Development of Mechanisms to Incentivize Inter-state Exchange of Renewable Energy

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Renewable Integration and Sustainable Energy Initiative Under Greening the Grid (GTG-RISE), New Delhi, India

September 05, 2019, Thursday
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Introduction

- Identify factors that currently inhibit trading/exchange of RE across the states
- Critical review of existing regulatory, policy, commercial, and infrastructural constraints to identify key challenges and potential measures that need to be addressed
- Suggesting measures to create an eco-system for sustainable inter-state exchange of RE
Key drivers of RE capacity addition in India

- High RE potential in country (Solar 750 GW; Wind 302 GW)

- Eight states have over 60% & 90% of the total solar and wind potential in the country

- Uneven geographical distribution of the potential results in RE rich and deficit states

- Government incentives

- RPO Targets by SERCs

- Declining cost of RE generation boosting affordability

Source: GOI Energy Statistics-2018
Issues in inter-state RE exchange

- Regulatory
- Transmission
- Markets & Commercial
## Issues in Promoting Inter-state RE Exchange

Effective RE Grid Integration is Prerequisite for Promoting Inter-state RE Exchange

<table>
<thead>
<tr>
<th>Regulatory</th>
<th>Transmission</th>
<th>Market &amp; Commercial</th>
</tr>
</thead>
</table>
| • Operational & commercial impact of Regulations  
• Misalignment in regulations | • Unavailability of transmission network  
• Exemption of inter-state transmission charges | • Incentivization to Flexible Operations of TPPs  
• Handling of load generation imbalance through DSM |
| Analysis of regulations pertaining to,  
• RE generation forecast error  
• Deviation in state’s drawl from regional grid  
• Ancillary services | • Review of planned transmission network  
• Cost recovery mechanism of planned transmission network | • Compensatory framework for flexible operation of thermal power plant  
• Imbalance market to incentivize the flexible energy sources |
**Regulatory Issue Analysis**

**Different RE Forecasting Penal Mechanisms**

- RE forecasting error (as per F&S Regulation) is within ≤15% for around 90% times of predicted value

- Different penal mechanism at inter-state (PPA linked) & Intra-state (absolute value)

- Fix rate based penalty is deterrent for new low-cost RE developer connected to state’s network, more impact on revenue

### Table: RE Generators Performance

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Inter-State Generator</th>
<th>Intra-State Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator Capacity (MW)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Annual Generation (MU)</td>
<td>1.66</td>
<td>1.66</td>
</tr>
<tr>
<td>PPA Rate (INR/kWh)</td>
<td>2.76</td>
<td>3.93</td>
</tr>
<tr>
<td>Forecast Error Penalty (INR)</td>
<td>43,171</td>
<td>2,06,336</td>
</tr>
<tr>
<td>Impact on Revenue</td>
<td>0.95%</td>
<td>3.16%</td>
</tr>
</tbody>
</table>

Assumed CUF 19%

SECI Solar Tender September, 2018

RERC Order for Solar PV Tariff Determination during FY 2017-18
Regulatory Issue Analysis

State-wise Deviation Profiles in Western, Northern & Southern Regions in MW (FY2018-19)

- In the Northern region, deviation for states of RJ, UP, & Hr is high as compared to other states.
- Low RE penetrated states like UP & Hr having wider deviation range as compared to RJ.
- State with high RE penetration e.g. RJ, TN, KA encountering problem, in managing load-generation imbalance.

Data Source: Respective Regional Load Dispatch Centre
Rajasthan Case Study
Trend of Rajasthan State’s Deviation Profile

• Rajasthan’s schedule deviation stays within ±12% of schedule, the MW deviation from schedule drawal can be above 250 MW, which leads to additional deviation penalties.

• During Jan-March’19, average monthly over-drawl quantum decreased & under-drawl quantum increased.
Impact of wind variability on state deviation DSM is visible. Similar instances of occurrences are spread across the year (for 23% time blocks of 4 hours each).

Peak deviation i.e. over-drawal, as seen in the example has crossed 500 MW which is far beyond the permissible level of 250 MW for RE rich states.

Rajasthan need to equip with more flexible generating resources to minimize imbalances.
Market linked DSM price impacted Ancillary Service Deployment.

Since January 2019, ancillary service deployment for regulation-up, decreased substantially, while regulation-down service increases.
## Issues in Transmission Infrastructure

### Transmission Planning for RE Evacuation

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Region</th>
<th>Phase – I Capacity (GW)</th>
<th>Phase - II Capacity (GW)</th>
<th>Total Capacity (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Western Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Gujarat</td>
<td>7</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>B Maharashtra</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>C Madhya Pradesh</td>
<td>2.5</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Sub-Total (WR)</strong></td>
<td><strong>10.5</strong></td>
<td><strong>17.7</strong></td>
<td><strong>28</strong></td>
</tr>
<tr>
<td>2</td>
<td>Northern Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Rajasthan</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Southern Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Tamil Nadu</td>
<td>1.5</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>B Andhra Pradesh</td>
<td>4.5</td>
<td>3.5</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>C Karnataka</td>
<td>2.5</td>
<td>5</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td><strong>Sub-Total (SR)</strong></td>
<td><strong>8.5</strong></td>
<td><strong>10</strong></td>
<td><strong>18.5</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>37.5</strong></td>
<td><strong>66.5</strong></td>
</tr>
</tbody>
</table>

- Planning to add transmission capacity to evacuate solar & wind capacity of 50 GW & 16.5 GW, respectively from **seven RE rich states**.
- Implementation of planned transmission capacity will require investment of INR 43,235 Cr.
- Funding to implement planned transmission network, will be contributed by project developers, solar park fund & socialization.
Market & Commercial Issues

Review of issues associated with policies, regulations, transmission infrastructure and, market and commercial

- Current PPAs & regulations do not have provisions for recovering financial losses due to flexible operations
- Commercial framework to compensate secondary ancillary services, from automatic generation control need to be developed
- Curtailment without compensation creates impact over project cash flow and debt-service cover ratio
- RE plants without PPAs do not participate in Day Ahead Market, as not allowed to revise schedule, leads to higher DSM penalties
Interventions
Regulatory Interventions

Roadmap to address identified issues and facilitate inter-state RE exchange

**Immediate**

1. Alignment in intra-state & inter-state RE forecasting penalty methodologies

   1. Load forecasting regulations, for better grid discipline

   2. Development of technical & Commercial provisions/guidelines to enhance flexible operation in thermal power plants

   3. Development of AGC framework for secondary ancillary service response

   4. Facilitating surplus RE exchange and RE Trading on Power Exchange

**Medium - Term**

1. Implementation of gate closure

2. Development of imbalance market

**Long - Term**

1. Mechanism for equitable cost allocation for transmission infrastructure required for RE
Technology & Information System Interventions

Roadmap to address identified issues and facilitate inter-state RE exchange

Immediate

1. Development of Central Data Repository to create an eco-system data driven policy formulations
2. Development of IT implementation strategy to optimize cost of software, hardware and cybersecurity
3. Improve real-time connectivity of metering & communication infrastructure to improve RE forecasts

Medium - Term

1. Implementation of communication & IT systems and its interfacing with different stakeholders for effective implementation of F&S regulation
2. IT application to implement RE curtailment instruction & monitoring of compliance of instructions
Conclusion
Conclusion

• Based on stakeholder consultation, analysis focuses on addressing several challenges in relation to regulation, transmission infrastructure, & markets and commercial interventions

• To manage the complexity emanating from high RE share, technology and information system can play vital role

• It is envisioned that implementing these measures through a phased approach shall result in efficient grid integration of wind & solar power capacity

• An eco-system which addresses the operational & commercial issues will create an eco-system to promote inter-state renewable energy exchange

• Effective RE grid integration is critical for inter-state RE exchange in sustainable manner
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