ENERGY ANALYTICS LAB
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Power Chronicle

Power System Overview & Analysis

Power Market Overview & Analysis

Regulatory & Policy Perspective

Editorial

Markets behave in response to newly discovered information, and the pace of that response reflects market efficiency. EAL's analysis (PC: Vol.3, Issue.2) highlighted a consistent behavioural observation that RTM prices were found to be proportionally higher than the DAM discovered price for the same time block across more days in a month, particularly during the late night and early morning hours. Power Market seems to have assimilated this information. Understandably, March 2021 recorded significantly fewer days with RTM prices being higher than the DAM prices during the mentioned hours of the day (see page 6).

The increasing share of variable RE (VRE) places stress on the thermal generators, which need to respond to variability in demand as well as VRE generation. Adequate ramping capability of thermal generating units, particularly those based on coal and lignite, is crucial to ensure system security and stability. CERC's (Terms and Conditions of Tariff) Regulations, 2019 provides for additional RoE for higher ramping capability while penalising any short fall.

EAL's analysis of the Guidelines for Assessment of Ramping Capability of ISGS issued by POSOCO-NLDC points towards at least five instances of relaxations in the overall framework. For example, 15% relaxation in measuring the proportion of time blocks having attained the ramping target in spite of the exclusion of the blocks under exigencies, ramp rate tolerance of 10% only for under-achievement of ramping target, and a minimum of 60-90 blocks/month (2-3 blocks/day) required to demonstrate the ramping capability. EAL suggests reconsideration of various relaxations to ensure that the beneficiaries and, hence, the consumers are not unduly burdened by the additional RoE and there is fair treatment of performance shortfall as well.

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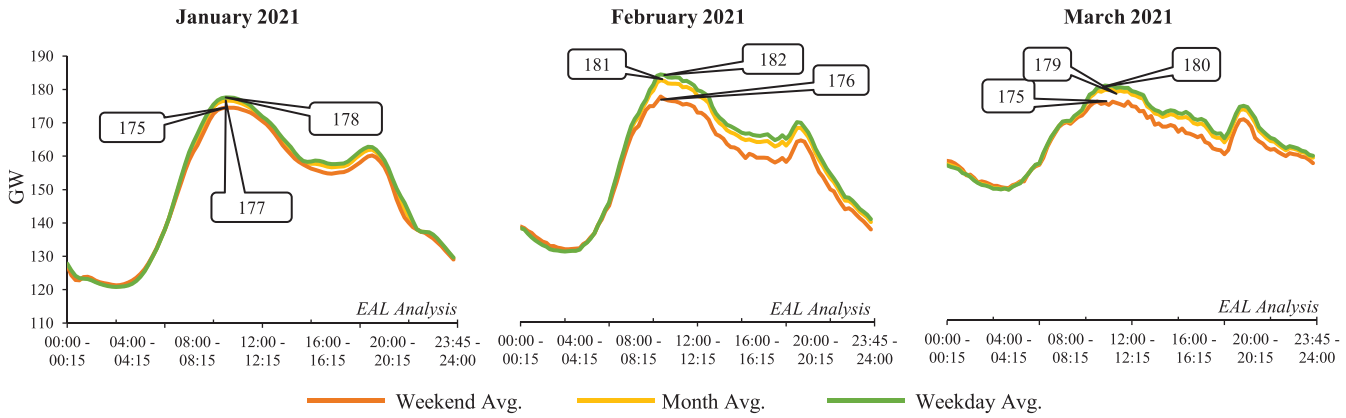
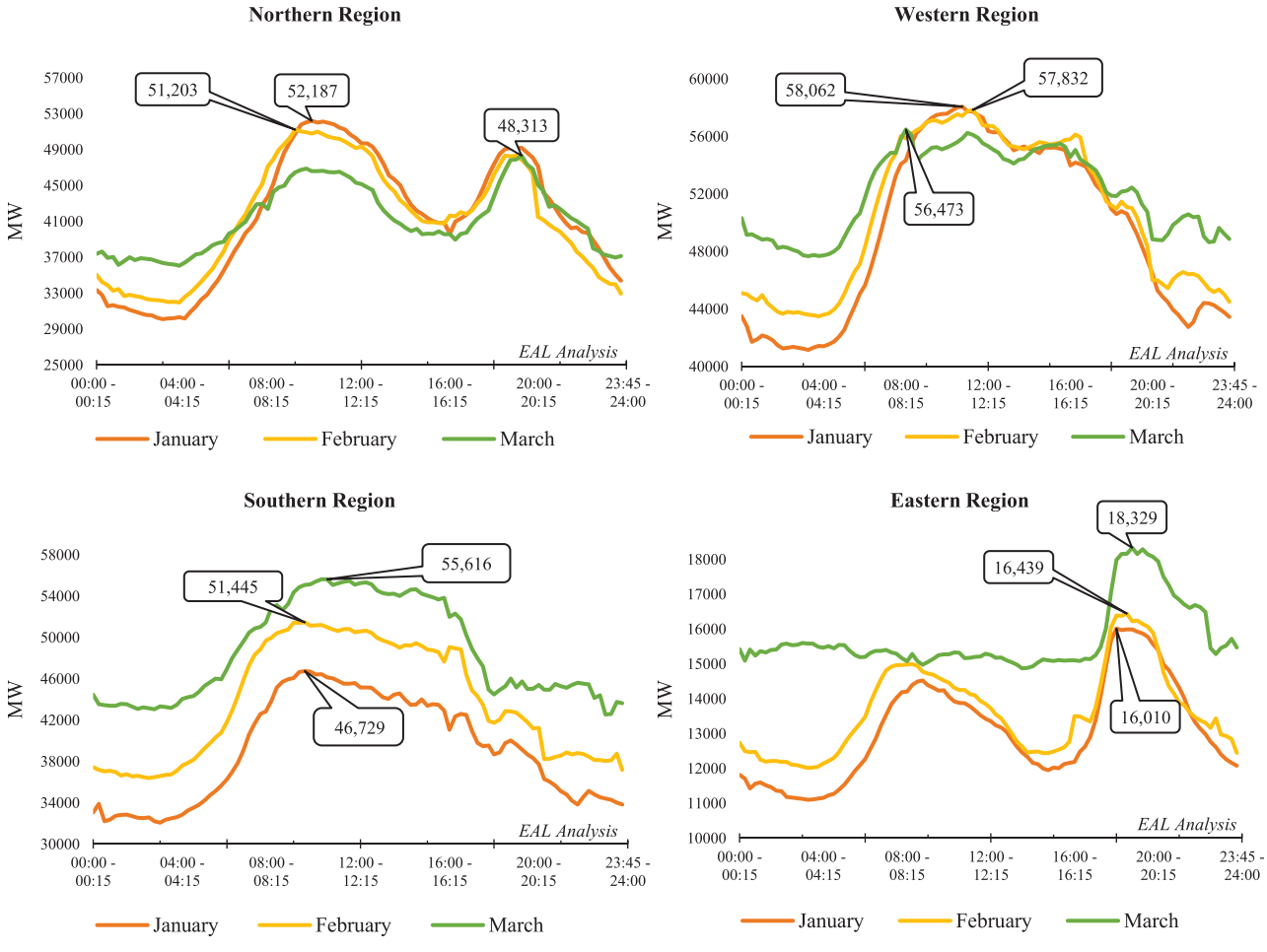
Power System Overview & Analysis

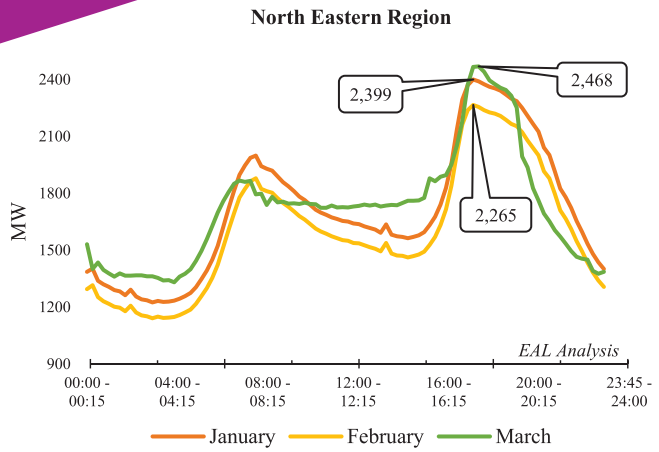
All India Demand Met Profile



From January to March quarter, all India peak demand reached 190 GW (10:30 - 10:45) on 30th January 2021, about 8.05% higher than the previous year's peak demand recorded at 175.84 GW (07:45 - 08:00) on 18th February 2020, during the same quarter.

Region-wise Demand Met Profile

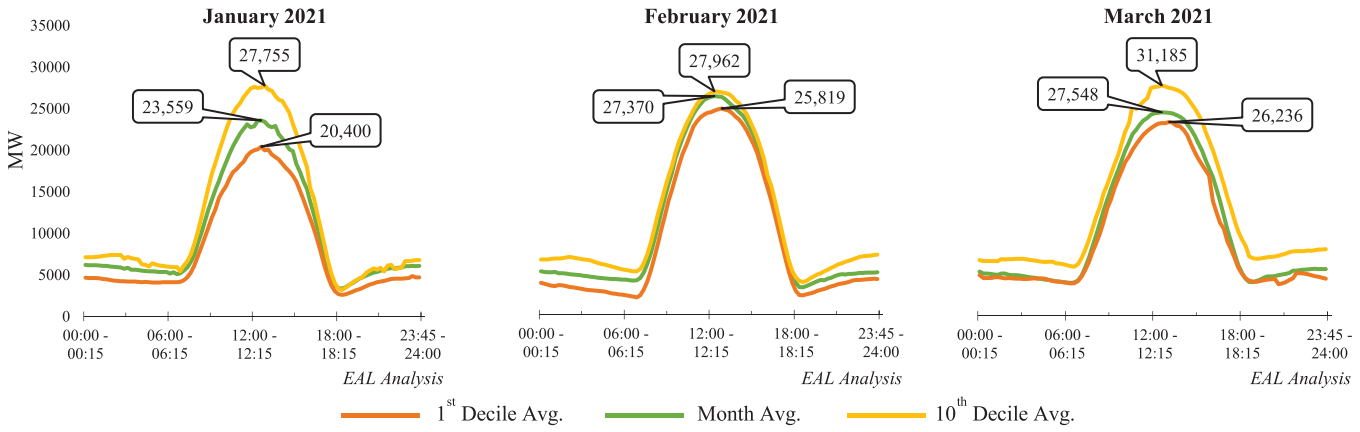




- Significant variation in demand profile can be seen across the months of January, February and March of some regions. Southern and Western region witnessed significant decline in electricity demand during night hours in January.
- In March, almost no variation in demand is seen till evening in the Eastern region; however, demand has increased in night hours.

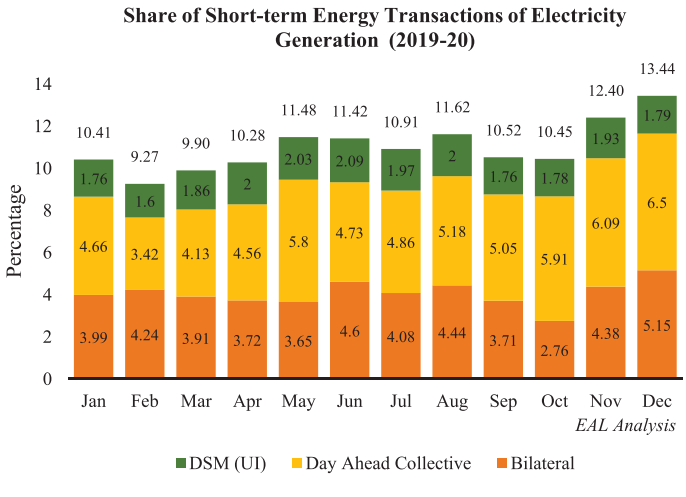
Demand and generation profiles at national, regional and state-level can be accessed on EAL's web portal.

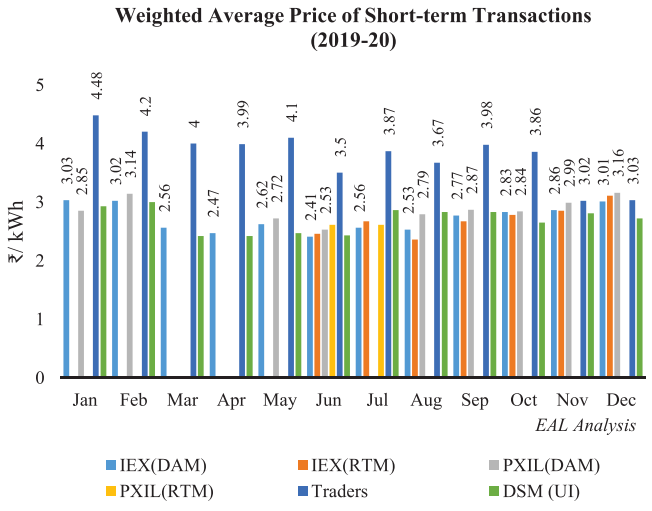
All India Renewable Energy (RE) Generation Profile



All India peak RE generation reached 32.22 GW (12:00 - 12:15) on 30th March 2021, about 9.78% higher than the previous year's peak of 29.35 GW (12:30 – 12:45) on 22nd January, 2020 during the same quarter.

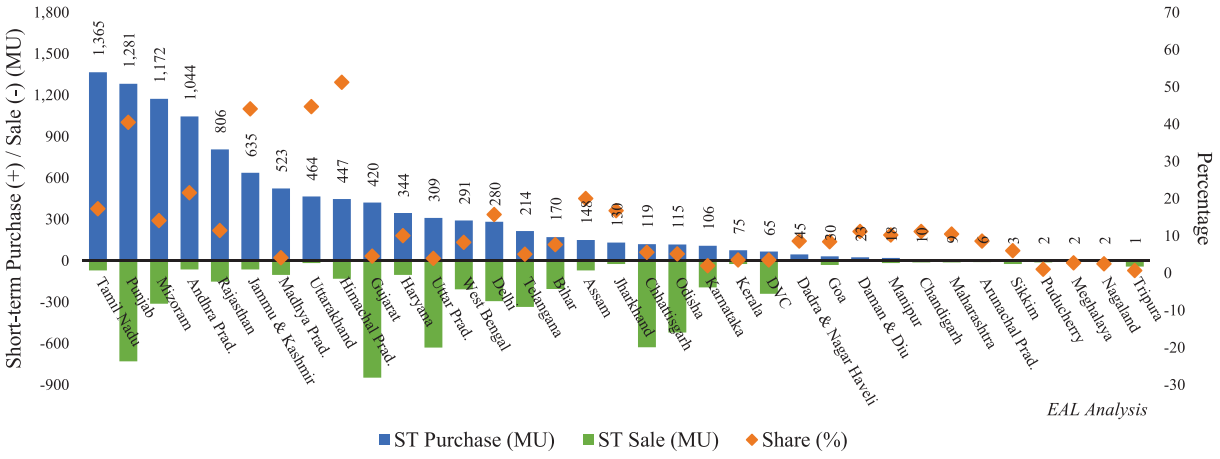
Short-term Energy Transactions



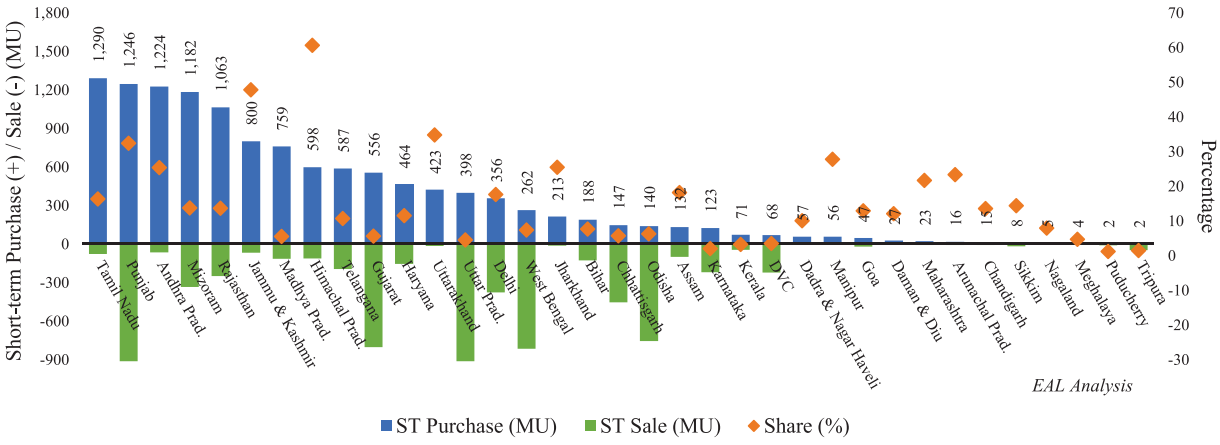


Monthly Short-term (ST) Purchase and Sale Quantum across States

ST Energy Sale, ST Energy Purchase and Share of ST Purchase in Total Energy Supplied (November 2020)



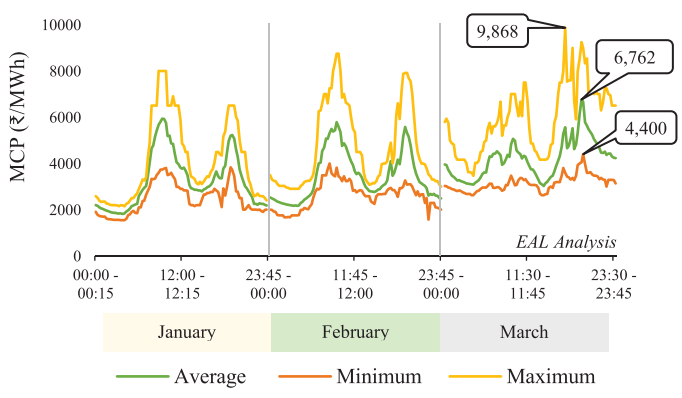
ST Energy Sale, ST Energy Purchase and Share of ST Purchase in Total Energy Supplied (December 2020)



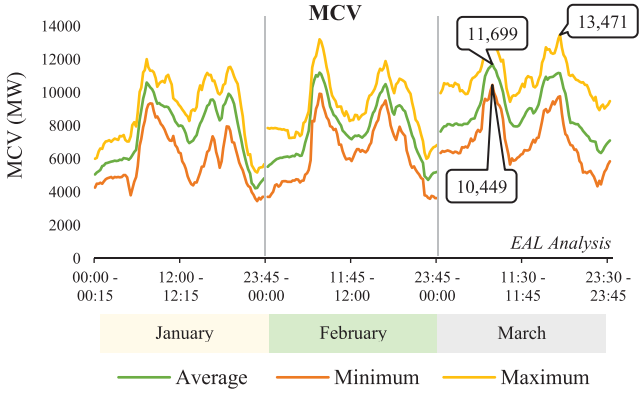
Power Market Overview & Analysis

DAM – Market Clearing Price (MCP) & Market Clearing Volume (MCV)

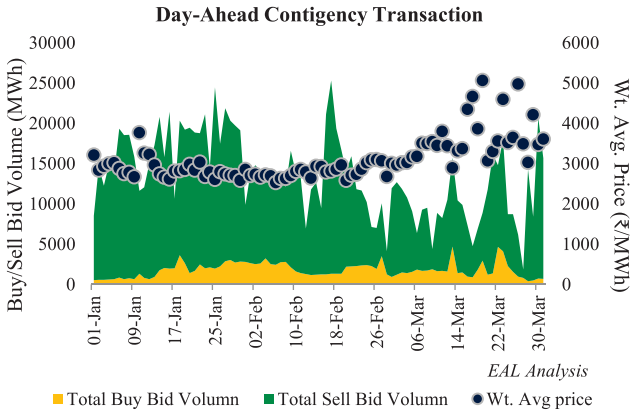
DAM Monthly Average, Maximum & Minimum MCP

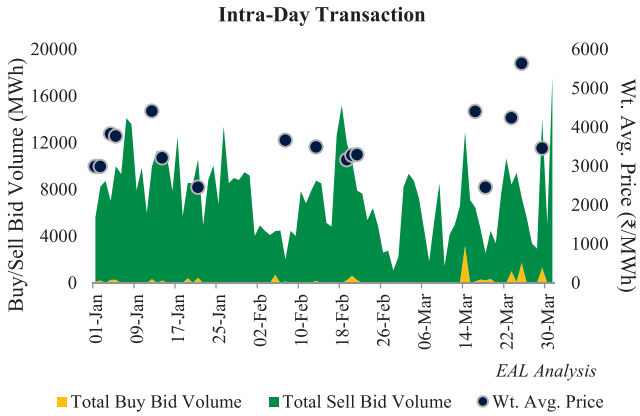


DAM Monthly Average, Maximum & Minimum MCV



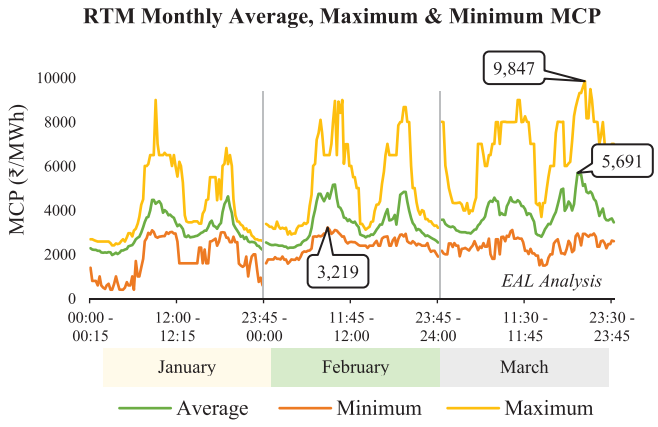
Term-Ahead Market (TAM)

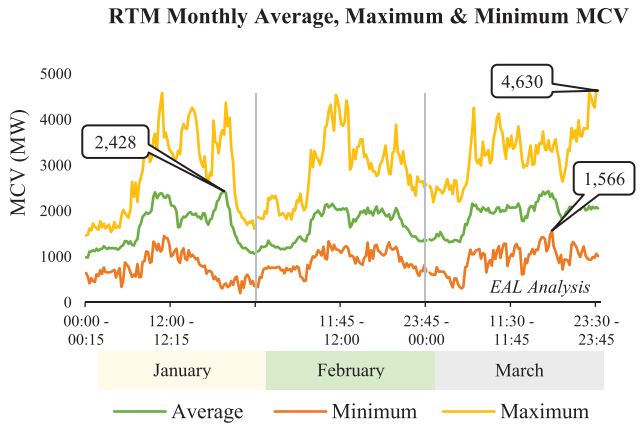




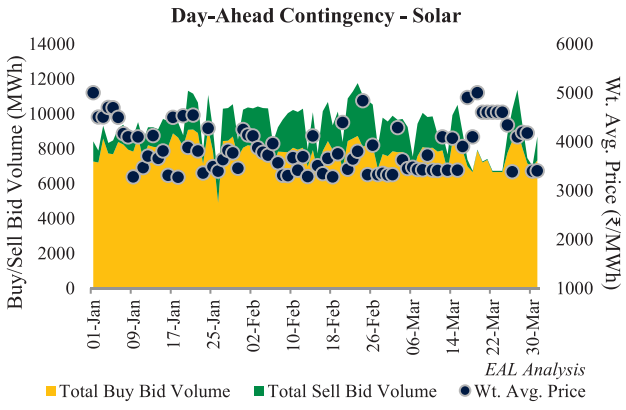
The weighted average clearing price observed in Intra-day market during January to March quarter is higher in comparison to the Day-Ahead Contingency market. Also, the proportion of sell bids is much higher when compared to purchase bids placed in the Term-Ahead Market.

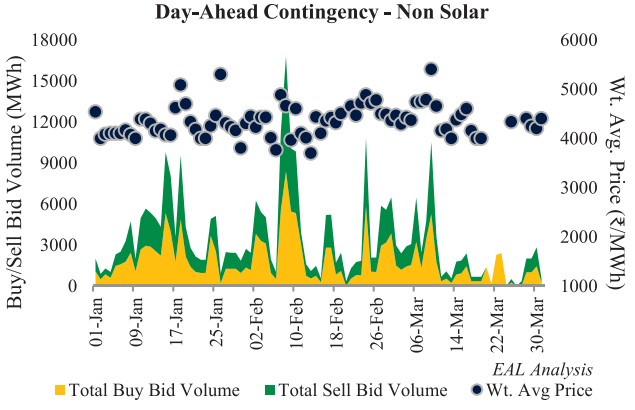
RTM – Market Clearing Price (MCP) & Market Clearing Volume (MCV)





Green Term-Ahead Market (G-TAM)

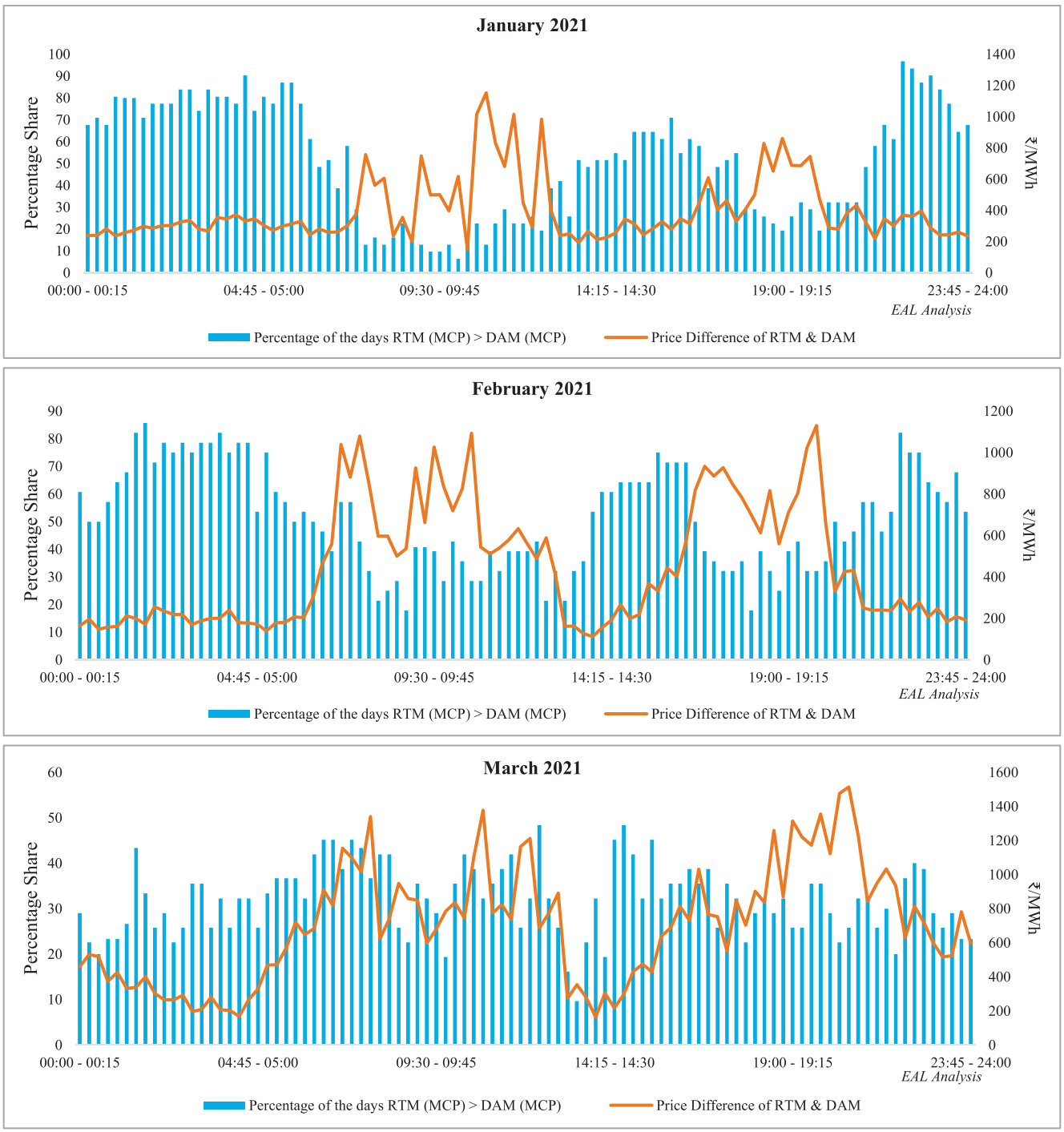




The weighted average clearing price of Non-Solar is higher in comparison to Solar in Day-Ahead transaction during January to March quarter. Also, the proportion of sell and purchase bids in Solar is higher when compared to the bids placed in Non-Solar.

Note: The above power market overview and analysis are based on the data obtained from IEX.

RTM Vs DAM on Market Clearing Price (MCP)



- The price difference between RTM and DAM is calculated only in cases where the former exceeds the latter. The block-wise RTM price exceeds the DAM price for about 51.60%, 51% and 31% of the days for the month of January, February and March, respectively.
- For block (22:00 - 22:15), 97% of the days in the month of January, RTM prices surpass DAM prices.
- Maximum difference between RTM and DAM price was observed to be ₹ 1152.96/MWh (10:45 -11:00), ₹ 1130.24/MWh (19:45 - 20:00) and ₹ 1514.04/MWh (20:30 - 20:45) in January, February and March, respectively.

Note: The above RTM vs DAM on MCP is based on the data obtained from IEX.

Regulatory & Policy Perspective

POSOCO-NLDC Detailed Guidelines on Ramping Assessment

POSOCO-NLDC released "Detailed Guidelines for Assessment of Ramping Capability of Inter State Generating Stations (ISGS)" on 30th Dec., 2020.

The document lays down a detailed procedure for evaluation of ramping capability for providing additional (reduction of) RoE for achieving (failure to achieve) minimum ramping rate of 1%/min*. The detailed guideline for assessment of ramping is summarized below.

1. Generators to declare "Declared Ramp Up and Ramp Down Rate (MW/Block)" to the concerned RLDC.
2. The RLDC prepares a schedule based on declared capacity, technical minimum and declared ramp rate, taking into account the impact of Automatic Generation Control (AGC). The Scheduled Ramp Rate (SRR_t) due to change in injection schedule across time blocks is given as:

$$\mathbf{SRR_t = Net\ Injection\ Schedule_t - Net\ Injection\ Schedule_{t-1}}$$

$$\mathbf{Net\ Injection\ Schedule_t = Final\ Injection\ Schedule_t + AGC\ MW_t}$$

where, $AGC\ MW_t$ is the 15-minute average of (AGC Setpoint – Unit Load Setpoint) for t^{th} time block.

3. Actual Ramp Rate (ARR) is: $\mathbf{ARR_t = Actual\ Average\ Generation_t - Actual\ Average\ Generation_{t-1}}$
4. $\mathbf{T_d/T_m}$ measures ability of the generator to achieve the declared ramping rate (≥ 1%) excluding period of exigencies. Furthermore, a generating station achieving the declared ramping rate at least during 85% of such time blocks would be eligible for further evaluation for additional RoE (See Figure 1). Reduction in RoE would not be applicable even if the declared ramping rate has been achieved during 85% of such time blocks. $\mathbf{T_d}$ is the number of blocks when both "Declared Ramp Up and Ramp Down Rate" are ≥ 1%. $\mathbf{T_m}$ is total number of time blocks in the period of computation.
5. **E/D** and **F/D** ratios represent the proportion of time blocks in which a generating station is able to achieve its SRR and a minimum ramp rate of 1%, respectively. To account for exigencies, an ISGS achieving the ramp rate ≥ SRR at least for 75% of **D** is eligible for additional RoE. **E/D** and **F/D** proportion is used for giving additional (reduction of) RoE by 0.25% as per Tariff Regulations, respectively.

   where, **D** is the number of blocks, when $SRR_t \geq 1\%$ in the net injection schedule; **E** is a subset of **D** with $ARR_t \geq SRR_t$, and if $SRR_{t-1} < 0.5\%$ and $ARR_t \geq 50\%$ of SRR_t; and **F** is the subset of **D** when ARR ≥ 1%, and if $SRR_{t-1} < 0.5\%$, and $ARR_t \geq 0.5\%$.
6. Change in RoE shall be effected only when **D** ≥ 60*M for calculating **E/D**, or **D** ≥ 90*M for calculating **F/D** to ensure ISGS have sufficient opportunity to demonstrate ramping capability (Figure 1). Where, **M** is the number of months.
7. Actual Average Ramp Rate (AARR) is average of ARR in blocks **D**, when SRR is ≥ 1%.

   When SRR_{t-1} < 0.5%: AARR shall be incorporated as below:

   if (AARR > SRR)

   then AARR = AARR

   else

   AARR = Min (2*AARR, SRR)

   end

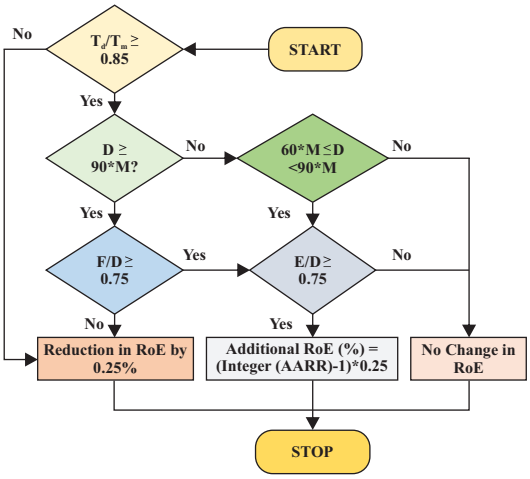


Figure1: Flow chart of RoE calculation for ISGS

Note *: Here onward, unit of the ramp rate is written as % instead of %/min.

EAL's Opinion

- 'Gate closure' for declaring ramping capability should be specified in line with that used for scheduling.

Table 1: Various relaxations for ramping assessment of ISGS

- **$T_d/T_m \geq 0.85$ - Clause 4 (4):** A threshold limit of 0.85 assumes that 15% of the time blocks across the year witness exigencies. This would be a significant over-estimation for most of the generating stations. Furthermore, the blocks with DC = 0 or schedule < technical minimum are already excluded from **T_m.** Since various exigencies can be identified and recorded, such time blocks can then be excluded while calculating **T_d/T_m**.
  The guidelines seem to suggest that number of time blocks **(T_d)** considered already exclude exigencies. If so, the threshold limit of 0.85 would not at all be justified. It is also important to note that the generating stations are allowed full recovery of fixed charges at 85% of availability.
- **Calculation of E and F for $ARR_t \geq 50\%$ of SRR_t - Clause 4 (5):** While calculating **E**, a SRR of 0.5% in a preceding time block assumes that the concerned generating station would experience technical challenges in bolstering up its ramping, for example, from 0.5% (t-1) to 1% (t) in the subsequent time block. It is likely that generating stations may often be subjected to such incrementally higher ramp rate. While, an increase in SRR from 0.51% to 1.0% may be justified, whereas 0.5% to 0.9% may not be.
- The 50% relaxation applicable for subsequent time block may often result in ARR < 0.5. For example, it would be ironic that an ARR of 0.4% (against SRR of 0.8%) would be acceptable for a subsequent time block. While preceding time block may have already witnessed SRR or ARR > 0.5%. We suggest that this relaxation should be lowered, and the resultant qualifying ARR (to be counted in E) should at least be 0.5%.
- This relaxation should only be applicable in case of SRR ≤ 0.5% and ARR ≤ 0.5% (i.e. not if ARR > 0.5%).
- **Ramp rate tolerance of 10% - Clause 4 (6):** The perceived randomness (of physical systems) inherently assumes a skewed distribution, wherein a 10% shortfall in ARR is condoned but 10% over-achievement of ARR is incentivized. From the perspective of beneficiaries, a similar tolerance should then also be provided on over achievement of ARR i.e., an ARR = 1.1% should be counted as ARR = 1%, thus saving payment of incentive.
- **D ≥ 60M for E/D and D ≥ 90M for F/D - Clause 4 (10):** The provision for additional RoE or reduction in RoE is applicable across the whole year, whereas higher (scheduled) ramping capability needs to be demonstrated only 2-3 blocks/day, and which may be achievable in an economical manner.
- **Cumulative impact of relaxations:** The relaxation in key parameters (T_m, T_d/T_m, **E & F**, **E/D & F/D**, ramp rate tolerance) towards assessment of demonstrated ramping results in cumulative relaxation of 23.5% to 66.25% while calculating eligibility for additional (penal) RoE.
- The overall framework merits further discussions to address some of the identified issues to ensuring that the guidelines are fair and equitable, while also providing sufficient incentive (penalty) for over (under) performance of ramping capability. Analysis of system/generator-wise data should provide input for same.

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