



Energy Efficiency Focused Renovation and Modernization (R&M) of Old Coal Fired Generation Units in India

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Presentation Roadmap

- Challenges in the Indian Power Sector
- Overview of WB Energy Program In India
- World Bank Engagement in R&M in India
- Addressing Barriers and Risks to R&M
- Questions



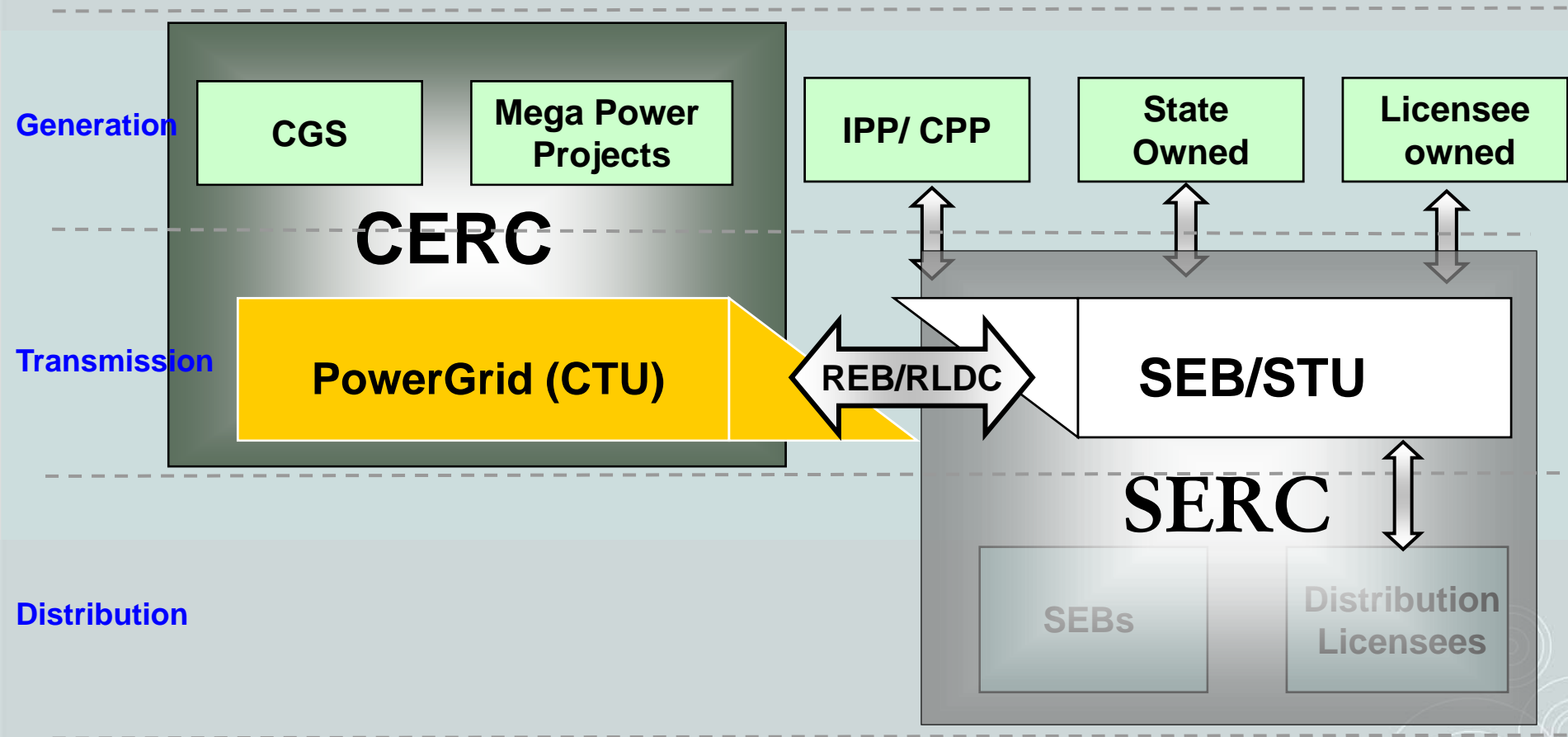
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Snapshot of the Present Indian Power Sector Structure

Concurrent subject under Indian Constitution





Current Challenges in the Indian Power Sector

For sustained & inclusive growth

Increase Access

30% villages/ 44% of pop. w/o electricity access

Improve Efficiency & Governance of Distribution Sector

40% AT&C losses. Reducing to 15% => \$4.4b addl. revenues/year
Incomplete sector reforms reflected in low cost recovery from tariff (82% for FY2007)

Expand & Diversify Power Generation

Biggest bottleneck to industrial growth and new investment:

60% of firms rely on captive power (21% in China)
Peak Deficit at 16.6%, Energy Deficit at 9.9%,
Econ. Cost of Shortages estimated at 7% of GDP

Growing CO2 Emissions

Power Sector represents 50% of India's CO2 (energy) emissions (0.5 bt/yr -> 2.5 bt/yr by 2030!)



Current Challenges in the Indian Power Sector

For sustained & inclusive growth

Rural Electrification Policy (2006)

Tariff Policy (2006)

Electricity Policy (2005)

Electricity Act (2003)

Integrated Energy Policy (2007)

These policy measures with increasing demand had injected impetus to reform effort.

Mandatory sector restructuring by allowing multi-buyer multi-seller model

Promotes competition and private sector participation through:

- Allowing open access
- Transparent and evolved multi year tariff regimes
- De-licensing generation by allowing competitive bid-based tariffs
- Strong anti power theft measures
- Promoting decentralized generation, rural franchisees and renewable

Consumer protection and advocacy, through setting up ombudsman, state advisory committees, consumer service standards of performance



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Bank program draws on lessons from past to foster institutional transformation ...

❖ Bank Operational Strategy:

- Builds on the prevailing satisfactory policy frameworks in India - main weaknesses in:
 - Implementation
 - Sector/corporate governance
 - Cross-sectoral linkages (Groundwater, River basin, Rural Development)
- Focuses on selective partnerships to build institutional capacity:
 - Service providers (supply chain)
 - Policy and regulatory authorities
 - Other stakeholders - demand side of good services and governance
- Uses range of instruments: Investment lending, DPLs (multi-sector) and non-lending TA/ESW/Capacity Building Activities;
- Seeks to further shape/refine policy frameworks based on lessons from lending and non-lending engagements



Bank Program Supports GoI Objectives

After five years of no new lending, since FY06 WB Bank is scaling up support, helping GoI to implement its reform/investment programs in key

Bank's
Engagement

- **Clean Energy Development -**
 - Hydropower projects with 2 hydro companies on 2 river basins (SJVN on Satluj basin in Himachal Pradesh and THDC on Alaknanda basin in Uttarakhand)
 - Coal plant rehabilitation with Gencos in 3 States
- **Expand transmission capacity – to facilitate efficient energy markets, inter-regional power transfer, and build institutional capacity of state transmission utilities**
 - Powergrid (Series of Loans), Maharashtra Transco (Loan and TA) and Haryana Transco (Loan and TA)
- **Strengthen governance and quality of electricity distribution services in selected states (including rural areas)**
 - West Bengal (TA) and Haryana Discom – DHBVN (loan and TA)



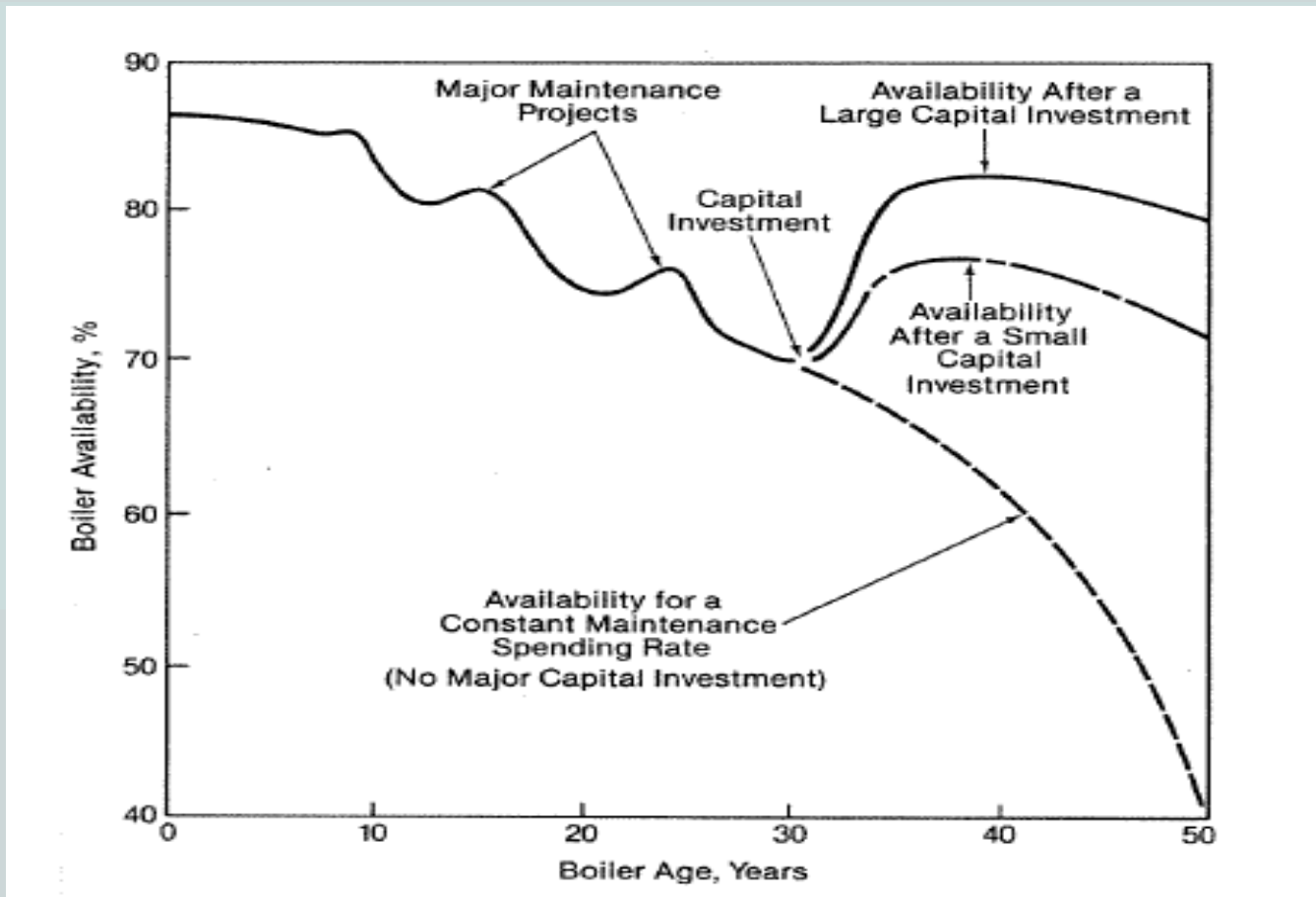
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Would it be possible to achieve these R&M targets in Bank's client countries?

A Typical Availability Curve for Large, High Pressure Boiler





Would it be possible to achieve these R&M targets in Bank's client countries?

Examples of Efficiency Gains Due Implementation of R&M

	Improvement	Net Efficiency Gain (% points)
Combustion System	Pulverizer and feeder upgrades	0.3
	Air preheater repair or upgrade	0.25
	Sootblower improvements	0.35
	Excess air I&C	0.2
Steam Cycle	Feedwater heater repairs	0.4
	Heat transfer tube upgrades	0.6
	Steam turbine blades	0.5
	Cycle isolation	0.5
	Condenser repairs	0.4
O&M	O&M training	
	Computerized maintenance and management systems and Reliability centered maintenance	Included in combustion and steam cycle gains. Efficient operation realized over the long term.
	Distributed control systems	
Combined Total		3.5



World Bank's Engagement on R&M

China Thermal Power Efficiency Project

The project development objective is to reduce coal consumption and GHG emission per unit of electricity production in Shanxi Province, Shandong Province and Guangdong Province in China, through:

- I. Mitigating the financial barriers of closing inefficient small-sized coal-fired units
- II. Demonstrating the viability of investments in efficiency improvements in existing mid-sized thermal units
- III. Developing effective regulations to implement the pilot ESD programs and conducting studies to support the transition to efficient generation dispatch.

The project will support pilot programs and demonstration sub-projects in three provinces that have significant potential for power sector efficiency improvements – Shanxi, Shandong and Guangdong



World Bank's Engagement on R&M

China Thermal Power Efficiency Project (Contd)

The project has five components:

1. Mechanisms to support the closure of inefficient small coal-fired generation units
2. Demonstration of power plant efficiency improvements
3. Transition to efficient generation dispatch
4. Technical assistance for project implementation;
5. Project management



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

Project development objective and key indicators

The objective of the project is to *improve energy efficiency of selected coal-fired power generation units through renovation and modernization (R&M) and improved operations and maintenance (O&M).*

The key indicators to measure the achievement of development objectives of the project will be *reduction in fuel (coal and oil) consumption per unit of power generation after completion of R&M.*



World Bank's Engagement on R&M in India

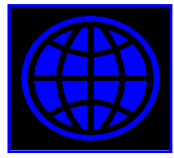
Seeks to Support GoI policies

Government Policies on R&M

- ❖ As said before, several policies such as National Electricity Policy, Integrated Energy Policy etc. provide broad frame work for future R&M.

National Electricity Policy on R&M:

- ❖ The provisions in the above policy documents read as under:
- ❖ **Para- 5.2.21** - One of the major achievements of the power sector has been a significant increase in availability and plant load factor of thermal power stations specially over the last few years. Renovation and Modernization for achieving higher efficiency needs to be pursued vigorously and all existing generation capacity should be brought to minimum acceptable standards. The Government of India is providing financial support for this purpose.
- ❖ **Para - 5.2.22** - For projects performing below acceptable standards, R&M should be undertaken as per well-defined plans featuring necessary cost-benefit analysis. If economic operation does not appear feasible through R&M, then there may be no alternative to closure of such plants as the last resort.
- ❖ **Para - 5.2.23** – For plants with poor O&M record and persisting operational problems, alternative strategies including change of management may need to be considered to improve the efficiency to acceptable levels of these power plants.



World Bank's Engagement on R&M in India Seeks to Support GoI policies

Government Policies on R&M

Integrated Energy Policy

The provisions in the above policy documents under the heading Increasing Efficiency of Coal-Based Power Plants read as:

- Increase the gross efficiency in power generation from the current average of 30.5% to 34%. All new plants should adopt technologies that improve their gross efficiency from the prevailing 36% to at least 38-40%.
- Require NTPC and SEBs to acquire technology to enhance the fuel conversion efficiency of the existing population of thermal power stations from an average of 30% to 35%. No new thermal power plant should be allowed without a certified fuel conversion efficiency of at least 38-40%.



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

- ❖ IBRD Loan (US\$180 million) and GEF Grant (US\$45.4 million)
- ❖ Component 1: Energy Efficiency R&M Pilots (US\$295.9 million)
 - West Bengal : Bandel, Unit-5 (210 MW)
 - Maharashtra : Koradi, Unit-6 (210 MW)
 - Haryana : Panipat, Units 3 & 4 (110MW each)
- ❖ Component 2: Technical Assistance (US\$7.5 million)
 - Support for Design of Energy Efficiency R&M (US \$2.5 m)- 840 MW of additional capacity in Maharashtra (Parli, Bhusawal and Chandrapur).
 - Support for Implementation of Pilot EE R&M Investments(US \$1.5 m)
 - Support for Addressing Barriers to EE R&M Projects (US \$1.1 m)- CEA
 - Support for Strengthening Institutional Capacities of Utilities (US \$2.4 m)



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

- ❖ Technical Assistance, Capacity Building & Sector Dialogue
 - Regulatory Study & Operations and Maintenance Study
 - Design and Safeguard studies for eight generation units, adding to 1480 MW
 - Studies for review of implementation experience for Bandel, Koradi and Panipat
 - Capacity Building Interventions at three state utilities and CEA
 - Dialogue for Expanding the Market for R&M

Sector Dialogue on National R&M Program

- ❖ Partnership with KfW and USAID (Eco-Asia CDC Program)
- ❖ Huge potential for scaling up engagement, as pilots progress



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

Key aspects of project design and preparation:

- ❖ Preparation of technical design of project by reputable consultants in close collaboration with gencos. Consultants responsible for review of Residual Life Assessment reports, conducting Energy Audit studies, development & evaluation of design options to select the preferred option, preparation of technical specifications & support on commercial and contractual design of bidding process.
- ❖ Detailed review of all technical aspects of project design by a panel of technical experts with extensive experience in design and implementation of R&M projects in India and abroad.
- ❖ Structuring of procurement for R&M of Unit-5 of Bandel into four packages – (a) Boiler, Turbine and Generator (BTG) package, (b) Coal Handling Plant, (c) Ash Handling Plant, and (d) Electrical System Package. This would allow supplier's accountability for unit performance as a whole, while also ensuring that the designs of various sub-systems are mutually compatible.

(Contd.)



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

Key aspects of project design and preparation (Contd.)

- ❖ Two-stage bidding for the main BTG package would allow further refinements in technical design and performance requirements based on concerns highlighted by bidders
- ❖ Independent implementation support and quality assurance consultants, working in collaboration with the concerned power generation utility, would be appointed for monitoring implementation progress & quality.
- ❖ Commissioning of Environmental Audit Due Diligence (EADD) and Rapid Social Assessment (RSA) studies and feeding the outputs from these studies in to the technical design. Preparation of a joint agreed action plan for implementation of recommendations from these studies

(Contd)

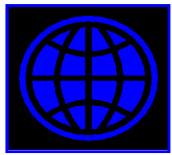


World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

Key aspects of project design and preparation: (Contd)

- ❖ Upfront preparation of a detailed strategy for handling surprises on opening the machines for R&M implementation and establishing a clear decision making framework.
- ❖ ESMAP funds have also been used for undertaking a “Study of O&M practices at Koradi and Bandel”. The study also brings out a plan for strengthening O&M practices at these power plants.
- ❖ ESMAP funds have been used for pursuing a “Study of Options for Regulatory Treatment of Rehabilitation Projects in India”.
- ❖ Phasing of implementation of pilot projects to allow transfer of learning from one pilot to the next.



World Bank's Engagement on R&M in India

INDIA: Coal Fired Generation Rehabilitation Project

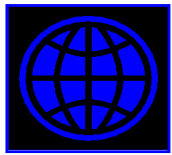
Current Status

- ❖ **Bandel Unit 5 (210 MW) - Procurement notice for main BTG package issued by WBPDCCL .Pre-Bid conference held and responses being prepared to the bidder's queries.**
- ❖ **Koradi Unit 6 (210 MW) - Detail Project Report finalized. Bidding documents under finalization.**
- ❖ **Panipat Units 4 & 5 (110 MW) - Appointment of consultants for Design, EADD and RSA being processed.**



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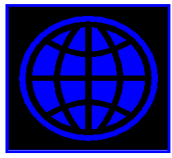
Addressing Barriers and Risks to R&M

- ❖ R&M Design based on thorough Design Studies to Minimize Surprises
- ❖ Incorporation of past experiences in R&M design
- ❖ Environmental compliance requirements included in technical specifications
- ❖ Development of a Strategy to Handle Surprises
 - Anticipate surprises and plan for possible component / work requirements
 - Decision making process should be clear upfront
 - Keep the regulator into loop – in-principle approval for possible cost escalation
- ❖ Develop deeper market for design consultancy services
- ❖ Attract Private Sector Participation



Addressing Barriers and Risks to R&M

- ❖ Two-stage procurement process to allow feedback on techno-commercial aspects of bid process
- ❖ Getting Greater Supplier Participation
 - Contract Design is critical
 - Contract Packaging is important
 - Qualification Requirements should allow broader participation
 - Performance Guarantees should not be excessive
 - Show-casing the large R&M requirement in India
 - Bundling of R&M
 - Soliciting interest from Asia and Eastern Europe



Addressing Barriers and Risks to R&M

- ❖ Elaborate planned shutdown
- ❖ Integration of higher price and physical contingencies in project analysis
- ❖ Deployment of Implementation Support Consultants and Quality Assurance Consultants
- ❖ Technical Assistance for Strengthening O&M Practices
- ❖ Capacity building both at the State and Center.



Addressing Barriers and Risks to R&M

- ❖ Making R&M Less Onerous on Utilities Going Forward
 - First Few Pilots likely to be challenging and effort intensive
 - Subsequently, based on the feedback from the pilot projects the following approaches may be explored so as to have an equitable sharing of risks and reduce the cycle time:
 - Standardization of Technical Solutions
 - Specifications should focus on Functional Requirements
 - Standardize Bidding Documents
 - Bundling of Units
 - Rolling R&M over an Extended Period instead of One Shot R&M
 - PPP Solutions



Addressing Barriers and Risks to R&M

Participation of private Sector in R&M is key to success as public sector may have limitations!

Existing Transaction Options to date :

- Lease, Rehabilitate, Operate and Transfer (LROT)
- Sale of Plant
- Joint Venture

- There have been 3 to 4 transactions between the state utilities and NTPC (public-public partnership) under Sale of plant route and one transaction under the JV route
- States/power utilities can also consider other innovative options.
- Selection of PP would generally be through competitive bidding
- **There has been no PPP transaction till date.**



Addressing Barriers and Risks to R&M

Attracting participation of private Sector in R&M has started!

- In order to better understand the lack of progress in PPP transactions, ESMAP-funded study to provide power sector regulators and other stakeholders in India with *“a coherent understanding of regulatory options available to encourage investment in energy efficient renovation and modernization (EE R&M) at the state level”*.
- The study, also aimed to develop workable regulatory solutions derived from a comprehensive understanding of the issues in India and, where relevant and appropriate, from international best practice.
- Study completed in October 2008 and sets out a number of options based on the range of regulation found across states in India. Recommendations discussed by the Forum of Regulators in November 2008.
- A follow-up ESMAP-funding study commissioned to operationalize improved incentives to invest in energy efficiency rehabilitation of coal-fired generation plant in India.



Addressing Barriers and Risks to R&M

Attracting private players in R&M is proving a difficult task!

The objectives of the follow-up ESMAP study are:

- To identify states and public sector counterparties where improvements to the policy/regulatory framework can increase the rate of investment in energy efficient R&M.
- Specify the exact regulatory/policy requirements. An important aspect of the work will be to better understand applicability to different states in India and then to advance the work (carried out in the prior study) on the options to operationalize the solutions for the identified states.
- Prepare third party investors/developer investment. Possibility to use “Distribution Franchisee model” known to the Indian power sector.
- To clearly identify the information (regulatory, financial, contractual, etc) that the interested firms would require prior to putting together a bid. This work will include identification of specific potential transactions and the preparation of an ‘Information Note’ for potential bidders.



Next Phases of WB Energy Program

If current programs are successful...

1: National Hydro Development

Improving institutional capacity and decision making framework for hydro development in two states

2. National R&M Program

- Scale up program based lending in existing genco clients (West Bengal, Maharashtra and Haryana)
- Identify and provide TA to national technical agency for leading this program

3. National Electricity Fund (to support State Transcos)

Scale up program lending in existing State Transco clients
Provide TA through National Champion agency

4. Improving Distribution Viability

Develop principles and guidelines to support National Programs (APDRP/ RGGVY)



Thank You

Questions are welcome