Partnership to Advance Clean Energy Deployment (PACE-D 2.0)

Technical Assistance Program : Technical Workshop

Importance of Resource Planning in DISCOMs
25 November 2019

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Agenda

- Importance of Demand Forecasting and Resource Planning
- DISCOMs Need to Rethink - Resource Planning - Why?
- Demand Forecasting – Existing Practices and Gaps.
- PACE-D 2.0 RE Program Plan and Schedule
Resource Planning

Resource Planning is the process used by DISCOMs to select supply resources to meet long-term requirements of customers at a low cost with least regret.

1. Demand Forecast
2. Estimate Need for New Resources
   - Existing Resources
   - Conventional Generation Options
   - Grid-Connected RE
   - Demand Options
   - T&D options
3. Develop Alternative Resource Portfolios Using Capacity Expansion Model
   - Policy Goals and Regulatory Environment
   - DER Uptake
   - EV Uptake
4. Uncertainty and Risk Analysis of Alternative Portfolios
5. Resource Plan

1. Demand Forecast over the planning horizon?
2. Will existing resources be able to meet the demand? If not, what will be deficit over the plan years?
3. What will be the best mix of resources to procure to bridge the gap?
Key Attributes of Resource Planning

- **Demand Forecasting**
- Resource Mapping
- Estimating Additional Resources
- Developing Alternative Resource Portfolios
  - Combinations of RE, Demand Side and Conventional
  - Develop Options (Managing Risk and Uncertainty)

- Overestimation of demand an indication of poor planning – Lead to undue burden of fixed charges in PPC and effect consumer tariffs
- Underestimation of demand lead to power shortages and result in higher emission and other economic losses
Why DISCOMs need to Rethink Resource Planning in RE Rich Environment

• Development 1: Falling Prices of Renewable Energy

• Development 2: DSM Measures provide additional resource

• Development 3: Advances in Technology lead for Possibilities to match variations in supply with demand across space-time
Renewable is cheaper compared to conventional.

Time is not far that soon with the thrust on RE
- RE will no longer enjoy must run status
- Permissible variation limit will shrink

However challenge remains, RE is uncertain and unpredictable and hence require a better understanding of load curve to support integration.

Development 1: RE to play a big role in India’s Power Sector

- RE Installed
  - 78 GW (22% of Installed Cap. May’19)
- RE Target by Y2022
  - 175 GW (Aiming for 225GW)
- Falling RE Prices
  - Wind: ₹2.5 - 2.85/kWh
  - Solar: ₹2.4 - 2.65/kWh
- Discoms’ Avg. Procurement Cost
  - ₹3.6/kWh (APPC FY18-19)

Discoms’ Avg. Procurement Cost

<table>
<thead>
<tr>
<th>Year</th>
<th>Thermal &amp; Hydro</th>
<th>RE</th>
</tr>
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<tbody>
<tr>
<td>FY15</td>
<td>22GW</td>
<td>2GW</td>
</tr>
<tr>
<td>FY16</td>
<td>23GW</td>
<td>7GW</td>
</tr>
<tr>
<td>FY17</td>
<td>10GW</td>
<td>18GW</td>
</tr>
<tr>
<td>FY18</td>
<td>5GW</td>
<td>12GW</td>
</tr>
<tr>
<td>FY19</td>
<td>3GW</td>
<td>9GW</td>
</tr>
</tbody>
</table>

Capacity Addition Trend – RE Focused

- 0% to 100%
RE is now a candidate for long term and offer potential for DISCOM success

**Future Power Generation Costs in India (cents/kWh)**

- **2018**
  - Non Pit Head Coal: 7.1
  - Ground Mounted Solar PV: 4.1
  - Onshore Wind: 3.7

- **2030**
  - Non Pit Head Coal: 10.0
  - Ground Mounted Solar PV: 4.0
  - Onshore Wind: 3.2

**Savings in Power Purchase Cost with Increase RE Additions (%)**

- Punjab: 30%
- Gujrat: 25%
- Assam: 20%
- Jharkhand: 15%

Savings in Power Purchase Cost (%)

- RE Addition 5%
- RE Addition 10%
- RE Addition 15%
- RE Addition 20%
- RE Addition 25%
- RE Addition 30%

**PPC reduce by 10%**
Development 2: Demand Side Support Available

Solar
- Solar and Wind are Variable and Uncertain. Non-dispatchable
- Supply not necessarily correlated to Demand/Peak
- Seasonal variations with Wind Generation
- Solar generation available only during the day
- Supply side reliability is a challenge
- Appropriate Reserve with high-ramp capability required

Wind

Roof-top Solar

Dist. Generation

EE & EC Price Signals

EVs

Focus Areas

Supply Side Impact
- New & non-traditional impacts on demand side
- Demand Curve may take un-expected shape in future
- High EV thrust going to add demand surges in certain hours of day, bringing in new supply side pressure
- Roof-top Solar and Distributed Generation impact both supply side and demand side, supressing demand seen in the grid
- EE & EC has vividly impacted demand growth in India the recent past years (CEA has made downward revisions in 19th EPS), and the thrust is going to continue further

Demand Side Impact

Long Term Resource Planning, with efficient Demand Forecast helps prepare Discoms for the challenges ahead
**Development 3**: It is possible to better match variations in supply with demand across space-time

- Thermal Resource fairly a base load, predictable and stable.
- The peak requirements were attended through Peaker's.
- Demand was considered uncontrollable.
- Demand was higher than supply. Load control was through load shedding.
Matching Supply and Demand Curve - Possibility of Higher RE Share without External Support (contd.)

- Substantial efforts are on for RE (Wind, Solar, Storage) forecasting
- Requirement is to predict a better and granular demand curve.
- Demand can be controlled by DR and time of the day tariff.

Better matching of the variations in the supply with demand across space-time will reduce the cost of grid integration of the RE estimated to be 1.11 Rs/unit for 2022 in India

### Details of calculation for All India scenario for 2022

<table>
<thead>
<tr>
<th>S.no</th>
<th>Balancing Cost</th>
<th>Rs./Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total balancing charge for Gas based station (fixed +fuel charge)(Rs/kWh)-Spread over renewable generation</td>
<td>0.04</td>
</tr>
<tr>
<td>2</td>
<td>Impact of DSM per unit- Spread over renewable generation</td>
<td>0.30</td>
</tr>
<tr>
<td>3</td>
<td>Impact on tariff (Rs/kWh) for All India discom for backing down Coal based generation assuming solar and wind at Rs. 2.50/kWh and tariff of coal based generation at Rs. 3.50/kWh- Spread over renewable generation</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Stand by charge (Rs/kWh)- Spread over renewable generation</td>
<td>0.50</td>
</tr>
<tr>
<td>5</td>
<td>Extra transmission charge (Rs/kWh)- Spread over renewable generation</td>
<td>0.26</td>
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</tbody>
</table>

**Total Impact- Spread over renewable generation (Rs/kWh)**

Source: CEA Report, Balancing Cost for Accommodating Renewables
Power procurement cost is 60-70% of the total cost of supply.

1. How to use low cost RE more in their portfolio?
2. How to minimalize system integration cost of RE?
3. How to blend varying RE resources with stable thermal resources?
4. How to make advantage of ICT technology and DSM measures?
5. How to exploit variations in demand and RE generation?
6. How to build/develop resources to deal with new challenges of RE dominated power portfolio?
• This requires forecasting with higher accuracy for both Renewable Energy and Demand.

• Space time requirement matrix for additional resources.

therefore, call for better **Demand Forecasting** ....
<table>
<thead>
<tr>
<th>Demand Forecasting</th>
<th>CEA</th>
<th>States</th>
<th>Global Best Practices</th>
<th>Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizon:</strong> 10-year Demand Forecasting through EPS Projections for 15-20 years</td>
<td><strong>Horizon:</strong> 5-year Demand Forecasting</td>
<td><strong>Horizon:</strong> Typically 10-year Demand Forecasting</td>
<td>• Need to improve forecasts using <strong>load research techniques</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Method:</strong> Partial End Use Methodology for 10 year projection.</td>
<td><strong>Tool:</strong> Excel</td>
<td><strong>Tool:</strong> Sophisticated commercial tools.</td>
<td>• Cognizance of <strong>DRE, EV and EE</strong></td>
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<tr>
<td><strong>Method:</strong> CAGR considering Loss and Policies</td>
<td><strong>Method:</strong> Advanced methods like Time series, PEUM and Econometric</td>
<td></td>
<td>• <strong>Use of sophisticated tools</strong> to manage long term resource plan</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• <strong>Regulatory framework</strong> for resource planning</td>
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How better Demand Curve Matching Helps Higher RE Uptake? – Simulation Studies

With better Demand Forecast & Resource Planning, RE Share can Get Doubled

Results:

- Capacity Addition: 2x Solar, 2.5x Wind, Others-Nil
- PLF of TPPs: 72% from 71%
- RE Generation Share: 30% from 15%
- Avg. Power Cost: Rs 4.63/u from 4.88/u (Decrease of about 5.2%)

Rajasthan

Actual Dispatch on December 14, 2018

Simulation for December 14, 2022

Karnataka

Generation Dispatch on 25-03-2019

Generation Dispatch on 25-03-2030 with proposed Generation

Business As Usual (+) RE Scenario (+)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Business As Usual (+)</th>
<th>RE Scenario (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal</td>
<td>4720 MW</td>
<td>2670 MW</td>
</tr>
<tr>
<td>RE</td>
<td>0 MW</td>
<td>6400 MW</td>
</tr>
<tr>
<td>Storage</td>
<td>-</td>
<td>2000 MW</td>
</tr>
<tr>
<td>Cost</td>
<td>17,800 Cr.</td>
<td>16,800 Cr.</td>
</tr>
</tbody>
</table>

No stranded asset created
No system level grid security issues
Savings of 1000 Crs/annum

11245 MW

19127 MW
PACE-D 2.0 RE program is working towards developing software tool to improve Resource Planning process in state of Assam
Approach for Power Sector Planning in Assam

- Demand Forecast Module
- Generation Mapping Module
- Power Procurement Optimization Module
Approach for Power Sector Planning for Assam

**Current Practices v/s Best Practices**

Undertake study to assess utility demand forecasting, resource planning and least cost power procurement practices.

**Software Design & Development**

Develop Methodology and design tool in 3 modules (demand forecasting, resource planning and least cost procurement)

**Procurement Plan**

- Deploy Tool and develop procurement plan,
- Model guidelines and regulation

**Scaling & Outreach**

- Build Capacity of planners,
- Disseminate Knowledge and
- Replicate for national adoption.
Key Benefits for Other States

01. Demand forecasting software will be **modular** in nature and states can input their data.
02. Freely available to use for other states.
03. Help in **procurement planning** and revalidation of the forecasting mechanism currently adopted by states.
04. Reskill planners to use software’s having better techniques for planning.
05. Review and calibrate **long term and medium term plans**.
Project Milestones

- Current practices across globe
- Requirements from DISCOM
- Develop framework

- Functional, Technical requirement document
- Development of Beta software
- Factory Acceptance Test

- Customizations
- Deployment of Final SW
- Site Acceptance Test

- Data collection & Modeling
- Demand Forecasting
- Generation Mapping
- Power Plan Development

- Training/Video calls
- Reskilling of Utility members
- Building analytical skills to maximize utilization of SW

- Development of Strategy
- Support Documents
- workshops/training for other DISCOMs in India
### Project Milestones

**Start**
- Gap Analysis

**Done**
- Dec-19

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<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>DF Module</td>
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<td>2</td>
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**Demand Forecasting Module Development**

- Regional Workshop on Demand Forecasting
- Regional Workshop on Algorithms and Equations utilized in software module for Demand Forecasting
- Development of Use Cases and Test Cases and Steering committee approval
- Testing of Module
- Deployment of Module B-version by Dec 2019

- Functional, Technical requirement document
- Development of Beta software
- Factory Acceptance Test
Workshop Outline

Forenoon Session-

– Technical presentation: Importance of Resource Planning for DISCOMs

– Audience Introduction and brief status of Resource Planning in respective states

Afternoon Session-

– Three technical presentations and Brainstorming Tutorial Exercise
  
  • Demand Forecasting Methodology and Development of Demand Profile – Basic Approach
  
  • Values, Sources and Assumption of various elements of Demand Profile – Presentation and Focused Group Discussion
  
  • Demand Forecasting – Output Parameters