

## SECTOR ASSESSMENT (SUMMARY): POWER

### Sector Road Map

#### 1. Sector Performance, Problems, and Opportunities

##### a. National Power Sector

1. The Electricity Act (2003) enabled the unbundling of state power utilities in India into separate entities for generation, transmission, and distribution. The act established and empowered national and state regulatory agencies, enabled open access to transmission networks, and promoted competition in the electricity industry. As provided in the act, the Government of India published the National Electricity Policy in February 2005 to establish targets to eliminate power shortages and increase availability, establish the lifeline consumption level, and make sector entities profitable. In August 2006, the government published the Rural Electrification Policy, as provided for in the Electricity Act. The policy defines rural electrification and an electrified village, and announced several mechanisms and financing support for states to accelerate rural electrification to reach the target of complete electrification by 2012. The mechanisms included both grid and off-grid electrification (distributed generation), and innovative financing and operating mechanisms to enable rapid development of services to rural areas.

2. The Ministry of Power provides overall guidance to the sector through the Central Electricity Authority (CEA), a statutory body provided for in the Electricity Act. CEA assists the ministry with technical and economic matters. It is responsible for the technical coordination and supervision of programs, is entrusted with some statutory functions, and is responsible for preparing a national electricity plan in accordance with the National Electricity Policy. The government owns central power utilities, such as National Thermal Power Cooperation, National Hydroelectric Power Cooperation, Nuclear Power Cooperation, and Power Grid Corporation of India, which are engaged in generation and interstate power transmission. Rural Electrification Corporation and Power Finance Corporation are government-owned institutions dedicated to financing power projects. The Power Trading Corporation manages trading among states, as well as between states and central power utilities.

3. India has accelerated the development of conventional and nonconventional generating capacity in the last decade. By the end of fiscal year (FY) 2012, the total grid-connected installed capacity was 223.6 gigawatts (GW): coal-fired capacity 130.4 GW (58% of the total), hydropower 40 GW (18%), other renewables 27.5 GW (12.3%), gas-fired 20.1 GW (9%), nuclear 4.8 GW (2.1%), and diesel-fired 1.2 GW (0.5%). A further 19.5 GW of captive generating capacity is available for on-grid operation.<sup>1</sup> Despite this significant capital investment in generation capacity, national energy deficits persist with a peak power deficit of 9% (12 GW).<sup>2</sup> Power shortages have adversely affected the country's economy; in FY2012, power shortages accounted for \$68 billion (0.4% of gross domestic product). Improving the power sector is essential for the economic well-being of the country and enhancement of the quality of life of citizens.

##### b. Power Sector in Assam

4. In 2003, the Government of Assam (GOA) introduced the Power Policy Statement (2003) highlighting the need to (i) increase commercial orientation and financial viability of the power sector; (ii) carry out technical, managerial, and administrative restructuring of power utilities; (iii) increase the number of power utilities in the state, and (iv) promote private sector

<sup>1</sup> Central Electricity Authority. 2013. *Monthly Review of Power Sector, April 2013*. New Delhi.

<sup>2</sup> Central Electricity Authority. 2013. *Load Generation Balance Report 2013–14*. New Delhi

participation in the sector. To implement this policy framework, GOA formulated the Assam Power Sector Development Program). GOA unbundled the Assam State Electricity Board into five companies: Assam Power Generation Corporation; Assam Electricity Grid Corporation (AEGC); and three distribution companies: Central Assam Electricity Distribution Company, Lower Assam Electricity Distribution Company, and Upper Assam Electricity Distribution Company. The latter three were subsequently (in 2009) merged into one company, Assam Power Distribution Company (APDC). The Assam State Electricity Board was formally dissolved in 2013.

5. Demand for power in Assam peaked at 1,250 megawatts (MW) in FY2012 against the availability of 960 MW, indicating about a 23% shortfall. Electricity consumption has been growing at an average annual rate of 5.3% since 1994, averaging 10.1% annual growth during FY2008–FY2012. The all-India average growth rate was about 8.4% over the same 5 years.<sup>3</sup> Demand forecasting indicates a probable 10-year increase in demand by about 100% from 2012. Assam Power Generation Corporation now has three operating power plants: the 119.5 MW Namrup Thermal Power Plant, the 120 MW Lakwa Thermal Power Plant, and the 100 MW Karbi Langpi Hydroelectric Power Station. The 60 MW oil-fired Chandrapur Thermal Power Plant, which was closed due to high oil prices, is being modified as a coal-fired plant. Supply deficits persist despite Assam purchasing as much as 200 MW from the open market (through bilateral trades from power traders and Indian Energy Exchange) at high costs.

6. AEGC inherited 3,862 circuit-kilometers (ckm) of transmission lines and 38 substations with total transmission capacity of 1,637 megavolt-amperes. It added 902 ckm of transmission lines and augmented transmission capacity by 1,764 megavolt-amperes. Total energy losses in the transmission network (400 kV, 220 kV, and 132 kV) were approximately 4% of energy distributed in FY2013. Transmission losses have been consistently reducing, reflecting ongoing investment in the network and better management. Network availability has been maintained at over 99%. The Power System Master Plan identifies the need for ongoing investment in AEGC's transmission network up to 2022 to meet the needs of APDC's rapidly growing customer base. In particular, reinforcement is required in some areas to maintain statutory voltage limits on 33/11 kV transmission substations to maintain security of supply. The ongoing multitranche financing facility (MFF), Assam Power Sector Enhancement Investment Program, has several components for improving AEGC's transmission system.<sup>4</sup> The World Bank and other development partners are providing sector assistance. Hence, the transmission network is not the focus of the proposed ADB assistance to the Assam power sector.

7. As in many Indian states, distribution is the weakest link in the power supply chain in Assam. The distribution segment is characterized by chronic underinvestment, poor quality of engineering and construction, aged equipment, and inadequate human resources. Improvements have been made in physical infrastructure through ADB interventions, but further investment is required to increase network capacity to reach a growing customer base and to match with the proposed expansion in the transmission network. Chronic underinvestment is evident in poor voltage regulation and frequent interruptions caused by equipment failure. Of the state's total 25,124 villages, 19,729 (79%) were electrified by the end of FY2011. APDC serves approximately 2.76 million customers. It owns 5,150 ckm of 33 kV lines, 36,107 ckm of 11 kV lines, 64,694 ckm of 0.4 kV lines, and 240 33/11 kV substations with a total installed capacity of 2,036 megavolt-amperes.

<sup>3</sup> Central Electricity Authority. 2013. *Growth of Electricity Sector in India from 1947–2013*. New Delhi.

<sup>4</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility and Technical Assistance Grant to India for the Assam Power Sector Enhancement Investment Program*. Manila.

8. APDC had some success in reducing its distribution network losses but loss reduction has stagnated since 2011 and still at about 24% of the total energy sent out. APDC has consistently fallen short of loss targets approved by AERC for tariff-setting purposes (by as much as 5.6 percentage points for FY2012), and consequently APDC has suffered persistent revenue shortfalls. APDC has petitioned for a total loss allowance of 23% for FY2014, reducing to 22% in FY2016. Achieving these targets will need significantly improved performance and capital investment. In this context, AERC has issued several directives designed to address and improve APDC performance. In particular, APDC has been directed to instigate a task force to improve detection of and prosecution for electricity pilferage. Actual, forecast, and AERC approved distribution and transmission losses are summarized in the table.

### Transmission and Distribution Losses

Fiscal Year	Transmission Losses		Distribution Losses	
	Actual/Forecast	Approved by AERC	Actual/Forecast	Approved by AERC
2011	4.81	4.50	25.44	21.60
2012	4.29	4.25	26.33	20.60
2013	4.08	4.25	25.21	19.60
2014	4.08	4.08	23.00	18.60
2015	3.84	3.84	22.50	18.10
2016	3.85	3.64	22.00	17.60

Source: Assam Electricity Regulatory Commission.

## 2. Government's Sector Strategy

9. Assam possesses an estimated 320 million tons of coal, plus oil and natural gas reserves sufficient to sustain current production for at least another 50 years; and a vast, though largely untapped, potential for hydropower generation. However, in spite of an abundance of natural resources, Assam has not made much progress in the field of power generation and use of electricity. Per capita consumption of electricity in Assam is one of the lowest in India (just above 25% of the country's average) and power shortages have been a feature over the last two decades. With more than 80% of the state's population living in rural areas, the household electrification rate is very poor (around 37%) and is lowest among the northeastern states.

10. The major challenges facing Assam's power sector are to
- (i) provide universal access to power (the goal is to achieve universal access to grid electricity by FY2021, with the interim target of 70% by FY2017);
  - (ii) provide quality and reliable power supply;
  - (iii) ensure long-term energy security by optimizing internal resources and accessing cheaper power from outside the state;
  - (iv) increase per-capita consumption;
  - (v) ensure cost-recovery and financial sustainability of sector companies;
  - (vi) modernize power systems by using state of the art technologies;
  - (vii) modernize the power companies and use computerized systems for asset and human resource management, billing, and communication; and
  - (viii) train and build capacity of power sector agency staff for accounting, auditing, financial management, project development, implementation, monitoring and evaluation, procurement, demand-side management, dispatch management, power trading, and human resource management for institutional sustainability.

11. The state's draft Power System Master Plan includes increasing generation capacity from 365 MW (as of May 2013) to 1,410 MW (by March 2022). Despite the hydropower potential of the

northeastern states, planning and construction delays mean that generation shortfalls will persist; the generation deficit during low hydro inflow is expected to be as much 2,000 MW, or 50% of forecast demand, by end of the 13th plan (FY2017- FY2022). In recognition of this deficit, Assam is planning to add new thermal and hydro generation and to procure power under long-term open access arrangements. The northeastern region of India is expected to increase its generation capacity by 3,636 MW during the 12th 5-year planning period. Assam plans to get its share of 990 MW from these central generating stations to meet the growing demand. Demand-side management is likely to be a feature of Assam's plans, and rooftop solar holds significant appeal particularly in remote villages.

12. Loss reduction remains a key focus for the distribution subsector. A total loss of 19% is targeted by FY2021 (comprising 15% distribution loss and 4% transmission loss). In tandem with a physical investment program, institutional strengthening initiatives will be continued, particularly to improve construction supervision capacity; enhance management of ongoing projects; and improve financial management systems, practices, and processes.

### **3. ADB Sector Experience and Assistance Program**

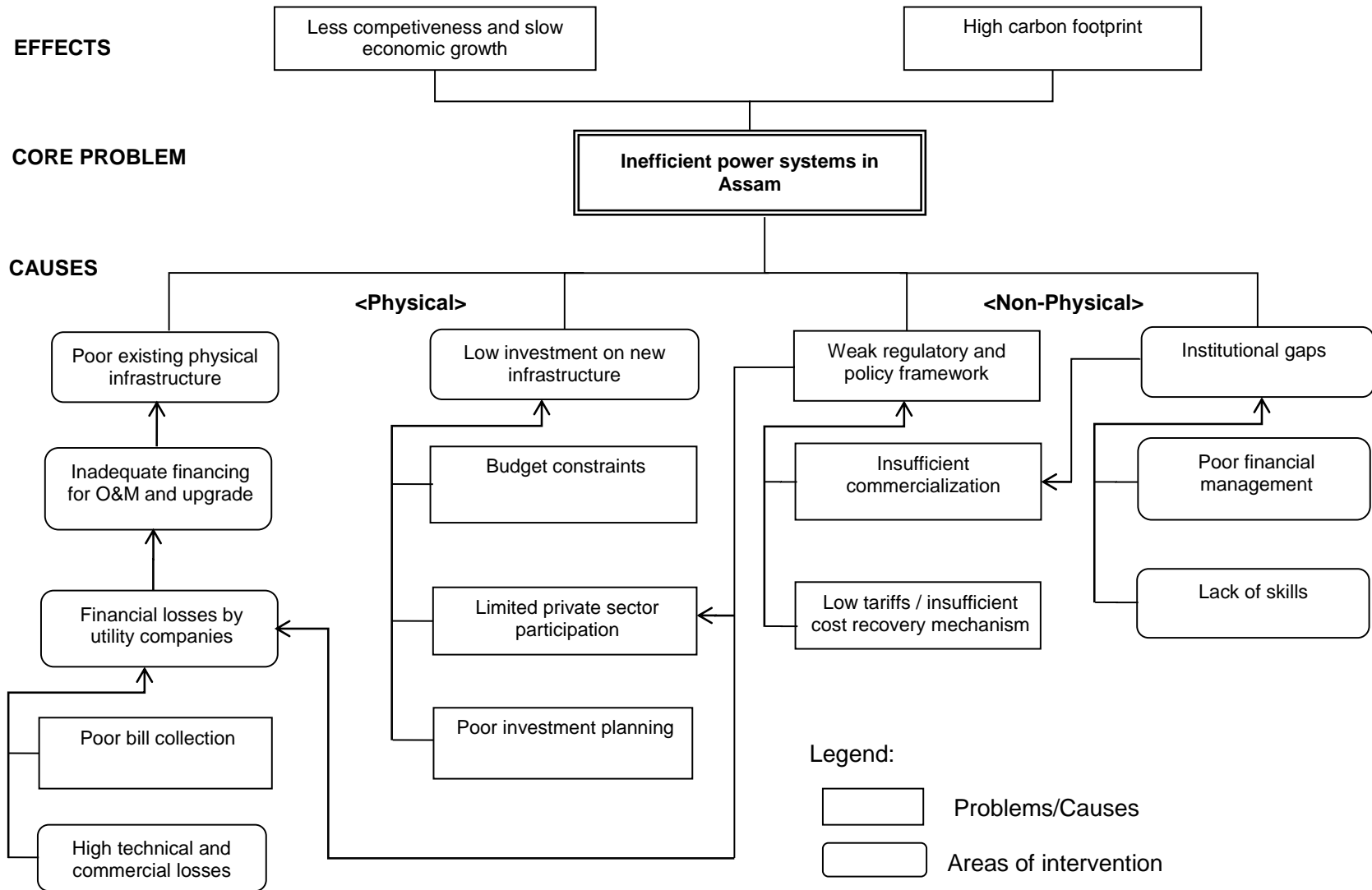
13. ADB has been a longstanding partner for Assam's power sector. ADB has supported development of transmission and distribution infrastructure. It also assisted with power sector reforms for unbundling energy utilities and capacity development of an independent energy regulator by providing a loan of \$250 million for the Assam Power Sector Development Program, which was successfully implemented during 2003–2009.<sup>5</sup> In continuation of GOA's Power Policy Statement, 2003, ADB helped prepare a master plan with the least-cost plan for transmission and distribution system enhancement (footnote 5). Based on this, GOA prepared an investment program with a total cost of \$764.0 million. ADB supported the program with a \$200 million MFF for the Assam Power Sector Enhancement Investment Program (footnote 4). The program, which is currently being implemented, focuses primarily on improving intrastate power transmission facilities, and includes physical investment to address customer connectivity and to improve energy efficiency in the distribution network. Support for expanding the geographic reach and scope of Assam's distribution franchising program is also included in the MFF.

14. Major lessons from previous ADB interventions in Assam include the need to: (i) increase connectivity of the Assam grid to the northeast region; (ii) build capacity for power companies; (iii) continue ongoing efforts on loss reduction; (iv) increase in-state power generation capacity; and (v) strengthen the Assam regulatory agency. These lessons were taken into account in designing the investment program. ADB's ongoing investment program in Assam invests mainly in improving connectivity with the northeast region and some improvements in the distribution system. The proposed investment program complements the ongoing investment by focusing mainly on generation and capacity building. It also provides limited support for distribution improvements.

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<sup>5</sup> Supported by Asian Development Bank. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Assam Power Sector Development Program*. Manila. In 2008, a master plan for investing \$764.0 million in the Assam power sector during the 11th Five Year Plan (2007–2011) and up to 2014 was prepared.

### Problem Tree for Power



**Legend:**

- Problems/Causes
- Areas of intervention

O&M = operation and maintenance

## Sector Results Framework (Energy 2013–2017)

Country Sector Outcomes		Country Sector Outputs		ADB Sector Operations	
Outcomes with ADB Contribution	Indicators with Targets and Baselines	Outputs with ADB Contribution	Indicators with Incremental Targets	Planned and Ongoing ADB Interventions	Main Outputs Expected from ADB Interventions
Increased and efficient use of energy including renewable energy	<p>Aggregate technical and commercial losses reduced to 20% in 2017 (baseline: 2011: 26%)</p> <p>Percentage of electrified villages increased to 100% in 2017 (baseline 2012: 93.8%)</p> <p>Share of new and renewable energy in total installed capacity increased to 25% by 2017 (baseline 2012: 12%)</p> <p>Transmission capacity for interregional power flows increased to 65,550 MW by 2017 (baseline 2012: 27,750 MW)</p> <p>11,000 MW of savings achieved through demand-side management and energy efficiency by 2017 (baseline = 0)</p>	Energy system expanded, improved, and well managed	<p>Nonrenewable generation capacity (including hydropower) increased by 88,537 MW by 2017 (baseline 2011)</p> <p>Hydropower generation capacity increased by 10,897 MW by 2017 (baseline 2011)</p> <p>Grid-connected renewable power generation capacity increased by 30,000 MW by 2017 (baseline 2011)</p> <p>Wind power generation capacity increased by 15,000 MW by 2017 (baseline 2011)</p> <p>Solar power generation capacity increased by 10,000 MW by 2017 (baseline 2011)</p> <p>Small hydropower generation capacity increased by 2,100 MW by 2017 (baseline 2011)</p> <p>Biomass and other generation capacity increased by 2,900 MW by 2017 (baseline 2011)</p> <p>110,340 ckm of power transmission lines installed or upgraded by 2017 (baseline 2011)</p> <p>1.3 million ckm of power distribution lines installed or upgraded by 2017 (baseline 2011)<sup>a</sup></p> <p>46,825 MW of nonrenewable generation capacity (private sector) installed by 2017 (baseline 2011)</p>	<p><b>Planned key activity areas</b> (% of funds):</p> <p>Solar power (20%)</p> <p>Hydropower (15%)</p> <p>Other renewable (10%)</p> <p>Electrical power transmission (40%)</p> <p>Electrical power distribution (15%)</p> <p><b>Pipeline projects</b></p> <p>Thirteen projects for \$1,948 million for 2013–2015 (including four EGM projects)</p> <p><b>Ongoing projects</b></p> <p>Twenty-six ongoing loans totaling \$3,682 million as of 31 December 2012 (including two projects categorized as EGM)</p>	<p><b>Planned key activity areas</b></p> <p>About 1,500 MW of solar power, hydropower, wind power installed or upgraded; transmission investments totaling about \$1.75 billion; and distribution investments of about \$1 billion</p> <p><b>Pipeline projects</b></p> <p>1,250 MW of solar power; hydropower, wind power installed or upgraded; \$1.5 billion transmission system investments; \$970 million of distribution system investments</p> <p><b>Ongoing projects</b></p> <p>885 MW of hydro power being installed; 7,760 ckm of transmission lines being installed or upgraded; 104,481 ckm of distribution lines being installed or upgraded</p>

ADB = Asian Development Bank, ckm = circuit-kilometer, EGM = effective gender mainstreaming, km = kilometer, kV = kilovolt, MW = megawatt.

<sup>a</sup> This includes 135,000 ckm of 33 kV lines, 560,000 ckm of 11 kV lines, and 610,000 ckm of low voltage engines.

Source: Government of India and Asian Development Bank estimates.