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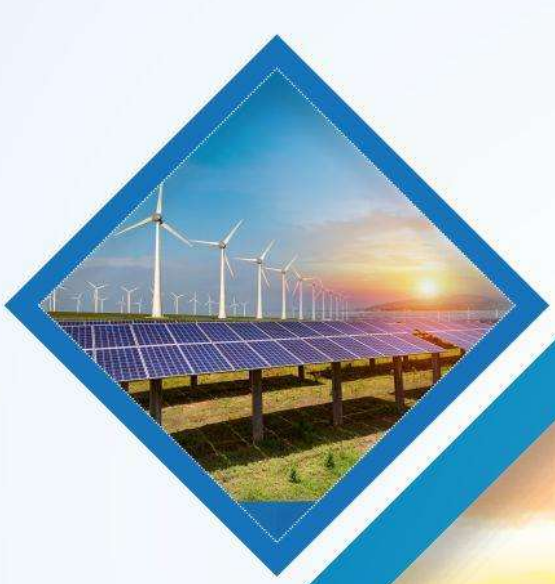
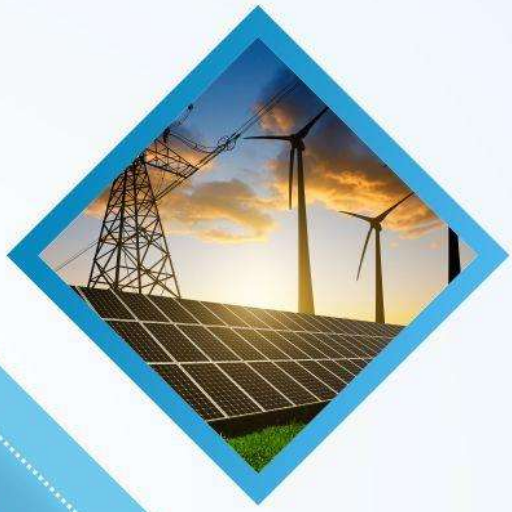
Recommendations for Model Regulations

Regulatory Framework for Resource Planning





August 2020

REGULATORY FRAMEWORK FOR RESOURCE PLANNING

USAID-MNRE PARTNERSHIP TO ADVANCE CLEAN ENERGY DEPLOYMENT 2.0 (PACE-D 2.0 RE) PROGRAM

USAID TASK ORDER AID-OAA-I-13-00019AID-OAA-TO-17-00011

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ACRONYMS

2YRPSAS	Two-Year Probability of Supply Adequacy Shortfall
APDCL	Assam Power Distribution Company Limited
ARR	Annual revenue requirement
CAGR	Compound annual growth rate
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CO2	Carbon dioxide
CTU	Central Transmission Utility
DER	Distributed energy resources
DISCOM	Distribution company
DR	Demand response
DRE	Distributed renewable energy
DSM	Demand-side management
EV	Electric vehicle
FoR	Forum of Regulators
GW	Gigawatt
IEGC	Indian Electricity Grid Code
INR	Indian rupee
kWh	Kilowatt hour
MNRE	Ministry of New and Renewable Energy
MU	Million units
MW	Megawatt
MYT	Multi-year tariff
PACE-D	Partnership to Advance Clean Energy Deployment
POSOCO	Power System Operation Corporation Limited
PPA	Power purchase agreement
RE	Renewable energy
REPOSE	Renewable Energy Procurement Optimization and Smart Estimation
RPO	Renewable purchase obligation
SAE	Statistically adjusted end use
SERC	State Electricity Regulatory Commission
STU	State Transmission Utility
UK	United Kingdom
USA	United States of America
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

In the electricity distribution business, power purchase costs account for about 60 to 80 percent of total costs. The optimization of supply resources and greater use of cheaper (compared to existing thermal generation) renewable energy (RE) generation can significantly impact the economically strapped distribution companies (DISCOMs) and help customers by reducing the electricity tariff. A new class of supply-side resources, such as distributed energy resources (DER), demand response (DR), and demand-side management (DSM), coupled with a new class of demand-side resources, such as electric vehicles (EV), provides more options to optimize supply-side resources for cost or/and environment reasons.

There is no doubt that RE generation costs are lower than thermal generation costs, but uncertainty remains concerning the costs of system integration, which varies based on location, time, power system conditions, exiting generation portfolios, etc.

Medium- and long-term resource planning can address optimization of the resources and minimization of system integration costs for RE. Following unbundling of the power sector, the industry focused more on electrification and 24x7 supply by the DISCOMs. It has limited resource planning to an annual plan as part of the annual revenue requirement (ARR) or, the identification of a demand and supply gap. The unscheduled interchange penalties in the availability-based tariff shifted the focus to day-ahead scheduling and planning. However, it did not draw the attention of regulators and DISCOMs to the fact that incremental gains from better day-ahead scheduling can be converted into quantum gains by medium- and long-term resource planning. To highlight this, a white paper— "Rethinking DISCOM Resource Planning in a Renewable Energy Rich Environment"—was developed under the United States Agency for International Development (USAID) Partnership to Advance Clean Energy Deployment (PACE-D) 2.0 RE program. The paper recommended the following three strategies, which were supported by several stakeholders:

- development of software for resource planning;
- development of model regulations for resource planning; and
- capacity building.

The PACE-D 2.0 RE program is working on all three recommendations, but this report focuses on the second bullet.

To develop the model regulations, an extensive primary and secondary research is conducted for around 12 states in India. States are selected based on the criteria such as: rich in RE resources; have existing resource planning guidelines; are progressive in their adoption of new regulations, technology, etc.; and are representative of the North, East, West, and South of India. The primary research consisted of structured questionnaires in four categories (Regulations, DISCOMs, Methodology, and New Drivers) and telephone interviews. International practices and the existing resource planning regulations and practices in India informed the secondary research. Further, all documents at the federal and state levels pertaining to existing resource planning regulations, multi-year tariffs (MYT), electricity supply codes, state grid codes, the Indian Electricity Grid Code (IEGC), national electricity plan, and new Central Electricity Authority (CEA)/Central Electricity Regulatory Commission (CERC) guidelines on planning are also examined.

Primary and secondary research reveals notable gaps that exist in the current regulatory framework for resource planning. These gaps are related to the very existence of a regulatory framework for resource planning, the methodology adopted, importance to renewable energy in power portfolios,

and the availability of trained staff to formulate the resource plans. Specific gaps identified through primary and secondary research are as follows:

- The basic regulatory framework for resource planning exists, through either MYT regulations or grid codes; however, there has been no amendment for the last 15+ years.
- There are no specific regulations for resource planning to cater to the high influx of renewable resources in the power system.
- Lack of importance to advanced methodologies in formulating the resource plans. Most of the DISCOMs develop resource plans utilizing excel models.
- There is an absence of specific timelines for submission and approval of resource plans. For example, ARR submission and its scrutiny is the timeframe when resource plans review occurs.
- Emerging technologies such as DER, EE, and EVs and their impact on the demand is not part of regulations.
- With large-scale renewable integration, regulations for the development of hourly demand profiles and load research are essential attributes to understand the utility demand pattern.
- Lack of responsibility and trained staff for resource planning both at the regulator and DISCOM level.

To fill the existing regulatory gap on resource planning, there is an urgent need for comprehensive guidelines for medium- and long-term resource planning. Through these guidelines, the planning will receive greater attention than it has, high end software and analysis will minimize the uncertainty in the planning. The feedback from few regulators and DISCOMs was sought to gauge the ease of implementation.

1. INTRODUCTION

Resource planning is a process that helps DISCOMs optimize their supply resources to meet long-term and medium-term consumer demand while incorporating objectives related to cost-effectiveness, environmental impact, and energy security, among others. In recent years, India has significantly increased its share of RE capacity. For example, renewables accounted for 75 percent of the new capacity added in 2019, and the trend is expected to grow in the future. Further, the government is considering revision of the capacity target for RE from 175 gigawatts (GW) to 228 GW by 2022 and 450 GW by 2030.[1]

Resource planning involves three sequential sub-processes:

- Forecasting demand over the planning horizon;
- Mapping existing supply-side resources over the planning horizon to meet the forecasted demand; and
- Identifying the power to be procured to meet the forecasted demand minus the existing supply resources. This optimization of power procurement is done based on the objectives of the DISCOM, such as least cost, lowest carbon dioxide (CO2) contribution, etc.

The Ministry of New and Renewable Energy, Government of India (MNRE), in partnership with USAID, launched the second phase of the PACE-D 2.0 RE Program in January 2019 with Assam, Jharkhand, and Gujarat as partner states. PACE-D 2.0 focuses on enhancing the deployment of RE technologies by making them a more cost-effective and reliable resource for meeting India's energy security and economic objectives. One of the key interventions of this program is strategic energy planning for RE deployment. Strategic energy planning aims to use the three sequential steps of resource planning listed above to maximize the share of RE in the power portfolio of DISCOMs in a cost-effective manner.

The white paper published in 2019, "Rethinking DISCOM Resource Planning in a Renewable Energy Rich Environment," evolved out of intense research and consultation with stakeholders focused on India's need to transition from an electricity sector dominated by fossil fuels to one dominated by RE. The white paper resulted in key recommendations that if adopted will improve the resource planning in India. Two key recommendations are:

- development of a rigorous, modular, and easy-to-adopt resource planning software tool, and
- development of a regulatory framework for resource planning.

Representatives from six state electricity regulatory commissions (SERCs), including the vice chairman from the Forum of Regulators (FOR), and representatives from ten DISCOMs supported thae above recommendations at the launch of the white paper. They suggested that if USAID supports the development of the software and model regulations, they will help implement these key recommendations throughout the electricity sector. USAID agreed to take up this work under the PACE-D 2.0 RE Program.

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[1] http://cea.nic.in/reports/others/planning/irp/Optimal_mix_report_2029-30_FINAL.pdf

To arm utilities with a world class software tool for resource planning, the program-initiated development of software for long-term demand forecasting and power procurement—Renewable Energy Procurement Optimization and Smart Estimation (DISCOM-REPOSE). The software has three modules (Demand Forecasting, Resource Mapping, and Optimization of Power Requirement) that can work independently as well as in an integrated fashion. PACE-D 2.0 RE has already developed and deployed the first two modules in the partner state utilities of Assam and Jharkhand. The results are encouraging, and it is expected to have the complete software package ready by November 2020.

This report presents the work undertaken toward the second recommendation of the white paper *i.e.*, the development of the model regulations for resource planning. After reviewing the existing regulatory framework and international best practices and interviewing key stakeholders and experts, the model regulations are drafted. Only a few states, such as Andhra Pradesh, Haryana and Gujarat, have specific regulatory guidelines for resource planning. In other states mostly some provisions of resource planning are covered in multiple documents (such as multi-year tariff (MYT) regulations, state grid code, and distribution code).

This report outlines the importance of resource planning, followed by the detailed methodology used in review of existing regulations, research work conducted to develop the model regulations, and conclusions from the primary and secondary research. Please see the complete model regulations in Annex 1.

2. IMPORTANCE OF RESOURCE PLANNING

India has a commitment to include 175 GW of RE in the existing 362 GW grid by 2022 with an ambition to achieve 450 GW by 2030. With rapid technological progress in the past five years, India has added an unprecedented amount of renewable capacity (85.9 GW as of December 2019[2]). In 2019, RE accounted for 75 percent of the total capacity additions made to India's system, and this trend is expected to continue as the RE market matures and costs fall (from 5 INR/kWh in 2015 to 2.5INR/kWh in 2019[3]).

Falling RE prices coupled with innovative technologies such as distributed renewable energy (DRE), EV, DSM, forecasting, and planning offer an opportunity for DISCOMs to absorb more low-cost RE into their system with minimum system integration costs. In order to seize the opportunity offered by cheaper RE and technology developments DISCOMs must review their existing resource planning practices and determine how to incorporate more renewables into their power portfolios.

Historically in India, resource planning uses peak demand as a reference point to be met by fossil-based generation instead of using demand profiles, which can help resource planners incorporate RE when it is the least-cost option. This is a matter of great importance, as RE-dominated power portfolios can be cheaper than those reliant on fossil-based generation. They also can influence the cost of power procurement, which accounts for 60 to 70 percent of the average cost of supply. For example, PACE-D 2.0 RE analysis showed that a 25 percent injection of RE can result in a 10 percent reduction in the power procurement costs for DISCOMs[4].

On the demand side, there is an absence of robust data on the actual demand for electricity. This is mainly because a significant portion of electricity consumed is not metered. Without clear data on the actual demand for electricity, it is difficult to determine how much supply is required. This leads to under- or over-estimation of demand and investments in new generation capacities. Under-estimation of electricity demand leads to massive load shedding and blackouts, whereas over-estimation leads to an undue burden of fixed charges included in power procurement costs, ultimately leading to higher consumer tariffs. For example, a PACE-D study revealed that its partner utility, Assam Power Distribution Company Limited (APDCL), projected demand that was 35 percent higher than actual demand in 2019. This led to a significantly higher cost burden for the DISCOM in terms of fixed/minimum charges.

DISCOMs must address this twin pair of challenges since they are the primary off-taker and remain financially impacted. They require better techniques, software, and studies that can help them better match supply and demand and integrate RE distributed generation, DR, and energy efficiency (EE) into the planning processes. With software such as DISCOM REPOSE, utilities are in a position to better

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[2]MNRE Annual Report, 2019-2020, https://mnre.gov.in/img/documents/uploads/file_f-1585710569965.pdf

[3]*Analyzing the falling solar and wind tariffs: Evidence from India, February 2020, ADBI Working Paper* https://www.adb.org/sites/default/files/publication/566266/adbi-wp1078.pdf

[4]PACE-D 2.0 RE white paper "Rethinking DISCOM Resource Planning in a Renewable Energy Rich Environment."

understand the utility load curve, produce more granular demand forecasts up to the next fifteen years and on an hourly basis, and capitalize better on the seasonal variability of RE and demand.

The Indian power sector is changing rapidly with greater contribution from RE, the presence of DER, the expected growth of energy storage, and behind-the-meter activities such as EV charging.

Resource Planning Helps DISCOMs:
I. Reduce financial losses due to over/underestimation of demand;
II. Increase RE uptake leading to a less polluted environment and other economic gains;
III. Improve energy security;
IV. Reduce power purchase costs, leading to lower consumer tariffs; and
V. Make optimal use of new supply resources—energy efficiency, demand response, distributed energy resources, and electric vehicles.

The current practice of resource planning requires a nimble approach to accommodate such contributions with minimum grid integration costs and use of the technology-driven measures of DSM for optimizing the supply and demand. A robust regulatory framework that emphasizes improved methodologies for increasing the uptake of RE and channels capacity development can steer a clear direction for India to achieve its ambitious targets, help DISCOMs be more financially sustainable, and equip utility professionals to manage a RE-dominated portfolio.

One of the functions of the SERCs under section 86(1) (b) of The Electricity Act 2003 is to regulate the power purchases and procurement processes of the distribution licensees. The gap exists at the regulatory framework level, where a need arises to shape the outdated regulations to better address new realities. This work attempts to address this regulatory issue by developing model regulations. The next chapter discusses the methodology adopted to capture the data on the existing framework for resource planning in India and assimilate information in the development of model regulations.

3. METHODOLOGY

This section provides the methodology adopted for the review of existing regulations on resource planning and the development of model regulations. The review process utilized two main consultation techniques: primary research and secondary research. The methodology serves as the basic premise for successive chapters of this report.

3.1. CONSULTATION TECHNIQUES

Engaging the technique of secondary research, the team leveraged understanding of existing regulations published by SERCs, reviewed publications by central agencies on the subject, and examined international best practices on the subject. The primary research consisted of collecting information directly from regulators, utility professionals working in planning departments, industry leaders, etc. Figure 1 presents an overview of the methodology.

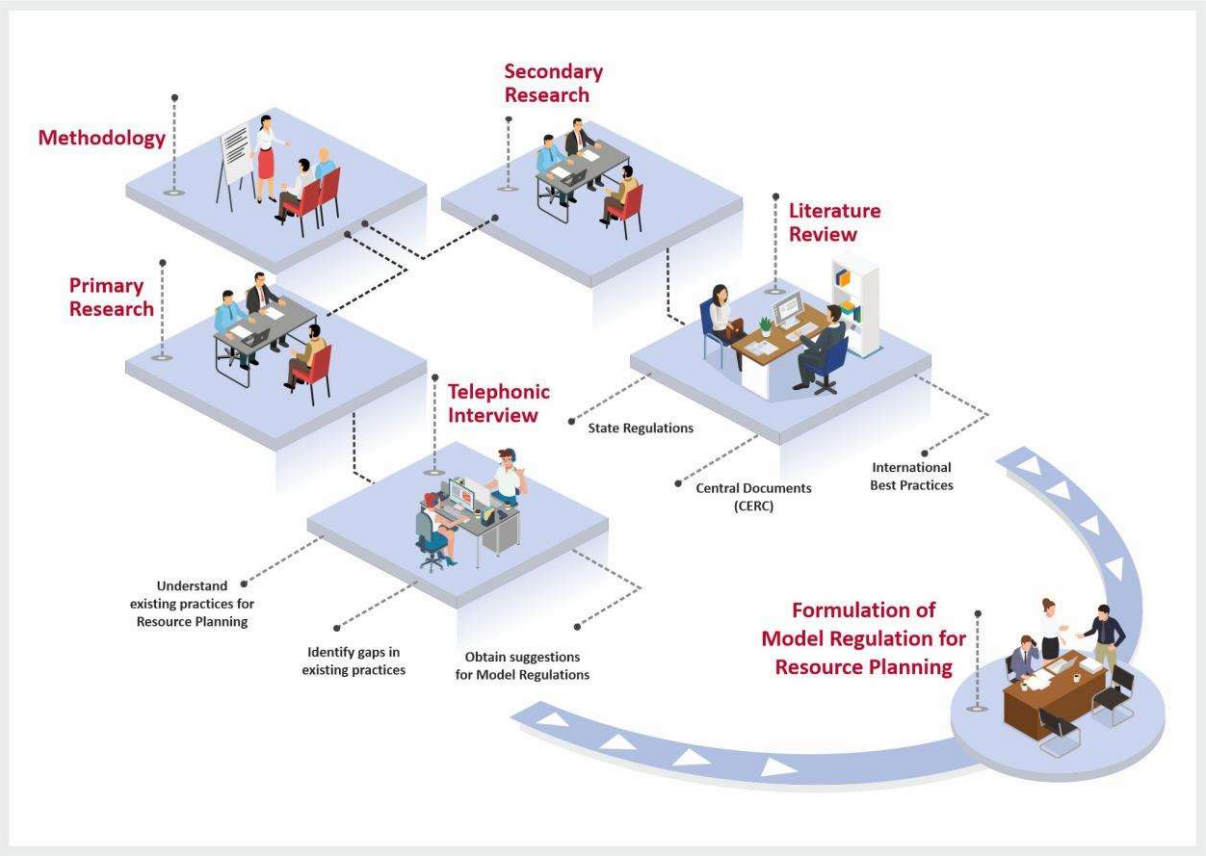


Figure 1 Methodology for Review of Existing Regulations and Development of Model Regulations

3.2. SAMPLE SELECTION

Given the vast number of DISCOMs (62 distribution utilities present in India, 25 SERCs), it was meaningful to identify a sample that represents the existing population for both primary and secondary research. Thus, the following steps were adopted as shown in Figure 2 while conducting both primary and secondary research.

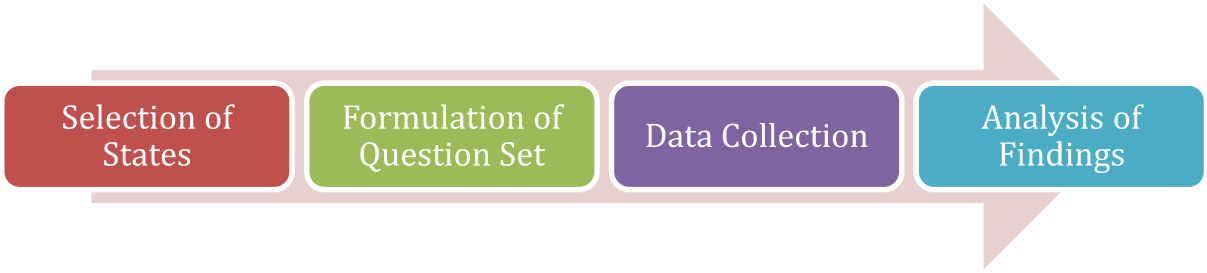


Figure 2 Steps for Regulatory Review

3.2.1.1 SELECTION OF STATES

The PACE-D 2.0 RE Program selected states that are

- rich in RE resources;
- have existing resource planning guidelines;
- are progressive in their adoption of new regulations, technology, etc.; and
- are representative of the North, East, West, and South of India.

Based on these criteria, the program chose the following 12 states for review: Rajasthan and Gujarat (RE rich states), Andhra Pradesh and Haryana (states with resource planning guidelines), Tamil Nadu, Punjab, Jharkhand, Delhi, Karnataka, Assam, Bihar, and Meghalaya.

3.2.1.2 FORMULATION OF QUESTION SET

Once the states were finalized, a set of questions were developed to help reveal areas that require improvement in the planning process. The questions relate to the existing regulatory framework, development and submission of resource plans by DISCOMs and review of resource plans by SERCs, higher uptake of low cost RE, consideration of upcoming technology, and finally the methodology to be used for planning. The team determined answers to these questions by evaluating multiple policy documents and interviewing key DISCOM and SERC officials.

3.2.1.3 DATA COLLECTION

For the purposes of data collection, an extensive study of multiple documents, including policy documents is adopted. Additionally, telephone interviews with key officials, including regulatory commission members, advisors, and staff and DISCOM general managers were also conducted.

3.2.1.4 ANALYSIS OF FINDINGS

All findings were recorded and analyzed to examine the gaps and key points present in the existing regulatory framework for resource planning.

4. SECONDARY RESEARCH

In an attempt to ascertain an understanding of the existing regulatory framework for resource planning in India and the spectrum of practices followed at both the central and state levels, the program examined the following documents in detail:

- State documents:
  - guidelines/regulations on load forecast, resource plans, and power procurement;
  - tariff methodology and regulatory tariff orders;
  - MYT regulations;
  - grid codes; and
  - electricity supply codes/distribution codes.
- Central publications:
  - CERC Planning Code 2020;
  - Indian Electricity Grid Code (IEGC); and
  - National Electricity Plan (NEP).
- International best practices and regulations on resource planning.

4.1. REVIEW OF STATE REGULATIONS

Relevant sections of documents published by each of the 12 states were studied to understand information related to load forecast, resource mapping, and power procurement optimization. Table 1 provides the sections and documents.

Table 1 Review of State-Level Regulations/Guidelines

S. N.	REGULATIONS/ GUIDELINES	STATE	KEY SECTION(S)
1.	Guidelines for Load Forecasts, Resource Plans, and Power Procurement	Andhra Pradesh	•**Guideline 2.1** (Load Forecasting) •**Guideline 3.2.4** (Power Procurement Plan) •**Guideline 3.1 and 3.2.3** (Resource Plan) •**Guideline 3.3.3(iv)** (Emphasis on DSM)
2.	Terms and Conditions for Determination of Tariff Regulations, 2017	Delhi	•**Section 5 and 11** (Load Forecasting)
3.	Power Purchase and Procurement Process of Licensee Regulations, 2012	Punjab	•**Section 4** (Load Forecasting) •**Section9(i) and 7(1)** (Power Procurement Plan) •**Section4(1)(iii)** (Emphasis on DSM)
4.	Guidelines for Procurement of Power by Distribution Licensees	Gujarat	•**Guideline 3** (Load Forecasting) •**Guideline 3** (Power Procurement Plan)
5.	Terms and Conditions for Determination of Distribution Tariff Regulations, 2015	Jharkhand	•**Section 5.8, 5.20, and 6.37** (Load Forecasting) •**Section 5.8** (Emphasis on DSM)
6.	Power Purchase and Procurement Process of Distribution Licensee Regulations, 2004	Rajasthan	•**Section 3** (Load Forecasting)

S. N.	REGULATIONS/ GUIDELINES	STATE	KEY SECTION(S)
7.	Terms and Conditions for Determination of Tariff for Intra State Transmission / Distribution of Electricity Under MYT Framework Regulations, 2009	Tamil Nadu	•**Section 24** (Load Forecasting)
8.	Terms and Conditions for Determination of Tariff for Distribution and Retail Sale of Electricity Regulations, 2006	Karnataka	•**Section 2.5.4** (Load Forecasting) •**Section 2.8.2** (Power Procurement Plan)
9.	Terms and Conditions for Determination of Multi Year Tariff Regulations, 2018	Assam	•**Section 25** (Load Forecasting) •**Section 24 and 25** (Power Procurement Plan) •**Section 25.3** (Emphasis on DSM)
10.	Power Purchase and Procurement Process of Licensee Regulations, 2017	Bihar	•**Section 4,** (Load Forecasting) •**Section 6 and 8** (Power Procurement Plan) •**Section 4.2 and 4.3** (Emphasis on DSM)
11.	Power Purchase and Procurement Regulations, 2012	Meghalaya	•**Section 4** (Load Forecasting) •**Section 9** (Power Procurement Plan) •**Section 4(3)(e)** (Emphasis on DSM)
12.	Guidelines for Load Forecasts, Resource Plans, and Power Procurement Process	Haryana	•**Guideline 2** (Load Forecasting) •**Guideline 3.3** (Power Procurement Plan) •**Guideline 3** (Resource Plan) •**Guideline2.3(a) and 3.3.2** (Emphasis on DSM)
13.	Assam Electricity Distribution Code	Assam	•**Section 4.7, 4.8, and 4.10** (Load Research) •**Section 4.8** (Demand Forecasting) •**Section 4.10** (Use of Software) •**Section 4.8** (Emphasis on DSM)
14.	Tamil Nadu Electricity Distribution Code	Tamil Nadu	•**Section 6(2)** (Load Research) •**Section 6(1) and 6(4)** (Demand Forecasting)
15.	Gujarat Electricity Distribution Code	Gujarat	•**Section 4.5** (Load Research) •**Section 4.4** (Demand Forecasting) •**Section 4.4.3, 4.5.3, and 4.5.4** (Emphasis on DSM) •**Section 6.12.1** (DISCOM's responsibility to train staff)

The review revealed the following key conclusions:

- More than 80 percent of the states do not have specific regulations/guidelines for resource planning; Andhra Pradesh, Gujarat and Haryana are the only states that do.
- Where exclusive guidelines/regulations exist, they are more than ten years old and have not been amended.
- Guidelines/regulations in most states lack specific methodology to formulate the resource plans.

- There is little emphasis on new parameters, such as DRE, EVs, etc. Some regulations mentioned DSM.
- Generally, sensitivity, probabilistic and scenario analysis are not part of the planning process.
- Resource planning is examined by SERCs as part of ARR examination. Therefore, it does not get the attention it requires.
- There is a lack of trained staff to carry out resource planning exercises and to examine resource planning documents at the regulatory end.
- There is no focus on medium- and long-term resource planning. In most DISCOMs, the only planning is on an annual basis, as part of the ARR.

4.2. CENTRAL PUBLICATIONS

Review of Electricity Grid Code

The commission order dated May 28, 2019, created an expert group, comprised of officials from CEA, CERC, and Power System Operation Corporation Limited (POSOCO) to:

- Review the provisions of Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2010, based on past experience, recent developments in the power system of India, changes in market structure, and future challenges including a high level of renewable penetration in the grid and introduction of new products in the market.
- Suggest appropriate regulatory intervention and prepare a draft IEGC, making recommendations for proposed amendments or changes to the IEGC.

The report, released on January 2020, provided the rationale for the changes and additions carried out while drafting the new IEGC with a view to improving grid security, stability, and flexibility in the operation of generating resources in the context of national targets for high RE penetration. A few of the suggestions made in this report are relevant to this discussion.

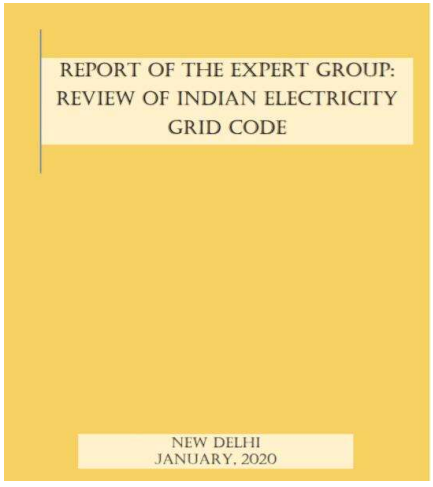


Figure 3 Front Cover of the Indian Electricity Grid Code Report

Chapter 4 of the report envisages enhancing the scope of system planning in a more holistic manner by including provisions related to "Demand Forecasting by State" and "Generation Resource Planning." For the sake of convenience, exact replication of the provision is as follows:

(a) Demand forecasting by State

i. *Each distribution licensee of the state shall **estimate the demand** in its control area including the demand of open access consumers for next five years starting from 1st April of the next year and **submit to State Transmission Utility (STU) by 30th September** every year.*

ii. *STU, in co-ordination with all distribution licensees, shall estimate the demand by 31st October of every year for the entire state duly considering the diversity, for the next five (5) years starting 1st April of the next year using **trend method, time series, econometric methods or any state of the art methods** and submit the same to Central Electricity Authority (CEA) and Central Transmission Utility (CTU).*

iii. *CTU, in consultation with STUs, shall estimate by 31st December every year, the demand for each region as well as the entire country taking into account the diversity for the next five (5) years starting 1st April of the next year based on the inputs from STU.*

iv. *The demand estimation shall include **daily load curve (hourly basis)** for a typical day for each month.*

Regarding "Generation Resource Planning," the code stipulates that demonstrable resource adequacy, including a list of resources along with associated capacities, shall be submitted to the respective STU and SERC. The code emphasizes generation flexibility, DR, and economic dispatch, as mentioned below. The full text follows:

(b) Generation Resource Planning

i. *Each distribution licensee shall ensure demonstrable resource adequacy as specified by the respective SERC for the next five (5) years starting 1st April of the next year. Adequacy statement containing a list of such resources along with associated capacities shall be submitted to the respective STU and SERC. STU shall submit the same to CTU.*

ii. *The National Electricity Plan may consider the following from grid operation perspective:*
   (a) Generation flexibility, ramping and minimum turndown level and start-stops
   *(b) Requirement of energy storage systems and **demand response** measures*
   (c) Generation reserve requirement
   (d) System inertia for grid stability
   (e) Cross-border electricity exchange
   (f) Fuel security

iii. *While finalizing transmission plan for implementation, CTU shall simulate the economic dispatch considering grid security under various scenarios based on adequacy statement furnished by STU and provide feedback to CEA."*

The salient points of this report include the following expert guidance:

- Revisit the timeline to submit the demand forecast by September 30 every year (delink from ARR);
- Include in the methodology of the forecast trend, time series, and econometric methods to identify the best fit before submission;
- Develop daily load curve (hourly basis) for a typical day for each month; and
- Consider demand-side measures (DSM) such as DR and storage in planning.

4.3. INTERNATIONAL PRACTICES

International best practices related to regulatory frameworks were studied for four countries on the leading edge in the transition to a RE-dominated electricity sector—the United States of America (USA), Australia, Germany, and the United Kingdom (UK).

Our research noted that the strong regulatory frameworks in these countries focus on regular resource plan submissions. Further, they use advanced statistical methodologies like econometrics for demand forecasting along with deterministic and probability analysis. Moreover, resource planning also considers load research and new technologies and objectives such as distributed renewable energy,

EVs, and EE while formulating the resource plans. Table 2 summarizes the findings for resource planning globally.

The four countries identified provide a valuable lesson on development of resource plans and utilization of load research, etc., for India. They remind us to look out for ways to improve planning in RE-rich electricity sector.

Table 2 International Best Practices

	Resource Planning	Findings	Source
United States	Econometric, end use, and statistically adjusted end use (SAE) are most prevalent models. Approaches combining deterministic and probability outlook.	Strong regulatory framework for resource planning. Recognition of uncertainty and best practice management.	*"Resource Planning Guidelines for Electric Utilities" by Arkansas Public Service Commission*
Europe	Econometric and end use are most prevalent. Typically, sequential probability Monte Carlo method including deterministic constraints.	Improve forecasts using LR and develop cognizance of new realities (RE, DER, EV, and EE). Engagement of stakeholders	*"Grid Development Plan" by TSOs*
Australia	Econometric method. Two-Year Probability of Supply Adequacy Shortfall (2YRPSAS).	Regular updates of resource planning. Modeling and software use.	*"Integrated System Plan" for the National Electricity Market by AEMO*
UK	Bottom-up approach for forecasting down to postal code. Strong regulatory framework.	High degree of temporal and spatial granularity. Development of options based on multiple scenarios.	*"Distribution Future Electricity Scenarios" by Electricity North West*

For further details, please refer to chapter 5 of the white paper "Rethinking DISCOM Resource Planning in a Renewable Energy Rich Environment."

From the secondary research, we conclude that:

1. The majority of the states do not have specific regulations on resource planning, and those that do have not amended the regulations to cater to India's requirement that RE become the dominate supply resource.
2. There is little emphasis given to emerging technologies, such as DRE and EVs or to uncertainty analysis.
3. There is a lack of trained staff for formulating the resource plans.
4. Planning codes at the central level envision timelines and methodologies along with development of hourly load profiles and subsequent generation planning but these are not converted into regulations at the state level.
5. Generally, sensitivity, probabilistic and scenario analysis are not part of the resource plan
6. Regulatory frameworks in other countries mandate regular resource plan formulation using advance statistical methods.

5. PRIMARY RESEARCH

To review the existing regulatory framework for resource planning in India, PACE-D 2.0 RE conducted extensive primary research through surveys, interviews, and observations. For the purposes of data collection, telephonic interviews were done with key officials ranging from the technical directors to members of regulatory commissions to DISCOM general managers from DISCOMs. See Annex 2 for a complete list of interview subjects.

The primary research gathered data related to the following three questions:

1. Are the existing practices related to resource planning conforming with existing regulations and guidelines?
2. What are the gaps between practices and regulations/guidelines related to resource planning?
3. Are there any valuable suggestions related to content that should be incorporated into the model regulations?

An analytical approach is adopted to review against a defined set of parameters, which are chosen and framed in a way to integrate the findings and observations under the four key pillars. Against each pillar, different sets of questions are formulated to review the existing status of the regulatory framework. The questions pertain to the following:

- Regulations
- Methodology
- DISCOMs
- New Drivers

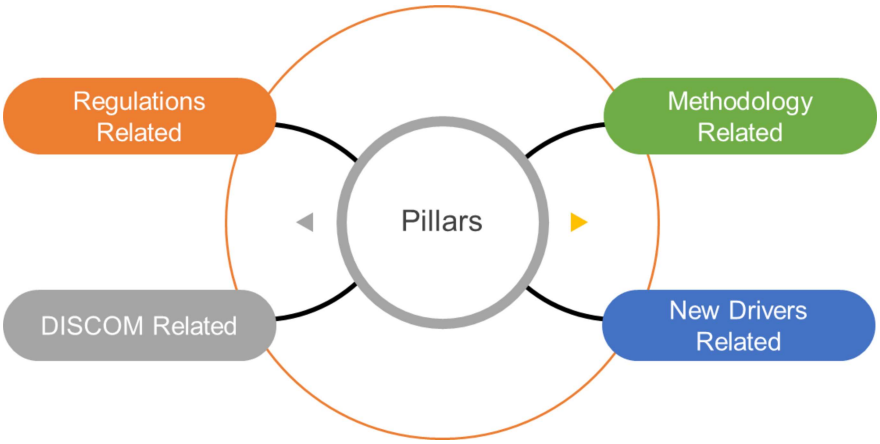


Figure 4 Key Pillars for Primary Research

1. **Regulation related** – Parameters concern whether specific regulations for resource planning exist, whether they account for the impact of DRE, DSM, and EVs, and whether planners practice probability analysis. Parameters also concern the timelines for resource planning and the importance given to RE.
2. **Methodology related** – Parameters pertain to the methodology adopted by DISCOMs and the use of load research and probability analysis.
3. **DISCOM related –** Parameters evaluate whether DISCOMs have dedicated departments, software tools, and availability of trained manpower for resource planning.
4. **New drivers related** – Parameters ascertain how much consideration is given to new drivers such as DRE, DSM, and EVs in resource planning.

Table 3 shows the parameters that will be studied under each key pillar.

Table 3 Four Key Pillars

Regulation Related	Methodology Related	DISCOM Related	New Driver Related
Existence of Resource planning **Guidelines/ Regulations**	Adhere to specific **Methodology** for Resource Planning	Internal **guidelines** for Resource Planning	Incorporation of **DRE, DSM, and EVs** in resource plans
Treatment of parameters relating to DSM, EVs, and DRE.	Incorporation of **sensitivity, probability, and scenario** analysis	Conducting **sensitivity, probability, and scenario** analysis	
Conducting **sensitivity, probability, and scenario** analysis	Emphasize **load research** for resource planning	Emphasis on **renewables?**	
Rigorous examination of resource plans by trained staff in no paucity of time	Development of **hourly demand** profile to increase uptake of RE	**Dedicated department** for resource planning, with trained staff	
Specific timelines for review, approval and modification of resource plan		Use of complex **software tool** based on algorithms	
Considering the requirement of change in resource planning due to **RE rich environment**		Availability of **trained** manpower?	

The subsequent section elaborates the key questions along with responses obtained through primary and secondary research.

5.1. REGULATION RELATED

Following questions are developed to review the resource planning from a regulatory point of view.

1. Do the regulators have specific guidelines/regulations for resource planning?
2. When were the resource planning guidelines/regulations last amended?
3. How are specific parameters (cost, solar, etc.) for resource planning treated?
4. Do the regulations specify sensitivity, probability, and scenario analysis for resource planning?
5. When are resource plans generally reviewed and approved by the regulators (timeline)?
6. Is resource planning examination a rigorous exercise at the regulator end with sufficient time?
7. Do the regulators have trained staff to examine resource plans?
8. How frequently do regulators review the resource plan?
9. Does the regulator consider requirements for change in resource planning due to the RE rich environment?

1. The findings against each question have been summarized below. **Do the regulators have specific guidelines/regulations for resource planning?**

   Response: It is observed that the importance of resource planning was limited in the past by issues related to power purchase and infrastructure planning. As a result, most of the states do not have any specific regulations/guidelines for resource planning. However, the importance has now increased because of cheaper renewable energy and its incorporation in the power portfolios. Further, in these states, other regulations such as Power Purchase and Procurement Regulations

or Terms and Conditions for Determination of Tariff Regulations incorporate provisions relating to resource planning. Only two states (Andhra Pradesh and Haryana) have specific guidelines/regulations for resource planning.

2. **When were the resource planning guidelines/regulations last amended?**
   Response: Among all the state guidelines/regulations studied, only two states (Andhra Pradesh and Haryana) have specific guidelines/regulations for resource planning. These were issued more than 10 years ago (2006 and 1999, respectively) and haven't been amended since.

3. **How are specific parameters (cost, solar etc.) for resource planning treated?**
   Response: It was observed that adoption of renewable energy has increased in the near past due to its cheaper cost. Therefore, most of the states don't emphasize enlisted parameters. However, the guidelines of Andhra Pradesh and Haryana consider specific parameters related to DSM, uncertainties, etc. for load forecasting and use of computer programs for least-cost power planning.

4. **Do the regulations specify sensitivity, probabilistic and scenario analysis for resource Planning?**
   Response: The sensitivity analysis is an advanced concept which most of the states have not adopted. The primary research also revealed that only one state envisions conducting sensitivity analysis for resource planning. None of the state regulations studied contains provisions that provide for conducting probability and scenario analysis for resource planning.

5. **When are resource plans generally reviewed and approved by the regulators (timeline)?**

   Response: The interviews with DISCOM employees and regulators revealed that, in practice, the resource plans are reviewed and approved by the regulators as part of tariff setting/ ARR exercises. Approval or rejection of the resource plan takes place within three months of the date it was first submitted to the regulator.

6. **Is resource planning examination a rigorous exercise at the regulator end with sufficient time?**
   Response: The interviews with regulators working at the central level revealed that since the resource planning exercise is implemented at the state level only, no apparent role is played by the CERC. They also revealed that resource planning examination is not a rigorous exercise at the regulator end with sufficient time. In practice, resource planning is done as part of the MYT setting process.

7. **Do the Regulators have trained staff to examine resource plans?**
   Response: The primary research helped uncover that most regulators do not have trained staff to examine the submitted resource plans.

8. **How frequently do regulators review the resource plan?**
   Response: The interviews with DISCOM employees and regulators working at the central and state level revealed that, for the most part, regulators review resource plans annually, when required by SERC, or when a new submission is made to SERC by a developer. One such time is when developers are seeking approval for a power purchase agreement (PPA).

9. **Does the regulator consider requirements for change in resource planning due to the RE rich environment?**

Response: While there is consensus on the fact that there is a requirement for change in resource planning, especially in today's RE rich environment, all the subjects of the primary research pointed out that no such changes have been adopted in any of the states yet.

Table 4 provides a summary of the findings in response to the regulatory-related questions.

Table 4 Summary of Regulatory Findings

QUESTIONS	FINDINGS
Do the regulators have specific guidelines/regulations for resource planning?	• **Majority of the states** do not have regulations/guidelines for resource planning. • States having regulations/guidelines: **Andhra Pradesh and Haryana**
When were the resource planning guidelines/regulations last amended?	• The guidelines in two states were issued **more than 15** years ago (2006 and 1999, respectively) and **haven't been amended** since.
Treatment of specific parameters (cost, solar etc.) for resource planning	• **Majority** of the states do not provide much emphasis on the enlisted parameters. • The guidelines in two states consider **parameters** relating to DSM, uncertainties, etc., for load forecasting and use of computer programs for least-cost power planning.
Do the regulations specify sensitivity, probability, or scenario analysis for resource planning?	• **Only one state** envisions using sensitivity analysis.
When do regulators generally review and approve resource plans (timeline)?	• Part of tariff setting/ARR exercise. • Approval or rejection within three months of date first submitted to the regulator.
Is resource planning examination a rigorous exercise at the regulator end with sufficient time?	• Resource planning is implemented at **state level only**; hence, no role for CERC. • Usually resource planning is done as part of the **MYT setting process** but is **not a rigorous exercise.**
Do the regulators have trained staff to examine resource plans?	• Most Regulators **do not have trained staff** for resource planning, and there is a **shortage** of staff.
How frequently do regulators review the resource plans?	• For the most part, **annually**, when SERC requires it, or when a **new submission** is made to the SERC by a developer. **Example:** at the time when PPA approval is sought.
Does the regulator consider requirements for change in resource planning due to the RE rich environment?	• **No such changes** adopted in states thus far.

5.2. METHODOLOGY RELATED

Following questions are developed to review the resource planning from a methodology point of view.

1. Do DISCOMs follow specific methodologies for resource planning?
2. How do DISCOMs carry out sensitivity, probability, and scenario analysis?
3. Is emphasis placed on load research at DISCOMs?
4. How are renewables treated in resource plans: hourly profiles, megawatts (MW) or million units (MUs)?
5. Is the output in the form of an hourly profile or in terms of peak and average power?

The findings against each question have been summarized below:

1. **Do DISCOMs follow specific methodology for resource planning?**
   Response: Most DISCOMs use Excel-based modeling and trend and compound annual growth rate (CAGR) methods to forecast demand. Some DISCOM professionals use their experience in predicting the demand for the next few days based on patterns observed in previous few days. In addition, planners apply the growth rate on historical demand when predicting the future demand.

2. **How do DISCOMs carry out sensitivity, probability, and scenario analysis?**
   Response: Probability analysis plays an important role in judging the risks associated with fluctuations of demand in the future. These fluctuations may happen due to technological interventions and policy interventions such as 100 percent electrification. Although DISCOMs do not currently conduct sensitivity, probability, and scenario analysis, it is important to consider these types of statistical analysis in order to fully meet the future demand.

3. **Is emphasis placed on load research at DISCOMs?**
   Response: Load research plays an important role in understanding the demand pattern at the consumer level. By utilizing the patterns from load research, DISCOMs may shift the demand, for example, when renewable generation is higher. However, DISCOMs do not currently emphasize load research.

4. **How are renewables treated in resource plans: hourly profile, MW or MUs?**
   Response: RE capacity is going to increase as renewables are a cheaper source of energy. As of now PPAs for renewables are signed on a MW basis to include them in power portfolios. However, with an increase in RE capacity and their intermittent nature, it will be important to incorporate renewables on an hourly basis in order to have more grid balancing and minimize system integration costs.

5. **Is the output in the form of an hourly profile or in terms of peak and average power?**
   Response: With more new technologies coming in the future, such as DRE and EVs, it is important to have an hourly demand profile. However, the majority of state DISCOMs mention output in terms of peak and average power and in MUs. An hourly demand profile will help DISCOMs better match supply and demand as both are variable.

Table 5 provides a summary of the findings in response to the methodology-related questions.

Table 5 Methodology-Related Findings

QUESTIONS	FINDINGS
Do DISCOMs follow specific methodologies for resource planning?	• Only **Trend and CAGR methods** are used
How is sensitivity, probability, and scenario analysis carried out at DISCOMs?	• **Not adopted**
Do DISCOMs emphasize load research?	• **No**
How are renewables treated in resource plans: hourly profile, MW or MUs?	• PPAs are signed on **MW basis**
Is the output in the form of hourly profile or in terms of peak and average power?	• Majority of state DISCOMs mention output in terms of **peak and average power** and in **MUs**

5.3. DISCOM-RELATED

Following questions are developed to review the resource planning from the DISCOM point of view.

1. Do the DISCOMs conduct only load forecasting or complete resource planning exercises?
2. Do the DISCOMs carry out sensitivity, probability, and scenario analysis for resource planning?
3. Which entity does the resource planning exercise for the state? The DISCOM itself or some other agency?
4. How are DRE, DSM, and EVs incorporated in resource plans?
5. What type of software tool do DISCOMs use for resource planning?
6. Do the DISCOMs have any internal guidelines for resource planning?
7. How frequently do DISCOMs conduct resource planning exercises?
8. Does the DISCOM consider RE in resource planning?
9. Do the DISCOMs have a dedicated department for resource planning?
10. Are there enough trained staff to carry out resource planning?

The findings against each question have been summarized below.

1. **Do the DISCOMs conduct only load forecasting or complete resource planning exercises?**
   Response: The reviewed guidelines envisages conducting load forecasting, but very few regulations mention conducting resource planning exercises along with demand forecasting. Only states like Andhra Pradesh and Haryana have specific clauses related to resource planning.

2. **Do the DISCOMs carry out sensitivity, probability, and scenario analysis for resource planning?**
   Response: Probability analysis is important for anticipating the challenges due to new technological interventions. Out of 12 states whose regulations/guidelines were reviewed, only one state, *i.e.*, Haryana, mandates sensitivity and risk analysis for use in formulating the least-cost plan.

3. **Which entity does the resource planning exercise for the state? The DISCOM itself or some other agency?**
   Response: It is important to have a specific entity that carries the responsibility of formulating the resource plans. The responsibility for formulating resource plans for the state lies with one of the following organizations within the state:
   - Distribution licensee;

- Transmission company; or
- Holding company.

4. **How are DRE, DSM, and EVs incorporated into resource plans?**
   Response: These parameters are important when considering the future. None of the state regulations reviewed provide for incorporation of DRE and EVs in the formulation of resource plans. Andhra Pradesh and Haryana do mention DSM in their regulations.

5. **What type of software tool do DISCOMs use for resource planning?**
   Response: Use of statistical techniques helps in predicting the demand by considering parameters such as weather, the economy, policy directives, etc. None of the organizations mandated to carry out resource planning exercises, including distribution, holding, and transmission companies, use any statistical software tool based on algorithms. Microsoft Excel–based modeling is the most commonly used tool for resource planning.

6. **Do the DISCOMs have any internal guidelines for resource planning?**
   Response: There are no specific in-house guidelines issued by DISCOMs; however, broad guidelines, as part of a regular prescription, exist in some DISCOMs.

7. **How frequently do DISCOMs conduct resource planning exercises?**
   Response: Resource plans need to have specific timelines similar to ARR submissions. However, it differs from state to state, and on average, most DISCOMs do resource planning exercises as part of the ARR submission only.

8. **Do the DISCOMs consider RE in resource planning?**
   Response: Currently, DISCOMs procure renewable power as part of a renewable purchase obligation (RPO) and consider this also in resource planning.

9. **Do the DISCOMs have a dedicated department for resource planning?**
   Response: It is important to have a dedicated department that conducts resource planning. However, the majority of states do not have a dedicated department for resource planning. Only a few states, like Punjab, have a specific planning department that manages resource planning.

10. **Are there enough trained staff to carry out resource planning?**
    Response: DISCOMs lack adequate staff in general. In addition, the available staff are not trained to incorporate changing trends in technology into resource planning.

Table 6 provides a summary of the findings in response to the DISCOM-related questions

Table 6 DISCOM-Related Findings

QUESTIONS	FINDINGS
Do the DISCOMs conduct only load forecasting or complete resource planning exercises?	• All state regulations/guidelines envision load forecast exercises. • Two out of 12 states undertake resource planning exercises.
Do the DISCOMs carry out sensitivity, probability, and scenario analysis for resource planning?	• Less than 10 percent of state regulations provide for conducting sensitivity analysis.
Which entity does the resource planning exercise for the state? The DISCOM itself or some other agency?	• Either the transmission company, the distribution licensee, or the holding company formulates the resource plan in the states surveyed.
Incorporation of DRE, DSM, and EVs in resource plans	• Less than 20 percent of state regulations incorporate DSM in resource planning. • None of the state regulations incorporate any of the other drivers.
What type of software tool do DISCOMs use for resource planning?	• Excel is the most commonly used tool.
Do the DISCOMs have any internal guidelines for resource planning?	• Broad guidelines, as part of regulatory prescriptions, exist in some DISCOMs
How frequently do DISCOMs conduct resource planning exercises?	• Mostly every 5 years
Do the DISCOMs consider RE in resource planning?	• Considered as a part of RPO
Do the DISCOMs have a dedicated department for resource planning?	• Some DISCOMs, such as Punjab
Are there enough trained staff to carry out resource planning?	• DISCOMs have created positions but not provided training. In addition, there are frequent transfers of staff.

5.4. NEW DRIVERS RELATED

Following questions are developed to review the resource planning from new drivers point of view.

1. **How are intermittent drivers such as DRE, DSM, and EVs considered by DISCOMs?**
   Response: DISCOMs do not give significant consideration to new drivers such as DRE, DSM, and EVs on an hourly basis. They consider existing PPAs of RE in terms of MW and as some fixed percentage of reduction in demand due to DSM measures. For example, a 5 percent reduction in demand due to DSM measures.

Table 7 provides a summary of the findings related to the question on new drivers.

Table 7 New Driver–Related Findings

QUESTIONS	FINDINGS
How do DISCOMs consider intermittent drivers such as DRE, DSM, and EVs?	DISCOMs do not give significant consideration to new drivers such as DRE, DSM, and EVs on an hourly basis. They consider existing PPAs of RE in terms of MW and as some fixed percentage of reduction in demand due to DSM measures. For example, a 5 percent reduction in demand due to DSM measures.

6. FORMULATION OF MODEL REGULATIONS

This chapter describes the gaps identified through primary and secondary research. Filling these gaps requires development of a well-defined regulatory framework for resource planning. Table 8 shows the gaps in the existing regulatory framework for resource planning.

Table 8 Identification of Gaps

	GAPS
Regulatory Framework for Resource Planning	• Basic preliminary regulations, which are outdated and haven't been amended for the last 15+ years exist in very few states. • No detailed specific regulations for resource planning are in force.
Methodology of Resource Planning	• Regulations lack mention of methodology to develop resource plans. • In practice, most of the DISCOMs adopt Excel-based modeling for resource planning.
Timelines	• None of the regulations provide specific timelines for submission, approval, and modification of resource plans. • For example, ARR submission by DISCOMs occurs on a set timeline.
Consideration to Scenario Configurations and Uncertainty Management	• DISCOMs do not practice any scenario-building exercise based on sensitivity or probability analysis. Such analysis helps in anticipating the risk associated with new technological interventions and future policy directives.
Load Research	• DISCOMs conduct almost no metering-based studies, some survey-based studies, but they do not emphasize load research.
Demand Profile	• None of the regulations support development of an hourly demand profile, which is an important attribute that should be considered in a RE rich environment.
Evaluation of DER, EE, and EVs	• Regulations address the impact of DSM on demand forecasting but do not consider other new drivers.
Use of Software Tool	• DISCOMs do not use models for planning, only simple spreadsheets. • The regulations provide for very limited use of software tools based on advanced statistical algorithms.

Responsibility for Resource Planning in DISCOMs	• DISCOMs do not have any specific department for planning. Generally, commercial/finance departments of the DISCOMs conduct resource planning while filing the ARR.
Lack of Trained Staff	• DISCOMs and regulators do not have trained staff to develop/examine resource plans.

From the gap analysis, it is evident that the basic preliminary regulations exist in a few states but are outdated and have not been amended to address current conditions. In addition, the current regulatory framework for resource planning provides for day-ahead scheduling and demand forecasting up to five years (medium-term), among other obsolete provisions. The model regulations have been drafted to fill the existing regulatory gap for resource planning.

These model regulations titled "Medium-Term and Long-Term Demand Forecasting, Resource Planning, and Power Procurement Regulations." are provided in Annex I. The model can act as a guide for states to either adopt or modify the existing regulations through constructive discussion and deliberation.

The draft model regulations consist of the following chapters:

Chapter 1: Title, Commencement, and Applicability
Chapter 2: Definitions of such terms as Act, Area of Supply, Availability Factor, etc.
Chapter 3: General Instructions Regarding Resource Plan Submission
Chapter 4: Demand Forecast
Chapter 5: Resource Plan
Chapter 6: Power Procurement
Chapter 7: Miscellaneous

Kindly note that the proposed regulations intend to facilitate efficient resource planning to help in power procurement. They are in no way intended to be used for the purpose of state infrastructure planning.

ANNEX 1: MODEL REGULATIONS

ELECTRICITY REGULATORY COMMISSION

NOTIFICATION
(----------)

In exercise of the power conferred under subsection 181(1) read with clause(b) of subsection (1) of section 86 of the Electricity Act, 2003 and all powers enabling it in that behalf and after previous publication the ----------Electricity Regulatory Commission hereby makes the following Regulations, namely; "Medium-Term and Long-Term Demand Forecasting, Resource Planning, and Power Procurement Regulations."

Chapter - 1.

1. Short Title and Commencement and Applicability

1.1. These regulations shall be called the; "Medium-Term and Long-Term Demand Forecasting, Resource Planning, and Power Procurement Regulations."

1.2. The Regulations shall come into force on the date of their notification in the Gazette of ------- .

1.3. These Regulations shall supersede all other rules, regulations, or guidelines issued by the Commission earlier, regarding Demand Forecasts, Resource Plans, and Power Procurement.

1.4. These Regulations shall apply to all distribution licensees and other stakeholders within the State of-------while forecasting the medium- and long-term demand for power within their area of supply, while formulating resource plans and schemes for the medium and long term, and while purchasing and procuring power for distribution and supply in the State.

Chapter – 2

Definitions

2.1 The words and expressions used in these Regulations but not defined herein shall have the same meaning as assigned to them in the Act. Expressions used herein but not specifically defined in these Regulations or in the Act but defined under any law by a competent legislature and applicable to the electricity industry shall

have the same meaning assigned to them in such law. In these Regulations, unless the context otherwise requires-

a. **"Act"** means the Electricity Act, 2003 (36 of 2003);

b. **"Area of Supply"** means area within which a distribution licensee is authorized by his license to supply electricity;

c. **"Availability Factor (AF)"** means the amount of time that a resource is able to produce electricity over a certain period, divided by the amount of the time in the period;

d. **"Commission"** means the Electricity Regulatory Commission;

e. **"CUF"** means the capacity utilization factor for RE plants;

f. **"Demand"** means the demand that is connected to the grid. Normally load plus technical and commercial losses is demand;

g. **"Distribution Licensee"** means a licensee authorized to operate and maintain a distribution system to supply electricity to consumers in his area of supply and shall also include a deemed licensee;

h. **"Existing Resource"** means electricity generation resources that are either owned by the licensee or for which the licensee has signed a power purchase agreement to take power.

i. **"License"** means a license granted under section 14 of the Act;

j. **"Load Research"** means an activity embracing the measurement and study of the characteristics of electric loads to provide a thorough and reliable knowledge of trends and general behavior of the load characteristics of a customer;

k. **"Load"** means the electricity load connected at the customer end;

l. **"Long-Term"** means twenty years for development of demand forecast, resource plan, and power procurement plan;

m. **"Medium-Term"** means five years for development of demand forecast, resource plan, and power procurement plan;

n. **"Plant Load Factor (PLF)"** means the ratio between the actual energy generated by the resource and the maximum possible energy that can be. generated with the resource working at its rated capacity and for a duration of an entire year;

o. **"RE"** means the renewable energy sources used for generation of electricity;

p. **"Resource"** means the electricity-generating machine or unit or plant;

q. **"Supply"** means, in relation to electricity, the sale of electricity to a licensee or consumer;

r. **"Year"** means the financial year, starting from April 1 and ending on March 31;

s. **"Retiring Resource"** means electricity generation resources that are either owned by the licensee or for which the licensee has signed a power purchase agreement to take power but will not be available to the licensee after a certain period in the future.

t. **"Upcoming Resource"** means electricity generation resources that are either owned by the licensee or for which the licensee has signed a power purchase agreement to take power in the future.

Chapter – 3

General

3.1 All licensees involved in power purchase of more than 10 MW and 35 million units[5] of electricity annually shall submit to the Commission their medium-term and long-term demand forecast, resource plan, and power procurement plan by August 31 every two years, as per the guidelines provided herein and in the manner prescribed in this regulation.

3.2 Medium-term and long-term demand forecasts, resource plans, and power procurement plans shall be submitted in the form of a petition and in compliance with the procedure described in Business Regulations for filling of any petition before the Commission.

3.3 The Commission shall review the demand forecast, resource plan, and power procurement plan submitted by the licensee and shall pass an order within 90 days of the acceptance of petition. This approved demand forecast, resource plan, and power procurement plan will be used by the licensee for developing their annual revenue requirement.

3.4 The long term and medium term for the purpose of this regulations shall be considered as:

[5]10 MW power with a load factor of 40 percent. The 10 MW capacity should be changed based on the data of the licensee. The small licensee should be exempted from implementation of these regulations due to any capacity and resource difficulties.

a. Long-term procurement plan for a period up to 20 years.

b. Medium-term procurement plan for a period up to 5 years.

3.5 The long-term and medium-term plan shall be in terms of MW and MU and the medium-term plan shall also consist of monthly profile (MU vs time and MW vs time). The plan shall also include profiles for weekends and holidays.

3.6 For the purposes of developing the medium-term plan, the licensee shall conduct load research for a select category of customers, which shall have significant impact on the overall demand of the licensee. It shall be conducted for a minimum of two such customer categories and by adopting the methodology described in the Electricity Distribution Code issued by the commission.

3.7 The licensee may use either a customized software tool developed for this requirement or purchased from the market, or their own existing tool. In either of the cases, the licensee must justify the selection of the tool in terms of fulfilling the requirements of these regulations and the merits and limitations of the tool.

3.8 The guidelines issued by the central electricity authority for "Medium-Term and Long-Term Demand Forecasting, Resource Planning, and Power Procurement" shall be considered by the licensee. Any inconsistency with these regulations shall be brought to the notice of the Commission with merits and demerits of the inconsistent guidelines.

Chapter – 4

Demand Forecast

4.1 The licensee shall determine the load forecast for each category of customer for which the Commission has provided separate retail tariffs.

4.2 The licensee shall determine the load forecast for a customer category by adopting all the following methodologies:

(a) compounded average growth rate (CAGR);

(b) end use;

(c) trend;

(d) partial end use; and

(e) econometric (specifying the parameters used, algorithm, and source of data).

The licensee may use other methodologies than the above-mentioned after recording the merits of the method.

4.3 For the purposes of deciding the load forecast for a customer category and the methodology to be used for load forecasting of a customer category, the licensee must conduct statistical analysis and shall select the method for which standard deviation is lowest and R-square is highest.

4.4 The load forecast for each customer category shall be determined by following the procedure described in clause 4.2 and 4.3 above.

4.5 The Licensee may modify the load obtained on either side, for each customer category, by considering the impact for each of the following activities. The impact shall be considered by developing trajectories for each of the activities based on the economic parameters, policies, historical data, and projections for the future.

(a) demand-side management;
(b) open access;
(c) distributive resources;
(d) electric vehicles;
(e) tariff signals;
(f) availability of supply; and
(g) policy influences such as 24X7 supply to all customers, distributive energy resources, storage, and policies, which can impact econometric parameters. For each policy, a separate trajectory should be developed for each customer category.

4.6 The licensee may use activities not mentioned in clause 4.5 after recording the merits of its consideration.

4.7 The medium-term load profile of the customer categories for which load research has been conducted may be refined on the basis of load research analysis. A detailed explanation for refinement conducted must be provided.

4.8 The summation of load forecast obtained for each customer category as per clause 4.5 and clause 4.6, as the case may be, shall be the load forecast of the licensee.

4.9 The licensee shall calculate the net demand (in MU) by adding a loss trajectory approved by the Commission in the latest tariff order. In the absence of the loss trajectory as approved by the Commission for the planning horizon, an appropriate loss trajectory stipulated by State or National policies shall be considered with detailed explanation.

4.10 The peak demand in MW shall be determined by considering the average load factor of the last three years and the demand in MU obtained in clause 4.9. If any other appropriate load factor is considered for future years, detailed explanation shall be provided.

4.11 The licensee shall conduct sensitivity and probability analysis to determine the most probable demand forecast. The licensee must also develop long-term and medium-term demand

forecasts for possible scenarios, while ensuring that at least three different scenarios (most probable, business as usual, and aggressive scenarios) are developed.

Chapter – 5

Resource Plan

5.1 The licensee shall map all the existing resources, upcoming resources, and retiring resources to develop the existing resource map in MW for the long term and medium term as defined in clause 3.4 above.

5.2 The mapping shall include critical characteristics and parameters of the generating machines, such as heat rate, auxiliary consumption, ramp-up rate, ramp-down rate, etc., for thermal machines; hydrology and machine characteristics, etc., for hydro machines; and renewable resource forecasts, CUFs, etc. for renewable resource–based power plants to be considered in the resource plan. All the characteristics and parameters with their values for each generating machine considered should be provided in the resource plan.

5.3 Constraints such as penalties for unmet demand, forced outages, spinning reserve requirements, and system emission limits as defined in State and Central electricity grid codes and emission norms specified by the Ministry of Environment and Forest shall be identified and enlisted.

5.4 The licensee shall also include a planning reserve as specified by the Commission. In the absence of any guidelines from the Commission, the licensee can consider suitable planning reserve. The value of planning reserve considered should be specified in the resource plan along with justifications.

5.5 The sum of generation from each machine/generating unit over a time axis of 15-minute intervals or longer, but not more than one hour, will form the resource map of the licensee.

5.6 The licensee shall subtract the resource map developed in clause 5.4 from the demand forecast developed in section 4 to identify the resource gap.

5.7 The resource gap for the long term and medium term shall be developed in the manner prescribed in clause 3.5 of these regulations.

5.8 The licensee shall conduct sensitivity and probability analysis to determine the most probable resource gap. The licensee shall also develop long-term and medium-term resource gap plans for possible scenarios, while ensuring that at least three different scenarios (most probable, business as usual, and aggressive) are developed.

5.9 The licensee shall demonstrate to the Commission that procurement of the power based on the resource gap developed under the provisions of this Chapter ensures, to the maximum extent of its own control and influence, that all customers connected to its distribution system will receive an adequate, safe, and economical supply of electricity, having regard to quality, continuity, and reliability of service.

Chapter – 6

Power Procurement

6.1 The resource gap developed in section 5 shall be classified into two categories, base and variable. The licensee shall procure power for the base gap, which will remain constant for the entire period of the long-term plan by long-term contracts. The licensee shall procure variable gap power based on the profile of the gap by medium-term contracts of not more than two years after consideration of the following minimum parameters:

(a) cost;
(b) grid integration cost;
(c) power available at power exchanges; and
(d) demand response and other demand-side measures.

6.2 The licensee shall endeavor to procure power through competitive bidding. In the case of any proposal for procurement of power through a memorandum of understanding (MoU), the licensee shall obtain prior approval of the Commission.

6.3 In the case of procurement of power through competitive bidding, the licensee shall initiate the process for power procurement in accordance with the Ministry of Power's "Guidelines for Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees," notified by the Ministry of Power on January 19, 2005, and in force from time to time.

6.4 In the case of procurement of power from generating sources, where the tariff is to be determined/adopted by the Central Electricity Regulatory Commission, the licensee shall take prior approval of the Commission before entering into any such arrangement.

6.5 In the case of procurement of power from generating sources, where the tariff is to be determined by the Commission, the licensee shall enter into such arrangement or agreement only after getting prior approval of the power purchase agreement.

6.6 Where the licensee is to procure power on a short-term basis or there is a shortfall due to any reason whatsoever, or failure in the supply of electricity from any approved source of supply during the year, for any reason whatsoever, the licensee may enter into a short-term arrangement or agreement for procurement of power through power exchanges or through a transparent process of open tendering and competitive bidding.

Chapter – 7

Miscellaneous

7.1 Removal of difficulties

The Commission may, by general or specified order, remove any difficulty in implementing the provisions of these regulations, not being inconsistent with the Act in the manner considered appropriate.

7.2 Power to relax

The Commission reserves the right to relax any of the provisions of these regulations or any of the directives or guidelines issued from time to time subject to such conditions as it may deem necessary.

7.3 Power to amend

The Commission may, at any time, on an application or suo motu, amend, modify, alter any of the provisions of these regulations as it may deem necessary.

7.4 Savings

Nothing in these regulations shall be deemed to limit or otherwise affect the power of the Commission

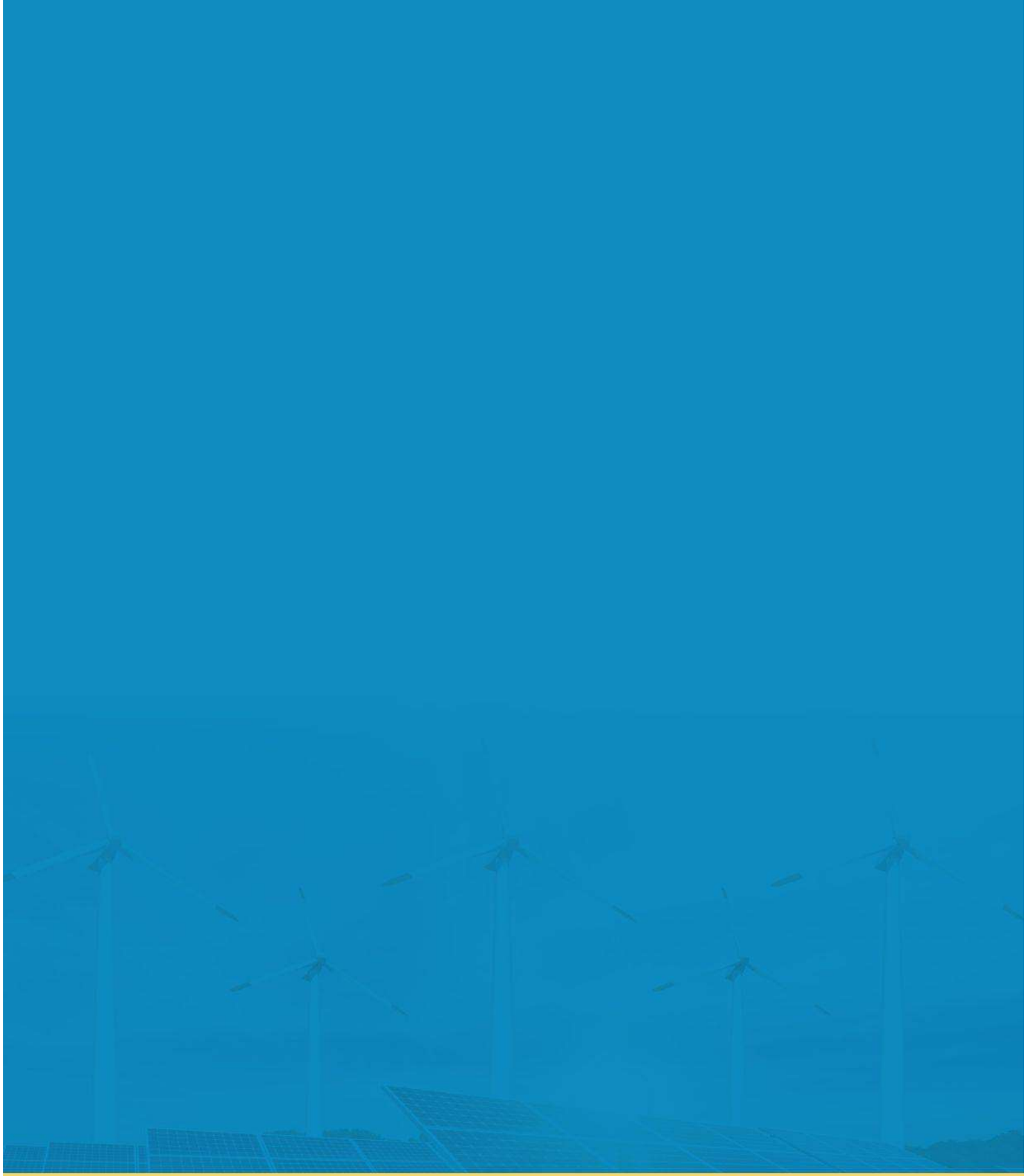
(a) To issue any order direction, as it may deem necessary in public interest.

(b) To adopt any procedure, in conformity of with provisions of the Act, which is at variance to the provisions of these regulations, to deal with any matter or exercise any power under the Act for which no regulations have been framed.

ANNEX 2: PEOPLE INTERVIEWED

Annex 2 contains the list of people interviewed while conducting primary research.

NAME	STATE	DESIGNATION/ORGANIZATION	DATE OF SURVEY
Ms. Anjuli Chandra	Punjab	Member, Punjab State Electricity Regulatory Commission	May 2020
Mr. Rajul Agarwal	Delhi	Vice President and Head, Regulatory Department, BSES Yamuna Pvt. Ltd.	May 2020
Mr. Himanshu Khurana	Rajasthan	Director Technical, Rajasthan Electricity Regulatory Commission	June 2019
Mr. Sudhir Sharma	Rajasthan	Executive Engineer, Rajasthan Urja Vikas Nigam Limited	June 2019
Mr. P.K Jani	Gujarat	Deputy Director Legal, Gujarat Electricity Regulatory Commission	June 2019
Mr. M.J Gadhvi	Gujarat	SE, Gujarat State Load Dispatch Centre	June 2019
Ms. Renu Kumari	Bihar	DE, Planning, Bihar State Power Transmission Company Limited	May 2020
Mr. Anand Suman	Bihar	Executive Engineer, Bihar State Power Holding Company Limited	May 2020
Mr. Pradeep	Karnataka	Executive Engineer, Karnataka Electricity Regulatory Commission	May 2020



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