ENERGY ANALYTICS LAB
Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur

Volume 2 Issue 2
October 2019

Power Chronicle

Power System Overview & Analysis

Power Market Overview & Analysis

Regulatory & Policy Perspective

Editorial

The Indian power market has largely been dominated by long-term power agreements which lock-in the quantum as well as the fixed and the variable cost of power procurement (with escalation factors).

Post Electricity Act 2003 and subsequent setting up over of the power exchanges, development of the short-term power market has brought in a competitive spirit in the price discovery. The residual imbalances continue to be subjected to the Deviation Settlement Mechanism (DSM).

Growing share of variable renewable energy i.e. wind and solar, has added to the uncertainty associated with availability of electricity as well as, the demand uncertainty of the consumers having behind-the-meter electricity generation based on such resources. Inability of the intraday electricity trading contracts to provide a liquid platform to manage short-term deviations in generation and demand, have necessitated development of an efficient mechanism for electricity trade closer to the real time. Development of Real-Time Market (RTM) for electricity is expected to fill this vacuum in the short-term electricity market. This will also provide for market-based discovery of price for un-requisitioned surplus available with DISCOMs and will help dynamic changes in the generation and demand profile across the day. RTM's vibrancy can be further enhanced by developing effectively designed demand response program across DISCOMs.

The state electricity regulatory commissions and distribution entities should use the price signal from the RTM to design more effective TOD/TOU tariff. Recent efforts in the development of the market, including RTM and the SCED, are targeted towards efficient discovery of price signals on a short-term basis. However, this falls short of providing a price signal for creation of generation capacity over the long-run. Development of the capacity market alongside such initiatives would help to address the long-term capacity adequacy in the Indian power sector.

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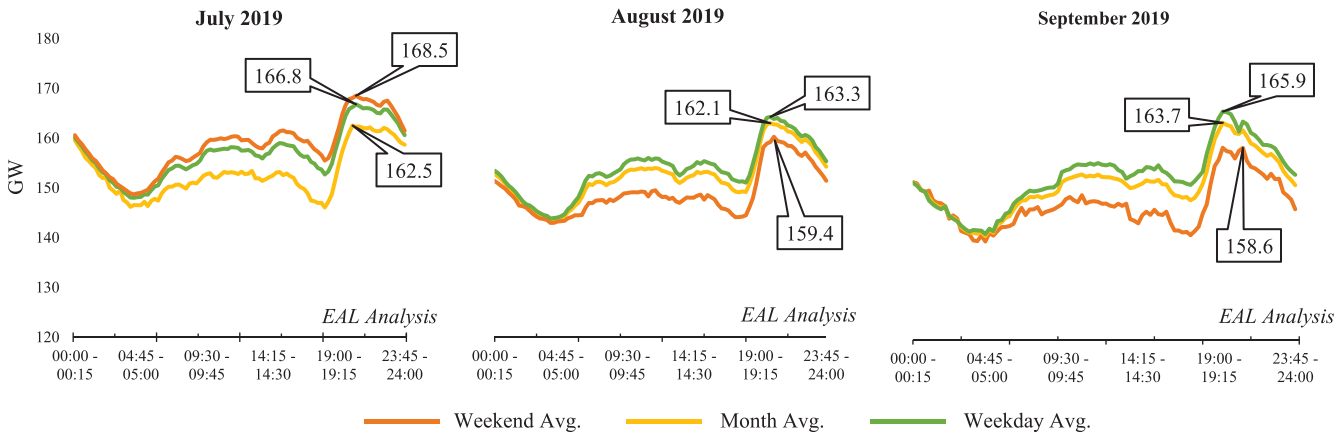
Power System Overview & Analysis

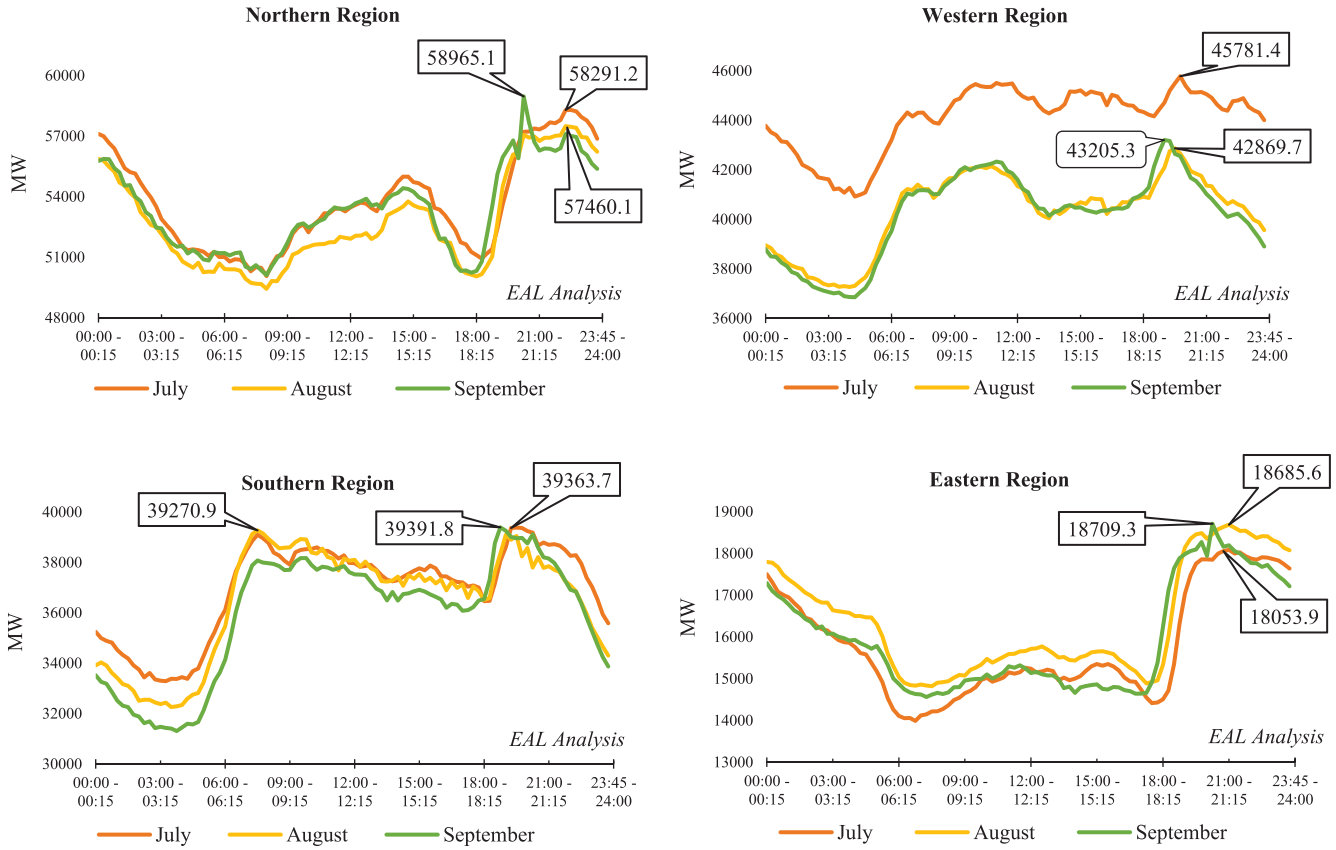
All India Demand Met Profile



For July – September quarter, all India peak demand reached 177.9 GW on 29th August 2019, about 1.2 percent higher than the previous year's peak demand during the same quarter (175.8 GW on 18th September 2018).

All India, region-wise and state-wise load profiles can be accessed at EAL web portal.

Region-wise Demand Met Profile



Note: *Load profile for North-Eastern Region is not reported here due to inaccessibility of data.*

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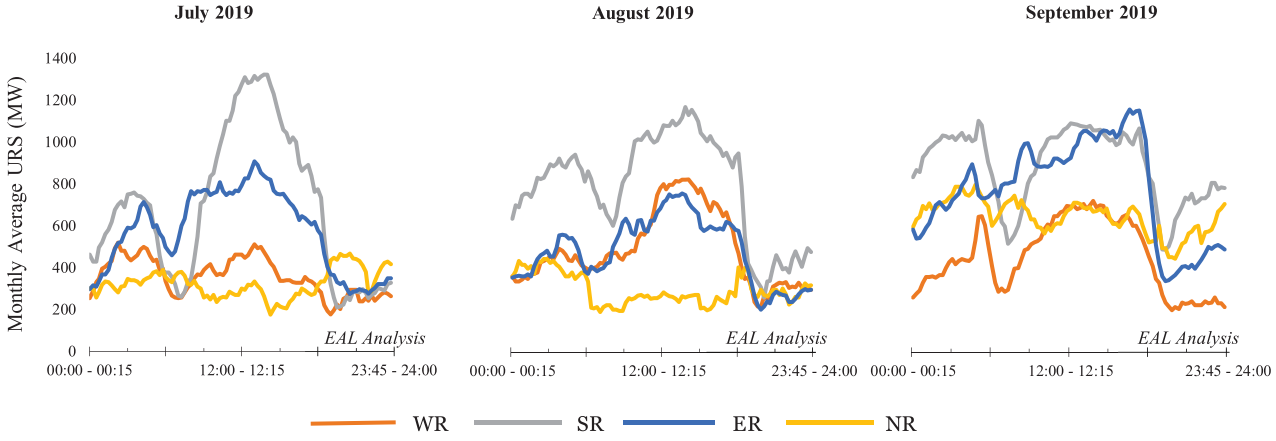
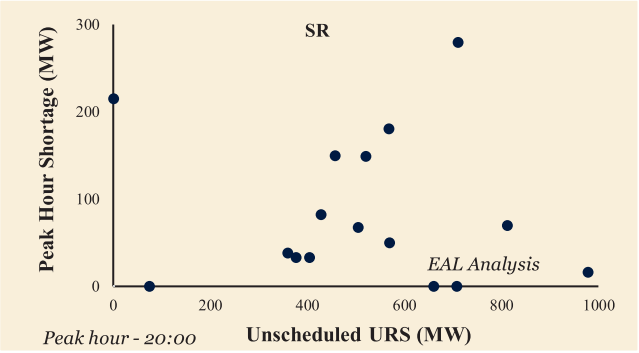
Un-requisitioned Surplus (URS) Analysis

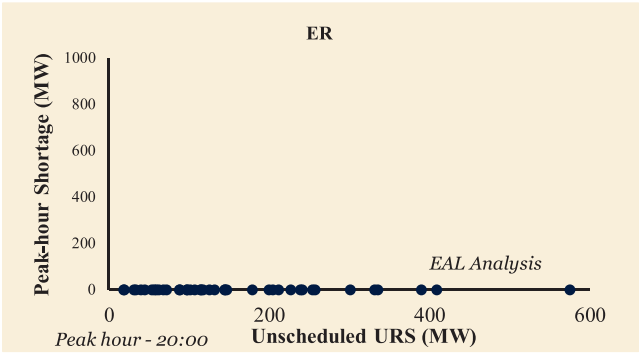
Region-wise Scheduled URS

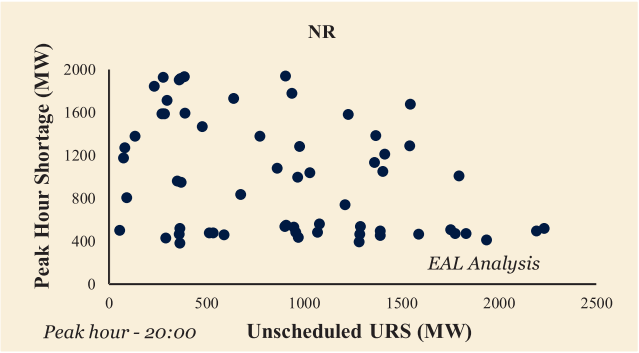


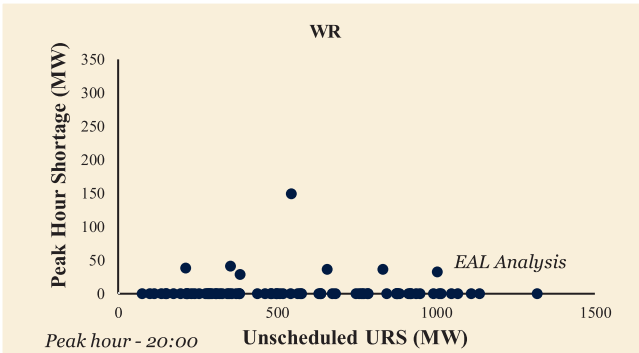
Region-wise Unscheduled URS (Excluding Gas Power Plants)

All India highest peak-hour demand shortage during July to September 2019 was recorded to be 4030 MW, on 11th September 2019 for NR. Persistence of shortage amidst availability of unscheduled URS highlights a need to explore the economics of furthering the exchange of unscheduled URS. Presence of URS even after SCED highlights scope for further improvement in cost effective power procurement.









NR records peak-hour shortage, the region continues to have unscheduled URS. Subject to intra-regional transmission availability and economics, unscheduled URS can be utilised for reducing the peak-hour shortage. A similar approach can also be adopted at inter-regional level for minimising shortages economically.

All India and regional URS can be accessed on System Dashboard of EAL web portal.

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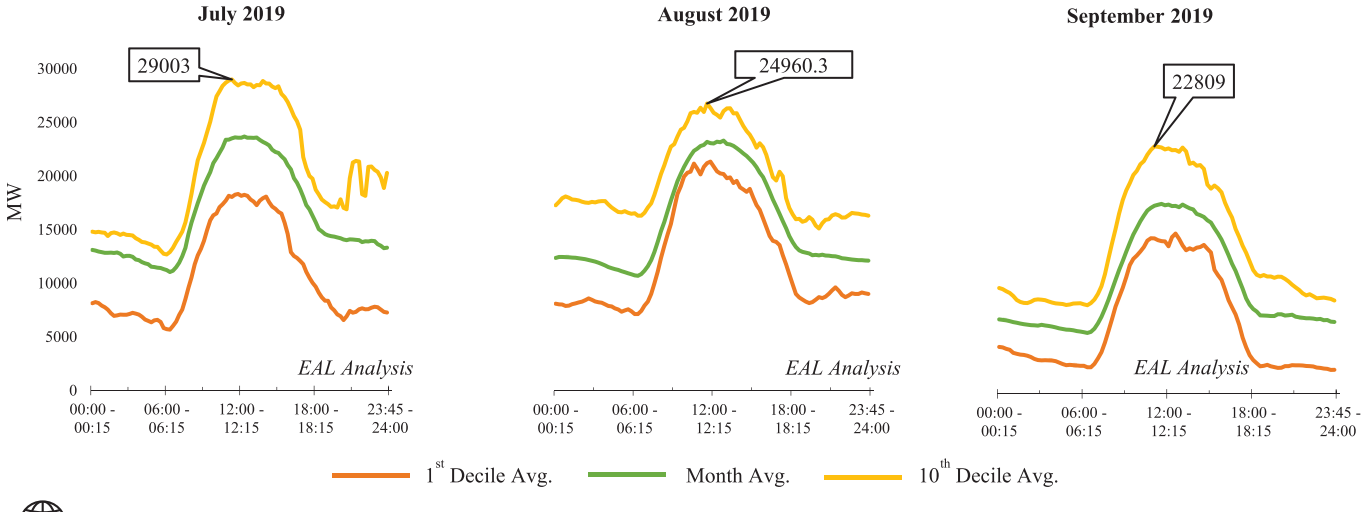
State Electricity Tradability Index (SETI)

The load profiles of certain pairs of states are complementary in nature. EAL developed an index – State Electricity Tradability Index (SETI) – to gauge such complementarity between pairs of states, for both import as well as export. Given adequate transmission capacity and favorable economics, such complementarities highlight opportunities for inter-state trade of URS within as well as across regions.

State Electricity Tradability Index (July – September 2019)

All India Renewable Energy (RE) Generation Profile



All India RE Generation Profile can be accessed on System Dashboard of EAL web portal.

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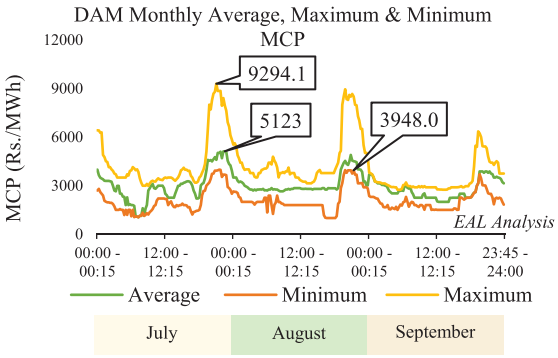
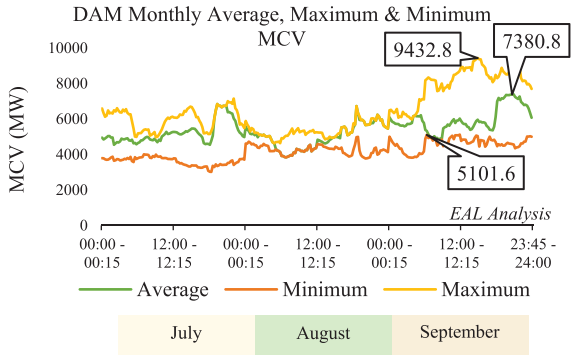
Power Market Overview & Analysis

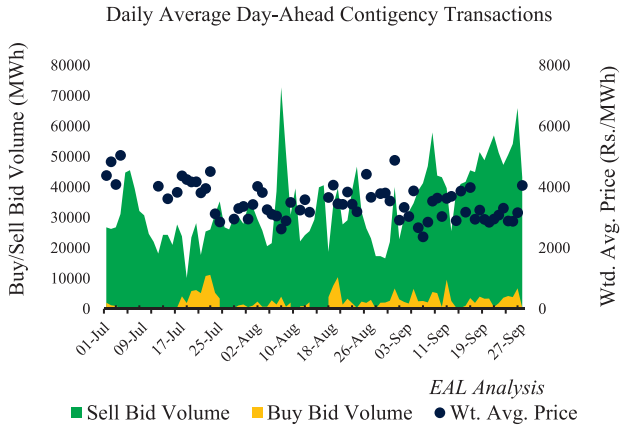
DAM – Market Clearing Price (MCP) & Market Clearing Volume (MCV)

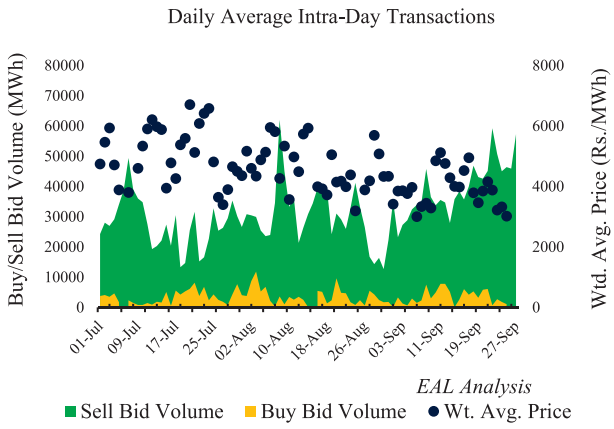




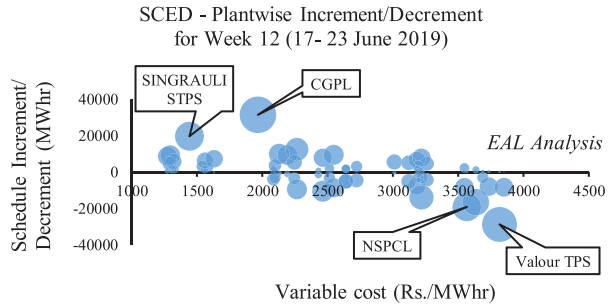
September 2019 experienced a general price fall in DAM, with MCP peaking at Rs. 9294.1 per MWh, on 13th July 2019.

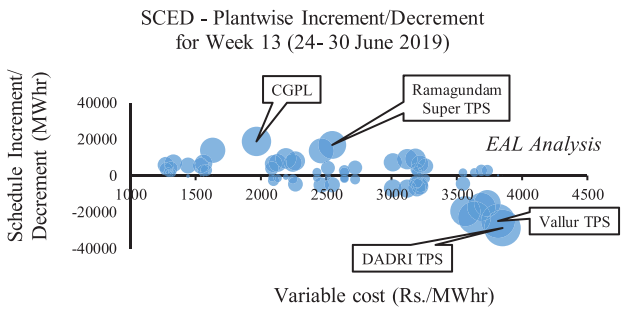
Term Ahead Market (TAM)

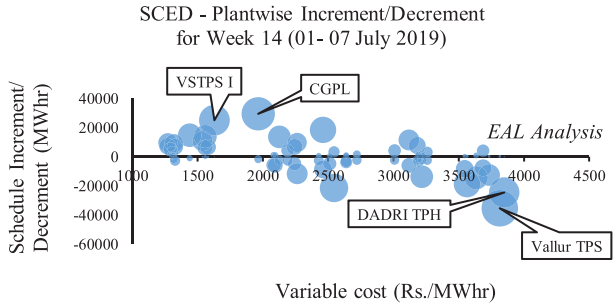


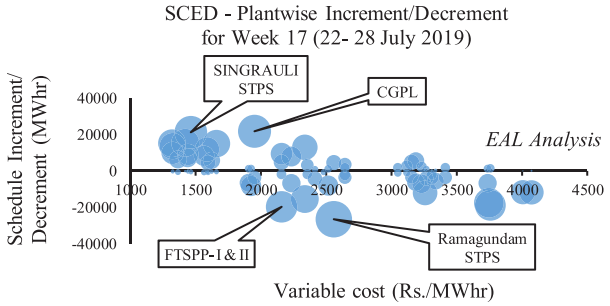


Security Constrained Economic Despatch (SCED): EAL's Analysis









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Regulatory & Policy Perspectives

Proposed Framework for Real Time Market (RTM) for Electricity

Proposed Market Design

- Implementation of a financially and physically binding half hourly market based on double side auction with uniform clearing pricealong with introduction of Gate Closure.
- Buyers and Sellers to place bids for each 15 min time block in the half hourly market.
- Failure in following the dispatch instructions of RTMwill attract charges under DSM.

Proposed Amendments

- Right to revision of schedule to be available until 7/8 time blocks before delivery of actual power.
- Any revision made in the odd time block will be effective from 7th time block onwards and any revision made in even time block to be effective from 8th time block onwards, counting the time block in which revision is done as time block number 1.
- Availability of a revolving reserve for DISCOMs in the form of half hourly training opportunity to meet their real time energy needs according to the one-to-one bilateral contract price under the existing system of right to revision of schedule.
- All grid connected generators can participate in RTM and buy power in case of forced outages to honour their commitment to the buyers.
- Power Exchange to optimise and clear the market considering the available transmission margins.
- Intra-day market will continue to clear the continuous transactions except for the time blocks for which RTM operates.

Sharing and Settlement in RTM

- As per the 4thAmendment to DSM Regulations, DSM prices are to be linked with the RTM prices as and when it comes into effect.
- Commission proposed to treat conventional and non-conventional sources of power participating in the RTM as per the existing DSM Regulations.
- GENCOS having long term PPAs to share the revenue in 50:50 with DISCOMs, if participating in the proposed market and earning revenue over and above the regulated variable cost.
- The mechanism proposed by commission facilitates participation of generators in RTM with their un-requisitioned capacity.

EAL OPINION

- Because of uncertainty related to short-term load forecasting, a liquid RTM would allow DISCOMs to reduce grid imbalances. Further, this will also assist greater RE integration across states.
- Enhanced liquidity for Real Time Market (RTM) would also provide better value to electricity available across different hours of day.
- A two-hour ahead forecasting would provide a much reliable RE generation forecast specifically for RE sources like wind and solar.
- RTM price signals should be used by the DISCOMs for designing more effective TOD/TOU tariff.
- Although recent regulatory developments are leading to more efficient and competitive price discovery, the regulatory framework does not provide for appropriate signals for investment in capacity addition. A long-term objective should be to introduce a capacity market with active participation of the distribution utilities.
- Revenue sharing mechanism for additional revenue realization by ISGS generators by participating in RTM needs to be specified, such a mechanism should reduce overall cost of power procurement of distribution utilities.

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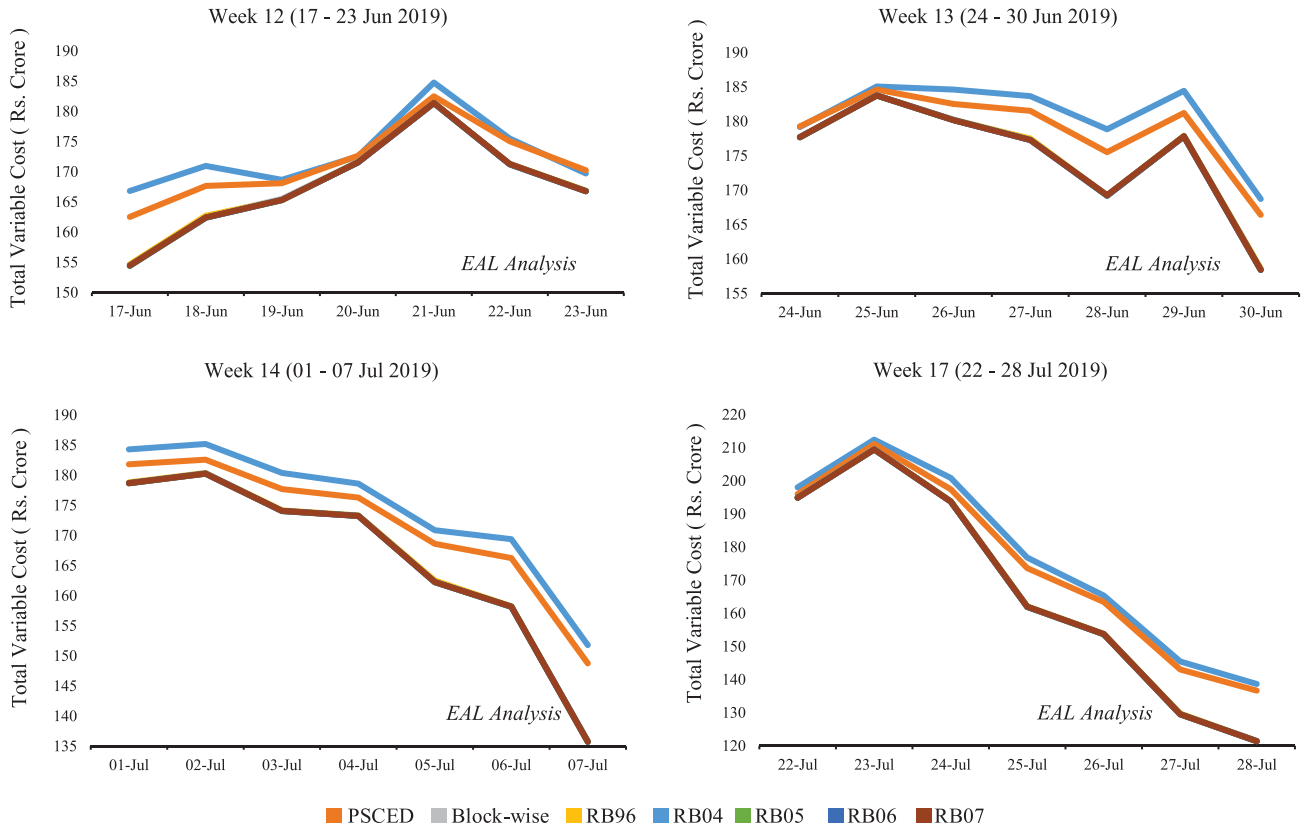
- Market monitoring framework needs to be significantly strengthened to ensure that participation across various market segments and those made available through PPA are not gained for the detriment of the procurers, making a long-term dent on the efficacy of the implemented power market design.
- As the share of DAM and Short-Term Market increases, the rule of transmission charges for long-term and short-term needs to be revised to ensure that long-term beneficiaries are not overburdened with transmission charges due to increase in share of short-term transaction.
- Same DSM framework should be applicable for Conventional and Non-conventional generators with a smaller margin to RE generators in deviation from scheduled power. A deviation of 5% is fairly acceptable.

Security Constrained Economic Despatch (SCED): A Rolling Block Framework



Note: WSCED – Prior to SCED; PSCED – POSOCO's SCED; Block-wise – Single block, similar to PSCED; RBXX – Rolling block SCED for XX blocks

In order to strive towards greater cost saving, EAL developed a rolling block framework for SCED by optimizing over a rolling window of multiple blocks. The proposed model takes into account a group of blocks and optimizes over the chosen blocks at a time. The size of the rolling block window selected would depend on the gate closure conditions and the advance visibility of the system parameters. We choose rolling window over multiple blocks of 4, 5, 6, 7 and 96 time blocks for the model simulation for 19 weeks covering the period from 1st April 2019 till 11th August 2019.

The results shown in the graphs indicate potential for additional savings for rolling block model in comparison to the single block SCED model. These additional savings range from Rs. 35 to 72 Crore per week. The model currently does not take into account transmission constraints. In the absence of transmission congestion, the model's results would be same as that with transmission constraints.

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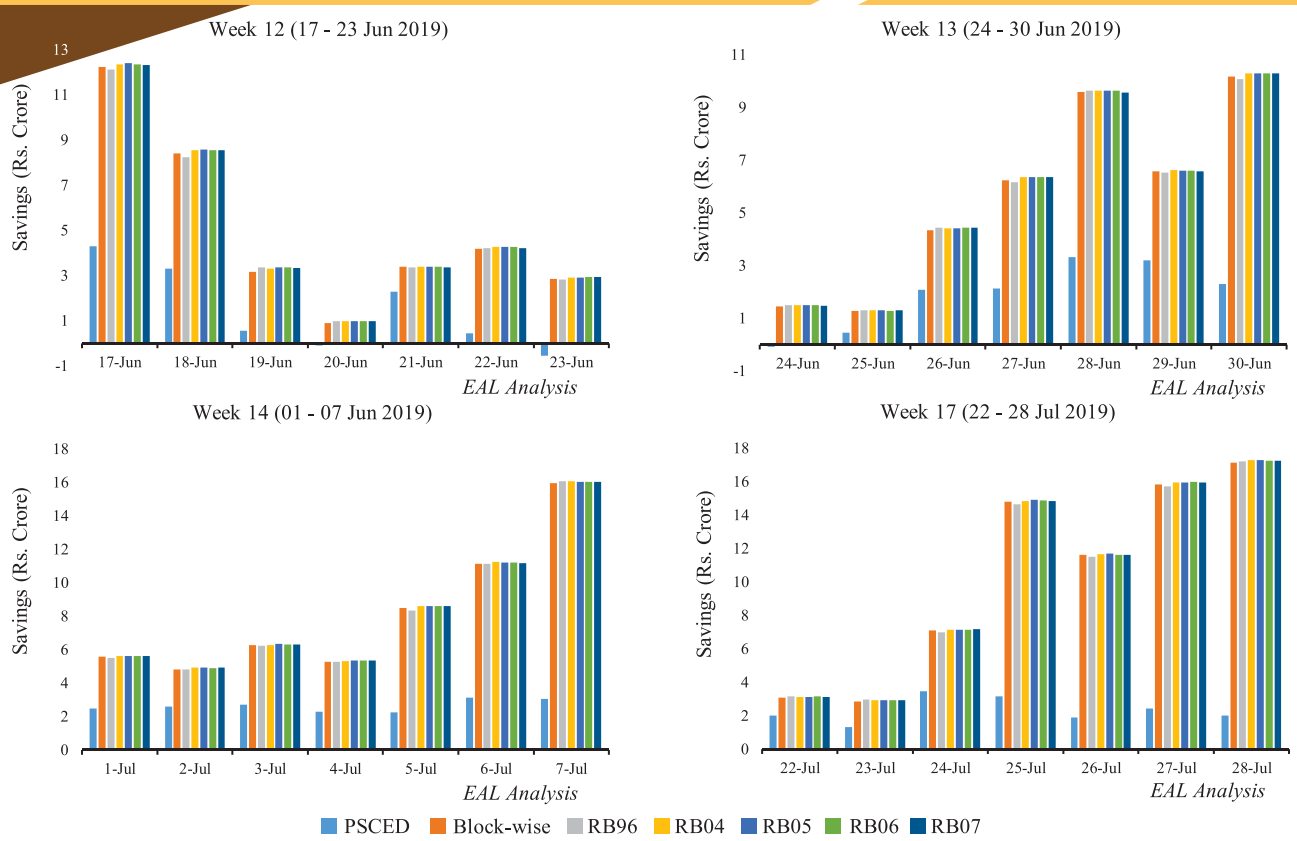

The results shown above demonstrate greater savings in the case of rolling block SCED framework. Given the additional cost savings, EAL suggested implementation of SCED framework on rolling block basis. It is also suggested to implement SCED framework at intra-state level where distribution entities individually optimize their power procurement portfolios, leaving room for further optimization. The following operational, commercial and regulatory issues need to be discussed and addressed:

- Impact of SCED on utilisation of transmission network and hence on determination of PoC charges and payment thereof.
- In case of take-or-pay based fuel supply arrangements, especially for gas-based plants, fuel cost savings may not materialize even with decrease in plant schedule.
- The savings accrued should primarily be distributed amongst the concerned distribution utilities, unless additional cost to generators can be demonstrated.

Note: Based on Singh et. al (2019), "Security Constrained Economic Despatch – India: A Rolling Block Implementation Framework" accepted in ICPS 2019, an upcoming IEEE Conference at MNIT Jaipur.

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