



# Completion Report

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Project Number: 34390  
Loan Number: CAM-2052  
November 2012

## Cambodia: Greater Mekong Subregion Transmission Project

## CURRENCY EQUIVALENTS

Currency Unit – riel (KR)

<b>At Appraisal</b> (as of 30 September 2003)		<b>At Project Completion</b> (as of 30 June 2012)	
KR1.00	=	\$0.00025	\$0.00024
\$1.00	=	KR4,000	KR4,100

## ABBREVIATIONS

ADB	–	Asian Development Bank
EAC	–	Electricity Authority of Cambodia
EDC	–	Electricité du Cambodge
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
GS	–	General Substation
kV	–	kilovolt
kWh	–	kilowatt-hour
MW	–	megawatt
NDF	–	Nordic Development Fund
NPV	–	net present value
SDR	–	special drawing rights

## NOTES

- (i) The fiscal year (FY) of the government is from 1 January to 31 December.
- (ii) In this report, "\$" refers to US dollars.

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## BASIC DATA

### A. Loan Identification

1.	Country	Kingdom of Cambodia
2.	Loan number	2052-CAM(SF)
3.	Project title	Greater Mekong Subregion Transmission Project
4.	Borrower	Kingdom of Cambodia
5.	Executing agency	Electricité du Cambodge
6.	Amount of loan	SDR 30.94 million (\$44.3 million equivalent)
7.	Project completion report number	CAM 1354

### B. Loan Data

1.	Appraisal	
	– Date started	30 September 2003
	– Date completed	9 October 2003
2.	Loan negotiations	
	– Date started	4 November 2003
	– Date completed	5 November 2003
3.	Date of Board approval	15 December 2003
4.	Date of loan agreement	10 November 2004
5.	Date of loan effectiveness	
	– In loan agreement	8 February 2005
	– Actual	25 March 2005
	– Number of extensions	1
6.	Closing date	
	– In loan agreement	31 December 2008
	– Actual	9 May 2011
	– Number of extensions	1
7.	Terms of loan	
	– Interest rate	1% during grace period, 1.5% thereafter
	– Maturity	32 years
	– Grace period	8 years
8.	Terms of relending	
	– Interest rate	4.2%
	– Maturity	20 years
	– Grace period	5 years
	– Second-step borrower	Electricité du Cambodge

#### 9. Disbursements Asian Development Bank loan

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
17 October 2005	1 April 2011	65 months
Effective Date	Original Closing Date	Time Interval
25 March 2005	31 December 2008	45 months

## b. Amount (SDR million)

Category Number	Category or Subloan	Original Allocation	Partial Cancellation	Last Revised Allocation	Amount Disbursed	Undisbursed Balance *
01A	220 kV works and bulk supply distribution	15.51		13.96	13.92	0.03
01B	Substations at Takeo and Phnom Penh	8.07	1.20	6.86	6.78	0.08
02	Capacity building	0.71		0.21	0.19	0.02
03	Consulting services	1.47		1.34	1.31	0.03
04	Interest charge	0.90		0.40	0.34	0.06
05	Unallocated	4.28	2.04	2.23	0.00	2.23
06	Various equipment	0.00		2.70	2.70	0.00
	<b>Total (SDR)</b>	<b>30.94</b>	<b>3.24</b>	<b>27.70</b>	<b>25.24</b>	<b>2.46</b>
	<b>Total (US\$)</b>	<b>44.30</b>	<b>5.00</b>	<b>47.88</b>	<b>38.90</b>	<b>3.98</b>

\* Total may not tally due to rounding.

10.	Local costs (financed)	
-	Amount (\$ million)	6.0
-	Percent of local costs	30.6%
-	Percent of total cost	7.9%

**C. Project Data**

## 1. Project cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign exchange cost	58.5	56.4
Local currency cost	36.5	19.6
<b>Total</b>	<b>95.0</b>	<b>76.0</b>

## 2. Financing plan (\$ million)

Cost	Appraisal Estimate	Actual
Implementation costs		
Borrower financed	18.1	3.2
Asian Development Bank financed	43.8	38.4
Other external financing		
Nordic Development Fund	10.4	12.5
World Bank	15.3	15.1
<b>Subtotal:</b>	<b>87.6</b>	<b>69.2</b>
Interest during construction costs		
Borrower financed	5.6	5.5
Asian Development Bank financed	0.5	0.5
Other external financing	1.3	0.8
<b>Subtotal:</b>	<b>7.4</b>	<b>6.8</b>
<b>Total:</b>	<b>95.0</b>	<b>76.0</b>

## 3. Cost breakdown by project component (\$ million)

Component	Appraisal Estimate	Actual
Infrastructure	52.0	54.5
Resettlement and land acquisition	2.5	2.4
22 kV bulk supply distribution	2.8	2.0
Capacity building	1.0	1.0
Project implementation consultants	3.2	5.0
Taxes and duties	15.0	0.0
Various equipment	0.0	4.1
Contingencies	11.1	0.0
Interest during construction	7.4	7.0
<b>Total</b>	<b>95.0</b>	<b>76.0</b>

## 4. Project schedule

Item	Appraisal Estimate	Actual
Date of contract with consultants	April 2004	22 July 2005
Completion of engineering designs	October 2004	November 2005
Civil works contract		
Date of award (transmission and distribution)	28 September 2005	28 December 2006
Completion of work (transmission and distribution)	31 October 2007	31 July 2009
Date of award (substations)	28 October 2005	28 June 2007
Completion of work (substations)	October 2007	31 July 2009
Maintenance vehicles and equipment	April 2006	25 October 2010
Dates		
First procurement	June 2005	29 December 2006
Last procurement	September 2005	28 June 2007
Completion of equipment installation	October 2007	April 2009
Start of operations		
Completion of tests and commissioning	May 2008	April 2009
Beginning of start-up	May 2008	April 2009
Other milestones <sup>b</sup>		

- <sup>b</sup>) i) 1 August 2008: Approval of extension of loan closing date by 24 months from 1 January 2009 to 31 December 2010 (including reallocation of loan proceeds).
- ii) 6 July 2009: Approval of 1st cancellation of SDR 3,244,793.73 (US\$ 5 million), effective 30 June 2009.
- iii) 12 May 2011: Approval of final cancellation of SDR 2,455,739.78 (US\$ 3.98 million), effective 9 May 2011.
- iv) 24 February 2006: Approval of change in implementation arrangement to use post-qualification instead of prequalification procedure for procurement.

## 5. Project performance report ratings

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From 25 March 2005 to 31 December 2005	Satisfactory	Satisfactory
From 1 January 2006 to 31 December 2006	Satisfactory	Satisfactory
From 1 January 2007 to 31 December 2007	Satisfactory	Satisfactory
From 1 January 2008 to 31 December 2008	Satisfactory	Satisfactory
From 1 January 2009 to 31 December 2009	Satisfactory	Satisfactory
From 1 January 2010 to 31 December 2010	Satisfactory	Satisfactory

#### D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members <sup>a</sup>
Fact-finding	18–26 Oct 2002	5	45	a, b, d, j, m
Appraisal	30 Sep–8 Oct 03	4	36	b, c, d, m
Project inception (joint with NDF)	6–13 Jun 2005	3	18	b, e, i
Review 1 (joint with World Bank)	19–25 Oct 2005	2	10	e, f
Review 2 (joint with NDF)	3–6 Apr 2006	1	4	e
Review 3	9 Oct 2006	1	5	d
Review 4	13–17 Nov 2006	2	10	e, h
Review 5	16–20 Jul 2007	3	15	b, h, n
Special administration	3–10 Sep 2007	1	7	d
Midterm review	3–7 Sep 2007	4	20	e, h, k, n
Review 6	11–18 Mar 2008	3	15	g, h, l
Special administration	27 May–3 Jun 2008	4	20	e, h, l, n
Review 7	5–16 Sep 2008	3	15	g, h, l
Special administration	8–12 Dec 2008	4	20	e, h, l, n,
Review 8	26 Mar–2 Apr 2009	3	15	g, h, l
Review 9	27 Nov–9 Dec 2009	2	8	h, l
Review 10	4–17 Jun 2010	1	5	h
Review 11	7–13 Dec 2010	1	4	h
Project completion review	16–17 Mar 2012	2	4	h, n

<sup>a</sup> a = sector director, b = financial analysis specialist, c = counsel, d = project economist/mission leader, e = senior energy specialist, f = environment specialist, g = project management specialist, h = senior project officer, i = project analyst, j = resettlement specialist, k = senior social development specialist, l = social safeguard officer, m = economist and poverty reduction specialist, n = operations officer.

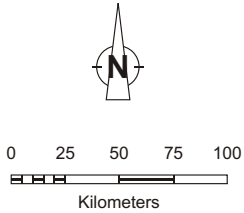
NDF = Nordic Development Fund.

# CAMBODIA GREATER MEKONG SUBREGION TRANSMISSION PROJECT (as completed)

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- Tonle Sap Lake during Dry Season
  - National Capital
  - Provincial Capital
  - City/Town
  - Project Substation
  - National Road
  - Other Road
  - Project Transmission Line
  - Linking Project (by other)
  - Railway
  - River
  - Provincial Boundary
  - International Boundary
- Boundaries are not necessarily authoritative.





## I. PROJECT DESCRIPTION

1. Ownership and operation of Cambodia's electricity supply system was fragmented and inefficient, the country being served by numerous small generating units each with capacity less than 5 megawatts (MW) and fueled by expensive light diesel or by heavy fuel oil (as the load centers were small). Cambodia did not have a system grid and the small systems were operated independently. The power supply industry, including Electricité du Cambodge (EDC) and private operators, was passing on its high operating costs via the tariff and was struggling to meet rapid growth in demand. High tariffs, in turn, were negatively impacting Cambodia's competitiveness and constituted a barrier to economic growth. The high tariffs together with high up-front connection costs were adversely affecting access by the poor to electricity. When the project was appraised in 2003, 15% of the population in Phnom Penh was living below the poverty line of \$0.63/capita/day, while the incidence of poverty in the project's targeted communities ranged from 25% to 75%. EDC is a limited liability state-owned company which operates independently except for setting tariffs. While EDC supplies major towns, rural electricity enterprises serve small towns and some villages.

2. Since 1992, the Asian Development Bank (ADB) has been playing a leading role in fostering cooperation in the Greater Mekong Subregion (GMS), including in the electric power subsector. Subregional electricity trade based on interconnected electric power networks had been identified as an approach that could provide significant economic and environmental benefits for individual countries and for the subregion as a whole. On 3 November 2002, Cambodia and other GMS members signed the Intergovernmental Agreement on Regional Power Trade in the GMS. The GMS Transmission Project, the first GMS energy project in Cambodia, was formulated to take advantage of opportunities to address Cambodia's power supply issues by establishing a high-voltage interconnection with Viet Nam. The project proposal was included in ADB's country strategy and program update (2003–2005), and the project was prepared and formulated using the findings of a technical assistance project completed in 2003.<sup>1</sup> The electricity cost from EDC's own generation or from the independent power producers, which ranged from \$0.11 to \$0.13/ kilowatt-hour (kWh), was much higher than that of about \$0.6 to 0.625/kWh at which EDC could purchase from Viet Nam.<sup>2</sup>

3. The project was appraised from 30 September to 8 October 2003. It had two main objectives: (i) to promote the provision of sustainable and reliable electricity at affordable prices to consumers in Phnom Penh and along the transmission corridor; and (ii) to enhance accessibility to power for the poor by promoting a pro-poor policy environment in the sector. The project provided for the construction of 109 kilometers (km) of 230 kilovolt (kV) transmission line together with associated substations and distribution facilities. This enables EDC to import up to 200 MW of power from Viet Nam for supply to Phnom Penh and to facilitate access to electricity for 50,000 households situated in nearby rural areas. The major components of the project are (i) 109 km of 230 kV double-circuit transmission line, (ii) substations at Takeo and at West Phnom Penh (cofinanced by ADB and the Nordic Development Fund [NDF]), (iii) 115 kV grid substation systems in Phnom Penh and a national control center (financed by the World Bank), (iv) a 22 kV bulk supply distribution system to supply villages along the high-voltage transmission line corridor, and (v) capacity building for staff of EDC and Electricity Authority of Cambodia (EAC). The project framework, comparing appraisal targets with the achievements of the Project, is in Appendix 1.

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<sup>1</sup> ADB. 2003. *Technical Assistance to the Kingdom of Cambodia for Preparing the Power Distribution and Greater Mekong Subregion Transmission Project*. Manila (TA 4078–CAM).

<sup>2</sup> The cited price range reflects normal-hours tariff rates in the rainy and dry season, respectively, as per the Power Purchase Agreement between EDC and Electricity of Viet Nam signed on 24 July 2000.

4. The project was based upon initiatives developed under the auspices of the GMS program. Namely, it provides a high-voltage interconnection link between Cambodia and Viet Nam, as envisaged in the GMS master plan on power interconnections.<sup>3</sup> The generating sources in Viet Nam comprise a mix of hydroelectric, conventional steam generation plants, and combined-cycle power plants that are fueled by indigenous natural gas. The project benefits Viet Nam by providing a means for exporting power, while it benefits Cambodia by supplying power to Cambodia at a cost lower than that for any alternative solution. The borrower is the Kingdom of Cambodia. The Ministry of Economy and Finance, acting on behalf of the borrower, lent the ADB loan proceeds to EDC, the project's executing agency (EA). NDF and the World Bank cofinanced the project on a parallel basis.

## II. EVALUATION OF DESIGN AND IMPLEMENTATION

### A. Relevance of Design and Formulation

5. The project was formulated to meet the government's development objectives and to address those power sector issues identified during appraisal. The government's Second Socioeconomic Development Plan 2001–2005 had targeted (i) economic growth for poverty reduction, (ii) development of the private sector, and (iii) good governance. This was supported, too, by the national poverty reduction strategy (2003–2005). Since 2001, a key priority of the government has been to provide its rural population increased access to power while developing adequate and reliable sources of electricity for its entire population. One of the most important aspects of the government's economic policy as outlined in its development strategy (2006–2010) is to develop the energy sector so that it responds effectively to the growing needs for low-cost electricity.<sup>4</sup> Energy sector development remains an important component of the current development strategy (2009–2013).<sup>5</sup> In particular, the government prioritizes boosting electricity supply capacity, reducing tariffs to an appropriate level, and expanding the grid-electricity infrastructure into rural areas while strengthening institutional mechanisms and management capability.

6. The project was in line with ADB's country operational strategy (2000–2005), which had identified interventions in energy as essential for development of the private sector. As stated in the country strategy and program 2005–2009, ADB continued providing support for power sector development as this sector plays a key role in Cambodia's economic growth and social sector development. The strategy emphasized that adequate supply of reliable and affordable power is a prerequisite for private sector-led economic growth. The strategy focused on expanding power generation, transmission and distribution systems as well as improving sector performance and operational efficiency through institutional strengthening and capacity building. ADB's country partnership strategy, for 2011–2013 supports the government's aim to achieve higher levels of (i) inclusive economic growth, and (ii) social development and gender equity. The partnership strategy recognizes that an energy sector assistance program will contribute to achieving these economic and social development objectives, as access to reliable, cost-effective, and environmentally sustainable electricity is an important tool to facilitate socioeconomic development. The project was included into the master plan on power

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<sup>3</sup> Intergovernmental Agreement on Regional Power Trade in the GMS signed by all six GMS member countries on 3 November 2002.

<sup>4</sup> Ministry of Planning, Royal Government of Cambodia. 2005. *National Strategic Development Plan, 2006–2010*. Phnom Penh.

<sup>5</sup> Ministry of Planning, Royal Government of Cambodia. 2010. *National Strategic Development Plan Update, 2009–2013*. Phnom Penh.

interconnection in the GMS countries and is benefiting both Cambodia and Viet Nam. The transmission line has the potential to be extended to Thailand, and hence it reinforces the regional interconnection. The project included a component on electrification of villages close to the transmission line route, thereby benefiting people living close to the transmission lines and who were adversely affected by the project.

## **B. Project Outputs**

### **1. Infrastructure**

7. **Transmission line.** At appraisal, it was envisaged that 109 km of 220 kV double-circuit transmission line financed under the ADB loan would be built to transport electric power from Viet Nam to Phnom Penh and nearby areas. The 220 kV was selected for compatibility with the Viet Nam grid system, as at project appraisal large-scale interconnection to Thailand was not envisaged for another 15–20 years. The transmission line runs from the Viet Nam border to a new substation on the outskirts of the town of Takeo (Takeo substation), and from there it continues to another new substation located to the northwest of Phnom Penh (West Phnom Penh substation). As envisaged at appraisal, a turnkey contractor was engaged to prepare detailed engineering designs and construct the transmission line. The line route and locations of the two substations were finalized during the detailed engineering stage. The new facilities were designed to meet the relevant technical requirements while minimizing negative social and environmental impacts.

8. The transmission line utilizes conductors hung from self-supporting steel lattice towers that take into consideration the periodic flooding that is prevalent along the transmission route. As built, the transmission line is designed for 230 kV operation in order to be compatible with the future Cambodia and Thailand grid systems. Although the supply from Viet Nam is at 220 kV, detailed engineering calculations have shown there are no adverse impacts from this difference such as increased technical losses or difficulties in synchronizing the Viet Nam and Cambodian power systems.

9. **Substations.** Two new substations financed by the ADB loan have been built to receive the high-voltage power delivered by the transmission line. As planned during appraisal and noted above, one is at Takeo and the other northwest of Phnom Penh. The two substations have been designed to allow for future expansion—in particular by the connection of a 230 kV input line to the Takeo substation and duplication of the 230 kV line between the Takeo and West Phnom Penh substations. Two additional transmission bays were installed at the Takeo substation to connect power from this substation to a substation on the outskirts of the town of Kampot via a transmission line financed by German development cooperation through KfW. The transmission line financed by KfW is not part of the project. The Takeo and West Phnom Penh substations have been in operation since 30 March 2009 and 8 May 2009, respectively, and, as of the date of the project completion review mission, these two new substations have functioned with no unplanned outages.

10. **Transformers, shunt capacitor banks, and other substation equipment.** As envisaged at appraisal, NDF financed the supply of transformers, shunt capacitor banks, and other equipment for the substations at both Takeo and West Phnom Penh. Savings under the NDF credit were used to install four additional transmission bays at West Phnom Penh.

11. **Reinforcement of the 115kV system.** As envisaged at appraisal, the World Bank financed construction of 14 km of double-circuit 115 kV transmission line from the West Phnom

Penh substation to General Substation (GS) 3 and stringing of conductors for about 22 km of 115 kV line to complete the second circuit between the three existing substations in Phnom Penh, known as GS1, GS2, and GS3. The system has been in operation since August 2009.

12. **Modifications to three 115 kV substations.** The World Bank financed modifications to the three 115 kV grid substations GS1, GS2, and GS3 as envisaged at appraisal. The complete works at the three substations comprise switchyard modification, transformer installation and connection of reactive compensation on the 22 kV side, and installation of the supervisory control and data acquisition system. All works have been completed and the upgrades have increased the available transformation capacity at GS1, GS2, and GS3 while reducing system losses by improving the power factor of the system.

13. **National control center.** As envisaged at appraisal, the World Bank financed construction of a national control center. Installation of electrical equipment and all works have been completed.

14. **22 kV bulk supply distribution.** Plans prepared at appraisal provided for the development of a bulk distribution system to serve rural communities in 20 villages of Takeo Province lying close to the new 230 kV transmission line. The 22 kV facilities would be operated by EDC while distribution facilities to connect end users would be constructed and operated by rural electrification enterprises. During project implementation, however, the contractor found that many of the planned 22 kV distribution lines had already been built by rural electrification enterprises. EDC staff and the contractor therefore jointly identified and developed a series of new distribution lines. The ADB-financed project eventually comprised the construction of 22 kV bulk distribution lines with connections to 20 feeders. The 22 kV system is operated by EDC. EDC supplies bulk power to rural electrification enterprises (REEs), which construct and operate points of distributions end-users.

15. Six REEs that draw power from the bulk supply lines have completed construction of the low-voltage lines that connect end users, while six small and medium enterprises have installed their own transformers and connected directly to medium-voltage lines. The project completion review mission found that EDC was using its own budget to construct additional connection lines from these new 22 kV lines to end users in 22 villages in Takeo Province. The rural electrification project financed by the World Bank implemented at the same time as the project has provided for extension of 22 kV lines from West Phnom Penh substation and from Takeo substation to Kampong Chrey and Samrong districts. The project financed by World Bank has also constructed medium-voltage lines in five provinces: Battambang, Kampong Speu, Kampot, Preah Sihanouk, and Takeo.

16. **Maintenance vehicles and electrical equipment.** A portion of savings on the ADB loan were used to finance the following: specialized vehicles and equipment needed for the maintenance of distribution lines (elevated platform vehicles, crane trucks, and underground cable fault location vehicles), vehicles for the project and maintenance teams, as well as electrical spare parts and tools (electrical test beds, testing lab for transformer oil analysis, and tools for the maintenance of transmission lines and substations), which are necessary for operation and maintenance activities.

## 2. Capacity Building

17. ADB financed an individual consultant to assist EAC, the tariff regulator, in monitoring licenses and reviewing tariff applications. The consultant also assisted EAC in reviewing initial

operational guidelines and provided operational support to EAC. Through its technical assistance, the World Bank also financed a consultant to provide operational support to EAC and financed various training programs for EAC staff. For EDC, the World Bank financed the following capacity building programs: (i) improvement of EDC commercial practices and management training; (ii) capacity building for land acquisition, resettlement, and environment; and (iii) power investment planning. Given that similar activities were financed by the World Bank, EDC did not request ADB to finance either the demand management and consumer services program or the training program on strengthening environmental management and social safeguards. The private sector participation program and the tariff review study were not financed under this project as envisaged at appraisal, but rather under ADB-funded technical assistance.<sup>6</sup>

### C. Project Costs

18. At appraisal, the project was estimated to cost \$95.0 million. Foreign exchange cost accounted for \$58.5 million (about 62% of the estimated total), including \$1.8 million for service charges and interest during construction. Local currency cost was estimated at \$36.6 million (38% of the estimated cost). ADB was to provide a loan for the equivalent of \$44.3 million from its Special Funds resources to finance 46% of the project cost. The World Bank was to supply \$16.0 million (17% of total project costs) of parallel cofinancing. NDF was to provide parallel cofinancing of €10 million (about \$11 million equivalent at time of appraisal) in cofinancing for a portion of the substation equipment, representing 12% of total project costs. The government was to fund \$23.7 million of domestic currency costs representing 25% of total project costs.

19. ADB and its cofinanciers fulfilled their undertakings to cofinance the project. At project completion, the cost came to \$76.0 million, of which ADB financed \$38.9 million, or about 51%. The World Bank financed \$15.53 million equivalent, or 20% of the cost, while the NDF credit accounted for \$12.9 million equivalent, or 17%.<sup>7</sup> The government and EDC funded the remainder, equivalent to \$8.7 million, or 11% of the project cost. The government funds were used to pay for resettlement and land acquisition, while EDC funded the local cost component of interest during construction and used its own budget to help extend the distribution network. The actual cost covered by the government was lower than estimated at appraisal as the government waived taxes and duties, thereby reducing its contribution by \$15.0 million.

20. The actual total project cost of \$76.0 million is significantly lower than the \$95.0 million estimated at appraisal. The reduction occurred notwithstanding the use of \$4.1 million in ADB loan savings to purchase sundry equipment required for operation and maintenance activities. The largest saving was \$15.0 million in taxes and duties waived by the government. Comparing costs in real terms shows that all supply and works contracts came in under budget with the exception of a contract for modifications to existing substations (increase of \$1.2 million) financed by the World Bank.

21. The actual total cost for the project components financed by ADB decreased by \$5.4 million from \$44.3 million estimated at appraisal to \$38.9 million. A major reason is that the actual cost for the infrastructure components financed by ADB was just slightly above that estimated at appraisal, and thus the major portion of contingencies allocated at appraisal was not used. In addition, the actual cost for the 22 kV bulk supply distribution component decreased

<sup>6</sup> ADB. 2010. *Technical Assistance to the Kingdom of Cambodia for the Rural Electrification Project*. Manila (TA 7675-CAM).

<sup>7</sup> The difference between the actual NDF cofinancing and approved NDF amount was due to foreign exchange gain.

by \$0.8 million from \$2.8 million estimated at appraisal to \$2.0 million. Furthermore, ADB financed only \$0.2 million of the capacity building component compared to the cost of \$1.0 million estimated at appraisal, as some similar capacity building activities were financed by the World Bank. The actual cost for the project implementation consultants financed by ADB was \$1.99 million compared to \$2.20 million estimated at appraisal. Savings of \$4.11 million from ADB loan proceeds were used to finance the supply of electrical spare parts and equipment, which were not originally planned at appraisal.

22. Appendix 2 compares the actual detailed costs for each component of the project with appraisal estimates. For cost comparison, local currency costs incurred by EDC and payments in euro funded under the NDF credit have been converted into dollars at rates prevailing at the time of each transaction. The average exchange rates used are shown in Appendix 3.

#### **D. Disbursements**

23. The ADB loan was disbursed more slowly than envisaged at appraisal because of implementation delays, especially during the initial implementation stage. Loan proceeds were disbursed in accordance with ADB's *Loan Disbursement Handbook*. Disbursements from the loan account were completed on 9 May 2011. At the government's request, ADB cancelled SDR3,244,793.73 of the loan savings on 30 June 2009. ADB also cancelled the remaining balance of SDR2,455,739.78 on the closing date of 9 May 2011, reducing the size of the loan to SDR25,240,466.49. No disbursement schedule had been included in the appraisal documents. Based on the implementation schedule prepared at appraisal, however, the projected disbursements were developed and are shown in Appendix 4 with the actual disbursements.

#### **E. Project Schedule**

24. The ADB Board approved the loan on 15 December 2003. The loan agreement was signed on 10 November 2004, and the loan became effective on 25 March 2005. The original closing date had been 31 December 2008. ADB approved the government's request to extend the loan closing date to 31 December 2010, which proved sufficient to enable completion of the project and to utilize a portion of loan savings to procure additional electrical equipment. At appraisal, the project had been estimated to be implemented over 5 years from the date of loan effectiveness. Procurement had been expected to commence in July 2004 and construction to start in July 2005 with completion in June 2008. Construction activities actually commenced in January 2007 and were completed in November 2011. Appendix 5 compares the actual implementation schedule with the appraisal schedule.

25. The project faced initial implementation delays, especially in achieving loan effectiveness, recruiting implementation consultants, and awarding civil works contracts.<sup>8</sup> As a result, the cumulative delays for commencement of the transmission line contract and the substations contract were 18 months and 24 months, respectively. The loan was declared effective 11 months later than envisaged at appraisal due to delay in signing the loan agreements and delay in obtaining government approval of the legal documents during the transition period following formation of a new government.

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<sup>8</sup> Delays in milestones: 11 months in loan effectiveness (March 2005 from April 2004), 12 months in fielding of consultants (May 2005 from May 2004), and 18 months in approval of bidding documents (June 2006 from December 2004).

26. Recruitment of project implementation consultants was also delayed because advance procurement action was not taken as envisaged at appraisal. The EA started the recruitment process only after the loan was declared effective. Times spent in preparing consultant recruitment documents, bid documents, and bid evaluation reports were also longer than envisaged at appraisal. The transmission and distribution line contract was completed behind the original schedule because EDC wanted to utilize savings to expand the 22 kV lines in more rural villages. Similarly, implementation of the substations contract was completed later than originally scheduled mainly due to additional substation works financed by loan savings.

## **F. Implementation Arrangements**

27. Apart from the delays in project implementation, the implementing arrangements were as envisaged at appraisal. EAC is the country's regulatory agency, responsible for issuing rules, regulations and procedures and regulating the power market operators. REEs, which are private operators licensed in accordance with EAC's procedures, construct and operate the low voltage distribution lines. EDC, the EA of the Project, is the state-owned company responsible for electricity production, transmission, and distribution in licensed areas assigned to EDC by EAC. EDC established two project management units to separately implement the works funded under ADB and NDF loans and under the WB loan. The Director of EDC's Corporate Planning and Projects Department headed both units. The implementation arrangements worked well and resulted in establishment of two permanent project management offices within the Corporate Planning and Projects Department instead of ad hoc project implementation units. Project Management Office Number 1 of this department undertook daily project management activities with support of the implementation consultants. This office was headed by a senior engineer and supported by 12 experienced engineers and supervisors, and it was responsible for coordinating implementation activities with EDC's Finance and Accounting Department. The project's organization chart is provided in Appendix 6.

## **G. Conditions and Covenants**

28. All financial loan covenants were complied with but two: the revenue breakeven covenant and the debt service coverage ratio covenant. In 2005 and 2008, revenues were marginally below the levels required to comply with the revenue breakeven covenant. In 2004 and 2005, EDC failed to comply with the debt service coverage ratio covenant when its debt service obligations spiked upward despite improvements in its profitability.<sup>9</sup> EDC's inability to comply with the revenue breakeven covenant in 2005 and 2008 was due to rapid escalation in costs caused by a sharp rise in oil prices, as EDC was not able to adjust tariffs to customers during these years notwithstanding a steady and commendable increase in its operating efficiency since 2005. EDC's financial performance until 2008 was influenced by fuel prices, as major energy sources were from diesel generators. After commissioning of the project's transmission line in 2009 and the beginning of electricity imports from Viet Nam and Thailand,<sup>10</sup> there was a major improvement in EDC's financial performance as savings in electricity costs were used to strengthen EDC's financial position. Since 2009, there has been continuous improvement in all of EDC's operational and financial performance indicators. Currently, EDC readily exceeds the requirements of the financial covenants. Full compliance with the debt-to-equity ratio and accounts receivable covenants during the entire 2004–2010 project

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<sup>9</sup> This loan covenant requires that a minimum debt service coverage ratio of 1.2 be achieved in 2004–2006 and a ratio of 1.3 from 2007 onward.

<sup>10</sup> Import of electricity from Thailand is through a different transmission line operated by the private sector.

implementation period indicates that EDC maintained a reasonable debt level and collection performance.

29. All standard and sector loan covenants were fully complied with, except a loan covenant requiring EDC to implement a project performance monitoring system to monitor impacts and benefits of the project with regard to end-consumers and rural electrification enterprises. The baseline survey was conducted, but a comprehensive impact evaluation study was not prepared. Therefore, this loan covenant is rated as partly complied with. The system losses were significantly improved, as these declined from 14% in 2004 to 10% in 2010, which is far below the loan covenant requirement of 16%. This significant improvement was achieved as a result of improved network and as EDC implemented measures such as requesting industrial and large commercial customers to install capacitors to maintain the minimum power factors, setting up vigilance squads to conduct surprise checks at customers' premises to detect energy theft, implementing energy audit systems, and implementing a new financial accounting and utility management information system. Details of compliance with the key loan covenants are provided in Appendix 7.

## **H. Consultant Recruitment and Procurement**

### **1. Consultant Recruitment**

30. The ADB-funded consultants were recruited in accordance with ADB's *Guidelines on the Use of Consultants*. The project implementation consultants (PICs) to assist EDC in procurement activities and supervision of transmission line and substation works were recruited using the quality- and cost-based selection method. At appraisal, the PICs were expected to be fielded by April 2004. Despite approval of advance action, a consulting services contract was not signed until 22 July 2005 while the loan was declared effective on 25 March 2005. At appraisal, it was envisaged that the implementation consultant contract would include 60 person-months of international and 60 person-months of domestic consultants. Given implementation delays, extensions of services from key consultant staff members were required. Actual implementation consultant inputs totaled 75 person-months of international and 81 person-months of domestic consultants.

31. As envisaged at appraisal, an individual consultant was recruited to assist EAC in monitoring license and reviewing tariff applications as well as providing other operational regulatory support. A contract for the services of this individual consultant was signed in February 2006 and his total intermittent inputs of 8 person-months were completed in January 2008. Other individual capacity building services that had been earmarked for ADB financing were replaced by a contract financed by World Bank that was awarded to a firm providing a coordinated package of services for improving EDC commercial practices and management training. This contract was implemented between February 2008 and December 2011.

### **2. Procurement**

32. The procurement of goods and services under the ADB-funded project components was conducted in accordance with ADB's *Procurement Guidelines*, while procurement of goods and services under those components funded by NDF and World Bank was in accordance with their own procurement procedures. At appraisal, procurement of works under the ADB-funded components was divided into two contract packages: (i) a turnkey contract for 220 kV transmission line and bulk supply distribution, and (ii) a turnkey contract for substations at Takeo and West Phnom Penh and 22 kV feeders. As requested by the government, ADB



approved the use of a portion of loan savings to finance maintenance vehicles and equipment. Procurement of these items was divided into three contract packages: (i) Operation and Maintenance Trucks & Equipment; (ii) Supply of Test Equipment, Measure Equipment, Various Equipment, and Survey Equipment and Accessories; and (iii) Vehicles.

33. **Turnkey contract for transmission line and bulk supply distribution.** Preparation of the bidding documents for this contract, which has an estimated amount of \$22.2 million, commenced later than envisaged at appraisal due to the delay in recruiting the project implementation consultants. The first draft bid documents for this contract were submitted to ADB for comments on 20 February 2006. After incorporating ADB comments, an invitation for bids was issued on 2 June 2006. Twenty-four bids were received and opened on 7 August 2006. Bids evaluation was a lengthy exercise, as the bids were reviewed and evaluated in detail, and clarifications were sought to establish that the equipment and services to be supplied were in accordance with the provisions of the bid documents. The bid evaluation report was submitted to ADB in October 2006 and approved by ADB in November 2006. The contract agreement was awarded on 28 December 2006, which was 15 months after the time envisaged at appraisal.

34. **Turnkey contract for substations.** The bidding process for the distribution works also started late compared to the schedule envisaged at appraisal. As for procurement of the generation works, the government's procurement committee spent considerable time in evaluating commercial terms and conditions and technical requirements of the bids, and thus extended the expiry date for bid validity. Bids were received and opened on 10 October 2006, and EDC submitted the bid evaluation report to ADB on 24 April 2007. ADB approved the executing agency's bid evaluation report and recommendation to award the contract on 15 May 2007. The EA signed the contract agreement on 28 June 2007, which was 20 months after the time envisaged at appraisal.

35. **Maintenance vehicles and electrical equipment.** Procurement of these maintenance vehicles and equipment was not envisaged at appraisal, and a portion of loan savings were used to finance these items needed for maintaining the project facilities. The bidding process commenced in March 2009 and the supply of all equipment was completed in December 2010.

## I. Performance of Consultants, Contractors, and Suppliers

### 1. Consultants

36. The consulting services covered, among other things, detailed engineering design, preparation and evaluation of bidding documents, supervision of civil works contracts, and technical support and training services for EDC staff. The PICs followed their terms of reference and provided all staff inputs as required in their contract. The PICs did not, however, act as the project manager (formerly engineer) as defined in the International Federation of Consulting Engineers (FIDIC) contract, but rather provided assistance in construction supervision through the review of design and advisory services. The role of the PICs in construction supervision was limited as the PICs had insufficient budgetary provision to supervise the two turnkey contracts on a daily basis. This limitation on their services undermined the PICs' incentives to take ownership of the project. The overall performance of the consultants was rated satisfactory.

37. The consultant recruited to support EAC also performed satisfactorily. The consultant provided advice and assistance in monitoring license and reviewing tariff applications. EAC reported that the services of this consultant were valuable.

## **2. Contractors**

38. The contractor for the transmission line and bulk supply distribution lines did not undertake steel tower design by itself, but assigned its subcontractor, a steel tower manufacturing company, to undertake both the design and manufacturing. Submission of the final tower design was delayed due to initial calculation errors, which were then corrected. The contractor did not mobilize adequate teams to undertake foundation works at the initial stage. Although these shortfalls caused some initial delays, the contractor later mobilized additional teams to accelerate the work. The transmission and bulk distribution lines were inspected and commissioned by the PICs and EDC, and the testing results showed these lines to be of acceptable quality and meet the technical specifications. Overall, the performance of the contractor was satisfactory.

39. Implementation of the substation contract faced initial delays due to difficulty in finding suitable sites for the substations and permissions for the construction of bypass roads to the selected substation sites. After this issue was addressed, the contractor mobilized additional teams to catch up. The plants and equipment were inspected, tested, and commissioned by the PICs and EDC. The quality of substation works was found to be satisfactory, and there was no significant malfunctioning of equipment supplied and installed under the contract. Overall, the performance of the contractor was satisfactory.

## **3. Suppliers**

40. The transformers, shunt capacitor banks and other substation equipment, maintenance equipment, and other electrical equipment were delivered as scheduled. EDC and the PICs conducted inspections and tests to ensure this equipment was in good condition and met the technical specifications before accepting it. The suppliers' performances were rated satisfactory.

## **J. Performance of the Borrower and the Executing Agency**

41. EDC successfully implemented the project with the advisory services from the consultants. EDC acted as both employer and project manager of the two main turnkey contracts and mobilized its engineers to monitor work progress at the project sites on a daily basis. EDC capacity in procurement was limited, but it has been improved through the establishment of a new procurement department and the recruitment of additional procurement staff. The government's counterpart funds were made available on a timely basis, and the independent monitoring agency for resettlement activities confirmed that compensation payments for project affected peoples were completed before commencement of the works. The performances of the borrower and executing agency are considered satisfactory.

## **K. Performance of the Asian Development Bank**

42. The project was originally administered from ADB headquarters, but administration was transferred to the Cambodia Resident Mission in February 2008 for close monitoring. Four ADB project team leaders administered the project during implementation. ADB conducted 17 project administration missions, including three joint review missions with the World Bank and NDF. The missions included meetings with the project stakeholders as well as project site visits. The borrower and EDC recognized the positive role that the ADB missions played in advising on technical issues, preparing and evaluating bid documents, and providing close monitoring, including participating in a number of monthly progress meetings after project administration was delegated to the resident mission. Overall, the performance of ADB is rated satisfactory.

### III. EVALUATION OF PERFORMANCE

#### A. Relevance

43. The project was consistent with the government's development goals in the energy sector as follows: (i) provide an adequate supply of energy throughout Cambodia at reasonable and affordable prices; (ii) ensure a reliable and secured electricity supply at reasonable prices, which facilitates investment in Cambodia and development of the national economy; (iii) encourage exploration of environmentally and socially acceptable development of energy resources; and (iv) encourage the efficient use of energy to minimize detrimental environmental effects. The large infrastructure developments comprising the high-voltage transmission line and its associated substations are meeting operational performance targets that allow Cambodia to import low-cost electricity from Viet Nam and this is having beneficial economic, environmental, and social impacts. The new transmission lines and substations have in turn helped address the identified issues within the power sector by enabling expansion and integration of the grid electricity infrastructure and providing a basis for connecting more than 50,000 mainly poor households in rural areas and some 40,000 new customers in Phnom Penh. The project is considered highly relevant.

#### B. Effectiveness in Achieving Outcome

44. The project is rated effective. It substantially achieved the outcomes envisaged at appraisal. Except for delays, project implementation followed the arrangements envisaged at appraisal. The use of PICs to supervise turnkey contractors was a highly effective approach, but it could have been improved by strengthening the role of the PICs to enable the fielding of experts who could have closely supervised the contractors and taken ownership of the project. The cofinancing arrangements with the World Bank and NDF worked as envisaged and ensured that all components and support required for success were financed. In the final analysis, all the planned facilities were implemented and are operating satisfactorily. The investments strengthen interregional links and extend Cambodia's national electrical infrastructure.

45. The cost of the investments is below budget and the imports of low-cost electricity from Viet Nam for supply to consumers has duly materialized. EDC's reduced power costs have transformed EDC from a loss-making to a financially profitable organization. Reports on rural electrification show that over 50,000 households within areas that are served by the project's facilities have gained access to electricity compared to a target of 14,200 households at appraisal. The poverty impact is therefore substantial, given that the newly connected households are generally in areas where the majority of the population lives below the poverty line.

#### C. Efficiency in Achieving Outcome and Outputs

46. The project had been assessed at appraisal as an exceptionally profitable investment for EDC with a financial internal rate of return (FIRR) of 35% and a highly beneficial development for the Cambodian economy with an economic internal rate of return (EIRR) of 32%. Results at project completion are higher than forecast at appraisal and well above the relevant hurdle rates. The project FIRR is estimated at 41% and the project EIRR at 47%. The improvement is the result of lower costs incurred in both investment and operation and benefits greater than anticipated. The financial benefits include reduced local generation in relatively inefficient power plants, while the economic benefits include avoided investment in new, high-cost generation

capacity. The benefits are manifested by EDC's much improved financial performance and a significant increase in electricity consumption within Phnom Penh and nearby rural areas. The project investments have also increased EDC's bulk distribution capacity and enabled a significant rural electrification program. The returns from extended distribution have been evaluated over a range of conditions reflecting the variations in such parameters as household income and location that determine the returns from electrification. These sample calculations show that the economic returns from providing connections to the rural households range from 18% to 49% and average 33%. Given this, the project is rated as efficient in achieving its outcome and outputs, despite delays in implementation. Appendix 8 provides details on the methodology and assumptions underlying the FIRR and EIRR calculations.

#### **D. Preliminary Assessment of Sustainability**

47. The sustainability of using electricity imports from Viet Nam to strengthen the Cambodian power sector is dependent upon the availability and price of electric power in Viet Nam, which is subject to pricing and availability risks. The line is also the only high-voltage link between Viet Nam and Cambodia, which in itself is a risk given that the line could be taken out of service by natural or other disasters. However, the project has paid back the upfront capital investment within the first 2 years of its operation, and, given that the facilities funded by the project have a long economic life and comprise static fixed assets with relatively low operating costs, the facilities should readily cover ongoing costs for the foreseeable future and in time the line could play a role in an expanded subregional power network.

48. Cambodia has already absorbed most of the import supply capacity provided by the transmission line and needs to continue in efforts to diversify its energy supplies and improve energy security. Options include investment in domestic energy development, increasing local power plant capacity, and additional interregional links. Due to growing power demand within Viet Nam itself since completion of the project facilities in 2009, Viet Nam has so far sold only 135 MW of power to Cambodia through the transmission line from its commitment to export up to 200 MW from 2008 as stipulated in the Power Purchase Agreement between Cambodia and Viet Nam signed in 2000. This issue should not impact the overall GMS power trade, however, and EDC and Electricity of Viet Nam continue to discuss increasing power supply from Viet Nam. ADB's role should involve ensuring EDC maintains the project facilities and that it continues its efforts to help Cambodia to diversify its energy supplies, build more interregional links, and facilitate implementation of the Power Purchase Agreement. Sustainability of the project is considered likely.

#### **E. Impact**

49. The project is classified as Category B on environmental impacts. The initial environmental examination had concluded that the environmental impacts of the project were minor and that careful consideration was given to transmission and distribution routes to avoid environmentally sensitive areas, existing villages, and valuable agricultural land. Environmental mitigation measures were identified to address potential impacts. The detailed environmental management plan recommended mitigation measures to ensure that (i) there are monitoring programs by the relevant government agencies; (ii) the contractors, under supervision of the PICs, prepared and carried out the construction environmental management; and (iii) the contractors conducted self-monitoring to ensure the mitigation measures were implemented effectively. The impacts were identified through the use of a self-monitoring checklist, and no serious impact was observed. The minor adverse environmental impacts were effectively addressed through mitigation measures as proposed in the environmental management plan.

The project created positive environmental impacts by replacing a large number of old diesel generating units.

50. The social impacts include the provision of access to electricity to more than 50,000 rural households in areas where a majority of residents are rice farmers living below the poverty line. The project completion mission visited a number of newly electrified rural villages whose inhabitants clearly appreciate the improvements that access to electricity has brought them. The implementation of a full-scale and very detailed resettlement action plan is another feature indicating that serious efforts were made to redress the negative social impacts caused by both involuntary resettlement and persons' loss of income-producing assets. The largest impact on Cambodia's electricity demand and supply balance, however, has been to increase the supply of electricity to people and businesses within Phnom Penh. This gain has enabled EDC to connect 40,000 new customers within Phnom Penh itself and at the same time reduce local purchases of power from relatively inefficient power producers.

51. The project has successfully proven that economic benefits from interregional linkages can be substantial. Viet Nam has earned export income from sale of surplus electricity and Cambodia has made exceptional economic returns on its investment. The results are manifested by the many new rural and urban connections that have been made, and by a financially strengthened EDC that has been able to play its part in providing the power that is needed for national economic growth. The project construction has had few adverse environmental impacts and some significant environmental benefits have been generated given that Cambodia has delayed, if not avoided, investment into fossil-fuel power stations. Socioeconomic and environmental impacts in rural areas are also positive, given that newly connected households are no longer reliant on recharge stations and lead-acid batteries and/or on other fossil fuels such as wood, charcoal, and kerosene.

52. The resettlement action plan submitted in January 2005 was a full and comprehensive document that fulfilled government undertakings to finalize resettlement and compensation arrangements prior to project implementation. That plan covered the ADB and World Bank project components and was jointly reviewed and approved by ADB and the World Bank. The primary social impacts from the project were permanent relocation of households and loss of income-earning assets, such as sugar palms, by many of the affected persons. The Government paid compensations for 1,311 affected households, 8,868 affected structures, 31,560 affected trees, and for land acquisition of 402,717 square meter. The resettlement process was independently monitored by an independent monitoring agency. Appendix 9 gives the background to the resettlement.

#### **IV. OVERALL ASSESSMENT AND RECOMMENDATIONS**

##### **A. Overall Assessment**

53. Based on the review of its relevance, effectiveness, efficiency and sustainability, the project is rated successful. It has been implemented in accordance with the concept detailed at appraisal with only minor fine-tuning to adapt and optimize line routes and to relocate the site of the West Phnom Penh Substation. With the exception of the implementation delays, the project has performed as planned with benefits that exceed the favorable assessments made at appraisal. During implementation and after project completion, the demand for and value of electricity have significantly grown in the project areas. There is clear evidence that adequate and reliable power has stimulated development of small businesses and provided power to more poor households.

## B. Lessons Learned

54. There were implementation delays in the initial period, especially in achieving loan effectiveness, recruiting implementation consultants, and awarding civil works contracts. These delays occurred even though advance procurement action had been approved. The formation of a new government following loan approval was a major factor in this respect, as was the time taken for a new executing agency to climb the learning curve on use of ADB procurement procedures. To facilitate project start-up, it is recommended that ADB should extend the services of the procurement consultant financed under the project preparatory technical assistance project until loan consultants are fielded.

55. The devolution of project administration responsibilities to the resident mission during the project helped facilitate close working relationships between ADB staff and key officials. The experience EDC gained in this project and the relationships that have developed between the resident mission and counterparts should greatly benefit any future project.

## C. Recommendations

### 1. Project Related

56. **Future monitoring.** Although the project is performing well and meeting all expectations, its success depends upon the single high-voltage transmission line linking Cambodia and Viet Nam. Regular monitoring of the level and cost of imports and their impact on EDC is advisable. The need for close and frequent monitoring should diminish as and when alternative supply arrangements provide Cambodia greater security of supply. EDC should continue to conduct socioeconomic monitoring activities to assess the project's benefits for the rural population.

57. **Project financial reports.** The audited project accounts that are part of the financial reporting requirements disclose sources of funds (ADB, NDF, and counterpart) and expenditures by disbursement category (civil works, consultants, etc.). The project accounts are prepared in US dollars, but they do not account for such relevant Ministry of Economy and Finance transactions as interest charges and debt service. They also do not include information on project expenditures co-funded in parallel by the World Bank. Rather, the expenditure details mirror ADB's own internal disbursement record rather than detail investments made by asset or type of asset. The ADB may consider requiring EDC to detail all project transactions and ask that these be reconciled against the asset values in local currency in EDC's asset register. This would provide ADB with a more complete financial report on the project and show what assets and expenses have been funded by the disbursements.

58. **Financial covenants.** The financial covenants proved sufficient for monitoring EDC's financial performance and financial status during project implementation and are considered adequate for ongoing monitoring and evaluation. However, the auditor's calculation of the financial covenants raises issues of interpretation that may need to be clarified in case there are any contentious developments. In calculating the debt-to-equity ratio, for example, the auditor has taken debt to be borrowings and has excluded other items shown in the EDC balance sheet as "noncurrent liabilities" that are debt under the definition provided in the ADB loan and project agreements.<sup>11</sup> Given that this is not an isolated example, ADB could consider supplementing

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<sup>11</sup> The term "debt" means any indebtedness of the borrower maturing by its terms more than 1 year after the date from which it was originally incurred.

the definitions in loan agreements by distributing examples to the auditors showing how the ratios are calculated. The interpretations of these covenants may also have been unduly confused by the widespread adoption of cash flow statements in place of flow of funds statements in financial reporting. The adoption of cash flow statements should, however, simplify the definition of financial covenants, given that many of the covenants focus on adequacy of cash flows and the viability of executing agencies.

59. **Construction supervision.** The role of the PICs in construction supervision was limited as they did not have sufficient budgetary provision to supervise the two turnkey contracts on a daily basis. This limitation on the PICs' services undermined their incentives to take ownership of the project. Requirement for close supervision of contractors should be built into the consultant's terms of reference together with adequate funding allocation in the consulting services budget.

60. **Further action or follow-up.** Follow-up actions on operation and maintenance of project facilities as well as monitoring of benefits of rural electrification should be undertaken through the ongoing and future ADB-financed projects.

61. **Timing of the project performance evaluation report.** The project is complete and a project performance evaluation could be undertaken at any time. The recommendation is to schedule the project performance evaluation review for July 2013, by which time another year's financial and operational performance reports will provide additional perspective on the project's longer term impacts and sustainability. This includes further insights into the pricing and availability of electricity imports from Viet Nam, which are currently being reviewed by the two countries.

## 2. General

62. This project has provided exceptional returns from both the transmission and the rural electrification components. Overall, the project benefitted not only the local populations, but it also helped businesses to start up and therefore had a very positive impact. ADB should continue to provide assistance for rural electrification projects to enable the Government to increase the electrification rate, especially for the rural poor.

63. ADB should assist the EA in evaluating complex turnkey contracts, especially when the EA is not familiar with the evaluation of technical aspects and with ADB's bid procedures or bid evaluation. In a country where the government's procurement committee is comprised of several agencies, major procurement delay can occur if the bid evaluation reports are not in line with ADB guidelines and procedures and thus need to be revised.

## PROJECT FRAMEWORK

Design Summary	Performance Indicators/ Targets	Monitoring Mechanisms	Assumptions and Risks	Achievements
<p><b>Goal</b> To stimulate trade and economic growth in the subregion and to promote poverty reduction in Cambodia</p>	<p>Economic growth to achieve or exceed government targets and to meet Millennium Development Goals</p>	<p>Macroeconomic and socioeconomic data  Trade statistics</p>	<p>Government pursues cross-border trade in the subregion and pro-poor policies</p>	<p>Despite the global economic downturn, Cambodia's average gross domestic product growth was about 4% during 2009–2011.</p>
<p><b>Purpose</b> To promote the provision of sustainable and reliable electricity at affordable prices to consumers in Cambodia  To enhance accessibility for the poor by promoting a pro-poor policy environment in the sector</p>	<p>EDC to trade sufficient energy to ensure the financial and economic viability of the project  EDC to offer lower-cost, 5-ampere capacity connections and to assess the need to allow connection fees to be paid in installments</p>	<p>Metering of energy trade; EDC to follow agreed generation expansion plan  Monitoring by ADB of the consumer services upgrade component of the project</p>	<p>Compliance with the power purchase agreement between Cambodia and Viet Nam  Assumes that the EDC program to encourage rural electricity enterprises is successful</p>	<p>EDC bought 135 MW of power from Viet Nam through the project's transmission line.  The project is financially and economically viable (economic internal rate of return at 47% and financial internal rate of return at 41%).  EDC issued an instruction that allows poor customers to pay connection fees in installments and also offered low-cost, 5-ampere capacity connections to poor customers.</p>
<p><b>Outputs</b> 220 kV transmission line from the Vietnamese border to Phnom Penh and substations at Takeo and West Phnom Penh and reinforcement of 115 kV transmission ring</p>	<p>Commissioning and operation of the 115 kV ring by December 2006 and of the transmission line by October 2007</p>	<p>Project progress reports and completion report  Socioeconomic surveys; EDC consumer statistics  ADB review missions  Project progress</p>	<p>Commitment from the Vietnamese authorities that they will implement their section of the project as agreed with the Cambodian authorities  Components funded by the World Bank and</p>	<p>The 230 kV transmission line and 115 kV ring have been in operation since May 2009 and August 2009, respectively.</p>



Design Summary	Performance Indicators/ Targets	Monitoring Mechanisms	Assumptions and Risks	Achievements
<p>22 kV feeders around Phnom Penh and Takeo; bulk supply to affected communities living along the transmission route</p> <p>An environment and resettlement unit established in EDC</p> <p>Households affected by the infrastructure development fully resettled according to the resettlement plan</p>	<p>Bulk supply connections to 20 villages along the transmission corridor by October 2007</p> <p>Unit established and staffed with one environmental and one resettlement specialist</p> <p>3,700 affected households resettled and compensated by 2006</p> <p>Implementation of the resettlement plan prior to the commencement of works in each area</p>	<p>reports and review missions</p> <p>Surveys of affected people</p> <p>Independent monitoring reports</p>	<p>the Nordic Development Fund are not delayed</p> <p>Government will support the resettlement plan and provide adequate staff and resources for implementation</p> <p>Affected people will accept the compensation packages offered</p> <p>Relocated affected people will be able to purchase replacement land</p>	<p>Bulk supply connections to 22 villages along the transmission corridor completed in December 2010.</p> <p>Resettlement and environment unit was established in EDC.</p> <p>All 3,198 affected households received compensation.</p> <p>Implementation of the resettlement plan was completed prior to the commencement of works in each area.</p>
<p><b>Activities</b></p> <p>Engagement of implementation consultants to design and supervise construction of the works and update and supervise implementation of the resettlement plan</p> <p>Construction of the transmission line and bulk supply distribution works</p>	<p>Consultants appointed during second quarter of 2004; resettlement specialists and independent monitoring organization mobilized before detailed measurement survey started and resettlement plan updated</p> <p>Works completed and line commissioned by Oct 2007</p>	<p>ADB review missions</p> <p>Quarterly progress reports</p> <p>Project completion report</p> <p>Reports from the resident financial adviser and from EDC on accounts receivable progress</p> <p>Independent monitoring organization reports</p> <p>Consultants' quarterly reports and ADB review missions</p>	<p>Performance by the Implementation consultants will be satisfactory</p> <p>No major land acquisition or resettlement problems occur</p> <p>Rural electric enterprise owners will be trained and will invest in consumer connections from EDC's bulk supply</p>	<p>Project implementation consultants were appointed in July 2005.</p> <p>Resettlement specialists and independent monitoring organization were mobilized.</p> <p>Resettlement plan was updated and approved by ADB.</p> <p>Transmission line and bulk supply distribution line were commissioned in May 2009 and November 2010, respectively.</p>

Design Summary	Performance Indicators/ Targets	Monitoring Mechanisms	Assumptions and Risks	Achievements
<p>Implementation of the agreed financial action plan for EDC</p> <p>Capacity building of the Electricity Authority of Cambodia (EAC) and EDC</p>	<p>Completed by the end of 2004</p> <p>Resident financial manager in place by mid-2004</p> <p>All capacity building completed satisfactory by June 2006</p>		<p>Risk that the agreed action plan will not be implemented</p> <p>Risk that capacity building does not succeed</p>	<p>Financial action plan was implemented, and EDC's financial performance was improved.</p> <p>Capacity building program of EAC was completed satisfactorily and various capacity building programs financed by the World Bank were also completed satisfactorily.</p>
<p><b>Inputs</b></p> <p>Consulting services Construction activities Capacity building</p>	<p>Consultants: \$4.0 million Infrastructure: \$89.8 million Capacity building: \$1.2 million <b>Total: \$95.0</b></p>	<p>EDC's audited project accounts</p> <p>ADB review missions</p> <p>Report from independent monitoring organization</p>	<p>Cost escalation and exchange rate movements do not cause cost overruns</p> <p>Counterpart budget is available when required</p> <p>Competent consultants are recruited and their advice followed</p> <p>Counterpart staff are available</p>	<p>Consultants: \$5.0 million Resettlement: \$2.4 million Infrastructure: \$54.5 million Bulk supply distribution: \$2.0 million Capacity building: \$1.0 million Equipment: \$4.1 million Interest during construction: \$7.0 million <b>Total: \$76.0</b></p>

ADB = Asian Development Bank, EAC = Electricity Authority of Cambodia, EDC = Electricité du Cambodge, kV = kilovolt, MW = megawatt.

**APPRAISAL AND ACTUAL PROJECT COSTS**  
(\$ million)

Item	Appraisal Estimate			Actual Estimate *		
	Foreign Currency	Local Currency	Total Cost	Foreign Currency	Local Currency	Total Cost
<b>A. Infrastructure</b>						
1. 220 kV transmission line	14.82	2.72	17.54	17.50	1.99	19.49
2. Takeo substation	4.88	0.88	5.76	5.40	0.78	6.18
3. West Phnom Penh substation	13.02	1.92	14.94	14.40	2.47	16.87
4. National control center	3.60	0.40	4.00	1.70	0.33	2.03
5. Reinforcement of 115 kV system	3.27	0.74	4.01	3.10	0.54	3.64
6. Modifications to general substations 1, 2, and 3	3.37	0.38	3.75	4.75	1.04	5.79
7. Spares and equipment	0.60	0.00	0.60	0.40	0.07	0.47
8. High-voltage line operation and maintenance (12 months)	1.40	0.00	1.40	0.00	0.00	0.00
<b>Subtotal (A)</b>	<b>44.96</b>	<b>7.04</b>	<b>52.00</b>	<b>47.25</b>	<b>7.22</b>	<b>54.47</b>
<b>B. Resettlement and Land Acquisition</b>	<b>0.00</b>	<b>2.50</b>	<b>2.50</b>	<b>0.00</b>	<b>2.40</b>	<b>2.40</b>
<b>C. 22 kV Bulk Supply Distribution</b>	<b>1.39</b>	<b>1.39</b>	<b>2.78</b>	<b>1.02</b>	<b>1.02</b>	<b>2.04</b>
<b>D. Capacity Building</b>						
1. EDC financial management advisor	0.15	0.00	0.15	0.00	0.00	0.00
2. Demand management and consumer services	0.29	0.13	0.42	0.00	0.00	0.00
3. Private sector participation	0.00	0.10	0.10	0.00	0.00	0.00
4. EAC operation support	0.20	0.00	0.20	0.00	0.04	0.04
5. EDC tariff review	0.10	0.00	0.10	0.18	0.00	0.18
6. Other capacity building programs	0.00	0.00	0.00	0.77	0.00	0.77
<b>Subtotal (D)</b>	<b>0.74</b>	<b>0.23</b>	<b>0.97</b>	<b>0.95</b>	<b>0.04</b>	<b>0.99</b>
<b>E. Project Implementation Consultants</b>	<b>2.43</b>	<b>0.81</b>	<b>3.24</b>	<b>1.73</b>	<b>3.27</b>	<b>5.00</b>
<b>F. Taxes and Duties</b>	<b>0.00</b>	<b>14.99</b>	<b>14.99</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>G. Various Equipment</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>3.91</b>	<b>0.21</b>	<b>4.12</b>
<b>Subtotal Base Costs</b>	<b>49.52</b>	<b>26.96</b>	<b>76.48</b>	<b>54.86</b>	<b>14.16</b>	<b>69.02</b>
<b>H. Contingencies</b>						
1. Physical	4.42	2.48	6.90	0.00	0.00	0.00
2. Price	2.76	1.52	4.28	0.00	0.00	0.00
<b>Subtotal Contingencies</b>	<b>7.18</b>	<b>4.00</b>	<b>11.18</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>I. Interest during Construction</b>	<b>1.76</b>	<b>5.63</b>	<b>7.39</b>	<b>1.50</b>	<b>5.47</b>	<b>6.97</b>
<b>Total</b>	<b>58.46</b>	<b>36.59</b>	<b>95.05</b>	<b>56.36</b>	<b>19.63</b>	<b>75.99</b>

EAC = Electricity Authority of Cambodia, EDC = Electricité du Cambodge.

\* Total may not tally due to rounding.

**CURRENCY EQUIVALENTS**  
(annual averages)

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<b>(1 January–31 December)</b>	<b>Riel per \$1.00</b>
2005	3,866.77
2006	3,888.99
2007	3,899.21
2008	3,955.55
2009	4,080.84
2010	4,137.02
2011 <sup>a</sup>	3,995.42

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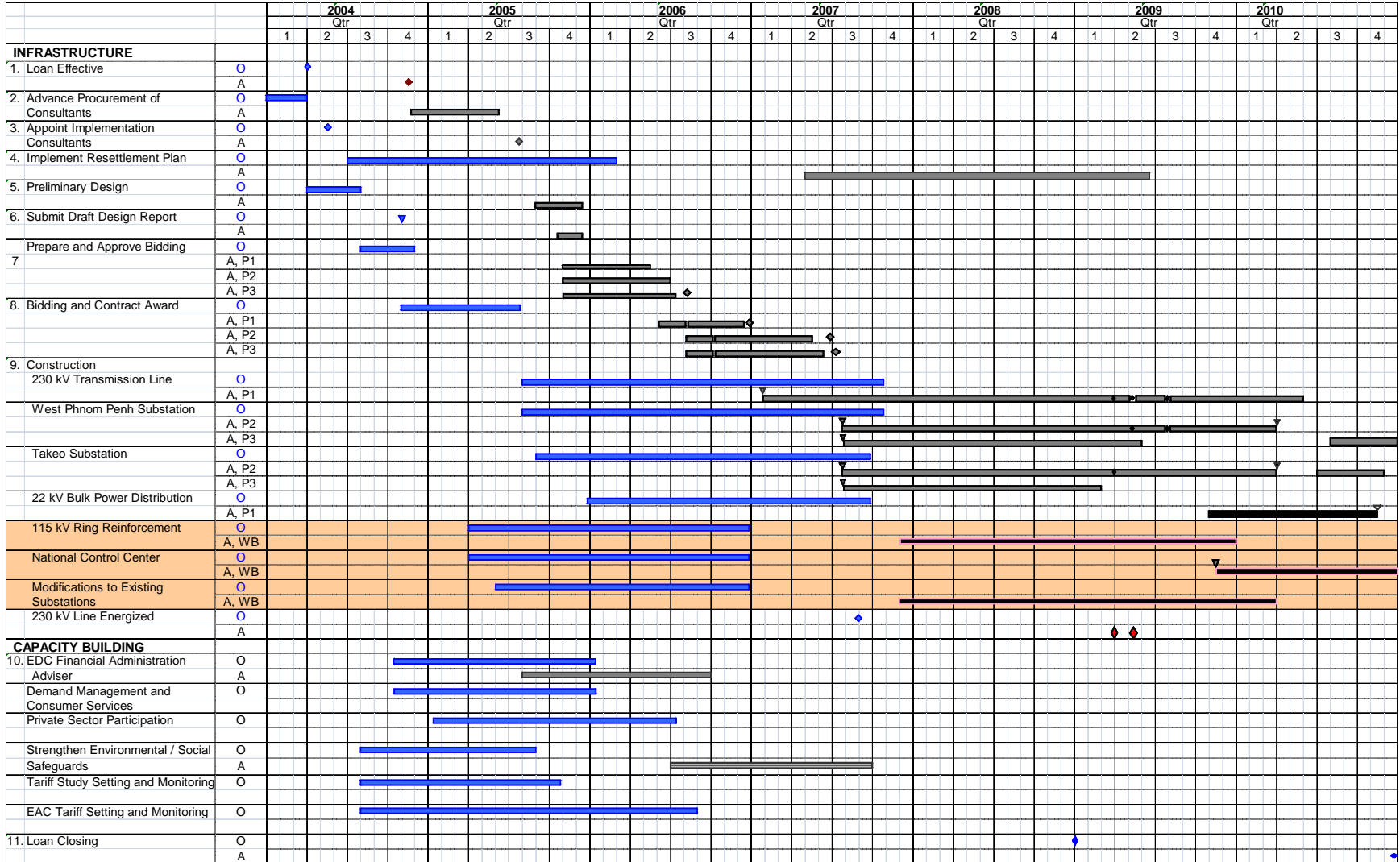
<sup>a</sup> 2011 Exchange rate is for 1 January–30 April 2011.  
Source: Asian Development Bank.

**PROJECTED AND ACTUAL DISBURSEMENTS**  
(\$ million)

<b>Year</b>	<b>Projected</b>	<b>Actual</b>
2004	1.198	0.000
2005	10.901	0.243
2006	20.143	0.390
2007	7.538	2.992
2008	4.520	13.245
2009	0.000	9.447
2010	0.000	8.795
2011	0.000	3.786
<b>Total</b>	<b>44.300</b>	<b>38.898</b>

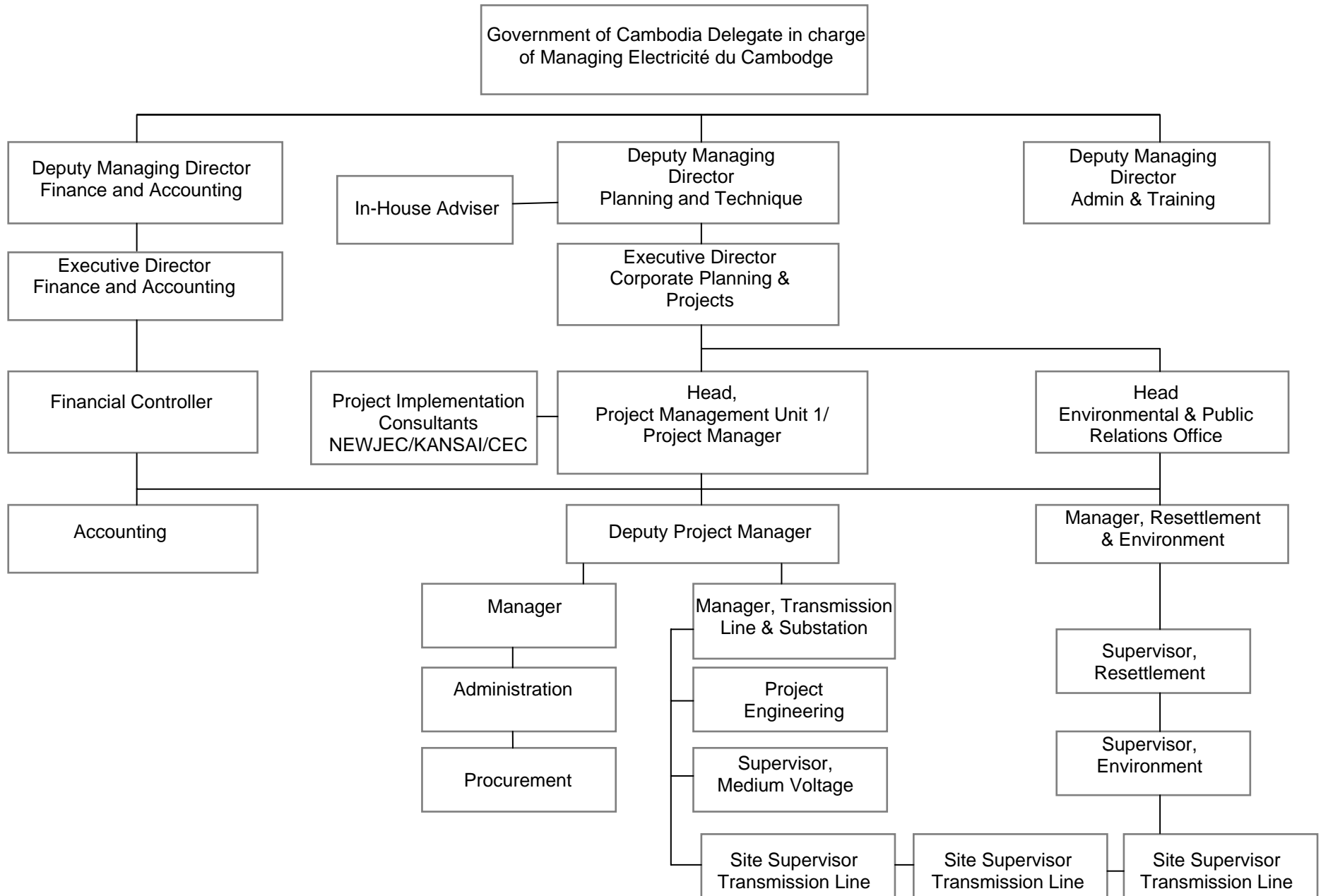
Source: Asian Development Bank's Loan Financial Information System.

## PROJECT IMPLEMENTATION SCHEDULE



A = actual; EAC = Electricity Authority of Cambodia; EDC = Electricité du Cambodge; kV = kilovolt; O = original; P1 = Package 1; P2 = Package 2; P3 = Package 3; Qtr = quarter; WB = World Bank.

## PROJECT ORGANIZATION CHART



### STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
<p><b>Implementation Arrangements</b> EDC shall ensure that throughout Project implementation the PMU shall be headed by a senior staff member with experience and qualifications acceptable to the Bank as Project Manager, and shall further include an adequate number of suitably qualified experienced administrative and technical staff assigned on a full-time basis.</p>	<p>Loan Agreement (LA), Schedule 6, Para. 1</p>	<p>Complied with.</p>
<p><b>Legal Framework</b> The Borrower shall promptly notify the Bank of any proposal to amend, suspend or repeal any provision of the Governing Laws that would have a material effect on the operations of EDC and EDC's ability to comply with the provisions under this Loan' Agreement and the Project Agreement, and shall afford the Bank an adequate opportunity to comment on such proposal prior to taking any action thereon.</p>	<p>LA, Schedule 6, Para. 2</p>	<p>Complied with.</p>
<p>Within six (6) months of the Effective Date, the Borrower shall have prepared a draft sub-decree with tariff setting guidelines for use by EAC and shall submit the same to the Bank. Within six (6) months after the Bank has made its comments on the draft sub-decree, the Borrower shall have promulgated a sub-decree with tariff setting guidelines for use by EAC.</p>	<p>LA, Schedule 6, Para. 5</p>	<p>Complied late.</p>
<p><b>Financial Matters</b> A minimum debt service coverage ratio of 1.2 is achieved in FY 2004 and maintained thereafter through FY 2006 and then a ratio of 1.3 is achieved in FY 2007 and maintained thereafter.</p>	<p>LA, Schedule 6, Para. 7(a)</p>	<p>Partly complied with. FY2004: 0.67 FY2005: -0.21 FY2006: 4.30 FY2007: 7.62 FY2008: 2.46 FY2009: 15.26 FY2010: 12.96</p>
<p>A debt to equity ratio not greater than 1.5 to 1 is achieved in FY 2004 and maintained thereafter.</p>	<p>LA, Schedule 6, Para. 7(b)</p>	<p>Complied with. FY2004: 20:80 FY2005: 31:69 FY2006: 28:72 FY2007: 26:74 FY2008: 35:65</p>



Covenant	Reference in Loan Agreement	Status of Compliance
<p>Beginning in FY 2004, accounts receivable shall be maintained at a level that does not exceed the equivalent of three (3) months' average sales revenue.</p>	<p>LA, Schedule 6, Para. 7(c)</p>	<p>FY2009: 36:64 FY2010: 31:69</p> <p>Complied with. FY2004: 2.23 FY2005: 2.10 FY2006: 1.72 FY2007: 1.15 FY2008: 1.37 FY2009: 1.49 FY2010: 1.33</p>
<p>EDC shall produce revenue breakeven for FY 2004 and maintain the revenue breakeven thereafter, such that total operating revenues are equivalent to or not less than the sum of (i) its total operating expenses; and (ii) the amount by which debt service requirements exceed the provision for depreciation.</p>	<p>LA, Schedule 6, Para. 7(d)</p>	<p>Partly complied with. FY2004: +KR455 million FY2005: -KR11,612 million FY2006: +KR53,803 million FY2007: +KR40,306 million FY2008: -KR26,839 million FY2009:+KR186,770 million FY2010:+KR230,506 million</p>
<p><b>Sector</b> EDC shall take all necessary action to maintain transmission and distribution losses at a level not exceeding 16% (within the EDC Phnom Penh electric transmission grid area) in FY 2004 and in each subsequent fiscal year.</p>	<p>LA, Schedule 6, Para. 14</p>	<p>Complied with. FY2004: 14% FY2005: 12% FY2006: 11% FY2007: 11% FY2008: 11% FY2009: 10% FY2010: 10%</p>
<p>EDC shall make available five ampere connections to low income residential consumers in the Phnom Penh electric transmission grid area.</p>	<p>LA, Schedule 6, Para. 16</p>	<p>Complied with.</p>
<p><b>Social</b> The Government should ensure that land acquisition, compensation, relocation, resettlement and rehabilitation is carried out in accordance with the Resettlement Plan (as updated upon completion of the detailed measurement survey and a sugar palm/income restoration study with the study's findings incorporated into the Resettlement Plan) agreed upon between the Borrower and the Bank, the Borrower's laws, regulations, and procedures and the Bank's requirements as defined in the</p>	<p>LA, Schedule 6, Para. 18</p>	<p>Complied with.</p>

Covenant	Reference in Loan Agreement	Status of Compliance
<p>Bank's <i>Policy on Involuntary Resettlement</i> and the <i>Handbook on Resettlement</i>.</p> <p>The Borrower shall ensure (i) that EDC provides adequate information to all Project affected people such as to enable them to reach an informed decision, including any hosts who provide land to Project affected people, and (ii) that Project affected people are regularly consulted in advance of compensation agreements that affect livelihoods or living conditions as a result of the Project. EDC and other officials implementing resettlement shall keep complete records on consultations and grievances relating to resettlement and shall make such records available to the Bank upon request.</p>	LA, Schedule 6, Para. 21	Complied with.
<p>No civil works shall commence in a specified geographic area prior to EDC having satisfactorily completed in that area, and in accordance with the approved Resettlement Plan, compensation payment and relocation, if appropriate, and having ensured that all rehabilitation assistance to Project affected persons is in place and that the specified geographic area required for civil works is free of all encumbrances.</p>	LA, Schedule 6, Para. 22	Complied with.
<p><b>Environmental Management</b></p> <p>The Borrower and EDC shall ensure that the contract documents for the civil works include specific mitigating measures as indicated in the Initial Environmental Examination (IEE) and in accordance with the Bank's <i>Environmental Assessment Guidelines</i>, 2003 to mitigate negative environmental impacts caused by the Project.</p>	LA, Schedule 6, Para. 24	Complied with.
<p>The Borrower shall ensure that EDC develops and implements an Environmental Management Plan for the Project, based on the IEE, ensuring that the Project complies with best environmental practices and meets the mitigation and monitoring requirements in a timely manner as described in the IEE and prevents damage to the natural environment as a result of the design, construction, operation and maintenance of Project facilities.</p>	LA, Schedule 6, Para. 25	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
<p><b>Health and Related Risks</b></p> <p>EDC shall include a requirement in the civil works contract documents for a dissemination campaign or campaigns on the risks of sexually transmitted diseases (including HIV/AIDS), and on the risks of trafficking women and children, to those employed during Project implementation and to communities in the Project area.</p> <p>Civil works contracts should include mandatory provisions on health, sanitation and appropriate working conditions, including accommodation, for construction workers at campsites during the construction period.</p> <p>The civil works contractors should comply with all applicable labor laws, including elimination of gender differentiated wages or food rations, and do not employ child labor in construction activities. The Borrower shall ensure that EDC's contract documentation contains such requirements.</p> <p><b>Auditing</b></p> <p>EDC should submit within six (6) months after the end of the fiscal year un-audited financial statements of EDC's consolidated operations which will consist of an income statement, balance sheet, statements of cash flows and related notes and disclosures and submits within nine (9) months after the end of the fiscal year audited financial statements of EDC's consolidated operations, consisting of an income statement, balance sheet, statements of cash flows and related notes and disclosures. EDC also submits within six (6) months after the end of the fiscal year audited accounts for the Project</p> <p>The auditors shall be required to provide an opinion on EDC's compliance with the financial covenants in this Loan Agreement and the Project Agreement.</p>	<p>LA, Schedule 6, Para. 26</p> <p>LA, Schedule 6, Para. 27</p> <p>LA, Schedule 6, Para. 28</p> <p>LA, Schedule 6, Para. 29 (i)</p> <p>LA, Schedule 6, Para. 29 (ii)</p>	<p>Complied with.</p> <p>Complied with.</p> <p>Complied with.</p> <p>Complied with.</p> <p>Complied with.</p>

<b>Covenant</b>	<b>Reference in Loan Agreement</b>	<b>Status of Compliance</b>
<p><b>Monitoring</b> EDC should implement a Project performance monitoring system (PPMS) to monitor impacts and benefits of the Project with regard to end consumers and REEs. The PPMS shall include a benchmark survey and an impact survey. The benchmark survey shall be completed prior to commissioning of the transmission line and shall include a sampling of villages along the transmission corridor which are planned for inclusion in the MV distribution system. The impact survey shall be completed within one month of Project completion and shall cover the same households, to the extent possible, as were included in the benchmark survey. An analysis of survey data shall be submitted to the Bank within one month of the impact survey's completion.</p> <p><b>Reporting Requirements</b> EDC should prepare regular progress reports for submission to the Bank on a quarterly basis.</p> <p>EDC should prepare a Project Completion Report (PCR) and submit to the Bank within three (3) months after Project completion.</p>	<p>LA, Schedule 6, Para. 30</p> <p>LA, Schedule 6, Para. 31</p> <p>LA, Schedule 6, Para. 33</p>	<p>Partly complied with.</p> <p>Complied with.</p> <p>Complied late.</p>

## FINANCIAL AND ECONOMIC REEVALUATION

### A. General

1. The financial and economic evaluation reviews (i) the net benefits of the total project investment, and (ii) the net benefits of sample distribution investments. The reevaluation is based on cost and benefit streams expressed in constant dollars at 2012 values. Figures from the appraisal which were in 2003 values have been converted to 2012 values in the following text to facilitate comparisons. Financial costs and benefits are measured in market prices. Economic costs and benefits are measured in border prices using the world price numeraire.

2. All investment funded by the project has been completed and the facilities are in operation. The major part (94%) of the investment has provided Electricité du Cambodge with a transmission line together with new substations at West Phnom Penh and at Takeo to handle imports of electricity at 220 kilovolt (kV) from Viet Nam. The project has also strengthened the general substations 1, 2, and 3 as well as 115 kV lines that facilitate electricity distribution. The bulk supply distribution component (6%) accounts for the balance of the investment and provides for increased access by rural households located near Takeo Township.

### B. Financial Evaluation

3. At appraisal, the project's benefits were taken to be the revenues from the sale of power imports valued at an average tariff equivalent to \$0.17 per kilowatt-hour (kWh). For the reevaluation, the benefits of the imports are based on actual changes in power demand and supply and are taken to be a mix including replacement of high-cost power and increased sales. The increased sales are valued at the current average tariff of \$0.19 per kWh, while the cost savings from replacement of locally generated power by low-cost imports have been valued at \$0.13 per kWh. As at appraisal, the financial costs have been taken to be the capital and operating costs of the project facilities, the costs of the imported electricity, and other costs incurred in serving the increased sales volume. The resulting returns are shown in Table A8.1

**Table A8.1: Project Financial Benefits**

	At Appraisal	At Project Completion
Project financial internal rate of return (%)	35	41
Project net present value (\$ million, 2012)	756	130

Source: Asian Development Bank.

4. The reevaluated financial internal rate of return has increased from 35% at appraisal to 41% at project completion. The project has exceeded the excellent returns forecast at appraisal because (i) the project base cost of \$72 million is significantly below the appraisal budget of \$93 million (2012 currency values), largely due to the government's waiving taxes and duties on imported equipment; (ii) the cost of power imported from Viet Nam at 6 cents per kWh has been lower than forecast; and (iii) the real average yield from sales in 2012, at \$0.19 per kWh, is higher than the value of \$0.17 per kWh used at appraisal.

### C. Project Economic Evaluation

5. For the economic reevaluation the project's benefits are (i) the resource cost savings from avoided investment and operation of new generation capacity, and (ii) the incremental consumption induced by the availability of lower-cost imported power. The most likely "without project" option is investment in combined-cycle gas turbine power plant(s) that would have been fueled by diesel. Given that real oil prices have risen by 270% between 2003 and 2012, the savings from avoided fuel-based generation have been calculated for each year of the project life and are considerable. The difference between supply from new combined-cycle power plants at around \$0.18 cents per kWh and imported power valued at 0.06 cents per kWh at the border is over 11 cents per kWh. The induced demand has been valued at the average tariff of \$0.19 per kWh, which is the minimum measure of willingness to pay. The allowance for costs includes the full project investment (\$67 million) and estimated operating and maintenance costs for the transmission facilities at 2% of capital cost and for distribution facilities at 4% of capital cost. Given that the government has waived taxes and duties on project plant and equipment, the financial costs have been taken as equivalent to the economic costs, whereas fuel prices have been converted to economic values by a standard conversion factor of 0.85. The result is presented in Table A8.2.

**Table A8.2: Project Economic Benefits**

	At Appraisal	At Project Completion
Project economic internal rate of return (%)	32	47
Project net present value (\$ million, 2012)	243	90

Source: Asian Development Bank

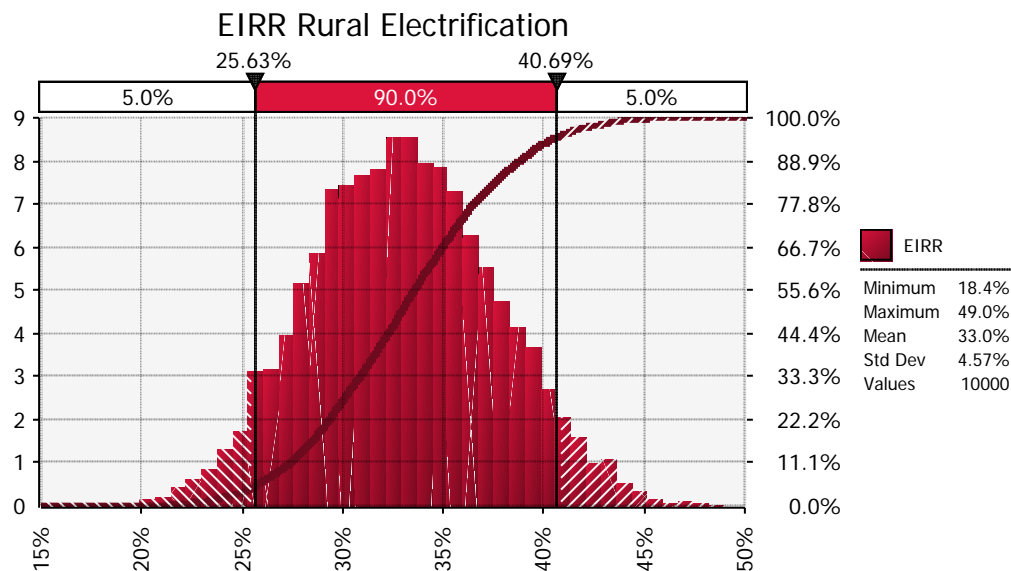
6. Notwithstanding the conservative approach taken to valuing benefits, the project readily exceeds the minimum hurdle rate of 12%. Further, the project's economic internal rate of return (EIRR) at completion of 47% is significantly higher than the EIRR of 32% that was forecast at appraisal. Analysis of the net present value (NPV) from operations to date shows that the project achieved a positive NPV in 2011 or in other words a payback of less than 2 years from the start of operations. Given the pricing and supply risks associated with imports from Viet Nam, the reevaluated returns over the remainder of the economic life of the project have been conservatively estimated. Comparison is reasonable with the NPV estimated at appraisal, which had forecast undiminished earnings over the life of the project.

### D. Distribution Component/Rural Electrification

7. The distribution component of the project has been analyzed as an "add-on" to the transmission component. It has enabled rural electrification enterprises and/or Electricité du Cambodge to successfully connect some 50,000 households.<sup>1</sup> Many of the costs incurred in connecting these households to the distribution network have been funded by rural electrification enterprises and by the World Bank under the Rural Electrification and Transmission Project, which is beyond the scope of the project. The economic costs and benefits of households electrification have therefore been reevaluated utilizing updated sample costings on household electrification and information from recent studies undertaken in Cambodia on household energy consumption.

<sup>1</sup> Electricité du Cambodge, Project Management Office 2. 2012. Implementation Completion Report for a Rural Electrification and Transmission Project. Phnom Penh.

8. The costs of household electrification vary significantly depending on the distance from a given house to the nearest supply point and the facilities used (e.g. type of poles, meters, transformers, and conductors). Likewise, the impacts of electrification vary considerably from household to household, and these depend to a large extent on a household's income. The reevaluation has therefore analyzed the impacts of electrification over a range of values for the independent variables that affect the economics of household electrification. The relevant variables are: investment cost, energy consumption patterns, and household income. The analysis has been completed using @Risk (an add-on to Microsoft Excel) to undertake a Monte Carlo simulation. The result of the analysis is the production of a range of EIRRs that cover the different household situations that have benefited from the Project. The result is shown in the figure below.



9. The current mean EIRR of 33% has been estimated using data available at project completion and is comparable with the EIRR of 25% that was estimated at appraisal. The results also show that household electrification remains an economically viable proposition over a wide range of conditions.

## RESETTLEMENT ACTIVITIES

### I. Resettlement Plan

1. The resettlement action plan is a full and comprehensive plan that met government undertakings to the Asian Development Bank (ADB) and World Bank to finalize resettlement and compensation arrangements prior to project implementation. The plan was submitted in January 2005 by the government's Inter-ministerial Resettlement Committee and accepted by ADB. As agreed, the action plan provided a comprehensive basis for assessing impacts and detailing procedures for addressing resettlement processes and procedures. The plan was revised and updated during the project's design and implementation phases as new and more detailed information came to hand.

2. The resettlement action plan was updated section by section, so that implementation of civil works for the construction of transmission towers could proceed while the rest of the resettlement action plan was being updated. The following are the main updates that were made to the plan prior to its receiving final approval from ADB:

- i) Results of a so-called "detail measurement survey" carried out by the Inter-ministerial Resettlement Committee teams were taken into account.
- ii) The results of a replacement cost study were incorporated into the plan.
- iii) Comments and clarification from ADB were incorporated into the plan.

3. The updating process was finalized in early 2009. Both the 220 kilovolt (kV) and 115 kV transmission lines incorporate a 30-meter corridor of impact where settlement and structures are not permitted and vegetation restrictions apply. The primary social impacts from the project were the permanent relocation of households and other buildings that had been located within the corridor of impact and land use restrictions. There are no indigenous or ethnic minorities that could have been affected and no cultural sites, such as temples.

4. In 2005, the resettlement action plan identified some 3,198 persons who were expected to be affected by resettlement, of which some 145 were classified as seriously affected persons. The seriously affected persons were those living within the transmission corridors or on the sites acquired for the substations. In addition to resettlement or physical relocation, people were also considered to be impacted if they lost productive income-generating assets. A loss of 10% or more of income was used to assess severity of income. The area through which the line passes is classified as a rice and sugar palm complex, thus highlighting the economic importance of sugar palm trees to the inhabitants. Initial estimates were that some 7,300 economically valuable trees (primarily sugar palm) could be lost, although it was acknowledged that this could only be determined with any degree of accuracy once the corridor of impact had been pegged out by the contractors.

5. The establishment of the transmission lines corridor of impact did not in itself require land acquisition. Rather, the requirement was that Electricité du Cambodge have right of access and control over such activities within the corridor of impact as necessary for safe implementation and operation of the line, such as removal of trees. Compatible land uses such as rice farming have been allowed to continue. Approximately 100 square meters (m<sup>2</sup>) of land was acquired for each of the 300 or so towers for the 220 kV line, but only 4 m<sup>2</sup> for each of the 93 pole sites on the 115 kV lines. The plans for siting the towers were designed so that no landowner would need to sell more than a single site. The acquisition of land for the two new substations had a more serious effect on the inhabitants, however, as the acquired land can account for a considerable portion of an owner's landholdings, and the land is peri-urban rather than rural. These considerations were



taken into account in determining the compensation rates that were built into the resettlement action plan.

6. Some 87% of the affected persons are rice farmers, with an average household income of \$249 per year. Based on the poverty line income of \$168 per person per year the plan assessed that 87% of the severely affected persons could be classified as living at or below the national poverty line. Particular attention was also given to the 26% of people who were classified as "vulnerable," such as those in female-headed households, the disabled, the very poor, or children without parents. These groups were provided special attention and support.

7. The plan details the objectives and principles of resettlement that are in accordance with ADB and World Bank requirements and with Cambodian law. It provides details of processes and procedures for assessing eligibility and entitlements, consultation, grievance redress and participation, relocation and rehabilitation, income restoration strategy, and the institutional framework for implementation. The compensation rates for the various categories were harmonized with those agreed under the ADB Primary Roads Improvement Project in Cambodia and were estimated to total \$2 million in 2003 currency values inclusive of a 20% contingency.

## II. Resettlement Impacts

8. Upon completion of the project, the total resettlement impacts were as follow:

### Results of Resettlement and Compensation

Description of Item	Sec. 1	Sec. 2	Sec. 3	Sec. 4	Sec. 5	Takeo SS	WPP SS	Total
Affected households	112	365	541	149	129	10	5	1,311
Area of land acquisition (m <sup>2</sup> )								
- for towers and poles	10,275	19,350	24,649	9,788	516			64,578
- in corridor of impact	0	44,329	152,345	35,632	8,618			240,924
- substation site						32,416	64,799	97,215
Affected structures (m <sup>2</sup> )								
- Type 1	0	595	1,930	-	41	-	-	2,566
- Type 2	0	731	2,246	265	1,585	-	-	4,827
- Type 3	0	146	1,284	-	45	-	-	1,475
Number of affected trees	839	9,397	18,341	2,450	533	-	-	31,560

m<sup>2</sup> = square meter, sec. = section, SS = substation, WPP = West Phnom Penh. Type 1: structure with thatch, leaf, and/or plastic roof. Type 2: structure with metal sheet and/or fiber cement roof. Type 3: structure with tile roof. Sources: Inter-ministerial Resettlement Committee, project implementation consultants' final report.

The resettlement process had been independently monitored by an independent monitoring agency.