

APRIL 2021

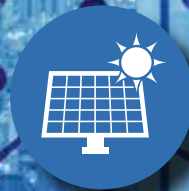
PTChronicle

Journal from PTC India Limited



ENERGY PORTFOLIO MANAGEMENT

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DRIVING
DECISIONS**



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From the Chairman's Desk

Today, when India is facing the second wave of COVID-19 pandemic affecting people's health, livelihood and getting the supplies, power sector has a greater role to play than ever before. First, it needs to ensure uninterrupted power supply to all especially those related to healthcare facilities and second, it needs to perform commercial and operational functions efficiently when many power sector professionals and their family members are suffering from the pandemic. The resilience of the sector shall be ascertained while performing above two important functions in this challenging time. Ministry of Power's initiative to vaccinate the power sector professionals is a welcome step to safeguard the workforce in the sector.

The key dimensions of Human Development Index (HDI) viz. long and healthy life, knowledge and a decent standard of living are the subjective parameters represented by quantitative variables like urbanization, electricity consumption, piped water and domestic gas facility, educational infrastructure, health facility, and needless to say all other items required to improve quality of life. More than 25% of total urban population speaks of road ahead and further resource allocation to meet the growing and unmet demand. The electricity will be key and measurable input in reaching to our desired goals of HDI due to its ever growing dependence. Government's initiatives for supplying power to all, T&D infrastructure strengthening, promoting renewable energy and many others have reached to all citizens of country and has generated enormous data about consumption pattern, collective demand pattern, absorption level, supply assessment and optimal price level. This provides opportunity for further detailed analysis and making use of the outcomes for improving operations and performance.

This edition of PTChronicle covers an important aspect of power sector viz. Energy Portfolio Management (EPM) to decipher correlation between data and decision in making electricity available and affordable to all. The software driven decision tools are expected to help various stakeholders viz. policy makers and regulators in creating the suitable frameworks, market players in planning products suiting to end consumers, consumers in getting uninterrupted power at lowest rates and investor community investing into generation capacities and associated services.

I would like to thank all our readers and acknowledge their feedback & continued support. Wish you all a valuable read.

Deepak Amitabh
Chairman & Managing Director
PTC India Ltd.

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Editorial

With the vaccination drive going on in full swing, I on behalf of Editorial Team wish all its readers and fellow citizens a safe and healthy time ahead, free of COVID -19. During the pandemic, which began in March 2020, slowed down for few months and then increased with higher intensity in April 2021, the struggle between life and livelihood continued. The national lockdown of almost 60 days, mass labor migration, increased healthcare cost burden on the Government and resilience of economy had been some key events of the last financial year 2020-21. However, the new financial year 2021-22 came up with the challenges related to much higher requirements of healthcare facilities for saving lives and to continue the growth momentum of the economy. A country having population of more than 130 crore lived to its true spirit of standing together in tough time with continued support from our frontline healthcare professionals, easing fiscal policy and liquidity support packages like Atmanirbhar Bharat etc.

In this entire melee of unfolding events, power sector has demonstrated its resilience to variations of demand and supply. The demand contraction of more than 16% in first quarter and highest ever peak demand of 187 GW in Jan 2021 (traditionally a low demand month) had been extremes of last financial year. The past investments in planning and designing of network systems and generation assets, availability of coal and finally data driven decision making processes to manage demand and supply gaps have been key achievements.

The availability of products across all tenures from long term, medium term and short term (day ahead as well as real time) has given opportunity to “Use – Process - Analyze” dynamic data for collective benefit of the system. As we continue to deep dive in the system development, the better estimation of derived factors of demand and supply will be observed to create a soft infrastructure enveloping physical infrastructure of “Generation – Transmission – Distribution”. The expected savings from this will go a long way in increasing power consumption in India. This edition of PTC Chronicle attempts to present the readers, the concept, usage and benefits of Energy Portfolio Management (EPM) and associated nuances of data driven decision-making process in pursuit of making electricity affordable and available to all. Energy Portfolio Management as a value added service with its modularity and scalability in implementation, positions itself as a future ready product for all the service providers.

We thank you for your continued support and solicit your suggestions to make PTChronicle more enriched with each subsequent edition.

Harish Saran
Chief Editor
PTChronicle



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ENERGY PORTFOLIO MANAGEMENT:

A Paradigm Shift in Utility Operation

Harish Saran

Executive Director (Marketing and Commercial),
PTC India Ltd.

India a country of diversity and unity has always fascinated the world with its unique blend of identity. With its growing economy and population, India is 5th in the world electricity consumption arena much above its peer countries. With the advent of industrial revolution, rapidly developing technologies and new scientific innovations, the demand of electricity has been growing consistently. Indian Electricity sector has been very instrumental in the making of Modern India. Indian electricity demand is primarily taken care of three broad segments of power sector i.e. Generation, Transmission and distribution. Out of the three, the distribution sector is managed by the respective state utilities who are engaged in servicing the electricity requirement of the state by operating a portfolio of power/energy and service to the people of the country. Also recent growth of industries led to industrial pollution as an aftermath. Industrial pollution poses threats on all sphere of living being by contaminating drinking water, releasing toxins into the air and degrading the nature of soil. The need of the hour is to look for alternate green energy generation from renewable energy resources in-order to maintain environment sustenance and environment protection. In this direction, the focus of electricity generation has been shifted to renewable energy sources such as solar, wind

in particular to a large extent. This solar and wind power is intermittent by nature and largely dependent on the weather parameters. This intermittency and volatility in renewable generation is detrimental both commercially and technically to the power system by impacting the grid stability. This volatility has really impacted the day to day operation and pose a challenge for real time scheduling of power.

In today's energy market, where there are multiple market players it has become imperative to manage the operation of day to day activities of procuring, selling and supplying power to consumers in a systematic, scientific and agile manner.

PTC India the pioneer in power trading business has been a frontrunner in the power sector in India in coming up with new initiatives and products from time to time. And recently PTC has put a step forward to facilitate consultancy services to state utilities in achieving the targeted goal of state utilities by providing **Energy Portfolio management consultancy services**. This is a unique solution provided exclusively by PTC to manage the entire portfolio of the utilities. PTC has already provided and established its expert solution of the Energy

Portfolio management (EPM) to the states like Bihar and recently spread its footprint in Madhya Pradesh. The need of the hour for the utilities is to understand the when, what, where and how the EPM solution works. The core strength of PTC's EPM solution is the scientific and decades of expertise in providing energy solutions to all the key market players. The EPM starts with a holistic approach by understanding the as is process, the demand pattern, the power availability of the concerned state/UT and develop customized EPM solution for the particular state.

The EPM Solution comes with demand forecasting software tool using state of the art technology of AI-Machine Learning based algorithm, The software takes critical weather parameters as inputs like temperature, humidity, rain, wind along with the states demand pattern, demand history, seasonal variations, demand variation due to special events etc. The optimum schedule dispatch model uses the Merit Order Despatch (MOD) principle, real time monitoring of demand /supply position etc. to name a few. EPM provides the software solution that is needed to optimize management of assets and meet demand. The application allows to adjust parameters and price curves, so that the flexibility to run best scenario. It factor risk strategies into all aspects of operation, and provides a support system for strategic decision-making that minimizes exposure to risk. It allows to maximize Revenue potential, Reducing Cost in terms of Savings in Operation of contracts etc. EPM allows the integration of RE power in day to day operation and reduces the challenge for real time scheduling of power.

As a particular case, with the launch of the Real Time Market (RTM) on 1st June, 2020 for carrying out

power trading activities in the exchange. The activity of operations of power trading in the RTM has been increased substantially, EPM Solution not only facilitates utility in earning revenue by selling available surplus power but also has supported in providing uninterrupted supply of power to its consumers in case of shortage under contingency situations. The trading activities need to be carried out multiple times in a day and the operation involves data collection from various sources, data analysis, incorporation of constraints, bid creation and submission etc. with a high level of accuracy. EPM solution provides the opportunity to handle this bidding operations at ease. The Software Solution is capable of automatically calculating the demand and supply gap in the system and on the basis of the surplus/deficit of power, it suggests to sale/purchase power in the market.

As an example, financial gains, a utility can enjoy through implementation of EPM solution is saving made by replacing costlier power with cheaper power available on the market. In this changing times where the power sector is evolving to a new generation with newer technologies in all spheres of generation, transmission and distribution sector, along with power market and real time trading, EPM solution by PTC India is a complete game changer for DISCOMs whose implementation reduces the burden of higher cost of purchase of power in an optimized way and better efficient way of asset utilization with minimum wastage of resources on real time basis.

With more innovations in the power sector and commitment of providing uninterrupted cheaper power supply to all users, EPM solution may be suitably termed is a boon for utilities.

Integrated Forecasting: A competitive advantage in short-term power portfolio management

Adrien Rosen

Head of Product Business Ownership,
N-SIDE, Belgium



Today, the structural changes in the energy sector are bringing unprecedented levels of variability and uncertainty in energy portfolios. This also comes with unprecedented levels of volatility in the energy markets which can be frightening for utilities.

This is a worldwide trend and India is also facing these changes as it is undergoing one of the fastest energy transformations in the world according to a recent report from the International Energy Agency (IEA 2021), India Energy Outlook 2021. IEA reported that electricity demand has doubled over the last 2 decades and another 35% increase is planned by 2030. Moreover, India is also on the fast track with regards to the de-carbonization of the electricity sector and is on the way to overcome its engagements from the Paris Agreement with an ambitious addition of 450 GW of renewable capacity by 2030.

The increasing uncertainty and market volatility is making energy portfolio management more challenging, requiring more innovative approaches.


Energy portfolio management is often split into 2 parts, managed by distinct teams: one for the far curve and long-term procurement, and the other one focusing on short-term optimization. This split can easily be explained by the fact that long-term and short-term curve management

implies different expertise and market drivers are not necessarily the same. On one hand, on the far curve (long term), the accuracy of the portfolio position is highly linked to the quality of the underlying data systems. Traders have to focus more on macroeconomics trends for what regarded as market valuation and optimization of open positions. However, it should be noted that there is an increasing correlation between the markets movements at front and the far curve. As a result, more quantitative techniques, such as technical trading, can reveal themselves profitable on long-term markets as well but require a decent level of liquidity.

On the other hand, short-term teams are much more data-driven, not only to have an accurate view of their portfolio (weather driven, local condition) but also to make winning trading decisions.

On top of that, the amount of data available is exponentially increasing (think of the amount of data generated by the 250 million smart meters which will be installed in the next few years at the Indian electricity consumers end), making it more and more challenging for a human brain to extract the relevant information. Hence, it becomes crucial for them to have access to reliable decision support tools, extracting the relevant information from the data ocean to drive their business.





Machine Learning algorithms can be a powerful tool to help portfolio managers to extract information from data, making it possible to embrace uncertainty, better manage risks, and make the most of the increasing market uncertainty.

For an energy portfolio manager, the notion of risk is ultimately related to a financial metric. The risk does not lie so much in the uncertainty on volume (MWh) but rather in the financial uncertainty it creates (i.e. with an open position of 1 MWh, what will be the final price?). At the end of the day, a short-term portfolio manager does not care so much if the forecast used to manage their position had a low Mean Absolute Error or a striking Root Mean Square Error but much more about his average imbalance cost. Aligning the machine learning objective function with the business objective is quite often overlooked in generic machine learning toolboxes that aim to target a wide number of use cases. We combine the best of both algorithmic and business expertise, allowing to always deliver state-of-the-art forecast, trained with the most relevant objective function.

Nevertheless, even the best forecasting models cannot alleviate all uncertainties. By definition, it is only possible to have an accurate view on consumption and production ex-post; furthermore, in most cases, this ex-post view is based on several assumptions such as standard load

profiles used to disaggregate distributed load between the different retailers. For instance, renewable energy sources cannot be planned 100% accurately, in which case, you need to rely on a forecast, meaning there will be deviations as you move towards delivery and, therefore, portfolio managers need to hedge them constantly.

On top of the ability to integrate the underlying business objective, the second benefit machine learning algorithms can bring in short-term trading is its ability to analyze thoughts of data signals, such as weather, outages, market levels, and market recent moves, to provide a clear direction of where the market will evolve in the future.

N-SIDE, a Belgium-based company specialized in the development of decision support tools based on advanced analytics, has developed very specific expertise in both customized volume forecasting and market arbitrage forecast; this unique combination allows to have an integrated portfolio strategy with which portfolio managers can reduce their financial risks and embrace the volatility created on the markets by competitors. This integrated portfolio management strategy will be required to increase both direct and indirect margins and overcome the challenges brought by the ongoing energy transition in India.

ENERGY PORTFOLIO MANAGEMENT - BIHAR: A CASE STUDY

Maresh Pujari

Assistant Vice President (Marketing),
PTC India Limited

Background:

The Bihar State Electricity Board (BSEB) has been unbundled into five companies w.e.f. November 1, 2012 under the new 'Bihar State Electricity Reforms Transfer Scheme 2012'. The new companies are Bihar State Power (Holding) Company Limited (BSPHCL), Bihar State Power Transmission Company Limited (BSPTCL), Bihar State Power Generation Company Limited (BSPGCL) and two distribution companies viz. South Bihar Power Distribution Company Limited (SBPDCL) and North Bihar Power Distribution Company Limited (NBPDC). BSPHCL owns the shares of the newly- incorporated four other companies.

Over the years state has shown promising results on various counts such as Regulatory clarity, timely filing of tariff petition, Timely receipt of subsidy from the State Government, Fuel & Power Purchase Cost Adjustment (FPPCA) framework, Improvement in payables days & declining trend over the years, improvement in AT&C losses over the years etc.

However, the concerns over key drivers of the utility such as high dependence on subsidy support and High power purchase cost continued to plague the financials of state. BSPHCL formed a power management cell (PMC) to take care of the requirement and management of power for the state. PMC carries out the purchase of power as per requirement under the guidance of Hon'ble BERC by strictly adhering to the Bihar Electricity Regulatory Commission (Power Purchase and Procurement Process of Licensee) Regulations, 2018.

Energy Portfolio Management Roadmap:

Power Management Cell (PMC) carries out the demand management by conducting the demand forecasting for short term, day ahead, medium term and long term. To enhance the performance of power management cell, Energy Portfolio Management (EPM), a digitally enabled tool & service, was envisaged.

PTC being pioneer in power trading and providing unique power solutions to utilities over two decades approached BSPHCL to manage their energy portfolio. After detailed presentation to the top management of BSPHCL, PTC started EPM services for state of Bihar. PTC deployed the

requisite man-power for development of EPM solutions for the state to understand the As Is process, an important starting point. In terms of pre- roll out preparations, deployment of resources, and configuration of software, all the Project milestones was achieved in 180 days from the zero date.

During these 180 days of rigorous study of Bihar state power dynamics, PTC could come up with various EPM tools to optimize the overall cost of power purchase along with ease of operation. Demand forecasting was started for the first time by using scientific tools and AI algorithm. The forecasting methodology comprehensively covers the parameters responsible for load/demand change. These parameters includes weather updates like Rain/ Wind, temperature etc. which are uncontrollable and affects the demand pattern of the state on diurnal basis, as well as hourly basis. EPM team serving round the clock also engages itself in monitoring demand and optimum scheduling of power on daily basis in close co-ordination with SLDC.

Key Deliverables:

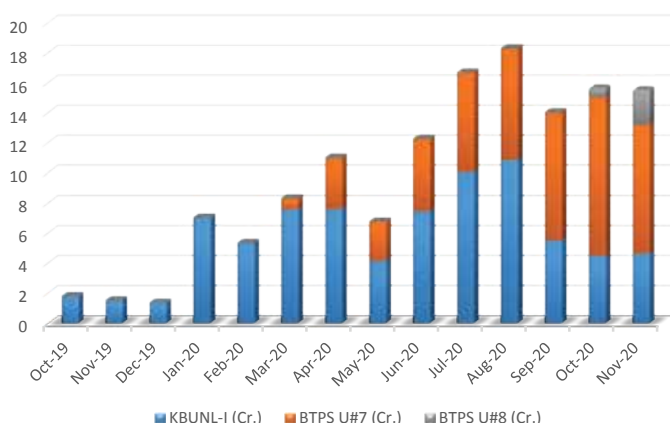
The Key deliverables of the EPM solutions are:

- Demand Forecasting and Gap Assessment for for Day-ahead, intraday, Short-term, Medium-term and Long-term.
- Power Procurement/Sale Planning and execution for Day-ahead (DAM), Intra-day (TAM) Short & Medium-term (Banking, DEEP & Bilateral),
- Optimal Dispatch Scheduling and compliance of Merit Order of Dispatch,
- Ensuring of RPO Compliance through short-term/ REC purchase,
- Compliance with Institutional and Regulatory Directives,
- Price Forecasting,
- Energy Accounting,
- Network Management,
- Web based Enterprise Visualization for Management Dashboard,
- Coordination with ERPC and ERLDC on Inter-regional Operational and Technical aspects

Key Achievements (Financial Savings):

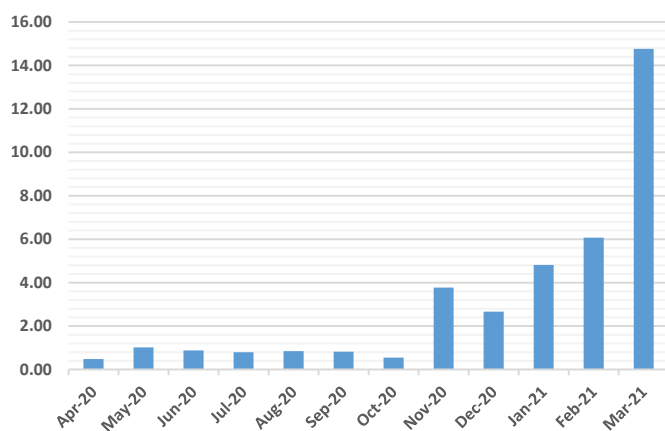
Month	KBUNL-I (Cr.)	BTPS U#7 (Cr.)	BTPS U#8 (Cr.)
Oct-19	1.81	-	-
Nov-19	1.53	-	-
Dec-19	1.37	-	-
Jan-20	7.05	-	-
Feb-20	5.36	-	-
Mar-20	7.62	0.72	-
Apr-20	7.65	3.37	-
May-20	4.18	2.61	-
Jun-20	7.49	4.79	-
Jul-20	10.1	6.6	-
Aug-20	10.9	7.42	-
Sep-20	5.53	8.52	-
Oct-20	4.49	10.59	0.64
Nov-20	4.67	8.59	2.34
Total	79.75	53.21	2.98

Saving on account of keeping higher VC units under RSD



Regular monitoring and analysis of the demand and supply situations and proactive analysis in portfolio management with timely intervention of keeping the higher Variable Charge (VC) units power under Reserve Shut Down (RSD) and managing the same requirement through replacement of power from exchange

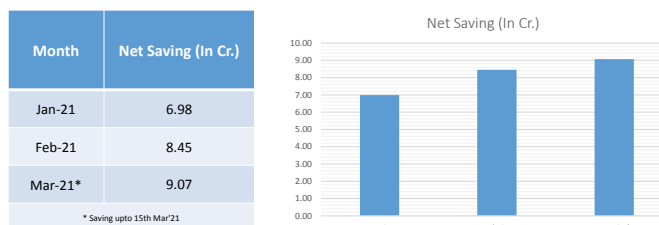
Net Profit (In Cr.) on account of Power sale on Exchange based on plants VC



Net Profit (in Cr.) due to Differential bidding:

After evaluating the bid success rate and possible revenue earning potential, PTC suggested the strategy of differential bid strictly in accordance with surplus quantum from different units w.r.t. the VC of the respective units thereby increasing the chances of the bid getting cleared and a revenue is generated.

Net Savings by running the RSD units and selling power in IEX:



Summary/Conclusions:

The EPM Solution comes with demand forecasting software tool using state of the art technology of AI-Machine Learning based algorithm. The software takes critical weather parameters as inputs like temperature, humidity, rain, wind along with the states demand pattern, demand history, seasonal variability, demand variation due to special events etc. The optimum schedule dispatch model uses the Merit Order Despatch (MOD) principle, real time monitoring of demand /supply position etc. to name a few. EPM provides the software solution that is needed to optimize management of assets and meet demand. The application allows to adjust parameters and price curves, so that the flexibility to run best scenario. It allows to factor risk strategies into all aspects of operation, and to provide a support system for strategic decision-making that minimizes exposure to risk. It allows to maximize Revenue potential, Reducing Cost in terms of Savings in Operation of contracts etc. EPM allows the integration of RE power in day to day operation and reduces the challenge for real time scheduling of power.

POWER DEMAND: DECLINE AND RECOVERY DURING FINANCIAL YEAR 2020-21.

Although the overall demand fell by around 1% during Financial Year 2020-21, mainly due to coronavirus-induced lockdowns across the country, the economy in later months i.e. from August-September onwards picked up during the unlocking process resulting in picking up of demand for electricity.

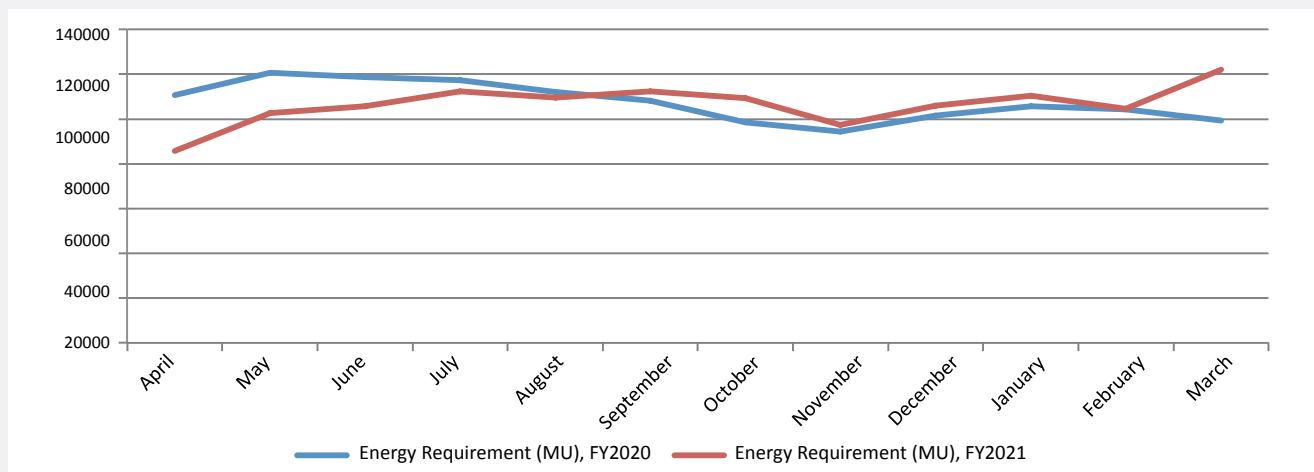
The revival was depicted in the increase of demand during the later months for example; power consumption in the country grew 24.35% in March at 123.05 billion units over the corresponding month a year ago, showing a revival in the economic activities and power demand.

Market based power procurement up by 41% in FY21.

Spot power trading on exchanges increased by 41% in the fiscal ended March 31, indicating a significant shift in the Indian power market that has been largely dominated by bilateral deals.

During 2020-21, around 79.6 billion units (BU) has been traded at the two operational power exchanges as compared to 56.5 BU during 2019-20, showing significant growth of 40.9%.

Power demand during Financial Year 2019-20 and 2020-21



The Power Bites





DAY-AHEAD MARKET FOR GREEN POWER IN NEXT FEW MONTHS

In a bid to encourage merchant RE capacity, policy planners, system operators, and other stakeholders are working on modalities to roll out Day Ahead Market for green power. India is set to launch a day-ahead market for renewable power in about three months to promote merchant green power plants independent of power purchase contracts. Almost all green projects currently are set up based on power contracts with states or bidding agencies like NTPC and Solar Energy Corp of India (SECI). Green term-ahead markets, enabling electricity trade for up to 11 days, have been functional since last year. The Day Ahead Market for green power would require preparations in terms of changes in software and alteration in regulations by the power regulator. The green day-ahead market is likely to be operational by August 15.

Green markets will give an option to renewable energy companies to sell their power, particularly in context of recent examples of contract renegeing by state distribution companies. They will also encourage renewable developers at a time when spot power prices on exchange are higher than the tariff discovered through competitive bidding. Separate green markets are required to enable extending exemptions like transmission fee waiver or other benefits, presently available to long-term renewable contracts, to short-term renewable contracts. However, new projects may face financing issues unless supported by good balance sheets. It is expected to be a good route for old and under dispute PPAs.



GOVT KEEPS DOMESTIC NATURAL GAS PRICE UNCHANGED AT \$1.79/MMBTU

The central government has kept the price of domestic gas unchanged at \$1.79 per million British thermal units (mmBtu) as higher production and lower demand continue to keep global gas prices suppressed. The ceiling price for gas to be produced from difficult fields (which have higher pricing and marketing freedom) has however been cut by 10.8% to \$3.62/mmBtu. The new prices will be effective for six months starting April 1. The Centre had slashed domestic gas price by a sharp 25.1% to the current all-time low rate in September, 2020. The domestic gas price is linked to the weighted average price of four global benchmarks (US, UK, Canada and Russia). Spot US LNG prices have risen 2.4% in the last six months to \$2.5/mmBtu.

The average gas output cost of state-run Oil and Natural Gas Corporation (ONGC), which produces about 80% of the domestic natural gas is \$3.7/mmBtu. ONGC had indicated earlier that it may face a loss of around Rs 7,000 crore in FY21 from its gas businesses. More than 95% of the gas currently produced by ONGC is sold at government determined rates.

India aims to increase the share of natural gas in its energy mix to 15% by 2030 from the current level of about 6%. Fall in natural gas prices will be positive for the fertiliser and the city gas distribution (CGD) companies. Indigenous natural gas production caters to about only 51% of the country's requirements. Demand for the natural gas in the domestic market is traditionally dependent on the fertiliser (28%), power (23%), CGD entities (16%), refineries (12%) and petrochemicals industries (8%).

In India ~25000 MW Gas Power Plants, built at an investment of more than Rs. 1 Lakh Crore, have reached a dismal state out of which ~16000MW are stressed projects and rest are stranded. More than 11000 MW belongs to Private sector. Getting these projects back on operation is one of the biggest challenges that Indian power sector is facing today.



RAILWAYS LOOKS TO BAG 45% OF PORTS TRAFFIC BY 2030

With the ambitious target of garnering upto 45% port traffic and 100% electrification of the track, the national transporter's electricity requirement is expected to take quantum jump. The complexity of traction power requirement will give rise to more value added services in meeting the moving demand.

The railways has set a target to bag around 45% of the traffic from ports by 2030, as compared to the 27% it carries currently according to the National Rail Plan. The overall traffic handled at major ports is likely to increase from the present 700 MT to 925 MT by 2026 and 1,400 million tonnes by 2030. In order to meet the growing demand, the Indian Railways has undertaken some works on top priority with targeted completion by 2024.

These works include the Chennai Beach Attipattu line (Kamarajar port), Kanaknadi Panambur line (New Mangaluru port), Raipur Titlagarh Doubling (Vishakapatnam), Madurai Tuticorin Doubling (Tuticorin), Titlagarh Sambalpur Doubling (Paradip), Banspani Daitri Jakhapur Doubling (Paradip), Sambalpur Talcher Doubling (Paradip), Hospet Tenaighat Vasco Doubling (Marmugao), Budhapank Salegaon 3rd and 4th line (Paradip) and the Bhadrak Vizianagram Vizag

Vijaywada 3rd Line, which cover all major ports on the East Coast.

The western ports of Gujrat and JNPT in Maharashtra will get connected to the northern hinterland of Rewari National Capital Region as well as Punjab (Ludhiana) via the Western Dedicated Freight Corridor along with feeder routes.

The connectivity of Kolkata and Haldia port to the Eastern Dedicated Freight Corridor will be established through the Sonnagar Dankuni leg of the Eastern Corridor.

At present, railways carry 25-27% of the major port traffic. By 2026, it aims to increase this share to 32-35% of the projected 925 MT, and by 2030 to 40-45% of the projected 1,200 MT.

As part of first phase projects under Vision 24, two Dedicated Freight Corridors (DFCs) will be commissioned much before 2026 to allow traffic to grow to 32-35% of the share from the present 27%. In second phase, three new DFC corridors will be developed before 2030 to achieve the target of 45% share in port traffic.

NATIONAL HIGHWAYS AUTHORITY OF INDIA (NHAI) SETTING UP INFRASTRUCTURE INVESTMENT TRUST (INVIT)

The National Highways Authority of India (NHAI) has filed draft papers with the Securities and Exchange Board of India (SEBI) to set up an Infrastructure Investment Trust (InvIT) to raise Rs 5,100 crore. An infrastructure investment trust is a quasi-debt instrument that provides investors with a steady yield derived from cash flows from operating infrastructure projects such as roads, transmission lines or renewable energy projects.

The InvIT is part of NHAI's plans to mobilize resources by unlocking value in operational road assets. On similar lines, the NHAI has been selling toll concessions of operating roads to financial investors under the toll-operate-transfer (TOT) model.

Earlier, in January, PowerGrid Corp of India Ltd filed the draft paper for the initial public offering of its InvIT through which it aims to raise Rs 8,000 crore through both primary and secondary share sales. While PowerGrid is planning an IPO of its InvIT, NHAI's InvIT is going to be a privately placed one.

While SEBI notified regulations for InvITs and REITs (Real Estate Investment Trusts) in 2014, only a few such trusts have listed their units in the country so far. It is widely expected that InvIT offerings by high quality sovereign backed institutions such as the NHAI and PowerGrid would give a boost to this category, attract long term patient foreign capital and help infrastructure companies mobilize resources for building new projects.

STATUS OF DISCOMS' OUTSTANDING DUES TO POWER GENCOS



The outstanding overdues of power distribution utilities fell by over Rs 15,118 crore to Rs 74,510 crore in March this year, as compared to the preceding month, mainly due to the release of the second tranche of liquidity infusion package, according to PFC Consulting Ltd data. The overdue amount stood at Rs 89,628 crore in February, 2021.

Power producers generally give 45 days to Discoms to pay bills for electricity supply. After that, outstanding dues become overdue and generators charge penal interest on that in most cases. To give relief to power generation companies (gencos), the Centre enforced a payment security mechanism from August 1, 2019. Under this mechanism, Discoms are required to open letters of credit for getting power supply. The Central Government had also given some breathers to Discoms for paying dues to power generating companies in view of the COVID-19- induced lockdown.

The Government had also waived penal charges for late payment of dues in the directive. In May, the government announced Rs 90,000 crore liquidity infusion for Discoms under which these utilities would get loans

at economical rates from Power Finance Corporation (PFC) and REC Ltd. This was a Government initiative to help gencos to remain afloat. Later, the liquidity infusion package was increased to Rs 1.2 lakh crore and further to Rs 1.35 lakh crore. So far, loans of Rs 1,35,497 crore have been sanctioned (under the liquidity infusion scheme and Rs 46,321 crore have been released to states/DISCOMs by REC and PFC.

Due to the nationwide lockdown, the revenues of the power distribution companies nosedived in the first half of FY2020-21, as people were unable to pay for electricity consumed. Overdue of independent power producers amount to around 46% of the total overdue of Discoms in February. The proportion of central PSU gencos in the overdue was around 40%. Due to the liquidity infusion, the overdue amount as a multiple of average monthly billing also showed a marked improvement - from 5.1 times in February, to 4.6 times in March, 2021. Among individual states Uttar Pradesh, Andhra Pradesh, Telangana, Bihar and Manipur have improved their overdue position in March compared to February, 2021.

PLI SCHEME FOR PROMOTING MAKE IN INDIA:



Under Atmanirbhar Bharat scheme, GOI has approved a Production-Linked Incentive (PLI) scheme of 2 Lakh Cr. out of which a substantial portion will go to solar projects. This step will have dual effect on economy first of which will be boost to solar capacity addition and second will be a positive addition to GDP.

The government approved a PLI scheme for ten key sectors,

including telecom, automobiles and pharmaceuticals, taking the total outlay for such incentives to nearly Rs 2 lakh crore over a five-year period. The scheme will help encourage domestic manufacturing, reduce imports and generate employment as the government works to bolster economic growth. The financial outlay for the new scheme will be Rs 1,45,980 crore.

PLI scheme will provide great incentives for manufacturers and help the country move towards the objective of 'Aatmanirbhar Bharat'. The PLI scheme will also provide encouragement to the critical sunrise sectors by ensuring necessary support from the government in addition to creating jobs and linking India to global value chain.

The 10 sectors that will be entitled to get the incentives include high efficiency solar PV modules. It is entitled to get Rs 4,500 crore. Other sectors are electronics and technology products (Rs 5,000 crore); automobiles and auto components (Rs 57,042 crore); pharmaceuticals and drugs (Rs 15,000 crore); telecom and networking products (Rs 12,195 crore); textiles products (Rs 10,683 crore); food products (Rs 10,900 crore); white goods (Rs 6,238 crore), Advance Chemistry Cell (ACC) battery (Rs 18,100 crore) and speciality steel (Rs 6,322 crore).

The scheme across these 10 sectors will make Indian manufacturers globally competitive, attract investment in the areas of core competency and cutting-edge technology, ensure efficiencies, create economies of scale, enhance exports and make India an integral part of the global supply chain.

INDIA H2 ALLIANCE (IH2A):

Led by domestic energy giant Reliance Industries, many global energy and industrial players came together to form a new energy transition coalition, called the India H2 Alliance (IH2A), to help commercialise hydrogen technologies in their bid to build net-zero carbon energy pathways in the country.

The alliance will work together to build the hydrogen economy and supply-chain here and also help develop blue and green hydrogen production and storage apart from building hydrogen-use industrial clusters and transport use-cases with hydrogen-powered fuel cells.

The alliance will focus on industrial clusters, specifically steel, refineries, fertilizers, cement, ports and logistics as well as heavy-duty transport use-cases and help establish standards for storing and transporting hydrogen in pressurized and liquefied form.

To achieve the objectives, the alliance will work with the government on five areas: to develop a national hydrogen policy and roadmap 2021-30; to create a national H2 taskforce and mission in a public-private partnership format; to identify nationally large H2 demonstration-stage projects; too help create a national India H2 fund; and to create hydrogen-linked capacity covering hydrogen production, storage and distribution, industrial use-cases, transport use-cases and standards.

This alliance seeks to bring in best-in-class hydrogen technology, equipment and know-how to create a hydrogen supply chain in the country. By prioritizing national hydrogen demonstration projects, innovations to further reduce the cost of hydrogen will become prominent, locally.

There is a need to identify and execute large-scale hydrogen demonstration projects to be part of the global hydrogen supply chain. The alliance will have a panel of hydrogen experts and a secretariat to support member companies. Proactive private-public collaboration is the key to creating a hydrogen economy in the country. The alliance is an industry coalition of global and domestic companies committed to the creation of a hydrogen value-chain and economy.



E-COMMERCE COMPANIES TO USE ELECTRIC VEHICLES FOR LAST MILE CONNECTIVITY

Fighting the pollution and higher oil prices, the e-commerce platforms are investing into Electric Vehicles (EVs) for last mile connectivity with their consumers. This move is expected to bring in institutional players in development, design and operation of individual mobility solution based on EV platform.

This will substitute the fossil fuel based mobility solutions with EV and is expected to create direct and indirect job creation and investment into niche EV platforms.

Flipkart has partnered with Mahindra Logistics to accelerate use of electric vehicles in last-mile delivery and will deploy over 25,000 EVs in the fleet by 2030. The Mahindra Group's logistics arm has already launched an electric last mile delivery service — EDel — in six cities and has partnered with companies in the consumer and e-commerce space to provide such services. Mahindra Logistics will play a significant role in working with various original equipment manufacturers (OEMs) and help Flipkart's sustainable transition to EVs. Flipkart has already partnered with many OEMs and introduced two and three-wheeler electric vehicles in its supply chain.

The company's partnership with Mahindra Logistics EDel will further propel this momentum and help in deployment at a national scale, further enhanced

by infrastructure and technology support that spans charging, tracking, asset, safety, and cost. Mahindra Logistics through EDel will enable Flipkart in its journey towards building a green supply chain by building supporting infrastructure and technology such as charging stations and parking lots, training workforce, route planning and battery-swapping stations in the near future.

STORAGE TECHNOLOGY AS A MEASURE TO STABILIZE POWER SUPPLY BY RENEWABLE ENERGY TO DISCOMS

To bring about reliable power supply amid increased use of renewable energy, Discoms and State Governments are investing in storage technologies. Tata Power Delhi Distribution Company (TPDDL), one of the power distribution companies in Delhi, for instance, recently inaugurated a 'community energy storage system' in collaboration with Nexcharge. The project entails setting up a 150 KW battery storage system at the Ranibagh sub-station of the company in north Delhi.

Similar example is that of Tamil Nadu where a study by Climate Trends and JMK Research and Analytics stated that renewable energy with battery storage in the States could help reduce curtailment of renewable energy. A chunk of solar power in Tamil Nadu was curtailed since the lockdown. Similarly, curtailment of wind power in 2019 went up to 3.5 hours per day from 1.87 hours per day in 2018. Analysis found that the cost of hybrid renewable energy with a battery storage system is on a par with new coal power plants in Tamil Nadu. Moreover, in 10 years, incremental capacity addition would further drive down the cost by over 31%.

The analysis tracks the system from an initial capacity of 800 MW of solar and 200 MW of wind along with 500 MWh of storage, that would cater to Tamil Nadu's average annual power demand for two hours per day from 2021-2023. Its capacity is augmented to three hours of daily backup for 2024-2026, and then four hours per day for 2027-2030. In the last year, the hybrid system would meet 29% of Tamil Nadu's average annual power demand at a competitive levelised cost of Rs 3.4/kWh.

It also puts into perspective that Tamil Nadu has five thermal power projects in the pipeline over the next three years. The Cheyyur ultra mega coal power plant is the biggest of these, with a tariff of Rs 5-6/kWh, which would be 32-43% more expensive than the system modelled in the analysis.

However, the economic feasibility of the lithium-ion-based battery energy storage system has been questioned by experts. The cost is around Rs 5-6/kWh and if one takes into consideration the life of the battery, which could be two-to-three years, it may not be economically feasible as one has to again invest in the battery. Only if there is a technological breakthrough in battery storage, would it be feasible.

CONSOLIDATION IN ROOFTOP SOLAR SEGMENT:



Azure Power Global has signed a binding agreement to sell its solar rooftop portfolio to Radiance Renewables for Rs 536.5 crore. The company, which is listed on the New York Stock Exchange, expects to receive the proceeds from the sale before December 31, 2021.

Azure's 167 MW rooftop solar capacity includes 151 MW of installed and 16 MW of under-construction projects. Out of Azure's pan-India solar portfolio of 6.9 GW, 2 GW are operational and 0.9 GW are under construction.

The company's remaining 4 GW have received a letter of the award but their power purchase agreements have yet to be signed with the Solar Energy Corporation of India (SECI). Azure's untied capacity is a part of the 12 GW projects awarded in the maiden auction for the manufacturing-linked solar scheme, through which Adani Green Energy will build 8 GW generation capacity and Azure will develop 4 GW and supply power at Rs 2.92/unit. As a part of the deal, the two companies will also build 3 GW of solar manufacturing capacities in the country (Adani 2 GW and Azure 1 GW).

Radiance, the buyer of Azure's rooftop portfolio, is a 100% subsidiary of Green Growth Equity Fund which is managed by EverSource Capital. Radiance now manages an operational capacity of 95 MW across Maharashtra, Tamil Nadu, Karnataka, Chhattisgarh, Telangana and Rajasthan and has close to 40 MW of projects under construction and another 60 MW under development.

HYDROGEN FUEL BUS SERVICE TO START ON DELHI-JAIPUR ROUTE BY NTPC

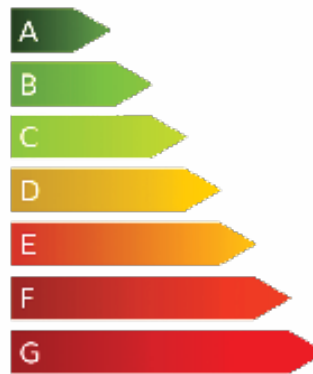
Green mobility is taking the fast lane in the country; apart from establishing a complete EV supporting infra, the Indian government is now also planning more options towards alternative fuels in order to reduce dependence on traditional fuels. While electric cars and taxis are been promoted heavily by the government, it is now also conducting a feasibility study on hydrogen fuel buses.

India's largest energy conglomerate, NTPC Limited (National Thermal Power Corporation Limited) is planning to start a premium hydrogen fuel bus service on Delhi to Jaipur route. It is going to be the first Fuel Cell Electric Vehicle (FCEV) bus service in India to be used for intercity commute. The new service is going to be a pilot project to test the viability of fuel cell buses for the intercity commute. It will also help to analyze the affordability quotient of fuel cell buses against the conventional Inter City Express (ICE) bus service.

Toyota Motor Corp., Hyundai Motor Co., Tata Motors Ltd, Ashok Leyland Ltd and KPIT Technologies Ltd have evinced interest in India's maiden initiative to run hydrogen-powered fuel cell-based electric cars and buses.



Energy Efficiency Services



PTC has been continuously making strides in the direction of Energy Efficiency Management. PTC, through MoUs, has partnered with leading organizations like Bureau of Energy Efficiency (BEE), Energy Efficiency Services Limited (EESL), National Productivity Council (NPC), University of Petroleum and Energy Studies (UPES) etc. to work jointly in the area of energy efficiency.

- Prestigious Projects undertaken
 - Indian Railways
 - Airport Authority of India
 - Major Ports, SEZs
 - Prominent buildings like National Archives, Presidential Estate, AIIMS Delhi etc.
- PTC is empaneled with BEE as Grade-1 ESCO
- PTC has been part of Government's initiatives in the area of energy efficiency such as:
 - Unnat Jyoti by Affordable LEDs for All (UJALA)
 - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
 - Street Light National Program (SLNP)
- Under SLNP, PTC is currently managing around 25 Lakh LED based street lights across more than 550 Urban Local Bodies in eight states of the country



PTC India Limited

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New Delhi - 110066



ENERGY PORTFOLIO MANAGEMENT:

Intelligence behind power supply business

Anand Kumar

Assistant Vice President, STA to CMD
PTC India Ltd.

Energy Portfolio Management, with its portfolio concept to electricity management brings in multi – source, multi- location, Multi – allocation to bring out optimal economic equilibrium to satiate electricity demand. This approach of electricity distribution helps stakeholders in carrying out their responsibility.

Energy Portfolio Architecture



With limited resource at one's end at supplies (especially in short term), a paradigm shift in the energy management is required, which is beyond the

monolithic approach of arriving at demand & supply equilibrium. Energy portfolio management (EPM) approach to electricity distribution provides regulators, Distribution Companies (Discoms), suppliers and other parties with a systematic process and set of tools to optimally manage its role & responsibility in an economic & transparent manner. EPM assists stakeholders in input data and assumptions, identify and quantify the trade-offs between objectives under alternative strategies (planning horizon, resource profile, social profile etc).

EPM endeavours to achieve these through

- developing a resource plan,
- procuring the portfolio of resources identified in that plan,
- management of portfolio of resources on an ongoing basis.



A Deep dive into the Distribution Companies and Policy Planner's parametric view of EPM:

- Planning Horizon: Use of a reasonably long-term horizon, allows a range of resources and costs to be considered, including new renewable resources that have yet to be built, capacity & storage solutions (available as well aspirational) and determined path of carbon dioxide emission regulations.
- Forecasting Tools for Demand and Supply assessment:
- Macro Level: Forecast the quantity of capacity and generation required for meeting un-constrained demand. These requirements can be forecasted, and are obviously subject to uncertainty. These multi - variables of demand forecast can be grouped into organic growth rate (population, education, employment and other social growth indicators) and in-organic growth rate (fiscal and monetary policies induced growth).
- Micro Level: the quantities of demand forecast required for hour to hour and day to day are very difficult to forecast as they are sensitive local situations (weather, customs, working conditions & consequent economic conditions). The disruption is visible at the smallest disequilibrium.
- Competitive supply landscape: In retail competition markets there is additional uncertainty as to what quantity of load will switch to, or from, competitive suppliers.
- Viability & hedging instrument:
 - Demand side management and energy efficiency
 - Distributed generation
 - Supply side resources
 - Physical contracts
 - Financial instruments

While planning, each source and their key attributes need to be mapped (for each time horizon) with temporal variations of availability, consequent cost and implied volatility. The alternative strategies & resource mixes can be identified using reliable service at reasonable rates. This may entail evaluating possibilities & plans with different arrangements and combinations of resources.

Regulators may also consider fuel diversity targets, renewable energy targets, carbon dioxide targets, other environmental goals, service to low-income customers, impacts on the local economy, and flexibility to respond to major changes in market conditions and public policies over time.

Generators with different fuel feed (Hydro, Wind, Solar, Gas-fired, Coal-fired, Nuclear and any upcoming technology) and inherent technical limitations helps in developing a mechanism for resource planning and its economic impact.

The complexity of supplies (availability, quality, affordability) and rapidly changing ecosystem, EPM is a market agnostic software based solution for different planning horizon and planning objective. The interplay of large generating stations with small distributed energy sources coupled with storage, its technical and financial implications is key interest area for all the stakeholders for planning capacities. It can address traditional cost-based engineering

optimization analysis of traditional supply-side resources, scenario based comparisons of different sources on the twin matrix of robustness & time horizon.

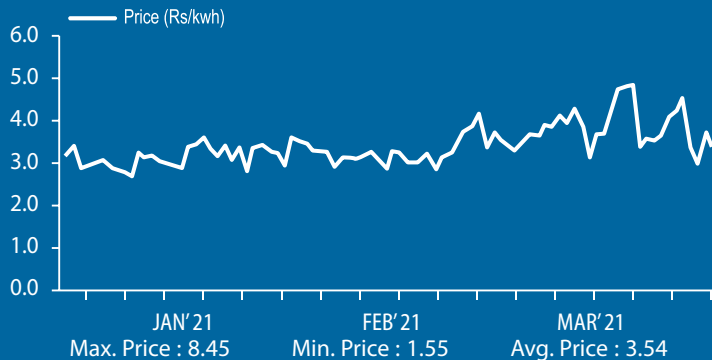
In addition, these tools would benefit from improving their methodologies for analyzing long term risks and comparing long-term decisions under uncertainty. For example, some existing optimization models require the representation of system operation to be simplified and limit the number of resources that can be considered in a model run. Such modelling constraints can prevent the long-term costs and benefits to consumers of a diverse mix of resources from being evaluated fully.

So, while we feel the need of a tool (non- adaptive, adaptive depending on user maturity profile) to help us prospective plan our electricity demand – supply business, due focus is also required for the man-power training to properly use the software / incorporate abstract social & economic development into usable variables for desired outcome from EPM.

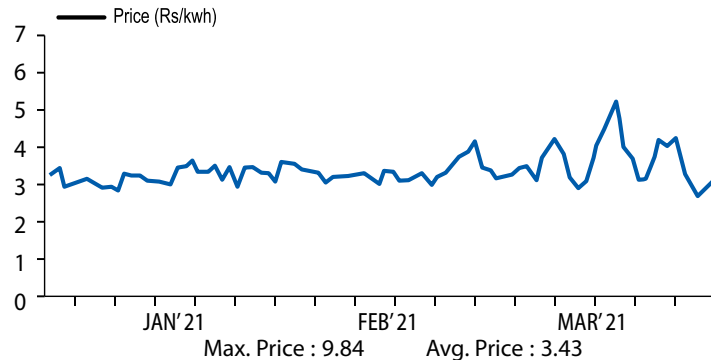
Further, in an era of cloud computing and super-specialization, policy planners and generators may use EPM as third party services from the agencies / companies engaged in solving the real-time complex issue of making power available to every citizen every time at economically viable price point.



MARKET WATCH



Daily Prices - Indian Energy Exchange (IEX) : Day Ahead Market



Daily Prices - Indian Energy Exchange (IEX) : Real Time Market

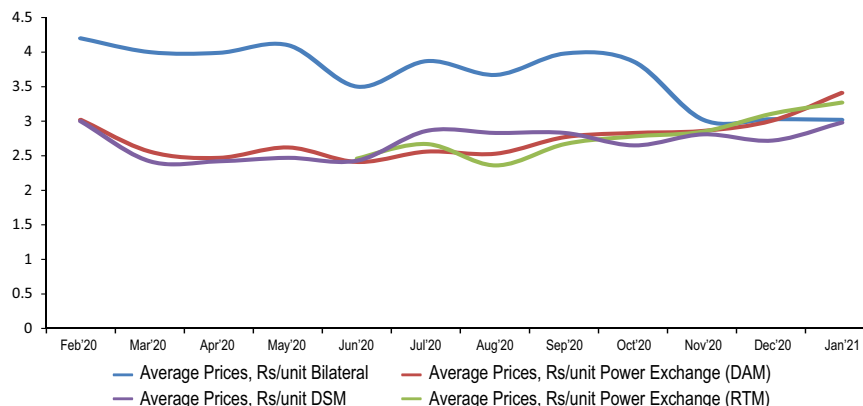
POWER TRADING

MARKET SIZE

Bilateral Trade And Power Exchange Market

Year	Electricity Transacted through Traders (BU)	Price of Electricity Transacted through Traders (Rs/kWh)	Size of bilateral Trader Market (Rs Crore)	Electricity Transacted through Power Exchanges (BU)	Price of Electricity Transacted through Power Exchanges (Rs/kWh)	Size of Power Exchange Market (Rs Crore)	Total Electricity Traded in bilateral and Power Exchange (BUs)	Total Size of the bilateral trader + Power Exchange Market (Rs Crore)
2009-10	26.72	5.26	14055	7.19	4.96	3563	33.91	17617
2010-11	27.70	4.79	13268	15.52	3.47	5389	43.22	18657
2011-12	35.84	4.18	14979	15.54	3.57	5553	51.38	20532
2012-13	36.12	4.33	15624	23.54	3.67	8648	59.66	24272
2013-14	35.11	4.29	15061	30.67	2.90	8891	65.78	23952
2014-15	34.56	4.28	14801	29.40	3.50	10288	63.96	25089
2015-16	35.43	4.11	14557	35.01	2.72	9539	70.43	24096
2016-17	33.51	3.53	11829	41.12	2.50	10280	74.63	22109
2017-18	38.94	3.59	13979	47.7	3.45	16457	86.64	30436
2018-19	47.32	4.28	20253	53.52	4.26	22800	100.84	43052
2019-20	29.95	4.51	13507	56.45	3.24	18290	86.40	31797

Short Term Prices in Last 1 Year under Biletral, Day Ahead Market and Real Time Market

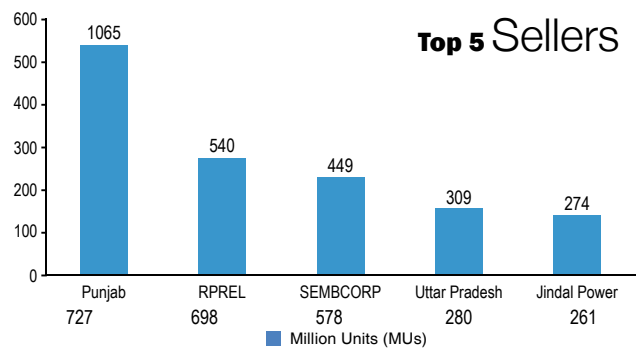
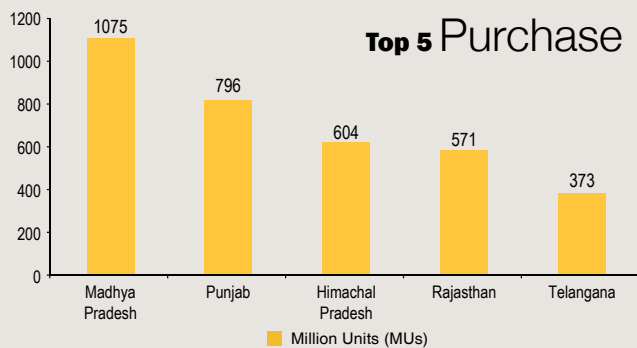


PTC India Limited

Source:

CERC Market Monitoring Report • Indian Energy Exchange • Power Exchange India Ltd. • CEA

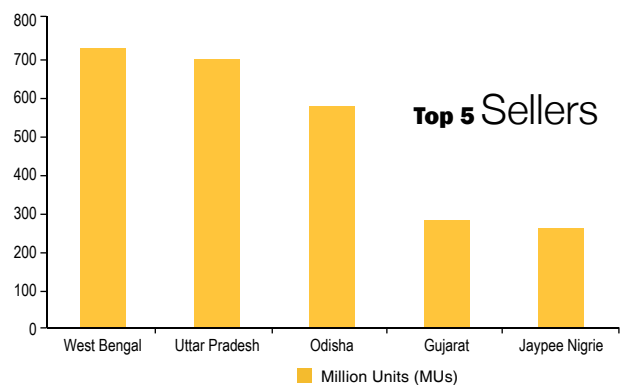
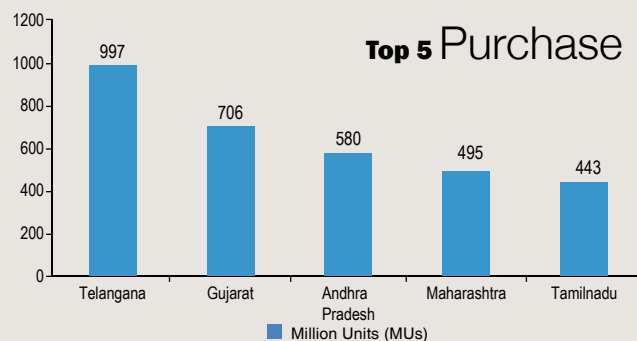
BILATERAL MARKET



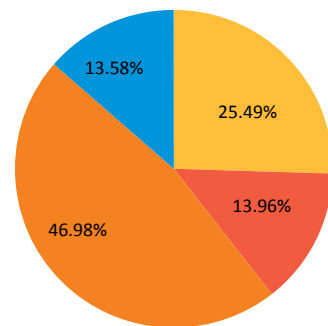
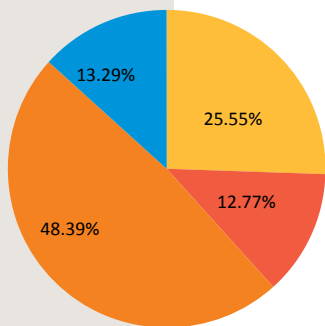
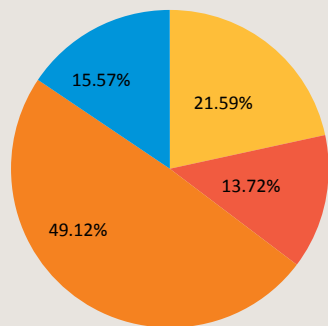
MARKET TRADE

The trading data corresponds to purchase and sale made in the month of January 2021.

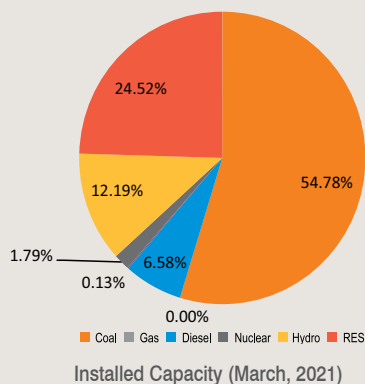
SPOT MARKET



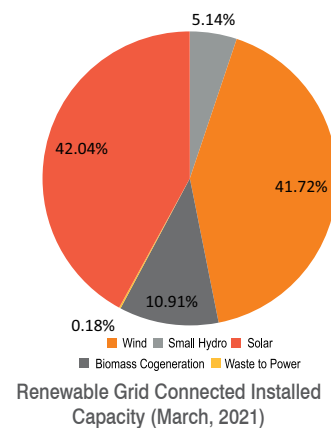
Total Short Term Contract Volumes (Nov 2020-Jan 2021)



All India Installed Capacity as on 31st March, 2021 (in MW)



Ownership/ Sector	Modewise Breakup							
	Thermal							
	Coal+Lignite	Gas	Diesel	Total	Nu- clear	Hydro	RES (MNRE)	
State	66812	7120	236	74167	0	27070	2392	103628
Private	76003	10599	274	86875	0	3493	88947	179315
Central	64890	7238	0	72128	6780	15647	1632	96187
Total	207705	24957	510	233171	6780	46209	92970	379130



POWER SUPPLY POSITION

State Wise Power Supply Situation (April, 2020 to March, 2021)

Region	State/UT	Energy Req. MUs	Energy Avail-ability, MUs	Surplus/Deficit (-)%	Peak Demand MWs	Peak Met, MWs	Surplus/Deficit (-)%
Northern	Chandigarh	1,523	1,523	0.0%	383	383	0.0%
	Delhi	29,559	29,555	0.0%	6,314	6,314	0.0%
	Haryana	53,161	53,108	-0.1%	10,982	10,982	0.0%
	Himachal Pradesh	10,171	10,116	-0.5%	1,932	1,932	0.0%
	UT of J&K and Ladakh	19,773	17,222	-12.9%	3,280	2,680	-18.3%
	Punjab	58,460	58,393	-0.1%	13,148	13,148	0.0%
	Rajasthan	85,325	85,219	-0.1%	14,441	14,441	0.0%
	Uttar Pradesh	124,087	123,103	-0.8%	23,797	23,747	-0.2%
	Uttarakhand	13,809	13,800	-0.1%	2,372	2,372	0.0%
Western	Chhattisgarh	31,021	31,007	0.0%	4,682	4,682	0.0%
	Gujarat	112,085	112,085	0.0%	18,483	18,483	0.0%
	Madhya Pradesh	83,514	83,513	0.0%	15,756	15,668	-0.6%
	Maharashtra	151,097	151,081	0.0%	25,513	25,513	0.0%
	Daman & Diu	2,225	2,225	0.0%	355	355	0.0%
	DNH	5,495	5,495	0.0%	888	888	0.0%
	Goa	4,027	4,027	0.0%	599	599	0.0%
Southern	Andhra Pradesh	62,086	62,082	0.0%	11,193	11,193	0.0%
	Telangana	67,062	67,058	0.0%	13,688	13,688	0.0%
	Karnataka	68,951	68,931	0.0%	14,367	14,367	0.0%
	Kerala	25,132	25,116	-0.1%	4,278	4,269	-0.2%
	Tamil Nadu	101,177	101,172	0.0%	16,263	16,263	0.0%
	Puducherry	2,641	2,641	0.0%	423	422	-0.2%
	Lakshadweep	56	56	0.0%	11	11	0.0%
Eastern Region	Bihar	34,227	34,095	-0.4%	5,995	5,938	-1.0%
	DVC	21,212	21,212	0.0%	3,173	3,173	0.0%
	Jharkhand	9,857	9,628	-2.3%	1,651	1,623	-1.7%
	Odisha	29,806	29,806	0.0%	5,168	5,168	0.0%
	West Bengal	51,345	51,248	-0.2%	8,870	8,870	0.0%
	Sikkim	545	545	0.0%	120	120	0.0%
	Andaman- Nico-bar	346	323	-6.6%	58	54	-6.9%
North- Eastern Region	Arunachal Pradesh	717	712	-0.7%	158	149	-5.7%
	Assam	10,195	9,818	-3.7%	2,072	1,987	-4.1%
	Manipur	971	966	-0.5%	252	249	-1.2%
	Meghalaya	2,031	2,005	-1.3%	384	384	0.0%
	Mizoram	724	720	-0.6%	132	132	0.0%
	Nagaland	829	825	-0.5%	160	155	-3.1%
	Tripura	1,494	1,491	-0.2%	317	315	-0.6%
All India		1,276,335	1,271,546	-0.4%	190,198	189,395	-0.4%

Predicting Power Market Behaviour -

Flexible procurement Options for Utilities

Aditi Tandon

Head Research
Elektre Systems Pvt. Ltd.



In evolved power markets with a fair level of deregulation, a utility has multiple options such as long term, day-ahead and real time markets to meet its supply obligations. However, each type of market segment has its own underlying risks and complexities associated which makes it crucial for a utility to serve its load along with minimizing costs and managing supply risks.

Distribution utilities have a huge portfolio mix, procuring from all types of power at different tariff rates, having an impact on costing, based on a long- and short-term demand-supply arrangement.

Demand for the long term is based on a wider level forecast under-taken by government agencies such as CEA via the Electric power Survey Series and other planning activities. Supply on the other hand comes from legacy PPAs (mostly >25 years old) with state and central generators along with long term bilateral power purchase agreements.

In case of short term planning the load generation balance reports (LGBR) prepared at the state level highlights the shortfall in supply which is met by bilateral agreements, banking and power exchanges.

As the Indian economy continues to be impacted by COVID-19, it is an appropriate time for utilities to transit to an efficient and flexible procurement pattern, to help in economic revival.

Recent Movement

Plagued by ineffective PPAs with stranded capacity and dynamic short term prices especially on power exchanges, the utilities have, in the last two year period become more dynamic in buying power. Price input clearly highlights the beneficial purchase of power in the exchange market where prices have remained lower in the last fiscal with lockdown restrictions in place in the first quarter.

Further in CoVID times, inter-regional power trade has taken a hit along with power demand, with a fall of 11% in April'20 on a YoY basis and 5% in May'20, despite the country entering the summer season. This has continued to remain muted in

June, despite relaxations being allowed in the lockdown and an increase in domestic and agricultural consumption.

With the Government easing lockdown restrictions in May 2020, the trade picked up in, especially the short-term market. Exchange drawls were up by 53% in May'20 from April'20 levels with states opting for low prices. However, with the introduction of RTM, some volume shifted there with 515 MU traded in this segment against 4216 MU under DAM for June 2020.

Another factor for major states to become more flexible in procurement is the rising share of renewable energy in meeting the load curve. With infirm nature of both solar and wind generation, states have resorted to both DAM and RTM markets to bridge the gap. During the period September-October 2020, as wind generation peaked, long term draws came down majorly with states again shifting to exchange for overcoming shortfalls.

Figure: All India Inter-regional contractual trade (MU)

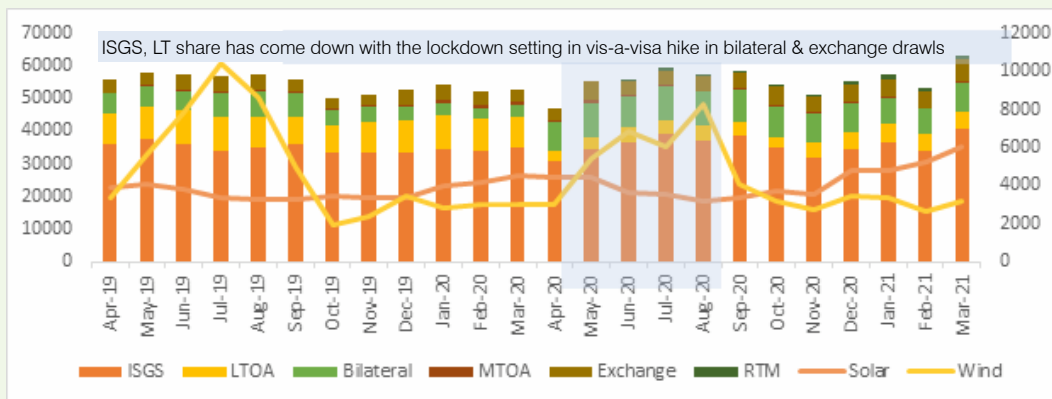
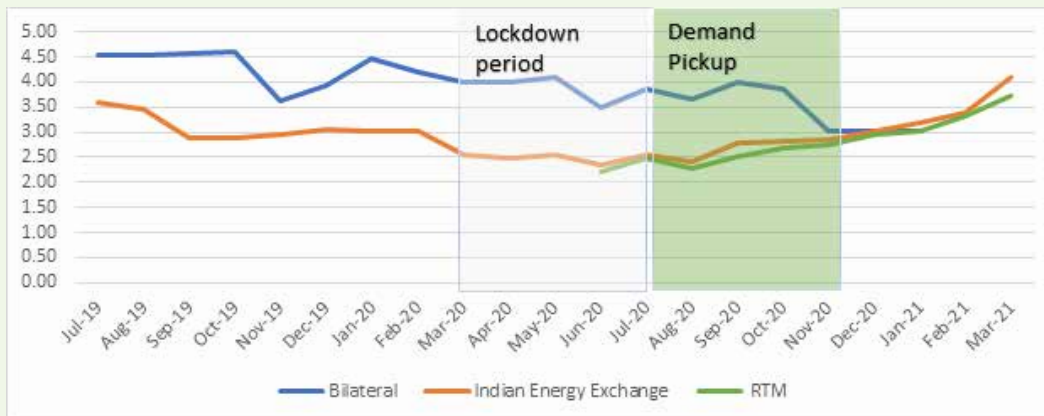
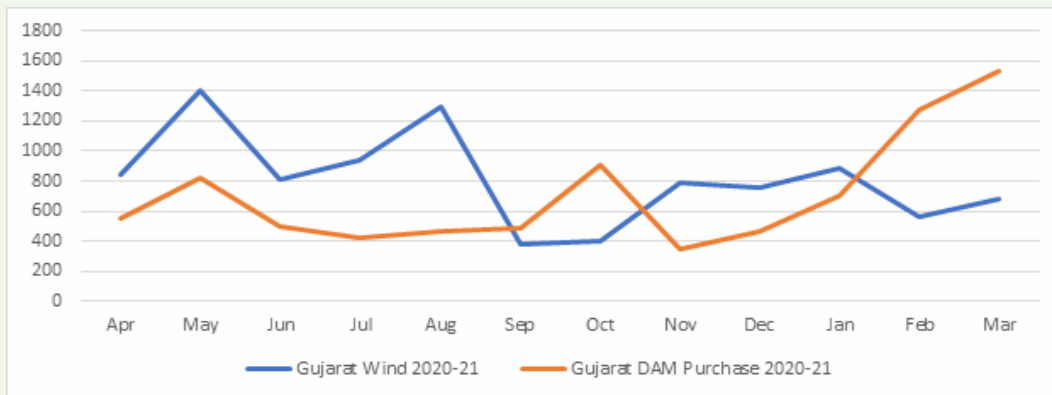


Figure: Short term pricing trend (Rs/unit)



The same can be seen with the case of Gujarat, one of the top five wind producer States. A fall in wind generation in a given month sees a rise in short term exchange drawls (as seen in FY21, given below)

Figure: Gujarat's wind generation trend vs Exchange Drawls (MU)



A deeper analysis also highlights that the state has PPA tie-ups in surplus of its peak requirement (excluding renewable sources). This leads to an added burden on procurement costs with continuous payment of fixed charges in case of backing down of plants.

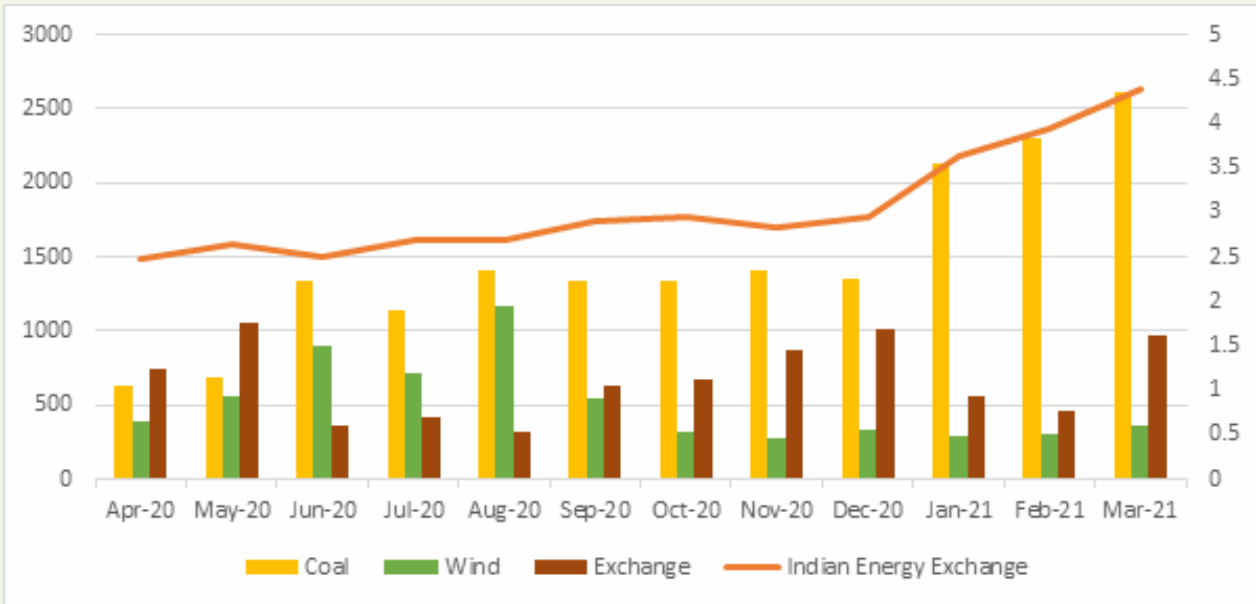
Figure: Gujarat's PPA Tie-ups vs Peak Demand (MW)



In the earlier part of the lockdown, an increasing number of major states and utilities began to understand the benefits of energy trading and maintaining a dynamic power portfolio. Exchange transactions have seen an upswing with prices falling below the average variable cost of a long-term supply contract. States are increasingly looking to maximise benefits under this option. Altering between exchange supplies and shutting down costlier generation has become a frequent exercise. When the price at the exchange increases to a level higher than the variable cost of the PPA, discoms can scale back the latter and vice versa.

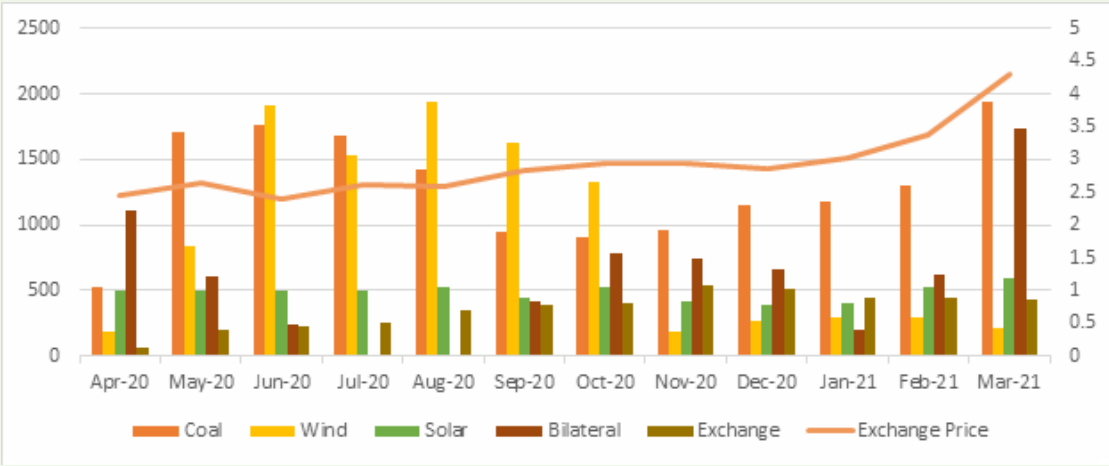
For instance, Andhra Pradesh had opted for an increasing purchase from IEX, enjoying benefits of prices as low as Rs 1.8/unit and saved Rs 1.88 billion. Additionally, its coal-based generation was down by 58% in April'20 from March'20 as the state decided to alter between must run sources and exchange to meet power demand. However with rising wind generation in June, state based plants become a more reliable option to balance the same. Further agricultural demand was on the rise in this period. However from January'21 onwards, state run plants were revived as wind generation fell and exchange prices rose for the state. Post June'20 onwards, the state had already stopped purchasing under ST bilateral segment and revived it for January and February'21.

Figure: Andhra Pradesh's Generation vs Exchange Trend (Volume in MU, Price in Rs/unit)



Tamil Nadu on the other hand has relied on increasing banking supplies form Punjab, especially in April'20 and reduced reliance on Exchange. However by June, with higher RE and resumption of industrial demand, exchange draws came down. The last quarter though saw higher bilateral, with pre- election activities going on in full swing.

Figure: TANGECO's Generation vs ST Draws Trend (Volume in MU, Price in Rs/unit)



Despite some utilities becoming more aware and active in the short-term market, the overall share of trade here continues to hover in the range of 10-13% of the total generation, indicating a scope of further deepening of the market.

With dues rising on all fronts for utilities, the flexibility in maintaining a dynamic procurement portfolio will enable potential savings benefits. By leveraging lower prices in the short-term market, distribution utilities have an opportunity to honor the existing financial commitments to generators.

At the same time, an active short term market also benefits developers who can also lower risks and make quicker recoveries at high priced hours.

States have begun understanding the benefits of trading in this market, when to benefit from lower exchange prices to opting for bilateral/banking supplies. This necessitates a deeper understanding of predicting market behavior under various circumstances.



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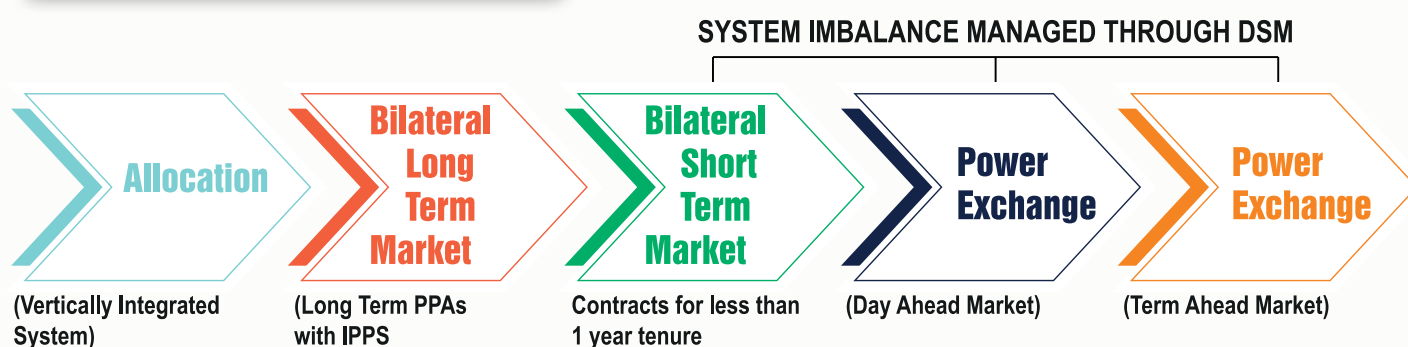
A recent study undertaken by TERI & SHELL laid out the technological options that India would likely need to consider if its energy system was to move to Net Zero emissions by 2050.

REAL TIME MARKET CHANGING FACE OF MARKET INSTRUMENTS

Hiranmay De

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PTC India Ltd.

Power Market Evolution:



1. MARKET SCENARIO AND NEED FOR REFORMS

In India, power procurement planning is predominantly on Long / Medium term basis. Data suggests that more than 89 % demand is met through long or medium term procurement. Balance power is procured mainly through the following avenues :

- A. Short term power procured through trader or directly from different entities (Independent Power Producers, Distribution companies etc.) This transaction includes banking transactions also.
- B. Power procured through power exchange platform utilizing various products like Day Ahead Market (DAM) or Term Ahead Market (TAM).
- C. Real time drawl from Grid through Unscheduled Interchange (Now called Deviation Settlement Mechanism).

Last ten year data (as tabulated hereunder) suggests similar trend of procurement, though variation observed in this year wherein bilateral quantum shifted to Power Exchange.

TABLE I

YEAR	ENERGY IN MU					% OF TOTAL			
	BILATERAL	POWER EXCHANGE	UI / DSM	TOTAL	GENERATION	BILATERAL	POWER EXCHANGE	UI / DSM	TOTAL
2011-12	51211	15543	27758	94512	874166	6%	2%	3%	11%
2012-13	50639	23542	24759	98940	907490	6%	3%	3%	11%
2013-14	52684	30481	21471	104635	962902	5%	3%	2%	11%
2014-15	50137	29402	19447	98987	1045094	5%	3%	2%	9%
2015-16	59471	35005	20754	115231	1102850	5%	3%	2%	10%
2016-17	54890	41123	23218	119230	1157938	5%	4%	2%	10%
2017-18	55710	47697	24209	127616	1202971	5%	4%	2%	11%

YEAR	ENERGY IN MU					% OF TOTAL			
	BILATERAL	POWER EXCHANGE	UI / DSM	TOTAL	GENERATION	BILATERAL	POWER EXCHANGE	UI / DSM	TOTAL
2018-19	66591	53475	25132	145198	1245317	5%	4%	2%	12%
2019-20	58120	56442	22589	137151	1248171	5%	5%	2%	11%
2020-21 Upto Dec'20	31667	54083	17396	103146	905355	3%	6%	2%	11%

Source : CERC Market Monitoring Report

Distribution companies plan power procurement based on demand forecasting using following two major techniques :

TYPE	REMARK / DETAILS	
A.	Long / Medium Term Forecasting	Generally it lasts multi year / year ahead. Major benefits are Capacity / Investment / Network planning, Fuel mix decision etc. Major influencing factors are growth rate, new customer, life style change etc.
B.	Short Term Forecasting	Granularity is monthly , weekly , daily or hourly. Major influencing factors are Weather, Events, festivals etc.

It is evident from TABLE- I, only 2 % i.e. UI / DSM Portion, Ancillary Schedule and very miniscule portion of Power Exchange (Intra day portion of TAM trade) and Short Term bilateral are scheduled on Real Time basis, whereas balance 98 % of power requirement is met through Day Ahead Basis.

Before implementation of Real Time market in Power Exchange, other real time adjustment to contain last mile system imbalance as mentioned above have their own concerns as indicated in TABLE –II:

TABLE - II

Sr. No.	Methodology	Remark / Concerns
1.	Re scheduling before 4 time blocks	Long Term / Medium Tem schedule can be revised before 4 time blocks. This methodology is very useful in case of downward revision, but for upward revision generally power allocated from the designated generating station is exhausted and distribution company does not have access to surplus available from the other generators not allocated to them. Hence surplus remain available remain unutilized though shortage is noticed in other distribution company's area.
2.	Short Term Intra Day contingency transaction through trader or through Power Exchanges	This method of real time procurement is not very successful in India because of two reasons. First one is, this process require lots of paperwork like signing of contract (if power scheduled through trader or bilaterally), STOA application for corridor allocation etc. and secondly this type of power is settled through pay-as-bid matching algorithm, which may not be the most economical w.r.t. available power on pan India basis.
3.	Reserve Regulation Ancillary Service (RRAS)	This method of Real Time adjustment is a centralized instrument and available only with system operator, but number of participants are very few in this segment as the generator whose tariff is not determined by the commission can not participate in this segment.
4.	Deviation Settlement Mechanism (DSM)	This methodology is being widely used for Real Time Adjustment though Central regulator is taking measures to discourage using DSM as a trading platform. Ideally it should be used only as a disciplinary mechanism.

Considering the facts stated in TABLE-II, it can be concluded that DSM and Ancillary Services are not meant to handle last mile system imbalances. Performance of Intra Day market is not encouraging so far. Hence Market reform was very much needed for Real Time system management which is going to be tougher considering the large scale integration of Renewable energy generator in the Indian grid in view of targeted 175 GW by 2022. Increasing penetration of renewable energy has to be complemented by market re-design otherwise it will adversely impact the system planning and power procurement planning process.

So we need to draw a line of demarcation between the two segments i.e “Energy Trade” and “System Imbalances”. Presently in the current scenario both the segments are mixed even though various penal actions are implemented by the regulator by way of various amendments of DSM regulation e.g. linking the rate of deviation with Power exchange discovered price, punitive action for violation of sign change regulation etc.

2. CHALLENGES FACED DURING IMPLEMENTATION OF REAL TIME MARKET

Real Time Markets are envisaged in a manner that they allow all stakeholders to correct their positions with firm financial commitments so that last mile system imbalance are replaced by energy trade and give robust stability to the grid.

Major challenges in the system during RTM implementation were:

Technology:

NLDC: communication with the power exchanges should be robust and preferably through Application Programming Interface (API)

RLDC: scheduling software of each RLDC is different, It must be same so that Real Time Corridor availability can be calculated automatically and there should not be any scheduling mismatch between seller, buyer and in-between RLDC

SLDC: Technology is the backbone of Real Time Market , hence all SLDC should implement suitable software to calculate real time mismatch between demand and availability and place bid accordingly in the power Exchange platform . In addition to the technology , SLDC should develop trained manpower to utilize the opportunity available in the Real Time Market.

Power Exchange: Real Time Market must be auction based (and not pay-as-bid based as available in intra-day TAM market), Unlike DAM market clearing and settlement system (once in a day) it should more than once in a day , Robust communication system , API base platform , details of transaction in form of Obligation Report etc. will give confidence to the stakeholders

Other Stakeholders: Suitable Technology platform , robust communication system , trained manpower to give confidence to the participants

Gate Closure: Provision of Gate closure was required to be implemented where the gate for schedule revision closes at a fixed time before the actual delivery. No more schedule revision is allowed after Gate Closure. Time of Gate closure can be reduced by system automation. Any shortfall / Excess due to Gate Closer is adjusted by Purchase / Sell from Real Time Market

Regulatory Changes: Implementation of Real Time Market needed changes of various regulations like Indian Electricity Grid Code, Open Access Regulation and Power Market Regulation

3. REAL TIME MARKET IMPLEMENTATION CHRONOLOGY AND SALIENT FEATURES

Based on the discussion paper published by CERC in July'18, Draft amendment of various related regulations were issued in August'19 and invited comments / suggestion / objections from the stake holders. Public hearing was held on 16-10-2019 and finally Real Time Market became operational from 01-06-2020. Evolution of Real Time Market is tabulated hereunder in TABLE III.

TABLE III

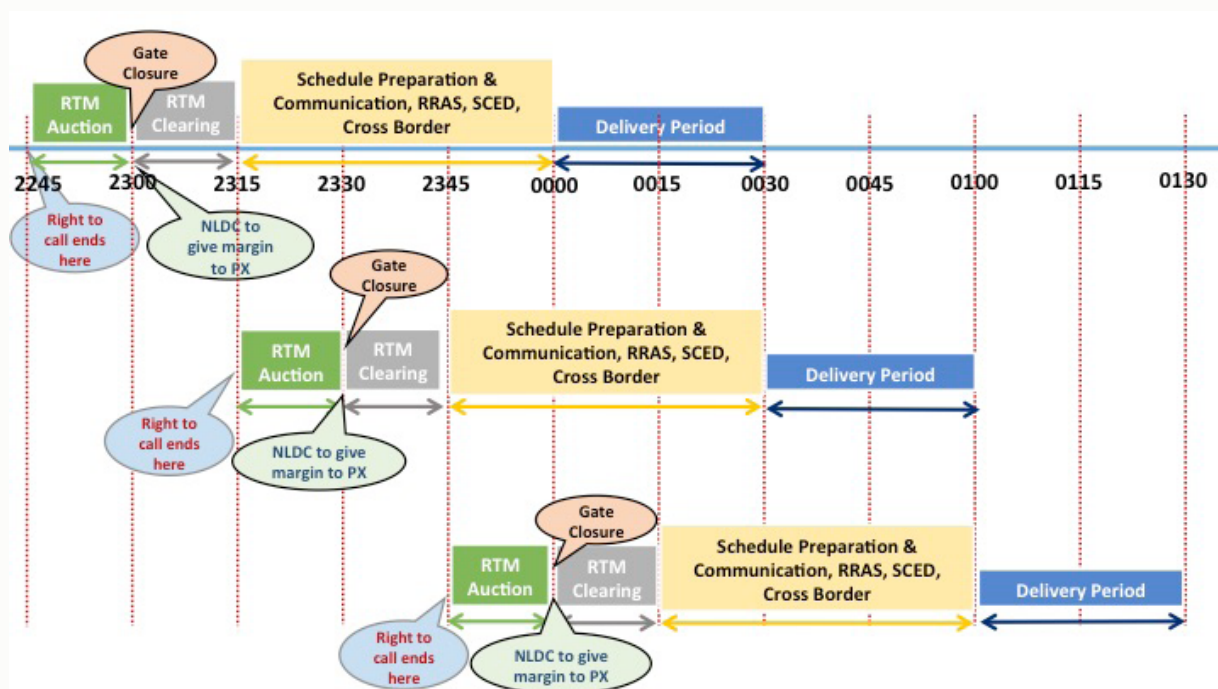
Date	Activity
25-07-18	Discussion Paper on Re-designing Real Time Electricity Markets in India published by CERC
06-08-19	CERC issued draft amendments to the Indian Electricity Grid Code, Power Market Regulation and Open Access in Inter-state Transmission Regulations
12-12-19	CERC Notified Final amendments of the Regulations mentioned above
03-03-20	NLDC published Draft Procedure for Scheduling Collective Transactions in the Real Time Market (RTM)
20-03-20	CERC extended RTM implementation due to COVID 19 Pandemic
15-05-20	NLDC finalized the procedure
28-05-20	CERC order published for margin allocation
31-05-20	NLDC circulated revised procedure
01-06-20	Real Time Market became operational in India

SALIENT FEATURES OF REAL TIME MARKET:

Key Features	Details
Duration	15 Min bidding window , 15 Min clearing window , Half hourly Market , 48 bidding session
Delivery	30 Mins (2 time block of 15 Min each)
Price Discovery	Double sided closed auction, Uniform pricing, Price and Volume discovered for every 15 Minutes similar to existing Day Ahead Market (DAM)
Gate Closure	1 hour time between gate closure and delivery

Key Features	Details
Nodal Agency	National Load Dispatch Centre (NLDC, POSOCO)
Curtailment due to corridor congestion	Collective transactions in DAM will be curtailed first followed by RTM
Sharing of Benefit	For PPAs signed under Section 62, net gain will be shared in the ratio of 50:50 limited to generator's gain of 7 paise/kWh.
If beneficiary trades surplus power, entire gain will be to that beneficiary	
Applicability under DSM	RTM would be financially and physically binding. Failure to follow the schedule will attract charges under DSM

Real Time Market Time Line, Gate closure and Process :



RTM auction start time	RTM auction End time	RTM clearing interval	Schedule prep and communication	Delivery Period
22:45 Hrs (of the previous day)	23:00 Hrs (of the previous day)	23:00-23:15 Hrs (of the previous day)	23:15-24:00 Hrs	00:00-00:30
23:15 Hrs (of the previous day)	23:30 Hrs (of the previous day)	23:30-23:45 Hrs	23:45-00:30 Hrs	00:30-01:00
23:45 Hrs (of the previous day)	00:00 Hrs	00:00-00:15 Hrs	00:15-01:00 Hrs	01:00-01:30

Process described hereunder for 1 session (30 mins) for Delivery period 00:00 Hrs to 00:30 Hours

- Window for trade in RTM for day (D 0): 22:45 hrs to 23:00 hrs of (D-1)
- Window for delivery of power (D 0): 00:00 hrs to 00:30 hrs,
- NLDC assesses and communicates the margin in each transmission corridor before the trading for RTM closes for a specified duration that will be available for delivery period in RTM transactions (say by end of 23:00 hrs for delivery of power between 00:00 hrs to 00:30hrs).
- Once the auction has ended, the power exchange runs the optimization/engine and clears the market considering the available transmission margins (say by 23:15 Hrs.)
- The power exchange immediately communicates the cleared transaction/volume to the NLDC. The NLDC, using this information communicates the schedule to the RLDCs/SLDCs to incorporate in the schedule. The LDCs in turn incorporate the schedules and informs the respective generators and Discoms.

KEY BENEFITS OF RTM:

RTM market seems to be win-win situation for all stake holders . Some of the benefits are:

Benefits to the Generators

- Technical capability , Ramping schedule can be properly maintained with financial benefits.
- Un tied capacity of RE generator can be sold in the larger pool
- RTM incentivize cheaper generator by increasing their visibility at national level
- Schedule commitment can be met during plant outage
- Thermal power station can sell UPS power to improve PLF
- Hydro station can sell their power during water spillage

Benefits to the Distribution Companies:

- Discoms can better manage their portfolio by harvesting the flexibility on Real Time Basis.
- Larger generation pool available to meet contingency with efficient pricing methodology.
- Reduce Over-drawl / Under-drawl / Sign change penalty in DSM
- Manage variation in RE generation.
- Better response to the generation outage

PTC'S EXPERIENCE:

- PTC has developed API based IEX compatible software, which PTC customers are using without any loss of time and human intervention.
- In addition, to give customer full satisfaction and confidence PTC engaged dedicated, trained manpower at PTC office, New Delhi on 24X7 basis. They are resolving technical / software issue on Real Time Basis, so that customer should not loose any session to manage their portfolio optimally.

We have tabulated hereunder last 7 months (Jun'20 to Dec'20) power Exchange transacted volume in different segment in TABLE-IV

TABLE - IV

MONTH	DAM (MU)	TAM (MU)	RTM (MU)	TOTAL (MU)	DSM (MU)	% OF TOTAL EXCHANGE VOLUME		
						DAM %	TAM %	RTM %
APR'20	3692	551		4243	1618	87%	13%	
MAY'20	5596	716		6312	1961	89%	11%	
JUNE'20	4189	175	517	4882	2080	86%	4%	11%
JUL'20	4487	91	785	5363	2133	84%	2%	15%
AUG'20	4498	123	861	5482	2065	82%	2%	16%
SEP'20	4841	579	704	6124	1933	79%	9%	11%
OCT'20	5550	1010	814	7375	1915	75%	14%	11%
NOV'20	4909	408	894	6210	1840	79%	7%	14%
DEC'20	5611	1352	1129	8092	1851	69%	17%	14%

Source: CERC Market Monitoring Report

From the above mentioned TABLE we conclude that RTM volume is increasing day by day and actually volume of DAM market is placed in RTM market after the DAM bidding is over and volume which is not cleared in DAM segment. DSM volumes is gradually decreasing which reflects that RTM as market instrument as balancing mechanism is getting acceptance by the market players.

On closer look of TAM segment volumes reveals that as we thought before implementation of RTM , Intra day volume has been shifted to RTM market. Detailed data tabulated in TABLE V

TABLE V

MONTH	CONTINGENCY (MU)	FIRM (MU)	TOTAL (MU)	% OF TAM VOLUME	
				CONTINGENCY %	FIRM %
APR'20	31	520	551	6%	94%
MAY'20	92	623	716	13%	87%
JUNE'20	24	152	175	13%	87%
JUL'20	26	65	91	29%	71%
AUG'20	2	121	123	2%	98%
SEP'20	38	541	579	7%	93%
OCT'20	21	989	1010	2%	98%
NOV'20	10	398	408	2%	98%
DEC'20	10	1342	1352	1%	99%

Source : CERC Market Monitoring Report

Finally we have listed Top 5 buyer and seller in RTM in the following TABLE VI, who are actively participating in the market.

TABLE VI

TOP 5 BUYER FROM JUN'20 TO DEC'20	
BUYER	PURCHASED VOLUME MU
J & K	1001
TELANGANA	787
RAJASTHAN	556
ANDHRA PRADESH	517
MAHARASHTRA	378
TOTAL RTM	5704

TOP 5 SELLER FROM JUN'20 TO DEC'20	
BUYER	PURCHASED VOLUME MU
NLC	690
ODISHA	441
J & K	392
KARNATAKA	334
UTTAR PRADESH	158
TOTAL RTM	5704

Source: CERC Market Monitoring Report

With the maturity of the market more and more entity will actively participate in the RTM and our aim to shift last mile system imbalance (using DSM) to energy trade (RTM) will be fulfilled



PTC India Limited was incorporated in 1999 as a Government of India initiative by the Ministry of Power. The major objective of PTC was to introduce power trading in India and encourage investments by facilitating market based transactions.

With an experience of more than 20 years, PTC India has spearheaded the industry introducing products and services for the development of the sector.

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We request the readers to send their valuable feedback and suggest any issue, that we may be able to address in the forthcoming editions of PTChronicle.

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