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Performance Evaluation Report
Madhya Pradesh Power Sector Investment Program
(India)
(Loans 2323, 2324, 2346, 2347, 2520 and 2732)

The attached report is circulated at the request of the Director General, Independent Evaluation Department. This report is also being made publicly available.

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Performance
Evaluation
Report

India: Madhya Pradesh Power Sector Investment Program



Independent
Evaluation **ADB**

Raising development impact through evaluation

Performance Evaluation Report
April 2020

**India: Madhya Pradesh Power Sector
Investment Program**

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Program Number: 32298
Loan Numbers: 2323, 2324, 2346, 2347, 2520, and 2732
Independent Evaluation: PE-821



Raising development impact through evaluation

NOTES

- (i) The fiscal year (FY) of the Government of India ends on 31 March. "FY" before a calendar year denotes the year in which the fiscal year ends, e.g., FY2015 ends on 31 March 2015.
- (ii) In this report, "\$" refers to United States dollars.
- (iii) For an explanation of rating descriptions used in Asian Development Bank evaluation reports, see Asian Development Bank. 2016. *Guidelines for the Evaluation of Public Sector Operations*. Manila.

| | |
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Abbreviations

| | |
|----------|---|
| ADB | – Asian Development Bank |
| APDRP | – Accelerated Power Development and Reform Program |
| AT&C | – aggregate technical and commercial (loss) |
| CPS | – country partnership strategy |
| DISCOM | – power distribution company |
| DISCOM-C | – Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited |
| DISCOM-E | – Madhya Pradesh Poorva Kshetra Vidyut Vitaran Company Limited |
| DISCOM-W | – Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited |
| DMF | – design and monitoring framework |
| EIRR | – economic internal rate of return |
| ERP | – enterprise resource planning |
| FCR | – facility completion report |
| FIRR | – financial internal rate of return |
| FVR | – facility validation report |
| GFA | – gross fixed assets |
| GSP | – gross state product |
| HVDS | – high-voltage distribution system |
| IED | – Independent Evaluation Department |
| IEE | – initial environmental examination |
| IPDS | – Integrated Power Development Scheme |
| IT | – information technology |
| MFF | – multitranche financing facility |
| MPERC | – Madhya Pradesh Electricity Regulatory Commission |
| MPPMCL | – Madhya Pradesh Power Management Company Limited |
| O&M | – operation and maintenance |
| PCR | – program completion report |
| PPER | – program performance evaluation report |
| PVR | – project completion report validation report |
| RRP | – report and recommendation of the President |
| SCADA | – supervisory control and data acquisition |
| TA | – technical assistance |
| TRANSCO | – Madhya Pradesh Power Transmission Company Limited |
| WACC | – weighted average cost of capital |

Weights and Measures

| | | |
|-----|---|---------------|
| GWh | – | gigawatt-hour |
| kV | – | kilovolt |
| kWh | – | kilowatt-hour |
| MW | – | megawatt |

Currency Equivalents

| | | At Approval (12 December 2006) | At Completion (26 June 2015) | At Independent Evaluation (9 September 2019) |
|--------|---|--|--|--|
| Rs1.00 | = | \$0.0226 | \$0.0157 | \$0.014 |
| \$1.00 | = | Rs44.22 | Rs63.55 | Rs71.5 |

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The report was prepared under the guidance of Marvin Taylor-Dormond, Director General, and Walter Kolkma, Director, Thematic and Country Division.

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IED retains full responsibility for this report.

Basic Data

India: Madhya Pradesh Power Sector Investment Program
(Program Number: 32298, Loans: 2323, 2324, 2346, 2347, 2520, and 2732)

Safeguard classification:

Environment B

Involuntary Resettlement C

Indigenous Peoples C

Sector Classification: Energy

Strategic Agenda: Environmentally sustainable growth

Inclusive economic growth

| Key Program Data | As per ADB Loan Documents (\$ million) | | | Actual |
|-----------------------------|--|---------------------|------------|--------|
| | Foreign Exchange Cost | Local Currency Cost | Total Cost | |
| ADB loan amount/utilization | 620.0 | 331.4 | 951.4 | 681.3 |
| Loan 2323 | 106.0 | 26.5 | 132.5 | 114.1 |
| Loan 2324 | 45.0 | 20.7 | 65.7 | 64.3 |
| Loan 2346 | 144.0 | 53.8 | 197.8 | 176.1 |
| Loan 2347 | 90.0 | 69.7 | 159.7 | 81.8 |
| Loan 2520 | 166.0 | 104.2 | 270.2 | 163.8 |
| Loan 2732 | 69.0 | 56.6 | 125.5 | 81.23 |

| Key Dates | Multitranche Financing Facility |
|----------------------|---------------------------------|
| Facility Appraisal | 12–14 Dec 2006 |
| Facility negotiation | 19–29 Feb 2007 |
| Board approval | 4 Apr 2007 |

| Key Dates | Tranche 1 / Loan 2323 | Tranche 2 / Loan 2324 | Tranche 3 / Loan 2346 | Tranche 4 / Loan 2347 | Tranche 5 / Loan 2520 | Tranche 6 / Loan 2732 |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Loan agreement | 12 Apr 2007 | 12 Apr 2007 | 23 Aug 2007 | 7 Mar 2008 | 27 May 2009 | 10 May 2011 |
| Loan effectiveness | 11 Jul 2007 | 11 Jul 2007 | 24 Dec 2007 | 11 Jun 2008 | 7 Sep 2009 | 29 Jun 2011 |
| Loan closing | 31 Jan 2013 | 15 Jul 2013 | 16 Sep 2013 | 1 May 2014 | 22 Jul 2015 | 26 Jun 2015 |

Borrower: Republic of India

Executing agencies: Madhya Pradesh Power Management Company Limited
Madhya Pradesh Power Transmission Company Limited
Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited
Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited
Madhya Pradesh Poorva Kshetra Vidyut Vitaran Company Limited

Internal Rates of Return (%)

| Item | At Appraisal | Upon Facility Completion | From PPER |
|-----------------------------------|--------------|--------------------------|-----------|
| Economic internal rate of return | 20.3 | 21.7 | 20.4 |
| Financial internal rate of return | 10.5 | 15.9 | 18.6 |

PPER = program performance evaluation report.

Missions Data

| Type of Mission | Number of Missions | Number of Person-Days |
|-----------------------------|--------------------|-----------------------|
| Facility fact-finding | 1 | 45 |
| Facility appraisal | 1 | 29 |
| Total loans administration | 70 | 701 |
| Consultation/inception | 10 | 118 |
| Loan review | 42 | 377 |
| Special loan administration | 10 | 120 |
| Midterm/completion review | 8 | 86 |

Source: Asian Development Bank.

Executive Summary

The Madhya Pradesh Power Sector Investment Program in India was a multitranche financing facility (MFF) designed to support Madhya Pradesh state's sustainable economic growth and social development by investing in the statewide power transmission and distribution networks. The MFF supported the state government in expanding its power transmission, distribution, and management infrastructure and capacity.

Overall, the evaluation assessed the facility *successful*, as it found the facility to be *relevant*, *effective*, and *highly efficient*, despite being *less than likely sustainable* due to more recent weak financial performance of the distribution companies and lack of a long-term strategy to mitigate the situation. The preliminary development impacts and the performance of both the Asian Development Bank (ADB) and the borrower were all deemed to be *satisfactory*.

The evaluation has two issues for ADB to consider: (i) a need for provision of technical assistance before MFF closure to ensure the sustainability of outcomes through risk mitigation, capacity building, and fostering behavioral changes; and (ii) a need to allocate sufficient monitoring support during long-term sector engagements to obtain consistent and accurate valuation of benefits. For follow-up, ADB should consider committing adequate resources for the economic and financial analysis during the preparation of the project completion reports for the two ongoing projects in the region and sector to better justify increased assistance for power distribution companies in developing member countries.

Background

The Asian Development Bank (ADB) provided a multitranche financing facility (MFF) of \$620 million to India for the Madhya Pradesh Power Sector. The facility was used to (i) install transmission lines and substations, and increase transformer capacity; (ii) implement new distribution substations and feeders and rehabilitate existing ones, separate agriculture and nonagricultural rural feeders (load segregation) to deliver better service to remote rural areas in Madhya Pradesh State, and upgrade agriculture feeders to a high-voltage distribution system (HVDS) to reduce losses; and (iii) mainstream the use of information technology (IT) based systems for improved management of the companies. These objectives were to be attained through six tranches implemented during 2007–2015. The MFF followed a sector development program approved by ADB in 2001 that supported the restructuring of the state power sector and formulation by the state government of the power sector road map.

Evaluation Purpose and Process

This program performance evaluation assessed the MFF for relevance, effectiveness, efficiency, and sustainability to arrive at an overall success rating. The evaluation also assessed development impacts and the performance of ADB, the borrower, and the executing agency. The assessment was based on desk reviews of relevant documents from ADB, the government, and other development partners, and on consultations and discussions with ADB staff at ADB headquarters and in the India Resident Mission. An independent evaluation mission to India undertaken in September 2019 involved consultations with the executing agencies, government officials, and project beneficiaries, along with visits to nearby power transmission and distribution sites that were upgraded and rehabilitated by the MFF.

Expected Impacts, Outcomes, and Outputs

The expected impacts of the MFF and its six tranches were (i) to achieve sustained economic growth and social development, and (ii) to meet the energy demand growth in the state of Madhya

Pradesh. The six outcomes of the MFF were (i) sustainability and commercial viability of the power sector, (ii) transmission expansion, (iii) distribution system expansion, (iv) institutional strengthening, (v) energy efficiency improvement, and (vi) increased private sector participation. These were mostly achieved through outputs aimed at improving Madhya Pradesh's infrastructure and capacity in power transmission, distribution, and management.

Assessment of Performance

Overall, the program is assessed *successful*. The performance review concluded that it had been *relevant, effective, highly efficient*, but *less than likely sustainable*.

Relevance. The MFF was designed to fit the requirements of the power sector, policy initiatives of the government, ADB's country partnership strategy, and the subprojects. The MFF would have merited a *highly relevant* rating because load segregation and HVDS were transformational. However, it did not achieve this rating partly because of the lack of a suitable intervention to eliminate commercial losses—a significant design shortcoming that continues to have a negative effect on sustainability. Although the design and monitoring framework (DMF) did not explicitly include commercial losses as a risk at the time of appraisal, it included targets for loss reduction and improvement of billing and collection. However, inadequate attention was given to the issue of commercial loss reduction during MFF implementation and a proven intervention or strategy was and is still lacking. As such, the MFF is assessed *relevant*.

Effectiveness. The physical infrastructure added under the MFF included transmission and distribution lines, transformers, substation equipment, energy meters, and enterprise resource planning data centers that spanned the entire state. The quantities indicated in the DMF at appraisal were based on engineering estimates for strengthened rural electricity services and as mentioned by the executing agencies, and as such, the quantities were adjusted during implementation to match the actual requirement in the field. Along with other programs implemented, the infrastructure needed to more than double the transmission and distribution

capacities has been put in place, and the quality of the electricity supply was within stipulated standards, supporting the claim that the output targets of the MFF have been achieved. There were shortfalls in quantities in some inputs compared with the DMF that were either implemented using alternate funding sources or offset by overachievement in other MFF inputs.

With the addition of transmission lines, transmission substations, and transformer capacity, Madhya Pradesh Power Transmission Company Limited (TRANSCO) is meeting with an adequate reserve margin the peak power demand, which normally occurs during the main cultivation season from October to February.

The MFF included investments for improvement of power supply in rural areas and reduction of commercial losses, which were key outcomes of the reform program. The three power distribution companies (DISCOMs) implemented segregation of agricultural and nonagricultural load in rural areas to improve rural electricity services by (i) ensuring uninterrupted electricity supply on the nonagricultural feeders to support productive and domestic activities; (ii) facilitating delivery of social services such as education, primary health, and entertainment; (iii) enabling household use of electrical appliances for improved quality of life; and (iv) providing a dependable power supply at the proper voltage for agricultural use (such as to power irrigation pumps and sprinklers). Improving electricity services has minimized the infrastructure inequality between urban and rural regions and may have also contributed to reducing rural–urban migration. The MFF had a minimal environmental footprint and the loss reduction that has been achieved has directly reduced the coal-based power generation needed to meet the state's power demand. The MFF achieved more than 80% of its outcomes and is assessed *effective*.

Efficiency. The subprojects included in the MFF were chosen according to the least-cost expansion plan, and all major contracts were awarded based on international competitive bidding and were completed under budget. The MFF did not incur major delays, as the last loan under the MFF was closed on 26 June 2015, almost 6 months later than the completion date of 31 December 2014 mentioned in the framework financing agreement. Quantitative analysis of economic

costs and benefits was carried out at appraisal and completion for all the six tranches, and the economic internal rate of return (EIRR) of the MFF, was estimated at 21.7% at completion compared with 20.3% at appraisal.

The program performance evaluation report (PPER) estimated the overall MFF EIRR as 20.5% by recalculating it separately for TRANSCO and the three DISCOMs and using MFF costs to assign weights. This PPER methodology is conservative; for example, it used the average electricity tariff instead of the economic value of electricity. The MFF is rated *highly efficient* as the EIRR has been repeatedly shown to be well above 18%.

Sustainability. The executing agencies' institutional capacities have improved with the implementation of the MFF and other ADB-funded projects since 2007. TRANSCO has introduced various innovations to mitigate risks from fires and climate change, while implementing preventive maintenance and routine testing regularly, and putting adequate redundancy in place to avoid delays in planned equipment shutdown.

The financial internal rate of return (FIRR) was also recalculated separately for TRANSCO and the DISCOMs; in both cases it was well above the weighted average cost of capital. The FIRR of the MFF, using the MFF cost as weights, was estimated at 18.6%.

The HVDS for irrigation load has significantly reduced the technical losses and the design of the consumer connections has made it difficult to tamper with service connections. The “ghost” consumers—those not registered with DISCOMs—were eliminated after being identified through a regular energy audit of distribution feeders where 100% metering was in place. Load segregation has been effective for ensuring 24x7 supply to nonagricultural load in rural areas and at the same time curtailing the peak demand by limiting the supply for agriculture use.

The MFF did not address tariff reforms, and agricultural users continued to receive highly subsidized electricity services without using consumer meters. Although overall metering has improved, it does not cover all distribution transformers and agriculture consumption, which prevents full feeder-level energy audits. Also,

power theft is yet to be eliminated even though the practice has been well documented over the past decades in government policies and reports.

The DISCOMs have reduced their commercial losses as compared to 2008, but the losses still exceed the government-established norm. The MFF lacked technical assistance (TA) support or a policy component to develop a commercial strategy and build institutional capacity when the need became apparent toward completion. Despite the high FIRR, the MFF is assessed *less than likely sustainable* because the (i) absence of a viable strategy to increase billing and collection rate to 100%, (ii) recent downturn in the billing rate, (iii) high commercial losses of the DISCOMs, and (iv) lack of administrative support that staff need to successfully address unmetered agriculture consumption all point to poor fiscal sustainability.

Issue, Lessons, and Follow-Up Actions

Issue for ADB. Insufficient utilization of technical assistance near the closure of the multitranche financing facility is opportunity lost for ADB to strengthen the facility's outcome sustainability. Although the MFF is designed to provide long-term support to a sector, a new risk might arise, or a known risk might become amplified during implementation that could adversely affect the program. For future MFFs, ADB should consider allocating TA resources for mitigating risks, specifically to build capacity and to foster behavioral changes. The actual need for TA and its design should be finalized toward the end of the MFF implementation cycle, when the actual program outcomes become predictable.

Lesson 1. Flexibility of the multitranche financing facility design and process contributes to greater efficiency and harmonization of funds in the sector. As the MFF was implemented concurrently with several other initiatives to improve the state's electrical distribution systems, it was essential for each successive tranche to be designed to fill gaps in the ongoing schemes and to ensure the best use of ADB loan funds. Project implementation was deemed successful thanks to the long-term partnership between the executing agencies and ADB with the use of the MFF modality. Inclusion of an additional tranche to support enterprise resource planning strengthened the executing

agencies' capacity to implement large investment projects and improve the operational efficiency of their power distribution network.

Lesson 2. When the design is appropriate, a multitranche financing facility can also bring benefits to the rural poor. The MFF enabled the transmission and distribution system to be augmented, and through initiatives taken by the government, there was increase in power consumption in rural areas with more low-income households. The actual increase in consumption in rural areas was estimated to be greater than a factor of 2.1. The power was mainly used for lighting, air-circulating fans, charging mobile phones, and powering televisions and other appliances. Expanding opportunities for improving household income have significantly improved rural households' quality of life. As the government's target of 24x7 electricity supply to all households was reached through the transmission and distribution networks strengthened by the MFF, rural communities benefited through access to better primary health care and education, and participation in decision-making.

Lesson 3. Incorporate lessons learned from earlier intervention during the implementation of the multitranche financing facility. An earlier PPER for the Madhya Pradesh Power Sector Development

Program implemented from 2002 to 2007 had highlighted the need to reduce aggregate technical and commercial losses as necessary measures for ensuring financial sustainability. The MFF evaluated failed to apply this lesson during implementation and it did not formulate a viable strategy to counteract the perverse incentives offered by local politics and traditional practices. As policy and behavioral changes are often necessary to ensure ownership and long-term sustainability of a program, both should have been retrofitted in the MFF design.

Follow-up Actions. Need to allocate sufficient monitoring support during long-term sector engagements. ADB has been engaged in the Madhya Pradesh power sector for nearly 2 decades, and it would therefore be meaningful to conduct a robust economic and financial analysis. ADB should consider committing adequate resources to engage experts for such an analysis during the preparation of the project completion reports for the two ongoing ADB-supported projects in the Madhya Pradesh power sector. Consistent and accurate valuation of benefits from all project components (including consumer surplus) could help ADB make a better case for increasing its assistance to DISCOMs in developing member countries and for the subsidies that governments provide to support social causes.

Introduction

1. In April 2007, the Asian Development Bank (ADB) approved a multitranche financing facility (MFF) to India for the Madhya Pradesh Power Sector.¹ The \$620 million MFF for the Madhya Pradesh Power Sector Investment Program was implemented to support the state's sustainable economic growth and social development by investing in the statewide power transmission and distribution networks. This chapter outlines the purpose and process of the independent evaluation and summarizes the MFF's expected impact, outcomes, and outputs.

A. Evaluation Purposes and Process

2. **Purpose.** The objective of this program performance evaluation report (PPER) is to assess the performance of the six tranche loans approved between April 2007 and December 2011 under the MFF for improving accessibility, quality, affordability, and sustainability of the electricity supply in the state of Madhya Pradesh.² The MFF and its tranches were to be completed by December 2014, but the actual date of completion was delayed because loan accounts were kept open to accommodate reimbursement of expenditures for physical works for Tranches 5 and 6, ultimately causing the MFF to close along with Tranche 5 after two extensions in July 2015. The PPER was initiated in 2019, 4 years after the closure of the MFF and 1 year after circulation of its facility completion report (FCR),³ along with the validations of the completion reports for all six tranches and the MFF.⁴ The performance ratings against the four core criteria, the three other performance assessments, and the overall assessment of the program completion report (PCR) validation reports (PVRs) concur with those of PCRs except for the following changes:

- (i) In the PVR for Tranche 1, the relevance rating was lowered from *highly relevant* to *relevant*, noting that due attention was not given to institutional aspects for implementation of the MFF.
- (ii) In the PVR for Tranches 1 and 2, the efficiency ratings were lowered to *less than efficient*, citing time overrun in implementation and lapses in the implementation of environmental and social safeguards.

¹ ADB. 2007. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to India for the Madhya Pradesh Power Sector Investment Program*. Manila.

² India has a federal structure that is a union of states. The responsibility for development is mostly vested with the subnational government of the states.

³ ADB. 2013. *Completion Report: Multitranche Financing Facility to India for Madhya Pradesh Power Sector Investment Program (Tranche 1)*. Manila; ADB. 2016. *Completion Report: Multitranche Financing Facility to India for Madhya Pradesh Power Sector Investment Program (Tranche 2)*. Manila; ADB. 2014. *Completion Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 3) in India*. Manila; ADB. 2016. *Completion Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 4) in India*. Manila; ADB. 2017. *Completion Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 5) in India*. Manila; and ADB. 2018. *Completion Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 6 and Multitranche Financing Facility) in India*. Manila (also referred to as the FCR).

⁴ ADB. 2015. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 1) in India*. Manila; ADB. 2016. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 2) in India*. Manila; ADB. 2015. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 3) in India*. Manila; ADB. 2017. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 4) in India*. Manila; ADB. 2018. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 5) in India*. Manila; and ADB. 2019. *Validation Report: Multitranche Financing Facility for Madhya Pradesh Power Sector Investment Program (Tranche 6 and Multitranche Financing Facility) in India*. Manila (referred to as the FVR).

- (iii) The PVR for Tranche 1 noted that the PCR lacked evidence of positive social impact and there were lapses in the implementation of environmental and social safeguards, so the development impact was lowered to *less than satisfactory*.
- (iv) The facility validation report (FVR) lowered the sustainability rating for Tranche 6 and the MFF from *likely sustainable* to *less than likely sustainable* because of the weak financial performance and low fiscal sustainability of the three power distribution companies (DISCOMs).

3. Furthermore, the PVR for Tranche 1 noted that the MFF investment had not contributed to a transformational impact in terms of decarbonizing as it indirectly facilitated greenhouse gas emissions. The share of thermal power generation capacity, including the state's share from central government and private sector projects, had increased from 56% in 2006 to 65% in July 2019. This PPER notes that the increase in greenhouse gas emissions was mostly attributable to the nearly 4-fold increase in total installed power generation capacity from 6,487 megawatts (MW) to 23,640 MW during the same period, which eclipsed the 95-fold increase of renewable energy capacity (waste, wind, and solar) from 51 MW to 4,824 MW. The state of Madhya Pradesh has significant wind and solar resources and is attracting considerable investments because of favorable policies and incentives announced in 2012,⁵ as evidenced by the nearly 10-fold increase in installed capacity from 490 MW in December 2012 to 4,824 MW in July 2019.⁶

4. According to the FCR, the long-term partnership between the Government of Madhya Pradesh and ADB, made possible through the MFF modality, helped modernize the electricity sector throughout the state. The road map for state-level investment and reform was established and successive projects were implemented with considerable flexibility in subproject selection based on changing priorities. The DISCOMs, established in 2002, utilized ADB support for the first time through the MFF, and the successive tranches helped them accumulate implementation experience and develop project capacity. The PVR for Tranche 5 opined that ADB needed to monitor improvements in the physical infrastructure of the power distribution system and in the financial performance of the DISCOMs, while the PCRs of early tranches suggested measures for improving procurement and implementation. The PPER aimed to verify whether the lessons learned from these findings were successfully fed back to the later tranches to increase the effectiveness and impact of the MFF as a whole.

5. **Process.** The preparation of this PPER followed the guidelines set forth by ADB's Independent Evaluation Department (IED).⁷ IED used various methods to collect and analyze data, including (i) a desk review of project documents and related materials, (ii) the preparation of the evaluation approach paper,⁸ (iii) the fielding of an independent evaluation mission to collect stakeholders' feedback and additional data,⁹ and (iv) discussions with ADB staff in the India Resident Mission and at ADB headquarters. The views of concerned departments and offices of ADB and those of the borrower and executing agencies have been considered while finalizing the PPER.

⁵ In FY2020, the DISCOMs are obliged to buy 12% of their energy from renewable energy sources under the renewable purchase obligation (Madhya Pradesh Electricity Regulatory Commission [MPERC]. 2017. *Cogeneration and Generation of Electricity from Renewable Sources of Energy*. Bhopal.) Furthermore, the Government of India has communicated in the Intended Nationally Determined Contribution toward climate change that the non-fossil-fuel-based power generation capacity would be about 40% of the aggregate capacity by 2030 with international support and technology transfer (Government of India. 2015. *India's Intended Nationally Determined Contribution: Working Towards Climate Justice*. Delhi)

⁶ Government of India, Ministry of Power, Central Electricity Authority. 2019. *Executive Summary of Power Sector*. Delhi.

⁷ ADB. 2016. *Guidelines for the Evaluation of Public Sector Operations*. Manila.

⁸ IED. 2019. *Evaluation Approach Paper: Project Performance Evaluation Report for the Multitranchise Financing Facility: Madhya Pradesh Power Sector Investment Program in India*. Manila.

⁹ The independent evaluation mission to India took place from 9 to 20 September 2019 and comprised Eungji Kim (senior evaluation specialist), Jyotirmoy Banerjee (senior project officer), Anil Terway (consultant), and Hari Krishnan Govindarajan (consultant). The mission comprised visits to the executing agency headquarters in Jabalpur, Bhopal, and Indore and nearby project sites.

B. Summary of Expected Impact, Outcome, and Outputs

6. The expected impacts of the MFF and its six tranches, as stated in the design and monitoring framework (DMF) of the report and recommendation of the President (RRP), were (i) sustained economic growth and social development in the state of Madhya Pradesh, and (ii) meeting energy demand growth in Madhya Pradesh. The MFF had the following six outcomes: (i) sustainability and commercial viability of the power sector, (ii) transmission expansion, (iii) distribution system expansion, (iv) institutional strengthening, (v) energy efficiency improvement, and (vi) increased private sector participation. Following the new guidelines for preparing the DMF, the impact should single out the long-term goal while the outcome should identify the expected result of the outputs.¹⁰ The appropriate impact for a facility of this size would have been economic growth, carbon dioxide emission reduction, and social development in Madhya Pradesh, while the outcome would have been sustainable delivery of electricity services.¹¹

7. The DMF of the RRP listed the outputs that were spread over the six tranches. These may be broadly reclassified into the following three types:

- (i) **Power transmission outputs—Tranches 1 and 3:** (a) new 220 kilovolt (kV) and 132 kV transmission lines; (b) additional 400/220 kV, 220/132kV, 220/33 kV and 132/33 kV transformer capacity and bays at new and existing substations; and (c) capacitor banks, associated control and protection equipment, testing instruments, and transformer oil filtration plants.
- (ii) **Power distribution outputs—Tranches 2, 4, 5, and 6:** (a) segregation of rural feeders between agriculture and nonagricultural consumers; (b) a high-voltage distribution system (HVDS) for agriculture feeders; (c) 33 kV and 11 kV network augmentation (including substations); (d) capacitor banks; (e) a supervisory control and data acquisition (SCADA) system; and (f) energy meters for substation, distribution transformer, and consumers, including automated meter reading devices.
- (iii) **Power management and sustainability outputs—Tranche 6:** (a) enterprise resource planning (ERP) software, data centers, and communication; (b) computers, copiers, and printers; (c) geographic information system updated consumer data; (d) modernized business management and management information system for power trade; (e) energy audit of distribution feeders; (f) energy conservation fund; (g) pilot private sector participation in distribution; and (h) financial sustainability of the power sector.

¹⁰ ADB. 2019. *Guidelines for Preparing A Design and Monitoring Framework*. Manila.

¹¹ Similar concise impact and outcome are mentioned in the subsequent MFF (ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility and Technical Assistance Grant to India for the Madhya Pradesh Energy Efficiency Improvement Investment Program*. Manila.)

CHAPTER 2

Design and Implementation

A. Rationale

8. With an area of 308,000 square kilometers, Madhya Pradesh is the second-largest state in India. Its population was 72.6 million in the 2011 census and provincial gross domestic product in FY2015 at FY2012 prices was Rs3,841 billion (\$54 billion).¹² During the early 2000s, the state faced formidable challenges in supplying the energy needed to spur poverty reduction and economic development. According to the 2001 census, 15% of villages (7,985 of 52,066) were unelectrified and more than 3 million households (38% of the total) lacked access to electricity.¹³

9. The Madhya Pradesh Power Sector Reform Act, 2000 became effective in July 2001 and sought to restructure the power sector to make it efficient, economic, and competitive.¹⁴ The Madhya Pradesh Electricity Regulatory Commission (MPERC), constituted a few years earlier, was brought under the state act and subsequently under the Indian Electricity Act, 2003.¹⁵ ADB supported the reforms with the approval of the Madhya Pradesh Power Sector Development Program in December 2001. The program included the following areas of support:¹⁶

- (i) **Unbundling of the state electricity board.** ADB supported the unbundling of the vertically integrated electricity board into five companies: the Madhya Pradesh Power Generating Company Limited to manage the power projects owned by the Government of Madhya Pradesh; the Madhya Pradesh Power Transmission Company Limited (TRANSCO) to manage the high-voltage transmission system;¹⁷ and three DISCOMs responsible of servicing customers in eastern, central, and western zones of the state.¹⁸
- (ii) **Creation of a power holding company.** ADB supported the creation in June 2006 of Madhya Pradesh Power Management Company Limited (MPPMCL). MPPMCL's main role was to buy power from Madhya Pradesh Power Generating Company Limited, central sector generation companies, independent power producers, and renewable energy generators on behalf of the DISCOMs. Power would be purchased under long-term power purchase agreements, while spot prices are determined every 15 minutes based on competitive bids for settlements arising from supply deviations. MPPMCL would also trade generation capacity excess and shortage with neighboring states.
- (iii) **Other power sector investments.** Support for other power investments in the state included (a) 33 kV and 11 kV distribution networks in the seven districts of Madhya Pradesh Poorva Kshetra Vidyut Vitaran Company Limited (DISCOM-E), (b) a pilot program in two districts for HVDS to prevent illegal tapping of supply on agriculture feeders, and (c) augmentation of 220 kV and 132 kV transmission lines and substations.

¹² Government of Madhya Pradesh. 2018. *Estimate of State Domestic Product Madhya Pradesh 2011-12 – 2017-18*. Bhopal.

¹³ Government of Madhya Pradesh. 2009. *Status of Rural Electrification in Madhya Pradesh*. Bhopal.

¹⁴ Ministry of Law and Justice, Government of Madhya Pradesh. 2001. *Madhya Pradesh Power Sector Reform Act 2000*. Bhopal.

¹⁵ Ministry of law and Justice, Government of India. 2003. *The Electricity Act*. New Delhi.

¹⁶ ADB. 2001. *Report and Recommendation of the President to the Board of Directors: Proposed Loans to India for the Madhya Pradesh Power Sector Development Program*. Manila.

¹⁷ In India, the Power Grid Corporation of India Limited, a central public sector unit, owns and operates the extra-high-voltage transmission grid (400 kV and higher). The states initially operated the 220 kV and 132 kV transmission systems within their respective geographical areas, and now, with increasing power flows, they are also implementing 400 kV transmission lines.

¹⁸ The names of the DISCOMs are Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited (DISCOM-E), Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited (DISCOM-C), and Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited (DISCOM-W).

10. Despite the reforms brought about through the Madhya Pradesh Power Sector Development Program, it was apparent that the investment had not matched increasing demand and the transmission capacity had become inadequate, as evidenced by a peak power demand deficit in excess of 20% and an energy deficit of about 13% in 2006. The power distribution system was perilously stretched and did not provide reliable supply, as decades-old networks and equipment caused high technical losses, numerous and prolonged power outages, low voltage, and an increasing delay in connecting new consumers—which was exacerbated by extensive power theft through illegal connections and poor metering.¹⁹ The power supply situation in rural regions raised serious concerns as the state's population was growing rapidly, increasing by 12.2 million between 2001 and 2011, and farmers relied increasingly on irrigation aided by the proliferation of polluting and expensive diesel-powered generators and irrigation pumps to ensure productivity.²⁰

11. To overcome the existing challenges, the government developed a road map and linked it with a comprehensive investment program for the sustainable growth of the power sector in Madhya Pradesh. The road map aimed to (i) strengthen power supply capacity for improving access to reliable and affordable electricity, (ii) enhance the efficiency and quality of the power supply, and (iii) ensure the financial health of the power sector through continued reform at the sector and corporate levels. The required investment was estimated at \$5.3 billion during 2007–2012, including \$2.3 billion (43%) for power generation; \$1.4 billion (26%) for transmission; and \$1.6 billion (30%) for distribution, including rural electrification. The investment also included \$40 million for a comprehensive capacity building program to meet the sector's increasing management capacity requirements.

12. The MFF modality was used to support the power sector investment program because (i) it supported the government's long-term investments identified in the sector road map, (ii) the performance of earlier tranches guided the provision of subsequent tranche loans, and (iii) it provided the executing agencies with flexibility to include subprojects based on changing priorities and different level of readiness. The executing agencies were commercial companies that had inherited the staff and management of the Madhya Pradesh State Electricity Board, which had functioned as the vertically integrated utility since 1956. Earlier implementation of the program component of the Madhya Pradesh Power Sector Development Program (footnote 16) had demonstrated the government's capacity to formulate and execute sector policy and had identified constraints in ERP. Initially, the MFF was to include five tranches prepared over 5 years and implemented over 8 years, but a sixth tranche was added in 2010 to carry out additional works in DISCOM-C and to implement ERP systems in DISCOM-E, DISCOM-W, and MPPMCL. The MFF was implemented concurrently with several other initiatives to improve the state's electrical distribution systems.²¹ To ensure the best use of the ADB loan funds, each successive tranche was specifically designed to fill gaps in the various ongoing schemes.²²

B. Time, Cost, Financing, and Executing Arrangements

13. The planned duration of implementation of the tranches under the MFF was about 8 years, from 20 February 2007 to 30 June 2015; and the periodic financing requests for individual tranches had to be submitted before 31 December 2010. The key dates of the implementation schedule for all the tranches are in Appendix 1. The final tranche was approved by the agreed date (21 December 2010). The loan agreement for Tranche 4, which had the longest implementation delay, was signed 6.6 months after loan

¹⁹ Distribution losses amounted to 40%–45% in many areas. Footnote 1, p. 4.

²⁰ Crops had the largest share (29% in FY2015) in gross value addition. In a good year, such as FY2017, the growth in gross value addition of crops was as high as 31%. Footnote 12, p. 49.

²¹ The MFF was followed by the approval of a second MFF in 2011 (footnote 11) and a project loan in 2013 (ADB. 2013. *Report and Recommendation of the President to the Board of Directors on Proposed Loan to India for the Madhya Pradesh Power Transmission and Distribution Improvement Project*. Manila.)

²² These initiatives included four national government programs: the Rajeev Gandhi Scheme for Electrification of Villages, the Deen Dayal Upadhyaya Jyoti Gram Yojna program for electrification of villages, the Restructured Accelerated Power Development Reform Program, and the ADB-supported Feeder Separation Program, as well as lower-level programs being implemented by each DISCOM, partly self-funded and partly financed by REC Limited and the Power Finance Corporation Ltd.

approval; other loan agreements were usually signed more quickly.²³ The actual closing date of the loan for the MFF's last tranche was 22 July 2015, or a delay of less than 1 month. The closing dates of all tranches had to be extended, the duration of the delay varied from 12 months to 28 months, or by 24% to 53%, and an average of 39%. The FCR gave the following reasons for the implementation delays:

- (i) The design–build basis of contract packages required the selected contractor to carry out design optimization before ordering equipment, which delayed the delivery by up to 18 months.
- (ii) Several contracts were cancelled because of poor performance when a single contractor was selected for several packages but was stretched for resources. In such cases, the DISCOM had to complete the works using its own resources, which avoided any implementation quality issues and usually lowered the cost.

14. The power sector investment program and indicative financing plan at appraisal was for \$5.3 billion, which included \$2.3 billion for power generation that was to be invested by independent power producers and the central government for projects with an earmarked share of Madhya Pradesh. Another \$40 million was allocated for capacity building that was mainly supported by the Department for International Development of the United Kingdom. The \$3.0 billion investment in transmission and distribution was to be financed by ADB's MFF; grants from the central government for promoting energy efficiency, renewable energy, and rural power supply; and loans from domestic nonbank financial companies, such as REC Limited (formerly Rural Electrification Corporation Limited) and Power Finance Corporation Limited. The aggregate cost of the six tranches implemented under the MFF was \$950.0 million and the actual cost was \$708.7 million.²⁴ The MFF was approved for \$620.0 million, which was the estimated foreign exchange component of the program cost; the actual disbursement under the six tranche loans was \$543.5 million (88% of the aggregate loan amount). Table 1 provides the breakdown of program cost at preparation of the tranches and actual cost at completion. Table 2 provides the breakup of six loan amounts, and the allocation and final disbursement among the five executing agencies.

Table 1: Estimated versus Actual Program Cost at Completion
(\$ million)

| Item | | Tranche 1 / 2323 | Tranche 2 / 2324 | Tranche 3 / 2346 | Tranche 4 / 2347 | Tranche 5 / 2520 | Tranche 6 / 2732 | Facility Total |
|---------------------------|-----|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------|
| Transmission | Est | 100.20 | | 155.00 | | | | 255.20 |
| | Act | 114.05 | | 176.10 | | | | 290.15 |
| Distribution ^a | Est | | 53.70 | | 126.80 | 212.60 | 115.40 | 508.50 |
| | Act | | 64.30 | | 81.77 | 163.76 | 81.23 | 391.06 |
| Consulting Service | Est | 7.30 | | 7.90 | | | | 15.20 |
| | Act | 0.00 | | 0.00 | | | | 0.00 |
| Contingency | Est | 15.60 | 8.10 | 23.00 | 17.00 | 29.60 | 8.60 | 101.90 |
| | Act | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Financial Charges | Est | 9.40 | 3.90 | 11.90 | 15.90 | 26.60 | 1.50 | 69.20 |
| | Act | 5.43 | 2.50 | 7.41 | 3.57 | 6.18 | 2.44 | 27.53 |
| ADB Total | Est | 132.50 | 65.70 | 197.80 | 159.70 | 270.20 | 125.50 | 950.00 |
| | Act | 119.48 | 66.80 | 183.51 | 85.34 | 169.94 | 83.67 | 708.74 |

Act = actual cost, ADB = Asian Development Bank, Est = estimated cost.

^a Includes three distribution companies and the Madhya Pradesh Power Management Company Limited.

Source: Project completion reports.

²³ A period of 1 year is allowed for signing loan agreement for an ADB loan. However, the period is expected to be much lower when MFF modality is used because of the closer coordination and advanced project preparedness.

²⁴ The actual project cost in the PCR did not include financial charges as the Government of Madhya Pradesh paid the interest during construction. The PPER has included the financial charges in the project cost for comparison with the appraisal estimate and because the regulator allowed the financial cost to be capitalized.

Table 2: Allocated Funds in Financing Plan versus Actual Disbursement by Executing Agencies
(\$ million)

| Executing Agency | | Tranche 1 / 2323 | Tranche 2 / 2324 | Tranche 3 / 2346 | Tranche 4 / 2347 | Tranche 5 / 2520 | Tranche 6 / 2732 | Total per Executing Agency |
|------------------|------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------------------|
| MPPMCL | All | | | | | | 1.85 | 1.85 |
| | Dis | | | | | | 3.28 | 3.28 |
| TRANSCO | All | 106.00 | | 144.00 | | | | 250.00 |
| | Dis | 97.27 | | 141.91 | | | | 239.18 |
| DISCOM-C | All | | | | 20.00 | 50.00 | 59.00 | 129.00 |
| | Dis | | | | 17.11 | 49.85 | 43.49 | 110.45 |
| DISCOM-E | All | | 45.00 | | 20.00 | 63.00 | 4.00 | 132.00 |
| | Dis | | 40.75 | | 14.78 | 49.30 | 3.88 | 108.71 |
| DISCOM-W | All | | | | 50.00 | 53.00 | 4.15 | 107.15 |
| | Dis | | | | 42.27 | 34.86 | 4.71 | 81.84 |
| ADB Total | All | 106.00 | 45.00 | 144.00 | 90.00 | 166.00 | 69.00 | 620.00 |
| | Dis | 97.27 | 40.75 | 141.91 | 74.16 | 134.01 | 55.36 | 543.46 |

ADB = Asian Development Bank, All = allocation, Dis = disbursement, DISCOM-C = Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited, DISCOM-E = Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited, DISCOM-W = Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited, MPPMCL = Madhya Pradesh Power Management Company Limited, TRANSCO = Madhya Pradesh Power Transmission Company Limited.

Source: Project completion reports.

15. The FCR listed several reasons for the loan savings, including (i) competitive bids with goods and services sourced from India, (ii) exemption from payment of excise duty, (iii) design optimization, (iv) devaluation of the Indian rupee over the 8-year implementation period, and (v) DISCOMs' use of other sources of funding for completing works of some cancelled contracts.

C. Procurement, Construction, and Scheduling

16. The procurement under the MFF was carried out using international competitive bidding. In general, these were turnkey contracts that included supply of equipment and material, installation, and adjustment to match the actual conditions at the site. Payment was linked to work progress and completion of the specific item. The five executing agencies awarded a total of 245 contracts, which reflected the distributed nature of works implemented under the MFF.²⁵ Goods procured for the tranches conformed to specifications and met operational standards. The executing agencies engaged third party consultants to inspect goods at the manufacturers' premises, which ensured quality. Substation transformers, transmission lines, and distribution feeders were erected according to agreed schedule. According to the FCR, 18 contracts were terminated because of delay in mobilizing the works. In these cases, ADB's approval was obtained to rebid the packages, upon which the contracts were awarded to the successful bidder and the works were subsequently completed. All contracts have been duly closed, but according to the DISCOMs, as of September 2019 three contractors whose contracts were cancelled were seeking arbitration.

17. The executing agencies used internal resources to engage external consultants for design, implementation supervision, and safeguards monitoring and reporting. The executing agencies also engaged experts for quality assurance during implementation of the project components, where required.

²⁵ DISCOM-C and DISCOM-E each awarded 35 contracts, DISCOM-W awarded 55, MPPMCL awarded 1, and TRANSCO awarded 120.

D. Safeguard Arrangements and Gender Action Plan

18. **Environment.** An environment assessment and review framework was prepared before the MFF was approved in accordance with ADB's environment policy.²⁶ Tranches 1 and 2, which were prepared along with the MFF, and all subsequent tranches were classified category B for environment. The initial environmental examination (IEE) report, including the environment management and monitoring plan, was disclosed with the RRP for the MFF, while the IEE reports for subsequent tranches were prepared and disclosed with the submission of periodic financing requests. The IEE reports considered that the potential for adverse environmental impact from the tranches was low, such impacts were site specific and reversible, and most mitigation measures could be readily designed. The key observations from IEE reports were as follows:

- (i) The distribution feeders were located along roads and existing rights-of-way.
- (ii) The new substations were constructed on unoccupied government land earmarked for the purpose, while existing substations were upgraded.
- (iii) The transmission lines entailed minor encroachment on forested areas and the required approval was obtained, resulting in minimal environmental impact that mostly involved clearing of overgrowth along the existing right-of-way.
- (iv) Contractors were required to take suitable mitigation measures during construction. For example, for temporary road closure, this involved stringing conductors over agricultural land between crop cycles during the dry season.
- (v) The construction of two transmission substations required the acquisition of privately held unoccupied barren land, which was done according to local government procedures.

19. Although the requirements of the environmental assessment and review framework and IEEs were met, there were delays in reporting on environmental aspects during the initial stage of MFF implementation, as TRANSCO and the DISCOMs were unfamiliar with ADB requirements. After the executing agencies engaged independent environmental consultants in 2011,²⁷ monitoring improved significantly and reports were submitted, ensuring that semiannual and annual environment reports were disclosed on ADB's website. The FCR received no complaints from the public regarding environment aspects of the MFF.

20. **Involuntary resettlement.** The transmission components (Tranches 1 and 3) of the MFF were classified category B for involuntary resettlement and indigenous peoples' impacts under ADB's policies at the time of appraisal.²⁸ TRANSCO prepared short resettlement plans for three substations (two under Tranche 1 and one under Tranche 3) that required the acquisition of private land. The land was mostly barren and unproductive, and compensation was paid through the revenue officials according to the applicable law and procedure. Compensation was also paid for temporary losses linked to transmission line construction and use of land for transmission towers. The PCRs noted that the resettlement plans were implemented as planned, and that the indigenous peoples were not affected significantly or disadvantaged by the tranches. As such, there were no stakeholders complaints in relation to Tranches 1 and 3. The distribution components (Tranches 2, 4, 5, and 6) were classified category C for involuntary resettlement and indigenous peoples' impacts. Works were carried out within existing ROWs and on land owned or controlled by the DISCOMs. In a few cases, land was acquired for the installation of new distribution transformers in rural areas. Barren, nonagricultural land was selected, and compensation was paid in accordance with prevailing laws. PCRs stated that there was no impact on indigenous peoples and no grievances or complaints were submitted by people affected by these tranches.

²⁶ ADB. 2002. *Environment Policy of the Asian Development Bank*. Manila. This policy was superseded in 2009 by the Safeguard Policy Statement (ADB. 2009. *Safeguard Policy Statement*. Manila).

²⁷ TRANSCO engaged Xavier Institute of Development Action and Studies, Jabalpur, and another individual consultant to monitor the implementation of resettlement plans.

²⁸ ADB. 1995. *Policy on Involuntary Resettlement*. Manila; and ADB. 1998. *Policy on Indigenous Peoples*. Manila.

21. **Gender.** The MFF did not include a gender action plan. Although no technical assistance (TA) was included in the MFF, a TA subproject that was part of a cluster TA funded by the Department for International Development of the United Kingdom focused on gender inclusivity and was implemented in parallel with the MFF.²⁹ The TA completion report mentioned that the MFF was successful in building capacity for implementing infrastructure projects in selected states. According to the project data sheet, of the \$600,000 approved for the TA subproject for Madhya Pradesh, \$287,418 was utilized. The outputs included training 1,514 meter readers, 579 of them women, and an overseas study tour for a group of state power sector officials from 20 to 24 August 2012. The subsequent MFF, approved in 2011 (footnote 11), was categorized *effective gender mainstreaming* and included an output to build the capacity of women's self-help groups. Box 1 summarizes the results.

Box 1: India Gender Equality Results Case Study

The multitranche financing facility for the Madhya Pradesh Energy Efficiency Improvement Investment Program included capacity development technical assistance of \$1 million for enhancing the business opportunities available to female microentrepreneurs because of the availability of a 24-hour supply of electricity in rural areas. It was implemented from October 2011 to June 2017 and the case study report of the gender-related impact of enhanced power supply and capacity development was published in February 2018.

The report describes how the technical assistance project imparted integrated enterprise module training, followed by gender and energy, skills development, and business development services for select women, to 20,729 women members of 2,803 self-help groups. The impact was assessed using quasi-experimental research design in which the treatment group (households whose women attended training) and control group (those who did not receive training) were compared. The report highlighted the following impacts: (i) an increase in the income of women entrepreneurs from low-income households, (ii) an increase in number of earning women, (iii) an increase in the propensity of women to save, (iv) a decrease in the time women spent on household chores, (v) a reduction in women's time poverty and drudgery and an increase in men's willingness to share household chores, and (vi) an increase in women's participation in household decision-making.

Source: ADB. 2018. *India Gender Equality Results Case Study: Enhancing Energy-Based Livelihoods for Women Micro-Entrepreneurs*. Manila.

E. Design Changes

22. It was envisaged that the construction and installation works under the MFF would be implemented at locations spread across the state of Madhya Pradesh. The components (substations, transmission and distribution lines, distribution transformers, and meters) were identified in line with the priority of achieving the outcomes of the MFF and designed according to applicable technical standards. While discrete components were added using available loan savings, the design basis for improving the power supply and reducing losses remained unchanged for all the tranches. The design basis was also consistent with the requirements of the second MFF and project loan to TRANSCO and the DISCOMs and was used in its implementation (footnotes 11 and 21).

F. Grant Covenants, Monitoring, and Reporting Requirements

23. The project loans under the MFF included an average of 31 loan covenants covering project implementation, financial and sector reforms, commercial operations, human resources, safeguards, performance, and monitoring. These covenants remained unchanged during implementation. TRANSCO and the DISCOMs complied with all but two financial covenants (a debt-service coverage ratio

²⁹ ADB. 2009. *Cluster Technical Assistance to India for Advanced Project Preparedness for Poverty Reduction*. Manila. (Subproject 23); and ADB. 2012. *Gender Inclusive Capacity Development for Electricity Distribution Loss Reduction in Rural Madhya Pradesh*. Manila.

of 1.2 and a self-financing ratio of 20%),³⁰ and DISCOM-C reported a bill collection efficiency of 92.6%, which was lower than the target of 95% for the MFF. It should be noted that the bill collection efficiency had markedly improved to effectively 100% by 2019.

24. The MFF financing framework was used to appraise periodic financing requests for tranches and the design and monitoring frameworks (DMFs) of the tranches were used to monitor project implementation progress. The India Resident Mission was responsible for MFF administration from 2008. The executing agencies had the required experience of project administration so there was no need for a project implementation consultant. ADB conducted midterm reviews for the six tranches. The executing agencies submitted most implementation progress reports, commitment and disbursement projections, and audited financial reports on time. ADB fielded 70 mission during the 8-year period, spending a total of 701 person-days on implementation supervision.

³⁰ The debt-service coverage ratio is the cash flow from operations divided by annual debt service obligations (interest and principal). The self-financing ratio is the cash flow from operations divided by average capital expenditure (over a 3-year period).

Performance Assessment

25. This chapter assesses the MFF's performance based on four core evaluation criteria: (i) its relevance to the government's development strategy and its alignment with ADB corporate priorities, and the adequacy of its design; (ii) its effectiveness in achieving intended outcomes; (iii) its efficiency in utilizing resources; and (iv) the sustainability of the improvements made in the power transmission and distribution assets in Madhya Pradesh. These core evaluation criteria are weighted equally to establish the overall assessment of the MFF, in accordance with IED's guidelines (footnote 7). A summary of ratings in the PCRs and PVRs of the tranches is in Appendix 2.

A. Relevance

26. The FCR and the FVR rated the MFF *relevant*. The MFF was fully aligned with the ongoing reform of the Madhya Pradesh power sector, as demonstrated by the Government of India's Integrated Energy Policy, which sought, with respect to the power transmission and distribution, (i) reduction in technical and commercial losses through upgraded infrastructure, metering, and accountability; (ii) segregation of agricultural consumption for targeted subsidies; (iii) continued reforms to enable private sector participation and competition where possible; (iv) improved energy efficiency and demand side management for lower energy intensity; (v) greater use of renewable energy resources; and (vi) electrification of all households and the provision of 30 kilowatt-hours (kWh) per month of electricity as a basic need.³¹ The MFF was relevant to these policy objectives.

27. The FCR and its validation noted that the MFF was aligned with ADB's country strategy and program for India, 2003–2006 and subsequent updates.³² ADB's country partnership strategy (CPS) for India, 2018–2022 recognized and supported the government's priority of revitalizing the power sector by providing inclusive power infrastructure and a stable power supply to all households.³³ Key impediments to sustained inclusive growth include power distribution as the weakest link in the power sector. Distribution companies have been unable to collect enough revenue to cover rising costs and their energy auditing is weak, making it difficult to operate commercially. The CPS lists three strategic priority pillars, including inclusive provision of infrastructure networks and services. It is clear that the MFF remains relevant to ADB's operations in India.

28. The most recent government figures show that the power sector in Madhya Pradesh has expanded (Table 3) and its technical performance had reached a reasonable level by 2019. In FY2007, the shortfall in peak demand was 20.8% and the energy supply deficit was 15.2%. ADB assistance of \$1.37 billion (approved between 2007 and 2013) and other investments under Government of India schemes have effectively eliminated power shortages. The government and the executing agency informed the independent evaluation mission that ADB's support for transmission and distribution capacity expansion anchored the power sector's complete investment program. The significance of ADB's

³¹ Government of India, Planning Commission of India. 2006. *Integrated Energy Policy, Report of the Expert Committee*. New Delhi.

³² ADB. 2003. *Country Strategy and Program, 2003–2006*. Manila.

³³ ADB. 2017. *Country Partnership Strategy for India: 2018–2022—Accelerating Inclusive Economic Transformation*. Manila; and Inclusive and Sustainable Growth Assessment (accessible from the list of linked documents in Appendix 3 of the CPS) pp. 9–10.

support is borne out by the fact that the MFF constituted 44% of TRANSCO's gross fixed assets in FY2014 and 15.2% of those of the three DISCOMs in FY2016.

Table 3: Growth of Power Sector in Madhya Pradesh

| Power Sector Indicators | FY2007 | FY2019 |
|---|-----------|--------|
| Available power generation capacity (MW) ^a | 6,487 | 23,334 |
| Peak demand met (MW) | 6,109 | 14,089 |
| Energy supplied (annual) (GWh) | 32,824 | 75,665 |
| Aggregate technical and commercial loss (%) | 42.4 | 29.1 |
| Number of consumers (million) | about 8.0 | 15.6 |

FY = fiscal year, MW = megawatt, GWh = gigawatt-hour.

^a includes state's share in central sector power stations and projects implemented by independent power producers.

Sources: Government of India, Ministry of Power, Central Electricity Authority. 2019. *Executive Summary on Power Sector* (Mar 2019). Delhi; Power Finance Corporation of India. 2013. *The Report on Performance of State Power Utilities for the Years 2009-2010 to 2011-12*. Delhi; Madhya Pradesh Power Transmission Company Limited. 2019. *Management Information System Report January–March 2019*. Jabalpur; and Ministry of Power. 2019. *State Health Card - Madhya Pradesh*. Delhi.

29. There is clear evidence that the MFF was designed to fit the requirements of the power sector, the government's policy initiatives, ADB's CPS, and the subprojects. Power supply security, reliability, and quality meet the standards set by the regulator as well as consumers' expectations.³⁴ Load segregation and the high-voltage distribution system (HVDS) had been piloted earlier and were rolled out across the state under the MFF and the subsequent MFF. These approaches had transformational effects for the provision of a 24x7 supply of good quality electricity services in rural areas. The MFF would have merited a *highly relevant* rating had it not been for a major design shortcoming that continues to have a negative effect on sustainability—the lack of intervention to reduce commercial losses. Although the DMF did not explicitly include commercial losses as a risk at the time of appraisal, it included targets for loss reduction (as required by the Madhya Pradesh Electricity Regulatory Commission [MPERC]) and improvement of billing and collection (90%, for DISCOM-C, 96% for DISCOM-E, and 94% for DISCOM-W). However, too little attention was given to the issue of commercial loss reduction during MFF implementation and a suitable intervention or strategy was and is still lacking (para. 58). As such, the PPER views this absence of an appropriate solution or options for addressing commercial losses as a lack of operationalization of this objective during implementation, reducing the potential transformational impact, and rates the MFF *relevant*, despite the impressive output in terms of power infrastructure.

B. Effectiveness

30. The investment program included financing by ADB, contributions by the Government of India through ongoing schemes for efficiency improvement and universal electrification, and loans from domestic financial institutions and banks. Therefore, the improvement in performance indicators from the baseline values (FY2007) is not attributed only to ADB-funded components. The achievements against the six outcomes identified in the MFF DMF are as follows.³⁵

- (i) **Sustainable and commercially operated power sector companies: Partially achieved (33%).** The transmission and distribution infrastructure have sufficient capacity and reserve margin to meet the present level of peak power demand and energy supply. However, the tariff set by MPERC for recovering revenue is based on a distribution loss of 19.92% (for FY2020). As the actual losses are about 10 percentage points higher, the difference will not be passed on to consumers and the DISCOMs will remain financially

³⁴ Madhya Pradesh Electricity Regulatory Commission (MPERC). 2012. *Distribution Performance Standards (Revision II) Regulations*. Bhopal (in Hindi). The standards include acceptable limits (and penalties to be paid for deviations) for technical parameters (voltage and harmonics) and service quality (time taken for fault rectifications).

³⁵ The achievements are as of FY 2019, while the DMF includes baseline and targets for only a few outcome indicators.

unsustainable.³⁶ Despite the high actual loss, DISCOM-W showed the potential for commercial sustainability, as it was given a B+ rating, indicating “moderate operational and financial performance capability” by a credit rating agency in the annual review of the performance of DISCOMs in India.³⁷

- (ii) **Transmission expansion, improvement in operational efficiency, voltage profile, and power delivery capacity of Madhya Pradesh: Achieved.** In FY2019, the system peak demand of 14,089 MW (up from 6,109 MW in FY2007) was met with little stress at grid substations and transmission lines. System availability was greater than 99.5% during January to March 2019 (compared with 95.0% in 2007). Transmission losses were reduced to 2.7% in FY2019 (from 5.2% in 2007),³⁸ and the supplied voltage and frequency remained within statutory limits.³⁹
- (iii) **Distribution enhancement—reduction in system losses and improved supply quality and reliability: Partially achieved (50%).** Aggregate technical and commercial (AT&C) losses remain high at 29% despite the target of reducing losses to 19% by 2012. Box 2 provides a brief explanation of AT&C losses and the main reasons for commercial losses. Despite the high AT&C losses, the three DISCOMs are meeting or exceeding the standards set by regulators for the time taken to rectify supply interruptions, replace distribution transformers, rectify faulty meters, add new connections and fulfill related applications, as well as standards for feeder reliability.⁴⁰
- (iv) **Capacity of sector institutions strengthened: Achieved.** The Energy Department of the Government of Madhya Pradesh has shown the capacity to continue its own power sector reforms. The MPERC has demonstrated the capacity to consider tariff petitions, and conduct consultation and issue orders. The executing agencies have trained and skilled staff, and where necessary, have engaged contract staff for specific tasks, while their financial management has improved through the use of the ERP system. Madhya Pradesh Power Management Company Limited (MPPMCL) manages power purchases efficiently and aggressively trades surplus generation capacity with neighboring states.
- (v) **Improved energy efficiency: Achieved.** Madhya Pradesh Urja Vikas Nigam Limited has been established as the special designated authority for promoting energy efficiency in the state. Its key roles include (a) assisting in the implementation of energy conservation schemes promoted by Bureau of Energy Efficiency, Ministry of Power; (b) conducting workshops, capacity building, empanelment of energy auditors, awareness raising programs; and (c) supporting labeling. The Bureau of Energy Efficiency schemes include design of demand side measures in buildings, agriculture pumps, municipal energy use, and offering partial guarantee for loans taken for energy efficiency projects.
- (vi) **Increased private sector participation: Achieved.** The state of Madhya Pradesh has attracted private sector investment in power generation, the DISCOMs have piloted leasing of billing and collection functions, and contract staff are being deployed by TRANSCO and DISCOMs for routine tasks. Infrastructure created by the MFF helped evacuate power from the private sector power generation projects, and as a result, the power generation capacity owned by the private sector had reached 10,454 MW by 30 April 2019, including 4,180 MW of mostly wind and solar projects. The most notable investment was in Rewa Ultra Mega Solar Limited. Supported by the World Bank, this

³⁶ Technical loss in a distribution system is low when 11 kV feeders are long and 0.4 kV lines that connect the consumers are short. Under Ujwal DISCOM Assurance Yojana (Appendix 3), the DISCOMs agreed to loss reduction and were given concessional funds to augment the system. Having made the required network investments, there is little justification for passing the billing inefficiency to consumers.

³⁷ Government of India, Ministry of Power. 2018. *State Distribution Utilities Sixth Annual Integrated Rating*. New Delhi.

³⁸ The loss reduction translates to additional annual supply, at zero power purchase cost, of 1,945 GWh (FY2019); valued at Rs3.64/kWh, the benefit was Rs7.1 billion (\$99 million).

³⁹ MPPMCL. 2019. *Salient Power Statistics (2017–2018 to 2018–2019)*. Jabalpur; and MPPTCL. 2019. *Management Information System Report January – March 2019*. Jabalpur.

⁴⁰ MPERC. 2018. *Achievement of Distribution Performance Standards FY2018*. Bhopal (in Hindi).

project involved 750 MW of photovoltaic solar capacity implemented by three companies based on competitive bidding, and tariffs of less than Rs3/kWh (\$0.042/kWh).

Box 2: Aggregate Technical and Commercial Losses

The technical loss in a transmission and distribution system is mainly the result of three internal properties: (i) transformer loss, which has two components: (a) fixed iron loss, which is the energy used for creating the magnetic field needed to step down the voltage, and (b) copper loss, which is proportionate to the square of the current carried by the transformer winding; (ii) loss along the conductors and cables to overcome the resistance, which is also proportional to the square of the current; and (iii) dielectric loss, which is the leakage across the insulating material used for safety, including the air between a bare conductor and the earth. The current varies continuously in an operating distribution system so technical losses cannot be measured directly. The indirect method for measuring losses is by determining the difference between the energy entering the distribution system (input gigawatt-hour [GWh]) and the sum of all energy sold to consumers as measured by the energy meters installed (sold GWh). The loss is generally expressed as a percentage of input GWh.

Distribution companies in India report the aggregate technical and commercial (AT&C) losses as a measure of efficiency. To monitor its losses, Madhya Pradesh Power Transmission Company Limited has installed energy meters at all interface points with its suppliers, trading partners, and power distribution companies. Based on these meters, the company's transmission losses were 2.71% in 2019. However, for the power distribution companies, the lack of 100% consumer metering coverage prevents even the indirect measurement of technical losses in the distribution systems. Only the AT&C losses can be measured on the following basis:

$$\text{AT\&C Losses} = (\text{Energy Input} - \text{Energy Realized}) / \text{Energy Input}$$

$$\text{where Energy Realized} = \text{Energy Billed} \times \text{Collection Efficiency}$$

$$\text{Collection Efficiency} = \text{Amount Realized} / \text{Amount Billed}$$

Commercial losses, or a shortfall in revenue recovery, arise from

- (i) errors in assessed energy consumption when meters are faulty or supply to consumers is unmetered;
- (ii) recording of lower or higher consumption because of meter error;
- (iii) inaccurate meter reading, either wilfully by staff or through genuine mistake;
- (iv) delayed payment by consumers or a higher revenue when arrears get liquidated;
- (v) delayed payment by public service entities supported by government budget, e.g., defence, police, hospitals, educational institutions, government offices, and streetlights;
- (vi) delayed transfer of subsidy linked to social schemes; and
- (vii) theft, when electricity supply is not routed through a meter, e.g., when a person taps power supply using a hook to connect to a bare conductor of the distribution network.

Source: Independent Evaluation Department.

31. The Government of Madhya Pradesh achieved a major milestone in June 2019 by providing all 12.6 million households in the state with electricity services. The Government of India announced the drive for universal household electricity connections on December 2014 through the Deendayal Upadhyaya Gram Jyoti Yojana initiative for households below the poverty line, and this was echoed in October 2017 through the Pradhan Mantri Sahaj Bijili Har Ghar Yojana (Saubhagya) initiative. A summary of all schemes for promoting electricity use is in Appendix 3.

32. With the addition of transmission lines, transmission substations, and transformer capacity, TRANSCO was able to meet the peak power demand, which normally occurs during the main cultivation season from October to February. While the n-1 design criterion had ensured security of supply,⁴¹ the substation voltage and frequency generally remained within the allowable limit (during the first quarter 2019, undervoltage of 9.1% was reported at only 7 (2.6%) of the 271 33 kV substations).⁴² TRANSCO

⁴¹ N-1 means that the system is planned such that, with all transmission facilities in service, the system is in a secure state, and for any one credible contingency event, the system moves to a satisfactory state (a common definition, quoted from the website of the Electricity Authority of New Zealand).

⁴² The allowable limits of voltage drift at substations are +5%/–10% for 400 kV; +10%/–10% for 220 kV and 132 kV, and +6%/–9% for 33 kV. The internal target for frequency drift is +1%/–2% and the statutory acceptable range is +3%/–3%. The frequency

installed and commissioned the SCADA center in Jabalpur in 2017 for smooth grid operations that are separate from the load dispatch function.⁴³ The center continuously monitors and analyses the metering data from all the 621 bus bars (junctions for power flow) across the state, allowing it to monitor all the power flowing in and out of the bus bars in real time. It enables the grid to (i) address power demand hot spots in real time by remotely disconnecting feeders when the frequency starts dropping, (ii) observe power demand trends for more accurate demand forecasts, and (iii) plan transmission capacity augmentation. TRANSCO claims to be the first transmission company in India to have installed SCADA, and the system has resulted in improved performance outcomes for TRANSCO, leading other domestic transmission agencies to benchmark and implement similar systems. The full potential of the system will be available after a dedicated and secure communication link is established between the central control room and all remote telemetering units, as it will then be able to be used to automatically switch grid components on a real-time basis. The DISCOMs are also installing suitable SCADA systems for monitoring the power flow in real time; however, they can only be utilized meaningfully after 100% metering has been achieved.

33. The MFF included investments to improve the power supply in rural areas and reduce commercial losses, which were key outcomes of the reform program. The three DISCOMs implemented segregation of agricultural and nonagricultural load in rural areas to improve rural electricity services by (i) ensuring uninterrupted electricity supply on the nonagricultural feeders to support productive domestic activities; (ii) facilitating delivery of social services such as education, primary health, and entertainment; (iii) enabling household use of electric appliances for improved quality of life; and (iv) providing a dependable power supply at the proper voltage for agricultural use (to power equipment such as irrigation pumps and sprinklers). Improving electricity services has minimized the infrastructure inequality between urban and rural regions and may also have contributed to reducing rural–urban migration.

34. With load segregation in Madhya Pradesh, the supply for agriculture feeders was restricted to 10 hours a day, scheduled to coincide with periods when power demand from other consumer categories was low. Together with widespread use of LED lighting, the peak demand on the high-voltage grid was observed to be during the morning, whereas it used to be during the evening hours. Diversifying the demand period has lowered the generation capacity addition needed to meet peak power demand. The agriculture feeders have also been converted to HVDS, as the following approaches were widely adopted in the eastern region where agriculture demand is relatively higher: (i) the higher voltage of the rural feeder and reduction in the length of 0.4 kV distribution lines directly reduced technical losses, (ii) the existing three-wire 0.4 kV conductors were used for 11 kV operation by upgrading insulators and brackets mounted on poles,⁴⁴ and (iii) 11/0.4 kV distribution transformers were installed close to the consumers' premises and rated to meet the demand of just five irrigation pumps with a sufficient margin.⁴⁵ The HVDS scheme effectively brought the consumer-end voltage within prescribed limit and improved irrigation efficiency, allowing the farmers to count on having an assured supply of power during the irrigation season, fewer motor burnouts, and a significant increase in the reach of water sprinklers as the pumps could now be powered to rotate at their top-rated speed.

35. The ERP system, provided in Tranche 6, significantly contributed to improving the executing agencies' management of human resources, inventory, financial accounting, and the projects overall. DISCOM-E has gone beyond ADB's scope of support and integrated customer relationship management into its ERP, allowing greater awareness of customers' needs and reducing delays in following up customers' complaints. The newest IT additions observed in DISCOM-E include (i) implementation of business intelligence and data analysis software (Microsoft PowerBI) to help visualize data from ERP for

is controlled by power generators by continuously matching demand and power generation; the voltage drift reflects the transmission design.

⁴³ The equipment was not funded by ADB.

⁴⁴ Stepping up the voltage by a factor of 27.5 lowers the current in the conductor by the same factor. This reduces power loss in the feeder conductor by a factor of 756 because it is the product of square of the current and conductor resistance.

⁴⁵ The 11/0.4 kV transformer capacity is 25 kVA and pumps are generally rated at 5 horsepower. As 1 horsepower = 746 watts, or a 5-horsepower pump consumes 3.7 kW, the transformer would operate at about 87% capacity.

better monitoring and decision-making, (ii) real-time monitoring and response to online customer satisfaction surveys, and (iii) the deployment of smartphone-based applications with global positioning system information to ensure that meters are read in person and on-site by meter agents. Similarly, DISCOM-W, based on the experience and IT development expertise gained during the implementation and rollout of the ERP, developed in-house with minimal external support (i) a new bill-generation system to serve its 420,000 urban consumers, (ii) a consumer relations management portal ("Urjas"), and (iii) a webmail system for its 10,000 employees and more than 20,000 retirees. In addition, MPPMCL integrated an additional module to its ERP—an Integrated Automatic Business Solutions (IABS) for power purchase and market participation for surplus capacity. The IABS now allows MPPMCL to efficiently trade power through submission of more aggressive bids for power trades with neighboring states, maximizing the additional revenue from the export of the state's surplus capacity.

36. The physical infrastructure added under the MFF included transmission and distribution lines, transformers, substation equipment, energy meters, and ERP data centers that span the entire state. The quantities indicated at appraisal in the DMF were engineering estimates of the electrification needed to strengthen rural electricity services and included estimated quantities for the executing agencies. The FCR (footnote 3) had tabulated the achievement for the different items, although the quantities implemented differed in many cases to match the actual requirement in the field, with the actual quantities commonly exceeding the original target. In general, the needed infrastructure for more than doubling the transmission and distribution capacity has been put in place and the quality of electricity supply provided was found to be within stipulated standards, supporting the claim that the output targets have been achieved.⁴⁶ However, some significant shortfalls in quantities are noted in Table 4 (based on the FCR), while in terms of project inputs, it is assessed that the shortfall would have been more than offset by the overachievement in other MFF items. In most cases, the estimated quantities at appraisal were based on general engineering practices and had to be scaled down based on the results of the site surveys undertaken by the contractors during detailed design of rural distribution feeders. Some equipment packages were moved to other loans for ease of implementation and to avoid further delay in the closure of the MFF.

Table 4: Facility Items with Shortfall in Actual Quantity

| Facility Items | Target | Actual | Explanation in FCR for shortfall |
|-------------------------|---------|---------|--|
| DISCOM-C | | | |
| High-tension lines (km) | 13,100 | 4,926 | High estimate |
| DTRs (units) | 54,000 | 13,573 | High estimate |
| Energy meters (units) | 318,000 | 0 | Installed under other projects to take advantage of bulk procurement |
| DTR meters (units) | 23,200 | 0 | Implemented under another project |
| High-tension lines (km) | 2,800 | 0 | Implemented under another project |
| Substations (units) | 21 | 0 | Implemented under another project |
| DISCOM-E | | | |
| Energy meters (units) | 750,000 | 439,559 | Balance installed under other projects to take advantage of bulk procurement |
| DISCOM-W | | | |
| High-tension lines (km) | 3,900 | 1,108 | High estimate |
| Rural feeders | | | |
| High-tension lines (km) | 5,100 | 0 | Implemented under government facility |
| DTRs (units) | 2,000 | 0 | Implemented under government facility |
| DTR meters (units) | 23,000 | 12,026 | High estimate |

DISCOM-C = Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited, DISCOM-E = Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited, DISCOM-W = Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited, DTR = distribution transformers, FCR = facility completion report, km = kilometer.

Source: Facility completion report.

⁴⁶ The feedback from the DISCOMs is that the required infrastructure was in place for good quality power supply in urban and nearly all rural areas.

37. The MFF also included four nonphysical outputs that can be summarized as follows:
- (i) **Development of management information system for power trade function: Implemented.** MPPMCL is using an advanced IT-based system to aggressively trade surplus generation capacity with neighboring states.
 - (ii) **Establishment of energy conservation fund: Partially implemented.** Madhya Pradesh Urja Vikas Nigam Limited, a special designated authority, has been promoting energy conservation activities, but it is unclear whether a specific energy conservation fund was established by the Government of Madhya Pradesh.⁴⁷
 - (iii) **Private sector participation in distribution: Partially implemented.** The Government of Madhya Pradesh noted that a pilot franchising scheme had been implemented in certain areas, and that it plans to expand the scheme to other high-loss areas to improve billing and collection.
 - (iv) **Financial sustainability of the power sector: Partially Implemented.** The DMF identified the following indicators and targets: (a) cash management function has been transferred to the DISCOMs, (b) the boards of the companies are functioning, (c) directors have been appointed, and (d) MPERC has issued a multiyear tariff for transmission charges. However, the orders for distribution tariffs have been issued annually together with true-ups (*ex post facto* adjustments) for legitimate shortfall of revenue during the previous year, loss reduction targets agreed with MPERC have not been achieved, and the billing targets have not been met. The collection target has been achieved and independent private auditors are performing audits of the annual financial statements and business processes.

38. As the environmental footprint of the tranches was relatively small, the environmental management plans, comprising mitigation measures to be taken during construction, were implemented effectively. The MFF did not require resettlement and private land was procured only for two new substations in compliance with government procedures. No complaints were received from the public regarding environment, social, and resettlement aspects and no safety issues were reported during implementation.

39. The MFF was rated *effective* in the FCR and the same rating was given for five of the six tranches. Tranche 4 was rated *less than effective* because some works identified in the periodic financing request had been removed from the project scope when DISCOM-E cancelled two large contracts and substituted them with other works. The PVR for the project agreed with the *less than effective* rating and added that the DISCOMs had not achieved two key financial management outcomes—the debt-service coverage ratio and the self-financing ratio.⁴⁸ Despite these shortcomings, this PPER rates the MFF *effective*, as more than 80% of its outcomes had been achieved by the time of evaluation,⁴⁹ albeit with certain delays compared with the DMF target dates.

C. Efficiency

40. The subprojects included in the MFF were chosen according to the least-cost expansion plan. All major contracts were awarded based on international competitive bidding and were completed under budget. The MFF did not incur major delays, as the last loan under the MFF was closed on 26 June 2015 against 31 December 2014 mentioned in the framework financing agreement. Quantitative analysis of

⁴⁷ ADB approved a TA project in October 2008 to help the energy conservation fund become financially stable. However, the TA was closed without making any disbursement. ADB. 2008. *Facilitating the Operations of the Energy Conservation Fund “Energy Smart” in Madhya Pradesh (Financed by the Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas)*. Manila. According to information provided by ADB’s South Asia Department, the TA was cancelled at the request of the Government of Madhya Pradesh because of a delay in establishing the coordinating department.

⁴⁸ The PVR was disclosed in July 2017, more than 2 years after the last project loan was closed, so the feedback could not have influenced MFF implementation.

⁴⁹ According to the guidelines, 80% achievement is generally assessed *satisfactory* (footnote 7).

economic costs and benefits was carried out at appraisal and completion for all six tranches, and the economic internal rate of return (EIRR) of the MFF, based on the FCR, was estimated at 21.7% compared with 20.3% at appraisal. Table 5 provides a comparison of the economic capital cost and EIRR for the six tranches and the weighted EIRR for the MFF.

Table 5: Economic Internal Rate of Return for Madhya Pradesh Power Sector Investment Program

| Entity | Tranche Number | Economic Capital Cost (Rs million) | | | Economic Internal Rate of Return (%) | | |
|----------------------------------|----------------|------------------------------------|-----------------------|-----------------------|--------------------------------------|-------------------|---------------------|
| | | As Appraised (2015 base) | Actual (2015 base) | Actual (2019 base) | As Appraised | PCR Re-evaluation | PPER Re-calculation |
| TRANSCO | 1 | 5,537.0 | 5,355.5 | | 14.9 | 20.6 | |
| | 3 | 7,674.0 | 6,832.1 | | 14.9 | 19.3 | |
| Total for TRANSCO | | 13,211.0 | 12,187.6 | 24,380.0 | 14.9 | 19.9 | 19.9 |
| MPPMCL ^a | 2 | 2,812.0 | 2,963.1 | | 14.7 | 18.5 | |
| | 4 | 4,812.8 | 5,193.1 | | 15.9 | 21.5 | |
| | 5 | 11,658.0 | 9,958.3 | | 27.2 | 25.3 | |
| | 6 | 4,643.0 | 3,791.0 | | 30.4 | 22.0 | |
| Total for MPPMCL | | 23,925.8 | 21,905.5 | 33,496.0 | 24.1 | 22.9 | 20.7 |
| Total for MFF^b | | | | | 20.3 | 21.7 | 20.4 |

MFF = multitranchise financing facility, MPPMCL = Madhya Pradesh Power Management Company Limited, PCR = project completion report, PPER = program performance evaluation report, TRANSCO = Madhya Pradesh Power Transmission Company Limited.

^a MPPMCL is the holding company for the three power distribution companies. The PPER determined the combined cost-benefit ratio of four loans.

^b The PCR determined the weighted average; the PPER first determined the combined cost-benefit ratio for each of the two entities and then calculated the weighted average.

Source: Asian Development Bank estimates and project completion reports.

41. In the PCRs, the reevaluated EIRRs for all six tranches were found to exceed 12% and were rated *efficient*. For the reevaluation, the project costs were updated and adjusted for actual economic cost, while the benefit was assessed conservatively in general. The reevaluation of the DISCOM projects included the following benefit streams:

- (i) **Incremental output.** This results from loss reduction during the initial period of continued power shortage, additional network capacity created, and improved reliability. It was difficult to determine the incremental output attributable to the project as several other projects were also being implemented. Therefore, the reevaluation used updated load flow data and the results of the HVDS study that the DISCOMs had provided at appraisal, and the loss reduction was kept at FY2014 level although the output increased annually, which was a conservative approach. Fault statistics were used to estimate the additional output resulting from improved reliability. The incremental output was valued conservatively at the weighted average end-use consumer tariff, while the consumer surplus was ignored because of the difficulty of estimation.
- (ii) **Non-incremental output.** This was largely from the reduction in technical losses in the network (capped at the value for FY2015). The PCR for project 5 mentions that the loss reduction was estimated at 717 gigawatt-hours (GWh), or only 1.9% of the energy sent to the three DISCOMs' network. This loss reduction was valued at the weighted average variable cost of coal-based power plants, as obtained from the tariff order issued by MPERC. Non-incremental output also included the switching by nondomestic consumers from self-generation to grid supply because of increased capacity and improved reliability of the network. It was also valued at the variable cost of coal-based power plants, which is a conservative simplification.

42. Similarly, the reevaluation of the transmission project, (Tranche 1 of the MFF) also estimated the benefits from incremental and non-incremental outputs. The non-incremental output resulted from a 1.2% reduction in transmission loss, or the difference between the target and actual level of losses in FY2012. By FY2019, the loss reduction was 2.7%, or 2.4 percentage points below the FY2006 level. It was valued at the power purchase cost given in MPERC's transmission tariff order. The incremental output

considered the increase in sale of electricity to the DISCOMs and apportioned a part to the project based on project capital cost and total investment by TRANSCO. It was valued using electricity elasticity to gross domestic product (0.95) as estimated by the Planning Commission of India. Again, the value was apportioned to TRANSCO and the DISCOMs.

43. While the PCRs rated all the tranches *efficient*, PCR validations rated Tranches 1 and 2 *less than efficient*. The reevaluation for project 1 (transmission) lacked clarity and consistency in the determination of actual economic capital cost,⁵⁰ as the operation and maintenance (O&M) cost was based on an assumption instead of actual costs, while there were problems identifying, quantifying, and valuing the benefits. Furthermore, project completion was delayed by 1 year. The efficiency rating for Tranche 1 was changed because of the shortcomings of the reevaluation and the implementation delay. According to the PVR, the reevaluation of Tranche 2 (distribution) was partially appropriate, as it agreed with the benefit stream because of the reduction in power purchases by DISCOM-E on account of lower technical losses, but the incremental benefit resulting from capacity addition and reliability improvement (tabulated as about 25% of the non-incremental benefit) was considered high as the project had not added new customers. Based on the concern that the reevaluated EIRR was overestimated, the PVR lowered the rating for Tranche 2 to *less than efficient*.

44. The validation report for subsequent tranches agreed with the PCR ratings. There were issues with the methodologies for determining economic capital cost and estimating benefits, but the EIRR of the individual tranches was expected to be higher than 12%. The validation also questioned the calculation of a weighted EIRR for the whole MFF using capital cost as weights, as a better alternative would have been to estimate all the benefits of the MFF (including benefits that had been ignored in the individual reevaluation) in estimating the overall EIRR for the MFF.

45. The PPER agrees with the PVRs regarding the quality of the economic analysis in the PCRs, and that the economic analysis did not sufficiently capture the benefits of the MFF. The PPER recognizes the difficulty in defining the boundary for individual projects that are part of a large network, especially considering that the investment in one location would change load flows in other sections, including locations without any ADB investment. However, even though the FCR includes a table listing 14 benefits from 8 different types of subproject included in the MFF and 23 valuation parameters, the economic analysis in the PCRs only included approximate measures of less than one-third of the parameters. The benefit stream for loss reduction was estimated based on what could be quantified but considering the increase in electricity sales from 32,824 GWh (FY2006) to 75,665 GWh (FY2019) and about 7 million newly connected households, the incremental benefit could have been greatly underestimated.

46. A rough estimate shows that the amount of program output that remained unbilled, but was being put to productive use, had nearly doubled between 2006 and 2019 as a result of network capacity expansion (Table 6). The level of losses was reported to be 42% in 2006. This can reasonably be assumed to comprise technical loss of 12% and commercial loss (such as power theft) of 30%. By 2019, the losses had dropped to 34%, comprising a technical loss of 8% and commercial loss of 26%.⁵¹ The unmeasured output, therefore, increased from 9,847 GWh to 19,928 GWh. A significant part of this would be for optimal economic benefit, such as more efficient irrigation and increased agriculture productivity, more industrial goods manufactured and sold, and consumption by large new commercial buildings (malls, office buildings, and hotels). Estimation of consumer surplus—even a rough one—would have better captured the benefit of the MFF.⁵²

⁵⁰ The PCR for Tranche 3, the other transmission project, did not include an appendix to explain the economic analysis.

⁵¹ Loss is the difference between the energy sent to DISCOMs and that billed by DISCOMs, unlike the AT&C losses that also take into account collection efficiency. The value suggested in the estimation may be considered as a benchmark for technical losses. In FY2017, the AT&C losses were 9% (i.e., minimal commercial loss) for Uttar Gujarat Vij Company Limited, one of the six DISCOMs graded A+ by rating agency (footnote 37).

⁵² The economic analysis for the similar 2013 project (footnote 21) includes consumer surplus, which is estimated to be about 56% of the net economic benefit.

Table 6: Unbilled Electricity that Contributed to State Economy

| Financial Year | Energy Sent to DISCOMs (GWh) | Energy Billed by DISCOMs (GWh) | Total Loss (GWh) | (%) | Technical Loss (GWh) | (%) | Commercial Loss (GWh) | (%) |
|----------------|------------------------------|--------------------------------|------------------|-----|----------------------|-----|-----------------------|-----|
| 2006 | 32,824 | 19,038 | 13,786 | 42 | 3,939 | 12 | 9,847 | 30 |
| 2019 | 76,347 | 50,311 | 26,036 | 34 | 6,108 | 8 | 19,928 | 26 |

DISCOMs = distribution companies, GWh = gigawatt-hour.

Sources: Madhya Pradesh Power Management Company Limited. 2019. *Salient Power Statistics (2017-18 to 2018-19)*. Jabalpur; and staff assumptions on the breakup of technical and commercial losses.

47. The PPER separately recalculated the EIRR of TRANSCO and MPPMCL (or the aggregate of the three DISCOMs) to better reflect the difference in risks. Both entities were subject to cost-recovery tariffs but TRANSCO's revenue came from only three DISCOMs based on transmission capacity, whereas the DISCOMs were required to recover costs from more than 15 million consumers based on forecasted energy consumption. To overcome the main issues noted in the FVR, the analysis used actual performance data and information in MPERC's tariff orders. Costs and benefits were updated to 2019 using the domestic cost index. Attribution was not an issue for TRANSCO as the MFF was the only investment during FY2007–FY2013. For MPPMCL, the ratio of MFF capital cost and gross fixed assets (GFA), as recognized by MPERC, was used to attribute benefits.

48. TRANSCO's O&M cost, instead of a percentage of capital cost, was based on the length of transmission lines and number of bays added under the MFF, which is also the basis for tariff determination. The non-incremental benefit was from improvement in transmission loss by 2% between FY2007 and FY2014 and valued at the average power purchase cost given that wholesale electricity prices are market based, and so could be considered a proxy for the economic cost of power. The incremental sale in FY2014 was considered the full benefit of the MFF. It was valued at the most competitive rate for solar power generation, which would be the viable alternative if the transmission grid were not to be expanded. Knowing that 64% of the electricity was sourced from coal-based power projects, the cost of carbon emission was included by valuing it at \$80 per ton. The EIRR for TRANSCO was recalculated as 19.9%.

49. The DISCOMs implemented the MFF from FY2008 to FY2014. Its benefits started accruing in FY2009 and were fully realized in FY2015. The O&M cost was based on the tariff orders, which indicates that it varied between 17% and 25% of the GFA over the years. The power purchase cost, as pass-through in tariff, was included in the economic cost. Three benefits attributed to the MFF were included: (i) the reduction in technical loss, in GWh terms, valued at the average variable cost of high-cost thermal power, which would have been scheduled for generation if the MFF had not been implemented and the losses had not been reduced; (ii) the increase in electricity sales valued at the average cost of supply in the tariff for FY2020, which is considered a conservative proxy for the economic value; and (iii) consumer surplus attributed to the electricity consumed without payment, or the commercial loss; it was also valued at the average cost of supply for FY2020. The EIRR for MPPMCL, or the three DISCOMs, was recalculated as 20.7%.

50. The overall MFF EIRR was estimated at 20.4%, using MFF costs for assigning weights. This PPER deems this PPER methodology to be a conservative estimate as it relied on prices instead of the economic value of electricity, such as using the average supply cost instead of willingness to pay for various consumer categories. A more accurate approach would only have been possible if additional sets of reliable data had been available during the evaluation period. The MFF is rated *highly efficient* as the recalculated EIRR has been repeatedly shown to exceed 18% (Table 5).

D. Sustainability

51. The institutional capacity of TRANSCO, MPPMCL, and the three DISCOMs has improved with the implementation of the MFF and other ADB-funded projects since 2012. For example, these entities have mainstreamed the ADB procurement procedures used in the MFF. ERP supports day-to-day tasks and

decision-making, while significantly strengthening inventory control, project implementation, human resources, and accounting. MPERC regularly considers petitions for tariff revisions and issues tariff orders and orders for true-up. The state government continues to support the sector financially through subsidies and funding for social programs.

52. TRANSCO's O&M structure is effective. One of the innovations TRANSCO introduced was a modern firefighting system that uses nitrogen enveloping, which had been installed to address the risks of transformer fire. To mitigate climate risk, the state is divided into five wind zones and the transmission towers are designed for the highest wind speed for each zone.⁵³ Preventive maintenance and routine testing are carried out on schedule, while adequate redundancy helps avoid delays in planned equipment shutdown.

53. The HVDS for irrigation load has significantly reduced the technical losses, and the design of consumer connections has made it difficult to tamper with service connections. The 0.4 kV distribution box, switches, and energy meters are mounted on the poles below the distribution transformers and aerial bundled cables used for service connections. "Ghost" consumers (those not registered with DISCOMs) were eliminated after being identified through regular energy audits of distribution feeders. Load segregation has ensured 24x7 supply of nonagricultural load in rural areas and at the same time curtailed the peak demand by limiting the supply for agriculture use. Switched capacitor banks have been installed at different network locations to ensure proper voltage at the far ends of the distribution feeders. Metering has significantly improved. All large consumers (greater than 10 kW demand) have energy meters that are read remotely. Smart meters, which can be read and disconnected remotely and have import-export capability, have been installed in urban areas that are prone to power theft to improve billing and collection, and there are plans to expand the use of smart energy meters to other areas.

54. The PCR rated the MFF *likely sustainable* based on the reevaluation of the financial internal rate of return (FIRR), which was found to be 15.9% (on a weighted average basis) compared with 10.5% at appraisal and exceeded the reevaluated weighted average cost of capital (WACC) of 2.0%. The PCR also noted the continued accounting losses recorded by the DISCOMs and the failure to achieve the covenanted debt-service coverage and self-financing ratios.⁵⁴ In 2019, the DISCOMs were still unable to reduce transmission and distribution losses to the level set by MPERC, so operating income remained much lower than operating expenses.

55. The financial analysis was based on actual capital cost and normative O&M cost, and benefit from (i) incremental revenue from capital investment allowed by MPERC in the tariff orders; and (ii) allowable incremental revenue because of reduction of distribution losses (for every rupee underrecovered, Rs0.33 can be included in the tariff for the subsequent year). Table 7 compares the reevaluated capital cost and the FIRR with that at appraisal for the six tranches and the overall facility. The reevaluation was carried out separately for TRANSCO and the three DISCOMs.

Table 7: Financial Internal Rate of Return for Madhya Pradesh Power Sector Investment Program

| Entity | Tranche Number | Financial Capital Cost | | At Appraisal | | PPER FIRR - reevaluated (%) |
|--------------------------|----------------|----------------------------|----------------------------|--------------|-------------|-----------------------------|
| | | Actual - 2015 (Rs million) | Actual - 2019 (Rs million) | FIRR % | PCR FIRR % | |
| TRANSCO | 1 | 5,202.00 | | 4.8 | 5.3 | |
| | 3 | 7,011.90 | | 4.7 | 15.8 | |
| Total for TRANSCO | | 12,213.90 | 13,379.36 | 4.7 | 11.3 | 12.3 |
| MPPMCL ^a | 2 | 3,438.00 | | 8.3 | 14.8 | |
| | 4 | 5,410.00 | | 10.9 | 6.7 | |
| | 5 | 10,236.00 | | 14.0 | 25.3 | |

⁵³ In 2018, several 220 kV transmission line towers came down during a storm, which was unprecedented. The damage may have been caused by severe weather conditions brought about by climate change.

⁵⁴ Loan agreements signed for subsequent loans to the Madhya Pradesh power sector—Loan 2764 in 2011, Loan 2830 in 2012 (footnote 11), and Loan 3066 in 2014 (footnote 21)—included a financial covenant only for debt-service coverage ratio.

| Entity | Tranche Number | Financial Capital Cost | | At Appraisal FIRR % | PCR FIRR % | PPER FIRR - reevaluated (%) |
|-----------------------------------|----------------|----------------------------|----------------------------|---------------------|--------------|-----------------------------|
| | | Actual - 2015 (Rs million) | Actual - 2019 (Rs million) | | | |
| | 6 | 4,606.00 | | 37.4 | 22.0 | |
| MPPMCL Total | | 23,690.00 | 24,118.74 | 17.0 | 15.9 | 22.1 |
| Facility Total^b | | | | 12.84 | 16.32 | 18.6 |

FIRR = financial internal rate of return, MPPMCL = Madhya Pradesh Power Management Company Limited, PCR = project completion report, PPER = program performance evaluation report, Rs = rupees, TRANSCO = Madhya Pradesh Power Transmission Company Limited.

^a As MPPMCL is the holding company for the three power distribution companies, the PPER determined the combined the cost-benefit ratio of four loans.

^b The PCR determined the weighted average, the PPER determined the combined cost-benefit ratio of two loans.

Source: Asian Development Bank estimates and PCRs.

56. The PVRs of Tranches 1 to 5 agreed with the *likely sustainable* rating considering the reducing trend of losses and robust FIRR. The validation reports pointed out certain issues with the financial analysis, such as the (i) capital cost being independent of the debt-equity ratio; (ii) use of terminal value (although it had a small impact on the FIRR); (iii) lack of supporting detail for improving the DISCOMs' financial health; (iv) noncompliance with ADB methodology as revenue was estimated at the sum of depreciation, interest payment, and return on equity; (v) double-counting of revenue from loss reduction; (vi) use of normative O&M cost instead of actual; and (vii) ignoring of some costs.⁵⁵ The FVR (Tranche 6 and the MFF) recognized the favorable FIRR but highlighted the fact that the DISCOMs continue to be unprofitable and have negative debt-service coverage ratio, resulting in a *less than likely sustainable* rating. The PPER separately recalculated the FIRR for TRANSCO and MPPMCL. The costs were updated to 2019 using the domestic price index and the benefits were attributed to the MFF based on the share of investment in the GFA recognized by MPERC.

57. TRANSCO's project cost was derived from the annual disbursement of the two loans, the average foreign exchange rate for the year, and estimated 20% disbursement toward local costs. The transmission tariff is expressed as rupees per MW per year so linked to the total transmission capacity as recognized by MPERC (6,011 MW in FY2007 to 12,317 MW in FY2014). The increase in capacity attributed to the MFF was based on the ratio of the cumulative MFF investment and the GFA (44%) in FY2014, or when the full benefit of the installations became available. The transmission tariff was taken from the annual tariff orders of MPERC. The PPER recalculated the FIRR for TRANSCO as 12.3%, and the WACC was estimated at 2.3%. MPPMCL's project cost was derived from the tables used in the FCR. In addition to the O&M cost, the power purchase cost had to also be considered as it formed part of the revenue. The full benefit of the MFF investments came in FY2016 and its share in GFA was 15.2%. This ratio was used to estimate the facilities share in the annual sale revenue that was provided for the DISCOMs in annual tariff orders. The PPER recalculated the FIRR for MPPMCL as 22.1% and the WACC was estimated at 7.3%. It is likely that the FIRR was about 5 percent points lower because of the high commercial losses. If the DISCOMs pursue strict measures to limit the AT&C losses in 2 years to the target of 15% set by the government and gradually eliminate all commercial loss by 2030, the FIRR is estimated to increase to 24.3%. The weighted FIRR for the MFF was estimated at 18.6%.

58. This PPER recognizes that the improvement in operational performance of the DISCOMs (consequent to ADB support and other investments) has the potential to make the MFF *likely sustainable*. The methodology used in the PCRs is similar to that used during appraisal, which avoids the difficulty in estimating revenue that is directly linked to project investment. It estimates revenue based on estimated tariff for the capital invested and increased electricity sales (in GWh) based on allowable transmission and distribution losses. This approach may well approximate the tariff, but it overlooks the reality that the DISCOMs are unable to bill the consumers or book subsidy for all the electricity consumed by customers. Continued under-recovery of sales revenue is still a matter of concern, and as such, the DISCOMs need to eliminate the commercial losses as the MFF sustainability requires billing and collection

⁵⁵ Different PVRs cited these issues.

to be near 100%. However, neither the executing agencies nor the state government were able to produce a systematic approach or an overall strategy to reduce or eliminate the commercial losses, as the MFF lacked TA support or a policy component to develop a commercial strategy and build institutional capacity when the need became apparent.

59. DISCOMs made significant commercial improvements, increasing billing for the energy received from TRANSCO from 58.0% in 2006 to 72.4% in FY2015.⁵⁶ Then the focus shifted to 100% electrification, and about 7 million new households, mostly from rural areas, were connected to the distribution network. This took the attention away from improving billing, which further deteriorated because of government policy supporting rural economy by provision of unmetered power supply for agriculture and a heavily subsidized flat tariff for small domestic consumers. As a result, the billing rate dropped to 66.0% in FY2019. This downturn in the billing rate should be seen as a symptom of inconsistent sector policy, as the MFF had not provided for the establishment of a consistent, overarching policy or strategy guiding the power sector beyond the MFF implementation cycle.

60. Along with the sector strategy, the MFF did not address tariff reforms, and this has resulted in agricultural users continuing to receive highly subsidized electricity services without using consumer meters. Energy conservation is underemphasized in agriculture because of the government's large power subsidy; there is also a risk of overuse of ground water. The lack of metered consumption also weakened the feeder-level energy audit and imposed a higher surveillance cost to ensure that farmers draw only the allotted amount of energy. Furthermore, another pro-rural government policy allowed farmers to get temporary connections during the irrigation season to help increase production, which opened a window of opportunity for ghost consumers who tapped into the distribution network illegally. Despite improvements in overall metering by the DISCOMs, they could not cover all distribution transformers and agriculture consumption, thus they failed to perform full feeder-level energy audits. Also, power theft was not addressed by the MFF, even though it has been well-documented over the past decades in government policies and reports.

61. Based on the tariff order for FY2020,⁵⁷ the employee cost of the three DISCOMs was Rs40,476 million (\$566 million), which was 11.0% of the assessed annual revenue requirement of Rs366,711 million (\$5,129 million) and 23.6% of the GFA of Rs171,613 million (\$2,400 million) as of 1 April 2019. This performance index was compared with a DISCOM from the neighboring state of North Gujarat, Uttar Gujarat Vij Company Limited, that was graded A+. The tariff order mentions the approved employee cost as Rs6,089 million (\$85 million), which was 4.9% of the annual revenue requirement of Rs123,428 (\$1,726 million) and 8.7% of the gross fixed asset of Rs69,686 million (\$975 million) in 1 April 2019.⁵⁸ Other details, such as the expenditure on outsourced services or whether the assets had been recently revalued, are not available but the wide difference in the share of employees cost indicates a need to monitor employee productivity, which is important for controlling the DISCOMs' operating expenses. The PPER notes that the high employee cost is not driven by low staff capacity alone, but may also be attributable to a difference in labor markets or regulations that make it nearly impossible to reassign staff or reduce redundant positions.

62. Despite the high FIRR, the PPER assesses the MFF to be *less than likely sustainable* because of the following symptoms that point to poor fiscal, policy, and institutional sustainability: (i) the absence of a viable strategy to increase the billing and collection rate to 100%, (ii) the recent downturn in the billing rate, (iii) the high commercial losses of the DISCOMs, and (iv) a lack of administrative support that staff need to successfully address unmetered agriculture consumption. The higher financial risk is also borne out by the low grade given by the credit rating agency in the annual review of the performance of

⁵⁶ MPPMCL. 2018. *Salient Power Statistics 2011-12 to 2017-18*. Jabalpur. MPPMCL. 2019. *Salient Power Statistics (2017-18 to 2018-19)*. Jabalpur.

⁵⁷ MPERC. 2019. *Aggregate Revenue Requirement and Retail Supply Tariff Order FY2019-20*. Bhopal.

⁵⁸ Gujarat Electricity Regulatory Commission. 2019. *Tariff Order, Truing up for FY2017-18, Mid-Term Review of ARR for FY2019-20 to 2020-21 and Determination of Tariff for FY2019-20 for Uttar Gujarat Vij Company Limited*. Gandhinagar.

DISCOMs in India. DISCOM-C and DISCOM-E are graded C+, indicating “low operational and financial performance capability,” while DISCOM-W is graded B+, “moderate operational and financial performance capability.”⁵⁹

⁵⁹ Footnote 37, p. 10.

Other Assessments

63. This chapter discusses assessments of the MFF's development impact and the performance of ADB, the Government of Madhya Pradesh, and the five executing agencies to provide additional depth to the evaluation.

A. Development Impacts

64. In the FCR, two indicators were identified in the DMF for development impacts: the gross state product (GSP) growth rate and the energy deficit reduction. The improved power infrastructure correlated well with the state GSP growth rate of 7.9% (2012 prices) from FY2012 to FY2018 (footnote 12), which was well above the target of 6.0% growth mentioned in the DMF at appraisal. This was corroborated by the rise in per capita income, which was estimated at Rs79,907 (\$1,117 at purchasing power parity terms and current prices) in FY2018 and had grown at an annual rate of 13.0% at current prices or 6.2% at 2012 prices during the same 6-year period. The energy deficit has been effectively eliminated (Table 8), which was also evidenced during the visit to the load dispatch center and distribution substations. The independent evaluation mission was informed that the transformers were mostly operating at about 60% of the rated capacity, and in most cases, it reflected the design criteria of n-1 (footnote 41). This also implied that the transmission and distribution networks were generally robust and have spare capacity to cater to the demand growth for a few more years without their reliability deteriorating.

Table 8: Madhya Pradesh Power Generation—Demand Balance Improvement

| Fiscal Year | Energy Required (GWh) | Energy Available (GWh) | Energy Surplus/ (Deficit) (GWh) | (%) | Peak Demand (MW) | Peak Met (MW) | Peak Surplus/ (Deficit) (MW) | (%) |
|-------------|-----------------------|------------------------|---------------------------------|--------|------------------|---------------|------------------------------|--------|
| 2009 | 42,054 | 34,841 | (7,213) | (17.2) | 7,564 | 6,810 | (754) | (10.0) |
| 2012 | 49,785 | 41,392 | (8,393) | (16.9) | 9,151 | 8,505 | (646) | (7.1) |
| 2015 | 53,374 | 53,082 | (292) | (0.5) | 9,755 | 9,717 | (38) | (0.4) |
| 2016 | 62,375 | 62,375 | 0 | 0.0 | 10,902 | 10,902 | 0 | 0.0 |
| 2017 | 65,760 | 65,759 | (1) | 0.0 | 11,512 | 11,501 | (11) | (0.1) |
| 2018 | 69,926 | 69,926 | 0 | 0.0 | 12,338 | 12,301 | (37) | (0.3) |

() = negative, GWh = gigawatt-hour, MW = megawatt.

Source: Data from (i) annual reports of the Madhya Pradesh Power Management Company Limited and (ii) [Load Generation Balance Report](#) of the Central Electricity Authority. There are variations between data disclosed by the two entities, but these are not significant.

65. The Government of Madhya Pradesh acknowledged that ADB's investment support was needed to strengthen and upgrade the power sector. After considerable investments during India's Eleventh Five Year Plan, FY2008–FY2012 and Twelfth Five Year Plan, FY2013–FY2017, and the completion of projects under the ongoing Thirteenth Five Year Plan, 2017–2022, the power supply is now secure and technical parameters remain within limits throughout the state. According to the state government, Madhya Pradesh achieved universal household electrification in June 2019 and was providing reliable, 24x7 power to rural areas, albeit restricted to 10 hours a day for agricultural use.

66. There was ample evidence that the MFF has had significant development impacts in the rural area, as the share of agriculture in GSP was the highest at 29.75% in FY2018 and led to a spike in demand for electricity to pump ground water during the dry season (October to February) when wheat would be

grown, which was verified by TRANSCO's records showing annual peak demand in January. The sale of electricity for irrigation increased from 9,438 GWh in FY2012 to 20,054 GWh in FY2019, or at a compound annual growth rate of 11.4%, which was 38% more than the rate for total sales. The share of actual electricity use for agriculture could be higher as the commercial losses can be mostly attributed to unmetered supply for irrigation pumps. The feedback from farmers were that (i) the power supply was dependable, and (ii) the supply voltage was compliant to the standards, which made diesel-operated pumps no longer necessary and significantly improved the range of the water sprinklers.

67. The quality of the electricity service for nonagricultural use in rural areas was similar to that in urban areas, except that it took longer to attend to breakdowns because of the remoteness of the consumers. The capacity of the strengthened distribution network enabled uninterrupted power supply even as the number of connections in rural areas, which were mostly categorized as domestic, increased by 79% (from 5.8 million to 10.4 million) between FY2012 and FY2019. The social impact of electricity reached registered below-poverty-line households through the Indra Griha Jyoti Yojna (Indra Gandhi Home Lighting Scheme), as it required the qualified consumer to pay only Rs100 (\$1.40) per month for the first 100 kWh consumed and Rs385 (\$5.38) per month for consumption up to 150 kWh starting in September 2019.⁶⁰ The government has committed to subsidizing the DISCOMs for the difference in revenue because of the scheme.

68. As the FCR and FVR rated the development impacts satisfactory, and in view of the positive correlation with the states GSP growth and the improved power supply in rural areas, this PPER also rates the MFF's development impacts *satisfactory*.

B. ADB Performance

69. ADB periodically fielded loan review missions and closely monitored procurement and project implementation progress. It provided support for meeting ADB's procedures for procurement, disbursement and monitoring, particularly during the initial period of MFF implementation. ADB conducted workshops to inform executing agency staff about monitoring the implementation of safeguard measures. Approvals, as required, were provided in a timely manner and delays minimized, while corrective action was taken, when necessary, through regular tripartite meetings between the government, the executing agencies, and ADB. Approval for Tranche 6 as an addition to the MFF improved operational efficiency, although ADB staff could have made more efforts to continue improving billing efficiency until the MFF closed in 2015. The drop in billing efficiency suggests that it would have helped to allocate resources to closely examine the issues and establish viable alternatives for increasing billing to near 100%. As both the FCR and its validation rated ADB performance *satisfactory*, and despite the shortcoming, the PPER also rates ADB performance *satisfactory*.

C. Government of Madhya Pradesh and Executing Agency Performance

70. The government and executing agencies arranged counterpart funds in a timely manner for smooth project implementation. The government also transfers subsidy to the executing agencies to help cash flow even with under recovery of sales revenue. The issue of high AT&C losses is now being closely monitored by the government and senior staff of the executing agencies. The state government informed the IEM that it has shifted from focusing on capital investments to addressing commercial issues (such

⁶⁰ The Pioneer. *Indira Griha Jyoti Yojana Implemented*. (accessed on 24 January 2020). The scheme, which received wide media coverage, evidently benefited low-income households. DISCOM-E informed the independent evaluation mission that the scheme started in April 2019 with a flat rate monthly charge of Rs100 with the assumption that electricity consumption of below-poverty-line households would be limited to lighting, a fan, and mobile phone charging. However, it soon became evident that the subsidised flat rate supply was leading to wastage, such as lights not being switched off, and encouraged even low-income households to buy household appliances and consume far more than 3 kWh per day, so the government announced that a telescopic tariff based on meter readings would apply from September 2019.

as shortcomings in billing, collection, and customer satisfaction) to ensure financial sustainability of the three DISCOMs.

71. As the executing agencies had adequate capacity for technical aspects of project design, procurement, and implementation before MFF implementation, ADB did not provide for engaging project implementation consultants. During the initial stage of MFF implementation, the executing agencies were unfamiliar with the monitoring and reporting requirements for safeguard implementation, but this was no longer an issue by the time major site works started, as the executing agencies had engaged domestic consultants to overcome this shortcoming.

72. In their feedback, the executing agencies noted that two concessions adopted to promote the rural economy significantly increased the cost of eliminating commercial losses. In 2017, the government allowed agricultural consumers to avail themselves of (i) a flat rate tariff for agricultural power consumption; and (ii) temporary connections for equipment to be used for limited periods, such as threshers and chaff cutters. An increasing number of consumers is taking advantage of these concessions, which has opened opportunities for dishonest gaming of the system in the following ways:

- (i) The tariff order provided the basis for determining the electricity consumption; for example, during the crop-growing season (October to February), the monthly consumption of a three-phase motor was assessed as 180 kWh per horsepower, or about 6 hours per day at full load (during off-season, the consumption is about half this level). As the government subsidized the flat rate to be paid by the agricultural consumer,⁶¹ DISCOMs were incurring high surveillance costs to account for the electricity for unmetered agricultural consumption and to ensure that the pumps operated according to nameplate data and for the allowed duration. Farmers with large landholdings could use the same pump for longer hours for irrigation and thus conceal the actual consumption.
- (ii) For a temporary connection, there was a system of advance payment for 1 or 3 month, based on the application. If the equipment was used longer than the period for which advance is paid, the DISCOM must disconnect the supply. Recovery of overdrawn dues from individuals was difficult because of a weak legal system. With the increasing number of temporary connections, the system imposed a heavy cost on the DISCOMs for effective monitoring.

73. Despite the shortcomings in power consumption monitoring because of concessions aimed at supporting the agricultural sector, both the FCR and its validation rated the executing agency performance *satisfactory*. This PPER agrees and rates the performance of the Government of Madhya Pradesh and the executing agencies *satisfactory*, as both have accepted their shortcomings and have consistently made efforts to overcome them, albeit with mixed results.

⁶¹ For example, the subsidy for a 12-horsepower pump used for 27% longer hours a day would work out at 88%, but the amount transferred by the government is 66% because it is based on normative use.

CHAPTER 5

Overall Assessment, Issues, Lessons, and Follow-Up Actions

74. This chapter provides the overall assessment of the performance of the MFF, discusses the issue that is crucial for sustainability of the sector, and outlines lessons and follow-up actions arising from the evaluation.

A. Overall Assessment

75. Overall, the FCR rated the MFF *satisfactory*, along with all its six tranches implemented over 8 years from July 2007 to June 2015. It was aligned with the development objective of Power for All in Madhya Pradesh (Appendix 3). The choice of MFF modality assured long-term support for expansion and improvement of power infrastructure, which continued with the approval of another MFF in 2011 (footnote 11) and a project loan in 2013 (footnote 21). The power sector has become more robust and has more than doubled the peak demand it can meet, while the electricity service has become significantly more reliable and key technical parameters consistently remain within permissible limits. However, billing and collection efficiency have yet to improve sufficiently to address the weak financial sustainability of ADB's investments in the power sector.

76. Table 9 summarizes the ratings of the FCR and this PPER. The reevaluated FIRR was well above the WACC but the PPER rates the program *less than likely sustainable* because of the weak financial performance of DISCOMs and lack of a viable strategy for significantly increasing billing and collection efficiency.

Table 9: Overall Assessment of Program Performance

| Evaluation Criteria | FCR | PPER | Comments |
|---|--------------------|------------------------------|--|
| Relevance | Relevant | Relevant | |
| Effectiveness | Effective | Effective | |
| Efficiency | Efficient | Highly Efficient | EIRR for the entire MFF has been verified to be above 18% (21.7% in FCR and 20.4% in PPER) |
| Sustainability | Likely sustainable | Less than likely sustainable | DISCOMs have shown poor fiscal, institutional, and policy sustainability, despite a relatively high FIRR |
| Overall Assessment | Successful | Successful | |
| Development Impact | Satisfactory | Satisfactory | |
| Performance of Recipient and Executing Agency | Satisfactory | Satisfactory | |
| Performance of ADB | Satisfactory | Satisfactory | |

ADB = Asian Development Bank, DISCOMs = power distribution companies, EIRR = economic internal rate of return, FCR = facility completion report, PPER = program performance evaluation report.

Source: Independent Evaluation Department.

B. Issues

77. **Lack of transparency in energy consumption.** Sustainable commercial operation of DISCOMs is only possible when billing is done for all the electricity that was purchased minus technical losses. This continues to be an issue in Madhya Pradesh, and as country-level data suggests, in many other states as well. The Electricity Act, 2003 required all distribution licensees to only provide metered supply; a grace period of 2 years was allowed that could only be extended by the state regulators. The Ministry of Power emphasized the need for 100% metering in the Ujwal DISCOM Assurance Yojana Program launched in 2016. According to the state health card, by June 2019, distribution feeders had 100% metering, distribution transformers had 96% metering in urban areas and 85% metering in rural areas, and modern static energy meters with error of less than 0.5% were in place to measure the energy sent out on all 11 kV feeders.⁶² The DISCOMs have installed a very large number of consumer meters but the share of metered, domestic, and irrigation connections was not readily available. The DISCOMs need to complete the installation of meters as early as possible and properly audit energy supply on all feeders.

78. **Improper measure of aggregate technical and commercial losses.** Determination of technical losses is difficult without 100% metering. In India, the DISCOMs' reported loss figures include assessed consumption by unmetered consumers and there is a very large variation, making it difficult to establish the optimal level of distribution losses. The Ujwal DISCOM Assurance Yojana scheme set a target of 15% in the context of reported all-India figure of AT&C losses of 25.4% (FY2013), but this cannot be considered an aggressive target. DISCOM-E estimated the technical losses as 18% using CYMDIST power system analysis software but this may reflect a modeling error as other DISCOMs have reported AT&C losses less than 16% and even as low as 9% (footnote 51). To get a sense of what technical losses may be, Table 10 provides data from a state-owned power company in Indonesia, a country with similar level of development, a more demanding network geography (the archipelago comprises over separate 6,000 inhabited islands and has more than 1,000 mini grids), and 97% household electrification. As part of its annual operational statistics, it shows that the country-wide total energy loss was less than 10% during 2010–2018, except in 2013, when it was slightly higher.⁶³

Table 10: Energy Loss in Perusahaan Listrik Negara, Indonesia

| Year | Transmission Loss (%) | Distribution Loss (%) | Total Energy Loss (%) |
|------|-----------------------|-----------------------|-----------------------|
| 2010 | 2.25 | 7.64 | 9.89 |
| 2011 | 2.25 | 7.34 | 9.59 |
| 2012 | 2.44 | 6.95 | 9.39 |
| 2013 | 2.33 | 7.77 | 10.10 |
| 2014 | 2.37 | 7.52 | 9.89 |
| 2015 | 2.33 | 7.63 | 9.96 |
| 2016 | 2.29 | 7.19 | 9.48 |
| 2017 | 2.39 | 6.53 | 8.92 |
| 2018 | 2.32 | 7.37 | 9.69 |

Source: Perusahaan Listrik Negara.

79. **Need for provision of technical assistance before multitranchise financing facility closure to ensure sustainability of outcomes.** Though MFFs are designed to provide long-term support for a sector, a new risk might surface, or a known risk might become amplified during implementation that could adversely influence the program. For example, uncontrolled commercial losses could threaten the sustainability of the MFF results (para 59). For future MFFs, ADB could consider allocating TA resources to mitigate risks, build capacity, and foster behavioral changes. The need for TA and its design should be finalized toward the end of the MFF implementation cycle when the actual program outcomes become predictable.

⁶² Ministry of Power. *State Health Card for Madhya Pradesh*. New Delhi. The report on the internet webpage is regularly undated.

⁶³ Perusahaan Listrik Negara. 2019. *PLN Statistics 2018*. Jakarta.

C. Lessons

80. **Lesson 1. Flexibility of multitranche financing facility design and process contributes to greater efficiency and harmonization of funds in the sector.** As the MFF was implemented concurrently with several other initiatives to improve the state's electrical distribution systems (para. 12), it was essential for each successive tranche to be specifically designed to fill gaps not covered by the various ongoing schemes to ensure the best use of the ADB loan funds. Project implementation was deemed successful thanks to the long-term partnership between the executing agencies and ADB with the use of MFF modality. Inclusion of an additional tranche to provide support for ERP strengthened the capacity of the executing agencies to implement large investment projects and improve the operational efficiency of their power distribution network.

81. **Lesson 2. Multitranche financing facility design, when appropriate, can also bring benefits to the rural poor.** The MFF enabled augmentation of the transmission and distribution system. The energy supplied to consumers has increased by a factor of 2.3 in 13 years (Table 3). Through initiatives taken by the government, there was increase in supply to rural areas with more low-income households. The consumption in rural areas increased by a factor of 2.1 from 13,891 GWh in FY2012 to 29,180 GWh in FY2019. The actual increase was even higher as the data do not account for commercial losses, which are higher in rural feeders. There is a lack of data to quantify the benefits accruing to rural low-income households, but the use of electricity for lighting, air-circulating fans, charging mobile phones, powering televisions and other appliances, and expanding opportunities for household income have had a significant impact in their quality of life. Rural communities benefit because a reliable supply of electricity supports social infrastructure such as primary health care and education, and participation in decision-making. Achieving the government's target for 24x7 electricity supply to all households was made possible by the strengthened transmission and distribution networks. The MFF, on the whole, should be considered an example of significant investment in pro-poor infrastructure.

82. **Lessons 3. Lessons learned from earlier interventions need to be incorporated during implementation.** An earlier PPER for the Madhya Pradesh Power Sector Development Program implemented from 2002 to 2007 had highlighted the need to reduce AT&C losses by improving billing and collection efficiency and discouraging electricity theft by taking legal action against pilferers as a necessary follow-up to ensure financial sustainability.⁶⁴ The MFF failed to apply this lesson during implementation and to effectively reduce AT&C losses as it did not include formulation of a viable strategy to counteract the perverse incentives offered by local politics and traditional practices (para 58). As policy and behavioral changes are often necessary to ensure ownership and long-term sustainability of a program, both should have been included in the MFF design and closely monitored during its implementation.

D. Follow-up Actions

83. **Need to allocate monitoring support during long-term sector engagements.** As the PPER and PVRs noted several shortcomings with the reevaluation of EIRR and FIRR, it is recommended that ADB provide adequate resources to engage experts for the economic and financial analysis (about 2 person-months) as part of preparation of the PCRs for the two ongoing ADB-supported projects in the Madhya Pradesh power sector. With consistent and accurate valuation of benefits from all project components (including consumer surplus) ADB could make a better case for increased support for power distribution companies in developing member countries and for the subsidies that governments provide to support social causes.

⁶⁴ IED. 2011. *Evaluation Study: Madhya Pradesh Power Sector Development Program in India*. Manila: ADB.

Appendixes

APPENDIX 1: KEY DATES OF IMPLEMENTATION SCHEDULE

| Tranche No. | Loan No. | Key Dates | | | | | | | | Months (effectiveness to closing) |
|-------------|----------|----------------------|----------------------|---------------|----------------|--------------------------------|-----------------------------|---------------------|------------------|--------------------------------------|
| | | Appraisal | Loan Negotiation | Loan Approval | Loan Agreement | Loan Effectiveness (agreement) | Loan Effectiveness (actual) | Closing (agreement) | Closing (actual) | |
| 1 | 2323-IND | 12 Dec ~ 14 Dec 2006 | 19 Feb ~ 20 Feb 2007 | 4 Apr 2007 | 12 Apr 2007 | 14 May 2007 | 11 Jul 2007 | 30 Jun 2011 | 31 Jan 2013 | 69 |
| 2 | 2324-IND | 12 Dec ~ 14 Dec 2006 | 19 Feb ~ 20 Feb 2007 | 4 Apr 2007 | 12 Apr 2007 | 14 May 2007 | 11 Jul 2007 | 30 Sep 2011 | 15 Jul 2013 | 75 |
| 3 | 2346-IND | 12 Dec ~ 14 Dec 2006 | 16 Aug ~ 17 Aug 2007 | 21 Aug 2007 | 23 Aug 2007 | 21 Nov 2007 | 24 Dec 2007 | 31 Dec 2011 | 16 Sep 2013 | 71 |
| 4 | 2347-IND | 12 Dec ~ 14 Dec 2006 | 16 Aug ~ 17 Aug 2007 | 21 Aug 2007 | 7 Mar 2008 | 5 Jul 2008 | 11 Jun 2008 | 31 Dec 2011 | 1 May 2014 | 71 |
| 5 | 2520-IND | 12 Dec ~ 14 Dec 2006 | 31 Mar ~ 1 Apr 2009 | 13 Apr 2009 | 27 May 2009 | 25 Aug 2009 | 7 Sep 2009 | 30 Jun 2013 | 22 Jul 2015 | 72 |
| 6 | 2732-IND | 12 Dec ~ 14 Dec 2006 | 10 Dec 2010 | 21 Dec 2010 | 10 May 2011 | 8 Aug 2011 | 29 Jun 2011 | 30 Jun 2014 | 26 Jun 2015 | 47 |

IND = India.

Source: Asian Development Bank.

APPENDIX 2: SUMMARY PERFORMANCE EVALUATION RATINGS

| Criteria | Facility | Tranche 1 | | Tranche 2 | | Tranche 3 | | Tranche 4 | | Tranche 5 | | Tranche 6 | |
|--|--------------------|--------------------|------------------------|--------------------|---------------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|--------------------|------------------------------|
| | PCR | PCR | PVR | PCR | PVR | PCR | PVR | PCR | PVR | PCR | PVR | PCR | PVR |
| Relevance | Relevant | Highly Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant | Relevant |
| Effectiveness | Effective | Effective | Effective | Effective | Effective | Effective | Effective | Less than Effective | Less than Effective | Effective | Effective | Effective | Effective |
| Efficiency | Efficient | Efficient | Less than Efficient | Efficient | Less than Efficient | Efficient | Efficient | Efficient | Efficient | Efficient | Efficient | Efficient | Efficient |
| Sustainability | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Likely Sustainable | Less than Likely Sustainable |
| Overall Assessment | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful | Successful |
| Development Impact | Satisfactory | Satisfactory | Less than Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory |
| Performance of Borrower & Executing Agency | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory |
| Performance of ADB | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory | Satisfactory |

ADB = Asian Development Bank, PCR = project completion report, PVR = project validation report.

Source: Independent Evaluation Department.

APPENDIX 3: INDIA: INITIATIVES FOR THE IMPROVED POWER DISTRIBUTION

1. **National Electricity Policy.** The policy was announced on 12 February 2005.¹ Electricity was recognized as a key driver for economic growth and poverty alleviation. The aims of the policy were for all households to have access to electricity in the next 5 years, electricity demand to be fully met by 2012, supply reliability and quality to be of specified standard at reasonable rates, per capita consumption by 2012 to be more than 1,000 kilowatt-hours (kWh) per year, a minimum daily provision of 1 kWh per household as a merit good, financial turnaround of the power sector, and protection of consumers' interests. The investment requirement, based on FY2003 costs, in generation, transmission, and distribution was estimated at Rs9 trillion (\$184 billion at Rs49 = \$1).
2. **Restructured Accelerated Power Development and Reform Program.** The Restructured Accelerated Power Development and Reform Program was announced in July 2008.² It refined the Accelerated Power Development and Reform Program that was launched in 2001. The restructured program focused on sustained loss reduction and included two parts. Part A included establishing the baseline data using consumer indexing; geographic information system mapping; metering of distribution transformers and feeders; information technology (IT) applications for meter reading; and IT enabled consumer service centers, supervisory control, data acquisition, energy accounting, and auditing. Part B included renovation, modernization, and strengthening of 11 kilovolt substations and networks. It promoted use of high-voltage distribution system (HVDS) and aerial bunched conductors for reducing power theft, load segregation for improving supply reliability, and installation of capacitor banks for loss reduction and power factor correction. The financial plan for Part A consisted of a 100% loan from the Government of India that was to be converted to a grant after the required baseline data system was established. The Government of India provided a 25% (90% for special category states) loan for Part B through the Power Finance Corporation and the Rural Electricity Corporation, half of which was to be converted to a grant when aggregate technical and commercial (AT&C) losses were reduced to 15%.
3. **Integrated Power Development Scheme.** Announced on 3 December 2014, the objective of the Integrated Power Development Scheme (IPDS) was strengthening power subtransmission and distribution networks in urban areas.³ Projects included (i) strengthening networks; (ii) metering distribution transformers, feeders, and consumers; (iii) using IT, including enterprise resource planning (ERP); (iv) providing smart metering solutions for large consumers (more than 200 kWh per month) and net metering applicable to solar power installation by consumers and government buildings; and (v) demand side management, such as by using LEDs for lighting. The approved projects have a cost of Rs290,581 million (\$4.06 billion) of which 87% had been awarded by April 2018. The financing plan included 60% (85% for special category states) as a grant from Government of India, 10% by the power distribution companies (DISCOMs), and 30% from financial institutions. The IPDS also sought to improve financial health of the DISCOMs by requiring states to take over 75% of the past debt and part of the future losses.
4. **Deen Daya Upadhyaya Gram Jyoti Yojana.** The scheme was launched on 3 December 2014.⁴ It complemented the IPDS in rural areas through the separation of agricultural and nonagricultural feeders for judicious supply rostering, strengthening and augmenting distribution infrastructure (including metering of distribution transformers, feeders, and consumers), and it subsumed the remaining tasks under the Rajiv Gandhi Grameen Vidyutikara Yojna, initiated in 2008. The estimated outlay totaled

¹ Government of India, Ministry of Power. 2005. *National Electricity Policy*. New Delhi.

² Government of India, Ministry of Power. 2008. *Re-structured Accelerated Power Development and Reforms Program During XI Plan*. New Delhi.

³ Government of India, Ministry of Power. 2014. *Integrated Power Development Scheme*. New Delhi.

⁴ Government of India, Ministry of Power. 2014. *Deendayal Upadhyaya Gram Jyoti Yojana*. New Delhi.

Rs823,080 million (\$11.5 billion). Similar to the IPDS, the financing plan included up to 75% in grant funding from the Government of India.

5. **Power for All.** Signed on 12 April 2016, the objective of Power for All was the provision of 24x7 power to all electricity consuming entities and adequate power for the agriculture sector by March 2019.⁵ A road map was prepared that included electrification of rural households and feeder segregation for 24x7 power supply and loss reduction in rural areas. The peak power demand by March 2019 was estimated at 12,643 megawatts and the energy requirement for FY2019 as 80,8 GWh. AT&C losses were to be reduced to 17% by FY2019. Generation, transmission, and distribution capacity increases were quantified. The road map also required the conversion to perpetual loans of DISCOM debt, as in FY2011, and electricity duty and electricity development cess during FY2012–FY2014.

6. **Ujwal DISCOM Assurance Yojana.** Signed on 9 August 2016, the tripartite agreement is between the Ministry of Power (Government of India), the Government of Madhya Pradesh, and Madhya Pradesh Power Management Company Limited—the holding company of the three DISCOMs.⁶ Its objective was to turn around the DISCOMs' operations. It included taking over Rs260,550 million (\$3.6 billion) of the DISCOMs' debt by converting it to equity and grants over 4.5 years starting in FY2017. The DISCOMs were required to reduce AT&C losses to 15% and eliminate the gap between average cost of supply and average revenue realized by FY2020. Target completion dates were agreed for feeder segregation, feeder and distribution transformer metering, and installation of smart meters for consumers using more than 200 kWh per month—all by 31 December 2019.

7. **Pradhan Mantri Sahaj Bijili Har Ghar Yojna – Saubhagya.** Announced on 11 October 2017, the scheme's objective was to provide the last mile connectivity and electricity connections to all remaining households in the country.⁷ The number of rural unelectrified households was estimated, based on the 2011 census and other data provided by the states, as 46 million, of which 18 million below-poverty-line households had been brought under the Deen Daya Upadhyaya Gram Jyoti Yojana. As another 5 million low-income urban households lacked electricity connections, the target was to extend electricity connections to about 30 million households in the country by March 2019, or in about 18 months. Households situated in remote and inaccessible areas were to be provided stand-alone solar photovoltaic power packs with enough capacity to power five LED lamps, one direct current fan, and one direct current socket. The outlay for the project was estimated at Rs163,200 million (\$2.3 billion), of which 75% was provided in grant financing by the Government of India.

⁵ Government of India and Government of Madhya Pradesh. 2016. *24x7 Power to All Madhya Pradesh, A Joint Initiative of Government of India and Government of Madhya Pradesh*. New Delhi and Bhopal.

⁶ Government of India, Ministry of Power; Government of Madhya Pradesh; and Madhya Pradesh Power Management Company Limited. 2016. *Tripartite Memorandum of Agreement between Ministry of Power, Government of Madhya Pradesh and MP Power management Company Limited for Achieving Turnaround of Madhya Pradesh Distribution Companies*. New Delhi.

⁷ Government of India, Ministry of Power. 2017. *Pradhan Mantri Sahaj Bijili Har Ghar Yojna*. New Delhi.

APPENDIX 4: ECONOMIC ANALYSIS

1. The economic analysis of the Madhya Pradesh Power Sector Investment Program was carried separately for Madhya Pradesh Power Transmission Company Limited (TRANSCO), which was the executing agency for Tranches 1 and 3, and for the holding and three power distribution companies (DISCOMs) taken together, which were the executing agencies for Tranches 2, 4, 5, and 6.¹ Although TRANSCO and the DISCOMs are regulated entities, there is a significant difference in the business environment. TRANSCO is the power grid operator and has lower commercial risks. The three DISCOMs are its only customer and its revenue is based on the capacity of the infrastructure (transmission lines and substations) to meet peak power demand in terms of megawatts (MW). The capacity is allocated to the three state DISCOMs and the Madhya Pradesh Electricity Regulatory Commission (MPERC) determines the tariff (Rs million per MW per year) under the postage stamp system. The TRANSCO's revenue is therefore not linked to the amount (gigawatt-hours [GWh]) of electricity purchased from the power generation companies. The MPERC determines the annual revenue requirement of the DISCOMs and establishes the retail tariff for various categories of consumers based on the sales forecast, the revenue is therefore mostly based on the amount of electricity sold.

2. The economic analysis used actual performance results and information in MPERC's detailed tariff orders. Costs and revenues were updated for 2019 using the domestic cost index. In a network industry it is not possible to categorically link specific assets to outputs quantified in operational reports. For example, during the project implementation period, electricity sales in Madhya Pradesh increased from 19,583 GWh in FY2007 to 50,237 GWh in 2016. As the executing agencies implemented several other projects during the same period, a reasonable estimation of the benefits of the multitranche financing facility (MFF) was done using the ratio of the cumulative MFF cost and the gross fixed assets (GFA) of the companies. In 2016, cumulative MFF investment was 15.6% of the GFA of the DISCOMs so the MFF benefit was estimated to be 15.6% of the revenue and then capped at the same level during subsequent years so the increase in revenue because of other investments was not counted. Other methods for determining costs and benefits are explained in following paragraphs.

3. **Madhya Pradesh Power Transmission Company.** The first disbursement was in FY2007 and disbursement ended in FY2013. It is assumed that the full benefit from the MFF was achieved a year later, in FY2014. To determine the MFF economic cost, the annual loan disbursement reported in the project completion reports (PCRs) was converted to domestic currency using the average exchange rate, increased by 20% to account for counterpart funds, multiplied by the shadow exchange rate factor of 1.04 as all goods were locally sourced, and adjusted to 2019 cost using local price index. Operation and maintenance (O&M) cost was determined on the basis of MPERC's order for FY2019, which provided the rate in million rupees per kilometer per year for transmission lines at various voltage levels, and in Rs million per bay per year for substations. The information provided in the PCRs was used to establish the kilometers of transmission lines and number of bays added by the MFF. The O&M cost for the assets added by FY2013 was calculated and it did not require a price adjustment. For the duration of project implementation, the same O&M cost was multiplied by the MFF progress expressed as percent.

4. The following quantifiable benefits were included in the analysis.

- (i) **Non-incremental.** The transmission system losses reduced from 5% in 2007 to 3% in 2014, i.e., 2% less electricity was purchased to meet the demand in Madhya Pradesh. The physical benefit in GWh terms was capped at the FY2014 value. The value of the additional electricity was taken as the average power purchase price agreed by MPERC in periodic multiyear tariff orders, which reflected the long-term fixed and variable costs of all power generation companies (those owned by the Government of Madhya Pradesh,

¹ Includes Madhya Pradesh Power Management Company Limited and the three distribution companies controlled by it, i.e., Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited (DISCOM-C), Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited (DISCOM-E), Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited (DISCOM-W).

central public sector enterprises, and independent power producers) and the market clearing price in the power exchange. The benefit in FY2014 was adjusted for progress during the MFF implementation period and adjusted to 2019 price level.

- (ii) **Incremental.** The increment in sales in FY2014 compared with FY2007 was considered the full benefit of the project. One of the viable options for valuing wholesale electricity in the without-transmission MFF case would be to consider installation of solar-based projects at the boundary of DISCOMs. Therefore, the incremental benefit was determined using the reported lowest bids of auction for the 750 MW capacity solar ultra mega project in Madhya Pradesh. As the bid price was for 2018 auction, it did not require cost adjustment. The MFF benefit was 44% of the full benefit in FY2014, which was the share of the MFF investment in TRANSCO's GFA.

5. The economic internal rate of return (EIRR) of the net benefit stream of TRANSCO for FY2007 to FY2030 was estimated at 43.1% (Table A4.1). It was not possible to compare the result with MFF appraisal and completion as the worksheets of the project appraisal and project completion reports (PCRs) were not available.

Table A4.1: Madhya Pradesh Power Transmission Company Limited
Estimation of Economic Cost and Benefit from Tranches 1 and 3 of the Madhya Pradesh Power Sector
Investment Program
 (Rs million)

| Year | Facility Economic Costs | | Benefits | | Net Benefit | Considering Environmental Cost | |
|-----------------|-------------------------|----------|-----------------|-------------------|--------------|--------------------------------|---------------------|
| | | | Non-Incremental | Incremental | | Carbon Emission Cost | Revised Net Benefit |
| | Facility Cost | O&M Cost | Loss Reduction | Incremental Sales | | | |
| 2007 | 1,466 | | | | (1,466) | | (1,466) |
| 2008 | 7,067 | | | | (7,067) | | (7,067) |
| 2009 | 9,898 | 183 | 142 | 575 | (9,365) | 295 | (9,660) |
| 2010 | 3,569 | 224 | 199 | 1,865 | (1,728) | 1,276 | (3,005) |
| 2011 | 905 | 235 | 414 | 2,863 | 2,138 | 2,204 | (67) |
| 2012 | 869 | 247 | 718 | 9,770 | 9,373 | 7,641 | 1,732 |
| 2013 | 607 | 256 | 1,102 | 17,456 | 17,695 | 15,024 | 2,671 |
| 2014 | | 256 | 1,609 | 26,766 | 28,200 | 25,036 | 3,164 |
| 2015 | | 256 | 1,609 | 26,766 | 28,200 | 30,139 | (1,938) |
| 2016 | | 256 | 1,609 | 26,766 | 28,200 | 24,281 | 3,919 |
| 2017 | | 256 | 1,609 | 26,766 | 28,200 | 19,771 | 8,430 |
| 2018 | | 256 | 1,609 | 26,766 | 28,200 | 14,470 | 13,731 |
| 2019 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2020 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2021 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2022 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2023 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2024 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2025 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2026 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2027 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2028 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2029 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| 2030 | | 256 | 1,609 | 26,766 | 28,200 | 11,997 | 16,204 |
| EIRR (%) | | | | | 43.4% | | 19.9% |

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

Source: Independent Evaluation Department.

6. The annual share of coal-based power generation in Madhya Pradesh was 63.7% in 2019. This provided the opportunity to include the cost of carbon emissions and reestimate the EIRR for the with-environment cost case. The value of carbon emissions was based on what experts considered to be the price consistent with achieving the goals of the Paris Agreement.² The reestimated EIRR was 19.7%.

7. **Distribution companies.** The first disbursement for the MFF was in FY2008 and the last in FY2014. The implementation period of subprojects was lower, so the benefits started accruing in FY2009 and full MFF benefits were available by FY2015. The actual MFF cost was taken from the financial internal rate of return tables in the PCRs of the four tranches and adjusted for 2019 prices. The MPERC tariff orders specify the annual O&M cost, which was the sum of required employee expenses, administrative and general expenses, repair and maintenance expenses (2.3% of GFA), and pension fund provision. The O&M cost as a percentage of GFA was determined for FY2008 to FY2020. The same percentage was applied to the MFF cost to determine the annual O&M cost and it was adjusted to 2019 prices. The O&M cost was capped at the FY2015 value but adjusted for the MFF progress during the implementation period and by the local price index until FY2019. The power purchase cost is pass-through for the DISCOMs, i.e., the cost is included by MPERC for determining the annual revenue requirement. Given that benefit estimates were based on the annual revenue data, it was necessary to include the cost of power purchase in the total economic cost of the project. The annual power purchase cost was taken from MPERC's tariff orders and adjusted for the share of MFF investment in the GFA. Like the O&M Cost, the power purchase cost was capped at the 2016 value but adjusted for the MFF progress during the implementation period and by the local price index until FY2019.

8. The following quantifiable economic benefits were included.

- (i) **Non-incremental.** There was resource cost saving because of the reduction in technical losses in the distribution network. However, because all sales and supplies at feeder and distribution transformers were not being metered, it is not possible to accurately quantify the technical losses. Madhya Pradesh Power Management Company Limited publishes statistical reports that include energy sold to DISCOMs and then to various consumer categories. The difference includes the technical and commercial losses.³ It is observed that the combined losses were lowest, at 26%, in FY2015. It is assumed that the network was operating optimally, and the level of technical losses was the least at the time, say 10%. Similarly, the technical and commercial losses were assessed with related assumptions regarding change in technical losses for all the years. The amount of technical loss was capped at the FY2016 level (full impact of MFF investment) and adjusted for the MFF share in GFA. The technical loss reduction was valued at the average variable cost of nine lowest-rated thermal power plants in the merit order during FY2019 as loss reduction avoided costly generation and the variable cost was a fair representation of resource cost saving, i.e., most of the variable cost was for domestic coal.
- (ii) **Incremental.** The highest economic benefit of the MFF investment in distribution network infrastructure was on account of the increased sale of electricity. In FY2016, the total energy sales of the DISCOMs was 45,507 GWh and the MFF share in GFA was 24.5%. Thus, the full quantity attributed to the MFF, and the cap, was estimated at 11,131 GWh. Similarly, the annual sales for the MFF during the implementation period were estimated using MFF investment amount as share of GFA. The sales were conservatively valued at the average sale price stated in MPERC's tariff order for FY2020, adjusted downward for the project implementation period. It is noted that a more accurate estimation of economic output resulting from the supply of electricity could be carried out using the electricity elasticity to gross domestic product, but sufficient data were not available to the evaluation mission.
- (iii) **Consumer Surplus.** The quantity of commercial loss is the free-of-cost electricity used by the consumers, which provided a basis for conservatively estimating the consumer

² World Bank. 2019. *State and Trends of Carbon Pricing 2019*. Washington, D.C.

³ The Aggregate Technical and Commercial Losses also includes the impact of collection efficiency.

surplus. The commercial losses were assessed as 21.2% in FY2019. It was expected that the stringent measures being implemented by the DISCOM managements will reduce the commercial losses to 8% so the AT&C losses fall below the target of 15% set by the Government of India. Thereafter, all commercial losses will be progressively eliminated by 2030. However, as the free-of-cost electricity was also valued at the average cost of supply, the reduction in consumer surplus will get added to incremental sales and so the net benefit would remain at the FY2019 level.

9. The EIRR of the net benefit stream of Madhya Pradesh Power Management Company Limited, the holding company of the three DISCOMs, for FY2008 to FY2030 was estimated at 20.7% (Table A4.2). It was not possible to compare the result with MFF appraisal and completion as the worksheets of the project appraisal report and PCRs were not available.

Table A4.2: Madhya Pradesh Power Management Company Limited
Estimation of Economic Cost and Benefit from Tranches 2, 4, 5 and 6 of the
Madhya Pradesh Power Sector Investment Program
 (Rs million)

| Year | Facility Costs | | | Project Benefits | | | Net Benefit |
|-----------------|----------------|----------|---------------------|----------------------|-------------------|------------------|--------------|
| | Capital Cost | O&M Cost | Power Purchase Cost | Resource Cost Saving | Incremental Sales | Consumer Surplus | |
| 2008 | 1,774 | | | | | | (1,774) |
| 2009 | 3,477 | 998 | 6,252 | 80 | 4,199 | 1,605 | (4,843) |
| 2010 | 6,353 | 2,691 | 12,567 | 323 | 10,305 | 3,480 | (7,502) |
| 2011 | 7,043 | 4,084 | 18,378 | 615 | 16,811 | 5,451 | (6,628) |
| 2012 | 6,501 | 5,841 | 28,804 | 1,121 | 29,239 | 9,857 | (928) |
| 2013 | 4,746 | 7,498 | 33,831 | 1,498 | 35,104 | 10,167 | 693 |
| 2014 | 3,602 | 6,792 | 37,875 | 1,571 | 46,151 | 10,271 | 9,725 |
| 2015 | | 6,916 | 36,623 | 1,576 | 44,023 | 8,741 | 10,801 |
| 2016 | | 6,477 | 38,417 | 1,363 | 46,180 | 9,169 | 11,819 |
| 2017 | | 6,644 | 39,406 | 1,363 | 47,369 | 9,405 | 12,088 |
| 2018 | | 6,965 | 41,310 | 1,363 | 49,658 | 9,860 | 12,606 |
| 2019 | | 7,409 | 43,947 | 1,363 | 52,828 | 10,489 | 13,324 |
| 2020 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2021 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2022 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2023 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2024 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2025 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2026 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2027 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2028 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2029 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| 2030 | | 7,705 | 45,705 | 1,363 | 52,828 | | 781 |
| EIRR (%) | | | | | | | 20.7% |

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

Source: Independent Evaluation Department.

APPENDIX 5: FINANCIAL ANALYSIS

1. The financial analysis of the Madhya Pradesh Power Sector Investment Program, like the economic analysis (Appendix 4), was carried separately for Madhya Pradesh Power Transmission Company Limited (TRANSCO), which was the executing agency for Tranches 1 and 3, and for the holding and three power distribution companies (DISCOMs) taken together, which were the executing agencies for Tranches 2, 4, 5, and 6.¹ The benefits of the multitranche financing facility (MFF) were attributed according to the share of MFF investments in the gross fixed assets (GFA) of the companies, and the costs and benefits were updated to FY2019 costs using domestic price index. Other methods for determining costs and benefits are explained in following paragraphs.

2. **Madhya Pradesh Power Transmission Company Limited.** The investment MFF, supported by external assistance, was exempted from taxes and duties. The MFF cost was based on the annual loan disbursement and updated to FY2019 prices. The operation and maintenance (O&M) cost was the same as that in the economic analysis. The tariff orders of Madhya Pradesh Power Transmission Company Limited (MPERC) notify the rate for transmission capacity payments that the DISCOMs need to follow each year. Rates were readily available for FY2013 to FY2019 and conservative estimates were used for FY2009 to FY2012. In FY2014, which was the year the full benefits of the MFF became available, the investment by the MFF was 44% of the increase in TRANSCO's gross fixed assets compared with FY2007. Further, the increase in transmission capacity was 6,306 megawatts, of which based on the share of the MFF investment in the GFA, 2,759 megawatts of capacity was attributed to the project. TRANSCO's revenue was determined based on its share in incremental transmission capacity and annual rate. The capacity was capped at the value in FY2014 and the revenue was capped at that for FY2019—the most recent year for which the transmission tariff has been notified. The financial internal rate of return (FIRR) of the net benefit stream of TRANSCO for FY2007 to FY2030 was estimated at 12.3% (Table A5.1).

**Table A5.1: Madhya Pradesh Power Transmission Company Limited
Estimation of Financial Cost and Benefit from Tranches 1 and 3 of the
Madhya Pradesh Power Sector Investment Program**
(Rs million)

| Year | Facility Costs | | Facility Benefit Revenue | Net Benefit |
|------|----------------|----------|--------------------------|-------------|
| | Capital Cost | O&M Cost | | |
| 2007 | 1,410 | | | (1,410) |
| 2008 | 6,795 | | | (6,795) |
| 2009 | 9,517 | 183 | 431 | (9,269) |
| 2010 | 3,432 | 224 | 869 | (2,787) |
| 2011 | 870 | 235 | 1,212 | 108 |
| 2012 | 836 | 247 | 1,524 | 442 |
| 2013 | 583 | 256 | 3,197 | 2,357 |
| 2014 | | 256 | 5,023 | 4,767 |
| 2015 | | 256 | 4,386 | 4,130 |
| 2016 | | 256 | 3,897 | 3,641 |
| 2017 | | 256 | 4,750 | 4,494 |
| 2018 | | 256 | 4,851 | 4,595 |
| 2019 | | 256 | 4,651 | 4,395 |
| 2020 | | 256 | 4,651 | 4,395 |
| 2021 | | 256 | 4,651 | 4,395 |
| 2022 | | 256 | 4,651 | 4,395 |
| 2023 | | 256 | 4,651 | 4,395 |
| 2024 | | 256 | 4,651 | 4,395 |
| 2025 | | 256 | 4,651 | 4,395 |

¹ Includes Madhya Pradesh Power Management Company Limited (MPPMCL) and the three DISCOMs controlled by it, i.e., Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited (DISCOM-C), Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited (DISCOM-E), Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited (DISCOM-W).

| Year | Facility Costs | | Facility Benefit Revenue | Net Benefit |
|-------------|----------------|----------|--------------------------|--------------|
| | Capital Cost | O&M Cost | | |
| 2026 | | 256 | 4,651 | 4,395 |
| 2027 | | 256 | 4,651 | 4,395 |
| 2028 | | 256 | 4,651 | 4,395 |
| 2029 | | 256 | 4,651 | 4,395 |
| 2030 | | 256 | 4,651 | 4,395 |
| FIRR | | | | 12.3% |

() = negative, FIRR = financial internal rate of return, O&M = operation and maintenance.

Source: Independent Evaluation Department.

3. The weighted average cost of capital (WACC) was estimated at 3.5% at appraisal for Tranches 1 and 2, and 2.0% for Tranche 6 at the completion of the MFF. At appraisal, these figures were based on the estimated amounts of the Asian Development Bank (ADB) loans, domestic loans, and equity provided by the government. Their shares deferred between tranches. The nominal cost was assumed to be 6.8% for the ADB loan, 10.5% for domestic loans, and 14.0% for equity, which were adjusted for tax and inflation to derive the real cost. However, the government did not provide equity, so it was excluded from the WACC recalculation at MFF completion and the ADB loan share was increased to 80%.

4. As an alternate approach for estimating the WACC, the program performance evaluation review (PPER) reviewed TRANSCO's multiyear transmission tariff order issued in June 2016,² which provided estimates of TRANSCO's outstanding loans and government equity from FY2017 to FY2019. Based on the capacity addition plan, outstanding loans were estimated at Rs34.6 billion in FY2017, Rs45.1 billion in FY2018, and Rs56.6 billion in FY2019 at the beginning of the financial years. The nominal interest rates from 19 sources of funds (including ADB) were tabulated and the interest charges to be recovered through tariff were determined. Based on the outstanding loan and interest payment, the weighted average nominal cost of the loan was determined to be 5.96%. The annual government equity contributions were taken to be Rs1.6 billion and the nominal return on equity, as allowed under the Electricity Act, was 15.5%. Based on these figures, the PPER recalculated the WACC for TRANSCO at 2.3% (Table A5.2), which was less than the FIRR estimate of 12.3%.

Table A5.2: Madhya Pradesh Power Transmission Company Limited
Estimate of Weighted Average Cost of Capital for Enterprise

| Item | Amount for FY2017–FY2019 (Rs million) | Weight (%) | Nominal Cost (%) | Adjusted Cost ^a (%) | Weighted Cost (%) |
|-------------|---------------------------------------|------------|------------------|--------------------------------|-------------------|
| Loans | 137,236 | 96.7 | 6.0 | 2.0 | 1.90 |
| Equity | 4,671 | 3.3 | 15.5 | 11.5 | 0.38 |
| WACC | | | | | 2.27 |

FY = fiscal year, WACC = weighted average cost of capital.

^a The company has been reporting negative net income so it does not have a tax liability, adjustment was made only for 4% inflation rate that was the target set by the Government of India for the period FY2017 to FY2021.

Source: Independent Evaluation Department.

6. **Distribution companies.** The method for estimating MFF, O&M, and power purchase costs was same as the economic analysis, except for the adjustment for the shadow exchange rate factor. The revenue from sales by the three DISCOMs was considered to be the annual revenue requirement agreed by MPERC in the annual tariff orders. By 2016, when the full MFF benefit was available, the share of MFF investment in the GFA was 15.2%. This figure was used to estimate the revenue attributable to the MFF investment. Required adjustments were made for progress and FY2019 prices. The FIRR of the net benefit stream of Madhya Pradesh Power Management Company Limited (MPPMCL), the holding company for the three DISCOMs, for FY2008 to FY2030 was estimated at 22.1% (Table A5.3). It is known that the actual DISCOM revenue has been lower than the annual revenue requirement because the

² MPERC. 2016. *Transmission MYT Order for FY2016-17 to FY2018-19*. Bhopal.

commercial losses have remained well above the level allowed by MPERC, so the actual FIRR would be about 5 percentage point lower.

**Table A5.3: Madhya Pradesh Power Management Company Limited
Estimate of Financial Cost and Benefit from Tranches 2, 4, 5, and 6
of the Madhya Pradesh Power Sector Investment Program**
(Rs million)

| Year | Facility Costs | | | Facility Benefit Revenue | Net Benefit |
|-------------|----------------|----------|---------------------|--------------------------|--------------|
| | Capital Cost | O&M Cost | Power Purchase Cost | | |
| 2008 | 1,706 | | | | (1,706) |
| 2009 | 3,343 | 945 | 6,252 | 7,409 | (3,131) |
| 2010 | 6,109 | 2,458 | 12,567 | 15,378 | (5,756) |
| 2011 | 6,772 | 3,582 | 18,378 | 23,302 | (5,430) |
| 2012 | 6,251 | 4,913 | 28,804 | 35,792 | (4,175) |
| 2013 | 4,564 | 6,058 | 33,831 | 41,321 | (3,132) |
| 2014 | 3,463 | 5,305 | 37,857 | 45,684 | (959) |
| 2015 | 2,044 | 5,976 | 36,623 | 46,591 | 1,949 |
| 2016 | | 5,335 | 38,417 | 53,298 | 9,546 |
| 2017 | | 5,565 | 39,406 | 59,440 | 14,469 |
| 2018 | | 5,511 | 41,310 | 63,234 | 16,413 |
| 2019 | | 5,905 | 43,947 | 63,234 | 13,382 |
| 2020 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2021 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2022 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2023 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2024 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2025 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2026 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2027 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2028 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2029 | | 6,001 | 43,947 | 63,234 | 13,286 |
| 2030 | | 6,001 | 43,947 | 63,234 | 13,286 |
| FIRR | | | | | 22.1% |

FIRR = financial internal rate of return, O&M = operation and maintenance.

Source: Independent Evaluation Department.

7. The management is expected to take steps to lower the commercial losses and get revenue from the free-of-cost electricity that is being supplied. This benefit will accrue beyond FY2019. If added to the net benefit, the FIRR rises to 24.3%.

8. Similar to TRANSCO, the PPER recalculated the WACC for MPPMCL using the information in MPERC's tariff order for FY2020. The average debt in FY2020 is estimated at Rs59.7 billion for MPPMCL. MPERC considered the government's equity contribution to be 30% of the annual GFA addition for tariff purposes, so the same assumption was used for determining the WACC. Again, the DISCOMs have continuously reported negative net income so the costs were adjusted only for the inflation rate of 4%. The WACC was estimated at 7.3% in the PPER, which was lower than the FIRR of 22.1%.

Table A5.4: Madhya Pradesh Power Management Company Limited
Estimation of Weighted Average Cost of Capital for Enterprise

| Item | Amount for FY2017– FY2019 (Rs million) | Weight (%) | Nominal Cost (%) | Adjusted Cost ^a (%) | Weighted Cost (%) |
|--------|---|---------------|---------------------|-----------------------------------|----------------------|
| Loans | 59,719 | 54.0 | 7.2 | 3.2 | 1.73 |
| Equity | 50,945 | 45.0 | 16.0 | 12.0 | 5.52 |
| WACC | | | | | 7.26 |

WACC = weighted average cost of capital.

^a The company has been reporting negative net income so it does not have a tax liability, adjustment was made only for 4% inflation rate that was the target set by the Government of India for the period to FY2021.

Source: Independent Evaluation Department.