



GOVERNMENT OF INDIA MINISTRY OF POWER

Greening the Grid

Evaluating grid readiness and interventions enabling variable renewable energy grid integration: Case of world's fastest growing economy, India 2nd Energy Evaluation Asia Pacific-EEAP 2019 Conference October 30-31 (Wed-Thurs) Amari Watergate Hotel Bangkok, Thailand

Greening the Grid (GTG) Program A Partnership between USAID/India and Government of India







Renewable Energy in India



- GOI has set a target to achieve 175 GW of RE capacity by FY 2022; comprised of 100 GW solar and 60 GW Wind. India has committed to achieve 40% of installed capacity from non-fossil fuel based energy resources by 2030.
- Absorbing Variable RE capacity of such magnitudes in the future requires a multi-pronged approach to grid integration.





Greening the Grid Study: 2022 Scenario (NREL-POSOCO) Purpose:

- If India develops <u>100</u> GW of solar and <u>60</u> GW of wind energy, how would the system operate in 2022?
- What can policy makers do to lower the cost of <u>operating</u> this system and better integrate RE?

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VRE: Grid Integration Challenges

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——— Forecasting and Scheduling of VRE (REMCs, SAMAST, etc.) REMCs under implementation across high RE states; FOR model framework for states to adopt obligating VRE generators to forecast and schedule themselves

Several initiatives have been taken by GOI in consultation with key stakeholders to enable reliable and cost-effective integration of 175 GW of VRE by 2022 **Green Energy Corridors & provision of Transmission** Ministry of Power outlined GEC I and II, which created significant enabling transmission infrastructure for evacuation of power from large VRE sites. GEC III under finalization to provide further fillip to this initiative

- Flexibilisation of Thermal Generation

Thermal generation shall form bulk of India's energy supply in 2030 although its share will decrease. Making this large capacity base flexible is key to integrating VRE at scale.

Redesign Markets (Faster S&D, RTM, SCED, Ancillary)

Faster Scheduling and Despatch, Introduction of Real-Time Markets with gate closure, Enabling Frequency Regulation through AGC, Security Constrained Economic Despatch

Battery energy storage systems

Evaluate and plan for the role of batteries in the power system, with increasing penetration of VRE.





Priority Takeaways

India's power system has significant latent physical flexibility to integrate 175 GW RE with existing plans

Harnessing this flexibility is the key challenge. Need appropriate regulations, markets, incentives...

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For example, consider ways at the state level to compensate thermal plants for operating flexibly

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Additional planning could identify optimal locations for new RE and associated inter- and intrastate transmission







Annual impacts: I75 GW RE can meet 22% of India's annual electricity demand with minimal RE curtailment







Retiring 46 GW of thermal (20% of thermal capacity) may not negatively affect operations







Greening the Grid - U.S.-India Joint Partnership



Goal: Enhance efforts to manage large-scale RE grid integration

- Robust analysis of challenges and solutions
- Integration pilots to validate scalable reforms >
- Sharing of knowledge and best practices

Asia EDGE (Enhancing Development and Growth through Energy) Initiative

EXTERNAL ACTORS

DONOR TO DONOR COORDINATION (with GiZ, DFID, ADB, etc)

USAID's GREENING THE GRID (GTG) PROGRAM

POWER SYSTEM PLANNING REFORMS (DOE LABORATORIES)

- National Grid Integration Study
- **Regional Grid Integration Plans**
- TA to Large-scale RE Parks
- Analysis Grid Integration Pilots

UNITED STATES GOVERNMENT COORDINATION

INDUSTRY ADVISORY COUNCIL (IAC)

Integrate GTG Components Special Activity Fund **U.S.-INDIA SYSTEM OPERATORS** (NARUC) PARTNERSHIP (USEA)

- Capacity Building of SLDCs, ISOs Utilities
- Peer to Peer Exchanges
- Training and Workshops
- India U.S. Private Sector Exchange

INDIA REGULATORY PARTNERSHIP

- Assistance to Forum of Regulators
- Twinning with State Regulators
- Training and Capacity Building
- Peer to Peer Exchanges

PILOTING REFORMS

(DELOITTE CONSULTING LLP)

Co-financing & TA for Pilots

Stakeholder Mobilization





Renewable Integration and Sustainable Energy (RISE)







Flexible Thermal Power Generation





success.



Emerging Scenario & Need for Flexibility

As per NREL study on Grid Modeling for India (2016), for a 2022 scenario, technical minimum of 70% for coal-based plants would result in RE curtailment of about 3.7%. The curtailment reduces to 0.76% for a tech. min. of 40%



Source: CEA committee Report on Roadmap for flexible operation





Pilot supports technical interventions and operational changes at NTPC's Ramagundam (200 MW unit), Jhajjar (500 MW unit) and GSECL Ukai TPS (200MW & 500 MW unit)



Stage I:Techno Economic Assessment & Roadmap

- Technical due diligence and detailed feasibility assessment
- Establishing reliable costs of flexibilisation – capex as well as opex



Stage 2: Regulatory Pathway and Fleet Level Strategies

- Assistance in framing Regulatory Mechanisms for Flexibility
- Assistance in building fleet level strategies for NTPC / GSECL

Stage 3: Pilot Implementation

- Technical Assistance in pilot / fleet level implementation to NTPC
- Leverage private partnerships and contribution in investments



Stage 4: Scale up

- Assist in fleet-wide implementation and national scale up
- Capacity building of operators – Procedures and Operational Toolkits

2019 2018 2020 2017 **Regulatory Frameworks for Pilot Conceptualization** Technical Assessment Facilitate fleet-wide flexibilization to CERC & GERC reports completed for adoption and On Boarding of Technical NTPC and GSECL units National scale up Pilot Test Runs & Fleet Wide Strategies Assistance (TA) Firm Executive Exchanges to US Knowledge Changes to Operating Procedures Stakeholder Discussions & Dissemination Data Collection Knowledge Dissemination Executive Exchanges & Knowledge Workshops Workshops **Dissemination Workshops TA Implementation Plan**





Greening the Grid - Key Highlights







GOVERNMENT OF INDIA



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