



# Completion Report

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## **PUBLIC**

Project Number: 47101-002  
MFF Number: 0083  
Loan Number: 3140  
December 2022

## India: Assam Power Sector Investment Program (Tranche 1)

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**Asian Development Bank**



## CURRENCY EQUIVALENTS

Currency unit – Indian rupee (₹)

		<b>At Approval</b> (11 July 2014)	<b>At Project Completion</b> (30 June 2019)
₹1.00	=	\$0.0170	\$0.0154
\$1.00	=	₹58.82	₹65.08

## ABBREVIATIONS

ADB	–	Asian Development Bank
APFS	–	audited project financial statement
APDCL	–	Assam Power Distribution Company Limited
APGCL	–	Assam Power Generation Corporation Limited
CPS	–	country partnership strategy
DMF	–	design and monitoring framework
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EMP	–	environmental management plan
ERP	–	enterprise resource planning
FIRR	–	financial internal rate of return
GWh	–	gigawatt-hour
ICB	–	international competitive bidding
IEE	–	initial environmental examination
kWh	–	kilowatt-hour
LKHPP	–	Lower Kopili Hydropower Project
LPP	–	Lakwa Power Plant
LRPP	–	Lakwa Replacement Power Plant
MFF	–	multitranche financing facility
MW	–	megawatt
NOx	–	nitrogen oxide and nitrogen dioxide
PCR	–	project completion report
PMU	–	project management unit
WACC	–	weighted average cost of capital

## NOTES

- (i) The fiscal year (FY) of the Government of India and its agencies ends on 31 March. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2022 ends on 31 March 2022.
- (ii) In this report, “\$” refers to United States dollars.

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## **CONTENTS**

	<b>Page</b>
<b>BASIC DATA</b>	<b>i</b>
<b>I. PROJECT DESIGN AND IMPLEMENTATION</b>	<b>1</b>
A. Rationale	1
B. Project Impact, Outcome, and Outputs	2
C. Project Costs and Financing	3
D. Disbursements	4
E. Project Schedule	5
F. Implementation Arrangements	5
G. Procurement	5
H. Safeguards	6
I. Monitoring and Reporting	7
<b>II. EVALUATION OF PERFORMANCE</b>	<b>8</b>
A. Relevance	8
B. Effectiveness	9
C. Efficiency	10
D. Sustainability	10
E. Development Impact	12
F. Performance of the Borrower and the Executing Agency	12
G. Performance of the Asian Development Bank	13
H. Overall Assessment	13
<b>III. ISSUES, LESSONS, AND RECOMMENDATIONS</b>	<b>13</b>
A. Issues and Lessons	13
B. Recommendations	14
<b>APPENDIXES</b>	
1. Design and Monitoring Framework	16
2. Project Cost at Approval and Actual	17
3. Project Cost by Financier	18
4. Disbursement of ADB Loan Proceeds	20
5. Contract Awards of ADB Loan Proceeds	21
6. Status of Compliance with Loan Covenants	22
7. Project Implementation Timeline of the Enterprise Resource Planning System	30
8. Implementation of the Procurement Plan	31
9. Economic Reevaluation	32
10. Financial Reevaluation	36
11. Financial Sustainability of the Executing Agency	41
12. Environmental Safeguards Management	43
13. Contribution to Strategy 2030 Operational Priorities	47



## BASIC DATA

### A. Project Identification

1.	Project number and project title	47101-002, Assam Power Sector Investment Program (Tranche 1)
2.	Mode of financial assistance	Multitranche financing facility
3.	Country	India
4.	Borrower	India
5.	Executing agency	Government of Assam and Assam Power Generation Corporation Limited
6.	Product	

Item	Approval Number	Financing Amount (\$ million)	Financing Source	Product Modality and Nature of Activities
Loan	3140	50.0	Ordinary capital resources	Multitranche financing facility
<b>Project Total</b>		<b>50.0</b>		

### B. Milestone Dates

Item	Loan 3140
Approval of concept clearance	
– Date started	12 June 2013
– Date completed	3 July 2013
Fact-finding mission	
– Date started	2 September 2013
– Date completed	12 September 2013
Loan negotiations	
– Date started	12 May 2014
– Date completed	13 May 2014
Date of Board approval	11 July 2014
Date of loan agreement	20 February 2015
Date of loan effectiveness	
– In loan agreement	21 May 2015
– Actual	12 May 2015
– Number of extensions	0
Project completion date	
– At approval	31 December 2018
– Actual	30 June 2019
Loan closing date	
– In loan agreement at approval	30 June 2019
– Latest revised	20 September 2019
– Number of extensions	0
Financial closing date	20 September 2019

### C. Project Cost and Financing

- Project cost (\$ million)

Cost	Estimate at Approval	Actual
Foreign exchange cost	42.34	23.21
Local currency cost	19.66	19.58
<b>Total</b>	<b>62.00</b>	<b>42.79</b>

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

Component	Estimate at Approval	Actual
Generation system upgraded and expanded	56.35	41.98
Institutional capacity of APGCL and APDCL strengthened	5.65	0.81
<b>Total</b>	<b>62.00</b>	<b>42.79</b>

APDCL = Assam Power Distribution Company Limited, APGCL = Assam Power Generation Corporation Limited.

## 3. Financing plan and actual (\$ million)

Cost	Estimate at Approval	Actual
Implementation cost		
Borrower financed	11.22	3.68
Asian Development Bank financed	50.00	39.11
Other external financing	0.00	0.00
<b>Total implementation cost</b>	<b>61.22</b>	<b>42.79</b>
Interest during construction costs		
Borrower financed	0.78	0.00
Asian Development Bank financed	0.00	0.00
Other external financing	0.00	0.00
<b>Total interest during construction cost</b>	<b>0.78</b>	<b>0.00</b>

## 4. Disbursements

## a. Disbursement dates

	First Disbursement	First Disbursement, Excluding Capitalization	Final Disbursement
Loan 3140	9 October 2015	9 October 2015	20 September 2019

## b. Loan disbursed amount (\$ million)

Category	Original Allocation (1)	Increased during Implementation (2)	Canceled during Implementation (3)	Last Revised Allocation (4=1+2-3)	Amount Disbursed (5)	Undisbursed Balance (6=4-5)
Civil works and erection	12.26	0.00	5.42	6.84	5.24	1.60
Equipment	30.76	0.00	0.00	30.76	30.64	0.12
Consultants	5.00	0.00	0.60	4.40	3.23	1.17
Unallocated	1.98	0.00	1.98	0.00	0.00	0.00
<b>Total</b>	<b>50.00</b>	<b>0.00</b>	<b>8.00</b>	<b>42.00</b>	<b>39.11</b>	<b>2.89</b>

## 5. Terms of loan

– Interest rate	London interbank offered rate plus 0.6% less a credit of 0.10% per year
– Maturity (number of years)	20
– Grace period (number of years)	5

## D. Project Implementation

## 1. Project Schedule

Item	Appraisal Estimate	Actual
<b>Component A: Lakwa Power Plant Replacement</b>		
Replacement of Gas Engine and Compressors		
Date of contract	January 2014	January 2016
Completion of work	December 2018	June 2019

Item	Appraisal Estimate	Actual
<b>Component B: Capacity Development</b>		
Project Implementation Consultants		
Date of contract	July 2014	February 2015
Completion of work	December 2018	June 2019
Capacity Development		
Date of contract	September 2014	January 2015
Completion of work	December 2018	June 2019
Enterprise Resource Planning		
Date of contract	March 2014	January 2015
Completion of work	December 2017	June 2019

## 2. Project Implementation Indicators

Project Indicator	Description
Project readiness	Procurement-ready
Concept approval to first disbursement (days) <sup>a</sup>	828
Signing to first disbursement (days)	231
Loan closing to financial closing (days)	0

<sup>a</sup> Concept approval date is 3 July 2013.

## 3. Project Performance Ratings

Implementation period	Overall	Contract Awards	Disbursement	Financial Management	Technical/ Output	Safeguards
2015	On track	100.0%	100.0%	Yes	Yes	S
2016	On track	99.0%	95.9%	Yes	Yes	S
2017	On track	98.9%	100.0%	Yes	Yes	S
2018	On track	99.4%	100.0%	Yes	Yes	PS
1 Jan–30 Jun 2019	On track	98.1%	100.0%	Yes	Yes	PS
1 Jul–30 Sep 2019	Potential Problem	99.9%	100.0%	Yes	Yes	PS
1 Oct–31 Dec 2019	On track	100.0%		Yes	Yes	PS

PS = partially satisfactory, S = satisfactory.

## 4. Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members	Virtual Mission (Yes/No)
Fact-finding mission	2–12 Sep 2013	6	66	a, b, c, d, e, f	No
Consultation mission	27–31 Jan 2014	3	15	a, c	No
Inception mission	1–6 Jun 2015	6	36	c, h, i, e, j	No
Review mission 1	17–23 Aug 2016	1	6	c	No
Review mission 2	5–9 Dec 2016	2	8	c	No
Midterm review mission	18–21 Apr 2017	3	12	c, g	No
Review mission 3	12–18 Dec 2017	1	7	c	No
Review mission 4	17–21 May 2018	2	10	c, g	No
Review mission 5	1–5 Oct 2018	3	15	c, j, k	No
Review mission 6	6–10 May 2019	3	15	c, j, k	No
Project completion review	31 Mar–1 Apr 2022	5	5	c, e, k	Yes

a = energy economist, b = environmental specialist, c = energy specialist, d = counsel, e = project officer, f = associate project officer, g = associate project analyst, h = portfolio management specialist, i = procurement specialist, j = senior project officer, k = project analyst.



## I. PROJECT DESIGN AND IMPLEMENTATION

### A. Rationale

1. As with many states in India, demand for electricity in the state of Assam grew faster than supply. At its peak, generation capacity had a 23% shortfall, and load shedding that was used to manage the supply deficit also hampered electrification. By 2012, only 37% of households had access to electricity. Even the electrified households could not have a continuous electricity supply, experiencing power cuts of up to 6 hours a day in some cases. Worse, one of Assam's main power plants, the 60-megawatt (MW) Lakwa Power Plant (LPP) operated by Assam Power Generation Corporation Limited (APGCL), was reaching the end of its economic life and was operating inefficiently, risking further reduction in the grid's supply capacity.

2. The unavailability and poor quality of electricity often undermined Assam's industrial competitiveness and agricultural potential. Many important industries could not be connected to the grid, electricity demand of connected consumers could not be met, and electricity from independent power producers were sourced at a high cost. The power sector's poor performance led to reduced competitiveness and productivity of industries, a dearth of investments, inefficient use of resources, and increased unemployment. To meet the supply shortage, consumers had to use less efficient and more expensive energy sources, such as standby diesel generators.

3. Following India's National Electricity Policy, 2005, all state electricity generation utilities were given targets to increase the availability of electricity supply and eliminate power shortages.<sup>1</sup> The Rural Electrification Policy, 2006 included provisions for accelerated rural electrification,<sup>2</sup> compelling the state electrical utilities to increase their generation capacities to meet the demand of new consumers. The Twelfth Five Year Plan, 2012–2017 stressed the need to move toward nonpolluting, cleaner power-generating technologies.<sup>3</sup>

4. With the assistance of the Asian Development Bank (ADB), the Government of Assam prepared a power sector master plan covering the 12th 5-year planning period.<sup>4</sup> The objectives were to (i) achieve universal access to electricity by 2022, (ii) improve the quality and reliability of the power supply, and (iii) remove power sector constraints to improve the state's economy. The master plan required the generation capacity to be increased from 365 MW as of May 2013 to 1,410 MW by March 2022. The investment program developed as part of the power sector master plan was consistent with ADB's country partnership strategy (CPS) for India, 2013–2017 which envisaged expansion, improvement, and better management of energy systems through clean energy development, transmission and distribution system improvement, and institutional strengthening.<sup>5</sup> Accordingly, ADB pledged financial support for the investments identified in the power sector master plan. Assisting Assam, one of India's less developed states, in maintaining its electricity supply capacity and access to electricity aligned well with ADB's strategic directions identified in Strategy 2020 and remained consistent with ADB Strategy 2030 (para. 52 and Appendix 13) and CPS for India, 2018–2022 at project completion.<sup>6</sup>

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<sup>1</sup> Government of India. 2005. [National Electricity Policy](#). New Delhi.

<sup>2</sup> Government of India. 2006. [Rural Electrification Policy](#). New Delhi.

<sup>3</sup> Government of India, Planning Commission. 2013. [Twelfth Five Year Plan, 2012–2017](#). Delhi.

<sup>4</sup> ADB. 2009. [Cluster Technical Assistance to India for Advanced Project Preparedness for Poverty Reduction](#). Manila.

<sup>5</sup> ADB. 2013. [Country Partnership Strategy: India, 2013–2017](#). Manila.

<sup>6</sup> ADB. 2008. [Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008–2020](#). Manila; ADB. 2018. [Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific](#). Manila; and ADB. 2017. [Country Partnership Strategy: India, 2018–2022—Accelerating Inclusive Economic Transformation](#). Manila.

5. The need to strengthen the capacity of power sector institutions in Assam was identified to undertake power sector investments in an efficient and expedited manner. To achieve the long-term goal of making electricity available across the state, providing financial and technical support through a long-term program was also required. A multitranche financing facility (MFF) was the most suitable funding modality for such long-term engagement between the power sector utilities and development partners, as an MFF allows assessment of sector issues at the commencement of the program and make investment decisions progressively. The MFF also had provisions to improve project readiness for implementation before committing for financing. ADB approved the MFF for the Assam Power Sector Investment Program and its first tranche<sup>7</sup> in July 2014. Project 1 focused on replacing the LPP with a more efficient power plant and strengthening the institutional capacity of APGCL and Assam Power Distribution Company Limited (APDCL). Tranche 2, approved in 2015, assisted APDCL in improving the state's distribution network. Tranche 3, approved in 2020, is supporting APGCL's implementation of the Lower Kopili Hydropower Project (LKHPP). Project 1 provided the design and initial implementation assistance for the subsequent projects, highlighting the benefits of the MFF financing model, where such analytical work can be carried out during the initial phase to improve project design and readiness.

## **B. Project Impact, Outcome, and Outputs**

6. The project's envisaged impact was increased capacity and efficiency of energy generation systems in Assam. By 2022, electricity generation in Assam was expected to increase by 962 gigawatt-hours (GWh) per year. The expected outcome was the LPP's increased capacity and efficiency, targeting by 2018 to increase (i) energy generation in Assam by 354 GWh per year and (ii) the LPP's plant load factor from 59% in 2013 to 90%.<sup>8</sup> The two project outputs identified to contribute toward the project impact and outcome were (i) upgrading and expanding the generation system by replacing the old and less efficient open cycle generating units (four 15 MW units) at the LPP with more efficient internal combustion generating units (107 MW units); and (ii) strengthening the institutional capacity of APGCL and APDCL by providing (a) support for an enterprise resource planning (ERP) system, and (b) capacity building and training. Support for ERP system implementation included procuring hardware and software as well as implementing a computerized management system for APGCL. In parallel, the project targeted to train (i) 30 staff on procurement, project implementation, demand-side management, safeguards, monitoring, and evaluation; and (ii) 70 staff on financial and human resource management.

7. The LPP itself was replaced with the new and efficient Lakwa Replacement Power Plant (LRPP) instead of only replacing the generation units at the LPP, contributing to the increase in the overall efficiency of power generation in Assam (Appendix 9).<sup>9</sup> Despite completing the LPP upgrade nearly on time and commissioning 70 MW of power generation capacity in place of the 60 MW decommissioned at the LPP in 2018, the expected overall impact and outcome of increased generation capacity could not be fully achieved because of construction delays with other power plants, including the northeastern region and eastern region power plants. By 2022, increased generation within the state was only 227 GWh per year.<sup>10</sup> The impact will be substantially achieved when the LKHPP, financed by ADB under tranche 3 to increase generation

<sup>7</sup> ADB. 2014. [Assam Power Sector Investment Program - Tranche 1](#). Manila.

<sup>8</sup> The LPP was referred to as Lakwa Thermal Power Station in the periodic financing request and Lakwa Gas Power Plant in the report and recommendation of the President.

<sup>9</sup> The project design and monitoring framework did not define an indicator to measure the improvement in efficiency.

<sup>10</sup> Electricity generation was 1,845 GWh in FY2014 and is estimated at 2,072 GWh in FY2022.

further by 470 GWh per year, is commissioned in 2024 and the planned thermal power plants are built.<sup>11</sup>

8. Of the two outcome indicators, the first outcome indicator on energy generation will be likely achieved with the commissioning of the LKHPP in 2024 and other thermal power plants (para. 7). The second outcome indicator was substantially achieved, with the plant load factor of the LRPP nearly reaching the 90% target at completion. After the running-in and testing period, the LRPP recorded a plant load factor of 82% in fiscal year (FY) 2020, the plant's first year of full operations. In the subsequent 2 years of operation, the load factors recorded were 78% and 77%, and the achievement was still more than 85% of the outcome target of 90%. The downward trend in the load factor is because of an issue on fuel supply that is beyond the project's control. APGCL is taking action to resolve the issue by liaising with the natural gas supplier.

9. **Output 1: Generation system upgraded and expanded.** The output indicator was achieved, with the replacement of old and inefficient generating units with new and efficient generating units completed in March 2018. Four open cycle gas turbine units of 15 MW each were decommissioned and 10 generating units of 7 MW each with reciprocating gas engines running on natural gas were installed. The LRPP started commercial operations in April 2018.

10. **Output 2: Institutional capacity of Assam Power Generation Corporation Limited and Assam Power Distribution Company Limited strengthened.** Two of the three targets (both related to the training programs) were carried out as planned. Despite capacity building and training on accounting, auditing, and budgeting were provided through the project, the continued delay in submitting audited project financial statements (APFS) (para. 32), auditors' qualified opinions on entity financial statements, and partial or noncompliance with some financial management covenants (Appendix 6) indicate the need for further improvement of financial management. However, as identified through due diligence, APDCL's financial management capacity was substandard at project approval and underwent an incremental improvement with the project.

11. The third indicator, implementation of the ERP system, was substantially achieved. As of November 2022, the physical progress of equipment supply contract was 90% and the implementation of the ERP system is expected to be completed within 2023. Information technology consultancy support required to implement the ERP system was provided through project 1 and the consulting work was completed in 2019. The broader equipment supply scope, additional budget, and the implementation timeline identified during the implementation of the consultancy work were included in project 3 (Appendix 7). The design and monitoring framework (DMF) detailing actual project achievement is in Appendix 1.

## C. Project Costs and Financing

12. The project was estimated to cost \$62.00 million at appraisal, inclusive of engineering, procurement, and construction costs; consultancy and project management costs; and taxes, duties, and interest and other charges on the loan during construction. Of this, \$42.34 million was to be incurred as foreign currency costs and \$19.66 million was to be spent in local currency.

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<sup>11</sup> A 1,600 MW thermal power plant is planned to be constructed in Margherita, Assam. The multiphase project is in the permitting stage, with the first phase expected to be commissioned in 2025. Carmen. 2021. [Margherita Thermal Power Project, India](#). Power Technology. 22 November.

13. However, the total cost was only \$42.79 million by project completion. The cost to upgrade the LPP decreased from the estimated \$43.02 million to \$35.88 million mainly because of the low bid prices received under international competitive bidding (ICB) (para. 23). In addition, consulting contracts with a total estimated cost of \$2.15 million were not executed (Appendix 8), and completion of ERP system implementation work (para. 11) and the procurement of an environment and social specialist for LKHPP were transferred to project 3 (Appendix 8). The consulting contracts that were executed by the project remained within budget, and the contingency provisions were also unused. Overall, the project cost decreased by \$19.21 million, 31% lower than the estimate. Only \$23.21 million was spent in foreign currency, 45% lower than the estimate, mainly because of the lower cost to upgrade the power plant. The cost incurred in local currency was \$19.58 million, almost the same as estimated at appraisal. Appendix 2 summarizes the estimated and actual project costs.

14. To finance the \$62.00 million estimated investment, ADB pledged a \$50.00 million loan from its ordinary capital resources to finance the cost of civil works and erection, equipment, consultants, and contingencies. The state government committed the balance as counterpart funding, mainly to finance taxes and duties, environmental and social mitigation costs, project management and construction supervision costs, and financial charges during implementation. By project completion, ADB had financed \$39.11 million, 22% lower than its commitment, while the state government's contribution decreased by 69% to \$3.68 million.

15. The unused loan funds were canceled in two stages. In 2019, \$8.00 million was canceled after output 1 was completed at a lower cost than estimated. At the financial closure of the loan, a further \$2.89 million in unused funds were canceled. As summarized in Appendix 3, the contributions of ADB and the state government were lower than expected because of the overall reduction in actual project costs.

## **D. Disbursements**

16. Disbursement of the \$39.11 million loan followed the procedures and guidelines in ADB's *Loan Disbursement Handbook* (2012, as amended from time to time), and detailed arrangements agreed between the borrower and ADB. Loan proceeds were to be disbursed from FY2016 to FY2018, with significant expenditure expected during FY2017 and FY2018. Annual disbursements were lower because of reduced overall project costs. Appendix 4 compares the cumulative loan disbursements against the projections made at appraisal, with the last loan disbursement occurring in September 2019.

17. Eligible expenditures incurred and paid for under advance contracting by APGCL at the start of the project were reimbursed from the ADB loan. Commitment procedures were followed for plant and machinery imports, which comprised 68% of project expenditure. For local costs and consultancies, ADB paid contractors directly on behalf of APGCL using loan funds.

18. Counterpart funds made available by the state government were channeled through APGCL to the project in the form of equity. According to the tariff filings made by APGCL to the Assam Electricity Regulatory Commission,<sup>12</sup> a major portion of ADB loan has been channeled to the project as a grant by the state government, while the rest was provided as state government equity. From the overall project investment, 80.44% has been given as a grant while the balance

<sup>12</sup> Assam Electricity Regulatory Commission. 2022. [True-Up for FY2020–21, APR for FY2021–22, APR for FY2022–23 to FY2024–25 and Tariff for FY2022–23 for Assam Power Generation Corporation Limited \(APGCL\)](#). Guwahati.

19.56% is treated as state government equity. No issues were identified in the disbursement of the ADB loan and counterpart funds.

## **E. Project Schedule**

19. The loan was approved by ADB's Board of Directors on 11 July 2014, signed by the borrower on 20 February 2015, and declared effective on 12 May 2015. Project implementation was planned from January 2015 to December 2018, and loan closing was scheduled for 30 June 2019. Despite completing output 1 and commissioning the LRPP on 9 March 2018, delays in implementing output 2 activities delayed overall project completion (para. 11). Upon transferring the balance of the ERP system implementation work to project 3 (Appendix 7), the remaining project scope was completed on 30 June 2019. The loan account was closed on 20 September 2019.

20. While the loan closing date could be extended to allow for the financing of the delayed project activities, the project's main investment component was already completed and new loan projects within the same MFF have become available to finance the same activities. The loan was closed 3 months later than scheduled, with the remaining activities transferred to project 3.<sup>13</sup>

## **F. Implementation Arrangements**

21. The Government of Assam and APGCL were the project's executing agencies. A steering committee, cochaired by the APGCL and APDCL chairs and Assam's Department of Power secretary, served as the supervision body. Led by a project director, a project management unit (PMU) jointly established under APGCL, APDCL, and the Assam Electricity Grid Corporation carried out overall project coordination. The PMU implemented and monitored the project and reported progress to ADB, the Government of India, and the Government of Assam.

22. Since upgrading the LPP was the project's main investment component, it was appropriate to designate APGCL as an executing agency along with the state government. The joint structure of the PMU enabled smooth implementation of the capacity building training activities for APGCL and APDCL. The implementation arrangements were generally adequate for the project to substantially deliver the outputs and achieve the intended outcome.

## **G. Procurement**

23. As planned, the project's main investment component was implemented through a single turnkey contract procured through ICB.<sup>14</sup> Bidding documents were originally issued on 23 January 2014, but because of some procedural shortfalls observed in the bidding process, ADB advised APGCL to rebid on 16 October 2014. The second round of bidding, which started in January 2015, was completed in January 2016 with the signing of the contract with the successful bidder.<sup>15</sup> The selected contractor performed satisfactorily, delivering within the agreed contract amount and timeline (paras. 9 and 13).

<sup>13</sup> (i) Completion of the implementation work of the ERP system; (ii) engagement of an environment and social specialist for LKHPP; and (iii) consulting work on project preparation, tender development, and award management for LKHPP have been transferred to tranche 3.

<sup>14</sup> Turnkey contract for design and engineering, manufacture, supply, erection, testing, and commissioning, including all civil and allied works of 70 MW (nominal) gas engine based Lakwa Thermal Power Replacement Project at Lakwa Thermal Power Station.

<sup>15</sup> The consortium of Wärtsilä Finland Oy and Wärtsilä India Private Limited was selected through the bidding process to implement the project at a contract amount of \$35.9 million.

24. The capacity building activities under output 2 were to be implemented through eight consulting contracts. Appendix 8 lists all the procurement packages of the project and the selected contractors under each package. Apart from the (i) ERP implementation and infrastructure development for APGCL contract that was transferred to project 3; and (ii) engagement of the safeguard consultants for projects 1 and 3, other contracts were implemented within budget. The performance of the consultants who delivered the implementation support and capacity building tasks was satisfactory.

25. Since the project had high readiness at appraisal, the awarding of contracts was expected to be completed by FY2017. However, because of the rebidding of the main turnkey contract and delays in implementing the ERP system, overall contract awards lagged projections. As shown in Appendix 5, total contract awards were lower than estimated because (i) actual contract amounts were lower than estimated, and (ii) some contract packages were transferred to project 3. Notwithstanding the delays and cancellation of loan funds, the overall progress of contract awards was satisfactory in terms of cumulative contract value, largely because the turnkey contract for upgrading the LPP accounted for 90% of the total contract awards.

## H. Safeguards

26. Project 1 was classified as *category B* for the environment following ADB's Safeguard Policy Statement (2009).<sup>16</sup> During appraisal, APGCL and ADB prepared an environmental assessment and review framework, resettlement framework, and an indigenous peoples planning framework, which were disclosed on ADB's website. The frameworks were meant to ensure screening, categorization, impact assessments, development of management plans, public consultation, information disclosure, monitoring and reporting, and institutional arrangements follow applicable laws and regulations of the national and state governments and ADB's Safeguard Policy Statement. Nationally, the project was classified as *category A* under environmental impact assessment (EIA) Notification 2006 and required an EIA to be prepared for approval by the Ministry of Environment and Forests. Appendix 12 details the findings of the EIA and the initial environmental examination (IEE), and how the mitigating measures identified through these studies were implemented to reduce the environmental impacts during construction and operation of the LRPP.

27. Since work was done within the LPP premises, no social safeguard issues, indigenous peoples, or resettlements were involved. The project was classified as *category C* for involuntary resettlement and indigenous peoples, which remained unchanged until project completion.

28. Based on the semiannual environmental monitoring reports submitted by APGCL, implementation of safeguards was generally satisfactory, and the project did not come across any safeguards issues to alter the project's outcome. Subject to the possibility that issues were not identified or reported, the project safeguards were managed effectively by the executing agency.<sup>17</sup>

<sup>16</sup> ADB. 2009. [Safeguard Policy Statement \(2009\)](#). Manila.

<sup>17</sup> Breaches of the national nitrous oxide and nitrogen dioxide emission standard were observed during measurements, which were reported as instrumentation errors. APGCL will verify the compliance with emission standards to ensure both project and environmental sustainability because power plants in breach can be requested to cease operation.

## I. Monitoring and Reporting

29. Out of 39 covenants in the loan agreement and project agreement, the borrower and/or APGCL fully complied with 30, partially complied with eight, and did not comply with one. Appendix 6 provides the status of compliance with each covenant. The covenants were reasonable, and the partial compliance related to audit issues by 2014 was because of APGCL's lack of capacity, which the project tried to address through capacity building. Overall, the partial and noncompliance of covenants did not adversely affect the project.

30. To monitor project progress and compliance with loan covenants, ADB fielded regular missions, including a midterm review mission in April 2017. While the mission team has discussed with and advised the executing agency on administrative and compliance issues in general, lapses on the participation of safeguards and financial management staff during missions were observed. From 1 January 2019, loan administration from ADB's side was transferred to the India Resident Mission. Monitoring and reporting continued after project delegation, with closer and more regular communication between the India Resident Mission and APGCL, including on safeguards and financial management concerns.

31. As specified in the loan agreement, APGCL submitted quarterly progress reports, which ADB then reviewed, with necessary guidance and recommendations for smooth implementation. The progress reports showed the status of achievement of performance targets in the DMF, and the issues and problems in meeting the outcome and targeted schedule.

32. At appraisal, APGCL's financial management risk was assessed as *high*. Accordingly, consultants were engaged to prepare manuals for accounting, auditing, budgeting and cost accounting, and material management; and APGCL staff received financial management training. Specific loan covenants covering financial management, such as resolving all pending reporting issues identified by the external audit and valuation and reconciling assets, were included in the loan agreement (Appendix 6). Financial auditing and reporting were done for the project annually, with APFS prepared and reconciled with ADB loan disbursement records and disclosed on ADB's website.<sup>18</sup> However, APFS submission was delayed for many financial years and ADB-requested clarifications on some audit observations were not provided on time.<sup>19</sup> A shortage of workers has been cited as the main reason for delays in preparing and submitting APFSs, clarifications, and reports.<sup>20</sup>

33. One of the consulting assignments of the project was to engage an environmental and social safeguard specialist, particularly to assist APGCL with pollution control aspects. However, the consultant was no longer available, and the contract was terminated (Appendix 7). Consequently, APGCL monitored and reported on safeguard matters. APGCL demonstrated adequate capacity to monitor and report environmental issues, using accredited third parties to measure environmental parameters and report compliance, whenever necessary. Semiannual safeguard monitoring reports were prepared by APGCL following the requirements in the IEE, submitted to ADB, and disclosed on ADB's website. Appendix 12 describes the issues APGCL

<sup>18</sup> Loan disbursements recorded in the APFS as of FY2020 matches ADB loan disbursement records, except for a minimal variance of ₹2.76 million (0.1%) caused by differences in the exchange rates applied in the two data sources.

<sup>19</sup> A response to the ADB communication letter issued with respect to audit observations in FY2019 has not been received, and it is not clear if actions to rectify the issue were taken.

<sup>20</sup> One of the covenants that APGCL did not comply with was preparing and submitting its PCR upon project completion. APGCL attributed this to the shortage of workers. However, APGCL cooperated and provided necessary information and clarifications in the process of preparing the PCR by ADB.

encountered in monitoring and reporting on safeguards, and to what extent these issues were resolved.

## II. EVALUATION OF PERFORMANCE

### A. Relevance

34. The project is rated *relevant*. The project was designed to resolve several critical issues in Assam's power sector on unavailability and poor quality of electricity that undermine the state's growth potential. The rationale for undertaking the project was consistent with the government strategies to address the power sector issues at approval and remained aligned with such strategies up to completion in 2019. Supported by the increased capacity and efficiency of the LRPP and the increased administrative capacity of the power generation and distribution utilities, Assam achieved 100% electrification in 2019 as part of the Government of India's Saubhagya rural electrification program.<sup>21</sup> The project was one of the capacity addition investments identified in line with the power sector master plan (para. 4). The MFF was a suitable financing modality for ADB to support the state government over a longer term, making sure the financed activities aligned with ADB's strategies and operational priorities. From inception to completion, the project remained well aligned with ADB's Strategy 2020 and Strategy 2030 (paras. 4 and 52); with CPS, 2013–2017 strategic pillar 1 on inclusive growth by broadening access to economic opportunities through projects that increase access to energy, connectivity, and skills development; and CPS, 2018–2022 strategic pillar 2 on inclusive provision of infrastructure networks and services by developing infrastructure in hinterlands and low-income states. No conflicts or overlaps were observed with any initiatives taken by other development partners supporting India and the state of Assam.

35. APGCL carried out detailed studies during project appraisal to identify the best technology for a gas-fired power plant. Since gas supply to Lakwa was erratic and the internal combustion engine can maintain high plant efficiency under varying operating conditions, the internal combustion engine technology was chosen. The project design was generally appropriate to deliver the intended outcome and to create the envisaged impact (paras. 6 and 7). However, the DMF had some weaknesses in the selection of performance indicators. In particular, the outcome on the expected increase in generation in Assam of 354 GWh per year cannot be achieved by only increasing the capacity of the LPP from 60 to 70 MW and the load factor from 59% to 90%.<sup>22</sup> The achievement of this outcome target is dependent on the completion of LKHPP and other thermal power plants which are outside the scope of project 1 (para. 8). Further, one of the key benefits of the project was the enhanced efficiency of the power plant, and the DMF should have also included a corresponding performance indicator to report on this improvement.

36. Under output 2, the indicator for ERP should have been limited to provision of consulting support and not full implementation since the supply of hardware and the corresponding budget were not considered under project 1 (para. 11). However, the inclusion of the ERP system

<sup>21</sup> The national Saubhagya program, launched in 2017 by the Government of India, relied on the availability of sufficient electricity generation capacity to meet the increase in electricity demand created by the newly connected consumers. Assam was the fourth state to join the program.

<sup>22</sup> A 60 MW power plant operating at 59% plant factor can generate 310 GWh per year, while a 70 MW power plant operating at 90% plant factor can generate 552 GWh per year. The maximum increase in generation possible by replacing LPP with LRPP is only 242 GWh per year, thus the higher outcome target of 354 GWh per year must have been set considering the contributions from other power plants aside from LRPP. No associated assumption or risk was indicated in the DMF for the outcome target. Moreover, from the state's point of view, the overall increase in generation within the state is a monitored parameter compared with generation by individual power plants.

implementation in a subsequent MFF tranche validates the importance of the ERP for the energy sector in Assam. Thus, including the ERP system in the capacity strengthening output was appropriate.

37. Apart from directly investing in the power plant upgrade, introducing an ERP system for APGCL, and providing training and manuals to staff on key administrative areas are expected to create transformational effects for the agency. As evidenced by the timely completion of the power plant project and satisfactory overall administration of the project, the PMU and its staff had gained capacity through training and other support provided to implement large investments, with the prospect of these staff undertaking similar investments in the future. Overall, the implementation arrangements were appropriate and adequate for the main investment component and capacity building activities. Given the depth of development coordination, the project did not overlap with other development partner initiatives.

38. Overall, the project helped Assam improve its power supply availability in alignment with the state and national governments' vision to increase supply capacity and ADB CPSs for India. With the subsequent national and ADB strategies aligning with the project objective, it can be confirmed that the project remained relevant from commencement to completion.

## **B. Effectiveness**

39. The project is rated *effective*. Out of the two outcome indicators, the target on increasing energy generation in Assam by 354 GWh/year will be likely achieved with the commissioning of the LKHPP in 2024, while the other indicator on increasing the load factor of Lakwa plant has been substantially achieved at 82% as of FY2020 (para. 8). Most output targets were met, resulting in the substantial achievement of the project outcome.<sup>23</sup> Output 1 on replacing the generation units of the Lakwa Power Plant to new gas engines was fully achieved and resulted in (i) increased generation capacity of 10 MW, (ii) improved operating efficiency by replacing an old power plant with a new one, and (iii) more consumers supplied with electricity at a lower fuel cost (para. 9 and Appendix 9). Output 2 was substantially achieved, providing support to ERP and empowering APGCL to undertake and implement similar projects and improve organizational sustainability on operational matters and financial management.

40. The overall project output can be considered substantially achieved. Output 1, which fully achieved its target, accounted for 98.1% of the actual total project cost, and was the main output that translates to the outcome of increased capacity and efficiency in Lakwa power plant. While the transfer of the extended scope of the ERP component to a subsequent tranche could have been avoided with more detailed studies before loan approval, the action taken was appropriate considering the built-in flexibility under an MFF modality for phasing and implementation of investments.

41. APGCL reported that project 1 adhered to the environmental requirements and had no social safeguard impacts. Environmental management measures were related to the construction of the new power plant (para. 26 and Appendix 12). Since the activities were mainly confined to the APGCL power plant complex, no complaints were received. Considering overall achievements and compliance with implementation requirements, the project is rated *effective*.

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<sup>23</sup> If weighting based on the relative financial cost of subprojects will be used, the overall output achievement of the project is more than 80%.

### C. Efficiency

42. The project is rated *highly efficient*. Project outputs were achieved at a lower cost than estimated (paras. 12 and 13); the main investment component of the project, the LRPP, was implemented on time (para. 19); and the capacity building activities were largely implemented on time and within budget (paras. 13 and 24). Anticipated benefits of the project are being realized satisfactorily. Details of the economic analysis are presented in Appendix 9, where project costs and benefits have been reevaluated and compared against the economic returns expected at appraisal. Costs and benefits of replacing the old and inefficient LPP with a more efficient and slightly higher capacity power plant were compared to derive the economic internal rate of return (EIRR) for the project.

43. The reevaluated EIRR of the overall project is 39.5%, which is considerably higher than the applicable hurdle rate of 12.0% and even higher than the EIRR of 17.3% at project appraisal. Demand for electricity in Assam has been increasing and the network infrastructure is available to supply electricity generated by the LRPP without any constraint. Based on the average generation recorded by the LRPP during the 3 years of operation up to April 2022, the LRPP is conservatively estimated to generate 483.9 GWh per year, about 126.3 GWh per year higher than the electricity generated by the LPP. Despite increased generation, because of the improvement in power plant efficiency from 25% to 45%, the LRPP's annual fuel consumption was 18.02 million standard cubic meters lower than the LPP's annual fuel consumption, translating to about 6.53 tons decrease in carbon dioxide emissions.<sup>24</sup> With the conservative benefit estimates done in the economic reevaluation, the resultant EIRR can be considered evidence of a highly efficient investment. In addition to being economically efficient, based on the sensitivity analysis undertaken as part of the economic reevaluation, the project was found to be economically robust, yielding high returns even under adverse conditions.

44. Implementation of the overall project followed streamlined processes from design to operations, following the guidance and technical assistance provided by ADB. The project was completed at a cost lower than expected and almost within the overall timeline projected at formulation. Thus, the process efficiency of implementation can be considered high. Considering the substantially high economic efficiency of the project and the high process efficiency, the project is rated *highly efficient* overall.

### D. Sustainability

45. The project is assessed as *likely sustainable* considering its financial, institutional, and environmental sustainability.

46. **Financial sustainability.** The revenue earned by APGCL for the electricity generated and supplied to the grid by its power plants is determined through a regulatory tariff setting process. While compensating for direct costs such as fuel and operation and maintenance (O&M), a return on equity is allowed for the investment. Furthermore, the LRPP's energy charge is lower than other thermal power plants in Assam, ensuring uptake of the entire generation of the power plant and a steady revenue stream over the project's economic life.<sup>25</sup> Based on the financial analysis at project completion, the financial internal rate of return (FIRR) was reevaluated at 16.8%. In

<sup>24</sup> The avoided diesel consumption of standby diesel generators used by industries when electricity is not available contributes to reducing carbon dioxide emissions by a further 26,203 tons.

<sup>25</sup> The energy charge approved for the LRPP in 2022 is ₹1.89 per kilowatt-hour (kWh), considerably lower than the ₹2.49 per kWh approved for the Namrup Thermal Power Station and ₹2.88 per kWh approved for the LPP.

comparison with the reassessed weighted average cost of capital of 8.48%, the project FIRR is considerably high, signifying the project's financial sustainability. The reevaluated project FIRR is higher than the FIRR of 5.5% at appraisal, mainly because of the increased grant contribution by the state government during implementation. Appendix 10 details the reevaluation.

47. APGCL is currently taking necessary action to ensure a reliable gas supply is made available. The sensitivity analysis undertaken as part of the financial analysis revealed that the expected financial returns are unlikely to vary much under adverse variations in key parameters such as a further reduction in plant load factor owing to gas supply unreliability, increased fuel consumption, and increased O&M cost. Under each of these adverse conditions, the FIRR would remain higher than the weighted average cost of capital, indicating strong financial sustainability.

48. **Institutional sustainability.** APGCL is adequately resourced and has the institutional capacity to operate and maintain the project assets. Through the project, staff capacity was strengthened on many administrative areas, empowering APGCL to undertake investments required to achieve operational sustainability. The large number of staff trained through the project will enable the capacity acquired by APGCL to be retained and multiplied. Necessary administrative manuals were prepared and have guided staff in their day-to-day operations. The ERP system implementation under project 3 is expected to streamline all processes within the institution. Project sustainability can be ensured with the required operational budgets provided through Assam's regulatory tariff regime. To assess the financial capacity of the entity to support O&M and meet its financial and other commitments, APGCL's financial performance from FY2016 to FY2020 was analyzed and presented in Appendix 11. This assessment revealed that under the regulatory tariff regime, APGCL has performed well in terms of its financials. One key element of the regulatory tariff-setting process is that recurrent costs incurred by APGCL, such as O&M of the power plants, are compensated through the tariff, generating sufficient a flow of cash to operate the power plants. Therefore, financing future operations can be assumed to be sustainable.

49. **Environmental and social sustainability.** Environmental impacts during construction were site-specific, temporary, and readily addressed through environmental management plan implementation. Mitigation was also available for operational impacts, although APGCL needs to address the operational nitrogen oxide and nitrogen dioxide (NOx) emissions. While the LRPP is fueled by natural gas, a nonrenewable finite resource that can affect environmental sustainability, by replacing an inefficient power plant, the project contributes to reducing greenhouse gases and aligns with the national low carbon strategy, which is compatible with the goals of the Paris Agreement. The project also does not prevent opportunities to transition to the Paris Agreement-aligned activities in India, which aims to increase the share of non-fossil fuel power generation, especially from renewables. India faces a simultaneous shortage of coal and electricity during a time when coal remains the dominant source of electricity. In this context, gas as a transitional fuel in the near to medium term can help reduce India's dependency on coal while meeting the growing demand for electricity; thus, the project is aligned with the Paris Agreement.

50. Considering natural gas-based power plants' operational flexibility, which is required for grid stability, the LRPP can be considered an environmentally sustainable thermal power option to complement large renewable energy use envisaged by India. Social impacts were absent, owing to the project being implemented within the power plant premises. No indigenous peoples were affected by the project.

## **E. Development Impact**

51. The project is expected to increase Assam's electricity generation capacity and efficiency. Delays and non-implementation of other contributory projects have led to the overall impact not being realized yet. However, since other contributory projects are in the pipeline, the project impact is likely to be achieved (para. 7). This overall increase in electricity supply is one of the key development drivers envisaged by the 12th Plan of the Government of India (footnote 3). By replacing an inefficient open cycle gas turbine power plant of 60 MW with a new and efficient gas engine power plant of 70 MW, power generation capacity and efficiency were increased, albeit marginally. However, since the old power plant was reaching the end of its economic life, the new power plant helped meet the increasing demand of the state and the electrification drive propelled by the Saubhagya national electrification program. The higher efficiency of the power plant is expected to reduce the overall cost of electricity generation, contributing to reduced tariff. Such tariff reductions would improve not only the quality of life of the consumers but also industrial competitiveness.

52. As one of the underprivileged states in India, even the smaller contributions made to the economy can lead to a revival of the state's development drive. The project contributed to the following key operational priorities in ADB Strategy 2030: (i) people benefiting from improved services in urban areas, (ii) people benefiting from increased rural investment, and (iii) entities having improved management functions and financial stability. Appendix 13 describes the project's contribution to ADB's Strategy 2030 operational priorities. Based on the extent of the project's contribution to the envisaged overall impact and the potential development impact created by the capacity strengthening activities, the project's development impact is assessed as *satisfactory*.

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

53. The Government of India is the borrower, and the state government represented the borrower in all deeds and communications to ensure necessary facilitation and supervision are provided without burdening the central government. The delegation of authority practiced in India allowed for all responsibilities to be assumed by the state government.

54. The executing agency, APGCL, demonstrated strong ownership of the project and the responsibilities assigned to it, ensuring satisfactory compliance with loan covenants (para. 29), following procurement and safeguard requirements, and delivering the envisaged project outcome by substantially achieving project outputs. The project was not affected by any delays because of shortage in counterpart funds. All required approvals and necessary staff were assigned for the PMU and for training activities, enabling the project to be implemented largely following the original design.<sup>26</sup> However, APGCL needs to address the operational NOx emission issue mentioned in footnote 19 and para. 49.

55. The implementation of capacity building activities related to the ERP system had to be deferred. However, this is not a serious failure of the borrower nor the executing agency, as introducing such novel systems has uncertainties that can only be addressed as and when they occur. With respect to audit observations, the borrower and the executing agency are yet to submit responses and rectifications to one loan covenant that was not complied with and some loan

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<sup>26</sup> The main deviation during implementation was the transfer of ERP implementation to tranche 3, which is considered an appropriate action to ensure project effectiveness (para. 11).

covenants that were partially complied with (para. 32). The overall performance of the borrower and the executing agency is assessed as *less than satisfactory*.

## G. Performance of the Asian Development Bank

56. The performance of ADB is assessed as *satisfactory*. ADB established and maintained effective communication with the PMU throughout implementation. ADB was in regular discussions with APGCL during procurement, through missions, site visits, and other interactions when the project was faced with the risk of cancellation of the first bidding round, and significant delays because of high bid prices and the prolonged contract negotiation. Necessary approvals and guidance were provided by ADB to overcome these initial procurement issues. Loan funds were disbursed on time, and ADB responded and resolved issues in coordination with government counterparts. However, oversight in environmental safeguards due diligence at project processing was noted (Appendix 12), and safeguard and financial management experts were not included in the ADB missions fielded during implementation. Loan administration was transferred to the India Resident Mission in 2019, and the transition did not cause any disruption to project implementation because of the close working relationship between the resident mission and APGCL, and only limited activities were pending completion by the time of this transition. Despite smooth implementation, ADB's performance on safeguards during project processing could have been improved, and project monitoring could have been enhanced by engaging safeguards and financial experts in detailed safeguards review missions, particularly since the IEE noted significant environmental impacts that could be generated without mitigation.

## H. Overall Assessment

57. The project substantially achieved the outcome and output targets, creating a highly favorable outlook for future development activities to be supported by ADB. The project was assessed as *relevant* and *effective*, and through the financial and economic reevaluations, assessed to be *highly efficient* and *likely sustainable*. Thus, overall, the project is rated *successful*.

### Overall Ratings

Criteria	Rating
Relevance	Relevant
Effectiveness	Effective
Efficiency	Highly efficient
Sustainability	Likely sustainable
<b>Overall Assessment</b>	<b>Successful</b>
Development impact	Satisfactory
Borrower and executing agency	Less than satisfactory
Performance of Asian Development Bank	Satisfactory

Source: Asian Development Bank.

## III. ISSUES, LESSONS, AND RECOMMENDATIONS

### A. Issues and Lessons

58. The project cost was 31% lower because of lower bid prices received under ICB, the transfer of part of the project scope to another project, and non-implementation of some project activities. To avoid unnecessary financing commitments and fund allocations, in the design of the project, it is important to undertake detailed needs assessments, not only of the main investment components but also of the capacity building and consulting activities. Failure to identify the scope

of even minor activities could cause delays in project completion and have a negative impact on the overall outlook of the project.

59. Compliance with financial covenants, such as institutional reforms and asset valuation and reconciliation (Appendix 6), need a high level of commitment, capacity, and resources extended by the executing agency. Further, substantial changes in state-owned enterprises take time to get implemented in full. Despite the efforts made by APGCL, lack of capacity and resources resulted in some of loan covenants to be achieved only partially.

60. APGCL managed the environmental safeguards without the planned safeguard consultant. However, engaging an experienced expert to support APGCL in handling pollution control aspects and strengthening internal staff capacity would have been desirable to ensure that issues were detected and reported properly. Despite being able to submit monitoring reports to ADB, in cases where capacity development was identified during project processing, executing agencies should engage qualified safeguards specialists to support implementation, supervision, monitoring, and reporting in future projects. The submission of regular environmental monitoring reports also needs to continue post-construction, at least up to the preparation of the project completion report (PCR), and an understanding of operational compliance is essential in determining the project's environmental sustainability. Similarly, fielding missions comprising not only technical and administrative experts but also safeguards and financial experts are required because monitoring and reporting may fail to identify some compliance issues.

61. In preparing the DMF, careful consideration should be given to the relevance of the performance indicators against the output and outcome targets. Greater cohesion between indicators and targets will lead to a proper evaluation of project achievements. The effectiveness of the capacity building could have been identified through appropriate indicators to allow closer monitoring and timely intervention by ADB.

## **B. Recommendations**

62. **Project design.** The need to modify some project outputs can be introduced at different stages. However, a proper mechanism should be established to initiate the revision of the DMF when the scope changes are agreed between ADB and the borrower and/or executing agency.

63. **Monitoring and reporting.** Closer monitoring by the project team and including safeguards and financial management staff in review missions should be practiced to properly identify and timely rectify the issues. Operational compliance with applicable standards should also be reported upon commissioning of projects such as power plants where violations can happen during and after construction (Appendix 12).

64. **Covenants.** The covenants in the loan agreement were relevant and should be maintained in their existing form under the ongoing project 3. Since compliance with some covenants need more capacity and time, continuing the financial and technical assistance provided by ADB to develop the required capacity and retaining the same covenants in future projects is recommended (para. 59).

65. **Further action or follow-up.** The project identified the exact scope of the ERP system required for APGCL, but implementation was transferred to project 3. ADB should follow up with APGCL on the ERP system implementation to ensure that the identified scope is captured in subsequent project designs. Some loan covenants were partially complied with, and the APFSs had qualified opinions with issues on non-repayment of loans to the state government and

nondisclosure of ADB loans. APGCL and ADB should follow up to ensure that capacities gained through training are implemented at the practical level. Finally, APGCL needs to continuously monitor stack emissions following the environmental management plan, maintain records, and ensure compliance with the national emission standard for NO<sub>x</sub> by regularly maintaining the gas engines.

66. **Timing of the project performance evaluation report.** The project performance evaluation can be scheduled any time after the approval of this PCR. However, in the interest of ensuring that the ERP system is also implemented as envisaged at project commencement, the performance evaluation may be delayed until the ERP system implementation work is completed under project 3.

## DESIGN AND MONITORING FRAMEWORK

Results Chain	Performance Indicators	Project Achievements
<b>Impact</b> Increased capacity and efficiency of energy generation systems in Assam	By 2022: Energy generation in Assam increased by 962 GWh/year (OP 4.1.2)	<b>Likely to be achieved.</b> By 2022, electricity generation in Assam increased by 227 GWh/year <sup>a</sup> and is likely to increase further with the commissioning of the Lower Kopili Hydropower Plant in 2024 and the planned thermal power plants in 2025.
<b>Outcome</b> Increased capacity and efficiency in Lakwa power plant.	By 2018: a. Energy generation in Assam increased by 354 GWh/year (OP 4.1.2)  b. Lakwa plant load factor increased to 90% (Base year 2013 = 59%) (OP 4.1.2)	<b>a. Likely to be achieved.</b> In FY2018, annual generation declined by 356 GWh due to a reduction in hydropower generation. In FY2022, increased generation within the state was only 227 GWh per year despite LRPP generating 470 GWh per year. However, from 2024, the addition of 470 GWh/year generation by the new Lower Kopili Hydropower Plant will result in achieving the target.  <b>b. Substantially achieved.</b> Lakwa Power Plant load factor increased to 82% in FY2020 in the first year of full and proper operation.
<b>Outputs</b>  1. Generation system upgraded and expanded  2. Institutional capacity of APGCL and APDCL strengthened.	By 2018:  1a. Lakwa 4x15 MW gas power generation units are replaced with new gas engines with (7x10) MW of total capacity. (OP 3.1.3)  2a. ERP system made fully operational by 2018 (OP 6.1.1)  2b. About 30 staff trained on procurement, project implementation, demand side management, safeguards, monitoring, and evaluation by 2017 (OP 6.1.1)  2c. About 70 of staff trained on financial and human resource management by 2017. (OP 6.1.1)	1a. <b>Achieved.</b> 4x15 MW gas turbine power generation units in Lakwa Power Plant were replaced with new 7x10 MW gas engines units in March 2018. <sup>b</sup>  2a. <b>Substantially achieved.</b> ERP and IT Consultancy work completed in 2019. Implementation carried out under project 3.  2b. <b>Achieved.</b> 30 staff provided with on-the-job training on procurement, project implementation, safeguards monitoring, and power plant operation and maintenance by 2018.  2c. <b>Achieved.</b> 70 staff from both APGCL and APDCL trained on financial and human resource management by 2018.

APDCL = Assam Power Distribution Company Limited, APGCL = Assam Power Generation Corporation Limited, ERP = enterprise resource planning, FY = fiscal year, GWh = gigawatt-hour, IT = information technology, LRPP = Lakwa Replacement Power Plant, MW = megawatt, OP = operational priority.

<sup>a</sup> Electricity generation in FY2014 = 1,845 GWh, Electricity generation in FY2022 = 2,072 GWh (estimated).

<sup>b</sup> Project Review Reports of APGCL.

Source: Asian Development Bank and Annual Reports of APGCL.

**PROJECT COST AT APPROVAL AND ACTUAL**  
(\$ million)

Item	Estimate at Approval			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
<b>A. Investment Costs</b>						
1. Civil works including erection	7.36	4.90	12.26	0.00	5.24	5.24
2. Equipment	21.53	9.23	30.76	21.46	9.18	30.64
3. Consultants						
a. Project management, design, and supervision	0.50	0.00	0.50	1.21	1.34	2.54
b. Capacity development	4.50	0.00	4.50	0.54	0.21	0.75
4. Environmental mitigation	0.40	0.00	0.40	0.00	0.00	0.00
5. Project management and construction supervision	0.00	0.31	0.31	0.00	0.46	0.46
6. Taxes and duties	0.00	2.24	2.24	0.00	3.15	3.15
<b>Subtotal (A)</b>	<b>34.60</b>	<b>16.37</b>	<b>50.96</b>	<b>23.21</b>	<b>19.58</b>	<b>42.79</b>
<b>B. Contingencies</b>						
1. Physical	3.04	1.44	4.48	0.00	0.00	0.00
2. Price	3.92	1.85	5.77	0.00	0.00	0.00
<b>Subtotal (B)</b>	<b>6.96</b>	<b>3.29</b>	<b>10.26</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>C. Financial Charges During Implementation</b>						
1. Interest during construction	0.73	0.00	0.73	0.00	0.00	0.00
2. Commitment charges	0.05	0.00	0.05	0.00	0.00	0.00
<b>Subtotal (C)</b>	<b>0.78</b>	<b>0.00</b>	<b>0.78</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>Total Project Cost (A+B+C)</b>	<b>42.34</b>	<b>19.66</b>	<b>62.00</b>	<b>23.21</b>	<b>19.58</b>	<b>42.79</b>

Source: Asian Development Bank estimates.

## PROJECT COST BY FINANCIER

Table A3.1: Project Cost at Approval by Financier

Item		ADB		Government/ APGCL		Total Cost
		Amount (\$ million)	% of Total Cost	Amount (\$ million)	% of Total Cost	Amount (\$ million)
<b>A.</b>	<b>Investment Costs</b>					
1.	Civil works and erection	12.26	100.00	0.00	0.00	12.26
2.	Equipment	30.76	100.00	0.00	0.00	30.76
3.	Consultants					
a.	Project management, design, and supervision	0.48	100.00	0.00	0.00	0.48
b.	Capacity development	4.50	100.00	0.00	0.00	4.50
4.	Taxes and duties	0.00	0.00	2.24	100.00	2.24
	<b>Subtotal (A)</b>	<b>48.00</b>	<b>96.00</b>	<b>2.24</b>	<b>4.00</b>	<b>50.24</b>
<b>B.</b>	<b>Other Costs</b>					
1.	Land	0.00	0.00	0.00	100.00	0.00
2.	Environmental and social mitigation	0.00	0.00	0.40	100.00	0.40
3.	Project management and construction supervision	0.00	0.00	0.31	100.00	0.31
	<b>Subtotal (B)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.72</b>	<b>100.00</b>	<b>0.72</b>
	<b>Total Base Cost (A+B)</b>	<b>48.00</b>	<b>94.00</b>	<b>2.96</b>	<b>6.00</b>	<b>50.96</b>
<b>C.</b>	<b>Contingencies</b>					
1.	Physical	1.44	32.00	3.04	68.00	4.48
2.	Price	0.55	10.00	5.22	90.00	5.77
	<b>Subtotal (C)</b>	<b>1.99</b>	<b>19.00</b>	<b>8.26</b>	<b>81.00</b>	<b>10.26</b>
<b>D.</b>	<b>Financial Charges During Implementation</b>					
1.	Interest during implementation	0.00	0.00	0.73	100.00	0.73
2.	Commitment charges	0.00	0.00	0.05	100.00	0.05
	<b>Subtotal (D)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.78</b>	<b>100.00</b>	<b>0.78</b>
	<b>Total Project Cost (A+B+C+D)</b>	<b>50.00</b>	<b>80.00</b>	<b>12.00</b>	<b>20.00</b>	<b>62.00</b>
	<b>% Total Project Cost</b>		<b>80.00</b>		<b>20.00</b>	<b>100.00</b>

ADB = Asian Development Bank, APGCL = Assam Power Generation Corporation Limited.

Note: Numbers may not sum precisely because of rounding.

Source: Asian Development Bank estimates.

**Table A3.2: Project Cost at Completion by Financier**

Item		ADB		Government/ APGCL		Total Cost
		Amount (\$ million)	% of Total Cost	Amount (\$ million)	% of Total Cost	Amount (\$ million)
<b>A.</b>	<b>Investment Costs</b>					
1.	Civil works and erection	5.24	100.00	0.00	0.00	5.24
2.	Equipment	30.64	100.00	0.00	0.00	30.64
3.	Consultants					
	a. Project management, design, and supervision	2.54	100.00	0.00	0.00	2.54
	b. Capacity development	0.69	91.21	0.07	8.79	0.76
4.	Taxes and duties	0.00	0.00	3.15	100.00	3.15
	<b>Subtotal (A)</b>	<b>39.11</b>	<b>92.40</b>	<b>3.22</b>	<b>7.60</b>	<b>42.33</b>
<b>B.</b>	<b>Other Costs</b>					
1.	Land	0.00	0.00	0.00	0.00	0.00
2.	Environmental and social mitigation	0.00	0.00	0.00	0.00	0.00
3.	Project management and construction supervision	0.00	0.00	0.46	100.00	0.46
	<b>Subtotal (B)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.46</b>	<b>100.00</b>	<b>0.46</b>
	<b>Total Base Cost (A+B)</b>	<b>39.11</b>	<b>91.40</b>	<b>3.68</b>	<b>8.60</b>	<b>42.79</b>
<b>C.</b>	<b>Contingencies</b>					
1.	Physical	0.00	0.00	0.00	0.00	0.00
2.	Price	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal (C)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>D.</b>	<b>Financial Charges During Implementation</b>					
1.	Interest during implementation	0.00	0.00	0.00	0.00	0.00
2.	Commitment charges	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal (D)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
	<b>Total Project Cost (A+B+C+D)</b>	<b>39.11</b>	<b>91.40</b>	<b>3.68</b>	<b>8.60</b>	<b>42.79</b>
	<b>% Total Project Cost</b>		<b>91.40</b>		<b>8.60</b>	

ADB = Asian Development Bank, APGCL = Assam Power Generation Corporation Limited.

Note: Numbers may not sum precisely because of rounding.

Source: Asian Development Bank estimates.

## DISBURSEMENT OF ADB LOAN PROCEEDS

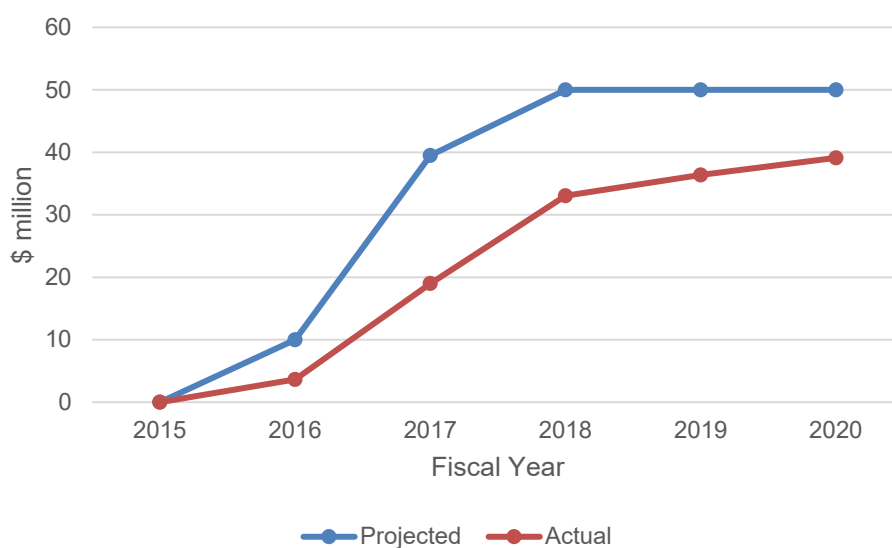
Table A4: Annual and Cumulative Disbursement of ADB Loan Proceeds

Year	Annual Disbursement		Cumulative Disbursement	
	Amount (\$ million)	% of Total	Amount (\$ million)	% of Total
FY2016	3.64	9.31	3.64	9.31
FY2017	15.36	39.26	19.00	48.57
FY2018	14.04	35.90	33.04	84.47
FY2019	3.33	8.51	36.37	92.98
FY2020	2.75	7.02	39.11	100.00
<b>Total</b>	<b>39.11</b>	<b>100.00</b>	<b>39.11</b>	<b>100.00</b>

ADB = Asian Development Bank, FY = fiscal year.

Source: Asian Development Bank.

Figure A4: Projected and Actual Cumulative Disbursement of ADB Loan Proceeds



ADB = Asian Development Bank.

Source: Asian Development Bank Estimates.

## CONTRACT AWARDS OF ADB LOAN PROCEEDS

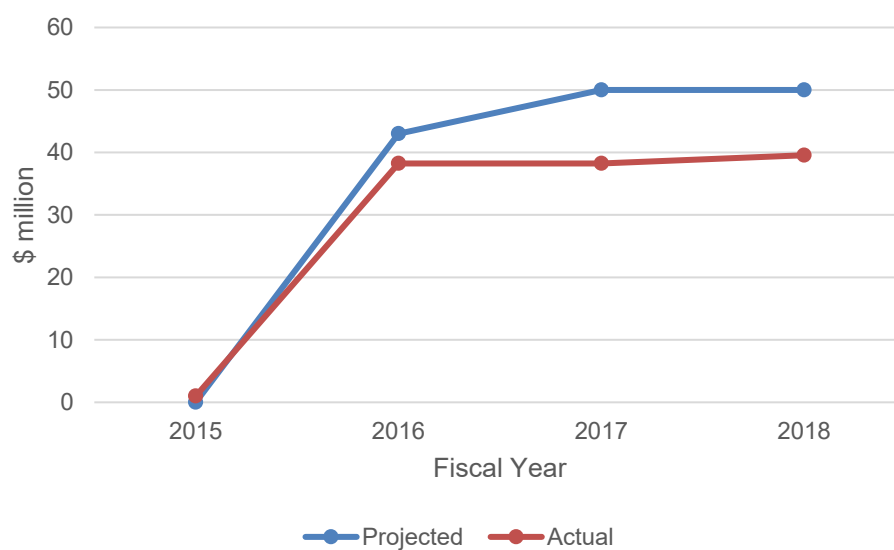
**Table A5: Annual and Cumulative Contract Awards of ADB Loan Proceeds**

Year	Annual Contract Awards		Cumulative Contract Awards	
	Amount (\$ million)	% of Total	Amount (\$ million)	% of Total
FY2015	1.00	2.53	1.00	2.53
FY2016	37.24	94.15	38.24	96.68
FY2017	0.00	0.00	38.24	96.68
FY2018	1.31	3.32	39.55	100.00
<b>Total</b>	<b>39.55</b>	<b>100.00</b>	<b>39.55</b>	<b>100.00</b>

ADB = Asian Development Bank, FY = fiscal year.

Source: Asian Development Bank.

**Figure A5: Projected and Actual Cumulative Contract Awards of ADB Loan Proceeds**



ADB = Asian Development Bank.

Source: Asian Development Bank Estimates.

### STATUS OF COMPLIANCE WITH LOAN COVENANTS

<b>Covenant</b>	<b>Reference in Agreement</b>	<b>Status of Compliance</b>
The Borrower and the executing agency shall ensure that the Project is implemented in accordance with the detailed arrangements set forth in the FAM. Any subsequent change to the FAM shall become effective only after approval of such change by the Borrower, the State, APGCL and ADB. In the event of any discrepancy between the FAM and this Loan Agreement, the provisions of the Loan Agreement shall prevail.	LA, Schedule 5, para. 1	Complied with.
Towards smooth implementation of the Project, grievance(s) if any from stakeholders, relating to Project implementation or use of funds, will be addressed effectively and efficiently by the State and APGCL.	LA, Schedule 5, para. 2	Complied with.
The State shall: (a) ensure sufficient counterpart funds from its budget for each fiscal year, in a timely manner, for the efficient implementation of the Project; and (b) ensure by itself or through APGCL, as required, adequate funds towards operations and maintenance of Project facilities, through budgetary allocations or other means, during and after the Project's completion.	LA, Schedule 5, para. 3	Complied with.
The Borrower and the EA shall ensure that the PMU and the PIU shall be provided with adequate staff, resources, and facilities to implement the Project.	LA, Schedule 5, para.4	Complied with.
The Borrower shall ensure, or cause the executing agency to ensure, that the preparation, design, construction, implementation, operation, and decommissioning of the Project, and all Project facilities comply with (a) all applicable laws and regulations of the Borrower and the State relating to the environment, health, and safety; (b) the Environmental Safeguards; (c) the EARF; and (d) all measures and requirements set forth in the IEE and EMP, and any corrective or preventative actions set forth in a Safeguards Monitoring Report.	LA, Schedule 5, para. 5	Partially complied with. There are some breaches of the national NOx emission standard during operation
The Borrower shall ensure or cause the executing agency to ensure that the Project does not have any indigenous peoples or involuntary resettlement impacts, all within the meaning of SPS. If the Project does have any such impact, the Borrower shall take or cause the executing agency to take all steps required to ensure that the Project complies with the applicable laws and regulations of the Borrower, the State, SPS, and the IPPF and RF, as appropriate.	LA, Schedule 5, para. 6	Complied with.
The Borrower shall make available, or cause the executing agency to make available, all necessary budgetary and human resources to fully implement the EMP as required.	LA, Schedule 5, para. 7	Complied with. However, the \$0.4 million allocated to environmental and social mitigation was not spent.
The Borrower shall ensure, or cause the executing agency to ensure, that all bidding documents and contracts for Works contain provisions that require contractors to: (a) comply with the measures and requirements relevant to the contractor set forth in the IEE and the EMP, and any corrective or preventative actions set forth in a Safeguard Monitoring Report. (b) make available a budget for all such environmental and social measures. (c) provide the EA with a written notice of any unanticipated environmental risks or impacts that arise during construction, implementation or operation of the Project that were not considered in the IEE or the EMP;	LA, Schedule 5, para. 8	Complied with.

Covenant	Reference in Agreement	Status of Compliance
(d) adequately record the condition of roads, agricultural land, the other infrastructure prior to starting to transport materials and construction; and (e) fully reinstate pathways, other local infrastructure, and agricultural land to at least their pre-project condition upon the completion of construction.		
The Borrower shall do, or cause the executing agency to do, the following: (a) submit semi-annual Safeguards Monitoring Reports to ADB and disclose relevant information from such reports to affected persons promptly upon submission. (b) if any unanticipated environmental and/or social risks and impacts arise during construction, implementation or operation of the Project that were not considered in the IEE or the EMP, as applicable, promptly inform ADB of the occurrence of such risks or impacts, with detailed description of the event and proposed corrective action plan; and (c) report any breach of compliance with the measures and requirements set forth in the EMP promptly after becoming aware of the breach.	LA, Schedule 5, para. 9	Partially complied with. ADB was not informed of breaches on the national NOx emission standard during operation.
The Borrower shall ensure, or cause the executing agency to ensure, that no proceeds of the Loan under the Project are used to finance any activity included in the list of prohibited investment activities provided in Appendix 5 of the SPS.	LA, Schedule 5, para. 10	Complied with.
The executing agency shall ensure that all civil works contracts under the Project follow all applicable labor laws of the Borrower and the State, and that these further include provisions to the effect that contractors: (a) carry out HIV/AIDS awareness programs for labor and disseminate information at worksites on risks of sexually transmitted diseases and HIV/AIDS as part of health and safety measures for those employed during construction; and (b) follow and implement all statutory provisions on labor (including not employing or using children as labor, and equal pay for equal work), health, safety, welfare, sanitation, and working conditions. Such contracts shall also include clauses for termination in case of any breach of the stated provisions by the contractors.	LA, Schedule 5, para. 11	Complied with.
The executing agency shall ensure that the anticorruption provisions acceptable to ADB, the Borrower, the State, and APGCL are included in all bidding documents and contracts financed by ADB in connection with the Project, including provisions specifying the right of ADB to review and examine the records and accounts of the State and APGCL and all contractors, suppliers, consultants, and other service providers as they relate to the projects. The Borrower, the State, and APGCL shall allow and assist ADB's representatives to carry out random spot checks on the work in progress and utilization of funds for the Project.	LA, Schedule 5, para. 12	Complied with.
APGCL shall announce the Project and business opportunities associated with the Project including on its corporate website. The website will disclose the following information in relation to goods and services procured for the Project: (a) the list of participating bidders; (b) the name of the winning bidder; (c) the amount of the contracts awarded; and (d) the goods and services procured.	LA, Schedule 5, para. 13	Complied with.

<b>Covenant</b>	<b>Reference in Agreement</b>	<b>Status of Compliance</b>
The executing agency shall undertake on a timely basis compliance with undertakings under Schedule 6 to the FFA, as applicable, with respect to, among others, (a) Project implementation, (b) financial management, (c) accounting and internal audit, and (d) institutional reform.	LA, Schedule 5, para. 14	Partially complied with.
The executing agency shall by 31 December 2014: (a) address all audit issues raised by the statutory external auditor in its external audit report for 2013, including conducting a one-time valuation of its assets and reconciliation of its fixed assets and mandatory spares; and (b) comply with all audit compliance measures required under the external audit report for 2013.	LA, Schedule 5, para. 15	Partially complied with.
The executing agency shall ensure that the enterprise resource planning system, including the asset management module, is fully operational by 2018.	LA, Schedule 5, para. 16	Partially complied with. The ERP component was moved to project 3.
The Borrower, the State, and APGCL shall (i) comply with ADB's Anticorruption Policy (1998, as amended to date) and acknowledge that ADB reserves the right to investigate directly or through its agents, any alleged corrupt, fraudulent, collusive, or coercive practice relating to the Investment Program; and (ii) cooperate with any such investigation and extend all necessary assistance for satisfactory completion of such investigation, and as included in detail in the FAM.	LA, Schedule 5, para. 17	Complied with.
The Borrower, the State, and APGCL shall (i) ensure that the anticorruption provisions acceptable to ADB, the Borrower, the State and APGCL are included in all bidding documents and contracts financed by ADB in connection with the Project, including provisions specifying the right of ADB to review and examine the records and accounts of the State and APGCL and all contractors, suppliers, consultants, and other service providers as they relate to the Project and as included in detail in the FAM, and (ii) allow and assist ADB's representatives to carry out random spot checks on the work in progress and utilization of funds for the Project.	LA, Schedule 5, para. 18	Complied with.
Within six months of Effective date, the executing agency shall establish for the Facility as well as for the Project, a project performance monitoring system as required by ADB. The performance reports for the Project will be compiled for preparing Facility level performance reporting.	LA, Schedule 5, para. 19	Complied with.
The Facility and the Project shall be under regular review by (i) the PMU monthly; and (ii) by the Steering Committee set by the State and APGCL on a semi-annual basis.	LA, Schedule 5, para. 20	Complied with.
In addition to periodic reviews, a mid-term review shall be carried out by ADB, the Borrower and the executing agency, two (2) years after the Effective Date for the Project as also for the Facility, focusing on all aspects including, but not limited to, the engineering, environmental, resettlement and social aspects, and reviewing the financial status of APGCL. The review will allow for any necessary midcourse corrections to ensure successful Project implementation and achievement of objectives of the overall Facility and the Investment Program.	LA, Schedule 5, para. 21	Complied with.
Without limiting the generality of the provisions under Section 2.08 (b) and (c) of the Project Agreement: (a) APGCL shall prepare progress reports for the Project and submit these to ADB on a quarterly basis within 30 days from the end of each quarter. Each report will provide a narrative description of progress made during the period in respect of the Project, changes in the	LA, Schedule 5, para. 22	(a) Complied with.

Covenant	Reference in Agreement	Status of Compliance
<p>implementation schedule, problems or difficulties encountered, and the work to be carried out in the next period. The progress report will also include Project expenditures for the year to date and total expenditure to date. APGCL shall undertake periodic project performance review for the Project, as also for the Facility, to evaluate the scope, implementation arrangements, progress, and achievements of objectives of the Project and the overall Facility. Performance shall be evaluated based on indicators and targets stipulated in the Design and Monitoring Framework for the Investment Program and the Project; and</p> <p>(b) APGCL shall furnish to ADB a Project completion report within 3 months of physical completion of the Project, and Facility completion report within 3 months of physical completion of the Facility. These reports will cover a detailed evaluation of the Project and the Facility respectively, covering the design, costs, contractors' and consultants' performance, social, environmental, and economic impact, economic rate of return, and other details for the Project and the Facility as may be requested by ADB.</p>		<p>(b) Not complied with. APGCL has not prepared and submitted a PCR due to the shortage in workforce.</p>
<p>(a) The State and APGCL shall carry out the Project with due diligence and efficiency, and in conformity with sound applicable technical, financial, business, and development practices.</p> <p>(b) In the carrying out of the Project and operation of the Project facilities, the State and APGCL shall perform all obligations set forth in the Loan Agreement to the extent that they are applicable to the State and APGCL respectively.</p>	PA, Section 2.01	<p>(a) Complied with.</p> <p>(b) Partially complied with.</p>
<p>The State and APGCL shall make available, promptly as needed, and on terms and conditions mutually acceptable to ADB and the Borrower, the funds, facilities, services, equipment, and other resources as required, in addition to the proceeds of the Loan, for the carrying out of the Project.</p>	PA, Section 2.02	Complied with.
<p>(a) In the carrying out of the Project, APGCL shall employ competent and qualified contractors, acceptable to ADB, to an extent and upon terms and conditions mutually satisfactory to ADB and the Borrower.</p> <p>(b) Except as ADB and the Borrower may otherwise agree, APGCL shall procure all items of expenditures to be financed out of the proceeds of the Loan in accordance with the provisions of Schedule 4 to the Loan Agreement. ADB may refuse to finance a contract where any such item has not been procured under procedures substantially in accordance with those agreed between the Borrower and ADB or where the terms and conditions of the contract are not satisfactory to ADB.</p>	PA, Section 2.03	<p>(a) Complied with.</p> <p>(b) Complied with.</p>
<p>APGCL shall carry out the Project in accordance with plans, design standards, specifications, work schedules and construction methods mutually acceptable to ADB and the Borrower. APGCL shall furnish, or cause to be furnished, to ADB, promptly after their preparation, such plans, design</p>	PA, Section 2.04	Complied with.

Covenant	Reference in Agreement	Status of Compliance
standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as ADB shall reasonably request.		
(a) APGCL shall take out and maintain with responsible insurers, or make other arrangements satisfactory to ADB for, insurance of Project facilities to such extent and against such risks and in such amounts as shall be consistent with sound practice.  (b) Without limiting the generality of the foregoing, APGCL undertakes to insure, or cause to be insured, the Goods to be procured including imported for the Project against hazards incident to the acquisition, transportation, and delivery thereof to the place of use or installation, and for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such Goods.	PA, Section 2.05	(a) Complied with.  (b) Complied with.
APGCL shall maintain, or cause to be maintained, records and accounts adequate to identify the items of expenditure financed out of the proceeds of the Loan, to disclose the use thereof in the Project, to record the progress of the Project (including the cost thereof) and to reflect, in accordance with consistently maintained sound accounting principles, its operations and financial condition.	PA, Section 2.06	Complied with.
(a) ADB, the State and APGCL shall cooperate fully to ensure that the purposes of the Loan will be accomplished.  (b) The State and APGCL shall promptly inform ADB through the Borrower, of any condition which interferes with, or threatens to interfere with, the progress of the Project, the performance of its obligations under this Project Agreement or the Financing Arrangements or the accomplishment of the purposes of the Loan.  (c) ADB, the State and APGCL shall from time to time, at the request of either party, exchange views through their representatives with regard to any matters relating to the Project, the State, APGCL and the Loan.	PA, Section 2.07	(a) Complied with.  (b) Complied with.  (c) Complied with.
(a) In so far as it relates to the Project, the State and APGCL as relevant shall furnish to ADB all such reports and information as ADB shall reasonably request concerning (i) the Loan and the expenditure of the proceeds thereof; (ii) the items of expenditure financed out of such proceeds; (iii) the Project; (iv) the administration, operations and financial condition of APGCL, and of the State; and (v) any other matters relating to the purposes of the Loan.  (b) Without limiting the generality of the foregoing, APGCL shall furnish to ADB periodic reports on the execution of the Project and on the operation and management of the Project facilities. Such reports shall be submitted in such form and in such detail and within such a period as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the period under review, steps taken or proposed to be taken to remedy these	PA, Section 2.08	(a) Complied with.  (b) Complied with.

Covenant	Reference in Agreement	Status of Compliance
<p>problems, and proposed program of activities and expected progress during the following period.</p> <p>(c) Promptly after physical completion of the Project, but in any event not later than 3 months thereafter or such later date as ADB may agree for this purpose, the State and APGCL shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the execution and initial operation of the Project, including its cost, the performance by the State and APGCL of its respective obligations under this Project Agreement and the accomplishment of the purposes of the Loan.</p>		<p>(c) Not complied with.</p>
<p>(a) APGCL shall</p> <p>(i) maintain separate accounts and records for the Project;</p> <p>(ii) prepare annual financial statements for the Project in accordance with accounting principles acceptable to ADB;</p> <p>(iii) have such financial statements for the Project audited annually by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB, in accordance with international standards for auditing or the national equivalent acceptable to ADB;</p> <p>(iv) as part of each such audit, have the auditors prepare a report (which includes the auditors' opinion on the financial statements, use of the Loan proceeds and compliance with the financial covenants of the Loan Agreement) and a management letter (which sets out the deficiencies in the internal control of the Project that were identified during the audit, if any); and</p> <p>(v) furnish to ADB, no later than 6 months after the close of the fiscal year to which they relate, copies of such audited financial statements, audit report and management letter, all in the English language, and such other information concerning these documents and the audit thereof as ADB shall from time-to-time reasonably request.</p>	<p>PA, Section 2.09</p>	<p>(i) Complied with.</p> <p>(ii) Complied with.</p> <p>(iii) Complied with.</p> <p>(iv) Complied with. The auditor issued a clean or unqualified opinion on all the APFS. The auditor also confirmed that proceeds of the loan have been utilized for the purpose per loan agreement and that financial covenants were generally complied with.</p> <p>(v) Complied with. All five annual APFS from FY2016 to FY2020 were submitted but four were delayed by 2.5 to 5 months. Unresolved management letter issues included non-maintenance of stock registers for materials purchased for the project. The executing/ implementing agency did not provide clarifications on both FYE's 2019 and 2020 management letter issues. ADB APFS disbursement as of FYE 2020 is matched/reconciled with LFIS data except for a minimal variance of ₹2.76 million (0.1%) due to differences in the application of the exchange rate.</p>

Covenant	Reference in Agreement	Status of Compliance
<p>(b) ADB shall disclose the annual audited financial statements for the Project and the opinion of the auditors on the financial statements within 30 days of the date of their receipt by posting them on ADB's website.</p> <p>(c) In addition to annual audited financial statements referred to in subsection (a) hereinabove, APGCL shall (i) provide its annual financial statements prepared in accordance with national accrual-based financing reporting standards mutually acceptable to ADB and the Borrower; (ii) have its financial statements audited annually by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB, in accordance with international standards for auditing or the national equivalent acceptable to ADB; and (iii) furnish to ADB, no later than 1 month after approval by the relevant authority, copies of such audited financial statements in the English language and such other information concerning these documents and the audit thereof as ADB shall from time to time reasonably request.</p> <p>(d) APGCL shall enable ADB, upon ADB's request, to discuss the financial statements for the Project and APGCL and its financial affairs where they relate to the Project with the auditors appointed by APGCL pursuant to subsections (a)(iii) and (c) hereinabove and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB. This is provided that such discussions shall be conducted only in the presence of an authorized officer of APGCL unless APGCL shall otherwise agree.</p>		<p>(b) Complied with.</p> <p>(c) Complied with.</p> <p>(d) Complied with.</p>
The State and APGCL shall enable ADB's representatives to inspect the Project, the Goods, and any relevant records and documents.	PA, Section 2.10	Complied with.
<p>(a) APGCL shall, promptly as required, take all action within its powers to maintain its corporate existence, to carry on its operations, and to acquire, maintain and renew all rights, properties, powers, privileges, and franchises which are necessary in the carrying out of the Project or in the conduct of its operations.</p> <p>(b) APGCL shall always conduct its operations in accordance with sound applicable technical, financial, business, development, and operational practices, and under the supervision of competent and experienced management and personnel.</p> <p>(c) APGCL shall always operate and maintain its plants, equipment, and other property, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound applicable technical, financial, business, development, operational and maintenance practices.</p>	PA, Section 2.11	<p>(a) Complied with.</p> <p>(b) Complied with.</p> <p>(c) Complied with.</p>
Except as ADB may otherwise agree, APGCL shall not sell, lease, or otherwise dispose of any of its assets which shall be required for the efficient carrying on of its operations or	PA, Section 2.12	Complied with.

Covenant	Reference in Agreement	Status of Compliance
the disposal of which may prejudice its ability to perform satisfactorily any of its obligations under this Project Agreement.		
Except as ADB may otherwise agree, APGCL shall apply the proceeds of the Loan to the financing of expenditures on the Project in accordance with the provisions of the Loan Agreement and this Project Agreement and shall ensure that all items of expenditures financed out of such proceeds are used exclusively in the carrying out of the Project.	PA, Section 2.13	Complied with.
Except as ADB and the Borrower may otherwise agree, APGCL shall duly perform all its obligations under the Loan Agreement, and shall not take, or concur in, any action which would have the effect of assigning, amending, abrogating, or waiving any rights or obligations of the parties under the Loan Agreement.	PA, Section 2.14	Complied with.
APGCL shall promptly notify ADB of any proposal to amend, suspend or repeal any provision of its constitutional documents, which, if implemented, could adversely affect the carrying out of the Project or the operation of the Project facilities. APGCL shall afford ADB an adequate opportunity to comment on such proposal prior to taking any affirmative action thereon.	PA, Section 2.15	Complied with.

ADB = Asian Development Bank, APGCL = Assam Power Generation Company Limited, EARF = environmental assessment and review framework, EMP = environmental management plan, FAM = facility administration manual, FFA = framework financing agreement, IEE = initial environmental examination, IPPF = indigenous peoples planning framework, LA = loan agreement, NOx = the nitrous oxide and nitrogen dioxide, PA = project agreement, PIU = project implementation unit; PMU = project management unit; RP = resettlement plan, SPS = Safeguard Policy Statement. Sources: Loan Agreement of Assam Power Sector Investment Program – Project 1 and Project Agreement of Assam Power Sector Investment Program – Project 1.

## **PROJECT IMPLEMENTATION TIMELINE OF THE ENTERPRISE RESOURCE PLANNING SYSTEM**

1. Implementation of an Enterprise Resource Planning (ERP) system for the Assam Power Generation Corporation Limited (APGCL) was identified as a key intervention of under project 1 with the overall objective of assisting APGCL in strengthening its institutional capacity.
2. It was originally envisaged that implementation was to be completed in 24 months. Accordingly, an ERP and information technology (IT) expert was engaged, and an individual contract was signed with the consultant in December 2014. The consultant started work in February 2015 and by October 2015, the consultant had completed the organization assessment and identification of improvement opportunities, as well as business requirements for the ERP system. Wide stakeholder consultations were held to finalize the requirements, which were completed in July 2016.
3. Draft bidding documents were prepared for the implementation of the ERP system through a procurement package comprising the following four lots:
  - (i) Lot 1: Supply, configuration, integration, installation, implementation, and support of ERP Application software for APGCL;
  - (ii) Lot 2: Managing and hosting the APGCL ERP on cloud;
  - (iii) Lot 3: Supply, installation, commissioning, and warranty for desktop computers, laptop computers, printers, scanners, related accessories, local area networking equipment along with related system software and cabling at APGCL locations; and
  - (iv) Lot 4: Installation and establishing Network Connectivity between Data Center and Disaster Recovery and APGCL locations.
4. Lot 1 was advertised for procurement in November 2017. However, the bidding round was unsuccessful as none of the bidders had the required qualifications. Hence, APGCL recommended, and ADB approved, to undertake rebidding. However, rebidding was not carried out as the process was already substantially delayed, and the scope had changed from a consulting contract to an equipment supply, which need additional budget allocation.
5. During the midterm review of project 1, considering the above implementation delays and budgetary issues, ADB and the executing agency decided to remove the procurement for the ERP system from the scope of project 1 and include in project 3. The Government of India endorsed the proposal and requested ADB to take necessary action, which ADB accepted.
6. Accordingly, APGCL is currently implementing the ERP system as part of project 3 financed by tranche 3 Loan 4029. At present, execution of the Lot 1 procurement package is being carried out. The total ERP implementation expenditure for Lot 1 package is ₹274,951,800 (inclusive of taxes), of which ₹233,010,000 is the basic cost and ₹41,941,800 (18%) is the tax amount. The contract agreement was signed on 31 July 2019. The actual implementation work began in October 2019, and the work is scheduled to be completed within 2023. The implementation of Lots 2–4 will follow upon completion of Lot 1 work.

## IMPLEMENTATION OF THE PROCUREMENT PLAN

Item	Contract Value (\$ million)	Status
<b>Goods and Works Contract</b>		
Turnkey Contract for Design and Engineering, Manufacture, Supply, Erection, Testing and Commissioning including all Civil and Allied Works of 70 MW (Nominal) Gas Engine based Lakwa Thermal Power Replacement Project at Lakwa Thermal Power Station	35.963	Completed
<b>Consulting Services</b>		
<b>A. Project Preparation and Implementation Support</b>		
1. Project Management and Construction Supervisor for Lakwa Replacement Gas Engine Based Power Plant	0.487	Completed
2. Project Preparation, Tender Development and Award Management Process for Lower Kopili Hydropower Project	1.314	Transferred to project 3 and still ongoing
<b>B. ERP and IT Support</b>		
1. ERP and IT Specialist	0.340	Completed
2. ERP Implementation and Infrastructure Development for APGCL	-	Transferred to project 3
<b>C. Capacity Building and Training Support</b>		
1. Environment and Social Specialist for Lakwa Replacement Gas Engine Based Power Plant	0.325	Contract mutually terminated <sup>1</sup>
2. Environment and Social Specialist for Lower Kopili Hydropower Project	-	Transferred to project 3
3. Accounting, Audit, Budget and Cost Accounting and Materials	0.127	Completed
4. Capacity Building and Human Resource Development for Power Sector Utilities	1.125	Completed

APGCL = Assam Power Generation Corporation Limited, ERP = enterprise resource planning, IT = information technology, MW = megawatt.

Source: Asian Development Bank.

<sup>1</sup> In September 2014, APGCL finalized the recruitment of the individual consultant. However, given that there were no construction activities for the Lakwa 70 MW gas fired power plant at the time, the contract with the consultant was signed only in September 2015, when the bidding process to appoint the turnkey contractor for the Lakwa project was finalized. However, after issuing a notice to proceed to the consultant, APGCL faced little response and communication from the consultant. APGCL did not get any responses on follow ups and reminders to commence with the assignment. The consultant later informed APGCL that she is not available to undertake the assignment, and it was mutually agreed to terminate the contract. No fund disbursements have been made under this contract, and no appointments were made as a replacement.

## ECONOMIC REEVALUATION

### A. General

1. The economic reevaluation was done to assess and validate the economic efficiency of the project 1 of the Assam Power Sector Investment Program<sup>1</sup> upon completion. In comparison with the economic evaluation done at project appraisal stage, its scope and costs are known now, and the likely benefits are more evident since the project is complete, allowing an accurate account of economic returns of the project. The economic reevaluation follows the same principles and approach employed at project appraisal, but validates the major assumptions used in the original economic analysis and presents more realistic forecasts on economic performance of the project. The economic reevaluation was carried out in accordance with the Asian Development Bank's Guidelines for Economic Analysis of Projects.<sup>2</sup>

2. The project was designed with the objective of increasing the capacity and efficiency of electricity generation system in Assam. The project aimed at delivering two outputs: (i) upgrade and expand the electricity generation system in Assam, (ii) strengthen the institutional capacity of Assam Power Generation Corporation Ltd. (APGCL) and Assam Power Distribution Company Limited (APDCL), the state-owned electricity utilities responsible for electricity generation and distribution within the state. Since the major investment was upgrading the generating system by replacing the aging Lakwa power plant with a new one, the economic reevaluation considers only the benefits arising out of this output.

3. The economic internal rate of return (EIRR) was recalculated to compare the economic efficiency of the project as realized at project completion against the evaluation done at project appraisal. With and without project scenarios were assessed to identify the costs and benefits associated with the project. As done in the original evaluation at appraisal, analyses were performed covering the period of 20 years from the commencement of power plant construction. All the costs and benefits denominated in Indian rupees (₹) are stated in constant 2021 prices using the domestic price numeraire, instead of using constant 2013 prices as done in the original appraisal. While a direct comparison between the monetary values may not be possible, the results of the evaluation are unaffected by the difference in the reference year selected.

### B. Demand Analysis

4. The long-term electricity demand forecast done by the Central Electricity Authority of India projects a baseline electricity demand of 17,257 gigawatt-hours (GWh) in 2037, which is more than double the present electricity demand in Assam, with an annual demand growth of about 3.2%.<sup>3</sup> This projection confirms that the electricity generation by the Lakwa Replacement Power Plant (LRPP) over a 20-year operating period can be fully utilized within the state.

5. In 2019, the state of Assam achieved state-wide electrification by expanding its supply network to provide access to electricity by the entire state population. Since the LRPP is only 70 megawatts (MW) compared with the state's peak demand of 1,400 MW, the network infrastructure will be adequate to facilitate the energy transfers from the power plant to consumers in the long term. Therefore, for economic reevaluation, it was assumed that the total generation of the LRPP would be utilized by the existing and new consumers without having to invest more on network infrastructure.

<sup>1</sup> ADB. 2014. [Assam Power Sector Investment Program - Tranche 1](#). Manila.

<sup>2</sup> ADB. 2017. [Guidelines for the Economic Analysis of Projects](#). Manila.

<sup>3</sup> Central Electricity Authority of India. 2019. [Long Term Electricity Demand Forecasting](#). New Delhi.

6. The energy production by the LRPP is assumed to be used as (i) direct replacement of energy previously supplied by Lakwa Power Plant (LPP) to its consumers; (ii) replacement of electricity supplied by small diesel generators when grid electricity was not available for industrial and general-purpose customers; and (iii) electricity supply source for households, commercial, and other types of consumers newly connected to the electricity grid.

### C. Economic Costs

7. Economic costs considered in the assessment mainly comprised the project upfront capital investments made over the implementation period and the incremental operation and maintenance (O&M) costs arising due to the replacement of the old power plant with a new power plant with a higher capacity.<sup>4</sup>

8. **Capital costs.** Project capital expenditures comprise civil works, equipment, consultancy, and tax. These costs are categorized into traded and non-traded goods and services, and skilled and unskilled labor. The cost analysis uses domestic price numeraire. The costs are converted from financial to economic terms using shadow pricing that eliminates transfer payments such as taxes and duties.

9. The tradable goods and services, i.e., the imported power plant machinery and foreign skilled labor, were converted using the shadow exchange rate factor of 1.04.<sup>5</sup> Non-traded goods and materials and skilled labor were in domestic market prices and are thus valued at 1.0. Unskilled labor was adjusted using a shadow wage rate factor of 0.75.<sup>6</sup>

**Table A9.1: Economic Capital Costs of the Project**  
(₹ million)

Cost Item	Traded	Non-traded	Skilled Labor	Unskilled Labor	CF	Financial Cost (₹ million)	Economic Cost (₹ million)
CF	1.04	1.00	1.00	0.75			
Civil works and erection	25%	40%	10%	15%	0.87	340.97	340.97
Equipment	100%	0%	0%	0%	1.04	2,056.95	2,118.66
Consultants	0%	0%	100%	0%	1.00	215.29	215.29
Total Cost						2,613.21	2,652.02

CF = conversion factor.

Source: Asian Development Bank estimates.

10. **Incremental operation and maintenance cost.** Since the LRPP is producing more electricity units than its predecessor owing to higher capacity and availability, the O&M cost was assumed to be increasing by a corresponding amount. Each additional kilowatt-hours (kWh) of generation made by the LRPP was estimated to be incurring an additional O&M cost of ₹0.47.<sup>7</sup>

### D. Economic Benefits

<sup>4</sup> The O&M cost of thermal power plants increases with generation. Thus, the higher generation by LRPP is expected to result in a higher total O&M cost than the power plant it replaced. The unit O&M cost of both power plants is assumed to be equal. Thus, the incremental O&M cost is due to incremental electricity production.

<sup>5</sup> Institute of Economic Growth. 2018. [Reassessment of National Parameters for Project Appraisal in India](#). Delhi.

<sup>6</sup> A minimum shadow wage rate factor of 0.6 has been recommended by the study publication cited as footnote 3. However, it is also recommended to use any reasonable value considering the minor impact the unskilled labor cost has on project economics. Therefore, the same SWRF of 0.75 used at project appraisal was retained for economic reevaluation.

<sup>7</sup> Assam Electricity Regulatory Commission. 2022. [Tariff Order for APGCL](#). Guwahati.

11. Part of the generation of the LRPP is being used to replace the energy previously produced by the LPP. Accordingly, this generation would result in a resource cost saving in the form of reduced gas consumption, a non-incremental economic benefit. Compared with the 0.41 standard cubic meters (SCM)/kWh fuel consumption rate (FCR) of the LPP,<sup>8</sup> the 0.23 SCM/kWh FCR of the LRPP results in substantial fuel and cost savings. In addition, with the increased electrification and demand for electricity, the full generation capacity of the LRPP is likely to be used. Based on the yearly generation records of LRPP, on average 483.9 GWh of electricity is expected to be produced by the power plant with a 1% annual degradation in capacity. This annual generation of LRPP is 126.3 GWh higher than the 357.6 GWh average generation of LPP (footnote 6). Part of this additional generation would be to supply industrial customers who were previously using small diesel generator units when electricity was not available from the grid. Replacement of electricity generated using diesel fuel (i.e., from the small generators) with electricity generated using gas creates substantial cost savings since gas is the cheaper and more efficient resource.<sup>9</sup> It is estimated that an electricity unit supplied by the LRPP will be 15.99 ₹/kWh cheaper than a unit of electricity produced using small diesel generators.

12. When households, small commercial, and general-purpose consumers are not supplied with sufficient electricity, they are unlikely to use alternative generating sources such as small diesel generators because of the high cost of these alternative supply sources. Therefore, shortage of grid electricity supply will reduce the electricity consumption and the economic output by these consumers. On the other hand, when sufficient electricity is made available to these consumers, the electricity consumption will increase resulting in an incremental economic output. To ascertain their willingness to pay (WTP) for the additional consumption, which was used as a proxy for the economic value of the incremental output, the economic reevaluation considered both the tariffs paid for electricity by the households, commercial and general-purpose customers and also the consumer surplus created by the additional supply.<sup>10</sup> Based on the prevailing electricity tariffs in Assam (footnote 7), the average domestic electricity tariff in real terms was estimated at 5.61 ₹/kWh while the weighted average commercial and general purpose tariff was estimated at 7.39 ₹/kWh. With consumer surpluses calculated as 0.14 ₹/kWh and 0.18 ₹/kWh respectively for household and commercial and/or general-purpose customer categories,<sup>11</sup> their WTP for the additional electricity was estimated at 5.75 ₹/kWh and 7.58 ₹/kWh respectively for the first year of operation of the LRPP. Since electricity is a non-tradable commodity denominated in domestic prices, no adjustments were made to reflect their economic value analyzed using domestic price numeraire.

## E. Economic Net Present Value and Economic Internal Rate of Return

13. By using the estimates of economic costs and benefits mentioned above, the economic net present value (ENPV) and the EIRR were recalculated for the project. Table A9.2 lists the annual costs and benefits of the project, yielding a reevaluated project ENPV of ₹1,284.44 million at a discount rate of 12.0% and an EIRR of 39.5%, well above the hurdle rate of 12.0% used by ADB at the time of project appraisal. The reevaluated EIRR is higher than estimated at project appraisal, partly due to the lower cost incurred in implementing the project and partly due to the consideration of the incremental benefit of generating and supplying additional energy to

<sup>8</sup> APGCL. 2013. *Detailed Project Report - Lakwa Natural Gas Reciprocating Engine based Replacement Power Project*. Guwahati.

<sup>9</sup> While the efficient operation of the LRPP would be reducing CO<sub>2</sub> emissions, the original economic evaluation has omitted environmental benefits. Accordingly, the reevaluation also disregarded the emission reductions and any economic benefits arising from the same.

<sup>10</sup> Asian Development Bank. 2013. *Cost Benefit Analysis for Development: A Practical Guide*. Manila.

<sup>11</sup> Consumer surplus =  $0.5 \times \text{tariff} \times \text{incremental consumption}^2 / (\text{elasticity} \times \text{present consumption})$ , where average price elasticity of electricity demand is taken as 0.423 (footnote 10).

previously unelectrified households, commercial and general-purpose consumers and avoiding small diesel generation by industrial consumers.

**Table A9.2: Economic Cost Benefit Analysis of the Project**  
(₹ million)

Year	Economic Benefits			Economic Costs			Net Benefit
	Non-incremental	Incremental	Total Benefits	Capital	O&M	Total Costs	
FY2016	-	-	-	322.10	-	322.10	(322.10)
FY2017	-	-	-	1,365.94	-	1,365.94	(1,365.94)
FY2018	-	-	-	1,063.58	-	1,063.58	(1,063.58)
FY2019	897.29	760.90	1,658.18	246.17	88.75	334.92	1,323.27
FY2020	849.79	770.22	1,620.00	202.69	85.08	287.77	1,332.24
FY2021	809.77	779.07	1,588.84	-	82.02	82.02	1,506.82
FY2022	809.20	787.47	1,596.68	-	82.89	82.89	1,513.79
FY2023	808.48	795.43	1,603.91	-	83.71	83.71	1,520.21
FY2024	807.60	802.96	1,610.56	-	84.48	84.48	1,526.09
FY2025	806.57	810.08	1,616.65	-	85.21	85.21	1,531.44
FY2026	805.40	816.79	1,622.18	-	85.90	85.90	1,536.29
FY2027	804.08	823.10	1,627.18	-	86.54	86.54	1,540.64
FY2028	802.63	829.03	1,631.66	-	87.15	87.15	1,544.51
FY2029	801.05	834.59	1,635.64	-	87.72	87.72	1,547.92
FY2030	799.35	839.78	1,639.13	-	88.25	88.25	1,550.87
FY2031	797.52	844.62	1,642.14	-	88.75	88.75	1,553.39
FY2032	795.58	849.12	1,644.69	-	89.21	89.21	1,555.48
FY2033	793.52	853.28	1,646.80	-	89.63	89.63	1,557.16
FY2034	791.35	857.12	1,648.47	-	90.03	90.03	1,558.44
FY2035	789.08	860.64	1,649.72	-	90.39	90.39	1,559.33
						<b>ENPV</b>	<b>1,284.44</b>
						<b>EIRR</b>	<b>39.5%</b>

(-) = negative; EIRR = economic internal rate of return; ENPV = economic net present value; FY = fiscal year; O&M = operation and maintenance.

Source: Asian Development Bank estimates.

## F. Sensitivity Analysis

14. The resulting EIRR was tested for sensitivity to adverse economic conditions, including (i) reduction in the plant factor of the LRPP by 20% due to supply shortage of natural gas, (ii) increase in operation and maintenance cost of the power plant by 20%, (iii) 20% reduction in the value of additional electricity supplied to consumers, (iv) 20% reduction in resource cost saving, and (v) all the above adverse condition occurring together. Table A9.3 shows the results of the sensitivity analysis carried out. Under all these adverse situations, occurring separately as well as together, the project exceeds the threshold EIRR of 12%, ensuring the efficiency of the project in the longer term.

**Table A9.3: Results of the Sensitivity Analysis**

Parameter	Change	EIRR
Base case		39.5%
Reduction of plant factor by	20%	23.7%
Increase in O&M costs by	20%	39.1%
Reduction in value of incremental energy by	20%	36.1%
Reduction in resource cost saving by	20%	36.8%
Combination of all above		19.4%

EIRR = economic internal rate of return, O&M = operation and maintenance.

Source: Asian Development Bank estimates.

## FINANCIAL REEVALUATION

### A. General

1. The financial reevaluation of project 1 was done to reassess and validate its financial sustainability for the executing agencies, upon project completion. The financial reevaluation was conducted using the guidelines for financial analysis.<sup>1</sup>

2. Yearly net cashflows generated by the project were estimated. Since the project generates tariff revenue determined through a regulatory tariff-setting process, the project was assessed on stand-alone basis to determine financial viability using the standard indicators financial net present value (FNPV) and financial internal rate of return (FIRR). The financial reevaluation was done for a period of 20 years covering the 3-year implementation period (fiscal year [FY] 2016–FY2018) and extending 17 years of the project operating period (FY2019–FY2035). This enables the comparison with the financial analysis done at project appraisal. All cash inflows and outflows were adjusted to FY2021 prices. The reevaluated FIRR was compared with the updated weighted average cost of capital (WACC) based on final financing rates at completion. Further, a comparison of FIRRs estimated at completion and at appraisal was done to identify any changes to project financial performance against the expectations of project design.

3. The project was financed through multiple sources including the direct equity contribution by the Government of Assam, and the Asian Development Bank (ADB) loan given by the government as a partial grant (approximately 80% of the project cost) to Assam Power Generation Corporation Limited (APGCL) with the balance treated as additional equity by the government. In the regulatory tariff setting process, capital expenditures funded through grants are not treated as investments but as direct financial benefits and therefore, not provided with a return. Since grant funds are not included in the revenue calculation, in calculating capital expenditure, expenses made using grant funding need to be removed. For this, in the financial reevaluation, the expenses made using grant funds are added back. To assess the financial viability of the project to the executing agency, the net cashflows derived after removing the grants from both income and expenditure need to be compared against the cost of capital excluding grants.

### B. Weighted Average Cost of Capital

4. To reduce the electricity tariffs within the state, the government has channeled the funds received from ADB as equity.<sup>2</sup> Thus, revenue-generating investment is limited to the government equity. Table A10.1 presents the re-calculation of project WACC, where the only source of capital relevant for the comparison is the cost of equity by the government. The reevaluated WACC is 8.48%, which is substantially higher than the original WACC estimated at 1.9%. The increase in WACC is due to the absence of low-cost debt financing from the WACC calculation.

<sup>1</sup> ADB. 2019. *Financial Analysis and Evaluations: Technical Guidance Note*. Manila.

<sup>2</sup> In determining the electricity tariff, the regulator tariff ignores any expenses made using grants (footnote 4). Therefore, in comparing financial returns of the project against the cost of capital, the grant amount needs to be removed altogether.

**Table A10.1: WACC of Project 1**

Item 1	Item 2	GOA Equity
A	Proportion of financing	100%
B	Nominal cost of capital	14.00%
C	Tax rate	0.00%
D	Nominal cost adjusted by tax, $B \times (1 - C)$	14.00%
E	Inflation rate	5.09%
F	Real cost adjusted by tax, $[(1 + D) \div (1 + E)] - 1$	8.48%
G	WACC in real terms	8.48%

GOA = Government of Assam, WACC = weighted average cost of capital.

Source: Asian Development Bank estimates.

## C. Project Costs

5. **Capital costs.** The project capital expenditures included equipment and materials, civil works, land, safeguards, consultants, and taxes. The actual expenditures incurred during each year of project implementation, as recorded in Audited Project Financial Statements and ADB loan disbursement records were adjusted for inflation to arrive at the total capital cost in constant FY2021 prices. The salvage value at the end of the 17-year evaluation period is reflected in the cash flow analysis.<sup>3</sup>

6. **Fuel cost.** The actual fuel cost incurred every year, along with the delivered fuel price and energy generation is recorded and verified by the regulator. Using the fuel costs and consumption data submitted to the regulator for FY2021, the annual fuel costs were derived by adjusting for estimated energy production of each year.

7. **Operation and maintenance costs.** APGCL submits the actual operation and management cost (O&M) cost of each power plant for approval and consideration in the tariff setting process by the regulator. The O&M cost incurred by Lakwa Replacement Power Plant (LRPP) in FY2021 was assumed to be fixed cost over the operating life of the LRPP. Based on regulatory tariff filing data of APGCL, the O&M cost is estimated at 0.46 ₹/kWh.<sup>4</sup>

8. **Tax.** A cash outflow corresponding to the increase in taxes payable by APGCL due to the increased revenue generated by the LRPP was included in the cashflow analysis. After providing for depreciation of project assets, a 34% tax rate was assumed for APGCL to be payable on the incremental earnings.

## D. Project Revenue

9. The revenue allowed to be earned through the regulatory tariff setting process includes the recovery of fixed costs including the operation and maintenance cost, the interest costs, depreciation cost as a proxy for recovery of capital investment, and a return on equity. However, the main component of the revenue is the fuel cost, which vary with the generation.

10. Project revenue is the income arising from the sale of electricity generated by the LRPP. The Assam Electricity Regulatory Commission allows recovery of costs and a return on investment based on the capital investment, approved performance criteria and the quantity of electricity generated. Based on project capital costs (Appendix 3), and the other expenses

<sup>3</sup> The capital expenditure was partially met through grant funds. These grant funds are ignored in determining the tariff, which determines project revenue. Therefore, the financial reevaluation considers the investment cost excluding the grants by adding back the grant as a negative cost.

<sup>4</sup> Assam Electricity Regulatory Commission. 2022. [Tariff Order for APGCL](#). Guwahati

recoverable through tariff, including O&M and depreciation, a regulatory tariff forecast for LRPP was done (footnote 4). Using the recorded average electricity generation of 483.9 GWh/year as the baseline generation, the income of LRPP through electricity sales was estimated for the 17-year operational period evaluated. Net cashflows after settling all expenses were considered the net financial benefit of the project.

#### **E. Financial Net Present Value and Internal Rate of Return**

11. Net cashflow, i.e., the difference between the revenue and direct project costs, were estimated for each year over the assessment period to calculate the project FNPV and FIRR. Table A10.2 shows the estimated project cashflows over the assessment period.

**Table A10.2: Project Cashflow Estimates**  
(₹ million)

Year	Cash Inflow		Cash Outflow				Net Cashflow
	Revenue from Sales	Grants	Capital costs	Fuel	O&M	Tax	
FY2016	-	254.51	316.41	-	-	-	(61.90)
FY2017	-	1,060.47	1,318.37	-	-	-	(257.90)
FY2018	-	868.91	1,080.23	-	-	-	(211.31)
FY2019	861.72	193.19	240.17	521.83	213.00	8.29	71.62
FY2020	856.40	158.95	197.60	516.61	213.00	8.29	79.84
FY2021	851.12	-	-	511.44	213.00	8.29	118.39
FY2022	845.90	-	-	506.33	213.00	8.29	118.28
FY2023	840.74	-	-	501.27	213.00	8.29	118.18
FY2024	835.62	-	-	496.25	213.00	8.29	118.07
FY2025	830.55	-	-	491.29	213.00	8.29	117.97
FY2026	825.54	-	-	486.38	213.00	8.29	117.87
FY2027	820.58	-	-	481.51	213.00	8.29	117.77
FY2028	815.66	-	-	476.70	213.00	8.29	117.67
FY2029	810.79	-	-	471.93	213.00	8.29	117.57
FY2030	805.98	-	-	467.21	213.00	8.29	117.47
FY2031	801.21	-	-	462.54	213.00	8.29	117.37
FY2032	796.49	-	-	457.92	213.00	8.29	117.28
FY2033	791.81	-	-	453.34	213.00	8.29	117.18
FY2034	787.19	-	-	448.80	213.00	8.29	117.09
FY2035	782.61	-	-	444.31	213.00	8.29	117.00
						<b>FNPV</b>	<b>315.44</b>
						<b>FIRR</b>	<b>16.8%</b>

(-) = negative; FIRR = financial internal rate of return; FNPV = financial net present value; FY = fiscal year; O&M = Operation and Maintenance.

Source: Asian Development Bank estimates.

## F. Results of Project Financial Reevaluation

12. The financial reevaluation has re-assessed the project FNPV as ₹315.44 million and FIRR as 16.8%. This reevaluated FIRR is considerably higher than the FIRR of 5.5% estimated at project appraisal. The reason for the increase in FIRR can be attributed to the steady revenue generation expected of the LRPP in contrast with the rapid reduction estimated at project appraisal. With the electricity demand projected to increase in Assam and the lower cost of generation of LRPP making the power plant suitable for regular operation, it is likely for the power plant generation to be maintained at maximum level, ensuring a steady revenue inflow.

13. To ascertain the sustainability of the project in the longer term, the reevaluated project FIRR was compared against the project WACC. The reevaluated FIRR of 16.8% exceeds the re-assessed project WACC of 8.48%, implying the project to be a financially sustainable venture.

## G. Sensitivity Analysis

14. A sensitivity analysis was performed to test the robustness of the project against adverse conditions the project is exposed to. The risk of inadequate gas supply forcing the LRPP to be under-utilized, resulting in a reduction in project revenue was tested by decreasing the plant factor by 20%. The project FIRR reduced marginally, but owing to the regulated tariff received by LRPP, the revenue reduction, mainly through the passthrough fuel cost, did not affect the project returns. Similarly, other adverse conditions such as the O&M costs increasing by 20% above the approved level and increasing the fuel consumption rate by 5% above the approved level were tested. None of the tested conditions resulted in the project FIRR to reduce to levels lower than the WACC. Considering that the regulatory tariff regime ensures recovery of all reasonable costs, it can be concluded that the project is financially sustainable for APGCL if the regulated tariff regime is in effect.

**Table A10.3: Sensitivity Analysis Results**

Parameter	Variation	FIRR
Base case		16.8%
Reduction of power plant load factor by	20%	16.4%
Increase in O&M cost by	20%	9.5%
Increase in fuel consumption rate of LRPP by	5%	11.7%

FIRR = financial internal rate of return, LRPP = Lakwa Replacement Power Plant, O&M = operation and maintenance.

Source: Asian Development Bank estimates.

## FINANCIAL SUSTAINABILITY OF THE EXECUTING AGENCY

1. The executing agency of the project, Assam Power Generation Corporation Limited (APGCL), was formed after the unbundling of the Assam State Electricity Board (ASEB) in December 2004 as part of the State Power Sector Reform Program implemented within the provisions of the Electricity Act 2003. Since 2005, APGCL has been functioning as a corporate entity, with 100% shareholding of the company by the state government of Assam. Ownership and operation and maintenance of all the existing power plants in Assam are the main functions of APGCL. APGCL is also responsible for the development of new power-generating facilities to meet the increasing demand within the state.

2. A tariff regulatory process that ensures the revenue requirement provides sufficient revenues for the company, ensuring its financial sustainability. APGCL's historical financial performance was reviewed using audited financial statements from fiscal year (FY) 2016 to FY2020. Table A11 presents the key commercial and financial indicators of the company's financial performance and the ratios derived from the financial data pertaining to each FY.

**Table A11: Financial Performance Indicators of APGCL**

Item	FY2016	FY2017	FY2018	FY2019	FY2020
<b>Commercial Indicators</b>					
Electricity transmitted grand total (GWh)	1,745.6	1,557.3	1,414.5	1,509.7	1,477.1
Average revenue per unit (₹/kWh)	3.956	3.549	3.621	3.892	3.801
Average cost per unit (₹/kWh)	3.337	2.714	2.638	2.833	2.843
<b>Financial Indicators (₹ million)</b>					
Revenue from operations	6,905.5	5,526.3	5,122	5,875.8	5,614.8
Expenses	5,825.2	4,225.9	3,731	4,277.1	4,199.7
Operating profit	1,080.4	1,300.4	1,391	1,598.6	1,415.1
Interest expenses	503.5	571.4	728.5	774.8	798.5
Depreciation and amortization	320.4	433.1	403.0	531.1	562.3
Gross profit	11.8	219.1	259.5	292.9	54.3
Tax expenses	2.4	46.7	55.4	67.8	11.6
Net profit after tax	9.4	172.4	204.1	225.1	42.7
<b>Financial Ratios</b>					
Operating profit margin (%)	15.65	23.53	27.16	27.21	25.2
Net profit margin (%)	0.13	3.11	3.98	3.83	0.76
Return on equity (%)	0.14	1.83	1.65	1.66	0.31
Debt-equity ratio	2.03	1.72	1.37	1.32	1.36
Debt service coverage ratio	2.61	1.623	1.461	1.459	1.157

APGCL = Assam Power Generation Corporation Limited, FY = fiscal year, GWh = gigawatt hour, kWh = kilowatt hour, ₹ = Indian Rupee.

Sources: Annual Reports of APGCL.

3. **Profitability.** Even with a reduction in generation during the analyzed period, APGCL has been making operating profits. The replacement of the Lakwa Power Plant has increased the interest and depreciation costs, resulting in a reduction in gross profit. In regulatory tariff calculations, grant funds received by the company are removed from equity. As the investments for the Lakwa Replacement Power Plant were provided by the government primarily in the form of grant and loan with the equity contribution limiting to 10%, the return on equity was reduced in

FY2020. This lower return on equity is expected to continue for the foreseeable future as the state government considers the supply of electricity as a service with minimal returns expected from its investment. On the other hand, the operating profit is going to be unaffected and will keep APGCL in strong financial standing.

4. **Sustainability.** Owing to the high operating profit margin ensured through the regulatory tariff regime, the financial sustainability of APGCL is expected to remain strong. Thus, the operation of the new power plant is unlikely to be affected by any financial distress that may be experienced by the company. As evidenced in Table A11, APGCL has maintained its debt service cover ratio above 1.4 in most years, and above 1.1 all throughout the analyzed period. Thus, the company will have sufficient funds to meet its debt commitments after meeting the operational expenses to allow future borrowings and expansion of the generation capacity required for sustained economic growth of the state.

## ENVIRONMENTAL SAFEGUARDS MANAGEMENT

1. According to the national environmental regulations, environmental impact assessment (EIA) Notification 2006, the Assam Power Generation Corporation Limited (APGCL) was required to carry out an EIA for the 70 megawatts (MW) Lakwa Replacement Power Plant (LRPP), the main investment component of project 1 of the Assam Power Sector Investment Program, with approval to be granted by the Ministry of Environment and Forests, due to potential for inter-state impacts resulting in it being categorized as A. Accordingly, an EIA was carried out by APGCL in 2012 following the terms of reference provided by the Ministry of Environment and Forests, Government of India.<sup>1</sup> Subsequently, consent to establish was obtained from the Assam Pollution Control Board, and consent to operate was obtained annually from the year of commissioning of the power plant up to current year. APGCL has reported that all statutory clearance requirements have been complied with.

2. As an integral project of the Assam Power Sector Investment Program multitranchise financing facility (MFF), the environmental assessment and review framework (EARF) prepared for the MFF had identified the need for an initial environmental examination (IEE) to be carried out for the project 1, which was categorized as B for environment. To comply with the Asian Development Bank (ADB) requirements, the Safeguard Policy Statement (2009) and the EARF, the government-approved EIA was supplemented by an initial environmental examination (IEE) following the outline given in Appendix 1 of ADB's Safeguard Policy Statement (2009). This IEE was disclosed in the ADB website in October 2013; however, the EIA that it reportedly supplemented was not attached.

3. The IEE has concluded that category B was appropriate for the project, based on residual impacts following mitigation. However, environmental categorization should have been based on potential impacts prior to mitigation rather than residual impacts to ensure adequate assessment and due diligence was undertaken.

4. During the preparation of the IEE, APGCL and the ADB project preparatory team undertook public consultations and other assessments on the potential impact of the project on the environment. The main environmental impacts were associated with decommissioning of the old plant, construction waste management, and excavation and disposal of waste and obsolete equipment. The IEE included procedures for disposal of any obsolete and hazardous material from the site, an environmental management plan (EMP) for the construction of the new plant, and a grievance redress mechanism to ensure issues and concerns of the public were addressed during implementation.<sup>2</sup> Since the power plant is not located in the vicinity of any environmentally sensitive areas, and the use of natural gas does not cause significant air, water, noise, or soil pollution, significant adverse environmental impacts were not identified by the IEE. Even for the minor impacts, the EMP had identified the mitigatory measures that need to be adhered to during the design, implementation, and operation stages of the project. Accordingly, the adverse impacts observed during construction period such as discarding of base materials and traffic conditions were mitigated using standard engineering and environmental practices. However, the IEE was highly qualitative, and it is unclear how it reached its conclusions especially with respect to air, noise and water related as not being significant post-mitigation. Since the national EIA was not

<sup>1</sup> To decide on the scope of the environmental impact assessment, an appraisal of the potential impacts of the project was done by a committee comprising representatives from various governmental agencies. This appraisal was done for the project on 6–7 August 2012.

<sup>2</sup> The IEE was compliant with all requirements of the Safeguard Policy Statement (2009). The environment audit (scoping) conducted for the project by government agencies was also compliant with ADB's Safeguard Policy Statement (2009). ADB. 2009. [Safeguard Policy Statement \(2009\)](#). Manila.

disclosed with the IEE, it is unclear if this EIA was more robust and included air quality dispersion modelling, etc.

5. There appear to have been some oversight in environment safeguards due diligence at the project processing stage. For operational emissions to air, the EMP required the national nitrous oxide and nitrogen dioxide (NO<sub>x</sub>) standard (100 parts per million [ppm]) to be adopted, instead of the more stringent good international practice of 25ppm set out in the International Finance Corporation (IFC) environment, health, and safety (EHS) guidelines on thermal power. In accordance with the Safeguard Policy Statement (2009), for less stringent standards to be adopted, they should be justified in the IEE. This could have been done through air quality dispersion modelling to demonstrate ambient air quality standards will still be met with the less stringent standard and 30-meter stacks proposed. Though no justification for adopting this standard was given in the IEE, one off 24-hour ambient air quality monitoring during operation did not indicate an adverse impact on the airshed compared to the World Health Organization ambient air quality guidelines (2021) and National Ambient Air Quality Standards for NO<sub>x</sub>. Similarly for noise, national industrial area noise standards have been followed, which are 75 decibel A (dBA) instead of the more stringent good international practice of 70 dBA set out in the IFC EHS general guidelines. Again, one off operational noise monitoring did not identify any exceedance of the more stringent standard even though this was not specified as a performance standard. Greenhouse gas monitoring was also not required by the EMP, despite it being mandated by Safeguard Policy Statement (2009) where a project contributes over 100,000 tons of carbon dioxide (CO<sub>2</sub>) emissions, which is likely to have been the case for the new power plant.

6. In the IEE, the environmental performance standards for pollution control should have been benchmarked against the EHS guidelines of the IFC, unless compelling specific project circumstances are justified. However, as mentioned above, in this case, the NO<sub>x</sub> level limit was set to meet the threshold set by the Pollution Control Board of Assam, the local regulator in charge of emissions and other pollutants in the state of Assam. Commissioning tests indicated that the new power plant could be operated such that it complied with the 100ppm national NO<sub>x</sub> emission standard. A review of emission measurements for this project completion report carried out at the power plant at commissioning and two subsequent years confirms that the power plant is generally operating satisfactorily. However, occasional violation of NO<sub>x</sub> emission levels by some of the engines was also observed. These breaches of the national NO<sub>x</sub> emission standard need to be attended to by APGCL to ensure both project and environmental sustainability because power plants in breach can be requested to cease operation. These breaches of the emission standards were not previously flagged to ADB as no stack emissions were reported in the environmental monitoring reports despite being required by the EMP, and they also appear to have occurred after reporting ceased.<sup>3</sup> APGCL needs to monitor stack emissions in accordance with the EMP, maintain records, and, ensure continual compliance with the national emission standard for NO<sub>x</sub> by maintaining the gas engines, and immediately identifying and implementing corrective action to rectify any exceedances. In all cases, quantitative compliance monitoring by APGCL has been based only on national standards. The IEE should have made it clear that IFC EHS guidelines, which are generally more stringent than the national standards, were to be adopted and thus used as benchmark. To ensure quantitative construction and operational compliance monitoring against limits established in the IEE was ensured, the inclusion of a more detailed environment monitoring plan for quantitative monitoring and reporting of environmental performance standards such as air, noise, water, and soil would have been beneficial.

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<sup>3</sup> According to the EIA and the IEE prepared for the project, the limit applicable for emission of NO<sub>x</sub> (@15% O<sub>2</sub>) is 100ppm, and Engines 4 and 6 were regularly exceeding this limit during the measurements taken in August 2019 and April 2020.

7. Since the project was categorized as environment category B, involuntary resettlement category C, and indigenous peoples category C in accordance with Safeguard Policy Statement (2009), the project monitoring and reporting requirements were required mainly for environmental safeguards. During the project implementation stage, the environmental mitigation activities identified in the EMP were to be implemented by APGCL and their engineering, procurement, and construction (EPC) contractor as part of the turnkey contract. Adherence to the EMP was specified in the bidding and contract documents and ensuring the implementation of the project followed the EMP was entrusted to the project monitoring unit and the consultants they engaged for project management and construction supervision. Accordingly, the costs of environmental mitigation and monitoring were wrapped up into the main turnkey contract and the project implementation consultant's contract, and APGCL itself did not incur any expenditure for implementing the measures it was directly responsible for. Therefore, the \$0.4 million identified at project appraisal to be spent on environmental and social mitigation activities went unspent.

8. In addition to the project implementation consultant, a safeguards consultant was included to provide expert support to APGCL, particularly in relation to pollution control aspects. As indicated in Appendix 8, recruitment of the Environment and Social Specialist was finalized in September 2014. In September 2015, with the commencement of the turnkey contract, the consultant was requested to commence work. However, due to unavailability of the engaged consultant to carry out the work, the consulting contract was terminated in 2016. APGCL initiated the procurement process to recruit a replacement consultant, aiming to complete the procurement in the second quarter of 2017. However, owing to procedural delays in engaging the replacement consultant, APGCL suspended the procurement of the consultant. Instead, with the assistance of the project implementation consultant, APGCL performed the safeguards implementation, supervision, monitoring, and reporting functions through the project monitoring unit with external parties to measure compliance with environmental performance standards for air, noise, water, and soil. If the environment and social specialist had been on board, it could have helped APGCL improve its implementation, supervision, monitoring, and reporting of project 1 especially with respect to pollution control during construction and operation.

9. Semi-annual environmental monitoring reports detailing the progress of the project, and the compliance with the national statutory clearances and ADB environment safeguard requirements were prepared by APGCL. These were regularly submitted and disclosed in the ADB website. Table A12 lists the timing of disclosure of the environmental monitoring reports (EMRs). EMRs were submitted to ADB between 6 months to 1 year from the reported period. The old power plant was decommissioned in June 2016 and the new power plant became operational in April 2018. EMRs were not submitted after July 2019 with financial closure in September 2019, which meant only the first year of operation was reported on. Further, the EMRs contain limited evidence of compliance especially during operation, with no stack emission or greenhouse gas monitoring provided despite the former being required by the EMP, and the latter required by the Safeguard Policy Statement (2009) (when a project contributes over 100,000 tons of CO<sub>2</sub> emissions). During the operational period of the power plant, regular monitoring and reporting to the national environmental regulators is required, which is currently being complied with. However, APGCL has failed to submit EMRs to ADB during the operational period post-financial closure.

**Table A12: Environmental Monitoring Reports Prepared and Disclosed**

Report	Document Date
EMR January–June 2016	August 2017
EMR July–December 2016	August 2017

Report	Document Date
EMR January–June 2017	January 2018
EMR July–December 2017	January 2018
EMR January–June 2018	July 2018
EMR July–December 2018	December 2019
EMR January–June 2019	December 2019

EMR = environmental monitoring report.

Source: Asian Development Bank.

10. Based on the EMRs submitted by APGCL, implementation of safeguards was generally satisfactory, and the project has not come across any environmental or social safeguard issues to alter the outcome of the project. This is mainly because the project was implemented within the existing Lakwa Power Plant complex, where the environment is already disturbed, not in the vicinity of any environmentally sensitive areas. The cumulative impact was minimized, if not beneficial, by replacing an old power plant with a newer, more efficient power plant. Impact mitigatory measures identified in the EMP, such as confining the noisy construction activities to daytime, reuse of excavated earth for backfilling, storing and disposal of hazardous material according to the guidelines, and the use of personal protective equipment were strictly followed, avoiding any significant environmental issues during construction. No physical or economic resettlements were involved. The grievance redress committee was functional. Although a grievance mechanism was in place, no serious complaints were received. No health and safety incidents have been recorded either.

11. An issue faced by LRPP is the quality of gas supplied to the power plant. A knocking phenomenon is frequently observed in the gas engines due to higher calorific value of gas received at the power station. Knocking not only lowers the plant factor, but affects the life of the gas engine components, increases the maintenance, and sometimes leads to breakdown/shutdown of the gas engines. The gas supplier has agreed to resolve the gas quality issue, which will enable increased power generation by LRPP as a relatively clean thermal power generation option. The power plant is expected to be operated at its full capacity once the fuel issue is resolved. Even in the long term, the operational flexibility that can be provided by gas engine-based power plants will ensure LRPP to be used ahead of other types of thermal power plants, notably coal-fired power plants that dominate India's grid, both as a relatively clean generation source and as a facilitator for higher utilization of renewable energy power plants, which need fast responding and easily controllable power plants to supplement their operation. Given this context, the environmental sustainability of LRPP is high, despite being fueled by petroleum gas. However, in line with the Paris Agreement and India's nationally determined contributions, APGCL now need to start to work towards achieving net zero CO<sub>2</sub> emissions in its power generation operations.

## CONTRIBUTION TO STRATEGY 2030 OPERATIONAL PRIORITIES

OP No.	Corporate Results Framework Indicators (Outputs and Outcomes)	Expected Value	Achieved Value	Expected and Implemented Method	Assessment
3.1.3	Low-carbon infrastructure assets established or improved (number)	1	1	Lakwa 4x15 MW gas power generation units replaced with new gas engines with (7x10) MW of total capacity	<b>Achieved.</b> 4x15 MW gas turbine power generation units in Lakwa Power Plant were replaced with new 7x10 MW gas engines units in March 2018.
4.1.2	Urban infrastructure assets established or improved (number)	1	1	Lakwa 4x15 MW gas power generation units replaced with new gas engines with (7x10) MW of total capacity	<b>Achieved.</b> 4x15 MW gas turbine power generation units in Lakwa Power Plant were replaced with new 7x10 MW gas engines units in March 2018.
6.1.1	Government officials with increased capacity to design, implement, monitor, and evaluate relevant measures (number)	100	100	Capacity building	<b>Achieved.</b> <ul style="list-style-type: none"> <li>• 30 staff provided with on-the-job training on procurement, project implementation, safeguards monitoring, and power plant operation and maintenance by 2018.</li> <li>• 70 staff from both APGCL and APDCL trained on financial and human resource management by 2018.</li> </ul>

APDCL = Assam Power Distribution Company Limited, APGCL = Assam Power Generation Corporation Limited, MW = megawatt, OP = operational priority.

Source: Asian Development Bank.