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IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IDA-51560, TF-13456, TF-13468)

ON A

CREDIT

IN THE AMOUNT OF SDR 297.7 MILLION

(US$448.9 MILLION EQUIVALENT)

TO THE

SOCIALIST REPUBLIC OF VIETNAM

FOR THE

DISTRIBUTION EFFICIENCY PROJECT

June 14, 2019

Energy and Extractives Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2018)

Currency Unit	Vietnamese Dong (VND)
VND 23,195 =	US$1.00
US$ 1.39078 =	SDR 1.00

FISCAL YEAR
January 1 - December 31

ABBREVIATIONS AND ACRONYMS

AusAID	Australian Agency for International Development
AMI	Advanced Metering Infrastructure
BAU	Business as Usual
BST	Bulk Supply Tariff
CMS	Customer Management System
CPC	Central Power Corporation
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
CTF	Clean Technology Funds
DSM	Demand-Side Management
DMS	Distribution Management System
DR	Demand Response
EMDP	Ethnic Minority Development Plan
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ERAV	Electricity Regulatory Authority of Vietnam
ERR	Economic Rate of Return
EVN	Vietnam Electricity
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIS	Geographic Information System
GoV	Government of Vietnam
HCMPC	Ho Chi Minh Power Corporation
HNPC	Hanoi Power Corporation
IA	Implementing Agency
LMIC	Lower Middle-Income Country
IBMIS	Integrated business management system
LDU	Local distribution unit

LV	Low voltage
MAIFI	Momentary Average Interruption Frequency Index
MDMS	Metering Data Management System
MIC	Middle-Income Country
MOIT	Ministry of Industry and Trade
NEDS	National Energy Development Strategy
NPC	Northern Power Corporation
NPV	Net Present Value
ODA	Official Development Assistance
PAD	Project Appraisal Document
PC	Power Corporation
PCom	Power Company
PDO	Project Development Objective
PDMP	Power Development Master Plan
PMU	Project Management Unit
RAP	Resettlement Action Plan
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SBV	State Bank of Vietnam
SCADA	Supervisory Control and Data Acquisition
SEDP	Socioeconomic Development Plan
SEDS	Socioeconomic Development Strategy
SPC	Southern Power Corporation
T&D	Transmission and Distribution
WACC	Weighted Average Cost of Capital

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P125996	Distribution Efficiency Project
Country	**Financing Instrument**
Vietnam	Investment Project Financing
Original EA Category	**Revised EA Category**
Partial Assessment (B)	Partial Assessment (B)

Organizations

Borrower	Implementing Agency
Socialist Republic of Vietnam	Electricity Regulatory Authority of Vietnam (ERAV), Vietnam Electricity

Project Development Objective (PDO)

Original PDO

The project development objective is to improve the performance of the Recipient's Power Corporations in providing quality and reliable electricity services, and to reduce greenhouse gas emissions through demand side response and efficiency gains.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
IDA-51560	448,900,000	448,900,000	413,885,871
TF-13468	30,000,000	30,000,000	19,887,794
TF-13456	8,000,000	8,000,000	4,747,377
Total	**484,529,700**	**483,987,195**	**438,521,042**
Non-World Bank Financing			
Borrower/Recipient	313,500,000	313,500,000	180,810,000
Total	**313,500,000**	**313,500,000**	**180,810,000**
Total Project Cost	**800,400,000**	**800,400,000**	**619,331,042**

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
11-Sep-2012	07-Feb-2013	19-Oct-2015	31-Dec-2018	31-Dec-2018

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
22-Jun-2016	356.79	

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Highly Satisfactory	Highly Satisfactory	High

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	19-Mar-2013	Satisfactory	Satisfactory	0
02	27-Oct-2013	Satisfactory	Satisfactory	44.55
03	20-Jun-2014	Satisfactory	Moderately Satisfactory	133.59
04	29-Dec-2014	Satisfactory	Moderately Satisfactory	240.55
05	17-Jun-2015	Satisfactory	Satisfactory	276.85
06	23-Dec-2015	Satisfactory	Moderately Satisfactory	322.28
07	06-May-2016	Satisfactory	Satisfactory	348.17
08	08-Nov-2016	Satisfactory	Satisfactory	373.63
09	02-Jun-2017	Satisfactory	Satisfactory	416.30
10	08-Dec-2017	Satisfactory	Satisfactory	442.70
11	12-Jun-2018	Satisfactory	Moderately Satisfactory	445.10
12	14-Jan-2019	Highly Satisfactory	Highly Satisfactory	446.81

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Energy and Extractives	**100**
Public Administration - Energy and Extractives	1
Energy Transmission and Distribution	46
Other Energy and Extractives	53

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Urban and Rural Development	**100**
Rural Development	100
Rural Infrastructure and service delivery	100

Environment and Natural Resource Management	**100**
Climate change	100
Mitigation	100

ADM STAFF

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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Country Context

1. **Vietnam became a lower-middle-income country (LMIC) in 2009.** By the time of the project appraisal in 2012, Vietnam had transformed from a primarily agricultural economy with a rural population to a mixed economy with substantial development of commercial and industrial activities. Economic growth averaged 7.3 percent between 2001 and 2010. In 2011, the country's gross domestic product (GDP) growth was 5.1 percent, per capita income had reached US$1,515.48, and poverty rate had fallen to 14.2 percent.[1]

2. **By 2012, Vietnam was finding it harder to maintain high levels of growth with macroeconomic stability, and at the same time aspired to avoid the middle-income trap and become a successful middle-income country (MIC).** The economy had gone through periods of macroeconomic instability with high levels of inflation, currency depreciation and instability, and signs of significant internal capital flight; and had not reached sustainability levels. The Government of Vietnam (GoV) reaffirmed its commitment to tackle the structural drivers of macroeconomic instability and enhance the economy's efficiency.[2]

3. **The GoV's development vision for the next decade was defined in its Socio-Economic Development Strategy (SEDS) 2011–2020, which defines three 'breakthrough areas', namely (a) promoting human resources or skills development, (b) improving market institutions, and (c) infrastructure development.** The SEDS' overall goal is to lay the foundation for a modern, industrialized society by 2020. The Socio-Economic Development Plan (SEDP) 2011–2015[3] elaborated the objectives of the SEDS and identified specific measures and resources needed for its implementation.

Sector Context

4. **By 2012, rapid urbanization, fast and sustained increase in energy consumption driven by the success of the electricity access program, improvements in living standards, and growing industrialization were core to Vietnam's development challenges in achieving energy security and sustainable growth in the power sector.** At the end of 2010, the total generation capacity in Vietnam was 19.74 gigawatts (GW), and annual demand growth rate from 2011 to 2015 was projected at 15 percent.[4] From 1995 to 2010, the household electricity access rate increased from 50 percent to over 96 percent; and annual per capita electricity consumption from 156 kilowatt hours (kWh) to about 983 kWh. Industrial consumption was growing at a faster rate than the national average. Investments in the power sector had been unable to keep up with demand growth leading to load curtailment, especially during dry hydrology and high peak demand periods.

[1] Word Bank data bank.
[2] Country Partnership Strategy (CPS) for the Socialist Republic of Vietnam (2012–2016).
[3] Approved by the National Assembly in November 2011.
[4] The National Power Development Master Plan 7 (PDMP7), approved by the Prime Minister in 2011.

5. **Climate change also represented a significant threat to economic and human development, and greenhouse gas (GHG) emissions had more than doubled over the past decade.** Industry, power, and transport sectors were projected to account for the bulk of future increases in GHG emissions. Several World Bank operations were providing support for energy efficiency to mitigate climate change, including the Vietnam Climate Change Development Policy Operation programmatic series and the Clean Production and Energy Efficiency GEF project.

6. **The challenge to the power sector evolved from quantity to quality of electricity supply, and to sustainable and reliable electricity at competitive costs to support economic growth and poverty reduction.** This would involve modernization and enhancement of power system efficiency and reliability, as well as promotion of efficient use of electricity to reduce investment needs and projected growth in GHG emissions from the power sector. The 'Demand-Side Management[5] (DSM) Assessment for Vietnam', commissioned in 1997 by Vietnam with World Bank technical assistance, concluded that DSM could play a significant role in managing the growth of electricity demand in Vietnam.

7. **In 2010, the GoV's National Assembly approved the electricity law on energy efficiency and conservation,[6] which introduced policies on, among others, economic and efficient use of energy and called for energy savings in all economic sectors.** The law required the power sector to develop programs, plans, and road maps to reduce electricity losses and improve efficiency in distribution systems. The Electricity Regulatory Authority of Vietnam (ERAV) was assigned the responsibility to develop the overall smart grid program for Vietnam, to increase efficiency in the power sector, and to implement efficient pricing in electricity tariffs and demand response (DR) programs.

8. **Vietnam Electricity (EVN), the state-owned utility, was organized as a holding company and was active in all electricity activities.** Five EVN subsidiary power corporations (PCs) were responsible for electricity distribution and retail supply services within their franchise areas, at voltage levels of 220kV, 110 kV, and below, and directly purchased energy generated by power plants with capacity not greater than 30 MW. The five PCs are (a) Hanoi Power Corporation (HNPC), (b) Northern Power Corporation (NPC), (c) Central Power Corporation (CPC), (d) Southern Power Corporation (SPC), and (e) Ho Chi Minh Power Corporation (HCMPC). The PCs' subsidiary Power Companies (PComs) owned and operated the medium-voltage and low-voltage distribution systems, including in urban and rural areas. As of 2011, about 75 percent of the distribution networks supplying rural households were under PCs. In the remaining rural areas, low-voltage distribution and retail supply services were undertaken by local distribution units, which purchase from the PComs at regulated wholesale tariffs.

9. **The PCs encountered multiple challenges in providing quality services and ensuring reliable business operation.** The PCs had absorbed the low-voltage networks that were previously owned by local distribution units and needed rehabilitation, presenting challenges of low supply quality and high technical losses; they lacked modern tools to capture and analyze system reliability and so were manually recording outage data and they had no call centers to attend to customer queries or complaints. At project appraisal, manual calculations were used to estimate the System Average Interruption Duration Index

[5] Demand Side Management is the modification of consumer demand for energy through various methods such as financial incentives and behavioral change through education.
[6] No. 50/2010/QH12.

(SAIDI)[7] and System Average Interruption Frequency Index (SAIFI)[8] levels in the project areas in each PC. Distribution losses (technical) were high and increasing (refer to Table 1).

Table 1. Reliability Indices of PCs at Appraisal

PC	CPC	HCMPC	HNPC	NPC	SPC
SAIDI	3,631	1,682	299	5,145	6,958
SAIFI	23.53	7.62	1.73	19.80	24.3
Loss (%)	13.58	7.86	19	24.58	10.24

10. In addition, the distribution system was not automated, and metering infrastructure was mechanical, meaning the PCs were limited in their ability to collect real-time data from both the supply and demand side, limiting their capacity to optimize the distribution system configuration.

11. **The GoV recognized the need for modernization of the power system to support the goals of achievement of energy security and power sector efficiency**. The Power Development Master Plan (PDMP7), which identified power sector investments toward reliable supply for the next 5 to 10 years, called for the development of a smart grid road map for transmission and distribution (T&D). Upgrading and expansion of the distribution system, combined with modernization and enhancement of planning and operation of PCs' systems, were critical for achieving sustainable and secure electricity supply at the lowest possible costs. In view of these challenges, the GoV requested financial and technical support for the five PCs to improve distribution system efficiency and business operations and support ERAV's regulatory activities.

Higher Level Objectives to which the Project Contributed

12. **The World Bank Country Partnership Strategy for the Socialist Republic of Vietnam (CPS 2012–2016) is closely aligned with the GoV's SEDS (2011–2020), the SEDP, and the National Energy Development Strategy (NEDS) guiding the power sector up to 2020 (Prime Ministers Decision, December 2007[9]).** CPS Pillar 1 on competitiveness would address, among others, 'the low quality of key infrastructure services due to inefficiencies in power distribution and transmission and in water and transport sectors'; whereas Pillar 2 on sustainability would address pollution control. The SEDS calls for quick development of electricity sources and completion of the electricity network system together with the use of energy saving technologies to guarantee sufficient provision of electricity for development demand. One of the major targets of the SEDP is that "The energy consumption based on GDP will be cut 2.5–3 percent annually"; and one of its oriented tasks is "…assuring energy security, while effectively controlling energy consumption demands." The decisions in the NEDS included reducing investment needs in the power sector, strengthening energy security, controlling and mitigating environmental pollution in energy activities, and fostering socioeconomic sustainable development.

13. **The project was designed to align to the World Bank CPS, the GoV's SEDS and SEDP, and the NEDS.** The project would provide financial and technical support to the five EVN PCs to improve efficiency in their distribution systems and business operations. In particular, the project would contribute to

[7] Reliability Index: SAIDI in project areas, calculated as in distribution code.
[8] Reliability Index: SAIFI in project areas, calculated as in distribution code
[9] Decision No. 1855/QD-TTg of December 27, 2007, approving Vietnams NEDS up to 2020, with 2050 vision.

addressing (a) electricity supply interruptions and low quality of power supply due to distribution system constraints and faults, (b) improvement of efficiency and maintenance of low losses in the management of electricity distribution systems, (c) lack of distribution automation and need for modernization, (d) lack of real time information in key points of the distribution system and in consumption, to optimize distribution system planning and operation, (e) the need for further enhancement of the tariff reform program, including the absence of demand-side response or control programs and lack of adequate pricing signals in time-of-use tariffs, and (f) shortage of funds for investments to keep up with the increasing demand.

Rationale for World Bank Support

14. The World Bank had supported Vietnam's energy sector for several years, supporting electrification rollout[10] and quality of supply[11], supporting the sector to achieve almost 100 percent electrification. The World Bank was also closely engaged in policy dialogue and in supporting the GoV's power sector reform program and its sector regulatory framework. One of the key emerging issues to ensure sustainability of the previous World Bank-funded programs, while supporting the GoV's economic goals, was to increase the efficiency of the PCs. The project was hence designed to focus on activities that would contribute to increasing the efficiency of the electricity distribution sector (reducing losses and improving service reliability).

Theory of Change (Results Chain)

15. The PDO is to improve the performance of the Recipient's Power Corporations in providing quality and reliable electricity services, and to reduce greenhouse gas emissions through demand-side response and efficiency gains. It implied three anticipated outcomes which are (a) improved performance of Vietnam's PCs in providing quality electricity services, (b) improved performance of Vietnam's PCs in providing reliable electricity services, and (c) reduced GHG emissions through demand-side response and efficiency gains. The theory of change presents the funded activities to achieve the PDO outcomes and contribute to the project's long-term outcomes.

16. The project activities, as shown in Figure 1, were grouped into three categories.

(a) Component A, System Expansion and Reinforcement, would finance expansion and reinforcement of 110 kV, medium voltage, and low voltage electricity networks of the PCs (including transmission or distribution lines and substations). This would increase the capacity of the electricity network to meet load growth, reduce losses, and improve power supply reliability and quality.

(b) Component B, Introduction of Smart Grid Technologies in Distribution, would finance utility automation (using the Supervisory Control and Data Acquisition [SCADA] system) and introduce advanced metering infrastructure (AMI) systems for key substations and

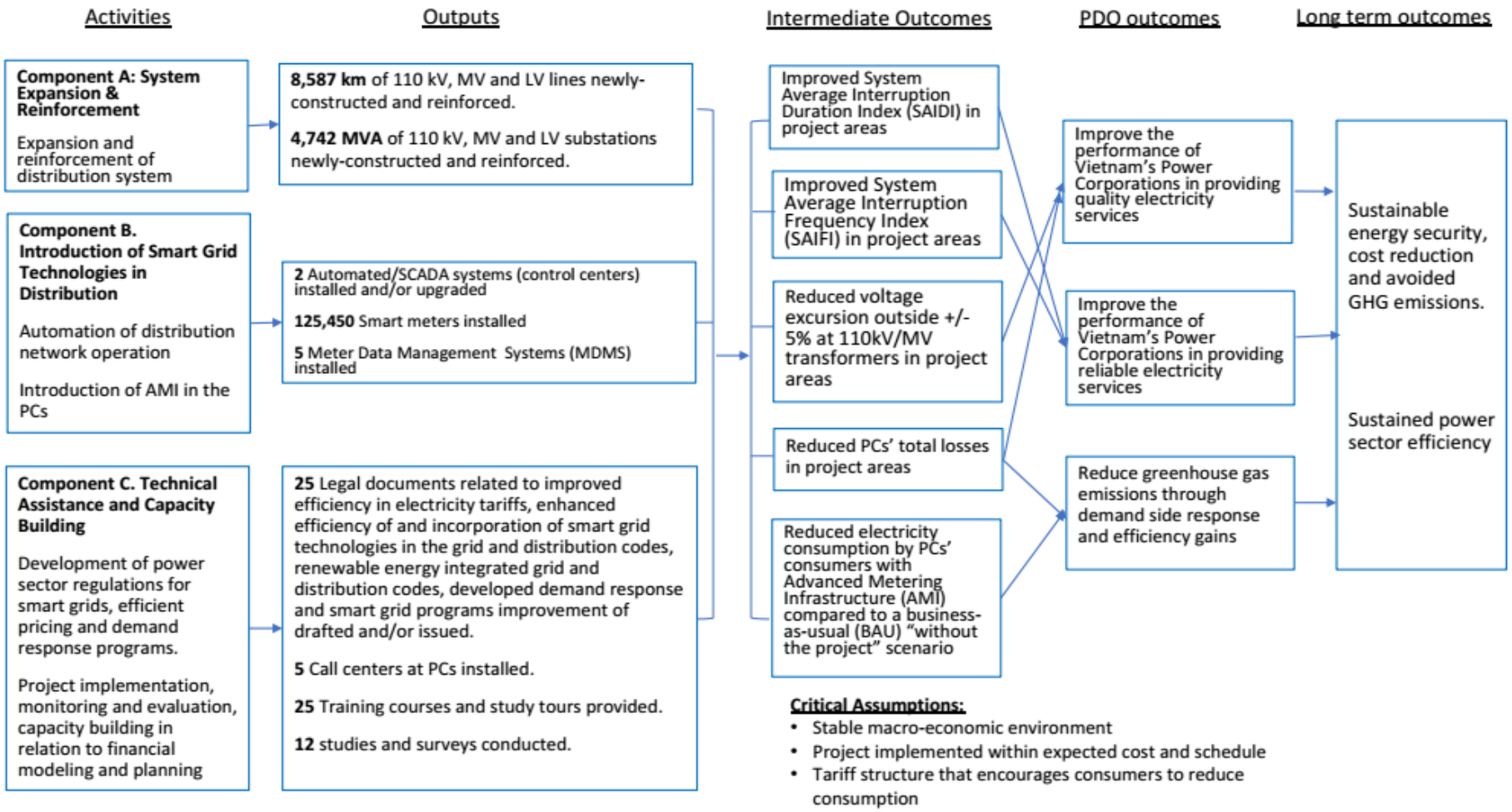
[10] Rural Energy Project: The overall development objective of the project was to improve access to good quality, affordable electricity services to rural communities, in an efficient and sustainable manner to support Vietnam's efforts towards socio-economic development (IDA-45760, IDA-40000, TF 54464) – closed in June 2014.
[11] Rural Distribution Project: The objective of the project was to improve the reliability and quality of medium voltage service to targeted retail electricity distribution systems (IDA-44440, TF 94257) – closed in June 2013.

customers. This would enable the utility to optimize distribution system configuration by providing real-time data from both the supply and the demand side and improving efficiency in data collection to improve network operations and customer service.

(c) Component C would provide regulatory enhancement support to assist in development of efficient tariff models and implementation of DR programs to encourage reductions in electricity consumption compared to a business-as-usual (BAU) 'without the project' scenario; and relevant capacity building and technical assistance needs, to help the PCs deliver on the project objectives.

17. All these investments through the project led to (a) improved electricity quality by reducing voltage fluctuations and distribution losses, (b) improved electricity reliability by reducing the duration and frequency of planned and unplanned outages, and (c) avoidance of GHG emissions associated with avoided thermal power generation. All three anticipated PDO outcomes contributed to the long-term outcomes.

Figure 1. Results Chain



Project Development Objectives (PDOs)

18. The PDO is to improve the performance of the Recipient's power corporations in providing quality and reliable electricity services, and to reduce greenhouse gas emissions through demand side response and efficiency gains.

Key Expected Outcomes and Outcome Indicators

19. The key expected outcomes to be used to assess the project are:

(a) Improve the performance of Vietnam's PCs in providing quality electricity services;

(b) Improve the performance of Vietnam's PCs in providing reliable electricity services; and

(c) Reduce greenhouse gas (GHG) emissions through demand-side response and efficiency gains.

20. The outcome indicators to be used to assess the outcomes are:

(a) **Performance Index:** Total distribution losses in project areas;

(b) **Performance Index:** Reduced consumption for AMI customers;

(c) **Power Quality Index:** Voltage excursion outside +/−5% at 110kV/MV transformers in project areas;

(d) **Reliability Index:** System Average Interruption Duration Index (SAIDI) in project areas;[12]

(e) **Reliability Index:** System Average Interruption Frequency Index (SAIFI) in project areas;[13]

(f) **Reducing GHG emissions:** Avoided GHG[14].

Components

21. The project was designed with three components, as detailed below:

(a) **Component A:** System Expansion and Reinforcement (IDA US$355.5 million, counterpart financing US$173 million). This component would support (i) building of new 110 kV substations, (ii) building of new low voltage substations, (iii) rehabilitation of old 110 kV substations, (iv) rehabilitation of low voltage substations, (v) building of new 110 kV lines, (vi) rehabilitation of old 110 kV lines, (vii) building of new low voltage lines, and (viii)

[12] Calculated as in the distribution code.
[13] Calculated as in the distribution code.
[14] Calculated by estimating the avoided power generation equal to demand reduction (Although the narrative in the PAD stated the measurement would include reduced electricity losses and reduced electricity consumption; the monitoring indicator was based on calculations of the demand reduction only).

rehabilitation of old low voltage lines. These activities would improve the network capability to meet load growth, reduce losses, and improve power supply reliability and quality. In total, 169 subprojects were implemented, against 90 planned.

(b) **Component B:** Introduction of Smart Grid Technologies in Distribution (IDA US$23.9 million, counterpart financing US$29.5 million, and Clean Technology Funds (CTF) financing US$30 million). This component would support (i) utility automation through supply of SCADA systems and (ii) installation of AMI systems for key substations and customers of selected PCs). In total, eight subprojects were completed, against nine planned.

(c) **Component C:** Technical Assistance and Capacity Building (IDA US$2.5 million and Australian Agency for International Development (AusAID) US$8 million). This component would support (i) ERAV for developing tools and procedures for Vietnam's regulatory environment, and (ii) capacity building for ERAV and technical assistance to the PCs.

22. The estimated and actual resource allocation for each component is shown in Table 2.

Table 2. Estimated and Actual Resource Allocation per Component

Component	Estimated Cost at Appraisal (US$, millions)	Actual Cost at Completion (US$, millions)
Component A: System Expansion and Reinforcement	**694.4**	**561.17**
IDA financing	418.7	403.87
Counterpart	275.7	157.3
Component B: Introduction of Smart Grid Technologies in Distribution	**95.5**	**53.07**
IDA financing	27.7	9.68
CTF financing	30.0	19.88
Counterpart	37.8	23.51
Component C: Technical Assistance and Capacity Building	**10.5**	**5.56**
IDA financing	2.5	0.33
AusAID grant	8.0	4.75
Total	**800.4**	**619.3**[15,16,17]

[15] 75% of this difference arose from savings in the counterpart fund. The cost estimates for the counterpart funds at appraisal, particularly for phase II subprojects which were not appraised at the time, were based on historical data when the price escalations were estimated at 15% per annum. During implementation, macroeconomic conditions were favorable, prices and price escalations were lower, hence the underspend of the counterpart fund.
[16] Because of competitive procurement practices and diligent project management, savings were realized in all phases of the project, and the last round of savings could not be utilized within the project lifetime.
[17] About US$ 7 million was not disbursed by HCM PC because of problems encountered with the on-lending agency (VDB) related to collateral, and HCM PC had to complete payments using their own source of funds.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

Revised PDOs and Outcome Targets

23. None.

Revised PDO Indicators

24. None.

Revised Components

25. None.

Other Changes

26. The project underwent a Level 2 restructuring that was approved on June 22, 2016, in response to the request from the State Bank of Vietnam (SBV) that was received on May 10, 2016. As part of a portfolio-wide request from the SBV, the project's Results Framework was removed from the Legal Agreements and placed in the relevant project manual.

Rationale for Changes and Their Implication on the Original Theory of Change

27. The restructuring had no implications on the theory of change.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating
Rating: High

28. The PDO of the project, "to improve the performance of the Recipient's PCs in providing quality and reliable electricity services, and to reduce the GHG emissions through demand-side response and efficiency gains", was highly relevant at the time of project appraisal and approval and remained highly relevant at project closure. The World Bank's Country Partnership Framework (CPF) for Vietnam (2018–2022) sets in its objective No. 9 (focus area 3[18]) to "promote low carbon energy generation, including renewables and energy efficiency, and reduce GHG emissions by improvement of reliability and efficiency of supply in Vietnam." Objective No. 10 of (focus area 3) states "Increase climate resilience and strengthen disaster risk management." These objectives are aligned to the PDO.

[18] The CPF 2018–2022, Report No. 111771-VN (dated May 2017): Focus Area 3: Ensure Environmental Sustainability and Resilience.

29. **The project objective is also aligned to Vietnam's national policy goal of improving the reliability of electricity supply**. The overall objectives of "Vietnam's Prime Ministers decision approving NEDS, guiding the sector through to 2020" called for, among other things, "supply of adequate high-quality energy for socio-economic development", and "exploitation and use of domestic energy resources in a rational and efficient manner." One of the specific objectives of the SEDP 2016–2018 was "Energy consumption over GDP will decrease 2.5–3 percent per annum on average." The activities in Component A of the project directly contributed to both the above objectives.

30. **The project investments contributed to the goals of the CPF, SEDP, and NEDS.** System reinforcement (Component A) and introduction of smart grid technologies and AMI systems (Component B) led to higher network efficiencies (reduced losses), allowing the sector to avoid increased generation, including thermal generators that would increase incidences of GHGs (Vietnam prioritizes hydropower and other renewable energy sources). The investments also led to higher power quality and reliability, by reducing voltage fluctuations and outages. The project investment in reinforcement of 110/35/22 kV networks enables evacuation of the energy generated by small, scattered renewable sources (mini-hydro, solar, and wind plants).

31. Given the PDO's consistency with the GoV's strategies for the electricity sector and the clear alignment to the World Bank's CPFs at appraisal, closing, and going forward, the rating for relevance is High.

B. ACHIEVEMENT OF PDOs (EFFICACY)

32. **The overall efficacy of the project is rated *High***. At project close, the project had fully met all its intended objectives. The indicators, which were all met and, in most cases exceeded, were designed to deliver on the objectives of the project (Table 3 summarizes the achievements of each target).

33. Although minor in the manner the PDO was formulated, the PDO statement could have benefited from separating the specific outcomes of 'quality services' and 'reliable services' from the other performance outcomes (losses and reduced consumption). Nonetheless, outcome indicators were designed to capture these aspects of the PDO and allowed assessing whether the objectives of the project were met.

Table 3. Summary of Achievement of Disaggregated PDO

	Indicators			
Objective	**Baseline**	**Target**	**Result**	**Achievement**
Improve the performance of the recipients' PCs in providing quality electricity services	**% of total distribution losses**	10.39	2.91	Exceeded
	CPC: 13.58	5.50	3.90	Exceeded
	HCMPC: 7.86	12.00	9.80	Exceeded
	HNPC: 19.00	11.39	9.63	Exceeded
	NPC: 24.58	7.60	4.39	Exceeded
	SPC: 10.24			
	+/−5% Volt fluctuation (no.)	0.00	0.00	On target
	CPC: 0.00	0.00	0.00	On target
	HCMPC and HNPC: 0.00	40.00	40.00	On target

	Indicators			
Objective	**Baseline**	**Target**	**Result**	**Achievement**
	NPC: 60.00 SPC: 25.00	4.00	0.0005	Exceeded
	AMI consumer reduction (GWh)	59.10	60.50	Exceeded
	CPC: 0.00	104.30	105.80	Exceeded
	HCMPC: 0.00	69.10	72.20	Exceeded
	HNPC: 0.00	181.60	210.00	Exceeded
	NPC: 0.00	414.50	448.50	Exceeded
	NPC, HCMPC, HNPC and CPC: 0.00			
Improve the performance of the recipients' PCs in providing reliable electricity services	**SAIFI (no.):**			
	CPC: 23.53	20.95	9.11	Exceeded
	HCMPC: 7.62	2.50	1.08	Exceeded
	HNPC: 1.73	1.67	1.63	Exceeded
	NPC: 19.80	18.65	11.26	Exceeded
	SPC: 24.30	21.60	3.23	Exceeded
	SAIDI (minutes):			
	CPC: 3,631.00	3,234.00	1,027.00	Exceeded
	HCMPC: 1,682.00	384.00	94.00	Exceeded
	HNPC: 299.00	291.00	265.00	Exceeded
	NPC: 5,145.00	4,656.00	989.00	Exceeded
	SPC: 6,958.00	5,525.00	598.62	Exceeded
Reduce GHG emissions through demand-side response and efficiency gains	**Avoided GHG (tons/year):**			
	CPC: 0.00	38,425.00	49,332.00	Exceeded
	HCMPC: 0.00	67,818.00	86,269.00	Exceeded
	HNPC: 0.00	44,890.00	58,872.00	Exceeded
	NPC: 0.00	118,015.00	171,234.00	Exceeded
	NPC, HCMPC, HNPC, CPC: 0.00	269,148.00	365,707.00	Exceeded

Note: Figures defer from last ISR sequence No. 12 archived on January 14, 2019 owing to corrections made after feedback from PC's.

Assessment of Achievement of Each Objective/Outcome

Objective 1: Improve the performance of the recipients' power corporations in providing quality electricity services.

Rating: High

34. After making tremendous progress with access, one of the major challenges faced by the Vietnam's electricity sector was moving from quantity (sufficient power supply) to quality (stable power for economic development and poverty reduction). To meet this objective, the PCs needed to address challenges of reducing electricity losses and improving the quality of information on power consumption to facilitate better planning and operation of the distribution system.

35. Good power quality is defined as a steady supply voltage that stays within a prescribed range. Regular performance indicators of utilities include, among others, system losses as a percentage of power

supply. The outcome 'Improve the performance of the recipients power corporations in providing quality electricity services' was designed to be measured by the following indicators: (a) number of voltage excursions outside +/−5% at the outlet of 110 kV substations in the project area, (b) percentage of total losses in the project areas, and (c) reduction in GWh of electricity consumption by PC customers with the AMI compared to the BAU scenario without the project. These indicators were the right ones to measure the achievement of the defined outcomes.

36. The targets related to the number of voltage excursions outside +/−5 percent at the outlet of 110 kV substations in the project area was fully met in all the project areas. The target related to 'PCs' total losses in the project areas,' was exceeded by 61.5 percent, whereas the target related to 'Reduction in electricity consumption by PCs' consumers with the AMI compared to BAU (without the project)' scenario was exceeded by 8.3 percent. Objective 1 was fully met.

37. The EVN's Annual Report 2017 acknowledges that total losses reduced during the project period: 'The power losses of the entire power system gently fell to 7.57 percent from 7.94 percent in 2015.[19] The bulk of the reduction in power system losses was on the distribution system, which was the focus of the projects rehabilitation and upgrade. The EVN's distribution loss rate in 2016 was 5.21 percent, which compares favorably with distribution companies in developed countries such as Australia and the United Kingdom.

38. The project delivered much better results than originally anticipated, owing to the following reasons: (a) the synergy effect of installation of the AMI systems and Metering Data Management Systems (MDMS) for large customers increased real-time awareness of electricity consumption and encouraged behavioral change in use of energy efficient equipment and energy consumption patterns leading to much lower consumption than originally anticipated (beyond the anticipated results due to technical interventions), and (b) efficient competitive procurement practices led to project savings that translated into more subprojects being carried out in the project areas, delivering better results than anticipated.

39. Benefits to the PCs arising from the achievement of the objectives include (a) increased energy sales without increased purchases of electricity owing to reduced losses and reduced energy not-served owing to improved reliability—for example, the HNPC acknowledged supplying 10 percent annual demand growth due to the enhanced capacity of the power T&D system and through electricity saved by the reduction of losses; (b) behavioral change by large customers with better access to information that helped them increase usage efficiency, thus releasing saved electricity to the grid; and (c) improved customer satisfaction arising from improved quality of supply—customer satisfaction surveys carried out indicated steadily improving customer satisfaction indices in the project areas over the project lifetime.

Objective 2: Improve the performance of the recipients' power corporations in providing reliable electricity services.

Rating: High

40. Another major challenge to the Vietnam electricity sector was to improve the reliability of Vietnam's electricity supply. Reliability of a power distribution system is defined as the ability to deliver

[19] EVN Annual Report 2017

uninterrupted service to customers. Reliability indices include, among others, the SAIDI and SAIFI. The first step to monitoring reliability is improving the quality of information to the utilities. The project financed installation of a SCADA system, which introduced automation of the distribution network operations and facilitated ease of collection of accurate network data. Notably, the project introduced, for the first time in the EVN's history, proper reliability measures for the PCs, so that they could track reliability indicators (SAIDI, SAIFI, MAIFI[20], and so on) properly. The indicator 'reliability of power supplied by PCs, monitored through the SAIDI and the SAIFI in the project areas', was exceeded in all the project areas (in totality was exceeded by 80 percent). Objective 2 was fully achieved.

41. The EVN's Annual Report for 2017 acknowledges that the SAIDI and SAIFI reduced during the project period: "A noteworthy improvement in the power supply quality was seen in 2016. The System Average Interruption Duration Index (SAIDI) remarkably declined to 1,651 minutes per customer from 2,281 minutes in 2015. The System Average Interruption Frequency Index (SAIFI) dropped to only 10.6 times per customer, equivalent to a 21% decrease as compared to 2015. The Momentary Average Interruption Frequency Index (MAIFI) experienced a considerable decrease of 28.7% to 1.51 times per customer."[21]

42. Accurate measurement of the SAIDI and SAIFI brought the added advantage of awareness to the network operators, which encouraged behavioral change to improve efficiency in network operations. Before introduction of the modern tools to accurately measure outage data, data was being manually collected by network operators, and analysis of the data was lacking. With the introduction of the tools, operators started paying attention to outage data and introduced new operational procedures aimed at minimizing network interruptions. Examples of operational improvements included (a) use of network capacity to divert loads during times of planned network maintenance to avoid shutdowns due to planned maintenance, (b) increasing use of live-line maintenance, and (c) faster interventions to react to unplanned network failures. The use of these improved procedures contributed to the targets for the SAIDI and SAIFI being exceeded beyond the original expectation, based on project supported technical interventions.

43. Owing to the demonstrated success of this intervention, the EVN incorporated the collection of outage data and reliability indices into their daily routine at an institutional level. During 2014, the EVN formally announced that the SAIDI and SAIFI indices will be used going forward to assess the performance of the PCs. This gives further incentive to the PCs to ensure efficient use of the tools and information to improve network performance, thus ensuring sustainability.

Objective 3: Reduce greenhouse gas emissions through demand-side response and efficiency gains.

Rating: High

44. The outcome 'Reduce greenhouse gas emissions through demand-side response and efficiency gains' was designed to be measured by calculation of avoided power generation and would be based on (a) reduction in the PCs' total losses and (b) reduction in electricity consumption. Following achievement of indicators related to PC losses and reduction in electricity consumption, this indicator was also

[20] Momentary average interruption frequency index.
[21] EVN Annual Report 2017.

overachieved in all the project areas. The indicator is a proxy for estimating avoided power generation equal to demand reduction. The project succeeded in reducing GHG by 365,707 tons per year against a target of 269,148 tons per year. Objective 3 was fully met.

45. The project effectively contributed to targeted capacity building, in line with the PDO, through Component C through a series of activities, as follows:

(a) **ERAV.** ERAV used the project to strengthen capacity in (i) DR, Smart Grids and Technical Codes—including piloting the DR programs for the PCs; (ii) enforcing and assessing load research regulation; (iii) improving and enhancing technical codes—grid codes, distribution codes, and technical procedures related to codes; and (iv) improving the efficiency of the tariff structure. This would enhance ERAV's capacity to deliver to the terms of Vietnam's Electricity Code. In addition, ERAV was assisted in drafting several legal documents related to improvement of efficiency in electricity tariffs and submitting them to the Ministry of Industry and Trade (MOIT) for issuance; and studies on sector reform were conducted to prepare for the power competition market.

(b) **PCs.** A series of training courses and study tours implemented by the PCs, and the workshops provided by ERAV under the project helped build capacity for the PCs' staff in areas of (i) improvement of customer satisfaction, (ii) implementation of AMI systems, (iii) load research, (iv) project management, (iv) monitoring and evaluation (M&E), and so on. In addition, intensive trainings on hotline repair and operation of Geographic Information Systems GIS were also delivered to the PCs' staff under the project (including training of trainers).

(c) **Both ERAV and PCs.** (i) Smart grid technology through study tours to more developed T&D grids to draw experience in development and operation of smart grid systems, (ii) application of regulations to encourage efficient electricity use, (iii) grid performance improvement and distribution efficiency, (iv) load forecasting and power grid system planning, (v) setup and operation of customer call centers, including communication skills and customer service, and (vi) medium voltage line and substation maintenance, including training of trainers to ensure transfer of knowledge. The training ensured that the EVN had internal capacity to supervise the project and sustain the installations funded by the project.

46. Component C also provided funds for some activities related to enhancement of regulatory activities by ERAV, that were in line with the PDO. Activities funded by ERAV included (a) revision and updating of technical regulations (distribution code, transmission code, metering code, and so on); (b) developing internal DR procedures including developing the DR road map and regulations; (c) developing guidelines and customized tools for load research; (d) developing a new tariff structure proposal; (e) developing Bulk Supply Tariff (BST) mechanism in preparation for the sector transition to wholesale competitive markets; and (f) developing market rules for the Wholesale Electricity Market of Vietnam. The activities contribute to achievement of the PDO as follows: (a) The revised grid code enhanced the standards for power system performance, operation, and metering, including setting indicators, reporting mechanisms and targets for network quality for PCs (SAIDI, SAIFI, and losses), and regulations on substation automation and electronic metering; (b) DR procedures and the new tariff structure increase incentives to PCs and their customers to manage supply/demand balancing, and hence manage quality

and reliability of supply; (c) the BST tariff mechanism provides incentives to the PCs to continuously reduce network system losses, since PC operational cost is an input to the BST; and (d) wholesale market rules give further incentive to the PCs to improve operational efficiency, since they would be bidding against each other to purchase electricity from generators.

Higher-level Objectives

47. The project contributed to the higher-level objectives for the sector. The electricity sector objective of sustainable energy security, cost reductions, and avoided GHG emissions were met through project activities resulting in reduction of distribution and commercial losses; sector objectives of sustained power sector efficiency were met through activities resulting in higher quality and more reliable electricity; and sector objectives of avoided GHG emissions were met through activities resulting in release of electricity to the network through rehabilitation of networks and reduction of technical and commercial losses.

Justification of Overall Efficacy Rating

48. **The overall efficacy rating is *High***. The project PDOs were fully relevant to the Vietnam electricity sector, and all the set objectives were either fully achieved or exceeded.

C. EFFICIENCY

Assessment of Efficiency and Rating

Rating: High

49. **Economic analysis.** The aggregated economic rate of return (ERR) and net present value (NPV) for the whole project at completion were 38.3 percent and US$2,496.7 million, respectively, indicating that the project was economically viable and increased social benefits by distributing more power with improved quality and efficiency. The aggregate ERR for the project at completion was significantly higher than 29.2 percent, which was calculated for the Phase 1 subprojects at appraisal. The detailed methodology and results are discussed in Annex 4.

50. **Financial analysis.** The aggregate financial internal rate of return (FIRR) and the NPV for the whole project at completion were 19.7 percent, and US$1,720.3 million, respectively. The FIRR was higher than 16.7 percent, which was calculated for the Phase 1 subprojects at appraisal and well above the 6 percent weighted average cost of capital (WACC) hurdle rate. The financial indicator indicates that the project was financially viable and brought various benefits to the PCs. In addition to the favorable condition of a stable macro economy, some key features of the Distribution Efficiency Project design and implementation contributing to enhance efficiency include:

(a) **Rapid and active implementation:** The average implementation period of a subproject ranged between 1 year and 1.5 years compared to 2 years assumed at appraisal. This contributed to the subprojects saving cost, mitigating the risk of cost overruns and promoting efficiency when being put into operation earlier than expected;

(b) **Efficient contract management resulted in virtually no cost overruns:** Investment cost at completion was generally less than that at appraisal owing to the stable macro economy, the practice of including anticipated project cost escalation at preparation,[22] project owners' good preparation, arrangement of sufficient counterpart funds[23], and efficient management; and

(c) **Good quality of completed works:** The first batch of subprojects were completed and have been in operation for five years. They are all still in a good shape, with stable and efficient operation and without any major issues. This contributes to promoting project efficiency.

51. Based on the economic and financial efficiency exceeding original expectations, the efficiency of this project is rated High.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

52. The overall outcome rating of the project is Highly Satisfactory. The PDO was highly relevant at the time of project design and is still highly relevant to the Vietnam electricity sector and the World Bank's strategy. All the project objectives were met or exceeded, and the efficiency of the project is higher than estimated at design. There were no shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Gender

53. An impact evaluation of rural electrification was carried out under the project,[24] that compared households connected to a reliable grid against those connected to an unreliable grid showed that households connected to a reliable grid significantly reduced the average time spent on housework by use of more numbers of suitable electrical appliances. The project therefore directly benefited women by reducing the time they spent on housework (women represent at least half of rural consumers, and more than half of the rural poor; and are also largely responsible for household activities that are highly dependent on the availability of clean and reliable sources of fuel, including collecting fuelwood for cooking, obtaining water for drinking and cleaning, preparing meals, taking care of children, and other activities essential for the family).

Poverty Reduction and Shared Prosperity

54. A study conducted in 2015[25] showed that, in general, access to good quality electricity supply in Vietnam contributed to improving the quality of life for many rural families. The PCs, through the project, improved efficiency, enhanced the quality and reliability of power supply services, reduced electricity

[22] Cost estimation at appraisal were done in a compliance with the GOV's cost norms that includes anticipated escalations in several following years. This practice was to avoid getting approvals again for the investment amount once it exceeds the approved level. The DEP was fortunately implemented under a stable macroeconomic context.
[23] Disbursed counterpart funds were lower than estimated at appraisal, but were sufficient for the purposes of the project.
[24] Report: "Impact of Rural Electrification in Vietnam" dated July 1, 2015
[25] Report: "Impact of Rural Electrification in Vietnam" dated July 1, 2015

losses, and improved the performance and accessibility of electricity distribution services; hence contributing to improving the quality of life for rural families.

55. **The impact evaluation study, "Impact of Rural Electrification in Vietnam", showed several positive impacts of having reliable electricity, as compared to unreliable electricity.** Most households surveyed indicated that (a) they extended their working hours and increased incomes, (b) the health of their family members was better, (c) electricity had created better conditions for children and adults to learn easily, and (d) socioeconomic factors of households had improved.[26]

Other Unintended Outcomes and Impacts

56. **The project contributed to Vietnam's recognition by the World Bank's World Doing Business Report (2018) for increasing the reliability of power supply by rolling out a SCADA automatic energy management system for the monitoring of outages and the restoration of service.**[27] The same report also recognizes Vietnam for reforms in the electricity sector that make it easier to do business and highlights as one of the areas of improved reforms: "Reliability of Supply and transparency of Tariffs[28]", recognizing the improvement in Vietnam's electricity supply reliability.

57. **The project, by contributing to improving operational efficiency of the EVN, contributed indirectly to achievement of the EVN in being awarded a BB credit rating by Fitch Ratings.** Overall quality and reliability of power supply is one of the factors against which the EVN is analyzed during credit rating audits. In 2018, the EVN achieved a BB credit rating with 'stable outlook' by Fitch Ratings. This is a major milestone for the EVN, allowing it to access offshore finance on a non-sovereign basis, since the GoV is no longer encouraging sovereign lending for infrastructure development in the electricity sector. The PCs are now, as a next step, preparing themselves for credit rating assessments.

58. **The project contributed to improvement of the EVN's services (which is an indication of improving electricity supply efficiency), as evidenced by regular customer service surveys that have shown consistent improvement of EVN services.** As a result of the study tours carried out under Component C, the EVN set up call centers and started conducting regular customer service surveys in all five PCs nationwide. The call centers established an interface between the PCs and their customer base and improved the relationship between the two. Customers can now call the PCs at any time to report any issues or claims and to request any services. In 2013, the EVN hired an independent consultant to evaluate its customer satisfaction index. The results of the assessment showed that within three consecutive years, the average customer satisfaction level of the EVN increased by 0.82 points, continually increasing with time. The customer satisfaction average score increased, on an improving 10-point scale, from 6.45 points in 2013, to 6.9 in 2014 and 7.27 in 2015.[29] The EVN reported in its 2016 annual report that their customer satisfaction index had improved.[30]

[26] There was a decrease in the number of simple houses (more concrete houses), increase in access to piped water, increase in households using septic tanks, decrease in average time spent on cooking, and decrease in proportion of poor households.
[27] World Bank's "World Doing Business Report 2018" page 140.
[28] World Bank's "World Doing Business Report 2018" page 204.
[29] EVN business report, 2016.
[30] EVN annual report 2016, page 3.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

Project Design

59. **The project was designed based on Vietnam's energy sector needs as defined by the NEDS guiding the sector to 2020, the GoV's PDMP, and provinces' priorities at the time of approval.** The strategy focused on improving sector efficiency to reduce generation requirements by increasing operational efficiency and reducing losses, hence contributing to reduced GHG emissions. Quality and reliability of electricity supply were also emerging as an important issue. The focus of the GOV's program was therefore on improving power system efficiency. The project was aligned to the GoV's strategies for the power sector (see section on 'Relevance of PDOs'). The project components were designed based on simple technical solutions relevant to solve the issues identified, which contributed to effective implementation and results.

60. **Relevant subprojects were selected from the list of subprojects in the City/Provincial PDMP that is approved by the MOIT and updated every 10 years with a vision to 20 years.** The first phase subprojects, which would already be aligned to the PDO, were picked in collaboration with the local authorities, ensuring speedy implementation, and laid down a good basis and experience for selection of subprojects in the second phase.

61. **The project design, as explained in the Project Appraisal Document (PAD), incorporated lessons learned from design and implementation of other World Bank-financed projects.** For example, the flexibility of the project implementation that was introduced in two earlier operations[31] was used in the project design. This flexibility meant approving projects in phases starting with those ready for implementation at appraisal, as the PCs cleared bottlenecks to projects to be implemented during subsequent phases. To ensure a fast start up, the project used this phased approach to choose subprojects. Those that were appraised and ready for implementation upon Board approval were included in the first phase. The project design required that the subprojects to be included in the second phase should be ready for implementation by midterm review or funds would be reallocated, thereby ensuring flexibility, allowing the use of cost savings or shifting of funds between subprojects, and creating incentives for timely implementation by the PCs.

Objectives and Results Framework

62. **The objectives of the project were clearly defined, easy to understand, targeted toward addressing specific issues, and relevant to the situation in the Vietnam energy sector that focused on improving efficiency of utility operations.** The PDO could have benefited from refining of the objective for the PC performance by de-linking it from the objectives of quality and reliability of service; however, that notwithstanding, these objectives were measured by a relevant set of indicators to assess their achievement as formulated in the PDO.

[31] Second Rural Energy Project (IDA-45760, IDA-40000, TF 54464, closed in 2014) and Rural Distribution Project (IDA-44440, TF 94257, closed in 2013).

63. **The PDO indicators were aligned to the operational objectives and met the SMART[32] criteria.** The intermediate indicators were directly linked to the project objectives. The baseline values were manually calculated a year before project approval, owing to lack of modern tools. Outage data was manually recorded and used to calculate baseline values for the SAIDI and SAIFI. The targets were realistically set and were all achieved and exceeded in the end. Some of the targets were exceeded by a very large percentage because (a) competitive bidding processes, including separation of bidding packages into 'goods' and 'works' led to savings that were reinvested back into more activities, (b) behavior change by distribution network operators to better manage planned outages following real-time awareness of the SAIDI/SAIFI indicators introduced by the measurement tools; and (c) behavioral change of large consumers following real-time awareness of their consumption patterns (see section on 'Assessment of Achievement of Objectives' – Objective 1 and Objective 2).

Risk and Mitigation Measures

64. The risks associated with the project were adequately identified at the design stage. These included (a) lack of counterpart funds, which could slow down implementation; (b) capacity of the HNPC as this was the first time this PC participated in a World Bank-financed project; and (c) opposition to some subprojects on use of land that could delay or deny construction permits due to changes in land use. The capacity building activities implemented under the project's technical assistance component helped mitigate these risks. Although there was complexity of land acquisition in some provinces and cities, this was mitigated by (a) the moderate impact level of the project; (b) seasoned social safeguards staff in the PCs; and (c) good performance on social safeguards by PCs in previous World Bank-financed projects.

Readiness for Implementation

65. **The project was designed in a manner to ensure that there are no delays in implementation of activities after project approval and effectiveness.** To facilitate advancement for numerous subprojects with different implementation speeds, it was decided at the time of appraisal that the project would be implemented in two phases. In the first phase, the subprojects that were ready for procurement, were appraised and approved. These subprojects kicked off as soon as the project was approved, even before effectiveness. In subsequent phases, subprojects were added to the project scope, subject to their meeting established criteria for economic, financial, technical, and social and environmental safeguards performance. This approach allowed for quick and efficient use of funding.

B. KEY FACTORS DURING IMPLEMENTATION

66. **The MOIT and the implementation agencies typically delegated authority for decision making to the lowest level practical, which helped to speed up the implementation progress.** The MOIT delegated the responsibility for overall coordination of the project to the EVN. The project had six implementing agencies (IAs), namely the five PCs for Components A and B and ERAV for Component C. A Project Operations Manual was prepared by the MOIT to serve as a guide to the IAs. The IAs delegated implementation to the lowest practical level within their structures. For example, the NPC (consisting of 27 provinces and numerous subprojects) split the contracts into supply and works contracts, and delegated responsibility for works on 110 kV and low voltage to the PComs, who are based in the field

[32] Specific, Measurable, Attributable, Relevant, Time-Bound.

and close to the communities and local authorities. This facilitated quick implementation because many subprojects were implemented simultaneously. Being based in the field, the Provincial People's Committees were instrumental in land acquisition. Centralizing procurement of goods helped the project to benefit from low prices due to economies of scale. A bottom-up approach to reporting on implementation progress was established, with the PComs reporting on a weekly basis to the Project Management Unit (PMU), which sent reports to the NPC every month. The NPC then sent quarterly reports to the EVN and Ministry of Planning and Investment. The reporting approach facilitated quick resolution to any project-related issue before escalation when necessary.

67. **The project at some instances suffered some delays owing to approval processes taking longer than anticipated.** For example, the EVN's slow decision on specifications of electronic meters and functionality of the MDMS caused delays in preparation of feasibility study reports and bidding documents, thus subsequently delaying the kickoff of the AMI implementation. In addition, the change to regulations of Official Development Assistance (ODA) management and Law on Public Investment, that required every single subproject to be approved by the MOIT, could have adversely affected the overall progress of the project, as it did other projects in the Vietnam portfolio. The flexible design of the project, in parallel with quick intervention by the IA's and the World Bank supervision team during implementation, ensured that these delays did not affect project outcomes.

68. **Difficulties in land acquisition in big cities and provinces (for example, Ha Noi and Dong Nai) caused delays in some subprojects, and eventually some of the subprojects were not fully implemented by project close.** For example, for the Phu Xuyen subproject in Ha Noi, the land for the substation could not be acquired within the project lifetime, and the new location for the substation is scheduled to be available for construction in June 2019; whereas in the case of the Giang Dien transmission line, land acquisition was affected by rapid urbanization and industrialization in Dong Nai province, resulting in increases of land prices. In both cases, equipment for the subprojects was purchased and delivered using the project funds, and counterpart financing is being used for implementation to subproject completion. The Giang Dien transmission line is scheduled to be complete by November 30, 2019. In three other subprojects, although by project close equipment was purchased, and installation works was advanced, the works portion of the projects could not be completed during the project lifetime, because of delays in land acquisition, however the three projects were completed by the end of May 2019. Although Phu Xuyen and Giang Dien subprojects were not fully completed by project closure, sustainability risk to their completion and operation is low.

69. **Because of the depreciation of the Australian dollar versus the U.S. dollar during the project lifetime, financing amounts under the grant agreements in U.S. dollars reduced.** At appraisal, the amount from AusAID was US$8 million equivalent that was later reduced to US$6.2 at effectiveness. Since the amount of the funding had reduced, the list of activities was revised to reflect the reduced amount, with priority given to those activities that contributed more to achievement of the PDO (for example, some of the prioritized projects included (a) DR program for PCs, (b) Supporting ERAV in implementing the smart grid program, and (c) Improving the efficiency of the tariff structure).

70. **Close supervision by experienced World Bank task team members on the ground, combined with the IA's staff experience and willingness to learn contributed to implementation success.** The PCs submitted monthly implementation progress reports to the World Bank task team, while the task team conducted implementation review meetings biannually and visited project sites at short notice as

necessity arose. This was practical owing to the task team's proximity to the project, with the team being based in the country office. This combination of activities between the PCs and the task team made it relatively easy to identify problems early in the lifetime of the subprojects and quickly identify solutions together with the PCs. For example, the task team regularly supported the PCs (a) during land acquisition periods, by participating in the meetings with Provincial People's Committees, (b) in meetings with the MOIT management when there were delays in approval processes, (c) with site visits to verify technical proposals and recommend solutions, and (d) with technical support on the AMI system functionality.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

71. **The M&E function was adequately planned for during project design and is relevant to the EVN for further projects.** Since some of the PCs were not familiar with the M&E mechanisms, ERAV hired a consultant to design the M&E framework and mechanism during project preparation. In addition, the PCs received capacity building support for its development and implementation. Because of this adequate preparation of the M&E framework and its successful implementation, the EVN incorporated the M&E framework into its operations and draws from it for monitoring of all their projects.

M&E Implementation

72. **The M&E function was managed satisfactorily by ERAV for the purposes of reporting.** The collection and reporting of the M&E indicators were provided to the World Bank task team monthly using a common template agreed upon between the PCs and the World Bank task team. Collection of data was through the PCs Integrated Business Management System modules (CMS[33], DMS[34] and MDMS [MDMS was installed through the project]). The PDO Indicators were collected, calculated by the PCs and submitted to the EVN and the MOIT in accordance with the guidelines of the revised distribution code. The indicators were also submitted to the World Bank task team. A special project monitoring template was developed by the World Bank task team for the IAs to use for reporting of intermediate indicators for monitoring of the implementation progress. The reports were submitted monthly. The task team followed the progress of the project to such detail as procurement status, construction status, and payment status; and if any issues emerged, the team gave adequate support such as advice or site visits to help the IAs solve any problem early in the subproject lifetime.

M&E Utilization

73. The indicators, being collected regularly, were effectively used to evaluate the timeliness of the project implementation and decide actions to remedy the implementation delay. Some of the project indicators (SAIDI, SAIFI, and MAIDI) are now used by the EVN for annual performance evaluation of the PCs. The indicators are regularly submitted to ERAV in accordance with the provisions of the distribution

[33] Customer Management System.
[34] Distribution Management System.

code. The data is also used to inform load forecasts and planning for network improvement/maintenance.

Justification of Overall Rating of Quality of M&E

74. The design of the M&E was adequate, and its operationalization and utilization were used to regularly inform all relevant parties on project progress, and highlight areas requiring quick decision-making during implementation. The quality of M&E is rated High.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

Social and Environmental Safeguards

75. **Overall, the social and environmental safeguard issues were addressed adequately in the project design to minimize social and environmental impacts and ensure compliance with the relevant World Bank safeguard policies.** The project triggered two World Bank's social safeguard policies: Involuntary Resettlement (OP/BP 4.12) and Indigenous Peoples (OP/BP 4.10). Social safeguard instruments (Resettlement Policy Framework, Ethnic Minority Policy Framework, and where relevant Resettlement Action Plans, and Ethnic Minority Development Plans) were prepared, reviewed, cleared and disclosed following the World Bank and Government's requirements. The project was classified as category B and triggered the safeguard policy OP 4.01 on Environmental Assessment due to the potentially negative environmental and social impacts during implementation of subprojects under Component A owing to civil works associated with the project activities. An Environmental Management Framework (EMF) was prepared and adopted by the EVN and applied to all subprojects.

76. **The safeguards rating at project close was 'Satisfactory' for both environmental and social safeguards.** The Environmental Management Plans (EMPs) for the subprojects were prepared in accordance with the EMF. The safeguard documents (EMF, EMPs) were disclosed in Vietnamese language at the Vietnam Development Information Center (VDIC), EVN, the PMUs, and the sub-project area provinces; and in English language at the WB Infoshop. Throughout the project cycle, the project complied with all safeguard policies triggered. PMUs dedicated staff for environmental safeguards management. Development and clearance of EMPs during implementation were in accordance with the national regulations and the WB's safeguard policies. Environmental provisions were incorporated in all bidding documents and the requirements were abided by. Environmental monitoring on contractors' performance was carried out as required. Reports on safeguard compliance were periodically submitted to the Bank for review and any issues identified during implementation supervision missions on contractor's performance were always addressed. There were no outstanding environmental issues.

77. As of May 31, 2019, the implementation of social safeguard instruments (RAPs and EMDPs) have been completed in 167 of 169 Component A subprojects (98.8 percent). The only pending issues are related to two subprojects (one for HNPC and one for SPC) where civil works and land acquisition/compensation activities have started and are targeted to be complete by June 30, 2019 (see paragraph 68). Nonetheless, all the PCs demonstrated good social safeguards performance on multiple fronts; although, in hindsight, the project could have benefited from more advance consultations on the ground with the local communities in areas prone to more difficult land acquisition practices. The PCs were able to minimize physical relocation (only five households were relocated out of 12,880 Project Affected Households) by the construction/execution of 169 subprojects. Although the number of affected

households was high (owing to the inherent nature of linear projects), the impact at household level was low and/manageable. The PCs implemented all the proposed mitigation measures. Consultation with affected households, local communities, and local authorities were conducted as per the requirements of OP 4.12 and OP 4.10. Compensation was paid to the affected households to a total of VND 287 billion (US$ 12.4 million equivalent). The PCs maintained solid internal systems allowing proper monitoring, tracking, and reporting of safeguards performance during the project lifetime.

78. **A major success of the project is the integration of the World Bank's safeguards policies into the EVN's day-to-day project activities,** owing to the success registered by following the World Bank's policies and procedures related to social and environmental safeguards management. The EVN is now using the World Bank template for their own and other financier-funded projects.

Procurement

79. **Procurement performance was rated 'Satisfactory' at project close.** This was owing to clear procurement regulations (both World Bank and country), excellent trainings from the PCs and the World Bank, and intensive guidance and monitoring from the procurement expert in actual preparation of the bidding documents and the bid evaluation. During the project period, no cases of fraud and corruption were detected.

Financial Management

80. **Financial Management was rated 'Satisfactory' at project close.** The financial management function of the project, which was managed by the Accounting and Finance division and project management teams at all IAs, performed satisfactorily, and in compliance with the World Bank's financial management policies and procedures throughout the project life. The project financial management arrangement, as well as the project implementation arrangement, was decentralized by the design. Each PC was responsible for their own budget preparation, financial reporting and auditing, contract and expenditures management, expenditures verification, and accounting records maintenance. The PCs managed the project designated accounts opened at commercial banks for each of IDA and CTF sources. CPC managed another designated account for AusAID-funded technical assistance activities. Interim financial reports were submitted by PCs to the World Bank quarterly. Financial audit by an independent firms was conducted annually, and audit reports of acceptable quality were submitted to the World Bank before end of June of the following year in accordance with the Financing Agreement. The PCs and the EVN also submitted their entity audited financial statements prepared in accordance with International Financial Reporting Standards to the World Bank annually.

Legal Covenants

81. The project, in the Financing Agreement, had five legal covenants, which were all met.

C. BANK PERFORMANCE

Quality at Entry

82. **The project was relevant to the GoV's energy sector priorities as defined in the NEDS, SEDP, and PDMP7.** PDMP7 identified power sector investments required for achieving sustainable development and security of supply in the years after 2011–2016; specifying, among others, development of a smart grid road map for T&D, upgrading and expansion of the distribution system, and modernization and enhancing planning and operation of the PCs. The design of the project effectively sought to address these critical issues by (a) improving the reliability, efficiency, and quality of power supply and (b) commercialization of the PCs as they become increasingly independent of the EVN and operate in a wholesale power market and under a new regulatory framework.

83. From technical, financial, and economic perspectives, the investment subprojects were sound, aligned to the development objective, and targeting the most urgent areas in the power distribution network first.

84. **During project preparation, the task team mobilized two trust funds that boosted the project funds to conduct technical assistance activities under the project.** Under the Australian TF, a series of technical assistance activities were implemented to assist ERAV in the process of reforming the power sector, preparing for a competitive market, and improving the capacity of the PCs. The Clean Technology Funds (CTF) assisted the PCs in introduction of the new technology of smart metering, enabling the PCs to improve operational services to large customers and contributing to reduction in gas emissions.

85. **The planned implementation arrangements were suitable, combining the centralized and decentralized institutional and governance structures in Vietnam**. The project implementation arrangement was optimized based on experiences from past World Bank projects as well as following the GoV's regulations on ODA projects. As guided by the World Bank team during project preparation, the PCs followed the practice of centralizing goods supply at the PC level, and decentralizing procurement and supervision of works at the PCom level. Centralizing goods supply helped the PCs take advantage of economies of scale. Decentralizing the procurement and supervision of works contracts to the PComs proved efficient especially since the PCs implemented projects in a large area involving many provinces. This arrangement maximized implementing capacity and brought implementation closer to the local authorities for easier management of land acquisition/compensation and environmental management issues. Separating goods and works packages for competitive bidding also led to substantial savings that were injected back to the project to deliver more subprojects. The project's design was flexible, ready for rapid start up, and could be implemented on a decentralized basis.

Quality of Supervision

86. **Throughout the project lifetime, the project had a competent and experienced task team leader supported by task team members consisting of all the relevant resources, including those related to fiduciary matters (finance, procurement, legal, and safeguards)**; all based locally and providing hands-on and quick support to the IAs when required. The project was regularly monitored through implementation support missions documented in Aide Memoires, and reporting was done through regular Implementation Status Reports. During each implementation support mission, the task team conducted

a very detailed assessment of the project status and challenges. They conducted site visits spread nationwide in each and every mission, each of which lasted at least a month. The missions always placed extra focus on the most challenging subprojects that needed the World Bank's support on resettlement, environment, and technical issues.

87. The task team filed 12 Implementation Status Reports through the project lifetime, regularly and systematically documenting candid project performance indicators and updating the Results Framework. The ratings from the ISRs were actively shared with the PCs and used as performance signals to the PCs. In the June 2018 ISR, the implementation progress of the project was downgraded from 'Satisfactory' to 'Moderately Satisfactory' despite good progress in most of the subprojects. This was to send an appropriate signal to PCs that had subprojects that were behind schedule, and this helped the task team to ensure that PCs stepped up implementation performance. At the last ISR, filed during January 2019, progress toward achievement of PDO rating and implementation progress ratings were both upgraded to 'Highly Satisfactory', mainly due to two reasons: (a) the project fully achieved or exceeded the targets of PDO-level indicators, and (b) the 177 subprojects implemented under the project exceeded by far (180 percent) the target of 99 subprojects that the five PCs planned at the project appraisal.

88. **The task team provided valuable support to the IAs through the project lifetime, contributing to the project success.** The task team consistently provided support on arising issues, including (a) procurement and implementation plan progress, (b) social and environmental safeguards compliance, (c) compliance with the legal covenants of the project, (d) financial management guidance, including management, and (e) technical guidance. Although there were some implementation difficulties, the World Bank team was proactive in its support to help identify and address the issues as they emerged. Examples of the proactivity and responsiveness of the task team include:

(a) Proactive support to the HNPC, that was implementing a World Bank-financed project for the first time, by delivering training through workshops and through on-the-job training on procurement;

(b) Providing clear guidance on fiduciary compliance requirements and providing training to the PCs in financial management and International Financial Reporting Standards requirements, since some PCs lacked experience in implementation of IDA-financed projects;

(c) Timely review and clearing a large number of goods and works procurement packages to enable rapid start-up and disbursements after the project became effective; and

(d) Supporting the EVN and the PCs with international expertise when they met technical difficulties defining the MDMS functionality by referencing similar projects worldwide and providing specialists' advice.

89. **Through workshops, the task team transferred knowledge to the IAs to fill relevant identified knowledge gaps.** At project launch, the task team held a workshop with the PCs and conducted training on all aspects of project implementation and management (financial management, procurement, M&E, and so on). During implementation, ad hoc training was conducted as required. Training was particularly important for the HNPC which was implementing a World Bank-financed project for the first time. The task team also conducted workshops covering project-relevant technical topics such as smart systems for

utilities, experiences of different utilities in sector reform, and so on.

90. **Despite the challenging and sometimes changing policy environment, the project was successfully delivered owing to a combination of a well-defined technical assistance component and diligent supervision from the World Bank team.** The project was implemented during a period of many changes, including (a) Vietnam graduating from being an IDA country, (b) public debt in Vietnam approaching the threshold, (c) ODA management changing from the State Bank of Vietnam to the Ministry of Finance, (d) the MOIT's management changing, and (e) change to regulations of the ODA management and Law on Public Investment requiring each subproject to be approved by the line ministry (MOIT). These factors added approval difficulties during the project implementation, requiring much closer supervision by the task team than normal. Owing to the flexible design of the project that allowed quick allocation of subprojects and/or technical assistance activities once funds became available, and the diligence of the task team in problem solving, there were no negative impacts on the PDO arising from the changing environment.

Justification of Overall Rating of Bank Performance

91. **The rating of the World Bank Performance is Highly Satisfactory.** The World Bank task team was diligent in preparation of the project, ensuring that the projects outcomes were relevant to Vietnam's energy sector needs and strategies at the time of project preparation and incorporated lessons from previous projects to ensure smooth implementation. The task team covered all the required project aspects during preparation, including fiduciary, risk assessment, M&E preparation and arrangements, social and environmental safeguards, and so on. During project implementation, the task team proactively supported the IAs, giving them guidance and advice, resulting in a highly successful project.

D. RISK TO DEVELOPMENT OUTCOME

92. **The risk that the development outcomes achieved by the project may not be sustained is Low.** The risks include (a) deterioration over time in the reliability and quality of electricity supply arising from increasing energy consumption in the project areas, (b) insufficient future investment in the power system to meet future load growth, and (c) increase of the GHG emissions from new electricity generation plans to fill gaps created by the demand growth.

93. **Vietnam's GDP growth is expected to continue at an average rate of 8 percent per year through to 2030, and this growth in electricity consumption will imply more strain on the distribution system which was revamped by the project.** The portions of the network that were not upgraded by the project (or other projects) will begin to feel the strain of load growth, as will the upgraded portions after considerable load growth has happened. The PCs will need to continue monitoring the electricity distribution network using the tools acquired by the project (for example, SCADA) and proactively plan further network reinforcement and upgrades. The utilities are aware of this threat and have gained the necessary training and experience both to monitor the network and identify areas that require improvement, and to conduct some of the works internally. The EVN has included performance, reliability, and quality indicators in their annual performance evaluation of the PCs, giving them an added incentive to ensure continued improvement of their networks. Component C of the project specifically included capacity-building activities in the areas of load research, improvement of efficiency in electricity tariffs, enhancement of efficiency of and incorporation of smart grid technologies in the grid and distribution

codes, integration of renewable energy in the grid and distribution codes, development of the DR and smart grid programs, and so on.

94. **Continuous upgrade of the distribution network will require substantial amounts of funding, while the GoV is moving toward reducing their dependency on foreign public loans.** Because of Vietnam's graduation to an MIC, combined with macro and fiscal economic constraints, the EVN needs to start mobilizing required capital expenditures from sources other than concessional loans. In 2018, the EVN achieved its first, positive rating (BB with 'stable outlook' for long-term foreign currency) from the Fitch ratings. This positive rating puts the EVN in a position to access international capital markets on a non-sovereign basis. According to the World Bank's recent report on Maximizing Finance for Development, the EVN can now access commercial financing or blended financing. There are many commercial banks (both domestic and international) that are willing to lend to well-structured projects, and currently there are trillions of dollars with institutional investors (for example, pension funds and insurance companies) that are beginning to look at emerging market infrastructure as a possible investment class because of the returns on these assets and because these infrastructure assets are typically long-term in nature, which matches their long-term insurance and pension liabilities.[35] The EVN is now able to access such funding to continue maintaining their networks.

95. **The GoV estimates that generation capacity needs to increase from the current 42 GW to 60 GW by 2020 and to 100 GW by 2030. This would require the installation of 5 GW annually between 2018 and 2030**. This increases the risk that generation sources capable of increasing GHG emissions would be exploited. The GoV, being aware of this risk, recently approved the Renewable Energy Development Strategy and set up specific RE targets in the PDMP. The PDMP is updated every five years, and the targets for RE are then assessed and updated.

96. Although the risks mentioned above may threaten the sustainability of the project outcomes, the GoV and the energy sector actors have the information, tools, and political will to mitigate these risks. The risk that the development outcomes achieved by the project may not be maintained is therefore Low.

V. LESSONS AND RECOMMENDATIONS

97. **Projects that are designed in alignment with government strategies and objectives; with high technical relevance to the energy sector; combined with solid preparatory work; implemented within a context of strong government ownership and interest; and supported by strong governance structures are more likely than not to achieve their final objectives.** Power system planning within the energy sector in Vietnam is centrally managed, and the decision-making process is collective. Projects are designed in alignment with clear Government strategies and based on sector-specific sound technical studies and a clear road map**.** Subprojects relevant to the PDO were picked from a pool of projects contained in the provincial plans. All the projects in the provincial plans are developed in alignment with the Government's NEDS. The NEDS, which is drawn from the SEDS/SEDP, is developed by the MOIT and approved by the PMO. The PDMP, which is drawn from the NEDS, is developed by the Energy Institute, which submits the plans to the MOIT to submit to the PM for approval. The provincial plans, which is the pool from which relevant subprojects are picked, are developed by the Energy Institute for the Provincial People's

[35] Vietnam - Maximizing Finance for Development in the Energy Sector - January 23, 2019

Committee, which submits them to the MOIT for approval. This process ensures that all subprojects planned for implementation are aligned to the NEDS, and the collective decision-making process ensured the project was adequately sold to management and staff of the PCs, and therefore increased incentive for successful project delivery.

98. A series of technical studies was carried out by the PCs during project preparation, to facilitate detailed design of the specific interventions of the project. All the five PCs implemented surveys during project identification and preparation to assess the application and potential of smart grid technologies in each PC, the challenges anticipated during implementation, and proposed technologies for future development. The assessments and findings were presented in a workshop that was held during project identification. The results of the studies formed the definition of the longer road maps for introduction of the new technologies for the smart systems, such as smart meters, SCADA, unmanned substations, and improvement in the business services such as call centers, customers' satisfaction, and so on. The short- and long-term outcomes were achieved because the subprojects were based on technically sound analysis. Because technical resources typically remain within the energy sector, there is technical stability within the sector institutions (MOIT, ERAV, EVN, and PCs), ensuring continuity and sustenance of the project outcomes.

99. **For successful implementation of a large, complex project such as this project, the project implementing structure and close and effective supervision (both internally within the IA, and by the World Bank task team), combined with capable staff in the IAs is a prerequisite.** Complexities in project management arose because the project had hundreds of subprojects under three different components (including many technical studies and capacity-building activities) and was implemented by five different IAs. The project implementing structure encouraged decision making at the lowest practical level, facilitating quick decision-making during implementation (see section on 'Key Factors Affecting Implementation'). Reporting from the lowest level of the PComs to the MOIT was well structured, ensuring tight management and reporting enforcement. The fact that the World Bank task team consisted of experienced team members, who were all based in the field, combined with the task team having in-depth knowledge of the status each subproject, helped facilitate close monitoring of the project implementation. The project management board established in each IA had strong and capable teams, with cross-cutting skills, including project management and sound technical skills. The technical assistance and capacity building helped fill gaps identified in technical skills. Coordination among various departments and between the PCs and the World Bank was effective, helping to deliver on the complex project.

100. **Flexibility during project management on aspects of physical scope and approval is essential for the sustained success of large complex projects.** The project had hundreds of subcomponents to be implemented by six different IAs, in difficult areas, over a long period of time. It was essential that the IAs could quickly adjust to unexpected conditions that would inevitably arise. The project benefited from the flexibility of the phased approach to project implementation as decisions on subprojects were made based on those which had the flexibility to be implemented quicker. Continuously introducing further flexibility during project implementation also helped to shorten time for critical decisions. For example, during the project lifetime, flexibility in land acquisition was introduced when the EVN successfully lobbied through the Ministry of Environment and Natural Resources to have land acquisition approved at the level of the Department of Environment and Natural Resources as opposed to the Prime Minister's Office. This greatly reduced the amount of time it was taking for approvals for land acquisition.

101. **Involving all relevant stakeholders including local authorities early in the project preparation process is critical to successful safeguard activities.** Land acquisition and resettlement activities required under investments are becoming increasingly difficult in Vietnam. The project suffered delays due to delayed approvals for land acquisition, and in some cases, the works portion of five subprojects could not be completed within the project lifetime; hence the project financed only the relevant material supply (see section on 'Environmental and Social Safeguards'). The project could have benefited from early consultations with the relevant local authorities outlining the benefits and potential impacts of the project and receiving their consensus before project implementation. For further strengthening the implementation of social safeguards, more emphasis should have been given to (a) information disclosure and consultation at project preparation, in a more targeted/tailored manner; (b) implementation of developmental activities (for example, training) provided to ethnic minority communities; and (c) close collaboration with the local authorities to match the proposed developmental support and local needs.

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ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: Improve the performance of the Recipient's PCs in providing quality and reliable electricity services.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Total Distribution Losses: 3. Southern Power Corporation (SPC) - Losses in project areas	Percentage	10.24 31-Dec-2011	7.60 31-Dec-2011		4.39 14-Dec-2018

Comments (achievements against targets):
The target was exceeded

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Power Quality: 2.	Number	0.00	0.00		0.00

: Ho Chi Minh City Power Corporation and Hanoi Power Corporation - Voltage excursion outside +/-5% at 110kV/MV transformers, in project areas		31-Dec-2011	31-Dec-2011		14-Dec-2018

Comments (achievements against targets):
The target was achieved.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Indicator consumption reduction for AMI consumers (2) - Northern Power Corporation (NPC)	Gigawatt-hour (GWh)	0.00 31-Dec-2011	181.60 31-Dec-2011		210.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Total	Percentage	13.58	10.39		2.91

Distribution Losses: 3:Central Power Corporation (CPC) - Losses in project areas		31-Dec-2011	31-Dec-2011		14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Total Distribution Losses: 3. Northern Power Corporation (NPC) - Losses in project areas	Percentage	24.38 31-Dec-2011	11.39 31-Dec-2011		9.63 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Power Quality: 2. Northern Power Corporation (NPC) - Voltage excursion outside +/-5% at 110kV/MV	Number	60.00 31-Dec-2011	40.00 31-Dec-2011		40.00 14-Dec-2018

transformers, in project areas					

Comments (achievements against targets):
The target was achieved.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.2 Central Power Corporation (CPC) - System Average Interruption Frequency Index (SAIFI) in project areas calculated as in Distribution Code (1).	Number	23.53 31-Dec-2011	20.95 31-Dec-2011		9.11 14-Dec-2018

Comments (achievements against targets):
The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Indicator consumption reduction for AMI consumers (2) - Hanoi Power Corporation	Gigawatt-hour (GWh)	0.00 31-Dec-2011	69.10 31-Dec-2011		72.20 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.2 Northern Power Corporation (NPC) - System Average Interruption Frequency Index (SAIFI) in project areas calculated as in Distribution Code (1).	Number	19.80 31-Dec-2011	18.65 31-Dec-2011		11.26 14-Dec-2018

Comments (achievements against targets):
The indicator was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.2 Southern Power Company (SPC) - System Average Interruption Frequency Index (SAIFI) in project areas calculated as in Distribution Code (1).	Number	24.30 31-Dec-2011	21.60 31-Dec-2011		3.23 14-Dec-2018

Comments (achievements against targets):
The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Indicator consumption reduction for AMI consumers (2) - Central Power Corporation (CPC)	Gigawatt-hour (GWh)	0.00 31-Dec-2011	59.10 31-Dec-2011		60.50 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Indicator consumption reduction for AMI consumers (2) - Total Northern Power Corporation (NPC), Ho Chi Minh City Power Corporation (HCM PC), Hanoi Power Corporation (HN PC) and	Gigawatt-hour (GWh)	0.00 31-Dec-2011	414.10 31-Dec-2011		448.50 14-Dec-2018

Central Power Corpor					

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Total Distribution Losses: 3. Ho Chi Minh City Power Corporation (HCMPC) - Losses in project areas	Percentage	7.86 31-Dec-2011	5.50 31-Dec-2011		3.90 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Power Quality: 2. Southern Power Corporation (SPC) - Voltage excursion outside +/-5% at 110kV/MV transformers, in project areas	Number	25.00 31-Dec-2011	4.00 31-Dec-2011		0.00 14-Dec-2018

Comments (achievements against targets):
The target was met.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Total Distribution Losses: 3. Hanoi Power Corporation (HNPC) Losses in project areas	Percentage	19.00 31-Dec-2011	12.00 31-Dec-2011		9.80 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Indicator on Power Quality: 2. Central Power Corporation (CPC) - Voltage excursion outside +/-5% at 110kV/MV transformers, in project areas	Number	0.00 31-Dec-2011	0.00 31-Dec-2011		0.00 14-Dec-2018

Comments (achievements against targets):
The target was met.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.2 Ho Chi Minh City Power Corporation (HCMPC) - System Average Interruption Frequency Index (SAIFI) in project areas calculated as in Distribution Code (1).	Number	7.62 31-Dec-2011	2.50 31-Dec-2011		1.08 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.1 Central Power Corporation (CPC) - System Average Interruption Duration Index (SAIDI) in project areas, calculated as in Distribution Code (1)	Minutes	3631.00 31-Dec-2011	3234.00 31-Dec-2011		1027.00 14-Dec-2018

Comments (achievements against targets):

The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.1 Northern Power Corporation (NPC) - System Average Interruption Duration Index (SAIDI) in project areas, calculated as in Distribution Code (1)	Minutes	5145.00 31-Dec-2011	4656.00 31-Dec-2011		989.00 14-Dec-2018

Comments (achievements against targets):

The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Indicator consumption reduction for AMI consumers (2) - Ho Chi Minh City Power Corporation (HCMPC)	Gigawatt-hour (GWh)	0.00 31-Dec-2011	104.30 31-Dec-2011		105.80 14-Dec-2018

Comments (achievements against targets):

The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.1 Ho Chi Minh City Power Corporation (HCMPC) - System Average Interruption Duration Index (SAIDI) in project areas, calculated as in Distribution Code (1)	Minutes	1682.00 31-Dec-2011	384.00 31-Dec-2011		94.00 14-Dec-2018

Comments (achievements against targets):

The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.1 Hanoi Power Corporation (HNPC) - System Average Interruption Duration Index (SAIDI) in project areas, calculated as in Distribution Code (1)	Minutes	299.00 31-Dec-2013	291.00 31-Dec-2011		265.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.1 Southern Power Corporation (SPC) - System Average Interruption Duration Index (SAIDI) in project areas, calculated as in Distribution Code (1)	Minutes	6958.00 31-Dec-2011	5525.00 31-Dec-2011		598.62 14-Dec-2018

Comments (achievements against targets):
The target was exceeded. The big difference between the target and the achievement is owing to human intervention in management of the network by the operators as a result of awareness introduced through the technical tools.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1.2 Hanoi Power Corporation (HNPC)- System Average Interruption Frequency Index (SAIFI) in project areas calculated as in Distribution Code (1).	Number	1.73 31-Dec-2011	1.67 31-Dec-2011		1.63 14-Dec-2018

Comments (achievements against targets):
The target was met.

Objective/Outcome: Reduce greenhouse gas (GHG) emissions through demand side response and efficiency gains

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Avoided GHG (3) - Northern Power Corporation (NPC)	Tones/year	0.00 31-Dec-2011	118015.00 31-Dec-2011		171234.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Avoided GHG (3) - TOTAL Northern Power Corporation (NPC), Ho Chi Minh City Power Corporation (HCM PC), Hanoi Power Corporation (HN PC) and Central Power Corporation (CPC)	Tones/year	0.00 31-Dec-2011	269148.00 31-Dec-2011		365707.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Avoided GHG (3) - Central Power Corporation (CPC)	Tones/year	0.00 31-Dec-2011	38425.00 31-Dec-2011		49332.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Avoided GHG (3) - Ho Chi Minh City Power Corporation (HCM PC)	Tones/year	0.00 31-Dec-2011	67818.00 31-Dec-2011		86269.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Avoided GHG (3) - Hanoi Power Corporation (HNPC)	Tones/year	0.00 31-Dec-2011	44890.00 31-Dec-2011		58872.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

A.2 Intermediate Results Indicators

Component: Component (A): System Expansion and Reinforcement

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Intermediate Result indicator for Component A: Implementation progress of 35/22/0.4 kV Lines - NPC, CPC, SPC, HCM PC, HN PC	Percentage	10.00 31-Dec-2011	100.00 31-Dec-2011		180.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Intermediate Result indicator for Component A: Implementation progress of 110 kV lines - NPC, CPC, SPC, HCM PC, HN PC	Percentage	10.00 31-Dec-2011	100.00 31-Dec-2011		190.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Intermediate Result indicator for Component A: Implementation progress of 35/22/0.4 substations - NPC, CPC, SPC, HCM PC, HN PC	Percentage	10.00 31-Dec-2011	100.00 31-Dec-2011		180.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised	Actual Achieved at Completion

				Target	
Intermediate Result indicator for Component A: Implementation progress of 110 kV substations - NPC, CPC, SPC, HCM PC, HN PC	Percentage	10.00 31-Dec-2011	100.00 31-Dec-2011		190.00 14-Dec-2018

Comments (achievements against targets):
The target was exceeded.

Component: Component (B): Introduction of Smart Grid Technologies in Distribution

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Intermediate Result indicator for Component B: Implementation of progress of AMI System - NPC, CPC, SPC, HCMPC, HNPC	Percentage	0.00 31-Dec-2011	100.00 31-Dec-2011		100.00 14-Dec-2018

Comments (achievements against targets):
The target was met.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised	Actual Achieved at

				Target	Completion
Intermediate Result indicator for Component B: Implementation progress of SCADA system - NPC, CPC, SPC, HCM PC, HN PC	Percentage	10.00 31-Dec-2011	100.00 31-Dec-2011		100.00 14-Dec-2018

Comments (achievements against targets):
The target was met.

Component: Component (C): Technical Assistance and Capacity Building

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Intermediate Result indicator for Component C: PCs & ERAV	Percentage	30.00 31-Dec-2011	100.00 31-Dec-2011		100.00 14-Dec-2018

Comments (achievements against targets):
The target was met.

B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Improve the performance of the recipients' power corporations in providing quality electricity services	
Outcome Indicators	1.Total Distribution Losses 2. Reduced Consumption for AMI customers 3. Voltage excursion outside +/−5% at 110kV/MV in project areas
Intermediate Results Indicators	1. Implementation progress of 35/22/0.4 kV lines - NPC, CPC, SPC, HCM PC, HN PC 2. Implementation progress of 110 kV lines - NPC, CPC, SPC, HCM PC, HN PC 3. Implementation progress of 35/22/0.4 kV substations – NPC, CPC, SPC, HCM PC, HN PC 4. Implementation progress of 110 kV substations – NPC, CPC, SPC, HCM PC, HN PC 5. Implementation progress of AMI system – NPC, CPC, SPC, HCM PC, HN PC
Key Outputs by Component[36] (linked to the achievement of the Objective/Outcome 1)	1. New 110 kV lines: 1,146.75 km completed against 924.5 km planned; 2. Rehabilitated 110 kV lines: 10.7 km completed against 99.7 km planned; 3. New LV lines: 4,001 km completed against 2446 km planned; 4. Rehabilitated old LV lines: 3,429 km completed against 4,062 km planned; 5. New 110 kV substations: 3,135 MVA completed against 2,351 MVA planned; 6. New LV substations: 258.82 MVA completed against 50.08 MVA planned; 7. Rehabilitated 110 kV substations: 1,195 MVA complete against 359 MVA planned; 8. Rehabilitated LV substations: 153.3 MVA completed against 117.32 MVA planned; 9. 5 AMI projects implemented against 5 planned.
Objective/Outcome 2: Improve the performance of the recipients' power corporations in providing reliable electricity services	
Outcome Indicators	1. Implementation progress of 35/22/0.4 kV lines (5 PCs) - percentage 2. Implementation progress of 110 kV lines (5 PCs) - percentage 3. Implementation progress of 35/22/0.4 kV substations (5 PCs) – percentage

[36] For results, see Table 3.

	4. Implementation progress of 110 kV substations (5 PCs) – percentage 5. SAIDI in project areas calculated as in the Vietnam distribution code 6. SAIFI in project areas calculated as in the Vietnam distribution code
Intermediate Results Indicators	1. Implementation progress of SCADA system (5 PCs) - percentage
Key Outputs by Component[37] (linked to the achievement of the Objective/Outcome 2)	1. New 110 kV lines: 1,146.75 km completed against 924.5 km planned; 2. Rehabilitated 110 kV lines: 10.7 km completed against 99.7 km planned; 3. New LV lines: 4,001 km completed against 2446 km planned; 4. Rehabilitated old LV lines: 3,429 km completed against 4,062 km planned; 5. New 110 kV substations: 3,135 MVA completed against 2,351 MVA planned; 6. New LV substations: 258.82 MVA completed against 50.08 MVA planned; 7. Rehabilitated 110 kV substations: 1,195 MVA complete against 359 MVA planned; 8. Rehabilitated LV substations: 153.3 MVA completed against 117.32 MVA planned. 9. 2 SCADA projects implemented against 3 planned.[38]
Objective/Outcome 3: Reduce Greenhouse Gas emissions through demand-side response and efficiency gains	
Outcome Indicators	1. Avoided GHG
Intermediate Results Indicators	
Key Outputs by Component (linked to the achievement of the Objective/Outcome 3)	There are no direct outputs for this objective. The results are derived from the outcomes of Objectives 1 and 2.

[37] For results, see Table 3.
[38] One subproject was implemented to conduct installation of equipment for checking rural grid status.

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Hung Tien Van	Task Team Leader
Beatriz Arizu de Jablonski	Task Team Leader
Pedro Antmann	Senior Energy Specialist
Hung Tan Tran	Procurement Specialist
Nghi Quy Nguyen	Senior Social Safeguards Specialist
Son Van Nguyen	Senior Environmental Safeguards Specialist
Hanh Huu Nguyen	Financial Management Specialist
Mai Thi Phuong Tran	SeniorFinancial Management Specialist
Sameena Dost	Senior Counsel
Teresita G. Velilla	Program Assistant
Cristina Hernandez	Program Assistant
Supervision/ICR	
Hung Tien Van	Task Team Leader
Hung Tan Tran	Procurement Specialist
Mai Thi Phuong Tran	Senior Financial Management Specialist
Huong Thi Thu Vu	Program Assistant
Thuy Cam Duong	Senior Environmental Specialist
Peter Leonard	Regional Safeguards Advisor
Hoa Chau Nguyen	Team Member
Nghi Quy Nguyen	Senior Social Development Specialist
Thuy Cam Duong	Environmental Specialist

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY11	4.200	14,316.52
FY12	54.306	194,359.81
FY13	22.295	114,764.54
FY14	.636	7,922.28
FY15	0	172,126.33
FY16	0	93,056.21
Total	**81.44**	**596,545.69**
Supervision/ICR		
FY12	0	611.86
FY13	41.500	107,035.99
FY14	32.403	103,864.39
FY15	25.712	142,240.17
FY16	53.414	207,021.15
FY17	32.450	113,740.92
FY18	26.701	125,871.21
FY19	36.901	205,782.91
Total	**249.08**	**1,006,168.60**

ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US$, millions)	Actual at Project Closing (US$, millions)	Percentage of Approval (%)
Component (A): System Expansion and Reinforcement	694.4	561.17	80.81
Component (B): Introduction of Smart Grid Technologies in Distribution	95.5	53.07	55.57
Component (C): Technical Assistance and Capacity Building	10.5	5.08	48.38
Total	**800.4**	**619.32**	**77.37**

ANNEX 4. EFFICIENCY ANALYSIS

1. The number of subprojects implemented under the DEP far exceeded the total number of subprojects that the five PCs proposed and planned for two-phase implementation at appraisal by 180 percent (177 implemented against 99 planned). An economic and financial analysis at the Implementation Completion and Results Report stage was conducted for evaluating 174 out of 177 subprojects under Components A and B, accounting for 76.2 percent (US$609.8 million) of the total project cost[39] at the appraisal stage (US$800.4 million) and 98.3 percent of the total project cost at the completion stage (US$619.8 million). The analysis results showed that the project achieved higher rates of economic and financial returns than anticipated at appraisal. The aggregated ERR and the NPV for the whole project at completion were 38.3 percent and US$2,496.7 million, respectively, indicating that the project was economically viable and increased social benefits by distributing more power with improved quality and efficiency. The aggregate ERR for the project at completion was significantly higher than 29.2 percent, which was calculated for the Phase 1 subprojects at appraisal.

Economic Analysis

Methodology at Appraisal

2. The economic analysis for the project components was carried out using two scenarios: (a) with the project and (b) without the project.

Component A

System Expansion and Reinforcement

3. The net economic flows are calculated as the difference between economic costs and benefits, 'with' and 'without' the project. An energy balance was done for each subproject area, 'with' and 'without' the project, for an assumed lifetime of 20 years.

4. **The 'with' project scenario** means investments in system expansion and reinforcement for (a) reduction of losses from 20–25 percent to about 4–7 percent; and (b) increase in power supply—in most cases, in the absence of the project, supply is at the limit of the capacity and demand growth and new connections cannot be accommodated; (c) improvement of quality of supply enabling productive use of electricity; and (d) avoidance of spending money on quality improvement devices, such as voltage stabilizers or standby diesel units.

5. **The 'without' project scenario** corresponds to no investment for the rehabilitation and expansion of the distribution system, leading to (a) further overloads in the systems, (b) increase in losses, (c) consumers choosing not to use grid power for productive uses due to major voltage fluctuations, and (d) no opportunity for new connections for either domestic or productive uses.

6. For estimation of the economic indicators, namely the ERR and the NPV, the following

[39] In this section, the total project cost means the sum of the amounts funded by the World Bank support and paid by the counterpart fund.

assumptions were made: (a) all the costs were expressed in constant 2012 prices, and 2010 or 2011 prices were adjusted for domestic inflation by the producer price index, and costs of imported equipment were updated with the Manufacture Unit Value index as published by the World Bank; (b) the cost for compensation and land acquisition were included in the economic cost of the project; (c) the economic costs included physical contingencies (but excluded interest during construction, taxes, and duties); (d) operation and maintenance costs were estimated at 2 percent of the investment costs; (e) energy purchased by the PC at the subproject boundary is valued at the avoided social cost of thermal generation of US$0.075 per kWh, based on the avoided cost tariff in Vietnam as gas-fired combined cycle gas turbine (CCGT) generation with gas price linked to the Singapore fuel oil price; and (f) the NPV is calculated at 10 percent discount rate[40] which is approximately the opportunity cost of capital in Vietnam.

7. Where subprojects encompass only the upgrading of 110 kV or medium voltage infrastructure and benefit is claimed for additional sales at low voltage, the costs of the additional future low voltage capital investment are added. When these costs are not known for the subproject area, they are estimated based on the total capital expenditure breakdown of the PC or the province, according to the applicable T&D plans.[41]

8. The energy purchased by consumers is valued at the consumer's willingness to pay of US$0.108 per kWh, estimated for residential consumers using the demand curve derived from the detailed rural household energy survey, and for other customers on the costs of self-generation burning diesel.

9. Where a subproject claims benefit for reliability improvement, the impact on net economic flows will be an increase in energy purchase cost (corresponding to the additional energy supplied). On the benefit side the net benefit is the avoidance of unserved energy, which is typically valued at five times the average WTP.[42]

Component B

AMI

10. The AMI to be funded under this project will target the larger customers (expected to cover customers consuming at least 2,000 kWh/month). The baseline case assumes that the consumption reduction is 0.5 percent (based on estimates in the European and international experiences).

11. Some AMI projects in other Asian countries have been justified primarily by reduction of high non-technical losses (such as India). However, non-technical loss rates in Vietnam are quite low. In the case of the HCM PC AMI subproject, non-technical losses for the largest customers are estimated at 1 percent, to be reduced to 0.5 percent because of advanced metering. It may also be noted that manual meter reading costs—the avoidance of which is one of the main benefits of smart meters in Europe and North America—

[40] In accordance with "Discounting Costs and Benefits in Economic Analysis of World Bank Projects," Technical Note 2016 and the MOIT's latest regulated discount rate for energy projects.

[41] For example, typical values of this capital expenditure multiplier for 110 kV extensions are between 0.9 and 1.2; for every dong spent on 110 kV infrastructure, VND 0.9–1.2 will need to be spent on medium voltage/low voltage and connections.

[42] The net benefit of the avoidance of unserved energy is quantified by estimating the avoidance of spending money on quality improvement devices, such as voltage stabilizers or standby diesel units. Economic benefit is greater than the financial benefit to the PC (which is simply additional sales at the retail tariff).

are also quite low in Vietnam.

12. Another benefits of the AMI in Vietnam was reduction of technical loss due to replacing the mechanical meters with smart meters that have a higher accuracy level (by 0.5–1.5 percent).

SCADA Subprojects

13. The feasibility study for the proposed SCADA system for the SPC (prepared by consultants)[43] lists several benefits, including the following four quantified in this analysis:

(a) Reduction of staff

(b) Reduction of maintenance cost (from 2 percent to 1 percent of investment cost)

(c) Reduction of technical losses

(d) Reduction of unserved energy

Avoided GHG

14. The SCADA and AMI projects result in net reductions of GHG emissions relative to the without-project scenario, because of better dispatch and avoided power generation due to lower technical losses and consumption reductions. For this analysis, GHG emissions are valued at US$30 per ton CO_2 equivalent,[44] and are calculated based on emission reductions at CCGT.[45] The ERR and the NPV are reported with and without GHG emission benefits; typically for AMI and SCADA projects, the ERR increases by 3–5 percent.

Subproject Economic Performance

15. The economic analysis was done for each subproject, using a cost-benefit methodology. The economic indicators, namely the EIRR and the NPV, were calculated with the following assumptions: (a) all costs were in constant 2012 prices, making no adjustment for shadow exchange rate or shadow wage rate; (b) the capital investment costs for Phase 1 were considered over 2012–2013, and analyses were made over a subproject economic life of 22 years (2012–2034); (c) the cost for compensation, land acquisition, and environmental mitigation were included in the economic cost of the subproject; (d) the operation and maintenance costs are estimated at 2 percent of the investment costs; (e) the input energy to the subproject was estimated for 2012 based on actuals for each PC in 2010 and 2011; and (f) the EIRR of the subproject was the discount rate at which the present value of the costs and benefits streams are equal, and the NPV was based on a discount rate of 10 percent, approximately the opportunity cost of

[43] PC, *SCADA System and 110 kV Substations Without Operators, Feasibility Study*, April 2010.
[44] "Social Value of Carbon in Project Appraisal," Guidance Note to World Bank Group Staff, September 2014 recommends projects use a base case estimate of social value of carbon at US$30 per ton CO_2 equivalent in 2015 and increasing to US$35 in 2020, and so on. Under the DEP, the conservative assumption was used (at the rate of US$30 per ton CO_2 in 2018).
[45] Although the standard UNFCCC CDM methodology for calculating emission reduction averages in the higher emission factors at coal projects, for consistency with the *actual* likely outcome of dispatch response to demand reductions which is to reduce dispatch of the most expensive project in the merit order, use of gas-based emissions is appropriate.

capital in Vietnam.

Methodology at Project Completion

16. The methodology is identical to that used at appraisal, except that (a) actual investment costs and exchange rate at project completion are used; (b) the actual loss rates 'before' and 'after' project, the improved reliability and quality, and reductions in consumption as a result of network reinforcement and installation and operation of AMI and SCADA systems at completion are used[46]; and (c) carbon emission factor for the power system is updated as published by the Ministry of Natural Resources and Environment in 2018.[47]

Results and Discussion

17. Table 4.1 show the results of economic analysis for each PC and for the whole project. The EIRR and the NPV for the whole project at completion were 38.3 percent and US$2,496.7 million, respectively. The economic returns at completion were obviously higher than those at appraisal, indicating that the project was economically viable and increased social benefits that included remarkably avoided thermal generation by reducing losses, enabling productive use of electricity, and avoidance of spending money on quality improvement devices, such as voltage stabilizers or standby diesel units by distributing more power with improved reliability and quality. Refer to Tables 4.3, 4.4, and 4.5 for the changes to the values of input parameters used for economic and financial analysis at appraisal and at completion.

Table 4.1. Results of Economic Analysis

PCs	At Appraisal (PAD)[a]		At Completion[b]	
	ERR (%)	NPV @10% (US$, millions)	ERR (%)	NPV @10% (US$, millions)
NPC	28.1	148.89	40.7	1,157.97
SPC	24.5	117.42	31.9	429.15
CPC	17.1	44.39	36.2	346.55
HNPC	21.7	44.27	40.6	280.12
HCMPC	53.7	271.95	40.7	282.91
Total	**29.2**	**626.92**	**38.3**	**2,496.70**

Source: PAD, Borrower's ICR.
Note: [a] The number of Phase 1 subprojects analyzed at appraisal was 46 with total investment cost of US$266 million, accounting for 33.23 percent of the total project cost at that time.
[b] The number of subprojects analyzed at completion was 174 with total investment cost of US$609.8 million, accounting for 98.3 percent of the total project cost at completion.

[46] Inputs for calculation of the completed subprojects were the actual data, whereas the inputs of the on-going or just-completed subprojects were the most updated figures.
[47] The values of carbon emission factor for economic analysis at appraisal in 2011 and at completion in 2018 were 0.41 kgCO2/kWh and 0.8154 $kgCO_2$/kWh as published by the MONRE, respectively.

Financial Analysis

Methodology at Appraisal

18. The project financial returns are calculated at constant 2012 prices and compared to the PCs' risk adjusted WACC assumed as 6 percent. Energy purchased by the PC at the project boundary is valued at the applicable BST for the PC, as estimated for 2012. The financial benefits to the PCs are based on the average retail tariff in the project area. Where these are not known, the estimated PC-wide averages may be used, as estimated by the EVN.

19. Where subprojects encompass only the upgrading of 110 kV or 35 kV infrastructure, if benefit is claimed for additional sales at low voltage, then the costs of the additional future low voltage capital investment are added. Where these costs are not known for the specific project area, they are estimated based on the total capital expenditure breakdown of the PC or the province (according to the applicable T&D plans).

Subproject Financial Performance

20. A financial analysis of the Phase 1 subprojects from the PC perspective was undertaken, by valuing incremental revenues and costs at the estimated tariff for 2012 based on the actual average tariff applied to the PCs in 2010 and 2011, which was assumed to remain constant during the period while incorporating changes in the composition of total demand served. The following cost assumptions were made: (a) capital costs were baseline costs plus physical and price contingencies, (b) power purchase prices at the connection point of the distribution system were estimated as average current purchase price of the PCs plus estimated losses to the point; power purchase prices were assumed to remain constant throughout the forecast period; (c) the O&M costs for medium voltage lines were estimated at 2 percent of investment costs; (d) losses were estimated at 3.5–7 percent for medium voltage networks after project implementation; (e) foreign costs were converted at the exchange rate of VND 21,000 per U.S. dollar, assuming all investments to be implemented during the first and the second year; (f) local inflation was estimated at 10 percent; and (g) WACC for the PCs was 6 percent, made up from 25 percent of equity and 75 percent debt at the rate at which the Government onlends, assumed as 3.6 percent.

Methodology at project completion

21. The methodology is identical to that used at appraisal, except that (a) actual investment costs and exchange rate at project completion are used; (b) the actual loss rates 'before' and 'after' project, the improved reliability and quality, and reductions in consumption as a result of network reinforcement and installation and operation of the AMI and SCADA systems at completion are used[48]; and (c) the BST and average retail tariff of each PC are updated as informed by the PC.

Results and discussion

22. Table 4.2 shows the results of financial analysis for each PC and for the whole project. The FIRR and the NPV for the whole project at completion were 19.7 percent, and US$1,720.3 million, respectively.

[48] Inputs for calculation of the completed subprojects were the actual data while the inputs of the ongoing or just-completed subprojects were the most updated figures.

At the time of project appraisal, the financial returns for the Phase 1 subprojects were above the hurdle rate at an FIRR of 16.7 percent and an NPV of US$565.6 million. However, the financial returns at completion stage were significantly improved because (a) the actual investment costs were lower than the estimated costs at appraisal, (b) the system efficiency was better than expected, and (c) the margins between the BST and the average retail tariff increased a little since the time of appraisal. The combination of these favorable conditions has generated robust revenues that shorten the payback period for the PCs. The analysis of the PCs also indicated that each PC has great benefits to implement the subprojects within its area.

Table 4.2. Results of Financial Analysis

PCs	At Appraisal (PAD)[a]		At Completion[b]	
	FIRR (%)	NPV @6% (US$, millions)	FIRR (%)	NPV @6% (US$, millions)
NPC	22.4	242.23	22.8	880.20
SPC	9.8	38.64	10.2	95.50
CPC	20.8	179.28	26.4	401.12
HNPC	16.0	52.47	18.4	219.04
HCMPC	11.9	52.98	17.1	124.45
Total	**16.7**	**565.60**	**19.7**	**1,720.30**

Source: PAD, Borrower's ICR.

Note: [a] The number of Phase 1 subprojects analyzed at appraisal was 46 with total investment cost of US$266 million, accounting for 33.23 percent of the total project cost at that time.

[b] The number of subprojects analyzed at completion was 174 with total investment cost of US$609.8 million, accounting for 98.3 percent of the total project cost at completion.

Table 4.3. Values of Input Parameters for Economic and Financial Analysis at Appraisal and at Completion

No.	Input Parameters	Unit	At Appraisal	At Completion
1	Number of analyzed subprojects	Number	46	174
2	Financial capital cost	US$, millions	266	609.8
3	Economic capital cost	US$, millions	241.8	554.3
4	Energy sales without project	GWh	730	2,150
5	Energy sales with project	GWh	2,650	8,400
6	Growth rate without project	%	0	0
7	Growth rate with project	%	6	8.8
8	Loss without project	%	10.5	9.5
9	Loss with project	%	7.0	6.0
10	Non-technical loss without AMI project	%	1	1.5
11	Non-technical loss with AMI project	%	0.5	0.3
12	AMI consumption reduction	%	0.5	2
13	Carbon emission factor	$kgCO_2/kWh$	0.41	0.8154

No.	Input Parameters	Unit	At Appraisal	At Completion
14	Social carbon price	U.S. dollars/ton CO_2	30	30
15	Discount rate	%	10	10
16	WACC	%	6	6
17	Avoided cost of thermal generation	U.S. cents/kWh	7.5	7.5
18	Willingness to pay	U.S. cents/kWh	10.8	10.8

Table 4.4. BST, Constant Price, VND/kWh

	2010	2011	2012	2018
NPC	609.1	822.0	879.5	1,227
SPC	793.1	995.9	1,065.6	1,398
CPC	570.1	840.5	899.3	1,241
HNPC	904.1	1,070.2	1,145.1	1,472
HCMPC	1,085.7	1,230.3	1,316.4	1,633

Source: EVN.

Table 4.5. Average Retail Tariff, Constant Price, VND/kWh

	2010	2011	2012	2018
NPC	944.4	1,132.5	1,211.8	1,634
SPC	1,018.1	1,182.5	1,265.3	1,673
CPC	1,012.2	1,214.5	1,299.5	1,780
HNPC	1,182.4	1,348.9	1,443.3	1,910
HCMPC	1,290.9	1,414.7	1,513.7	1,964

Source: EVN.

ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS[49]

1. **The NPC, HCMPC, and CPC** agreed with the draft ICR and had no comments.

2. **The SPC** requested to revise some of the monitoring indicators related to SPC's SAIDI, SAIFI, voltage excursion, and losses. The requested revision has been made in the final ICR. Below are the SPC's comments:

Following the meeting with the Bank team regarding WB's Implementation Completion and Results Report (ICR) in May 14, 2019, SPC would like to revise some indicators in the draft ICR:

Indicator Name	Actual Achieved at Completion	Revised Actual Achieved at Completion
Loss in project areas	4.52	4.39
System Average Interruption Frequency Index (SAIFI)	2.19	3.23
Voltage excursion outside +/-5%	4.00	0.0005
System Average Interruption Duration Index (SAIDI)	368.00	598.62

And the other items in the draft ICR, we have no objection. Thank you for your kind support.

Comments from HNPC

3. As per the World Bank's requirement regarding comment for the ICR of the DEP project, the HNPC sent the following two comments:

(a) **Paragraph 39, page 16:** please revise the phrase "HNPC acknowledged supplying the 10% annual demand growth largely through electricity saved by reduction of losses;" as "HNPC acknowledged supplying the 10% annual demand growth largely thanks to the enhanced capacity of power T&D system and through electricity saved by reduction of losses;"

(b) **Paragraph 68, page 24:** please revise the phrases "For example, for Phu Xuyen subproject in Ha Noi, local authorities failed to secure the land for the substation due to resistance from the local people. A new location for the substation was identified;" as "For example, for Phu

[49] The comments were reviewed, and the ICR updated where appropriate

Xuyen subproject in Ha Noi, the land for the substation could not be timely arranged. The new location for the substation is scheduled to be available for construction in June 2019."

Comments from ERAV

Item 45.a.

4. Based on the revised regulations specified in distribution code, ERAV has monitored the utilities in improving the quality and reliability of power supply (the criteria for customer care, SAIFI, SAIDI, and so on).

Item 45.c.

5. Training courses, study tours provided by the project have the crucial role in improving capacity of ERAV in many aspects of the project such as smart grid development, and the DSM. The enhancement of capacity allowed ERAV to support the MOIT to finalize the decision on the EVN's overall Smart Grid development program, which has an objective to replace mechanical meters to electronic meters for 50 percent of the customers by 2020. Capacity building played an important role to contribute to the reduction of power loss and promotion of power saving.

Item 46.

6. Technical assistance not only helps ERAV to achieve its objectives in the PDO, but also supports the implementation of demand-side management activities in the future, when Vietnam faces the risk of electricity shortage. The knowledge provided to the ERAV staff in the project has served to develop the Prime Minister's decision approving the national program on the DSM in the period of 2018–2020, orientation to 2030. This program, with the aim of reducing peak load to 1000 MW by 2020 and synchronously implementing the DR programs, is a continuation of the DR pilot component in the project.

7. We reaffirm that technical assistance for functional organizations/ERAV is a key factor to develop a sustainable and effective power industry in today's rapidly changing economic and social environment.

ANNEX 6. SUPPORTING DOCUMENTS (IF ANY)

Country Partnership Framework 2018–2022.

Country Partnership Strategy for the Socialist Republic of Vietnam (2012–2016).

Demand Side Management Assessment for Vietnam (1997).

DEP project documentation (PAD, ISR's, Aides Memoires, Legal Documents).

EVN Annual Report 2016.

EVN Annual Report 2017.

Impact of Rural Electrification in Vietnam (January 7, 2015).

The National Power Development Master Plan 7 (2011)

The Socio-Economic Development Plan 2011–2015.

The Socio-Economic Development Strategy 2011–2020.

World Bank Doing Business Report 2018.

World Bank Data Bank (Intranet)

Vietnam - Maximizing Finance for Development in the Energy Sector (January 23, 2019).