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

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Power Chronicle

Power System Overview & Analysis

Power Market Overview & Analysis

Regulatory & Policy Perspective

Editorial

SCED framework, rolled out on 1st April 2019 on a pilot basis, is expected to enhance the spirit of competition and efficiency, as enshrined in the Electricity Act 2003, with measurable gains in terms of savings due to optimisation of power procurement portfolio for ISGS plants. EAL estimates daily savings to range between Rs. 0.5 to 10.5 crores for the two weeks analysed for this newsletter. EAL's analysis of the increment and decrement pattern across ISGS plants highlights the outcome of optimisation in terms of increment/decrement in schedule for plants with lower/higher variable cost.

Based on higher cost savings using a multi-period optimisation model developed by EAL, we recommend that POSOCO can also adopt a similar framework wherein the SCED model is run prior to each time block while also considering the latest available schedule for rest of the time blocks in an identified rolling window. EAL is also developing a web-based tool to share the outcome of its SCED model through its portal.

The current SCED framework captures room for optimisation within the ISGS generation schedule provided by the beneficiary discoms. Expansion of the list of eligible generators would take us a step closer towards a nationwide wholesale market providing for nationwide optimisation of power procurement cost. Learnings from SCED would help achieve that goal.

EAL has been providing power system and power market snapshot and analysis to the stakeholders. We invite your suggestions to strengthen and empower decision making in the Indian Power Sector.

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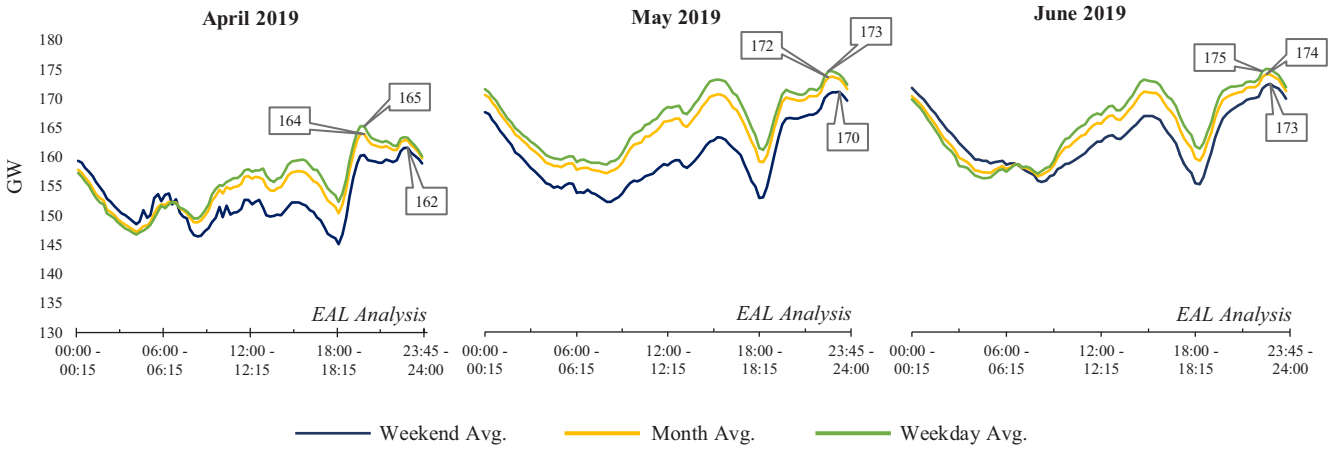
Power System Overview & Analysis

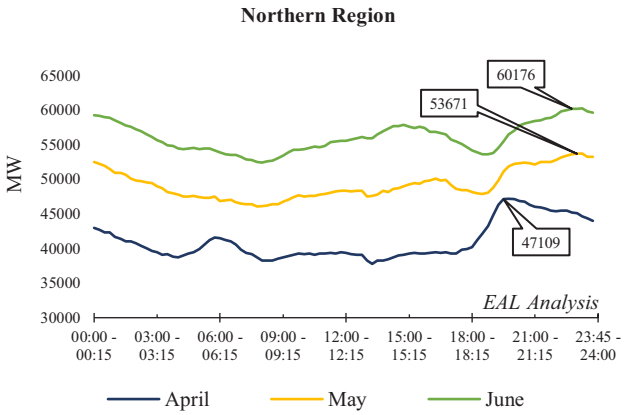
All India Demand Met Profile

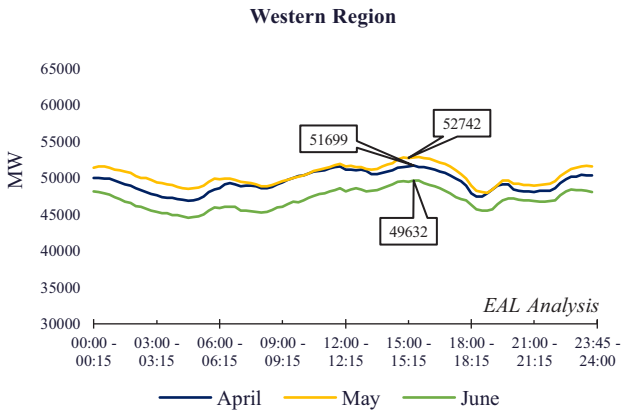


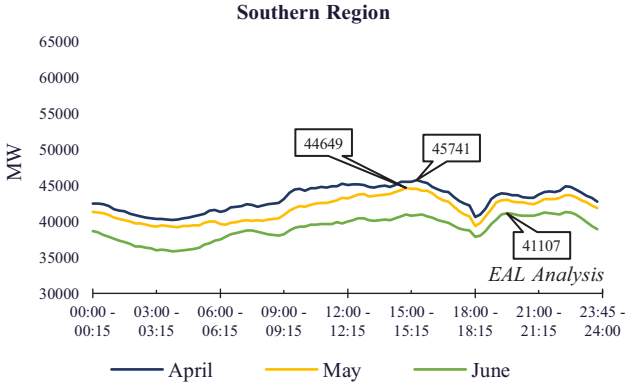
For April – June quarter, all India peak demand reached 182.3 GW on 30th May 2019, about 10 percent higher than that of the previous year's peak demand during the same quarter (165.4 GW on 22nd June 2018).

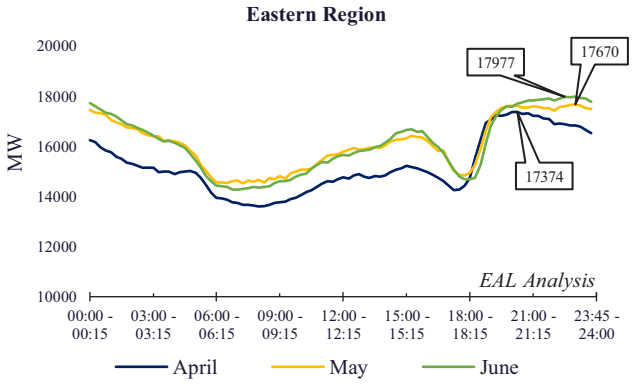
All India, region-wise and state-wise load profiles can be accessed at EAL web portal.

Region-wise Demand Met Profile



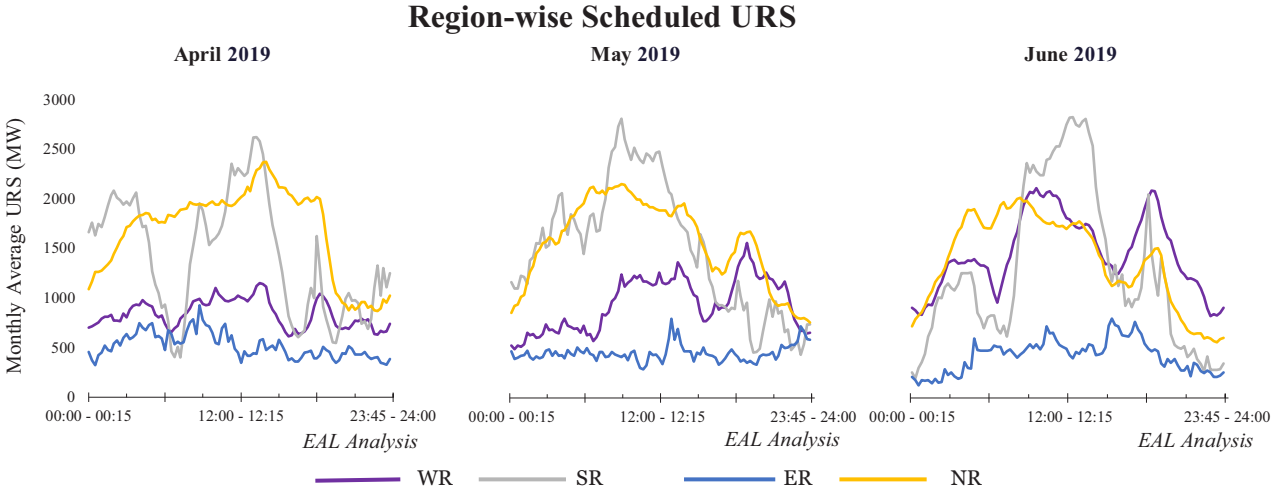






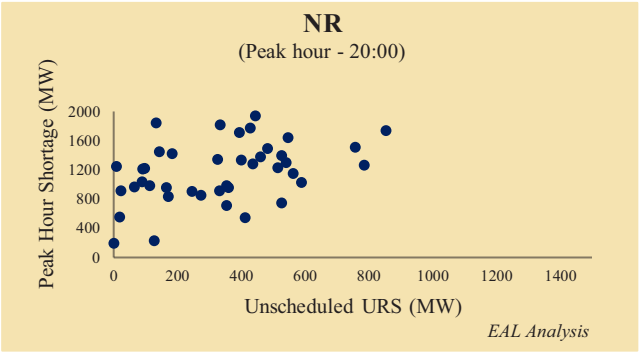
Note: *Load profile for North-Eastern Region is not reported here due to inaccessibility of data.*

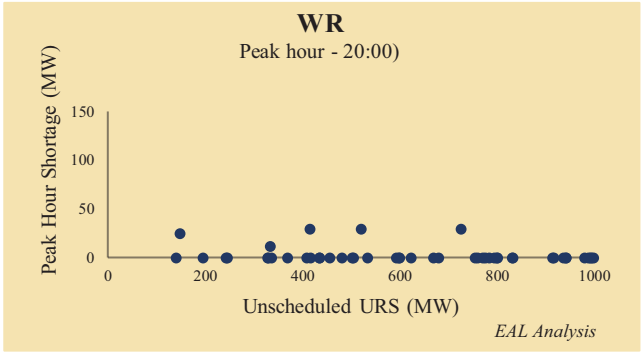
Un-requisitioned Surplus (URS) Analysis

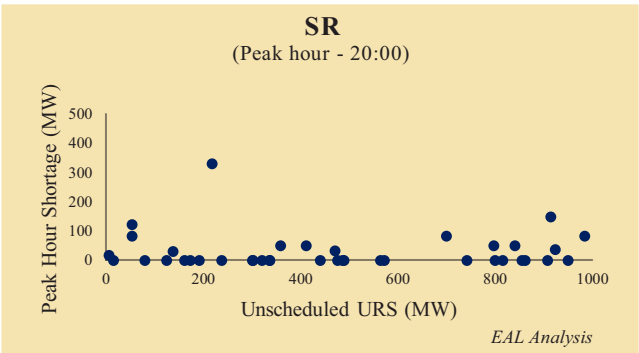


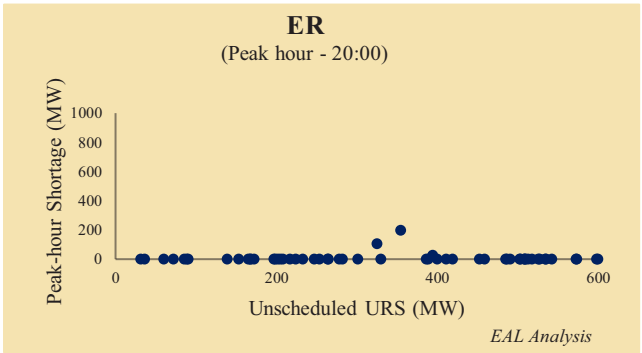
Region-wise Unscheduled URS (Excluding Gas Power Plants)

All India highest peak-hour demand shortage during April to June 2019 was recorded to be 4066.22 MW, on 17th June 2019, for NR. Persistence of shortage amidst availability of unscheduled URS highlights a need to explore the economics of URS. Presence of URS even after SCED highlights scope for further improvement in cost effective power procurement.





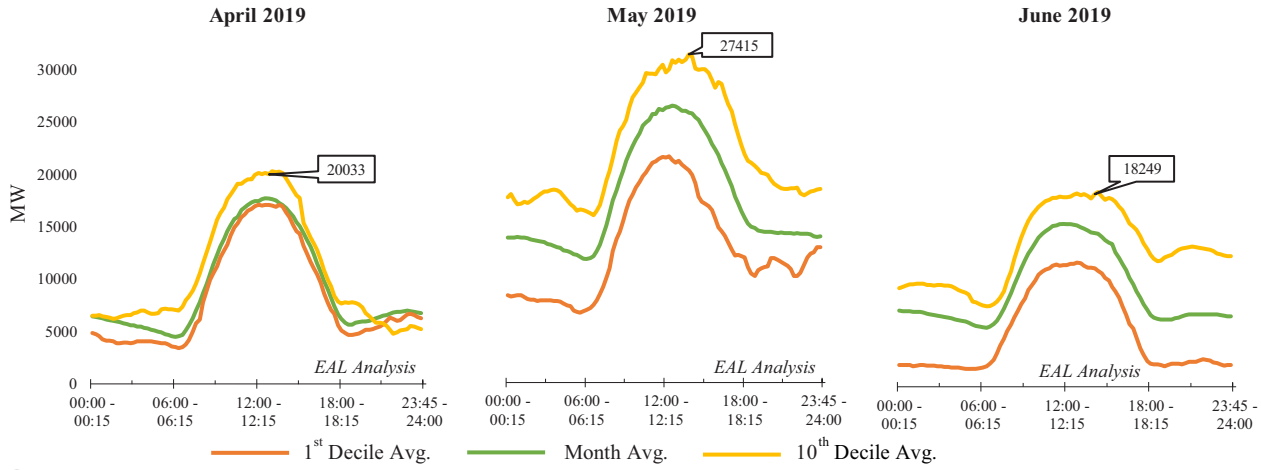




NR records peak-hour shortage, the region continues to have unscheduled URS. Subject to intra-regional transmission availability and economics, unscheduled URS can be utilised for reducing the peak-hour shortage. A similar approach can also be adopted at inter-regional level for minimising shortages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

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

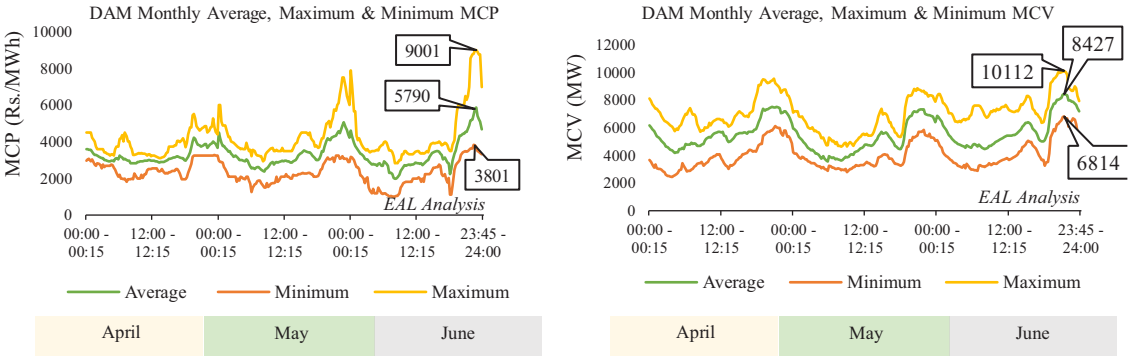
All India Renewable Energy (RE) Generation Profile



All India RE generation profile can be accessed on System Dashboard of EAL web portal.

Power Market Overview & Analysis

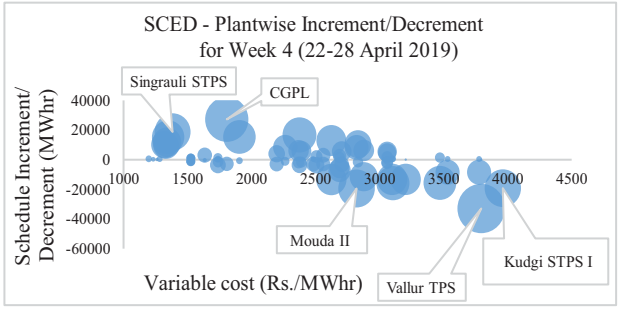
DAM – Market Clearing Price (MCP) & Market Clearing Volume (MCV)

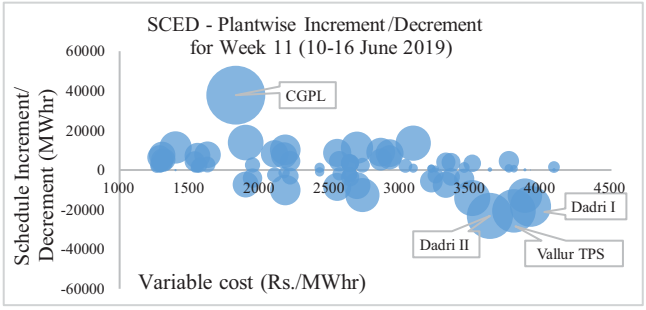


April 2019 experienced a general price fall in DAM, with MCP peaking at Rs. 9001 per MWhr, on 26th June 2019.

Follow the links here to access SETI and Term Ahead Market analysis.

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



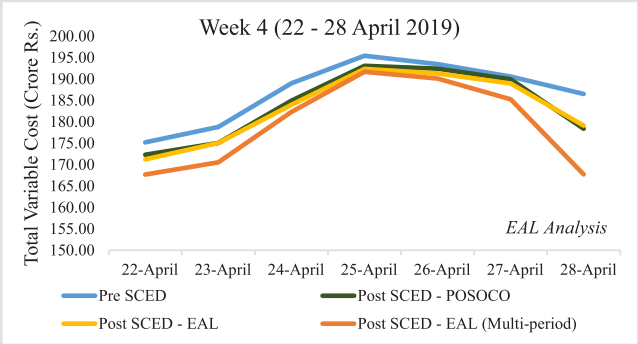


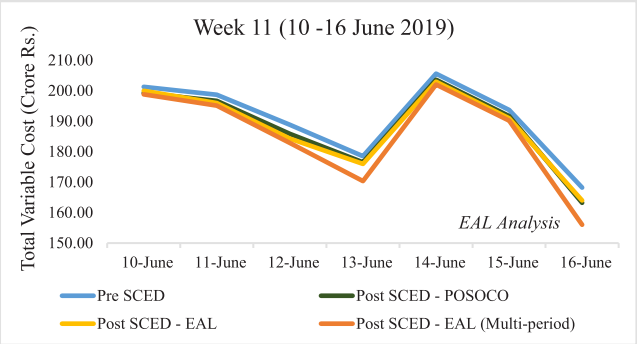
The Security Constrained Economic Dispatch (SCED) has largely delivered the expected results leading to cost optimisation across the ISGS plants. EAL's analysis finds that, subsequent to the rescheduling of these plans, the schedule of plant with cheaper (expensive) variable cost witnesses an increment (decrement) in the schedule. The extent of optimisation depends on the original schedule provided by the SLDCs, as well as changes in the demand pattern across states. EAL is also developing a web-based tool providing detailed analysis of the outcome of the SCED.

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

The SCED model implemented by POSOCO applies economic dispatch over the ISGS schedule independently for one block at a time while considering inter-regional transmission constraints. The resultant savings in daily cost of power procurement is estimated to range between Rs. 0.5 to 10.5 crore for two weeks analysed here Clearly, SCED brings about savings in total variable cost of eligible ISGS plants.

EAL has also developed an in-house SCED modelling framework. Initial results show that the outcome of EAL's SCED model largely follows that of the POSOCO's model, with somewhat lower cost of the former for the weeks considered here for analysis. EAL has also developed an alternate SCED model by adopting multi-period optimisation i.e. across all 96 blocks at a time. This multi-period SCED model demonstrates further savings potential over the single-period model.





Note: *EAL's SCED model currently doesn't consider transmission constraints. Given that there were only few instances of such constraints, the results of EAL's model are largely comparable with the POSOCO's model.*

EAL's Recommendations on SCED Design and Implementation

- The benefits demonstrated by SCED supports its extension to a larger set of generators, thereby bringing in greater cost savings at the national level, leading to a broader nationwide electricity market in future.
- Lower cost realisation in the case of EAL's multi-period SCED model highlights the need for adopting multi-period optimisation for SCED implementation. This can be implemented on a rolling window basis wherein the model is run for one time block at a time while considering rest of the time blocks of the rolling window.
- POSOCO can adopt multi-period rolling window for optimisation, thereby further reducing the power procurement cost from ISGS plants. The selection of rolling window period across multiple time blocks would depend on the gate closure conditions. Therefore, a rolling window of 4-6 time blocks at a time can be adopted, and which can be expanded in the future.
- Regulation up/down services in the Reserves Regulation Ancillary Services (RRAS) market are requisitioned on a merit order basis, from the available URS prior to the implementation of SCED. This reduces the optimisation space for the latter and, thus, highlights the need for co-optimisation of the market for energy and ancillary services.
- Recommendations on SCED design given by EAL in a previous newsletter (Power Chronicle, Volume 1 Issue 3) can also be considered while finetuning the implementation framework. These include - (i) addressing the information asymmetry in variable cost considered for SCED and for merit order despatch by SLDCs; (ii) consideration for landed cost incorporating transmission loss.

Note: *EAL is further developing its modelling framework for SCED which will be accessible at EAL's web portal.*

Regulatory & Policy Perspectives

CERC – Deviation Settlement Mechanism and Related Matters (Fifth Amendment), Regulations, 2019

New Definitions

- Daily Base DSM Charge: Sum of charges for deviations for all time blocks in a day payable/ receivable, excluding the additional charges.
- Time Block DSM Charge: The charge for deviation for the specific time block in a day payable or receivable, excluding the additional charges.

Charges for Deviations

- Charges in case of inter-regional and cross-border exchange to be computed based on unconstrained Market Clearing Price (MCP) in Day Ahead Market.
- For an entity covering multiple bid areas, charges to be based on the daily average Area Clearing Price (ACP) of the bid area with the largest share of the entity's demand.
- An upper cap of 303.04 paise/kWh for all generating stations.

Limits on Deviation and Consequences of Crossing Limits

Additional Charges for frequency above 50.10 Hz to be lower than of charges of deviation corresponding to grid frequency below 50.01 Hz but not below 50.0 Hz and the upper cap on deviation charges.

- Additional charge for sign change is applicable based on sustained deviation:-

	Permissible blocks with sustained deviation	Allowable Deviation Range (MW)
Up to March 2020	12	± 20
From April 2020	6	± 20

- Additional charge up to March 2020 is 10% of the DSM charge of the time block and the charges from April 2020 are: -

Number of daily violations	Additional Charge (% of daily base DSM charge)
1-5	3
6-10	5
>11	10

- Entities exempted from adherence to sign change norm: **a)** Regional renewable energy generator **b)** Run of river projects without pondage **c)** Infirm power during testing and commissioning activities **d)** Start-up power **e)** Inter-regional deviations **f)** Forced outage of a generating station in case of collective transactions on the Power Exchange

EAL OPINION

- As per clause 4.5 (a) and (b), to meet sign change norm, regional entities (buyer or seller) deviating beyond ±20 MW with reference to schedule need to pay additional charges. This range may be suitable for smaller states. However, for larger states this range may be expressed in terms of percentage of schedule power.
- As per provision of clause 4.5 (a) and (b), forced outage of a generating station participating in collective transactions on Power Exchanges are exempted from adherence to sign change norm. Such exemption due to forced outage may be applicable to all generating stations.
- As per CERC's DSM 3rd Amendment Regulation 2016, there are different methodologies for compilation of deviation charge. Post 3rd Amendment to the Regulation in 2016, deviation charges for renewable rich states (states with installed solar and wind capacity ⩾1000 MW) and the rest are differentiated. States like Gujarat, Karnataka, AP, MP, Punjab, Rajasthan, Tamil Nadu, Telangana and UP have reached 1000 MW RE generation capacity and few other states are close to reach this limit. As the number of states qualifying as renewable rich states rises, the asymmetric application of charges may need to be relooked in the future.

Proposed Methodology for Compilation of Coal Price Index

Currently, WPI (Wholesale Price Index) is used for computing the escalation rate for domestic coal based on methodology adopted by CERC in July 2009. Various stakeholders (mainly power producers) sought revision in this methodology as WPI is based on the price of all grades of non-coking coal (G1-G17) whereas only few grades (G7-G14) are allocated for power generation.

A new series of WPI (Base 2011-12), notification dated 12.5.2017 is now available for sub- section of coal grades G1-G6, G7-G14 and G15-G17. Stakeholders have expressed concern that even the new series of WPI considers average price of non-coking coal used for power sector and that used for other sector. Hence a new index based on Laspeyres Price Index (LPI) is proposed to be used by CERC from September 2019.

Overview

Present methodology for computing the escalation rate

- The annual escalation rates for payment have been computed based on latest twelve months' data (weekly/monthly). Steps followed are:

  Step 1: Compute average WPI for appropriate six-month period.

  Step 2: Compute half-yearly escalation rate computed based on the six-month index.

  Step 3: Compute annual escalation rate by doubling the half-yearly escalation rate.

Main Features of the Proposed Coal Price Index

- WPI index replaced with LPI with 2017-18 as base year.
- LPI is based on:

  a) Price of non-coking coal used for power generation and

  b) Source of coal (CIL, WCL and SCCL).
- Base year price to be the geometric mean of monthly prices.
- Weights to be based on grade-wise value (price × quantity) of non-coking coal.
- The proposed coal price index will be applicable from October 2019.

Compilation of Coal Price Index (Stages)

- First the grade-wise elementary price indices are calculated using "Jevons Index formula", which uses the Geometric Mean of price relatives (i.e. the price change).
- These elementary price indices are then aggregated using weighted arithmetic mean to obtain coal price indices using Laspeyre's index formula.

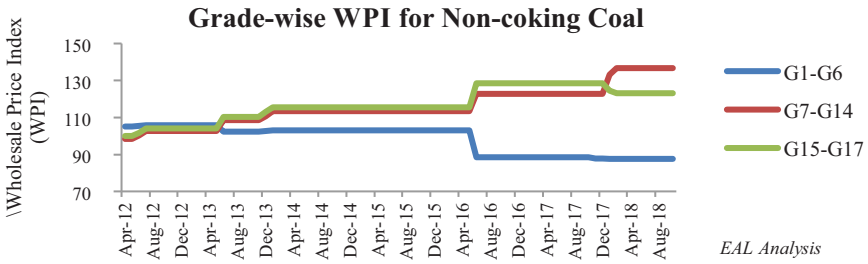
Merits of using LPI over WPI

- LPI is more representative since it is based on the value of non-coking coal applicable for power sector.
- Time lag in the availability of index is reduced to one month from three.
- It provides flexibility to choose the parameters such as composition of grades of non-coking coal, composition of coal prices and base year.

Note: The Laspeyres Price Index has an implicit disadvantage that the quantities of base year are taken as weights. To make the weights more appropriate it is proposed to change the base year from time to time, say every 5 years.

EAL OPINION

- **Need for Revision in Methodology for Escalation Index:** Variation in the coal prices for different grades, as shown below, clearly highlights the need for more representative coal price index for determining the escalation factor.



EAL Analysis

- **Laspeyres Vs Paasche index:** As acknowledged in the staff paper the Lespeyres index uses base year rates to derive changes in the Price index in a current period. It is suggested that the Paasche index would be more suitable as it uses current period weights. Since the coal cost burden is on account of the current period's coal purchases, Paasche index would provide a better picture of the cost escalation of the coal being consumed in the **current** billing period.
- **Weights used for Index:** The proposed methodology suggests use of value (price x quantity) as weights to derive the Price index. Adoption of value as weights would overestimate the Price index as costly coal grades would automatically have higher weights. Use of quantities as weights would be more appropriate.
- **Geometric Average for Base Year Price Index:** Geometric mean of monthly prices for the coal price may lead to under-estimation of the true cost of the coal basket.
- **Deriving Annual Rate from 6 monthly rate (Step 3 clause 8):** It would be more appropriate to account for compounding rather than doubling the six-monthly rate to derive annual rate.
- **Price Index for Captive Coal Mines:** Price escalation in coal prices published by CIL are a reflection of its inefficiency. In the case of captive coal mines operated by efficient private or public sector generators, one would expect the operations to be more efficient and should not warrant for a similar level of price escalation.

We request your feedback for making EAL more relevant to the sector.
Log on to our portal or write to us at:

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