

विद्युत मंत्रालय MINISTRY OF POWER



Report of the Group on Development of Electricity Market in India



Alok Kumar Secretary Ministry of Power, Government of India Chairperson of the Group Ministry of Power Shram Shakti Bhawan Rafi Marg, New Delhi



FOREWORD

The Ministry of Power had constituted a Group for Development of Electricity Market in India on 29th of July 2022. The objective was to review the issues faced in the electricity markets at present, identify the required interventions for implementation and draw up a roadmap for the future.

The Group identified key issues to be addressed in the redesign of the Indian electricity market. The issues include dominance of inflexible, long-term contracts, resource adequacy planning, reliance on self-scheduling, increasing share of renewables in the overall energy mix, electricity markets to integrate renewables and firmness in reserves for ancillary services. Over the course of time, 09 meetings of the Group were held with deliberations and consultations on various issues.

The report of group, prepared after detailed deliberations and consultations over a course of time, attempts to define a range of interventions with associated timeframes and requirements to enable efficient, optimal and reliable market operations.

The Group believes that with the implementation of the recommendations outlined in the report, the key issues being faced in having a robust electricity market will be addressed. A road map and scientific implementation approach has been outlined by the group in the report.

Date: 15 May 2023

Alok Kumar Secretary, Ministry of Power Government of India

Group On "Development of Electricity Market in India"

Ministry of Power, vide Order No. 45/6/2019-R&R/REM dated 29th July 2022, formed group for deepening of power market in India under the Chairmanship of Secretary, Ministry of Power, Government of India.

The Group has outlined the roadmap and specific recommendations in the redesign of the Indian electricity market of the future; in accordance with the terms of reference of the Group, in the form of a report. The focus areas are resource adequacy planning and capacity contracting, efficiency in the day-shead market, participation of renewable energy in the day-shead market, market-based mechanism for secondary reserves, demand response and aggregation, market monitoring and surveillance, financial products for electricity, five minute-based scheduling, dispatch, metering, and settlement along with larger balancing areas. The Group, hereby, submits the report to Ministry of Power, Government of India.

(Divyinshu Jha) Deputy Secretary Ministry of New & Renewable Energy

(S. S. Barpanda) Director (Market Operation), Grid-India Convener of the Group

(Saniay, Robey)

Principal Secretary, Energy Department, Government of Madhya Pradesh

(Ajay Talegaonkar) Member (E&C) Central Electricity Authority

(Sushamtii Kumar Chatterjee) Chief (Regulatory Affairs) Central Electricity Regulatory Commission

(Vijay Singhai) Chairman & Managing Director MSEDCL, Maharashtra

(Ita)esh Lakhoni) Chairman & Managing Director TNES and TANGEDCO & Chairman, TANTRANSCO

(Ghanshyam Prasad) Chairperson Central Electricity Authority

(Alok Kumar) Secretary Ministry of Power, Government of India Chairperson of the Group

Table of Contents

Ackr	nowledgement5			
Exec	Executive Summary7			
1.	Background11			
2.	Need for Power Market Redesign			
3.	Key interventions for Indian power market based on identified issues25			
4.	Resource Adequacy and capacity contracting29			
5.	Enhancing the efficacy of the Day-ahead market41			
6.	RE participation in day-ahead market49			
7.	Market-based mechanism for secondary reserves55			
8.	New actors in Indian power market (Demand Response and Aggregation)63			
9.	Market monitoring & Surveillance69			
10.	5 minute based metering, scheduling, dispatch and settlement73			
11.	Enlargement of Balancing Area77			
12.	Financial products for electricity81			
13.	Summary and overall implementation roadmap85			
Annexure 1 –Office order and Minutes of meeting87				
Annexure 2 - Resource adequacy process and determining Reserve margins				
Annexure 3 – Day ahead market130				
Annexure 4 – RE participation in day ahead market132				
Annexure 5 – Market-based mechanism for secondary regulation133				
Ann	exure 6 – Demand Response & Aggregation of DERs136			
Ann	Annexure 7 - Market-monitoring & surveillance139			
Annexure 8- Financial products for electricity – US experience142				
Annexure 9 – PJM market mechanism for ancillary services144				
Annexure 10 – Indices for market monitoring147				
Ann	Annexure 11 – Overview of various financial products for electricity148			

List of Figures

Figure 1: Power market reforms in India in the last two decades	. 14
Figure 2: Diversity in demand patterns across various states in India over the year.	. 15
Figure 3: NREL study to evaluate reserve requirements under alternate dispatch intervals in Western	
Interconnection (USA)	. 74
Figure 4: Illustration of BRP operation	. 78
Figure 5: Overall Roadmap for power market	. 86

List of Tables

Table 1: Key issues, interventions and redesigned states for Indian power market	25
Table 2: Key initiatives taken by relevant authorities to address issues at hand	27
Table 3: Description of different variants of short-term capacity markets	32
Table 4: Roadmap for short-term capacity market introduction	34
Table 5: Description of possible variants of long-term capacity markets	35
Table 6: Roadmap for introduction of long-term capacity markets	38
Table 7: Overview of day-ahead market mechanism in US and Europe	41
Table 8: Proposed pilot implementation for MBED	43
Table 9: Roadmap of proposed implementation for enhancing efficacy of day ahead market	46
Table 10: Various implementation requirements and enablers	46
Table 11: Options for enabling RE participation through Bilateral Contract Settlement (BCS)	51
Table 12: Roadmap of proposed implementation for mainstreaming RE participation in market	53
Table 13: Overview of the various ancillary service mechanisms in India	55
Table 14: Overview of market-based mechanisms for secondary reserves	56
Table 15: Types of products for secondary frequency regulation	57
Table 16: Types of market clearing mechanisms for secondary frequency regulation	58
Table 17: Types of auction mechanisms for secondary frequency regulation	58
Table 18: Types of faster responding sources for secondary frequency regulation	60
Table 19: Roadmap for introduction of Ancillary services	61
Table 20: Implementation requirements for market-based mechanism for secondary regulation	62
Table 21: Possible contours of market-based procurement of secondary reserves	62
Table 22: Roadmap for introduction of demand response and aggregation	66
Table 23: Implementation requirements for demand response in India	66
Table 24: Requirements for implementing a framework on aggregation of Distributed energy resourc	es in
India	67
Table 25: Roadmap for introduction of a mechanism for robust market monitoring & surveillance	
mechanism	71
Table 26: Requirements for implementing a framework on market monitoring and surveillance	71
Table 27: Shorter dispatch intervals in advanced electricity markets	73
Table 28: Implementation requirements for 5 minute-based metering, scheduling and dispatch	75
Table 29: Implementation requirements for introducing financial products for electricity market	82

Acknowledgement

The Group would like to thank Ministry of Power for constituting the Group and creating a platform for deliberating on vital aspects of development of electricity markets in India. The members acknowledge the extensive support provided by their parent organizations for accomplishing the assignment.

The Group would also like to thank Sh. Hemant Pandey, Sh. Suresh Annepu, Sh. Prashant Bhamu and Sh. Nishat Kumar from RCM Division, Ministry of Power for their vital contributions in preparation for the meetings.

The Group also acknowledges the wealth of information available in the literature & international experience in different countries which has provided deep insights into the finer aspects of designing newer and efficient electricity market products and services in India. The contribution of Sh. S.C. Saxena, ED, NLDC and Sh. K.V.N. Pawan Kumar, Chief Manager from Grid-India along with Sh. Shubhranshu Patnaik, Sh. Anish Mandal and Sh. Chandan Dikshit from M/s Deloitte (India) is also duly acknowledged.

S. S. Barpanda Director (Market Operation), Grid-India Convener of the Group