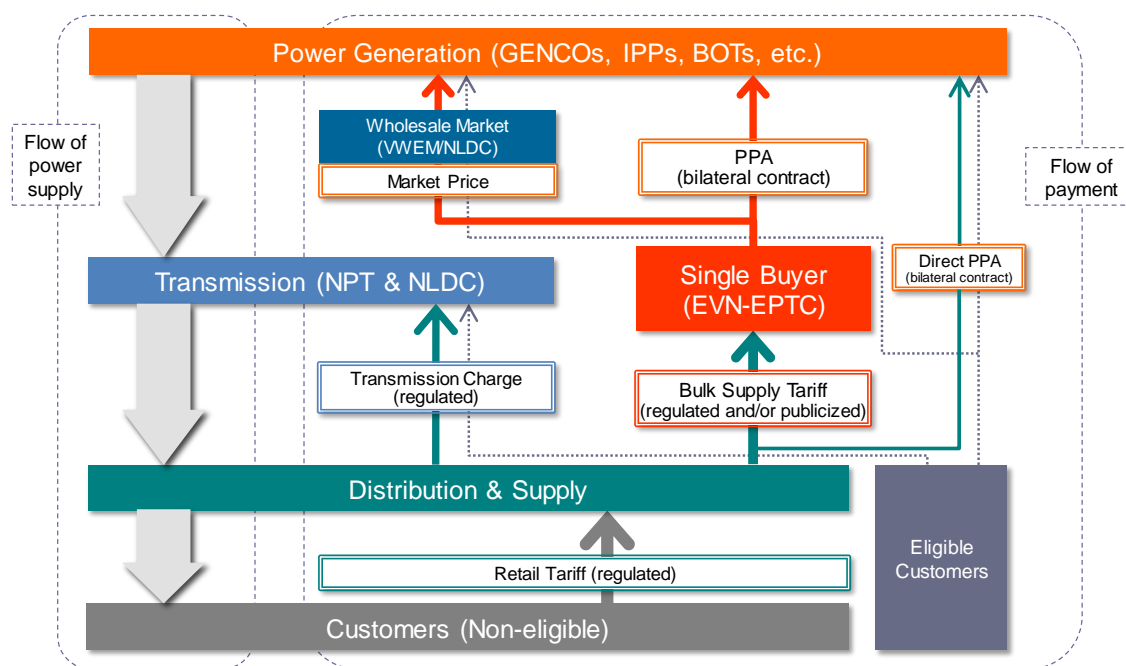
(Source: Prepared by the JICA Survey Team)

Figure 4-2 Payment flow among entities within EVN group: Future direction

A comparison between the two diagrams shows that the current payment flow structure is significantly different from the future direction, and that such a difference makes it difficult to achieve the leap from the centralized management administration to multiple-to-multiple transactions without steps. In Vietnam, the start of N-to-1 transactions between generation companies and the single buyer (NPTC) is called the first stage of the electricity trade market, a.k.a. the Generation Market, and the shift to N-to-N transactions is called the second stage, a.k.a. the Wholesale Market. The ERAV officer who was interviewed in this study explained that the second stage started from 2019 (this year) because direct PPA between generation companies and PCs have already been made possible. However, in reality, the overwhelming share of power generation procurement is still taken by the single buyer and it will take a certain amount of years to shift completely to the second stage, where PCs attain sufficient managerial resources to trade with generation companies at their own discretion.

It also has to be noted that, if the single buyer is abolished and the industry structure is totally transformed into market competition among PCs to promote cost efficiency, justification to maintain the universal tariff rates throughout the country will lose ground. At the moment, however, the situation in Vietnam is still too immature to discuss the abolishment of such universal tariff rates.

Though the shift to multiple-to-multiple transactions needs to be promoted, it seems to be too early to abolish the single buyer system in Vietnam. Therefore, this study suggests that introducing a “transitional structure” that can bridge between the current structure and the future direction and drawing a path of gradual shift to the future direction while enhancing the managerial autonomy of PCs step by step, is worth considering. An illustration of this proposed “transitional structure” is shown in Figure 4-3.



(Source: Prepared by the JICA Survey Team)

Figure 4-3 Payment flow among entities within EVN group: Transitional structure (proposed)

In this structure, the role of EPTC as the single buyer still remains but the collective payment of transmission charges by EPTC is abolished. That is, payments from PCs to EPTC are confined to the cost of power generation procured via EPTC. It is recommended that the wholesale generation costs that the single buyer imposes upon PCs, a.k.a. the Bulk Supply Tariff, are a regulated tariff or, at least, that it is mandated to be made public for a time, so that PCs can easily predict how much they will need to pay for power generation costs resulting from their operation of a power distribution business. Power transmission costs will be paid directly from PCs to NPT in accordance with the transmission service agreement between them and the actual performance of PCs utilizing the Wheeling Service. By shifting to such a transitional structure, PCs will be able to operate their business with an understanding of how much they will need to pay for power generation and transmission costs out of the revenue collected from customers and how much they can retain the remainder for their own. PCs are also motivated to achieve cost efficiency at their own discretion, such as in the reduction of power generation and transmission costs by controlling peak demand in their franchise area.

Considering that Vietnam aims to shift to multiple-to-multiple transactions as the next step following the single buyer system, expanding the power trades between power generators and PCs through either direct PPA or the wholesale market will be implemented little by little. Through this process, PCs are expected to enhance their skills in direct PPA and wholesale market trading, referring to the Bulk Supply Tariff offered by the single buyer as the benchmark price.

The proposed structure for the payment flow, where distribution companies pay the power generation and transmission costs to generation companies and the transmission company respectively, is a general practice in countries where the single buyer system is maintained under organizational separation among power generation, transmission and regional distribution companies, such as in Oman and Bangladesh. It would be easy to adopt such a practice in Vietnam considering that the current organizational structure of the electric power industry is rather similar.

There is a concern about imposing a universal retail tariff and wholesale tariff throughout the country in that, as discussed before, differences in geographical conditions among PCs may cause gaps in financial conditions. To address this issue, while PCs are motivated to work out their own solution as a responsible business entity to pay power generation and transmission costs on their own, a certain mechanism to levelize the financial conditions among them shall be applied so that the cost factors that are out of their control, such as different geographical conditions, can be adjusted through cross-subsidization. Thailand, where EGAT assumes both roles of single buyer and transmission company,

sets a universal Bulk Supply Tariff throughout the country, and then the wholesale price to two regional power distribution companies (MEA and PEA) by adjusting the Bulk Supply Tariff with cross-subsidization, considering the different business environment between these two companies. In Bangladesh, the wholesale power generation price offered by the single buyer (BPDB) to regional distribution companies is differentiated considering the regional conditions of each power distribution company. In Oman, while the universal wholesale price is applied from the single buyer (OPWP) to three regional distribution companies, the regulatory body (AER) provides subsidies to them considering the differences in their business environment.

This issue can also be solved in Vietnam either through the adjustment of EPTC's wholesale price to PCs considering the different business conditions or through cross-subsidy funds, which will be provided by the EVN Headquarters or the government, to levelize the gaps in financial performance among PCs. Even in the transition to multiple-to-multiple transactions, maintaining such a cross-subsidization mechanism at a minimum level helps to promote market competition among PCs while considering the handicaps that derive from the differences in business environment.

Chapter 5. Status of Support by other Development Partners

In order to understand the trends and characteristics of the assistance provided by other development partners to the power sector in Vietnam, a survey was conducted through literature research and interviews.

In Vietnam, the Vietnam Energy Partnership Group (VEPG) is a consultative body of international development organizations that provide assistance to the energy sector in Vietnam. The VEPG comprehensively summarizes the state of support provided by each partner, particularly by European development organizations. In addition, five Technical Working Groups (TWG) have been established within the VEPG for specific topics, and development partners that focus on the respective topics lead the discussions in each TWG. Based on the above information, this chapter provides an overview of the activities of each development partner.

Moreover, the current status of the power sector, the evaluation of future prospects, and the direction of future support by each partner were investigated in interviews with development partners based in Vietnam. Therefore, trends and characteristics of the assistance by each organization are also summarized in this chapter.

5.1 VEPG

VEPG was established by the Government of Vietnam and its international development partners in June 2017. VEPG aims to strengthen cooperation between the Government of Vietnam and international partners in the energy sector and to share knowledge among countries.

International development partners that provide financial assistance and technical cooperation in the field of electricity and energy in Vietnam, such as the World Bank (WB), Asian Development Bank (ADB), United States Agency for International Development (USAID), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Agence française de développement (AFD), Kreditanstalt für Wiederaufbau (KfW), United Nations Development Programme (UNDP), and Japan International Cooperation Agency (JICA), participate in the group. European governmental organizations such as the European Union and Danish government also participate as members. Financial institutions belonging to Export Credit Agencies (ECA) do not participate in the group.

The VEPG Steering Committee is chaired by MOIT and co-chaired by the EU and WB. In addition, GIZ has served as the secretariat of VEPG since July 2018, and has provided logistical support, progress monitoring, and conceptual and technical support.

At the VEPG, a High-Level Meeting is held once a year, which focuses on fostering a continuous energy policy dialogue between the Government of Vietnam and Development Partners. It also serves as a platform for coordinating the TWG in the five priority areas. The first High-Level Meeting was held in June 2017, the second meeting was held in November 2018 and the third meeting was held in December 2019. However, the fourth meeting has not been scheduled yet, mainly due to the outbreak of COVID-19.

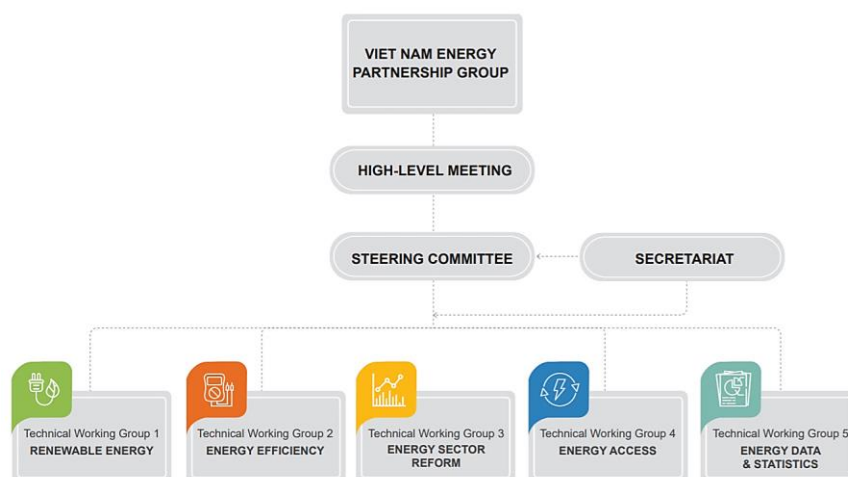


Figure 5-1 VEPG Organization Chart

(Source: [Introductory brochure of the Vietnam Energy Partnership Group](http://vepg.vn/wp-content/uploads/2018/11/Factfile-VEPG-EN.pdf)
<http://vepg.vn/wp-content/uploads/2018/11/Factfile-VEPG-EN.pdf>)

VEPG focuses on five priority areas in Vietnam’s energy sector: renewable energy, energy efficiency, energy sector reform, energy access, and energy data & statistics. Each TWG is chaired by the Vietnamese government agency and co-chaired by international partners, and they provide information and advice on energy policies and plans to the Vietnamese government. The date of holding a TWG meeting differs among TWGs, but each TWG held two meetings in 2018 and 2019 (in total, four meetings each), and had one meeting (the fifth meeting each) in 2020.

Table 5-1 shows an overview of each TWG and its recent activities, referring to VEPG’s introductory brochure and the report documents prepared for the fifth meeting of each TWG that was held between June and September 2020.

Table 5-1 Summary of each TWG in VEPG

TWG/Area	Chair (Upper) Co-chair (Lower)	Priority areas	Recent activities
TWG1 Renewable Energy	• EREA • German Embassy	<ul style="list-style-type: none"> • Removing the barriers for increased private RE investment • Increasing access to RE financing • Striking a balance between centralized and distributed RE power production • Facilitating RE integration into the grid • Training and capacity building for RE development and maintenance 	<ul style="list-style-type: none"> • Update on renewable energy policy and planning • Update on rooftop solar programme
TWG2 Energy Efficiency	• EESD* • UNDP	<ul style="list-style-type: none"> • Promoting Energy Efficiency and Conservation in all aspects of society • Developing specific targets/benchmarks and strategies for energy intensive sectors • Creating an investment climate for leveraging private and public sector resources • Enhancing accountability and monitoring/evaluation mechanisms • Raising awareness and building technical capacities for targeted stakeholders 	<ul style="list-style-type: none"> • Updates on implementation of VNEEP3 / National EE Action Plan (NNEAP) • Focus topic: Exploring the concept of an Energy Efficiency Foundation in Viet Nam

TWG/Area	Chair (Upper) Co-chair (Lower)	Priority areas	Recent activities
TWG3 Energy Sector Reform	<ul style="list-style-type: none"> • ERAV • WB 	<ul style="list-style-type: none"> • Implementing a suitable energy market design • Enhancing capacities for market monitoring and system operation • Increasing investor and market stakeholder confidence in the market system • Developing a Direct Power Purchase Agreement (DPPA) mechanism as an option for RE investors • Leveraging resources for research and best practices 	<ul style="list-style-type: none"> • Update on the wholesale electricity market and discussion of what's next in Viet Nam's competitive market development • Update on DPPA pilot program development and approval progress • Stakeholder priorities in energy sector reform
TWG4 Energy Access	<ul style="list-style-type: none"> • EREA • EU 	<ul style="list-style-type: none"> • Mobilizing resources for increased electricity access in rural and remote areas • Encouraging private investments for rural electricity access • Promoting independent power supply systems for off-grid areas • Increasing access to clean and efficient biogas and cookstove technologies • Facilitating access to Green Climate Fund (GCF) and other public climate funds 	<ul style="list-style-type: none"> • Update on target programme for rural electrification • Focus topic Bioenergy for rural areas – agri-food processing and waste management
TWG5 Data & Statistics	<ul style="list-style-type: none"> • EREA • Danish Embassy 	<ul style="list-style-type: none"> • Establishing the Viet Nam Energy Information System (VEIS) • Promoting inter-agency coordination for energy data and statistics • Establishing strong and effective institutions to implement and operate the VEIS • Developing skills, knowledge and methodologies for an improved strategic energy planning process 	<ul style="list-style-type: none"> • Viet Nam Energy Information System (VEIS) implementation update • Power Development Plan VIII (PDP 8) update in the context of other sector planning including the Energy Master Plan

*Note: EESD: Department of Energy Efficiency and Sustainable Development, Ministry of Industry and Trade
(Source: Survey Team based on the information from VEPG website and report documents of the 5th meeting of each TWG)

At the meetings of each TWG, information is shared on support programs being implemented or being considered by each organization, and policy recommendations on power and energy in Vietnam are made. Support trends related to power system design introduced at TWG1, TWG3 and TWG5 are shown below.

VEPG prepares the summary of achievement of each TWG's target area for the purpose of reporting to the annual High-Level Meeting. Thence the "status" in the following table indicates the progress status as of the third High-Level Meeting that was held in December 2019. Besides this, VEPG prepares a list of support programs of development agencies to the power and energy sector in Vietnam for information sharing among its members, titled "Mapping of Current Partner Projects in Viet Nam Energy Sector". The latest edition of this project list was publicized on 18th December 2020, which is shown in Table 8-2 as appendix. However, due to the delay of projects caused by the outbreak of COVID-19, no major progress has been seen since the status as of 2019.

Table 5-2 Renewable energy (TWG1)

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/Counterpart
1	Revision of the PPA for solar and wind energy: De-risk investments in solar and wind energy projects and mobilize domestic and international private sector investment potential.					
	Revise the PPA for solar and wind energy based on international standards.	Short-term (end of 2019)	Solar: Solar FIT 2 New PM Dec. and MOIT Circ. (replacing Dec. 11/2011 and Circ. 16/2017)	Ongoing	MOIT draft Solar FIT 2: new PM Dec. (replacing PM Dec. 11/2011) published for consultation (21.2.19)	EU/GIZ MOIT/EREA
		Short-term (end of 2019)	Wind: Circular to implement Dec. 39/2018	Completed	MOIT Circ. 2/2019 with revised PPA for Wind published (28.02.19)	EU/GIZ MOIT/EREA
2	Improvement of the solar rooftop incentive mechanism: Overcome investment barriers in the solar PV rooftop sector and mobilize private (residential rooftop) and private sector (commercial-industrial rooftop) investment potential.					
	Revise the existing net metering scheme (Dec. 11/2017/QD-TTg and related MOIT's Circular 16) to overcome the existing barriers (taxation).	Short-term (end of 2019)	Revision of PM Dec. 11/2017 and MOIT Circ. 16/2017	Completed	PM Dec. 2/2019 amending Dec. 11/2017 published (8.1.19) changing net metering to FIT mechanism. MOIT Circ. 5/2019 amending Circ. 16/2017 published (11.03.2019).	EU/GIZ/USA ID/WB MOIT/EREA
	Maintain investment incentive for solar Rooftop projects.	Short-term (end of 2019)	Solar FIT 2 for rooftop: New PM Dec. and MOIT Circ. (replacing Dec. 11/2011 and Circ. 16/2017)	Ongoing	MOIT draft Solar FIT 2: new PM Dec. (replacing PM Dec. 11/2011) published for consultation (21.2.19)	EU/GIZ/USA ID/WB MOIT/EREA
3	Develop future wind and solar support mechanisms (including auctioning): Develop a future procurement framework for renewable energies that limits barriers to project development and gives long-term investment security.					
	Develop the future procurement framework for renewable energies.	Short-term (end of 2019)	Revision of solar support mechanism (Dec. 11/Cir.16)	Ongoing	PM Dec. 39/2018 on revised Wind-FIT issued (10.09.2019). MOIT draft Solar FIT 2 (revision of PM Dec. 11/2011) published for consultation (21.2.19)	EU/GIZ MOIT/EREA
		Medium-term (end of 2020)	Development of auctioning pilot for solar/wind	Ongoing	Development of auctioning pilot program	GIZ/ADB/W B/USAID MOIT/EREA
		Long-term (post-2020)	Further development of other incentive mechanisms for RE (VWEM, RPS, DPPA, etc.)	Ongoing	Development of pilot DPPA Development of VWEM Development of RPS scheme	DPPA (USAID/ERAV) VWEM (WB/ERAV) RPS (USAID/EREA)
4	Integration of fluctuating renewable energy in the national grid: Implement measures that assure the necessary absorption capacity of the national power grid (in time and amount) to allow large-scale wind and solar generation development.					

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
	Develop and implement a transparent and comprehensive RE project approval process.	Short-term (end of 2019)	Revise process for including RE projects in Power Plan (PDP)	Completed/ Ongoing	Completed for wind: new procedures for Wind power project development (MOIT Circ. 2/2019, 28.02.2019). Ongoing for solar: New MOIT Circ. for solar project development (replacing Circ. 16/2017) will include guidelines from new MPI Planning Law	EU/GIZ MOIT/EREA /MPI
	Invest in grid expansion considering potential future RE development	Medium-term (end of 2020)	Align RE capacity planning and grid planning in PDP VIII	Ongoing	Ongoing PDP 8 development Ongoing MOIT/EVN grid expansion projects	GIZ/TWG (Denmark) EREA
	Increase the frequency of national PDP updates and align grid and RE capacity planning.	Medium-term (end of 2020)	Develop new PDP (in line with new Planning Law)	Ongoing	Implementation of new MPI Planning Law: Upcoming MPI Circular on implementation of new Planning Law	WB/USAID MOIT/EREA /MPI
	Review the grid codes for utility-scale RE and rooftop solar projects.	Short-term (end of 2019)	Review grid codes for utility-scale RE and rooftop solar	Ongoing	MOIT/ERAV Circular 25/2016/TT-BCT (Grid Code for transmission system) MOIT/ERAV Circular 39/2015/TT-BCT (Grid Code for distribution system) revised and issued.	GIZ/ Denmark MOIT/ERAV

Table 5-3 Energy Sector Reform (TWG3)

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
1	Implementation of the Viet Nam Wholesale Energy Market (VWEM): Develop and implement a suitable energy market design model and a clear and transparent legal and institutional framework.					
	Improve the detailed VWEM design in order to meet the target of a fully operational VWEM in 2021, and subsequent implementation of the VCRM in particular, with a cross-subsidy mechanism among Power Corporations	Short-term (end of 2019): VWEM Design Medium-term (end of 2020): Cross-subsidy mechanism	Further develop design of VWEM Implement cross-subsidy mechanism for PCs, pricing mechanism for public utility products, and mechanism for power system ancillary service costs.	Partially Completed	Start of VWEM full-operation; beginning of 2019 MOIT Dec. 45/2018, issued 15.11.2018, regulating details of VWEM operation Cross-subsidy mechanism under development	WB/ADB ERAV/MOIT
	Develop a pricing mechanism for public-utility products and services to supply	Long-term (post-2020)	Fully implement VWEM and VCRM.	Ongoing	Start of VWEM full-operation; beginning of 2019	WB/ADB ERAV/MOIT

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
	power to deep-lying, remote, border and island areas. A mechanism for managing the power system ancillary service (A/S) costs of SMO in both VWEM and VCRM.					
2	Development of a Direct Power Purchase Agreement (DPPA) mechanism: Develop a DPPA mechanism as an option for Renewable Energy investors.					
	Develop DPPA within a robust legal market framework and in compliance with the VWEM.	Short-term (end of 2019)	Prepare and implement pilot DPPA model.	Ongoing	Consultation on DPPA design on 12 June 2019 Internal government review and approval process ongoing	USAID ERAV
	Prime Minister's decision on implementing DPPA	Medium-term (end of 2020)	Analyze pilot DPPA model for further implementation of VWEM and VCRM.	Ongoing	Consultation on DPPA design on 12 June 2019 Internal government review and approval process ongoing	USAID ERAV
	Develop the legal basis for a Distribution Charge as a prerequisite for implementing the DPPA and VCRM.	Medium-term (end of 2020)	Develop legal base for a Distribution Charge	Ongoing	Consultation on DPPA design on 12 June 2019 Internal government review and approval process ongoing	USAID ERAV

Table 5-4 Energy Data and Statistics (TWG5)

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
1	Establish the legal framework for Vietnam Energy Information System (VEIS): Establish a strong, coherent and clear legal framework for the collection, processing and dissemination of energy data and statistics in Viet Nam.					
	Issue a MOIT decision on the approval of the VEIS Roadmap and Action Plan.	Short-term (end of 2019)	Issue MOIT decision on VEIS Roadmap and Action Plan approval.	Completed	VEIS Action Plan (MOIT Decision 4651/2018) was issued on 14.12.2018.	GIZ MOIT/EREA
	Develop and issue a legal decision on the implementation of the VEIS Roadmap and Action Plan.	Short-term (end of 2019)	Issue MOIT Circular on VEIS implementation.	Ongoing	Development of MOIT Circular ongoing (draft to be submitted to further government agencies for consultation in October 2019); Technical Working Group for development of Circular was established in early	GIZ MOIT/EREA

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
					September 2019 PM Decision on VEIS to be developed by 2021	
	Parallel preparatory work should be conducted on the terms of reference for the coordination platforms, a multi-annual VEIC work plan and the drafting of data sharing agreements.	Short-term (end of 2019)	Develop further preparatory work (ToR for coordination platforms, workplan etc.)	Ongoing	Will be partially covered by the MOIT Circular (under development), other activities under this target will be started in 2020	GIZ MOIT/EREA
2	Establish the institutional framework for Vietnam Energy Information System (VEIC): Establish a strong, coherent and clear legal framework for the collection, processing and dissemination of energy data and statistics in Viet Nam					
	Allocate an appropriate State budget for the institutional structure, including the Viet Nam Energy Information Center (VEIC).	Medium-term (end of 2020)	Allocate State budget for institutional structure of VEIS (incl. VEIC) (which budget period etc. to be specified).	Ongoing	Initial budget (non-state budget) needs to be defined by end of 2020 (to be submitted to MPI). Proposal for State Budget (2021-2025) by 2021. Pre-FS for VEIS investment is under development	GIZ MOIT/EREA
	Install a “VEIS leader” and an “inception team” composed of EREA, EESD, GSO representatives (among others) to initiate activities, supervise the preparatory work and coordinate with all stakeholders.	Short-term (end of 2019)	Install VEIS leader and inception team.	Revised	After issuing of MOIT Circular the MOIT Minister will decide in 2020 on overall VEIS Leader, VEIS working group installation and the establishment of the VEIC (staff, office equipment etc.). In compliance with legal regulations, this cannot be done before the MOIT Decision.	GIZ MOIT/EREA
	Install an inter-agency VEIS Steering Committee to facilitate coordinated decision making, an Energy Statistics Working Group (ESWG) for inter-ministerial technical discussions and coordination and finally, the Vietnam Energy Information Center (VEIC) to operate the VEIS and the Energy Data Management System (EDMS) on a day to	Medium-term (end of 2020)	Install VEIS Steering Committee, ESWG and VEIC.	Ongoing	Inter-ministerial Steering Committee and further working groups can be installed after issuing of MOIT Circular and decision by MOIT Minister.	GIZ MOIT/EREA

No.	Policy recommendations	Time-frame	Indicators	Status	Activities	Partners/ Counterpart
	day basis.					
3	Viet Nam Energy Outlook Report (EOR 2019): Improve and strengthen the functions of the EOR 2019 to improve Vietnamese experts' skills in data & statistics as well as for developing the Power Development Plan VIII					
	Utilize the knowledge, findings and recommendations, as well as the expertise developed in Vietnam under the EOR 2019 for the PDP VIII.	Medium-term (end of 2020)	Utilize 20 EOR 19 for the development of PDP VIII.	Ongoing	EOR 2019 was launched on 4 November. During the development of the EOR 2019, specific recommendations were made on PDP 8 development, design and methodology. In the preparatory work for the PDP 8, the EOR 2019 and its analytical setup has already benefitted the PDP 8 developments.	Denmark MOIT/EREA/ VN

(Source: Survey team based on VEPG "Technical Working Group 1: Renewable Energy Report of the 3rd Meeting"
http://vepg.vn/wp-content/uploads/2019/09/VEPG_TWG1_3rd_Meeting_Report_15-03-2019.pdf)

5.2 Identification of Support Policies and Characteristics of other Development Partners

In this study, we visited the WB, ADB, USAID, DEPP (Danish government), GIZ, AFD, Innovation Norway (Norwegian government), International Finance Corporation (IFC), and KfW to exchange views on the current status and future prospects of the power sector in Vietnam, as well as their policies on development assistance. In addition, although interviews with local staff were not held, information on the support policies of the US Trade and Development Agency (USTDA) was compiled based on various published information. Table 5-5 summarizes an overview of their support, technical assistance, and financial support.

Table 5-5 Trends of support by international development partners

Organization	Main activities
WB	<p>< Overview ></p> <ul style="list-style-type: none"> WB has worked on the energy sector in Vietnam for the past 20 years. Major initiatives include rural electrification, efficiency, and hydropower generation. <p>< Technical assistance ></p> <ul style="list-style-type: none"> Support for post-FIT <u>solar and wind auction mechanism</u> with ADB. <p>< Financial support ></p> <ul style="list-style-type: none"> <u>EVNNPT</u> requires about USD 1-1.5 billion per year for their capital investment, but transmission rates are capped by the government; therefore, they are struggling with the procurement of financial sources. To accelerate the <u>introduction of private financing in the transmission sector</u>, Independent Power Transmission (IPT) is one of the ideas that would allow private companies to participate in the operation of transmission lines. The introduction of private funds is not a jurisdiction of WB, but it is under IFC. <u>EVNPC</u> also requires capital investment of approximately USD 1-1.5 billion per year, but a credit rating is necessary to provide direct financing.
ADB	<p>< Overview ></p> <ul style="list-style-type: none"> ADB is one of the three major development partners working in Vietnam and it is working with other development partners including AFD, JICA, KOIKA, GIZ/KfW, and WB. <p>< Technical assistance ></p> <ul style="list-style-type: none"> Support for the formulation of PDP8 is not provided, but they assist MOIT in <u>Integrated Resource Planning</u> (IRP: a planning method considering both supply side resources and demand side resources) and technical evaluations. In partnership with WB, support for the <u>solar and wind auction mechanism</u>, as a post-FIT scheme, is provided. They also assist ERAV and EVN in the <u>design of a market framework and institutions</u>. In order to contribute to system stabilization through the <u>introduction of battery storage</u>, the optimal capacity of batteries for frequency control is examined in assistance for EVN. The capacity will be determined soon, and the results will be announced early next year, including where and how much capacity should be installed. EVN is planning a demonstration of battery storage, but since it is not economically affordable, economic and financial studies will be conducted and investment decisions will be made in the middle of next year. <p>< Financial support ></p> <ul style="list-style-type: none"> ADB is preparing a <u>sovereign loan to NTP</u> for a 500 kV transmission line construction project (supposed to be “51093-002: Northern to Central 500 kV Transmission Grid Reinforcement Project”). NTP has asked ADB to finance the project, and the project is awaiting the Prime Minister’s approval. ADB has completed due diligence and power system impact assessments with the support of IE. Sector program loans are not provided by ADB in Vietnam. (Note: financing is provided on the condition that the target country government is committed to sector reform. Financing is provided when certain targets are achieved.)

Organization	Main activities
USAID	<p>< Overview ></p> <ul style="list-style-type: none"> USAID is conducting VLEEP (Vietnam Low Emission Energy Program), and Deloitte has been commissioned to conduct the program. The program duration is a 5-year period from 2015 to 2020 and the budget is approximately USD 940 million. The program is scheduled to be completed in September of next year. The theme for the next phase will be decided in consultation with USAID and MOIT. The main themes of support are (1) support for electricity planning, (2) expansion of access to renewable energy, and (3) establishment of energy conservation standards for the industrial sector. <p>< Technical assistance ></p> <ul style="list-style-type: none"> As a co-advisor of MOIT and EREA, USAID provides support for the formulation of PDP8. Since development of PDP8 is led by IE, they assist IE in power generation cost modeling methods using PLEXOS. In the support for Direct PPA, ERAV is a counterpart and develops frameworks and regulations. Capacity building for DPPA transactions by NLDC and PC is one of the main areas of focus in the support. They are currently waiting for the prime minister's approval for the MOIT demonstration. Cross-donor support with GIZ and WB on rooftop solar power generation has been conducted and USAID is in charge of the private sector participation. There has been no major progress on RPS, except for a survey of stakeholders involved.
USTDA	<p>< Overview ></p> <ul style="list-style-type: none"> USTDA aims to help U.S. companies by exporting U.S. products and services to priority development projects in developing and middle-income countries. It also helps U.S. companies to facilitate export opportunities by funding project preparation and partnership building activities that promote sustainable infrastructure development and economic growth in partner countries. In 2017, the Ministry of Economy, Trade and Industry of the Government of Japan and USTDA signed a Memorandum of Cooperation on the "Japan-U.S. Strategic Energy Partnership (JUSEP)" and on assistance for energy infrastructure development, infrastructure procurement system development, and information exchange in third countries. <p>< Technical assistance ></p> <ul style="list-style-type: none"> In September 2018, technical support was provided to EVN and NLDC for feasibility studies on energy storage technologies. In April 2019, it was announced that GE would conduct economic and technical analyses to develop large-scale grid storage batteries by the beginning of 2020. <p>In May 2019, a US \$1 billion grant to EVN was announced for an LNG terminal and gas power project in southern Viet Nam. Since JUSEP is working on energy infrastructure development, there is room for Japan's involvement.</p>
DEPP (Energy Partnership Program Between Vietnam and Denmark)	<p>< Overview ></p> <ul style="list-style-type: none"> DEPP is being implemented under a partnership between the Government of Vietnam (Primarily MOIT) and the Government of Denmark. This 3-year program is scheduled to end in June 2020. The content of the next phase will be the same as that of the current phase. The Budget is USD 3.5 million, funded by the Danish Climate Change Fund. Private companies are not participating in the program. Since Vietnam is no longer a developing country, the Danish development agency, i.e. DANIDA, has been inactive since 2015. <p>< Technical assistance ></p> <ul style="list-style-type: none"> In partnership with EREA, support regarding the development of a long-term energy plan (Energy Outlook) is provided. This is a priority within the Danish program, and an Energy outlook report is published as part of the support. To support the development of the PDP8, the BALMOREL model is being used as a tool for the development of PDP as a part of capacity building; however, DEPP was not involved in providing assistance for the development of the PDP8. According to a DEPP representative, the process of learning BALMOREL is progressing gradually. Cooperation on the operation of the power market has been implemented for ERAV.

Organization	Main activities
	<p>Moreover, Danish transmission operators are assisting Vietnam's NLDCs in the area of renewable energy forecasts.</p> <ul style="list-style-type: none"> • Support for ERAV in the revision of the grid code has been conducted with GIZ. (Grid code revision is largely responsibility of GIZ.) In October 2019, DEPP made a roadmap related to grid code revision for the next 5 years. Further implementation regarding grid code revision in DEPP's next phase is desired. • A survey of ancillary services in Vietnam has been conducted. For ancillary services, a market-based incentive system should be proposed, but this is still a long way off in Vietnam. The development of grid codes is being promoted as a first step toward the introduction of Ancillary Services.
GIZ	<p>< Overview ></p> <ul style="list-style-type: none"> • Under the partnership between MOIT and GIZ, a project called Renewable Energy and Energy Efficiency (4E) is being implemented. Phase 1 amounted to a total of EUR 3 million from 2015 to 2018, and phase 2, a total of EUR 12.16 million from 2018 to 2021. • Working under the framework of the German government, the technical assistance covers only renewable energy and energy efficiency. GIZ provides only technical assistance and KfW provides loans. • Another program, Smart Grids for Renewable Energy and Energy Efficiency (SGREEE), targets smart grids in Vietnam. <p>< Technical assistance ></p> <ul style="list-style-type: none"> • A report on the wind power auction mechanism was published, but GIZ did not provide support for a demonstration, and WB is interested in this. • Support for the grid code is being provided to ERAV and is at the draft stage. It may be revised in about two years. Members of GIZ have borrowed money from ERAV. • Policy proposals and technical support are provided to MOIT and EREA as support for rooftop solar. Since there are concerns about the impact of rooftop solar power on power quality, technical support for EVN and SPC will be provided. • For GIZ's internal use, a grid capacity assessment for the southwest region was carried out. Necessary measures are proposed based on the current transmission capacity and the PDP transmission investment plan, and the work to be carried out in 2021 is described assuming that the investment decision arrives by 2022. • For technical assistance, energy access is not covered. In addition, since support for thermal power generation is out of scope, the flexibility of the electric power system is also not covered.
AFD	<p>< Overview ></p> <ul style="list-style-type: none"> • An AFD office was established in Vietnam in 1994, and support for the energy sector in Vietnam began around 2000. <p>< Technical assistance ></p> <ul style="list-style-type: none"> • Support for ERAV on the institutional design of electricity wholesale markets. <p>< Financial support ></p> <ul style="list-style-type: none"> • As part of the development project in the Mekong region (GMS: Greater Mekong Subregion), AFD co-financed with ADB for a transmission line development project to exchange power from the Lao People's Democratic Republic. AFD also provides financing for a 500 kV transmission line between Hanoi and Haiphong. • The first direct financing to EVN was provided for a hydropower project in 2008 (corporate finance without government support). Since then, AFD has been supporting projects including the development of a solar power generation business in the highland area in the central part of the country (total: 49 MW), development of a hydropower plant in the central part of the country (360 MW), and the development of a pumped storage power plant at Hoa Binh. • Direct loans to EVN subsidiaries are under consideration. EVNNPT is eligible for direct finance via sub-sovereign loans. As for EVNPC, it needs to start with technical assistance because a revenue and expenditure model has not yet been developed and developing one will take time. • Future support includes financing for transmission lines and hydropower. AFD is not considering thermal power plants because of the large amount of capital investment needed.
Innovation	< Overview >

Organization	Main activities
Norway	<ul style="list-style-type: none"> • Innovation Norway encourages private businesses to enter the Vietnamese market as a function of the Norwegian Embassy. The Norwegian development agency, i.e. NORAD, does not actively engage in the country because Vietnam is a middle-income country. <p><Financial support></p> <ul style="list-style-type: none"> • In order to improve the investment environment for LNG, cooperation is being implemented in the area of formulation of related regulations and policies. No technical assistance or ODA is provided but there is involvement in power generation projects through co-financing. • Innovation Norway is looking for investment opportunities in offshore wind projects to assist the Norwegian private sector.
IFC	<p>< Overview ></p> <ul style="list-style-type: none"> • As a member of the WB group, IFC specializes in private sector development in developing countries. <p>< Technical assistance ></p> <ul style="list-style-type: none"> • Green Building (energy-saving building) programs were implemented in Vietnam, China, Indonesia, and the Philippines from 2013 to 2019. Of the total of US \$10.5 million, US \$1.8 million was for grants to Viet Nam. In Vietnam, the project targets universities in Hanoi and Ho Chi Minh. <p>< Financial support ></p> <ul style="list-style-type: none"> • It is desirable to provide private financing for projects in which private companies other than NPT construct and own transmission lines. Under current laws and regulations in Vietnam, power transmission facilities are only allowed to be owned by the government, so one idea is an advisory for institutional changes regarding this matter. • In terms of private investment, financing for the construction of a transmission line from Vietnam to Laos is under consideration and an MOU has already been signed with the Lao government. Although the owner of the transmission line has not been decided, the IFC investment will cover the Lao to the Lao/Vietnam border portion and EVN investment will cover the border to Ho Chi Minh City. In the future, a feasibility study will be conducted, and then private financing from IFC will be considered. • The World Bank Group's Multilateral Investment Guarantee Agency (MIGA) is considering direct financing of non-sovereign loans to NPT.
KfW	<p>< Overview ></p> <ul style="list-style-type: none"> • KfW is a bilateral donor under the German government. Like GIZ, they work under the German government's framework, and their financing in Vietnam focuses on renewable energy and energy efficiency. <p>< Financial support ></p> <ul style="list-style-type: none"> • Non-sovereign loans have a track record in other countries, but not in Vietnam. For the EVN Group, prioritized areas for financial assistance are transmission and distribution. Financing for power generation projects is not necessary because of the active market participation. • Sub-sovereign loans to EVN have been under consideration for several years and have been discussed with the German government. As a result of consultation between the German and Vietnamese governments, sub-sovereign loans were managed on a case-by-case basis. Risk assessments for EVN and its subsidiaries are conducted by KfW and the German Ministry of Finance. • KfW has a hydropower expansion project in its pipeline, and this will be the first sub-sovereign operation and direct financing for EVN. • The expansion of 110 kV to 220 kV transmission lines in the SPC region is under consideration for a future non-sovereign loan. In addition, support for the implementation of rooftop solar power will be considered. • There is no collaboration with local commercial banks, such as in two-step loans or ECA, in the energy sector.

(Source: Compiled by JICA survey team based on the results of interviews with various organizations)

5.3 Possibility of further Support in the Future

The possibility of further support in the future was examined based on the current support provided by each development partner shown in 5.1 and 5.2. This is organized according to the VEPG classification of TWG (three of the five areas of assistance: renewable energy, energy sector reform, and energy data and statistics).

Table 5-6 Possibility of further Support in the Future

Area	Item	Possibility of further support in the future
Renewable Energy	<ul style="list-style-type: none"> Review of PPA for solar and wind power generation 	—
	<ul style="list-style-type: none"> Improvement of incentive system for rooftop solar power generation 	<ul style="list-style-type: none"> Expansion of power distribution facilities
	<ul style="list-style-type: none"> Development of support mechanisms for future wind and solar power generation (including a bidding system) 	<ul style="list-style-type: none"> Support for implementation of bidding system
	<ul style="list-style-type: none"> Grid integration of variable renewable energy 	<ul style="list-style-type: none"> Construction of transmission and transformation facilities Installation of storage batteries for systems Development of pumped storage hydro power plants Review of Grid Code Support for development of renewable energy output prediction system Technical support for system operation methods when introducing large amounts of renewable energy
	<ul style="list-style-type: none"> Reducing entry barriers for private renewable energy investors 	<ul style="list-style-type: none"> Institutional design for permission for private investment in the power transmission sector
Energy Sector Reform	<ul style="list-style-type: none"> Development of VWEM 	<ul style="list-style-type: none"> Assistance in institutional design for ancillary services market and capacity market Consideration of measures to secure frequency adjustment capacity Development of the ancillary services market
	<ul style="list-style-type: none"> Development of DPPA Mechanism 	—
Data & Statistics	<ul style="list-style-type: none"> Construction, implementation and operation of the Vietnam Energy Information System 	—
	<ul style="list-style-type: none"> Methodological and data support for PDP8 development 	<ul style="list-style-type: none"> Consideration of optimum renewable energy introduction

Chapter 6. Analysis of Issues in the Power Sector

Issues that have already occurred and/or are expected to occur in the power sector are summarized as follows.

6.1 Issues Concerning Demand/Supply Balance in the Overall System

Based on the revised PDP7 and the MOIT report on June 4, 2019, the issues in the power development plan are summarized as follows.

(1) Concerns about power shortages

In the revised PDP7, construction of many planned power generation facilities has been delayed, and there is a high possibility of power shortages in 2022 and 2023. If the construction of the power plants is delayed, power shortages will continue after 2024.

Instead, many solar power generation facilities are to be installed, and they can be expected to provide supply capacity during the daytime. However, since the required amount of power generation cannot be expected to be met after 18:00, the lighting peak of power demand, this cannot be a means to solve the shortage of supply capacity during peak times.

Construction of large-scale power plants is the most effective way of addressing this issue. Demand Side Management (DSM), which controls demand during peak hours, can also be useful. GIZ conducts institutional design and human resource development for smart grids in Smart Grids for Renewable Energy and Energy Efficiency (SGREEE).

(2) Securing the balance between supply and demand

At present, the maintenance of a balance between supply and demand is addressed by adjusting the output of large-scale hydropower plants. Since demand can be expected to increase dramatically in the future, the difference in demand between peak hours and off-peak hours will increase. In contrast, construction of large-scale hydropower plants can hardly be expected. Therefore, securing a balance between supply and demand against the difference in demand between peak hours and off-peak hours will not be achieved only by adjusting the output of large-scale hydropower plants. For this reason, it is necessary to adjust the output of gas fired power plants in particular in order to ensure a balance in supply and demand.

(3) Insufficient frequency adjustment capacity

The specified value of the frequency is 50 Hz, but if it fluctuates within ± 0.5 Hz, there is no significant effect on the customer's equipment. However, when the supply and demand balance of the system is disrupted due to sudden changes in supply capacity, such as in an accident at power facilities, the frequency fluctuates greatly. For example, when a plant failure occurs, the supply power decreases rapidly, and the frequency decreases at a stretch in accordance with the reduced amount of supply power. In general, measures are taken to prevent a collapse of the whole system, assuming an amount of frequency reduction whereby the plant with the largest single unit suddenly stops operation due to a failure. However, if the supply power suddenly decreases due to a plant failure when the system is in a state where the frequency has dropped to 49.5 Hz, the frequency will be 0.5 Hz lower than expected, even if the decrease in frequency is the expected amount. Therefore, there is a risk that the system may enter a dangerous zone and cause an entire collapse. For this reason, in general, facilities that can change their output at a fast speed (hydropower is the fastest) are put in place as frequency adjustment facilities, and output adjustment is performed to return to the specified value (50 Hz) in response to frequency fluctuations.

However, in order to function as a frequency adjustment facility that absorbs fluctuations within 1 minute, it is necessary to always operate in a state where the output can be increased or decreased. Such operation is never economical. For this reason, in a situation where no compensation is obtained for such operation, the power generation company does not have an incentive to perform frequency adjustment operations.

Large-scale hydropower under the umbrella of EVN (Hoa Binh, Ialy, Tri An, etc.) performs frequency adjustment operations per requests from NLDC. The installed capacity of reservoir-type hydro generators is currently about 40%, but the capacity rate will gradually decrease, becoming 17% in 2030. With the unbundling of EVN, the hydro generators are owned by a different company to the system operator. This different company intends to dispatch the generation so as to obtain the maximum generation price, instead of performing frequency control operations. As demand increases in the future, the required frequency adjustment capacity will increase, and an increase in renewable energy (solar and wind) is expected, so the required frequency adjustment capacity is expected to increase significantly. This change in the situation will surely lead to a further lack of frequency regulation ability.

ADB is providing system design support for the Vietnam Wholesale Electricity Market (VWEM) and mentions the ancillary service market, where frequency adjustment functions are traded in the market. However, the content only stipulates the role of each player in dealings with ancillary services within the framework of VWEM and does not go into concrete market design discussions. For this reason, there is room for JICA's support in the concrete design of the ancillary service market.

Power plants with high load following ability are required as an enhancement measure for frequency regulation capacity to cope with the increase in renewable energy. ERAV is considering establishing a system whereby thermal power plants also have to regulate the system frequency in the future, in addition to the hydro power plants which currently adjust the system frequency. ERAV also thinks that the necessary amount and locations for storage batteries should be studied.

In addition, it is necessary to offer incentives for implementing system frequency regulation to thermal power generation companies such as IPP, and it seems that the method for this will be the creation of an ancillary market, but work on the study for the market has not progressed, and ERAV mentioned that no support for the study has yet been secured.

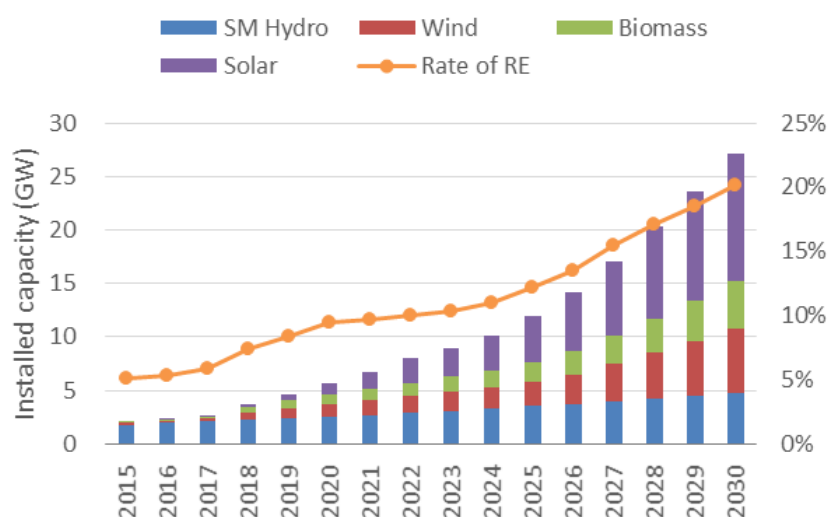
The Danish government is supporting the formulation of a grid code for ERAV as the first step toward the introduction of a future ancillary service market in VEPG's TWG3 (subcommittee discussing cooperation related to power sector reform). (This is a collaboration with GIZ. The introduction of an ancillary service market is still under discussion.)

6.2 Issues Concerning an Expansion of Renewable Energy

The Vietnam Government determined to develop renewable energy aggressively in the revised PDP7, which was published in March 2016, in accordance with the renewable energy development policy published in November 2015. The prospective installed capacity for renewable energy sources is shown in Figure 6-1. Note that the survey team classified the total amount of renewable energy sources in the revised PDP7 by types of power source based on the development policy.

Under this policy, renewable energy sources will increase drastically, with their capacity reaching 20% of the total generation capacity by 2030. In particular, solar and wind, the output power of which varies depending on the weather conditions, will increase significantly.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SM Hydro	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	3.1	3.3	3.5	3.8	4.0	4.3	4.5	4.8
Wind	0.1	0.2	0.3	0.6	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.6	3.5	4.3	5.1	6.1
Biomass	0.0	0.1	0.2	0.6	0.7	0.9	1.0	1.2	1.4	1.6	1.9	2.2	2.6	3.1	3.7	4.3
Solar	0.0	0.0	0.1	0.2	0.6	1.1	1.7	2.3	2.7	3.3	4.3	5.5	6.9	8.6	10.3	12.0
Rate of RE	5%	5%	6%	7%	8%	9%	10%	10%	10%	11%	12%	13%	15%	17%	19%	20%

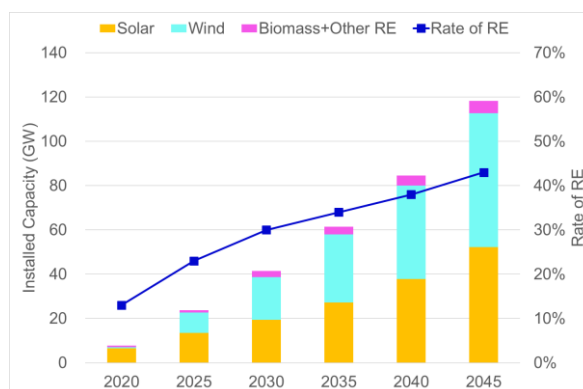


(Source: Drawn by JICA Survey Team based on the PDP7 revised)

Figure 6-1 Capacity increasing of Renewable Energy Sources

According to the materials from the workshop on the Eighth Power Development Plan (PDP8), which are expected to be announced soon, the installed capacity trend for renewable energies will increase significantly in the future, as shown in Figure 6-2, with plans to cover 30% of the total installed capacity with renewable energies by 2030. This figure is 1.5 times' higher than the 20% in the revised PDP 7 published in March 2016, indicating an intent to accelerate the adoption of renewable energy.

The majority of renewable energy generation is solar and wind. These sources are highly dependent on weather conditions, and a rapid increase in their power generation capacity could have a serious impact on the power grid, which is likely to require prompt action.



(Source: Prepared by JICA Survey Team based on Report in PDP8 Workshop, July 2020)

Figure 6-2 Trend of Renewable Energy Capacity

6.2.1 Curtailment of Generation Output from Solar Power Plants due to Insufficient Transmission Capacity

(1) Analysis of the Current Situation

Considering that FIT (Feed-in Tariff) applications for solar power generation plants expired at the end of June 2019 (a 2-year extension has been decided), developers rapidly developed solar power generation plants by the end of June 2019.

A study on transmission capacity is included in the document submitted at the time of construction approval for each power generation plant. However, these are studies only for each project, and if many plants are installed in the same area it becomes impossible to transmit all the power generated by the plants. Therefore, curtailing of output from solar power plants due to insufficient transmission capacity frequently occurs.

Output curtailment occurs mainly in Binh Thuan Province (24 sites: 992MW) and Ninh Thuan Province (18 sites: 1,271MW) in the south (SPC jurisdiction), where solar power installation is concentrated. In addition, although of a small amount, it also occurs in An Giang Province (110kV Tinh Bien - Chau Doc), the area surrounded by the red frame shown in Figure 3-13.

(2) Response by Vietnamese Power Sector and each Donor

(a) Response by Vietnamese power sector

At present, there is no output curtailment due to transmission capacity bottlenecks in the 500kV or 220kV backbone systems. However, if the development of renewable energy in Binh Thuan Province and Ninh Thuan Province is carried out continuously in the near future, there is a high possibility that output will be curtailed due to transmission capacity bottlenecks in the backbone system in the near future. In order to respond to this situation, the EVN Planning Department created a list of projects that should be implemented urgently, proposed it to MOIT, and obtained approval from the Prime Minister (No. 1891/TTg-CN: December 27, 2018). These projects are currently undergoing preparations for construction. An outline of the projects is shown below. It includes 4 projects with an accelerated schedule proposed in the revised PDP7, and 11 new projects.

Table 6-1 Overview of Projects to be implemented urgently (Accelerated Schedule in RPDP7)

	Name	Scale	Schedule	RPDP7
1	220kV Cam Ranh Substation	2x250 MVA	2020	2021-2025: M1-250MVA 2026-2030: M2-250MVA
2	220kV Phan Ri Substation	2x250 MVA	2020	2021-2025
3	220kV Ninh Phuoc Substation	2x250 MVA	2021	250MVA; 2026-2030
4	Install AT2 220kV Ham Tan Substation	250 MVA	2019	2016-2020: M2-250MVA

Table 6-2 Overview of Projects to be implemented urgently (New Projects)

	Name	Scale	Schedule
1	500/220kV Thuan Nam Substation	3x900 MVA	2024
2	500kV line connects to 500kV Thuan Nam Substation, transit 4 circuit 500kV Van Phong - Vinh Tan line	4x20 km	2024
3	500kV double circuit Thuan Nam - Chon Thanh	2x350 km	2025
4	4 double circuit connects to 220kV bus of 500kV Thuan Nam Substation which transits on 2 circuit 220kV Vinh Tan - Thap Cham line	4x25 km	2024
5	Upgrade capacity of 500kV Vinh Tan Substation	2x900 MVA	2021
6	Upgrade capacity of 500kV Di Linh Substation	900 MVA	2021
7	220kV double circuit line Ninh Phuoc - Vinh Tan	2x35 km	2023
8	220kV double circuit line Ninh Phuoc - 500kV Thuan Nam Substation	2x25 km	2023
9	Upgrade capacity of 220kV Thap Cham Substation	2x250 MVA	2020
10	Upgrade capacity of 220kV Dai Ninh hydropower plant substation	2x250 MVA	2020
11	Upgrade capacity of 220kV Da Nhim hydropower plant substation	2x125 MVA	2020

**TRANSMISSION SOLUTION FOR
SOLAR POWER SOURCE BY DECISION
1891/ TTg-CNT**

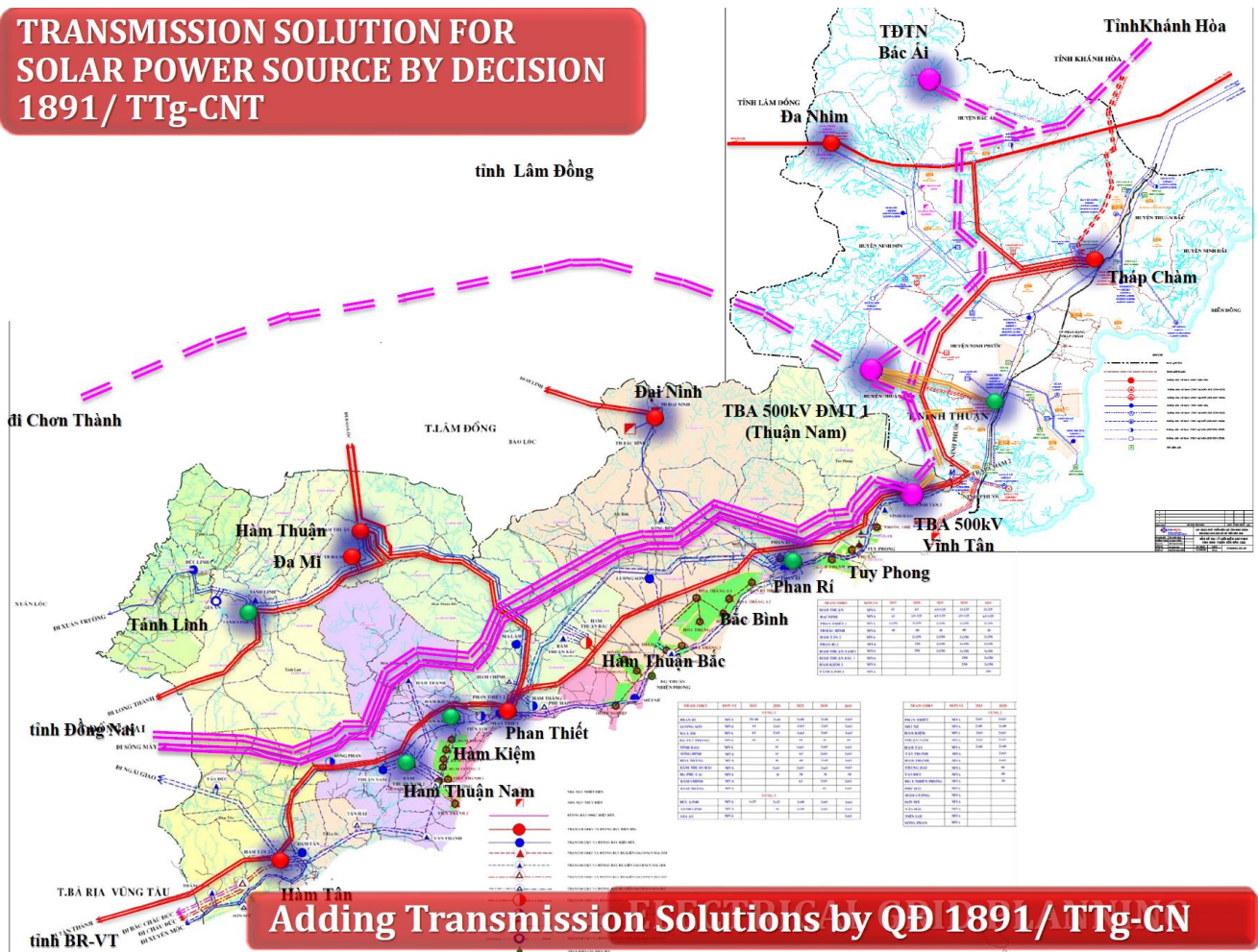


Figure 6-3 Map of Projects to be implemented urgently

Among the new projects, KfW has been commissioned to construct a new 500kV Thuan Nam substation in Ninh Thuan Province and a 500kV transmission line between Thuan Nam substation and Chon Thanh substation (350km). The other expansion plans will not be in time for donor funds, so these will be implemented via NPT's own funds and borrowing from commercial banks. In addition, build and operations are outsourced to private companies for some projects, and as of December 2020, some facilities have already been constructed and are in operation.

In addition, for 110kV transmission lines, where the output of solar power is curtailed due to insufficient transmission capacity, SPC has formulated a strengthening plan such as thickening the transmission line, and as of December 2020, some construction has already been completed. Although the situation of output curtailment has improved since December 2019, solar power curtailment is still occurring due to insufficient transmission capacity.

(b) Response by each Donor

KfW has expressed interest in a system enhancement project that underpins massive renewable energy connections, including the provision of non-sovereign loans. In addition, ADB and AFD, which provide support for the construction of 500kV transmission lines, may be interested in financing in this area.

6.2.2 Output Curtailment of Renewable Energy due to the Balance between Supply and Demand in the Overall System

At present, there is curtailment in the output of renewable energy due to transmission line congestion, but there is no output curtailment due to the balance of supply and demand in the overall system. However, if renewable energy is developed steadily in the future, it is assumed that around 2025-2030, curtailment in renewable energy output due to the supply-demand balance in the overall system will occur. Therefore, there is a high possibility that installation of power storage facilities for supply and demand adjustment (storage batteries, adjustable speed pumped storage power plants (PSPP)) will become inevitable.

(1) Present demand and supply balance

The current supply and demand situation is one in which the amount of power generated by solar power is high during the daytime hours, but still around 15% of the demand. Therefore, it is not necessary to change the output of thermal power greatly by adjusting the output of hydropower generation.

(2) Future prediction of demand and supply balance

In 2025, demand is expected to double. Assuming that the amount of renewable energy facilities totals 25 GW (mainly solar increases), which is about five times' the current amount, the supply and demand situation is assumed to be as follows.

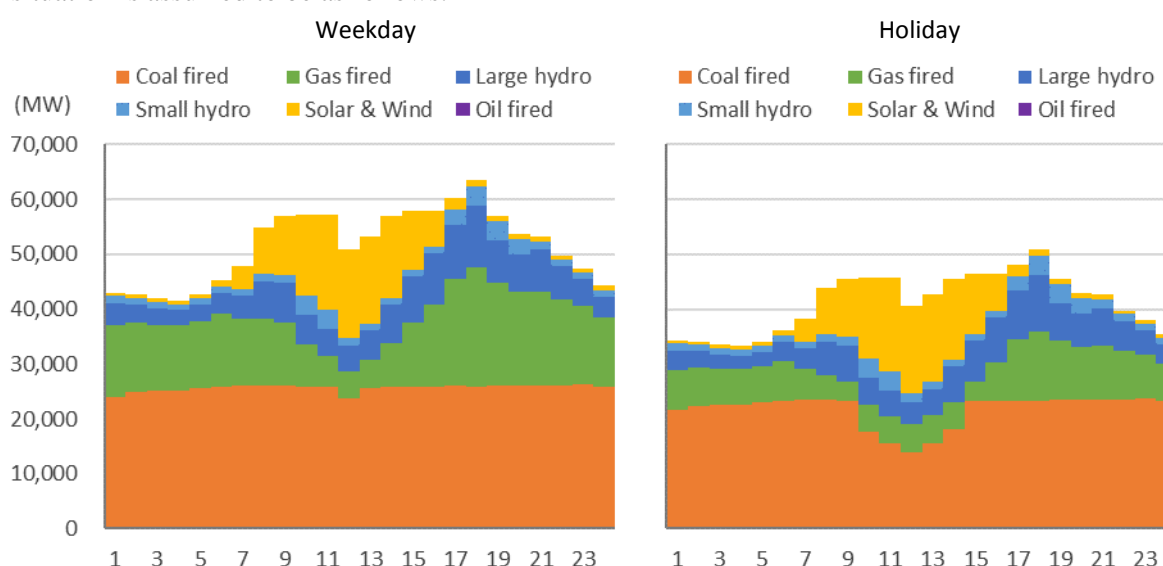


Figure 6-4 Prediction of Demand and Supply Balance around 2025

Especially on holidays, when demand decreases, renewable energy will supply more than 40% of demand, and thermal power will be forced to significantly reduce output. Even in such a situation, if all thermal power is procured from the market, renewable energy output will not be curtailed. However, if the purchase of a certain amount from thermal power is promised with PPA, the output of thermal power cannot be reduced, and the output of renewable energy should be curtailed. If there are power storage facilities in such a situation, it becomes possible to avoid the curtailment of renewable energy output. If the rate of renewable energy increases steadily after 2025, a more serious situation will occur.

(3) Response by Vietnamese Power Sector

The revised PDP7 (March 2016) plans to develop Bac Ai PSPP (1,200MW) in 2023 and 2025 (600MW for each year). (Other plans involve developing Dong Phu Yen PSPP (900MW) and Dong Duong PSPP (300MW) by 2030.)

The Vietnamese government has a policy of entrusting all of the PSPPs to the private sector because they are power generation plants. However, in the current situation, where no ancillary service market or capacity market have been established, it is difficult to secure a stable income even if private entities carry out development, so the possibility of development by private entities is extremely low.

According to the person in charge at IE, both storage batteries and PSPP will be introduced as power storage facilities in PDP8.

(4) Response by each Donor

For installation of storage batteries, ADB is implementing technical assistance for EVN from 2018 to 2021 as part of its capacity building in the renewable energy field. The optimal storage battery capacity for frequency adjustment is under consideration, and the results (region/capacity) will be announced early 2021.

For PSPP, WB conducted a survey on the necessity of PSPP in Vietnam in 2017. (Large-scale introduction of renewable energy is not being considered, and it was concluded that PSPP are not economical for peak supply capacity.)

European donors who want to sell their own products are likely to be interested. AFD, which has a track record in supporting hydropower development in Vietnam, may be interested. (However, AFD seems to be interested in development support for small and medium-sized hydropower.)

6.2.3 Renewable Energy Output Predictions

The market operator (NLDC) predicts the day ahead power demand, determines the operation output of each power generation plant by bidding so as to match the predicted value, and notifies each power generation plant of the operation schedule. At that time, renewable energy is not subject to market participation, so its supply capacity is deducted in advance at the power demand prediction stage.

At present, the share of renewable energy power plants is not very large, so even if a major mistake is made in the prediction of renewable energy supply capacity there will be no significant change in the operating output of other power generation plants. However, if the share of renewable energy power plants increases in the future and the supply capacity prediction is wrong, it will be necessary to drastically change the operating output of other power generation plants on the same day. As a result, there is a concern that it will not be possible to maintain economic operation, causing large losses.

For renewable energy output predictions, ADB is providing technical support to EVN from 2018 to 2021 as part of its capacity building in the renewable energy field.

In Danish-Vietnamese Energy Partnership Programme Phase II (DEPP II, 2017-2020) with the cooperation of the DEA and the MOIT, Energinet, a Danish transmission system operator (TSO), are providing support for the development of renewable energy output forecasting algorithms.

6.2.4 Power Flow Control

In the current situation, as described, 110kV transmission lines in the area where PV power plants are concentrated frequently cause overloads, because the generation output from each PV power plant is superimposed on the transmission lines. In order to relieve an overload, it is necessary to reduce the power output generated by the PV power plants. The EMS in NLDC sends output reduction signals to the PV power plants and the PV power plants reduce the generation output according to the signals received.

The current congestion is limited to 110kV transmission lines, but it is feared that it will occur in the 220kV transmission lines in the near future. If the 220kV transmission line enhancement is delayed, similar control action may be required.

In this power generation curtailment control, the reduced generation amount for each generator can be easily calculated in the case of a transmission line that is operated radially, like a 110 kV system. But in

the case of the 220 kV looped system, calculation of the generation reduction amount allocated for each PV power plant becomes complicated, and if the actual output distribution for each power plant changes, the distribution of the generation reduction amount for each power plant also changes from hour to hour. In addition, renewable energy power plants are concentrated in the southern area, and in order to control these and eliminate transmission line congestion, the output of hydropower and thermal power plants has been increased to cover the reduced power generation. This is viable if thermal power plants in the south have sufficient capacity, but when adjusting output at hydro power plants located in the northern area, the tie lines between the north area and south area change suddenly, so system stability must be taken into consideration. In particular, power generation capacity in the southern area is not sufficient until 2025, so the tie line power flow increasing toward the south is a great concern.

6.2.5 Ensuring System Stability

When a system fault occurs in the vicinity of a transmission system connected to renewable energy power plants, the voltage at the power station connection point drops significantly, the power conditioner (PCS) is temporarily blocked, and power generation stops. After this, when the system fault is removed and the voltage is restored, the PCS is restarted and power generation resumes.

PV power plants, which account for the majority of renewable energy, are concentrated in specific areas in the south. It is expected that the tie line power flow between the northern area and the southern area can fluctuate greatly when a fault occurs in the southern area during the daytime, and a power swing caused by the sudden tie line power flow change may appear.

In Vietnam, the impact on system transient stability has not been studied yet but will be studied in the future with technical assistance from the US or Denmark. However, the study conditions are set for a time when a generator with the maximum unit capacity (about 1,000MW) is tripped.

NLDC assumes that the output fluctuation of renewable energy will not exceed 1,000MW. However, if solar power plants concentrated in Ninh Thuan Province and Binh Thuan Province are shut down all together due to a voltage drop in the event of a nearby 500kV transmission line accident, a massive drop of 1,000MW or more could occur.

Compared to European and American power systems, Vietnamese systems have similar characteristics to Japanese power systems, so there seems to be room for technical support that will be beneficial to Vietnam.

6.2.6 Other Issues

(1) System operation method

NLDC has vague anxieties because it has no experience of how to operate the grid when the renewable energy amount increases to 20-30% in future. NLDC has requested technical support to gain an understanding of how the future grid operation will change, identify points for improvement and make plans for countermeasures.

(2) Reflection in grid connection conditions

In order to prevent renewable energy from adversely affecting the grid, it is necessary to newly establish several grid connection conditions, which are currently being studied by ERAV. For this reason, ERAV has requested that technical assistance be provided for battery system specifications and grid connection requirements.

Specifically, in assistance for battery systems, a pilot project has been demonstrated with ADB support, but the battery specifications have not been decided. Assistance concerning battery specifications is highly recommended. With regard to support for the development and revision of grid connection conditions, since the operators of renewable power plants, which fluctuate greatly, have no knowledge

of how to estimate generation output based on the weather forecast, ERAV is considering stipulating in the Grid Code that renewable power plants must have generation estimating abilities. This idea is not included in the Danish support. In addition, PV and wind power plants are expected to be remotely controlled to a greater extent in the future, but since security rules have not yet been established, technical assistance on security issues has also been requested.

(3) Optimal power supply composition for renewable energy

Recently, the power supply composition of Vietnam has been studied by European consultants, such as a group from Poland. However, according to their report, the renewable energy ratio is very high, and the thermal power ratio is extremely low. For system stability measures, the introduction of small-scale engine generators that use gas or oil as fuel was proposed. Small engines are said to be suitable for compensating for fluctuations in renewable energy because of their high reaction speed.

However, in the study conducted by IE, a conventional power source is required, so it is difficult to determine which is correct.

6.3 Issues in introducing the Principle of Competition

(1) Introduction of electricity market

EVN has historically been responsible for most of the electric power sector in Vietnam. However, in 2005, the Vietnamese government introduced the principle of competition to the power sector and has been pursuing power sector reforms with the aim of stabilizing low electricity tariffs. Already, competition in the power sector has been introduced via the Competitive Generation Market (VCGM), and the trial operation of the Wholesale Electricity Market (VWEM) began in 2016, allowing power companies to supply power through direct contracts with distribution companies and large customers. However, the introduction of VWEM is behind schedule, and it is expected that it will take some time to realize its full-scale introduction and active operation.

The introduction of the electricity market is discussed in TWG 3 of VEPG, and the support status of each donor is as shown in Table 3-32. In particular, ADB is assisting ERAV and EVN in designing electricity market systems.

(2) Procurement of renewable energies

When procuring renewable energies, they are initially being purchased at a higher price (FIT) than the market price. However, in the future, the principle of competition will be introduced with the intention of procuring through an auction system.

ADB and WB provide support for the EREA on solar auctioning; WB assists in the design of the auction scheme and ADB assists in the demonstration of auctioning. With regard to the auction mechanism for wind power projects, GIZ published a research report in July 2018. The report recommends that the transition from FIT to auction mechanism for wind power projects should not be implemented immediately but should be carried out after the business environment is improved. According to the report, the introduction of the auction is expected to begin after 2021, when the current FIT system expires, and a demonstration at a specific site is required for the preparations. Financial support from international donors is needed before the bidding system can be fully implemented.

Chapter 7. Recommendations regarding Direction of Japan's Cooperation in Power Sector

7.1 Direction of Assistance

Based on the issues shown in Chapter 4, the direction of assistance is summarized as follows.

Table 7-1 Direction of Assistance

Issues			Direction of assistance
Demand/supply balance in the overall system	Concerns about power shortages	→	Construction of large-scale power plants
		→	DSM to reduce peak demand
	Securing a balance between supply and demand	→	Payment for frequency-adjusted operation
	Insufficient frequency adjustment capacity	→	Creation of an ancillary service market that trades frequency adjustment functions in the market
Expansion of renewable energy	Curtailment of generation output from SPPs due to insufficient transmission capacity	→	Construction of new transmission and substation facilities (for the time being, in the future)
		→	Installation of batteries
	Output curtailment of RE due to the balance between supply and demand in the overall system	→	Construction of PSPP (adjustable speed-type)
	RE output predictions	→	Introduction of RE output prediction system
	Power flow control	→	Technical assistance on NLDC
	Ensuring system stability	→	Introduction of system stabilization equipment
	System operation method	→	
	Reflection in grid connection conditions	→	Review of Grid Code
	Optimal power supply composition for RE	→	Study on optimal power supply composition for RE
Introducing competition	Introduction of electricity market	→	Design of electricity market
	Procurement of RE	→	Design of auction system

Among these areas of assistance, the following two items are excluded from JICA's support.

Construction of large-scale power plants

The Vietnamese government basically entrusts the construction of new thermal power plants to the private sector. JBIC can provide assistance in this area, but JICA is unlikely to provide assistance.

Design of electricity market

ADB has provided support for the design of the Vietnam Wholesale Electricity Market (VWEM), and started trial operation of the VWEM in 2016. It intends to provide support for the institutional design of the ancillary service market and capacity market, but this can be implemented with technical assistance for NLDC.

7.2 Proposal of Assistance Plans

(1) Assistance plan 1: Construction of transmission and substation facilities to eliminate present transmission congestion

JICA will provide support for projects that the EVN Planning Department has proposed to the MOIT with a list of projects that should be implemented urgently and that have been approved by the Prime Minister (No. 1891 / TTg-CN: December 27, 2018).

Considering the necessity and urgency, the priority is very high, but the Vietnamese side has already studied the measures, and has a policy of implementing the projects using its own funds, together with borrowing from commercial banks. Therefore, there is little possibility of JICA assistance unless the time required for the loan process is significantly reduced. However, it is considered possible to refinance the borrowings from commercial banks with JICA funds at a later date.

(2) Assistance plan 2: Install storage batteries to eliminate present transmission congestion

Storage batteries will be installed in substations as an emergency measure to avoid the curtailment of renewable energy output due to transmission line congestion. Installation of storage batteries is an effective way of solving issues at an early stage because it has a shorter lead time, from decision-making to the start of operations, than construction of a transmission line. Therefore, it has a high priority in terms of its necessity and urgency.

However, measures to reinforce transmission lines have already been considered, and it is expected that output curtailment will be avoided around 2021. Furthermore, since the cost of storage batteries is high, there is a high possibility that the Vietnam side will be cautious about borrowing in terms of cost effectiveness, so the priority is “Low” considering Vietnam's intentions. (Approximately 15 billion yen and a site of approximately 20,000 m² is required for a 100MW x 4 hour storage battery.)

As a specific target, it is assumed that the proposal to install these in NPT substations will be an effective measure. If suppression of renewable energy output can be avoided, this will contribute to the reduction of greenhouse gas (CO₂) emissions.

In addition, if the control system is designed so that the storage batteries installed for emergency measures can also be used for supply and demand adjustment, they can be used continuously for supply and demand adjustment in the overall system, even after the completion of transmission and substation facilities constructed for the purpose of mitigating transmission line congestion.

(3) Assistance plan 3: Construction of transmission and substation facilities to eliminate future transmission congestion

It is expected that solar and wind power will continue to be installed in the future. There is a possibility that curtailment of renewable energy output will become necessary due to a shortage of transmission line capacity even in areas other than where output curtailment is currently occurring.

Assistance for the construction of additional transmission lines and substation facilities will be provided, with the aim of avoiding output curtailments in future due to transmission line capacity congestion that occurs due to large-scale renewable energy connections. The priority is “Very High” in terms of necessity, urgency, and Vietnamese intentions. Projects scheduled to start operations in 2021 are also included, and urgency is required. Therefore, lending via a method with a short procedural period will be effective, and direct lending to business entities (or EVN) is desired.

(4) Assistance plan 4: Construction of transmission and substation facilities in anticipation of mass introduction of solar power

As of December 2019, most of the solar power generation facilities are located in Binh Thuan and Ninh Thuan provinces, in the south of Vietnam (SPC's jurisdiction). Since this area has good sunshine conditions and there is a large amount of unutilized land, it is thought that the installation of solar power generation facilities will continue in the future. Since the power generated cannot be consumed in the region, it is necessary to transmit the surplus to Ho Chi Minh City, which is a neighboring large city.

In Binh Thuan and Ninh Thuan provinces, in addition to solar power generation facilities there are also plans to install an LNG-fired thermal power plant. A Japanese company is planning to participate in this. If power ends up being transmitted from not only the increasing amount of solar power generation facilities but also the LNG-fired thermal power plant, the transmission capacity between the Thuan Nam substation and Chon Thanh substation, currently undergoing an FS survey, will be insufficient. Therefore, a new project will be required. Considering this point, assistance will be provided for the construction of a 500kV transmission line connecting a new substation in Ninh Thuan Province (or Binh Thuan Province) and Binh Duong substation, located in the northeastern part of Ho Chi Minh City. (Distance: about 250km; support amount: about 25 billion yen.)

The priority is “Medium” because it is not particularly urgent. Since sufficient lead time can be secured before the start of construction, it would be possible to implement it with a conventional yen loan.

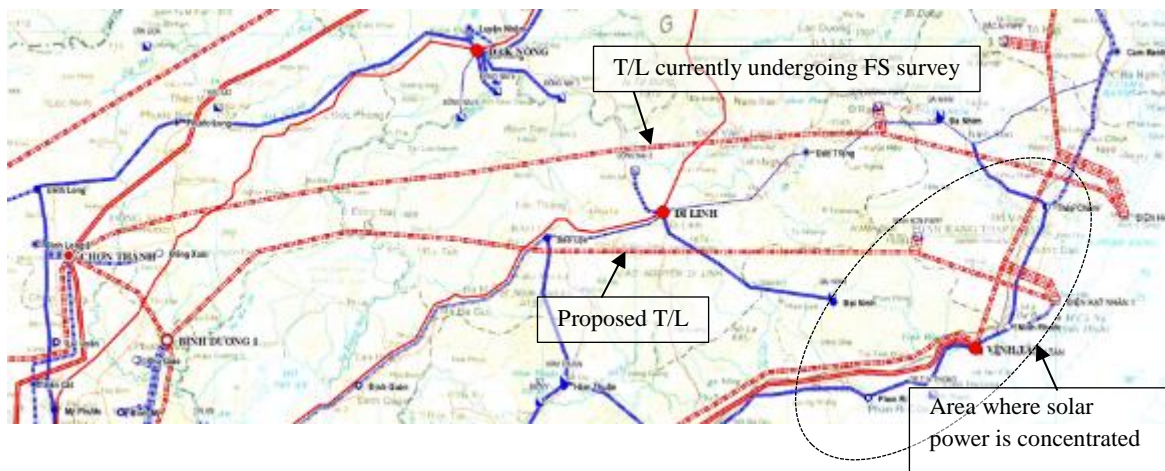


Figure 7-1 T/L in Anticipation of Large Amounts of Solar Power

(5) Assistance plan 5: Install storage batteries to balance supply and demand in the overall system

Assistance will be provided for the installation of storage batteries, with the aim of starting operation in 2025, to secure a balance between supply and demand in the overall system.

However, a lead time of about 2 years, from the decision on installation to the start of operations, will be sufficient. Therefore, there is no need to implement this at this time, so the priority is “Low”.

(6) Assistance plan 6: Development of PSPP

In the revised PDP7, development of renewable energy is actively promoted, and it is expected that the amount of renewable energy will increase in the future. According to the current outlook, around 2025, power storage facilities (pumped storage hydro or storage batteries) will be needed to absorb the surplus in the overall system’s supply capacity and avoid the curtailment of renewable energy output. A 2017 World Bank study concluded that the development of PSPP is not economical.¹² However, this conclusion was reached based only on their value as peak supply capacity, and it is considered to be the result of underestimating their value as power storage facilities.

With the introduction of large amounts of renewable energy, storage batteries are attracting attention as facilities that can absorb fluctuations in the output of renewable energy. Pumped storage power plants (PSPP), which have almost the same functions as storage batteries and a construction cost per

¹² A JICA “Preparatory Survey for Bac Ai Pumped Storage Power Plant Construction Project” conducted at about the same time concluded that it is economical considering the three functions: peak supply capacity, power storage function, and frequency adjustment function.

kWh of less than half that of storage batteries, have a significant cost advantage over storage batteries as power storage facilities. The input of a conventional PSPP machine (constant-speed type) is constant during pumping, and frequency adjustment functions cannot be expected to be provided. PSPP to be developed in the future will be pumped more to absorb excess power. In such a state, power generation equipment other than renewable energy is stopped or operated at the minimum output, so frequency adjustment functions cannot be expected to be provided. Considering this point, the construction costs are slightly higher, but the economic effects are expected to be higher if an adjustable speed machine that can perform frequency adjustment operations even during pumping is introduced.

Based on these points of view, assistance will be provided for the development of Bac Ai PSPP, for which an FS survey has already been undertaken.

For PSPP, a lead time of about 10 years (about 5 years for construction) is required, from decision making to the start of operations. Therefore, when using PSPP as a power storage facility, it is necessary to take action at the present time, so the priority is high considering the necessity and urgency. (If all units are adjustable speed machines, the total project cost will be about 130 billion yen. PSPP have not yet been introduced in Vietnam, so support from abroad will be effective. Adjustable speed machines are a technology that have a competitive advantage in Japan, and Japanese companies are likely to make a successful bid.)

Bac Ai PSPP will use the irrigation reservoir currently under construction as the lower reservoir in the current plan, so the plan may be changed depending on the progress of this irrigation reservoir construction. (There is information that EVN will construct some facilities for Bac Ai PSPP in advance in a place that will be submerged by the irrigation reservoir.)

(7) Assistance plan 7: Support for development of renewable energy output prediction system

A HimawariCast Reception System (resolution approximately 1km, data every 2.5-10 minutes) and a highly accurate weather forecasting system will be provided, together with assistance for the development of a system that predicts the supply capacity of various types of renewable energy (solar and wind power) based on the weather forecast. Specifically, NLDC engineers will accumulate data on the relationship between daily weather conditions and the supply capacity of renewable energies and analyze the accumulated big data. Using this big data, assistance is provided to develop a system that utilizes weather forecasts to forecast the supply capacity of renewable energies, based on Japanese know-how.

At present, the ratio of renewable energy is small, so the urgency is low. However, accumulating data from now on will help improve the prediction accuracy in the future, so the priority is “High”.

NLDC is interested in assistance for the development of this prediction system and has expressed a desire for it to be carried out it as JICA technical cooperation.

(8) Assistance plan 8: Study on measures to secure frequency adjustment capacity

If the ratio of renewable energy increases and the magnitude of fluctuations increases in the future, it will be difficult to secure the required amount for frequency adjustment using EVN's large-scale hydropower alone.

For this reason, technical cooperation for NLDC will be implemented to study measures to ensure the necessary frequency adjustment capability. In this study, assistance for institutional design of the ancillary service market will be implemented in order to procure suppliers of frequency adjustment capacity.

Although it is not a necessary area of support right now, the priority is “Medium” because of the possibility of insufficient frequency adjustment capacity around 2025.

(9) Assistance plan 9: Technical assistance for system operation methods when introducing large amounts of renewable energy

If the ratio of renewable energy facilities increases in the future, there is a high possibility that issues in the system operation that are not apparent now will occur. Possible issues are considered in order to ensure a balance between supply and demand in the overall system, which becomes more difficult to accomplish due to fluctuations in renewable energy output, with more frequency adjustment capacity being required.

At present, no major issues have occurred, so no specific countermeasures have been taken, but NLDC recognizes that there will be challenges in the future.

Technical support will be provided to NLDC regarding the system operation methods needed for the mass introduction of renewable energy. NLDC has expressed its intention to learn about the Japanese methods that have already been implemented regarding this.

(10) Assistance plan 10: Study on system stabilization measures

The solar power plants unevenly distributed in the south stop generation simultaneously due to a voltage drop caused by a nearby transmission line failure. Considering this phenomenon, assistance will be provided to study transient changes in the north-south interconnection power flow and the impact on system stability.

If instability phenomena are expected to occur as a result, assistance on the design and installation of system stabilization equipment will also be implemented.

This is not urgent, but it is an issue that may appear in the near future. By proceeding with a study at an early stage and identifying the necessity of introducing system stabilizing equipment, it is assumed that this will work advantageously in aiding the introduction of the equipment in the future. Therefore, the priority is “Medium”.

<Special Protection Scheme (SPS)>

In terms of issues caused by the installation of a large amount of renewable energy, the following system phenomena, caused by simultaneous temporary trips of renewable generators due to a voltage drop following a fault in transmission, are expected:

- Frequency drop due to generation shortage
- Under Voltage due to loss of voltage maintaining generators
- Overloading of transformer and transmission line due to sudden power flow change

Since PV generators have no inertia or synchronism force, the power system will have increased potential for frequency fluctuation and transient instability with the expansion of renewable energy.

In order to prevent a widespread blackout, several kinds of countermeasures are required in response to the phenomena and general countermeasures shown in the figure are conducted.

Countermeasures in green are called a Remedial Action System (RAS) and TEPCO has great experience in RAS. Toshiba, Hitachi and Mitsubishi have actual installation experience of several RASs.

Recently, Phasor Measurement Units (PMU) that can measure busbar voltage magnitudes and phase angles, as well as transmission line currents with time synchronization via GPS signals, have been installed at substations. Based on these electrical quantity measurement data and network operation statuses captured through the SCADA system, SPS can simulate cascading failure modes in advance. Therefore, the SPS can send predetermined stabilizing control signals to designated control equipment if an expected failure is triggered, thus preventing a cascading failure.

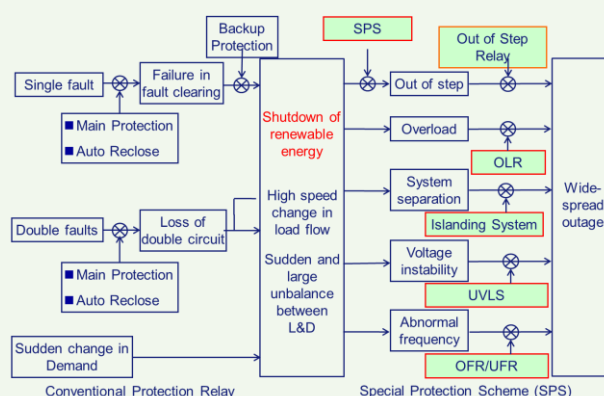


Figure 7-2 Conceptual Diagram of SPS

(11) Assistance plan 11: Study on optimum renewable energy introduction amount

Recently, the power supply composition of Vietnam has been studied by European consultants, such as a group from Poland. However, according to their report, the renewable energy ratio is very high, and the thermal power ratio is extremely low. For system stability measures, the introduction of small-scale engine generators that use gas or oil as fuel was proposed. Small engines are said to be suitable for compensating for fluctuations in renewable energy because of their high reaction speed.

However, in the study conducted by IE, a conventional power source is required, so it is difficult to determine which is correct.

Because the validity of the study conducted by the European consultant could not be evaluated, there was a request from the EREA staff (Mr. Hoang Tung, Planning Dept.) for assistance from JICA.

Assistance will be provided for a study on the optimum amount of renewable energy introduction. Securing stable operation measures (supply reserve capacity, frequency adjustment capacity, risk response capacity, power storage capacity, etc.) will be focused on in particular for when the mass introduction of renewable energy is realized, and a cost analysis, including power storage systems, will be carried out.

The need for a study is not particularly high, but the EREA staff wants to reflect its results in PDP8, so it is necessary to implement it urgently. Therefore, the priority is “Medium”.

(12) Assistance plan 12: Review of grid code

There are network security issues when remotely controlling unmanned power plants, which are expected to increase further in the future. In addition, system connection requirements for the large-scale introduction of storage batteries are ambiguous.

Currently, Denmark is assisting in the revision of the grid code, and ADB is assisting in the study on battery operation. ERAV Deputy Director (Mr. Tran The Quang) requested JICA assistance for “Security technology for power control networks” and “Specifications of storage batteries,” which are not included in the scope of the current grid code revision work or storage battery operation study. Assistance will be provided in these areas.

The priority is “Low” because it is assumed that no major issues have occurred at present.

(13) Assistance plan 13: Assistance for auction system

An auction system is currently being discussed in VEPG's TWG 1 to provide a new renewable energy purchase system. For solar power, WB has already provided assistance for specific institutional design. For wind power, ADB is assisting EREA and is preparing documents for a demonstration. Taking these points into account, JICA will cooperate with ADB on the wind auction system and provide support in the determination and development of demonstration sites.

If power curtailment due to transmission capacity bottlenecks occurs at the demonstration sites it will be a big risk for investors. Therefore, it is necessary to construct transmission lines to avoid output curtailment due to transmission capacity bottlenecks, and to select and maintain sites where investors can make appropriate decisions.

(14) Assistance plan 14: Demand curtailment via Demand Side Management (DSM)

DSM can be considered as one means of solving power shortages in the future. Since technical cooperation on DSM has already been implemented by many donors, assisting in the area of smart cities by narrowing down the target cities is considered effective.

7.3 Priority Evaluation for each Assistance Plan

(1) Priority evaluation indexes for JICA assistance plans

For the JICA assistance plans shown above, each plan is evaluated using the following indexes in a multifaceted manner and given a score, and the priority order is determined according to the highest score. In doing so, the three items of urgency, necessity and Vietnam's intentions are particularly important factors in deciding the priority of assistance plans, and evaluation of these three items is emphasized.

(a) Urgency (Weight: 3)

When an issue has already occurred and has had a bad impact, it is necessary to solve the issue at an early stage by urgently dealing with it. The urgency is high in this case. In addition, support measures that will not arrive in time if measures are not taken now for issues that will surely occur in future are judged to be highly urgent.

(b) Necessity (Weight: 3)

This is an index that measures the magnitude of the need to solve issues, and assistance plans that are greatly effective in solving issues are highly evaluated.

(c) Vietnam's intentions (Weight: 3)

This is an index that measures whether an endeavor is consistent with Vietnamese policy. If there is a strong request from Vietnam (MOIT or EVN), the evaluation is also high.

(d) Applicability of Japanese experience (Weight: 2)

This is an index that evaluates whether there is any Japanese experience or technology that can be used to implement the assistance plans. In addition, the evaluation of this index is judged to be high when benefits to Japanese companies can be expected by implementing the assistance plans.

(e) Cooperation with other Donors (Weight: 1)

This is an index that measures whether there is a possibility of involving other donors. In particular, based on the support activities of other donors so far, the evaluation is based on the presence of other donors who are interested in assistance plans.

(f) Impact on environment (Weight: 1)

This is an index for evaluating the impact on the surrounding environment and the global environment. In particular, if the curtailment of renewable energy output can be avoided, CO₂ reduction effects can be expected, so the evaluation is high.

Table 7-2 Priority Evaluation Indexes for each Assistance Plan

Indicator	Weight	Meaning of index
Urgency	3	Index that evaluates the urgency of the assistance plans
Necessity	3	Index that measures the magnitude of the need to solve issues
Vietnam's intentions	3	Index that measures whether it is consistent with Vietnamese policy
Applicability of Japanese experience	2	Index that evaluates whether there is any applicable Japanese experience or technology
Cooperation with other Donors	1	Index that measures whether there is a possibility of involving other donors
Impact on environment	1	Index for evaluating the impact on the surrounding environment and the global environment

(2) Priority evaluation for JICA assistance plans

The evaluation results based on the 6 index items, each with a maximum score of 5, are shown below. A higher score indicates a higher rating for that indicator, meaning that the priority of assistance plans with a high overall score is high.

Table 7-3 Priority Evaluation Results for each Assistance Plan

No.	Weight	Urgency	Necessity	Vietnam's intentions	Japanese experience	Cooperation with other Donors	Environmental impact	Total	Priority
		3	3	3	2	1	1		
1	Construction of T/Ls to eliminate present transmission congestion ¹³	5	5	0	1	5	4	41	--
2	Installation of batteries to eliminate present transmission congestion	5	3	1	4	2	4	41	Low
3	Construction of T/Ls to eliminate future transmission congestion ¹³	5	5	5	1	4	4	55	High
4	Construction of T/Ls in anticipation of mass introduction of solar power ¹³	3	4	4	3	4	4	47	Medium
5	Installation of batteries to balance supply and demand in the overall system	0	5	4	4	4	4	43	Low
6	Development of PSPP	4	5	4	5	4	4	57	High
7	Support for development of renewable energy output prediction system	3	4	4	5	4	4	51	High
8	Study on measures to secure frequency adjustment capacity	3	4	4	5	2	2	47	Medium
9	Technical assistance for system operation methods	3	4	4	5	2	2	47	Medium
10	Study on system stabilization measures	3	4	3	5	3	2	45	Medium
11	Study on optimum renewable energy introduction amount	4	3	4	4	2	3	46	Medium
12	Review of grid code	3	3	4	3	4	2	42	Low
13	Auction system for wind power	3	3	4	2	4	4	42	Low
14	Demand curtailment via DSM	2	3	3	4	4	4	40	Low

¹³ Regarding the Transmission lines construction project, it will have a negative impact on the surrounding environment, but by strengthening the transmission line, the transmission bottleneck will be eliminated and it will be possible to avoid curtailment the output of solar power generation. In order to contribute to the reduction of CO₂ emissions, the score for environmental impact is high.

7.4 Method for proceeding with each Assistance Plan

The following shows how to proceed with the projects that are “High” or “Medium” in the evaluation of the above assistance plans.

7.4.1 Construction of Transmission and Substation Facilities for eliminating Future Transmission Congestion (Assistance plan 3)

The purpose of these projects is to avoid output curtailment due to transmission line congestion that will occur in the future caused by large-scale renewable energy connections. Therefore, these projects should be prioritized considering their necessity and urgency, and the intentions of the Vietnamese side. Projects scheduled to start operations in 2021 are also included, and urgency is required. Therefore, lending via a method with a short procedural period would be effective, and direct lending to business entities (or EVN) is desired.

7.4.2 Construction of Transmission and Substation Facilities in Anticipation of mass Introduction of Solar Power (Assistance plan 4)

Construction of a 500kV transmission line (distance: about 250km; total construction cost: 35 to 40 billion yen) connecting Ninh Thuan province (or Binh Thuan province) and Binh Duong substation, located in northeast Ho Chi Minh City, does not need to be implemented urgently. For this reason, it is possible to secure a sufficient lead time before the start of the construction, enabling the use of a conventional ODA loan.

However, when using this project’s transmission line to transmit LNG thermal power to be developed in the Ca Na area of Ninh Thuan Province, it is necessary for it to be consistent with the start of LNG thermal power operations (currently 2025).

The future schedule is shown below. If the start of LNG thermal power operations (2025 in the current plan) is as planned, it will be necessary to shorten processes such as FS surveys, conclusion of loan agreements, and contractor selection.

Table 7-4 Implementation Schedule (New 500kV T/L)

Items	2021	2022	2023	2024	2025	2026	2027	2028	Remarks
FS survey		■							By PMB
Review of FS			■						By JICA team
Loan agreement			■						
Selection of contractor				■					
Construction work					■	■	■		

7.4.3 Development of PSPP (Assistance plan 6)

For Bac Ai PSPP, an FS survey has already been conducted. However, with regard to the number of adjustable speed units to be introduced, the FS review report recommends an all (four) units plan, but a final decision has not yet been reached. In addition, the surrounding 500kV transmission plan has been changed, so it is necessary to review the transmission plan. The main purpose of this PSPP development is as a power storage facility in anticipation of the large-scale introduction of renewable energy, and the same functions as storage batteries are required. Therefore, it is considered effective to introduce adjustable speed machines that can adjust not only output but also input during operation. In the future, when JICA provides support, assuming the introduction of all-unit adjustable speed machines, it will be necessary to check the necessity of adjustable speed machines and review the construction costs and construction schedule, including those for transmission line construction.

Sovereign loans were presupposed at the time of the FS survey, but approval of the Diet was required depending on the size of the loan, and the Ministry of Finance was concerned about an increase in national debt. Therefore, it is desirable to lend directly to EVN.

The future schedule is shown below.

Table 7-5 Implementation Schedule (PSPP)

Items	2021	2022	2023	2024	2025	2026	2027	2028	Remarks
Review of FS	■								TC by JICA
Loan agreement		■							
Detailed design		■	■						
Selection of contractor			■	■					
Preparatory work			■	■					
Construction work					■	■	■	■	#1 unit, 2028

7.4.4 Technical Assistance related to System Operation (Assistance plans 7 - 10)

The following four plans are all technical assistance, mainly for NLDC engineers. Therefore, it is possible to combine these assistance plans into one technical cooperation project.

- Support for development of renewable energy output prediction system (Assistance plan 7)
- Study on measures to secure frequency adjustment capacity (Assistance plan 8)
- Technical assistance for system operation methods when introducing large amounts of renewable energy (Assistance plan 9)
- Study on system stabilization measures (Assistance plan 10)

Table 7-6 Implementation Schedule (related to system operation)

Implementation items	2020	2021	2022	2023	2024	Remarks
Issue of request form	▲					Vietnam => Japan
RE output prediction system						Approx. 14MM
Introduction of weather forecasting			■			
Relation btwn weather and RE output			■			
Monitoring (data accumulation)			■	■	■	By Vietnamese
Support for system development				■	■	
Frequency adjustment capacity						Approx. 14MM
Study on necessary amount			■			
Study on ancillary services market			■	■		
TC for system operation methods			■			Approx. 6MM
System stabilization measures						
Study on necessity			■			Approx. 6MM
Introduction of equipment				■	■	Another project

Specifically, the necessary specialist assignments are “Demand & supply operation”, “System operation”, “System control”, and “Weather forecasting”, and a total of about 40MM is required. In addition, the purchase of weather satellite images may be necessary. When system stabilizing equipment is introduced, an additional investment of several billion yen will be required depending on the specifications of the equipment.

7.4.5 Study on Optimum Renewable Energy Introduction Amount (Assistance plan 11)

IE is currently studying the future introduction amount for renewable energy in the formulation of PDP8. However, it is not only considering renewable energy, but also an introduction plan for all power generation facilities. In studying various power supply configurations, it is necessary to evaluate factors such as economic efficiency, environmental performance, and energy security, but the optimum configuration differs depending on which factors are emphasized. IE says that it is "least cost planning", and that the study is being conducted with a focus on economic efficiency.

Based on this perspective, a study focused on securing stable operation measures (supply reserve capacity, frequency adjustment capacity, response capacity for various risks, power storage capacity, etc.) for the mass introduction of renewable energy will be implemented. After that, the costs, including those for the power storage system, will be analyzed.

Because the request for this study came from the EREA staff, it will be implemented as a technical cooperation project for EREA. The implementation period is about half a year, and the necessary specialist assignments are "Power development planning", "System planning", and "Demand & supply operation". About 8MM is necessary overall. The EREA staff wants to reflect the study results in PDP8, so in order to conduct the study in time before formulating PDP8, it may be implemented by extending the contract for this data collection survey.

7.5 Action Plan

The following is an action plan that JICA should implement in order to make each of the above assistance plans a JICA assistance project.

Table 7-7 Action Plan for each Assistance Plan

	Project name (tentative)	Estimated assistance (Yen)	Organizations	Action plans
0	Enhancement of transmission and substation facilities in Ninh Thuan and Binh Thuan Province	Unknown	EVN NPT	Understand the current situation (progress of F/S, funding, etc.) and explore the possibilities for JICA assistance.
1-1	Enhancement of transmission and substation facilities surrounding Hochiminh city	F/S review 150 million	EVN NPT	Conduct F/S review as JICA TC for F/S underway by PMB (construction schedule, construction costs, environmental impact assessment, etc.)
1-2	Distribution network development in Central Vietnam	F/S 100 million	EVN CPC	Conduct F/S for specific projects in consultation with CPC (outline of construction work, schedule, construction cost estimation, environmental impact assessment, etc.)
1-3	Distribution network development in Southern Vietnam	F/S 100 million	EVN SPC	Conduct F/S for specific projects in consultation with SPC (outline of construction work, schedule, construction cost estimation, environmental impact assessment, etc.)
2	Enhancement of 500kV transmission line from Ninh Thuan to Hochiminh city	F/S 250 million Loan 25.0 billion	EVN NPT	Conduct F/S as JICA TC in consultation with NPT (employ PMB as local consultant)
3	Construction of adjustable-speed type PSPP	F/S review 60 million	EVN	Consult with EVN to confirm loan needs After that, review the F/S survey (necessity of adjustable speed machines, construction schedule, construction costs, transmission plan, etc.)
4	Capacity enhancement in system operation	TC 150 million	EVN NLDC	Be received request form from Vietnamese Government
5	Technical assistance for national power development plan	TC 30 million	EREA	If it is necessary to reflect the results in the study on PDP8, this will be implemented by extending the contract for this project. If there is no urgent need, the request form will be received from EREA in the request survey in August 2021.

Note: The estimated amount of assistance for the loan is calculated at 70% of the total project cost.

Chapter 8. Reference Data

Table 8-1 Issues related to Renewable Energy Development and JICA's Assistance Plans

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
1	<p>Considering that FIT (Feed-in Tariff) applications for solar power generation plants expired at the end of June 2019 (a 2-year extension has been decided), developers rapidly developed solar power generation plants by the end of June 2019.</p> <p>A study on transmission capacity is included in the document submitted at the time of construction approval for each power generation plant. However, these are studies only for each project, and if many plants are installed in the same area it becomes impossible to transmit all the power generated by the plants. Therefore, curtailing of output from solar power plants due to insufficient transmission capacity frequently occurs.</p> <p>Output curtailment occurs mainly in Binh Thuan Province (24 sites: 992MW) and Ninh Thuan Province (18 sites: 1,271MW) in the south (SPC jurisdiction), where solar power installation is concentrated. (In addition, although of a small amount, it also occurs in An Giang Province.)</p>	<p><Vietnam></p> <p>In order to respond to this situation, the EVN Planning Department created a list of projects that should be implemented urgently, proposed it to MOIT, and obtained approval from the Prime Minister (No. 1891/TTg-CN: December 27, 2018). These projects are currently undergoing preparations for construction. An outline of the projects is shown below. It includes 4 projects with an accelerated schedule proposed in the revised PDP7, and 11 new projects.</p> <p>Among the new projects, KfW has been commissioned to construct a 500kV Thuan Nam substation to be newly constructed in Ninh Thuan Province and a 500kV transmission line between Thuan Nam substation and Chon Thanh substation (350km).</p> <p>In addition, for 110kV transmission lines, where the output of solar power is curtailed due to insufficient transmission capacity, SPC has formulated a strengthening plan such as thickening the transmission line, and as of December 2020, some construction has already been completed. Although the situation of output curtailment has improved since December 2019, solar power curtailment is still occurring due to insufficient transmission capacity.</p> <p><Donor></p> <p>KfW has expressed interest in a system enhancement project that underpins massive renewable energy connections, including the provision of non-sovereign loans.</p>	<p>Considering the necessity and urgency, the priority is very high, but the Vietnamese side has already studied the measures, and has a policy of implementing the projects using its own funds, together with borrowing from commercial banks. Therefore, there is little possibility of JICA assistance.</p> <p>(If JICA's financial assistance is on time, the possibility of assistance is high.)</p>	--

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
2	Same as above	<p><Vietnam> Urgent installation of storage batteries is not being considered in order to avoid the curtailment of renewable energy output due to transmission line congestion.</p> <p><Donor> In an interview with GIZ, they said that a study was necessary for measures to combat system congestion (including the installation of storage batteries) by expanding the introduction of renewable energy. GIZ is the secretary of VEPG's TWG1 (a group that discusses renewable energy-related cooperation) and may encourage implementation in this area. In addition, ADB, WB, etc. have also made remarks regarding similar interests (mainly TA).</p>	<p>Storage batteries will be installed in substations as an emergency measure to avoid the curtailment of renewable energy output due to transmission line congestion. Installation of storage batteries is an effective way of solving issues at an early stage because it has a shorter lead time, from decision-making to the start of operations, than construction of a transmission line. Therefore, it has a high priority in terms of its necessity and urgency. However, measures to reinforce transmission lines have already been considered, and it is expected that output curtailment will be avoided around 2021. Furthermore, since the cost of storage batteries is high, there is a high possibility that the Vietnam side will be cautious about borrowing in terms of cost effectiveness, so the priority is "Low" considering Vietnam's intentions. (Approximately 15 billion yen and a site of approximately 20,000 m² is required for a 100MW x 4 hour storage battery.) As a specific target, it is assumed that the proposal to install these in NPT substations will be an effective measure. If suppression of renewable energy output can be avoided, this will contribute to the reduction of greenhouse gas (CO₂) emissions. In addition, if the control system is designed so that the storage batteries installed for emergency measures can also be used for supply and demand adjustment, they can be used continuously for supply and demand adjustment in the overall system, even after the completion of transmission and substation facilities constructed for the purpose of mitigating transmission line congestion.</p>	Low

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
3	<p>It is expected that solar and wind power will continue to be installed in the future. There is a possibility that curtailment of renewable energy output will become necessary due to a shortage of transmission line capacity even in areas other than where output curtailment is currently occurring.</p>	<p><Vietnam> NPT has created a project list based on the revised PDP7. <Donor> KfW has expressed interest in a system enhancement project that underpins massive renewable energy connections, including the provision of non-sovereign loans. In addition, ADB and AFD, which provide support for the construction of 500kV transmission lines, may be interested in financing in this area.</p>	<p>Assistance for the construction of additional transmission lines and substation facilities will be provided, with the aim of avoiding output curtailments in future due to transmission line capacity congestion that occurs due to large-scale renewable energy connections. The priority is very "High" in terms of necessity, urgency, and Vietnamese intentions. Projects scheduled to start operations in 2021 are also included, and urgency is required. Therefore, lending via a method with a short procedural period will be effective, and direct lending to business entities (or EVN) is desired.</p>	High

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
4	<p>As of December 2019, most of the solar power generation facilities are located in Binh Thuan and Ninh Thuan provinces, in the south of Vietnam (SPC's jurisdiction). Since this area has good sunshine conditions and there is a large amount of unutilized land, it is thought that the installation of solar power generation facilities will continue in the future. Since the power generated cannot be consumed in the region, it is necessary to transmit the surplus to Ho Chi Minh City, which is a neighboring large city.</p>	<p><Vietnam> NPT is planning to construct a 500kV transmission line between the newly constructed Thuan Nam substation in Ninh Thuan Province and the Chon Thanh substation, located in the north of Ho Chi Minh City (350km). NPT is currently conducting an FS survey and has requested KfW to provide assistance.</p> <p><Donor> ADB, KfW and AFD, which provide support for the construction of 500kV transmission lines, may be interested in financing in this area.</p>	<p>In Binh Thuan and Ninh Thuan provinces, in addition to solar power generation facilities there are also plans to install an LNG-fired thermal power plant. A Japanese company is planning to participate in this. If power ends up being transmitted from not only the increasing amount of solar power generation facilities but also the LNG-fired thermal power plant, the transmission capacity between the Thuan Nam substation and Chon Thanh substation, currently undergoing an FS survey, will be insufficient. Therefore, a new project will be required. Considering this point, assistance will be provided for the construction of a 500kV transmission line connecting a new substation in Ninh Thuan Province (or Binh Thuan Province) and Binh Duong substation, located in the northeastern part of Ho Chi Minh City. (Distance: about 250km; support amount: about 25 billion yen.)</p> <p>The priority is "Medium" because it is not particularly urgent. Since sufficient lead time can be secured before the start of construction, it would be possible to implement it with a conventional yen loan.</p> <p>In addition, a Japanese company is planning to participate in the LNG thermal power plant to be built in Ninh Thuan province.</p>	Medium

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
5	At present, there is curtailment in the output of renewable energy due to transmission line congestion, but there is no output curtailment due to the balance of supply and demand in the overall system. However, if renewable energy is developed steadily in the future, it is assumed that around 2025-2030, curtailment in renewable energy output due to the supply-demand balance in the overall system will occur. Therefore, there is a high possibility that installation of power storage facilities for supply and demand adjustment (storage batteries, adjustable speed pumped storage power plants (PSPP)) will become inevitable.	<p><Vietnam> In the revised PDP7 (March 2016), there is no description of storage batteries, but IE has a policy of proposing the installation of storage batteries and the development of PSPP as power storage facilities in PDP8.</p> <p><Donor> For installation of storage batteries, ADB is implementing technical assistance for EVN from 2018 to 2021 as part of its capacity building in the renewable energy field. The optimal storage battery capacity for frequency adjustment is under consideration, and the results (region/capacity) will be announced early next year.</p>	<p>Assistance will be provided for the installation of storage batteries, with the aim of starting operation in 2025, to secure a balance between supply and demand in the overall system.</p> <p>However, a lead time of about 2 years, from the decision on installation to the start of operations, will be sufficient. Therefore, there is no need to implement this at this time, so the priority is "Low".</p>	Low

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
6	Same as above	<p><Vietnam> The revised PDP7 (March 2016) plans to develop Bac Ai PSPP (1,200MW) in 2023 and 2025 (600MW for each year). (Other plans involve developing Dong Phu Yen PSPP (900MW) and Dong Duong PSPP (300MW) by 2030.) The Vietnamese government has a policy of entrusting all of the PSPPs to the private sector because they are power generation plants. However, in the current situation, where no ancillary service market or capacity market have been established, it is difficult to secure a stable income even if private entities carry out development, so the possibility of development by private entities is extremely low. According to the person in charge at IE, both storage batteries and PSPP will be introduced as power storage facilities in PDP8.</p> <p><Donor> WB conducted a survey on the necessity of PSPP in Vietnam in 2017. (Large-scale introduction of renewable energy is not being considered, and it was concluded that PSPP are not economical for peak supply capacity.) European donors who want to sell their own products are likely to be interested. AFD, which has a track record in supporting hydropower development in Vietnam, may be interested. (However, AFD seems to be interested in development support for small and medium-sized hydropower.)</p>	<p>Assistance will be provided for the development of Bac Ai PSPP, for which an FS survey has already been undertaken, with the aim of starting operation in 2025, to secure a balance between supply and demand in the overall system. For PSPP, a lead time of about 10 years (about 5 years for construction) is required, from decision making to the start of operations. Therefore, when using PSPP as a power storage facility, it is necessary to take action at the present time, so the priority is high considering the necessity and urgency. (If all units are adjustable speed machines, the total project cost will be about 130 billion yen. PSPP have not yet been introduced in Vietnam, so support from abroad will be effective. Adjustable speed machines are a technology that have a competitive advantage in Japan, and Japanese companies are likely to make a successful bid.) Bac Ai PSPP will use the irrigation reservoir currently under construction as the lower reservoir in the current plan, so the plan may be changed depending on the progress of this irrigation reservoir construction. (There is information that EVN will construct some facilities for Bac Ai PSPP in advance in a place that will be submerged by the irrigation reservoir.) If EVN is positive about realizing this plan, support will be provided with a direct loan to EVN.</p>	High

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
7	<p>The market operator (NLDC) predicts the day ahead power demand, determines the operation output of each power generation plant by bidding so as to match the predicted value, and notifies each power generation plant of the operation schedule. At that time, renewable energy is not subject to market participation, so its supply capacity is deducted in advance at the power demand prediction stage. At present, the share of renewable energy power plants is not very large, so even if a major mistake is made in the prediction of renewable energy supply capacity there will be no significant change in the operating output of other power generation plants. However, if the share of renewable energy power plants increases in the future and the supply capacity prediction is wrong, it will be necessary to drastically change the operating output of other power generation plants on the same day. As a result, there is a concern that it will not be possible to maintain economic operation, causing large losses.</p>	<p><Vietnam> Each renewable energy power plant submits only the power generation availability to NLDC, and NLDC uses this information for the overall planning. However, as long as there are no system restrictions, the actual output depends on the weather conditions, so the actual results differ from the power generation availability. NLDC predicts the hourly output of renewable energies a day ahead based on the power generation availability, but the accuracy is not high.</p> <p><Donor> For renewable energy output prediction, ADB is providing technical support to EVN from 2018 to 2021 as part of its capacity building in the renewable energy field. In DEPP II (2017-2020) with the cooperation of the DEA and the MOIT, Energinet, a Danish transmission system operator (TSO), are providing support for the development of renewable energy output forecasting algorithms.</p>	<p>A HimawariCast Reception System (resolution approximately 1km, data every 2.5-10 minutes) and a highly accurate weather forecasting system will be provided, together with assistance for the development of a system that predicts the supply capacity of various types of renewable energy (solar and wind power) based on the weather forecast. Specifically, NLDC engineers will accumulate data on the relationship between daily weather conditions and the supply capacity of renewable energies and analyze the accumulated big data. Using this big data, assistance is provided to develop a system that utilizes weather forecasts to forecast the supply capacity of renewable energies, based on Japanese know-how.</p> <p>At present, the ratio of renewable energy is small, so the urgency is low. However, accumulating data from now on will help improve the prediction accuracy in the future, so the priority is "High". NLDC is interested in assistance for the development of this prediction system and has expressed a desire for it to be carried out it as JICA technical cooperation.</p>	High

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
8	<p>When the supply and demand balance of the system is disrupted due to sudden changes in supply capacity, such as in an accident at power facilities, the frequency fluctuates. For this reason, in general, facilities that can change their output at a fast speed (hydropower is the fastest) are put in place as frequency adjustment facilities, and output adjustment is performed to return to the specified value (50 Hz) in response to frequency fluctuations. However, in order to function as a frequency adjustment facility that absorbs fluctuations within 1 minute, it is necessary to always operate in a state where the output can be increased or decreased. Such operation is never economical. For this reason, in a situation where no compensation is obtained for such operation, the power generation company does not have an incentive to perform frequency adjustment operations.</p>	<p><Vietnam> Large-scale hydropower under the umbrella of EVN (Hoa Binh, Ialy, Tri An, etc.) performs frequency adjustment operations per requests from NLDC. However, because large-scale hydropower under EVN will be split off into a company and business efficiency will be required in future, there is a high possibility that appropriate compensation will be needed for frequency adjustment operations.</p> <p><Donor> ADB is providing system design support for the Vietnam Wholesale Electricity Market (VWEM) and mentions the ancillary service market, where frequency adjustment functions are traded in the market. In addition, the Danish government is supporting the formulation of a grid code for ERAV as the first step toward the introduction of a future ancillary service market in VEPG's TWG3 (subcommittee discussing cooperation related to power sector reform). (This is a collaboration with GIZ. The introduction of an ancillary service market is still under discussion.)</p>	<p>If the ratio of renewable energy increases and the magnitude of fluctuations increases in the future, it will be difficult to secure the required amount for frequency adjustment using EVN's large-scale hydropower alone.</p> <p>For this reason, technical cooperation for NLDC will be implemented to study measures to ensure the necessary frequency adjustment capability. In this study, assistance for institutional design of the ancillary service market will be implemented in order to procure suppliers of frequency adjustment capacity.</p> <p>Although it is not a necessary area of support right now, the priority is "Medium" because of the possibility of insufficient frequency adjustment capacity around 2025.</p>	Medium
9	<p>If the ratio of renewable energy facilities increases in the future, there is a high possibility that issues in the system operation that are not apparent now will occur. Possible issues are considered in order to ensure a balance between supply and demand in the overall system, which becomes more difficult to accomplish due to fluctuations in renewable energy output, with more frequency adjustment capacity being required.</p>	<p><Vietnam> At present, no major issues have occurred, so no specific countermeasures have been taken, but NLDC recognizes that there will be challenges in the future.</p> <p><Donor> Although some donors have spoken about the need for capacity building for grid operation methods, no specific support is being considered. It seems that there is a strong interest in NLDC's capacity building support as a market operator for the future development of the electricity trading market (WB, USAID, etc.)</p>	<p>Technical support will be provided to NLDC regarding the system operation methods needed for the mass introduction of renewable energy. NLDC has expressed its intention to learn about the Japanese methods that have already been implemented regarding this.</p>	Medium

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
10	<p>When a grid fault occurs, it is assumed that solar power plants may stop generation simultaneously due to a voltage drop. If the voltage drop is wide-ranging, the solar power output is greatly reduced instantaneously, and when the voltage is restored to the specified value, the output is instantly increased greatly. When such an event occurs, a large power flow change occurs in the power transmission facilities in a short time. In particular, solar power is unevenly distributed in the south, and if the installed capacity of solar power increases in the future, the amount of change in power generation output will increase due to voltage fluctuations caused by grid faults and sudden changes in weather conditions. There is a concern that such sudden changes in power generation output may cause large fluctuations in the power flow of the north-south 500kV interconnection line and affect the system stability between the north and south.</p>	<p><Vietnam> In Vietnam, the impact on system transient stability has not been studied yet but will be studied in the future with technical assistance from the US or Denmark. However, the study conditions are set for a time when a generator with the maximum unit capacity (about 1,000 MW) is tripped. NLDC assumes that the output fluctuation of renewable energy will not exceed 1,000 MW, and it seems that it is not considering the simultaneous shutdown and restart of renewable energy due to a voltage drop caused by a grid fault.</p> <p><Donor> System analysis and power flow analysis using PSS/E were also conducted in the Vietnam Energy Outlook created by the Danish government. However, this only uses the analysis that IE originally performed, and it seems that there is no special support in this field.</p>	<p>The solar power plants unevenly distributed in the south stop generation simultaneously due to a voltage drop caused by a nearby transmission line failure. Considering this phenomenon, assistance will be provided to study transient changes in the north-south interconnection power flow and the impact on system stability. If instability phenomena are expected to occur as a result, assistance on the design and installation of system stabilization equipment will also be implemented.</p> <p>This is not urgent, but it is an issue that may appear in the near future. By proceeding with a study at an early stage and identifying the necessity of introducing system stabilizing equipment, it is assumed that this will work advantageously in aiding the introduction of the equipment in the future. Therefore, the priority is "Medium".</p>	Medium
11	<p>Recently, the power supply composition of Vietnam has been studied by European consultants, such as a group from Poland. However, according to their report, the renewable energy ratio is very high, and the thermal power ratio is extremely low. For system stability measures, the introduction of small-scale engine generators that use gas or oil as fuel was proposed. Small engines are said to be suitable for compensating for fluctuations in renewable energy because of their high reaction speed. However, in the study conducted by IE, a conventional power source is required, so it is difficult to determine which is correct.</p>	<p><Vietnam> Because the validity of the study conducted by the European consultant could not be evaluated, there was a request from the EREA staff (Mr. Hoang Tung, Planning Dept.) for assistance from JICA.</p> <p><Donor> USAID and the Danish government provide MOIT (IE) with a tool to analyze power configuration optimization in their support for the development of PDP8. (Denmark has also been carrying out a supply-demand simulation in Vietnam Energy Outlook using the tools provided to MOIT). However, in both cases, capacity building is the main support and there is no direct involvement in the PDP8 formulation process.</p>	<p>Assistance will be provided for a study on the optimum amount of renewable energy introduction. Securing stable operation measures (supply reserve capacity, frequency adjustment capacity, risk response capacity, power storage capacity, etc.) will be focused on in particular for when the mass introduction of renewable energy is realized, and a cost analysis, including power storage systems, will be carried out.</p> <p>The need for a study is not particularly high, but the EREA staff wants to reflect its results in PDP8, so it is necessary to implement it urgently. Therefore, the priority is "Medium".</p>	Medium

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
12	<p>There are network security issues when remotely controlling unmanned power plants, which are expected to increase further in the future. In addition, system connection requirements for the large-scale introduction of storage batteries are ambiguous. With the introduction of roof-top solar, issues caused by the generation of harmonics in low-voltage systems are beginning to become apparent.</p>	<p><Vietnam> Currently, Denmark is assisting in the revision of the grid code, and ADB is assisting in the study on battery operation. ERAV Deputy Director (Mr. Tran The Quang) requested JICA assistance for "Security technology for power control networks" and "Specifications of storage batteries," which are not included in the scope of these support areas. <Donor> The Danish government and GIZ are providing support for the development of grid codes for large-scale and/or roof-top solar to ERAV. Denmark has created a roadmap for the grid code for the next five years. According to GIZ, it is currently at the draft stage and may be revised in the next two years.</p>	<p>Assistance will be provided for studies such as "Security technology for power control networks" and "Specifications of storage batteries" that are not included in the current grid code revision work and storage battery operation study. The priority is "Low" because it is assumed that no major issues have occurred at present.</p>	Low
13	<p>When procuring renewable energies, they are purchased at a higher price (FIT) than the market price.</p>	<p><Vietnam> In the future, the principle of competition will be introduced with the intention of procuring through an auction system. <Donor> An auction system is currently being discussed in VEPG's TWG 1 as a new renewable energy purchase system. For solar power, WB has already provided assistance for specific institutional design. For wind power, ADB is assisting EREA and is preparing documents for a demonstration in 2020 or 2021.</p>	<p>JICA will cooperate with ADB on the wind auction system and provide support in the determination and development of demonstration sites. GIZ published a research report in July 2018 on the auction mechanism for wind power projects. The report recommends that the transition from FIT to auction mechanism for wind power projects should not be implemented immediately but should be carried out after the business environment is improved. Therefore, the priority is "Low".</p>	Low

	Issue	Response by Vietnam and each donor	JICA's assistance plans	Priority
14	<p>In the revised PDP7, construction of many planned power generation facilities has been delayed, and there is a high possibility of power shortages in 2022 and 2023. If the construction of the power plants is delayed, power shortages will continue after 2024.</p>	<p><Vietnam> Many solar power generation facilities are to be installed, and they can be expected to provide supply capacity during the daytime. However, since the required amount of power generation cannot be expected to be met after 18:00, the lighting peak of power demand, this cannot be a means to solve the shortage of supply capacity during peak times.</p> <p><Donor> ADB assists MOIT in Integrated Resource Planning (IRP: a planning method considering both supply side resources and demand side resources) and technical evaluations. GIZ conducts institutional design and human resource development for smart grids in Smart Grids for Renewable Energy and Energy Efficiency (SGREEE).</p>	<p>Construction of large-scale power plants is the most effective way of addressing this issue. Demand Side Management (DSM), which controls demand during peak hours, can also be useful. Since technical cooperation on DSM has already been implemented by many donors, assisting in the area of smart cities by narrowing down the target cities is considered effective. Therefore, the priority is "Low".</p>	Low

1	Renewable Energy
2	Energy Efficiency
3	Energy Sector Reform
4	Energy Access
5	Energy Data and Statistics

Table 8-2 Support Programs provided by each Development Partner to the Power and Energy Sector in Vietnam (prepared by VEPG)

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5	
ADB	Power Transmission Investment Program–Tranche 1	ADB is supporting power transmission upgrades in Viet Nam to meet growing demand for electricity. The first tranche of the multitranche loan facility will finance the expansion and upgrading of 500 kilovolt and 220kV transmission lines and associated substations. It covers capacity development and support for project implementation, including detailed engineering and construction supervision.	Construction of 25,6 KM of 500 KV transmission Line 49.3 km of 220 kV Transmission line 6000 MVA 500/220KV Substation and 500MVA substation 220/110 KV	Loan (sovereign)	2011–2017	USD 120,500,000	Closed	National Power Transmission Corporation (NPT)	National Power Transmission Corporation (NPT)				x		
ADB	Power Transmission Investment Program–Tranche 2	The second tranche of the multi-tranche loan facility will finance the expansion of the transmission network, improve the operational effectiveness and efficiency of the National Power Transmission Corporation, and project implementation support.	Construction of 437 km of 500 KV transmission line and 28.2 km of 220kV	Loan (sovereign)	2012–2017	USD 110,190,000	Closed							x	
ADB	Power Transmission Investment Program–Tranche 3	The Asian Development Bank is working with Viet Nam to improve the transmission network to balance power loads in northern, central, and southern Viet Nam. The project is upgrading 500 kilovolt and 220 kilovolt transmission lines and improving the operational effectiveness and efficiency of the National Power Transmission Corporation.	The project is upgrading 500 kilovolt and 220 kilovolt transmission lines and improving the operational effectiveness and efficiency of the National Power Transmission Corporation.	Loan (sovereign)	2015 - 2020	USD 231,310,000	On-going							x	
ADB	Ha Noi and Ho Chi Minh City Power Transmission Development Sector project	To improve the capacities of HNCP and HCMPC and development and rehabilitate its 220KV and 110KV transmission lines. It is co-financed by ADB with ASEAN Infrastructure Fund (AIF) and US\$100 million from Vietnam Government.	The projects indicative outputs are (i) strengthened institutional capacities of HNCP and HCMPC; and (ii) the development and rehabilitation of 220 kV and 110 kV transmission lines and substations of Ha Noi and Ho Chi Minh City.	Loan (sovereign)	2014 - 2020	USD 172,700,000	On-going	Hanoi and HCMC Power Corporations	Hanoi and HCMC Power Corporations				x		
ADB	Renewable Energy Development Network Expansion and Rehabilitation for Remote Communes Sector	The primary objective of the sector Project is to develop rural electrification and renewable energy in Viet Nam to benefit ethnic minority communities inhabiting remote and poorer parts of the country. The Project consists of two investment components: (i) development of mini-hydropower plants in mountain provinces, and (ii) network expansion and rehabilitation of distribution networks serving poor provinces. The Project will include an associated technical assistance (TA) grant for capacity building for renewable energy development.		Loan (sovereign)	2009 - 2017	USD 151,000,000	Closed	NPC, CPC, SPC					x		
ADB	Renewable Energy Development and Network Expansion and Rehabilitation for Remote Communes Sector - Additional Financing			Grant	2015 - 2017	USD 3,000,000	Closed			x					

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
ADB	Capacity Building of Renewable Energy Development			TA	2009 - 2017	USD 2,500,000	Closed			x				
ADB	Establishing the Wholesale Electricity Market	Improve the capacity and knowledge of the Energy Sector Agency to operate effectively the VWEM mechanisms	The activities of the TA include (i) Basic and advanced trainings on generic wholesale market mechanisms; (ii) Recommendation on new functions and critical requirements of Power Corporations and NLDC (SMO) for the VWEM; (iii) Review the current ICT infrastructure of Power Corporations and NLDC (SMO), and recommendation for upgrading ICT infrastructure for the VWEM.	TA	2012 - 2018	USD 750,000	Closed	ADB	ERAV			x		
ADB	Rural Electrification	The project preparatory technical assistance (PPTA) will conduct a feasibility study for the Asian Development Bank (ADB)'s supported Rural Electrification (RE) Project in Viet Nam, which should include: (i) rationale/justification of the rural electrification project; (ii) assessments of the project sites proposed by the government; (iii) full feasibility study for the selected project sites; and (iv) preparation of all project documents required by ADB for the investment of the project.	Cancelled	TA	2015 - 2018	USD 1,000,000	Closed	ADB	MOIT and EVN				x	
ADB	Power Sector Reform Program	The TA impact will be an adequate and reliable supply of power for socioeconomic development. The outcome will be an improved regulatory framework and policy actions for a reliable and competitive wholesale electricity market.	The TA outputs will be (i) key policy actions and regulations for competitive power market operation (ii) key policy actions and regulations to ensure long-term adequate electricity supply.	TA	2016 - 2019	USD 1,000,000	On-going	ADB	MOIT (EREA and ERAV)			x		
ADB	Enhancing readiness for solar power deployment in Viet Nam	The Viet Nam Energy Sector Assessment, Strategy, and Roadmap, identifies support for energy efficiency and renewable energy generation as one of the five key areas for 2016 to 2020. The S-KSTA provides a substantive entry into the renewable energy space in response to the government's increased emphasis and identified financing requirements.	Assessment of Regulations and Law Assessment of the Potential projects Recommendations for future TA	TA	2017 - 2018	USD 225,000	Closed	ADB			x			
ADB	Integrated Resource Planning with Strategic Environmental Assessment for Sustainable Power Sector Development in the Greater Mekong	Based on the recommendations and lesson learnt of previous RETAs, the proposed RETA is designed to (i) enhance the GMS countries' capacity in applying IRP with SEA in their PDPs; (ii) improve regulations, policies, programs and/or targets for RE and EE as necessary and as validated through the IRP; and (iii) support the cross-border interconnections as necessary and as validated through the IRP. The RETA will particularly focus on Viet Nam as the country has greater potential for mitigating climate change impacts. The RETA outputs will be also disseminated through RPTCC meetings, which are organized twice a year. The TA activities will be closely coordinated with the GMS Environment Operations Center (EOC)'s Core Environment Program (CEP), which has provided		TA	2017 - 2019	USD 1,100,000	On-going	ADB Regional Project		x	x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		assistance on the SEA for power development planning in Viet Nam.												
ADB	Harmonizing the GMS Power Systems to Facilitate Regional Power Trade	To support the continuous work of the Regional Power Trade Coordination Committee, the Working Group on Performance Standard and Grid Code, the Working Group on Regulatory Issues, and eventually the Regional Power Coordination Center in laying the essential building blocks to facilitate GMS regional power trade.	The TA outputs will be (i) Demand Respond Assessment (ii) Utility EE financing model	TA	2015-2019	USD 3,000,000	On-going	ADB	ERAV		x	x		
ADB	Viet Nam: Municipal Waste-to-Energy Project	China Everbright International Limited (CEIL) aims to develop and invest in WTE projects with a combined capacity of up to 7,500 tons of MSW daily in Viet Nam. Each WTE plant will treat MSW, recover waste heat for power generation and supply to the local grid, purify waste gas, and treat leachate.	By 2028, 2.5 million tons of MSW will be treated per year, 790 GWh of electricity will be generated annually, and approximately 787,300 tons of carbon dioxide equivalent (tCO2e) emissions will be avoided on average per year.	Loan (non-sovereign)	2018-2028	USD 100,000,000	On-going	China Everbright International Limited (CEIL)		x				
ADB	Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility	The transaction technical assistance (TA) facility will provide project preparatory assistance, technical support, policy advice, knowledge sharing, and capacity building to support the implementation of ongoing projects and strengthen due diligence and improve project readiness to Southeast Asian developing member countries (DMCs) for a series of lending projects and programs identified in the country operations business plans, 2018-2020. The TA facility will also provide technical knowledge services and capacity building support to ongoing projects, especially for renewable energy grid integration, battery storage system, ESCO development, LED street lighting, rooftop solar project, and other needs as arise.	The outputs of the TA for each of the partners are: EREA (1) Development of RE local supply DEESD (1) Build EEAP for 6 provinces: Can Tho, Da Nang, Ha Noi, Hai Phong, Quang Nam and Quang Ninh. (2) Support for the development of legal framework for ESCO. (3). Energy Efficiency Fund. (4) MRV Framework for the VNEEP 3. EVN (1) Battery Energy Storage System. (2) Renewable Energy Forecast MOC (1) Technical standards for the LED Street Lighting; (2) Investment guidelines for Public Streeting lighting; (3) Support for Pre FS +FS + tender for EE in public lighting and Building for 6 provinces (CT, DN, HN, HP, QNam, QNinh)	TA	2018-2021	1,066,667	On-going	ADB	EREA DEESD EVN MOC		x			
ADB	Pilot Solar Auctioning Project in Viet Nam	The project aims to implement a pilot solar auctioning pilot in Viet Nam. the ADB will support in choosing the locations, conducting the Pre FS and FS as well as support to prepare for the tender and tendering process.	Pilot Solar Auction		not specified at this time	not specified at this time	On-going	ADB	MOIT	x				
AFD	Ensuring Sustainability of GMS Regional Power Development - Phase 2	Phase 2 of the study will strengthen the case for better consideration of environmental, social and energy security aspects into power planning in the GMS region: - Capacity building - SEA approach applied to a national power development plan (PDP) - tentatively Vietnam revised PDP VII - Technical exchanges on best practices (How to increase the share of intermittent energy? How to use demand side management as nega-watt?)			2015-2017		Closed	ADB	MoIT/loE					

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
AFD	Construction of Se San 4 solar power plant	EPC (engineering procurement construction) contract of the 49MWp solar power plant in Gia Lai Province, including 1-year O&M (operation & maintenance) period	New capacity of RE	Non sovereign loan to EVN	2019-2021	EUR 24,200,000	On-going	EVN	EVN	X				
AFD	Technical assistance to EVN in the fields of Health, Safety, Environment (HSE) and Operation & Maintenance (O&M)	Capacity building, training, procurement support Support to the Project Owner for supervisory purposes (above mentioned) in the fields of HSE	Workshops, training, study tours Supervisory missions	Grant	2019-2025	EUR 2,000,000	On-going	AFD + EVN	EVN	X				
AFD	Extension of laly hydropower plant	Extension of the existing laly hydropower plant in the centre of Vietnam with an additional capacity of 360MW	Additional capacity of hydropower to cover peak hours	Non sovereign loan to EVN	2020-2025	not specified at this time	Planned	EVN	EVN	X				
AFD	Grid strengthening project in the South of Vietnam	Improve, build, extend the 110kV grid network in the South of Vietnam to connect RE sources	Improve the power coverage, access and quality of service Connect the new RE capacities in the South of Vietnam	Non sovereign loan to EVN	2019-2024	not specified at this time	Planned	EVN/SPC	EVN	X			X	
ADEME /AFD/GIZ	Programme for Energy Efficiency in Buildings (PEEB)	The project promotes the creation of regulatory and normative framework conditions, which are a prerequisite for the transformation into a low-emission building sector and an important driver for the development of an energy efficiency market. In addition, it supports the creation of incentive systems that mobilize private sector investment in energy efficiency in buildings and provide long-term planning security for private investors.	Training on "Financing issue on EE buildings"	TA (GIZ, ADEME), FC (AFD)	2018-2020	EUR 570,000	On-going	MONRE (w/ MOC, MPI, MOIT)			X			
AFD	Technical assistance to EVN in the fields of ESHS management and construction as part of the Hoa Binh hydropower plant extension project	the TA aims at supporting EVN in key aspects related to E&S management and technical construction support, as part of the Hoa Binh hydropower plant extension project under AFD's financing	Implementing successfully E&S international standards and providing solutions for complex technical issues	TA to EVN	2020-2023	1.3 MEUR	On-going	EVN	EVN	x				
AFD	Extension of Hoa Binh hydropower plant	Extension of the existing Hoa Binh hydropower plant with an additional capacity of 480MW	Additional capacity of hydropower to cover peak hours	Non sovereign loan to EVN	2020-2025	not specified at this time	Planned	EVN	EVN	X				
AFD/ETP SEA	Energy Transition Partnership for the South-Est Asia	The Energy Transition Partnership (ETP) is a multi-stakeholders platform bringing together Governments, Philanthropies and Partner Countries to accelerate energy transition in Southeast Asia by increasing the deployment of renewable energy, energy efficiency and sustainable infrastructures. The ETP-SEA is eligible for Vietnam, Philippines and Indonesia	Provide more secure, resilient and clean energy services to achieve National Sustainable Development Goals, in conformance with the Paris Agreement	Technical and capital assistance projects	2021-2025	20 MUSD (up to 50 MUSD)	Planned	AFD + Vietnamese partners	MOIT, EVN and other government agencies	x	x	x		
AFD	Green credit line to the BIDV	SUNREF credit line to BIDV to finance green project (RE, EE)	Green projects (RE, EE)	Non sovereign loan to BIDV	2020-2022	100 MUSD	Planned	BIDV	BIDV	x	x			
Australia	Vietnam Climate Innovation Center (VCIC)	Australia and the UK are providing funds to a World Bank led project, the Vietnam Climate Innovation Center (VCIC). The project supports entrepreneurs/ SMEs in developing and commercializing innovative solutions in green economic sectors such as energy efficiency,	- 48 SMEs and startups received financial assistance to incubate and commercialize climate innovative solutions - VCIC is established and capable of providing effective climate technology	Technical Assistance, Grant	2015-2020	USD 5.37 million	On-going	National Agency for Technology Entrepreneurship and	WB	x	x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		waste management, transport, food and water security, renewable energy and biofuels. The project's objective is to increase green growth business innovations by supporting entrepreneurs and SMEs involved in technological solutions through the operations of the Vietnam Climate Innovation Center	innovation incubation and commercialization services to entrepreneurs					Commercialization (NATEC)- Ministry of Science and Technology (MOST)						
Australia	Vietnam's Energy Efficiency Standards and Labelling program (VEESL)	The Vietnam Energy Efficiency Standards and Labelling (VEESL) programme was implemented in a partnership between the Australian Department of Industry and Science (DIS) and the GoV. The project objective was to build capacity in the Vietnamese Ministry of Industry and Trade (MOIT), the Vietnam Standards and Quality Institute (VSQI) and test laboratories, and help develop lighting and appliance energy efficiency standards, registration, labelling, testing, compliance and monitoring mechanisms.	- An online system for manufacturers to register the energy efficiency of their products as required by governmental policy - The standards to test energy efficiency for refrigerators and lighting	Technical Assistance, Grant	2012-2015	USD 1.82 million	Closed	Ministry of Industry and Trade and Power companies	The Australian Department of Industry and Science (DIS)	x				
Australia	The Power Distribution Efficiency Project (DEP)	Through the Australia-World Bank Strategic Partnership, Australia provided technical assistance and capacity building to help Vietnam apply smart grid technology and develop appropriate tariff regimes to facilitate reform in the power sector.	- DEP provided technical assistance and built capacity in the Ministry of Industry and Trade (MOIT) and Power Companies to apply smart grid technology. - DEP supported MOIT develop appropriate tariff regimes in order to facilitate reform in the power sector.	Technical Assistance, Grant	2012-2016	USD 5.55 million	Closed	Ministry of Industry and Trade	WB	x				
Embassy of Denmark	Danish Energy Partnership Programme III with Vietnam (DEPP III)	The programme objective is Vietnam develops low carbon pathways related to energy in support of their NDC and Vietnam upscales NDC mitigation targets and related measures by 2025.	Development Engagement (DE) 1: Capacity Development for long-range energy sector planning DE 2: Capacity Development for Renewable Energy Integration into the Power System DE 3: Low carbon development in the industrial sector	Technical Assistance	2020-2025	EUR 8,099,794	On-going	Danish Energy Agency & Embassy of Denmark	Ministry of Industry and Trade	x	x			x
KFW	Rural Grid II - Decreasing the Emissions intensity of power supply (commissioned by the German Ministry for Economic Cooperation and Development (BMZ))	Rehabilitation and modernization of power grid in rural areas in Northern, Central and Southern Vietnam in order to reduce losses and avoid CO2 emissions and to ensure a reliable and cost-effective power supply. Installation of new meters, rehabilitation and upgrade of substations and MV & LV lines in rural grid.		Loan	2014-2018	120,000,000	Closed	EVN (NPC, CPC, SPC)			x			
KFW	Energy Efficiency in Urban Areas (commissioned by BMZ) (parallel financing with ADB)	Rehabilitation and modernization of power grid in urban areas in Hanoi and HCMC in order to reduce losses and avoid CO2 emissions and to ensure a reliable and cost-effective power supply. Installation of new meters, rehabilitation and upgrade of substations and MV & LV lines in urban grid.		Loan	2014-2020	100,000,000	On-going	EVN (Hanoi PC, HCMC PC)			x			
KFW	Son La – Lai Chau Transmission Line and Expansion of 500kV Son La Substation	Construction of the 500 kV transmission line Son La – Lai Chau and the extension of Son La substation; accompanying measures to ensure environmental and social sustainable construction of Lai Chau hydro power plant.		Loan	2014-2018	87,000,000	Closed	EVN, EVN NPT					x	

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
	(commissioned by BMZ)													
KFW	Smart Grid - Transmission Efficiency (commissioned by BMZ) (partly co-financing with ADB)	Improve transmission efficiency, enhance capacity of the transmission network to balance power load. Construction of new transmission lines and substations, upgrade of substations, use of smart technologies.		Loan	2015-2020	65,000,000	On-going	NPT			x			
KFW	Efficient Power Grids in small & medium sized cities I-II (Rural Grids III) (commissioned by BMZ)	Rehabilitation and modernization of power grid in small and medium cities in Northern, Central and Southern Vietnam in order to reduce losses and avoid CO2 emissions and to ensure a reliable and cost-effective power supply. Installation of new meters, rehabilitation and upgrade of substations and MV & LV lines and smart technologies.		Loan	2016-2022	350,000,000	On-going	EVN (NPC, CPC, SPC)			x			
KFW	Phu Lac Wind Farm (commissioned by BMZ)	Construction and operation of Wind Farm in Phu Lac (BinhThuan Province) – 24MW.		Loan	2013-2018	35,000,000	Closed	EVN / TBW		x				
KFW	Renewable Energy Development Facility "GET FiT" Vietnam (commissioned by BMZ)	Support the roll-out of wind and solar power technology in Vietnam by providing a top-up to renewable energy developers and IPP.		Grant	2018-2024	14,500,000	On-going	EVN		x				
OECD (supported by Denmark)	Clean Energy Finance and Investment Mobilization Programme	The OECD Clean Energy Finance and Investment Mobilization Programme is a multi-year, multi-stakeholder initiative to strengthen clean energy policies in Viet Nam and create an enabling clean energy investment environment. The programme has four core deliverables (i) an integrated and multifaceted review of key policy areas influencing the clean energy finance and investment environment; (ii) on demand policy technical assistance; (iii) in-country investor dialogues to connect OECD investors with local developers and project pipelines; and (iv) regional peer learning to highlight investment opportunities in Viet Nam and share good practices.	(i) Clean Energy Finance and Investment Policy Review (ii) On Demand Implementation Support Activities - Clean energy finance and investment mapping database - Background study to the Viet Nam Energy Outlook 2021 on energy financing challenges - Clean energy financing roadmap (proposed) - Clean energy financing training program (proposed) (iii) Investor dialogues (iv) Regional peer learning event	Policy TA	2020-2023	EUR 900000	On-going	OECD	EREA and DEESD	x	x	x		
EU	Energy Sector Policy Support Programme to enhance Access to Sustainable Energy in Rural Areas of Vietnam - Sector Reform Contract (Budget Support)	The programme aims at supporting the Government of Vietnam (GoV) to implement its targeted programme on electricity supply to rural, mountainous and island areas over the 2013 – 2020 period. More specifically the proposed programme aims to: 1) Support the implementation of the targeted programme on electricity supply to rural, mountainous and island areas 2013-2020; 2) Enhance the governance of the energy sector to facilitate the shift to a more sustainable energy development path.	Increased access of the rural population to sustainable electricity service: 1. Release of an annual report on the implementation of the targeted programme on electricity supply to rural, mountainous and island areas 2013-2020 (Decision 2081).; 2. number of rural households provided with a sustainable connection to the grid; 3. off-grid sustainable electricity services are supplied in rural areas; Enhanced governance in the energy	Grant	2017-2021	100.000.000	On-going	EREA	MOIT	x	x		x	x

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
			sector: 4. Establishment of an Energy Information System in Viet Nam; 5. Public release of an annual report on energy that includes new generation capacities by technology and a report on the implementation of Article 1 of the revised National Power Development Master plan for the period 2011-2020 with the vision to 2030 (Decision No 428/2016 QD-TTg dated 18 March 2016), the so-called revised PDP 7; 6. A decision on an increased Feed-In-Tariff (FIT) for Wind power and supporting circular is approved by the Prime Minister; 7. A National Biomass Energy Development Plan is approved by the Prime Minister; 8. A solar power development planning as foreseen in Decision 11/2017 is approved by the Prime Minister. 9. Adoption of a revised support mechanism for solar power project.											
EU	EU Vietnam Energy Facility	This is the complementary support to the above budget support programme. Its specific objective is that the Government and key stakeholders improve the pre-conditions for universal energy access, utilization of renewable energy and increase of energy efficiency. The Facility has four components, which are (i) Implementation of a Demand - Driven Technical Assistance Facility; (ii) Secretariat to the Vietnam Energy Partnership Group (VEPG) ; (iii) Monitoring of the above budget support programme; and (iv) Result monitoring, communication and visibility. The Facility is co-financed by the EU and the German Government.	1. A demand-driven technical assistant facility has been utilized by MOIT and other Stakeholders. 2. The Secretariat of the Vietnam Energy Partnership Group has been active in fostering exchange and political dialogue between the Government of Vietnam and Development partners 3. The implementation of the Sector Reform Contract (the above budget support programme) is regularly monitored	Grant	2018 - 2011	EUR 8,745,000 (EUR 7,500,000 EU contribution and 1,245,000 BMZ contribution)	On-going	GIZ	MOIT (EREA/DEESD)	x	x		x	x
EU	Supporting hydroelectric electricity production increase in Vietnam	Together with AfD, it is about accompanying the extension of laly power plant (laly II project Gia Lai Province) that will increase the capacity of the power plant by around 360 MW (+50%). The EU accompanying measure will help enhancing current practices regarding health, safety and environmental (HSE) aspects on the construction site as well as operation and maintenance (O&M) procedures to maximize electricity generation.		Grant	2018- 2023	EUR 2,000,000	On-going	AfD		x				
EU	Danang Solar Energy Development	Implemented by Danang Energy Efficiency Centre (DECC), the project is to contribute to increase accessibility to clean energy source in Da Nang on sustainable development basis. This will be achieved through: 1/ Improving regulatory environment for solar energy and promote solar energy services to end-users, 2/ Pilot installation of solar PV system in selected (local health centers and/or schools and some un-electrified		Grant	2017- 2020	EUR 400000	Closed	Local Authority - Danang Energy Conservation Centre			x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		poor households) including in the DECC showroom for demonstration effect, and 3/ Capacity building and knowledge exchange to enhance awareness among local authorities, energy managers, private investors, relevant stakeholder and even rural and remote households												
EU	EU Energy Initiative partnership dialogue support on "Net metering policy to promote the scale-up of solar rooftop in Vietnam	Objective was to support the shaping of a net metering in Vietnam. EU EI PDF has been able to provide technical capacity building, and to show that there was a very high potential for the integration of solar roof top electricity production. The results of the study include policy recommendation to address contractual issues with net metering. More technical issues, in particular the grid code requirements to ensure a proper development of solar roof top in Vietnam were also reviewed.		Grant	2016-2017		Closed	GiZ - ERAV		x				
EU	Civil society meets RE&EE - trainings, seminars and communication skills to boost RE&EE as a key tool for sustainable development and green growth strategy in Vietnam (E-Enhance)	To foster RE&EE development in Vietnam through building civil society and local champions for improving energy access and living conditions of Vietnamese citizens. The specific objectives are: 1. To transfer knowledge on important issues related to RE&EE into civil society and local organizations in Vietnam; 2. To communicate with Vietnam society, the importance of renewable energies and energy efficiency via civil society organizations and media; 3. To develop hands-on examples of RE&EE solutions for local people to apply in their daily life; 4. To increase energy efficiency in schools through changing their routines, attitudes and behavior	Estimated results: 1. A capable group of CSOs and local champions on RE&EE will be established to transfer related knowledge and practices into Vietnam society; 2. Awareness of public and the project's target groups on the importance as well as value of RE&EE for Vietnam's sustainable development will be increased by the end of 2020; 3. Energy access for targeted off-grid communities will be improved through development and application of RE&EE package; 4. Energy consumption of targeted schools will be reduced through application of EE activities	Grant	2017-2021	600	On-going	GreenID		x	x			
EU	Enhance Energy Data and Statistics of Vietnam in view of the Establishment of an Energy Information System in Vietnam	this project provides assistance to MOIT (EREA) to develop a roadmap and an action plan for the establishment of the Vietnam Energy Information System (VEIS°		Grant	2017-2018		Closed	EU	MOIT					x
EU	VEPG Secretariat 1 & 2	Support the establishment and start-up of the Viet Nam Energy Partnership Group (VEPG) between Development Partners and MOIT.		Grant	Mid 2016 - Mid 2018		Closed	EU	MOIT	x	x	x	x	x
EU	Support Vietnam EREA/MOIT to Conduct a Strategic Environmental Assessment (SEA) of the National Power Development Plan 8 in the Period 2021-	The overall objective of this Project is "to provide technical assistance to support EREA/MOIT to conduct the "Strategic Environmental Assessment Report (hereinafter referred to as SEA Report) of the National Power Development Plan in the period of 2021-2030 with visions to 2050 (PDP VIII)". the Specific objectives are:. 1. Rapid assessment SEA report of the existing PDP VII		Grant	2019-2020		On-going	EU	MOIT	x	x	x		x

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
	2030 with Vision to 2050 (PDP8)	revised; 2. Develop a methodology for the PDP VIII's SEA report which includes required input data; 3. Identification and measurement of the impact of PDP VIII on the environment; 4. Assist Vietnam to build a complete SEA report for PDP VIII; 5. Capacity building for Vietnam.												
EU	EU - Viet Nam Sustainable Energy Transition Programme	The overall objective is to contribute to a sustainable energy transition in Viet Nam. The specific objectives are: 1. Improved energy efficiency (VNEEP3); 2. Larger share of renewable energy in the energy mix (REDS); 3. Improved performance of the Viet Nam Energy Information System (VEIS). the programme will be made of a budget support operation and 4 complementary support measures	Induced outputs of the policy supported through budget support: 1. Improved energy efficiency (VNEEP3) 1.1. Legal and technical frameworks on economical and efficient use of energy are amended and/or supplemented; 1.2. Network of energy efficiency and cleaner production facilities is expanded; 1.3. Average energy consumption for the industrial sectors/sub-sectors is reduced; 1.4. Key energy users apply the Energy Management System. 2. Larger share of renewable energy in the energy mix (REDS) 2.1. Existing mechanisms to encourage investment in developing RE power generation (i.e. FIT) are revised; 2.2. Investment procedures and monitoring for the development of renewable energy projects are improved and simplified; 2.3. Direct Power Purchase Agreements (DPPA) are allowed; 2.4. On-site renewable or hybrid energy supply for remote, deep-lying and offshore areas is supported. 3. Improved performance of the Viet Nam Energy Information System (VEIS) 3.1. Legal framework set up and prepared for information infrastructure investment; 3.2. VEIS organizational capacity and infrastructure are strengthened.	Grant	2021-2026	142.000.000	Planned	EU (+ UNIDO + GGGI + WWF TBC)	MOIT (EREA/DEESD)	x	x	x		x
EU	Biomass Gasification Technology – Sustainable Energy Solution for Agri-Food Processing and Waste Management	Overall objective: To promote sustainable agri-food processing and contribute to enhancing waste management in Vietnam by facilitating the adoption of Continuous Biomass Gasification Technology (CBGT) as renewable energy among agri-MSEs Outcome/Specific objective 1: Through application of CBGT, agri-MSEs in four provinces (Thai Nguyen,	Output 1.1: Comprehensive cost – benefit calculations for CBGT deployment (including biochar by-products) are developed for target MSEs in tea and fruit processing, based on local conditions and markets. Output 1.2. Tea and fruit, and other agri-	Grant	2020-2024	EUR 2,433,451 (80% out of EUR 3,041,814)	On-going	OXFAM	Centre for Creativity and Sustainability (CCS)	x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
	in Rural Areas of Vietnam	Tuyen Quang, Son La and Yen Bai) achieve improved product quality and efficient energy consumption and contribute to managing rural waste. Outcome 2: Increased availability of mechanical and biomass supply services and access to finance for agri-MSEs to deploy CBGT consistently Outcome 3: 'Buy-in' and support from relevant government agencies for further adoption and replication of CBGT in agri-food processing and other industries	MSEs in the four target provinces have increased interest and capacity to apply CBGT Output 2.1: Local mechanical enterprises produce tailor-made biomass gasification equipment, provide on-site services and promote CBGT to MSEs. Output 2.2: Agri-food MSEs have reliable biomass supply for consistent CBGT application. Output 2.3. Agri-MSEs, mechanical enterprises and biomass collectors are assisted to better access to bank loans for CBGT investment. Output 3.1: Provincial governmental agencies improve policies and mechanisms to promote CBGT application among MSEs in other industries. Output 3.2. National agencies are influenced to replicate the Action's comprehensive approach in supporting enterprises to invest in CBGT.											
Finland	4 Cities MiniSCADA system – Vietnam	Mini-Scada System Project aims at improving reliability the power distribution system of Hue, DaNang Cities. The introduction of Mini-Scada is vital to minimize the system faults, reduce the risk of accidents and improve the reality of power supply.		loan	2006-2011	\$ 11 million	closed	EVN	EVN		X			
Finland	The Energy and Environment Partnership Programme for the Mekong region - Phase I (EEP Mekong I)	Objective: The EEP Mekong (2009–2014) aims at supporting wider provision and use of renewable energy and combating climate change in the Mekong Area (Vietnam, Thailand, Lao PRD and Cambodia). It is a grant offering program to promote the use of renewable energy, energy efficiency and clean technologies, financed by the Ministry for Foreign Affairs of Finland and the Nordic Development Fund (NDF).		Grant	2009 - 2014	\$ 9 million	closed		MOIT	X				
Finland	The Energy and Environment Partnership Programme for the Mekong region - phase II (EEP Mekong II)	Objective: Improved livelihoods and climate resilience in rural communities in the Mekong region (Vietnam, Thailand, Myanmar, Laos PDR and Cambodia) through provision of reliable, sustainable and affordable energy for households, social institutions and businesses.		Grant	2014-2018	\$9,6 million	closed		MOIT	X				
Finland	MiniScada/DMS project for Pleiku City and Tam Ky city	Mini-Scada System Project aims at improving reliability the power distribution system of Pleiku and Tam Ky Cities. The introduction of Mini-Scada is vital to minimize the system faults, reduce the risk of accidents and improve the reality of power supply.		loan	2014-2015	\$5 million	closed	EVN	EVN	x				
Finland	Transformer for DakLak provincial substations			Loan	1998	\$ 2million	closed	EVN	EVN				X	
Finland	Transformer for KonTum and			Loan	1998	\$2million	closed	EVN	EVN				x	

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
	BuonMeThuat substations													
Finland	Solar Energy for mountainous areas of Vietnam	provision of solar energy supply to 70 communes in remote mountainous area of Vietnam		Loan	2009-2011	\$5million	closed	CEM	CEM	x			X	
Finland	Rural network rehabilitation project for 4 provinces - HaNoi, ThaiNguyen, HungYen, Phu Tho	upgrading electricity grid in 4 provinces to improve energy supply and reduce energy loss.		Loan	2007-2011	\$6million	closed	EVN	EVN				X	
GIZ	Up-Scaling of Wind Power in Vietnam	<p>Considering the importance of promoting wind energy in Viet Nam, the German Federal Ministry of Economic Cooperation and Development (BMZ) has committed funds for technical cooperation to carry out the project 'Support to the Up-Scaling of Wind Energy in Viet Nam' in cooperation with MoIT.</p> <p>In order to successfully promote wind energy in the country, the project sets its focus on three components:</p> <ul style="list-style-type: none"> - Firstly, improving the framework conditions for public and private investors and project developers with regards to technical, commercial and socio-economic aspects. - Secondly, the GIZ project will work on building human capacities and expertise in private companies as well as public institutions. - Thirdly, technology transfer and international cooperation will be facilitated and encouraged. 	<p>1. Legal Framework</p> <p>1.1 Proposal for a new FIT</p> <p>1.2 Wind Power Investment Guidelines</p> <p>1.3 Levelized Cost of Electricity of Existing Wind Power Projects in Viet Nam</p> <p>2. Capacity Development</p> <p>2.1 Training for Vietnamese Project Developers</p> <p>2.2 Due Diligence Trainings for Local banks</p> <p>2.3 Project Development Clinic</p> <p>3. Technology Cooperation</p> <p>3.1 Viet Nam- Germany Joint Research Initiative</p> <p>3.2 Wind Power Summer School</p> <p>3.3 Wind Measurement Campaign</p>	Grant	2014-2018	EUR 690,0000	Closed	GIZ	MOIT-EREA	x				
GIZ	Renewable energy and energy efficiency (4E), Phase I	<p>The 4E project aims to generate and shape the necessary legal and regulatory preconditions for investments in renewable energy and energy efficiency, while at the same time providing the required technical and economic foundations for political decision-making and priority setting in Viet Nam.</p> <p>4E Core Targets:</p> <p>i) Improving legal and regulatory framework conditions as well as related capacities for energy efficiency and renewable energy investments.</p> <p>ii) Policy-making for energy efficiency promotion through systematic stock taking and data analysis as well as macro-economic cost benefit analysis.</p>	<p>Legal and regulatory framework</p> <ul style="list-style-type: none"> - Development of support mechanisms for further expansion of renewable energies and energy efficiency - Support to National Solar and Biomass Energy Planning - Development of a database for energy efficiency <p>Capacity development</p> <ul style="list-style-type: none"> - Trainings for policy makers, project developers and investors - On the job-training for local consulting firms and key energy companies <p>Technology cooperation</p> <ul style="list-style-type: none"> - Support to renewable energy and energy efficiency technology transfer to Viet Nam - Study trips and match-making events between Vietnamese and German companies 	Grant	2015-2018	EUR 300,0000	Closed	GIZ	MOIT	x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
GIZ	Smart Grids for Renewable Energy and Energy Efficiency	<p>The project supports experts of the Vietnamese power sector in developing a smart power supply system, which allows for an increase integration of renewable energies and supports greater energy efficiency. The project focuses on three main Action Areas that promote the participatory development of smart grid solutions, namely:</p> <p>1. Legal and Regulatory Framework The objective of this action area is to provide the Electricity Regulatory Authority of Viet Nam (ERAV) with information for improving the regulatory framework for a Smart Grid, which facilitates Renewable Energies and increases Energy Efficiency. Experts who update the Smart Grid Road Map (SGRM) and shape respective regulatory requirements receive support through training. Technically this means understanding the usefulness of internationally proven legal and regulatory requirements and adjusting them to the conditions in Viet Nam.</p> <p>2. Human Capacity Development One of the project's aims is to establish a Smart Grid knowledge hub, which helps Vietnamese experts and stakeholders to exchange knowledge about the development and management of Smart Grids, state-of-the-art technologies and international approaches. The exchanges also aim to promote awareness about Smart Grids between the government, policy makers, business, research institutes and civil society.</p> <p>3. Technology Cooperation Through activities in this action area, power sector experts will be presented with and exchange on available technology solutions for an intelligent power supply system, which facilitates the integration of Renewable Energies and improves Energy Efficiency. The experts will learn more about the technologies that are available on an international level and will get insights into the benefits these technologies can have for the Vietnamese power sector. This will happen by evaluating the technologies theoretically, developing and testing pilot schemes and then testing and evaluating system configurations which integrate different technologies.</p>	<p>1. Legal framework 1.1 Strategic advice on smart-grid development 1.2 Supporting the development of regulations for Smart-grids 1.3 Supporting the policy/stakeholders dialogue for policy making and awareness raising</p> <p>2. Capacity Development 2.1 Fostering knowledge on smart energy solutions 2.2 Trainings on grid operations with RE and SG technologies, grid planning, incl. exemplary development of scenario-based grid extension options 2.3 Establishing platform where smart grids experts can exchange the idea and get the latest information on the smart grids 2.4 Study tours of practitioners and decision-makers</p> <p>3. Technology cooperation 3.1 Promoting application of state-of-the-art technologies in terms of smart grids for RE and Energy Efficiency 3.2 Intensifying applied technology research and development 3.3 Matchmaking potentially technology cooperation between Vietnam and German companies</p>	Grant/ Loan	2017-2021	EUR 500,000	On-going	GIZ	MOIT-ERAV	x	x	x	x	
GIZ	Renewable energy and energy efficiency (4E), Phase II	<p>The objective of the second phase of the project is to generate and shape the necessary legal and regulatory framework for large-scale renewable energy installations and energy efficiency in industry and strengthen related capacities for its implementation.</p> <p>The project is organized along three main fields of</p>	<p>Output A: The Ministry of Industry and Trade and RE sector actors have improved capacities and instruments to control and develop the renewable energy sector.</p> <p>Output B: Key companies in the Vietnamese electricity sector have</p>	Grant	2017-2021	EUR 12,160,000	On-going	GIZ	MOIT	x	x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		<p>cooperation, namely:</p> <ul style="list-style-type: none"> - Legal and regulatory framework conditions as well as related capacities for renewable energy investments, with a potential focus on PV. - Policy-making for EE promotion through systematic stock-taking and data-analysis as well as macro-economic cost-benefit analysis - Awareness raising for RE and EE <p>The project is co-financed by the European Union to the tune of EUR 7.5mio to include the "Technical Assistance for the Implementation of the EU-Vietnam Energy Facility", which consists of 5 (Sub)Components.</p>	<p>improved capacities to use renewable energy.</p> <p>Output C: The Ministry of Industry and Trade has a well-founded and regularly updated data base as a basis for promoting energy efficiency in industry.</p> <p>Output D: Companies and the Ministry of Industry and Trade at (sub-) national level have improved capacities to increase energy efficiency.</p>											
GIZ	Programme for Energy Efficiency in Building (PEEB)	<p>The project promotes the creation of regulatory and normative framework conditions, which are a prerequisite for the transformation into a low-emission building sector and an important driver for the development of an energy efficiency market. In addition, it supports the creation of incentive systems that mobilize private sector investment in energy efficiency in buildings and provide long-term planning security for private investors.</p>	<p>Output I: In 3 partner countries, national actors have developed major projects to improve EE in the building sector.</p> <p>Output II: In 2 countries, national policymakers have proposals for the further development of energy efficiency policies for the building sector.</p> <p>Output III: Key actors perform their tasks in the development of eligible projects.</p> <p>Output IV: Systematically processed knowledge for the decarbonization of the building sector is available for use by specialists and the professional public.</p>	Technical Assistance		EUR 570,000	On-going	GIZ	MONRE (w/ MOC, MPI, MOIT)		x			
GIZ	Bioenergy Project	<p>The aim of BEM is to improve the preconditions for a sustainable use of biomass for electricity and heat generation in the country.</p>	<p>1. Legal and Regulatory Framework</p> <ul style="list-style-type: none"> - Adjustment to regulatory framework on planning and licensing of biomass energy projects - Assess the needs to facilitate the development of biomass energy - Develop strategies for provincial biomass development plans and draft recommendations for the improvement of the approval process of biomass energy projects <p>2. Capacity Development</p> <p>Improve private sector capacities for the development of biomass investment projects and enhance financial institutions capacities to finance biomass energy investment projects</p> <ul style="list-style-type: none"> - Capacity-need-assessment for biomass energy consultants, developers and investors; - Consultation on the design of criteria to assess the bankability of biomass energy investment projects; - Design for a financing mechanism based on biomass energy financing needs and 	Technical Assistance			On-going	GIZ	EREA	x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
			ODA/ climate fund sources 3. Technology Cooperation Technology cooperation and networks between Vietnamese and international enterprises, research institutions and universities on biomass for electricity and heat generation - Match making events - Analysis of subsectors - Study trips - Symposiums											
GIZ	Renewable energy and energy efficiency (4E), Phase III	To further develop legal and regulatory preconditions and related capacities for investment in renewable energy and energy efficiency as well as to further strengthen related capacities for implementation.	Renewable Energy: RE Law and related studies (Support Mechanism/ Connection/ absorption mechanism) Smart grid Technology Solution to support RE and EE Stakeholder capacity improvement Promoting EE development Energy Efficiency	Technical Assistance	2017-2021	EUR 12,160,000	On-going	GIZ	MOIT	x	x			
GIZ	Clean, Affordable and Secure Energy for Southeast Asia (CASE)						On-going	GIZ						
GIZ	Solar-Aquaculture Habitats (SHRIMPS)						Planned							
GIZ	Commercial & Industrial Rooftop Solar (CIRTS)						Planned							
GIZ	Viet Nam Energy Transition Project (VETP)						Planned							
GIZ	Aquaculture & Photovoltaics						Planned							
Italy	Vietnam – Improvement of National Statistical System	Providing assistance to the adoption of international standards, rules and classifications for the production and dissemination of high-quality statistics, as well as the improvement of the cooperation between national organizations to enhance the understanding and implementation of statistical methodologies and best practices. Specific components of the Project were identified as follows: Institutional building, Energy, Environment and climate change, Dissemination and communication, ICT.	Enhancement of Institutional building of GSO Improvement of the performances of the Department for the industrial statistics with the aim to increase its capacity to produce quality data on Energy Strengthening the capacity of the Department for Socio-Environmental Statistics to produce environmental statistics Strengthening the GSO'S capability to disseminate statistics also through the use of the most modern IT tools Improvement of the services provided by the ICT Department both to the GSO'S internal structure and to external users.	Grant	2017 - 2021	EUR 648,714	On-going	ISTAT	General Statistics Office					x

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
Italy	Enhancing operational functionalities of National Load Dispatch Center to integrate renewable energies	The Initiative aims at developing a dedicated non-programmable renewable energies power system management and to improve the overall electrical power system management in order to encourage the penetration in the Vietnamese power system of non-programmable renewable energies. If it is quite evident that economic policies with respect to a given technology can be an effective incentive to the development of that technology (e.g. feed-in tariff for solar), it is also clear that an ineffective and low-quality electrical power system management could rapidly stop further development of renewable energy.	Project is under formulation	Loan	2019-2023	EUR 11,500,000	Planned	AICS	EVN, NLDC	x				
Italy	Study on integration of non-programmable solar and wind energy into the national electric system of Vietnam	The aim of the initiative is to provide technical investigations in order to identify possible criticalities both as regards the operation of the power system and as regards to the network reinforcements necessary for the connection of the new renewable power plants in accordance with the security criteria adopted by the system operator. These investigations are at the basis for a feasible and reliable development of RES in Vietnam, considering that an advanced network system is a necessary precondition for integration and development of RES into the Vietnamese energy mix.	Project is under formulation	Grant	2019	EUR 300,0000	Planned	AICS	EVN, NLDC	x				
Innovation Norway / Equinor and probably Norad	Promoting Vietnam offshore wind local supply chain	Vietnam has enriched with offshore wind resources potential, which is estimated at 475GW (http://documents1.worldbank.org/curated/en/781371586848751429/pdf/Technical-Potential-for-Offshore-Wind-in-Vietnam-Map.pdf). In Vietnam national Power Development Plan 8th for 2021-2030 with perspective to 2045, under preparation by Ministry of Industry and Trade, offshore wind will play an important role to fuel Vietnam economic growth, which has been at 6-7% in last 10 years. The World Bank has proposed that 10 gigawatt offshore wind power could be in operation in Vietnam by 2030. On the other hand, the existing Vietnam oil and gas sector shows its growing interest in participate in offshore wind market, which creates a firm basis for establishment of a local supply chain to support ongoing and future offshore wind projects in Vietnam and in the region. Norway and Vietnam has many similarities such as equal size and long coastlines. Both countries have a substantial oil & gas industry and ocean economy plays an important role for both. Norway has been successful in bringing its long-term knowledge and experiences from oil and gas sector to develop offshore wind industry. Thanks to well-developed offshore wind supply chain, Norwegian offshore wind investors are now able to lower offshore wind power production cost to levels	The outcome of the work will be an understanding of Vietnamese supply chain capability, its potential and interest in meeting industry needs and identified gaps that needs to be closed. By analyzing these gaps, the intent is to make recommendation to both suppliers and government on what action to be taken to meet the demands of the industry over the next decade. The potential beneficiaries of the study will be local suppliers such as Petro Vietnam and its members, Shipbuilding industry corporation and its members, Lilama corporation and its members, local logistics companies and local port authorities, etc. Basic study workshop in Q1 2021 and Study finding workshop Q2 2021	Technical Assistance	12.2020 /May 2021	180,000 EUR	On-going	TBD	Innovation Norway/Equinor	x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		which are probably comparable to fossil fuels. Norway is willing to share with Vietnam its unique experience of developing an offshore wind supply chain from its world class competence within offshore activities in the oil and gas sector. As the result, Royal Norwegian Embassy in Hanoi/Innovation Norway and Equinor, in close cooperation with Vietnam Ministry of Industry and Trade, commission a study namely «Promoting Vietnam Local Supply Chain for Offshore Wind». The main objectives of the study are preparing for Vietnam to build up its owned offshore wind supply chain in order to materialize Vietnam offshore wind potential and to gradually reduce Vietnam offshore wind power generation cost.												
JICA	Data Collection Survey on Natural Gas Development and LNG Import to Vietnam	The survey aims to identify priority among various plans of LNG terminal developments and gas combined power plants in Vietnam and extract candidate projects in energy sector.	1) Conducting a survey of local gas supply sources and demand to define the volume and schedule for LNG import in Vietnam. 2) Providing an overview of LNG world market and comparing various options of receiving locations (LNG Terminals) and existing technologies for LNG import in Vietnam. 3) Based on LNG development lesson learnt from Japan, analyzing and recommending orientation for development of LNG market in Vietnam. The outputs will provide valuable information for future ODA projects including LNG terminal development and Gas Combined Power Plants to facilitate both Vietnamese and Japanese investment in Natural Gas and LNG system.	Technical Cooperation	Feb - Sept 2017		Closed	JICA Vietnam Office	PetroVietnam					
JICA	Data Collection Survey on Power Sector in Vietnam	To identify suitable projects in transmission and distribution to facilitate the development of renewable energy projects in Central and Southern Vietnam.	(1) To analyze the current status of power & energy sector (2) To analyze the issues caused by RE development (3) To identify and prioritize JICA's future cooperation	Technical Cooperation	Sept 2019 - Sep 2020		On-going	JICA	EVN, NPT	X				
LuxDev	Donor: Luxembourg Ministry of the Environment, Climate and Sustainable Development (MECSD) Agency: LuxDev	VIE/401: Energy Efficient Lighting NAMA Pilot in Hue City (MITIGATION) Other Climate Change (ADAPTATION) projects in Thue Thien Hue that were/are implemented by LuxDev: - Ongoing: Climate Adaptation and Resilience in Thue Thien Hue Province (VIE/433, 2018-2022) - Completed: Climate Adapted Local Development and Innovation Project (VIE/033, 2013-2018)	VIE/401 and VIE/433 are the first projects globally funded from Luxembourg ICF, through MECSD. VIE/401 (EE): The project works with Government, schools and private sector partners on Energy Efficiency (EE) interventions. Read: 1/ Software interventions >> EE awareness raising, action campaigns..., and 2/ hardware interventions >> replacement of conventional lighting by	Grant + TA	VIE/401 (EE): Jul 2018 to Jun 2020	EUR 2.2 Million (200k GOV contribution)	On-going	Lux-Development	Thua Thien Hue: PPC, DPI, DONRE, DOIT, DOET Hue City: MPC, HEPCO, DOET		X			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
			LED in public places i.e. 54 prim/sec/high schools in Hue City + on 18 city roads. An important component and target is 3/ conduct the MRV process as per UNFCCC requirements, and have the GHG emission reduction result formally registered with the GOV and with the international bodies. This EE intervention is a NAMA pilot, to be followed by an EE NAMA funded from ICF.											
OECD (supported by Denmark)	Clean Energy Finance and Investment Mobilization Programme	The OECD Clean Energy Finance and Investment Mobilization Programme is a multi-year, multi-stakeholder initiative to strengthen clean energy policies in Viet Nam and create an enabling clean energy investment environment. The programme has four core deliverables (i) an integrated and multifaceted review of key policy areas influencing the clean energy finance and investment environment; (ii) on demand policy technical assistance; (iii) in-country investor dialogues to connect OECD investors with local developers and project pipelines; and (iv) regional peer learning to highlight investment opportunities in Viet Nam and share good practices.	(i) Clean Energy Finance and Investment Policy Review (ii) On Demand Implementation Support Activities - Clean energy finance and investment mapping database - Background study to the VietNam Energy Outlook 2021 on energy financing challenges - Clean energy financing roadmap (proposed) - Clean energy financing training program (proposed) (iii) Investor dialogues (iv) Regional peer learning event	Policy TA	2020-2023	EUR 900000	Ongoing	OECD	ERA and DEESD	x	x	x		
Global Green Growth Institute	Scaling up Renewable Energy in Viet Nam	The project is a collaboration between GGGI and MOIT to support the development of RE market in Viet Nam through policy recommendations as well as bankable project development. Specifically, it supports Soc Trang PPC to develop the Provincial Biomass Energy Planning, as well as conducts pre-feasibility studies for a pipeline of biomass energy projects to get access to finance.		Technical Assistance	2017 - 2018		Closed	Global Green Growth Institute		x				
Global Green Growth Institute		Conduct a study and draft the National Plan on Renewable Energy Development that reviews the current status of the energy market, identifies difficulties and challenges, and propose solutions to scale up the market and meet the targets set by the National Strategy on Renewable Energy		Technical Assistance	2018		Closed	Global Green Growth Institute		x				
Global Green Growth Institute	Solar Rooftop Finance Facility	GGGI, in partnership with the Clean Energy Investment Accelerator (CEIA) acts as financial arranger and accelerator to form a Solar Rooftop Finance Facility in Viet Nam. The Facility is designed under a blended-finance structure under the risk sharing concepts between DFIs and local banks, aiming to provide finance for RESCO companies to develop solar rooftop in commercial and industrial (C&I) end-users. The initial capitalization target of the finance facility in 2019 is USD20mn and USD100mn in 2020, i.e. two closings.		Technical Assistance	2018 - 2020		Closed	Global Green Growth Institute		x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
Global Green Growth Institute	Vietnam Municipal Solid Waste to Energy	GGGI conducted a blended finance workshop for MSW2E developers in Hanoi and Saigon with the Energy and Environment Partnership Programme Mekong (EEP Mekong) in March 2018. EEP Mekong has recently provided support for 7 MSW2E developers in Viet Nam in the form of feasibility study grants. GGGI analyzed these 7 projects and selected the project with the best risk/reward to further de-risk and consequently mobilize blended project funding (bankable project). In this project, GGGI acts as a mandated financial advisor for the selected Vietnamese MSW2E developer to raise fund for a project with the waste treatment capacity of 500 TPD and expected total investment value up to US\$60m.		Technical Assistance	2018 - 2020		closed	Global Green Growth Institute		x				
The Kigali Cooling Efficien cy Progra m	Sustainable Urban Cooling in Viet Nam cities	The project will support 3 pilot cities of Hanoi, Can Tho and Tam Ky, selected to represent the range of municipal administrations in Viet Nam, to adopt Urban Cooling Action Plans (UCAPs), finance pilot projects and unlock municipal budgets for extreme heat and cooling. Interventions will include improved urban design, nature-based solutions, passive cooling measures, municipal incentives, district cooling and public procurement. Five learning cities will follow this work to ensure long-term scale-up. To unlock finance for UCAP implementation, a cooling fund will be established under the existing Environmental Protection Fund and contributions sought from public budgets and international donors.		Technical Assistance	2021- 2023		planned	Global Green Growth Institute and UNEP			x			
Europe an Union and Global Green Growth Institute	Accelerating Innovation for Energy Efficiency	The project will provide technical and financial assistance to promote startup projects on economical and efficient use of energy for the industry sector with secondary focus on transport, building and residential sectors. Specifically, the project will support startups to create marketable innovative EE solutions through enhanced policies and regulations, promote investment and access to private capital, and capacity building. To enhance policies and regulations, the project will develop and strengthen mechanism and policies on innovative startups in industry and other sectors as well as develop handbooks on energy efficiency. To increase access to finance, the project will organize 2 acceleration programs to promote energy efficiency startups in industry and other sectors, increase capital mobilization especially from private sector, and support the commercialization of innovative EE solutions and products. To build capacity, the project will develop training programs including curricula and courses on the new skills needed to promote EE and strengthen management capacity for businesses that develop innovative EE products through networking.		Technical Assistance	2021- 2023		planned	Global Green Growth Institute			x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
Global Green Growth Institute	Vietnam Municipal Solid Waste to Energy Financing Facility	This intervention mobilizes multi-layered blended financing, unlocks domestic capital to green investments and enables proven small and medium size circular economy companies to get access to non-recourse project finance. The establishment of such a finance facility would address the limited commercial financing offered by local banks in Vietnam and could thus have a catalytic effect across the country. Local commercial banks have expressed an initial interest in co-financing circular economy projects together with international development banks. Vietnam MSWTE FF aims to increase investment in circular economy in Vietnam by establishing a financing facility to provide finance for project development, project readiness, and development of investment guideline for the MSWTE in Vietnam. GGGI's previous projects in MSWTE and Bagasse-to-Power sub-sectors in Viet Nam supports quick facilitation of the upstream project pipeline.		Technical Assistance	2021-2022		planned	Global Green Growth Institute		x				
Global Green Growth Institute	Designing Policy Approaches under Article 6	This project aims to pilot the generation of policy approaches under Article 6, with a focus on developing policy approaches that may qualify for transaction as ITMOs under the World Bank's Transformative Carbon Assets Facility (TCAF)—i.e. that include an explicit carbon pricing element in non-forest sectors; as well as may be suitable for bilateral buyers. GGGI activities will support host countries to develop policy approaches with a carbon price component that enables them to undertake sectoral-level emission reductions. The project takes place in two phases. The first a scoping phase undertook assessment of sectoral-level market opportunities in Viet Nam in 2019-2020. The second phase includes three primary activities including a detailed feasibility study, identification and development of necessary regulatory instruments to operationalize the policy approach and consultations with the government on market mechanisms, policy approaches and potential transaction arrangements.		Technical Assistance	2019-2023		planned	Global Green Growth Institute		x	x			
UK Foreign, Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Support Minimum and High Energy Performance Standards (MEPS and HEPS) for electric motors (Regional Intervention working across Malaysia, Myanmar, Philippines, Thailand, Vietnam): This intervention is delivered in partnership with the International Copper Association (ICA) and aims to catalyze national level progress on Minimum and High Energy Performance Standards (MEPS and HEPS) on electric motors. The intervention will deliver the three key pillars which begin market transformation: harmonization of standards, setting MEPS and HEPS levels, and defining a Monitoring, Verification and Enforcement (MV&E) framework.	1.1 Impact Assessment Report 1.2 National roadmaps for MEPS/HEPS adoption 1.3 Recommendation report on MEPS and HEPS Monitoring, Verification and Enforcement (MV&E)	Technical Assistance	Oct-19 to Dec-21	USD 550,000	On-going	Carbon Trust	International Copper Association					x

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
UK Foreign , Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Promote improved EE target setting and performance by companies in the food and beverage sector, through adoption of Energy Management Systems (Regional Intervention working across Malaysia, Myanmar, Philippines, Thailand, Vietnam): Deliver technical support to companies in the Food & Beverage (F&B) sector to establish and maintain an Energy Management System (EnMS) with a focus on improving energy performance and publicly setting "energy productivity" (EP) targets. Given that there is a relatively low uptake of ISO 50001 in the PF5 countries due to its evidence requirements and associated high costs, the aim of this intervention is to increase the number of companies that have established an EnMS which would result in energy savings at no additional costs.	1.1 Capacity building workshops 1.2 Online tools and guidance documents 1.3 Technical assistance	Technical Assistance	Apr-20 - Mar-22	USD 940,000	On-going	Carbon Trust	Enerteam		X			
UK Foreign , Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Support the creation of a market for ESCOs to implement paid-from-savings EE projects in government facilities: This work package will attempt to establish new regulatory procedures for government agencies to follow in order to legally procure and contract with ESCOs to develop, implement and fund EE projects in government facilities and receive multi-year payments from reduced energy costs (Savings). This will be pursued under two parallel and independent approaches: 1) creation of new government procurement, contract and budget regulations and 2) synchronization of existing Private Partnership (PPP) regulations that already contain the 'salient features' applicable to an ESCO entering into an Energy Savings Performance Contract (ESPC) with a Government Contracting Agency (GCA).	1.1 Draft regulations	Technical Assistance	Oct-19 - Sep-21	USD 114,000	On-going	Carbon Trust	EPS Capital; EESD, MOIT		X			
UK Foreign , Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Support MOIT to deliver the VNEEP3: -Developing an MRV System for the rubber sector as well as a baselining and benchmarking study; x - Developing a Best Available Technology review of the rubber sector	1.1 Workshops 1.2 Baselining and benchmarking study 1.3 Recommendations report on MRV system design 1.4 MRV software development 1.5 Best Available Technology review	Technical Assistance	Oct-19 to Mar-22	USD 444,000	On-going	Carbon Trust	Enerteam; EESD, MOIT		X			
UK Foreign , Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Scope out an appropriate EE fund and/or de-risking instrument: LCEP is cooperating with GIZ, DANIDA and ADB via the Vietnam Energy Partnership Group (VEPG) to jointly offer technical assistance to set up an Energy Efficiency Foundation (EEF) for Vietnam. An EEF could provide an EE fund, as well as requisite EE technical assistance and EE awareness raising from a single institution. The concept of an EE Foundation is being based on Article 41, "incentives for economical and efficient use of energy", and Decision 280/QD-TTg, "to pilot the establishment of a foundation/fund to promote economical and efficient use of energy" (mentioned in	To be determined	Technical Assistance	Jan-21 to Mar-22	USD 115,000	Planned	Carbon Trust	MOIT		X			

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		the NEEAP 2020-2025). The intervention will focus on the design of an appropriate structure of the national EE Fund, and also provide recommendations on the delivery approach of the Foundation, potential funding sources, and roles and responsibilities of key stakeholders.												
UK Foreign Commonwealth and Development Office	Prosperity Fund ASEAN Low Carbon Energy Programme	Develop a pilot EE project implemented by a cement or steel company that demonstrates a bankable IGA and project-based financing: This work package will involve the LCEP team providing assistance to fill the current project development, technical and financing gaps as needed for the demonstration project to be successfully implemented and financed.	1.1 Technical Assistance 1.2 Investment Grade Audit 1.3 Funding Proposal	Technical Assistance	Oct-19 to Mar-22	USD 275,000	On-going	Carbon Trust	Enerteam; EPS Capital		X			
USAID	Vietnam Low Emission Energy Program (V-LEEP)	V-LEEP helps the Government of Vietnam (GVN) establish an effective policy, regulatory, and incentive environment for low-emission growth in the energy sector, while simultaneously attracting public-sector and private-sector investment in renewable energy (RE) and energy efficiency (EE). V-LEEP promotes the development of critical building blocks to scale up clean energy through access to technology, access to financing, development of bankable projects, and development of a sustainable clean energy supply industry for Vietnam. Under Component 1, V-LEEP helps GVN strengthen its clean energy planning, strategies, and policies. In its final few months of operation (through February 28, 2021), V-LEEP's primary focus continues to be on capacity building for Vietnam's cornerstone eighth national Power Development Plan (PDP-8) (a top priority of the Electricity and Renewable Energy Authority (EREA)) and supporting the Electricity Regulatory Authority of Vietnam (ERAV) to design and launch a pilot test of the Direct Power Purchase Agreement (DPPA) mechanism (USAID's top priority). Under Component 3, V-LEEP continues to support the Energy Efficiency and Sustainable Development (EESD) department ensure the enforcement and compliance with recently issued Minimum Energy Performance Standards for key industrial sectors.	1) 361,494 metric tons of greenhouse gas (GHG) emissions, estimated in metric tons of CO2-e, reduced, sequestered, and/or avoided as a result of USG assistance 2) 8 institutions with increased capacity to address clean energy issues as supported by USG assistance 3) 6 laws, policies, regulations, or standards addressing clean energy formally proposed, adopted, or implemented as supported by USG assistance 4) \$250 million of investment mobilized (in USD) for clean energy as supported by USG assistance 5) 200 megawatts (MW) of clean energy generation capacity supported by USG assistance that has achieved financial closure 6) 200 MW of clean energy generation capacity installed or rehabilitated as a result of USG assistance 7) 6 bankable RE projects developed with private sector financing 8) 15 private sector firms that have improved management practices or technologies as a result of USG assistance 9) 51 persons trained with USG assistance to advance outcomes consistent with gender equality or female empowerment through their roles in public or private sector institutions or organizations 10) 620 people trained in clean energy supported by USG assistance	Technical Assistance	2015-2021	USD 15.9 million	On-going	Deloitte Consulting LLP	MOIT; EREA, ERAV, EESD	x	x	x		x

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
			11) 20% of USG-assisted organizations with improved performance											
USAID	Vietnam Low Emission Energy Program II (V-LEEP II)	V-LEEP II is supporting Vietnam as it continues its transition to a clean, secure and market-based energy sector by increasing the deployment of advanced energy systems, improving energy sector performance, and increasing competition in the energy sector. USAID support aims to contribute to the design, financing, construction and operation of new clean energy resources including 2,000 megawatts (MW) of renewable energy and 1,000 MW of combined-cycle, gas-fired power plants. V-LEEP II works with the Government of Vietnam (GVN) to mobilize private sector investment to increase the deployment of advanced energy systems and will support project design for clean energy developers and provide technical assistance to lenders for clean energy investment. USAID and GVN work together to improve energy planning and operations practices to enhance energy sector performance. As Vietnam prepares to launch its Eighth National Power Development Plan, V-LEEP II will provide technical assistance for implementation of the plan, as well as support for grid integration and dispatch of variable renewable energy. In pursuit of a sustainable and market-based energy sector, V-LEEP II aims to promote transparency in procurement, monitoring, and evaluation of the Direct Power Purchase Agreement Pilot Program and engage in workforce and provincial government capacity building and other similar competitive procurement mechanisms. V-LEEP II provides grants to support innovative approaches to mobilize private investment in advanced energy systems, facilitate incubation and acceleration programs, and support empowerment for women energy professionals.	<p>Output 1.1: Costs & tariff recommendations report for LNG-to-power</p> <p>Output 1.2: Capacity building for PPA design and procurement</p> <p>Output 1.3: Capacity building for gas-VRE linkages</p> <p>Output 1.4: Gas-to-power roadmap</p> <p>Output 2.1: FIT analysis report</p> <p>Output 2.2: Deal Review and Project Investment Checklist report</p> <p>Output 2.3: Matchmaking event between project developers and lenders</p> <p>Output 3.1: Capacity building for modelling working group</p> <p>Output 3.2: Two PDP8 stakeholder consultations</p> <p>Output 3.3: Final PDP8 report</p> <p>Output 4.1: Voltage stability study</p> <p>Output 4.2: Frequency and ramping reserve report</p> <p>Output 4.3: Ramp rate recommendations report</p> <p>Output 5.1: DPPA monitoring and evaluation mechanism</p> <p>Output 5.2: DPPA pilot program analysis report</p> <p>Output 6.1: Competitive procurement enabling environment assessment</p> <p>Output 6.2: Procurement plans for select provinces</p> <p>Output 6.3: Procurement best practice trainings</p> <p>Output 7.1: Energy meetups hosted</p> <p>Output 7.2: Bootcamps, workshops, and masterclasses</p> <p>Output 7.3: 9 x pilot programs enabled</p> <p>Output 8.1: Gender toolkit</p> <p>Output 8.2: Pilot internship program</p> <p>Output 8.3: Outreach and mentoring program</p>	Technical Assistance	2020 - 2025	USD 36.25 million	On-going	Deloitte Consulting LLP	MOIT (EREA, ERAV, EESD, COGD), EVN	x		x		x
USAID	Vietnam Urban Energy Security	Vietnam Urban Energy Security aims to support cities in Vietnam to improve urban energy resilience and energy security by deploying advanced, distributed energy solutions which include solar rooftop and other forms of renewable energy and technical solutions to improving energy efficiency. Advanced energy solutions encompass the technologies and services, both emerging and established that make the energy system secure, high-	The Project plans to achieve at least 400 megawatts (MW) of distributed energy systems deployed, \$600 million in investment mobilized for advanced, distributed urban energy systems, and twenty (20) innovative solutions addressing urban energy and environment issues demonstrated and/or commercialized.	Technical Assistance and Grant	2019-2023	USD 13,974,519	On-going	DAI Global, LLC	Danang DOIT; HCM DOIT	x	x			

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
		performing, clean, and affordable. It is a dynamic and complex combination of resources, technologies, and services working together to collectively meet the evolving energy needs. Distributed energy refers to energy generated at point of or near to the point of consumption (mostly connected to the distribution grid) and encompasses a diverse array of distributed energy assets (i.e. generation, storage, etc.), digital services, electric vehicles (dynamic charging), management solutions and value-added services that include financing. The specific objectives of the Project are to assist Vietnam to (i) improve local enabling environment for the deployment of advanced, distributed energy solutions, (ii) mobilize public and private sector investment for the deployment of advanced, distributed energy systems, and (iii) increase adoption of innovative technologies, practices, business and financing models for advanced, distributed urban energy solutions.	The Project is designed with three (3) components. Component 1 - Strengthening Local Enabling Environment focuses on strengthening local enabling environment for the deployment of advanced, distributed energy solutions. The Project will support DOITs and relevant agencies strengthen their ability to support and encourage the adoption of renewable energy and energy efficiency measures locally. Component 2 - Unlocking Capital aims at involving relevant stakeholders in the renewable energy value chain, engaging key stakeholders to surface credible investment opportunities and identify which instruments are needed to mobilize public and private sector investment for the deployment of advanced, distributed energy systems. Component 3 - Spurring Innovation is to support the demonstration, commercialization and replication of innovative technologies, practices, business and financing models for advanced, distributed urban energy solutions. The component will focus on providing resources and support to entrepreneurs, innovators and others engaged in testing and scaling new approaches in renewable energy and energy efficiency.											
World Bank	Renewable Energy Development Project (REDP)	Credit line over US\$200 million to support development of small hydropower		Loan, Grant	Close July 2018	Closed	Closed	MOIT		x				
World Bank	Trung Son Hydropower Project	260 MW Hydropower Project		Loan, Grant	2020	Closed	Closed	EVN		x				
World Bank	Distribution Efficiency Project	Upgrading and Expansion of D-Network		Loan, Grant	2020	Closed	Closed	EVN and PCs			x			
World Bank	Transmission Efficiency Project	Upgrading and expansion of T-network		Loan, Grant	2020	Ongoing	On-going	EVN, NPT			x			
World Bank	EE for Industrial Energy Project	Promote EE in industry		Loan, Grant	2023		On-going	MOIT, Banks			x			
World Bank	GCF EE for Industry Risk Sharing Facility	Risk Sharing Facility to promote EE in industry		Loan, Grant	2024		On-going	MOIT			x			
World Bank	Scaling up ESCOs	Defining strategy for VN to develop ESCOs		Loan, Grant	2018		Closed	MOIT			x			
World Bank	Phasing Out Fuel Subsidies	Phasing out Fuel Subsidies		Grant	2018		Closed	MOIT				x		
World Bank	Variable RE Integration Study	Looking at costs and benefits of integrating various RE scenarios in power system plan		Grant	2020		Closed	MOIT		x				

Donor/ Agency	Project name	Description/Description of interventions	Main Outputs	Type of support	Time frame	Budget	Status	Implementing agency	(Government) Partner Agency	1	2	3	4	5
World Bank	EVN Credit Rating	EVN Credit Rating		Grant	2020		Closed	EVN				x		
World Bank	NPT Credit Rating	NPT Credit Rating		Grant	2020		Closed	EVN				x		
World Bank	PC Credit Rating	PC Credit Rating		Grant	2021		On-going	EVN				x		
World Bank	RE Mapping (wind, solar, hydro, biomass)	RE mapping		Grant	2020		On-going	MOIT, EVN		x				
World Bank	Maximizing Financing for Energy Development	Unlocking private sector commercial finance for VN energy sector		Grant	2019		Closed	GoV, MOIT				x		
World Bank	National Solar Strategy and Rooftop Strategy for HCMC and Danang	Scaling solar PV		Grant	2020		Closed	MOIT, HCMC, Danang		x				
World Bank	Solar Auction Design and Implementation	Solar Auction Program Design and Implementation		Grant	2021		On-going	MOIT		x				
World Bank	LNG Strategy	Develop LNG Strategy		Grant	2021		On-going	MOIT					x	
World Bank	Develop EE Targets and Mandatory EE Regime for VN	Develop efficient EE framework		Grant	2019		On-going	MOIT			x			
World Bank	Power Sector Development Policy Series	Develop Competitive Wholesale Electricity Market Series		Grant	2020		On-going	ERAV				x		
World Bank	Power Sector Development Policy Series	Assessment of cross subsidization		Grant	2020		On-going	ERAV				x		
World Bank	E-Mobility	National Framework development		Grant	2021		On-going							
World Bank	Offshore Wind Roadmap and Implementation Support	Wind sector development		Grant	2021		On-going							
World Bank	Power Sector Development Policy Series	Tariff transparency		Grant	2020		On-going	ERAV				x		
World Bank	Lao Vietnam Interconnector	Importing hydropower generated power from Laos to Vietnam		Grant	2021		On-going	MOIT, EVN, EDL, MEM				x		

(Source: “Viet Nam Energy Partnership Group “Mapping of Current Partner Projects in Viet Nam Energy Sector 2020”
http://vepg.vn/wp-content/uploads/2020/12/VEPG_Partner_Project_Survey_2020.xlsx)