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IEEFA.org

What Led to Increasing Power Prices at Exchange?

Renewables Along With Energy Storage Can Stabilise the Prices

Executive Summary

Electricity demand in India has peaked and dropped markedly as the country went into and out of COVID-19 lockdowns, exceeding seasonal peaks and declines.

The pandemic hit the world in 2020 and in India, with two months of complete lockdown until the end of May, electricity demand dropped, only to return to pre-pandemic levels as the lockdown eased and economic activities picked up.

In the second wave in April 2021, states announced partial lockdowns and demand declined again. As the economy bounced back quickly, electricity demand has shot up, especially in the past few weeks.

Lockdowns also slowed renewable energy installation. The government target of 175GW by 2022 and 450GW by 2030 requires annual installation of 25-30GW. The pace of installation is lagging with ~7GW of renewable energy capacity added in FY2020/21.

Lockdowns slowed renewable energy installation.

The Indian economy is on the path to recovery and the accompanying rise in electricity demand caused prices on the power exchange to skyrocket in the evening peak hours in August.

What led to such an increase and are these very high prices momentary or likely to continue? What was the cause -- the declining availability of thermal or renewable energy generation or a sudden spike in electricity demand? Can the prices be attributed to increased supply gap due to extreme weather or special occasions such as festivals?

This note tries to evaluate the drivers for such high prices on the power exchange and how, with more deployment of renewable energy along with storage technologies, such price shocks can be prevented. Analysis identifies what changed in the past year but, given that 2020 was a COVID year, comparison is also made to 2019 and 2018. Demand and supply in 2021 is compared not only to 2020 levels but to previous years as the economy witnessed a downturn from August 2019 to January 2020 with a minor recovery in February 2020, before the pandemic hit the economy again.

High Prices at Exchange in August and September 2021

August 2021 witnessed high prices on the power exchange during evening peak hours. Prices at the exchange had stabilised a decade ago, with a short period of high prices in 2018. The few other instances were mostly during the months when wind generation is low or when low domestic coal production during monsoon months affected thermal generation.

Prices at the exchange had stabilised a decade ago.

Analysis of monthly volumes and prices at the largest power exchange in India, Indian Energy Exchange (IEX) reveals that market clearing volume (MCV) decreased by 11% in 2019 due to economic slowdown. After a further hit to the economy by the pandemic in 2020, demand started picking up in the latter part of the year -- volumes on exchange increased by 23% in 2020 compared to low base in the previous year. For 2021, to the end of August the volume increased by 20% over 2020, by 37% compared to 2019 and by 30% over 2018.

With IEX launching various new products on the exchange, liquidity has increased. With increased volumes, the average market clearing prices (MCP) at IEX declined by 21% in 2019 and 16% in 2020 on year-on-year basis. However, to the end of August, the average prices in 2021 have increased by 38% compared to 2020, by 8% compared to 2019 and by 11% over 2018. Clearly, as economic growth revives, electricity demand grows and average prices at exchange increase.

Table 1: Monthly Volume and Prices at IEX

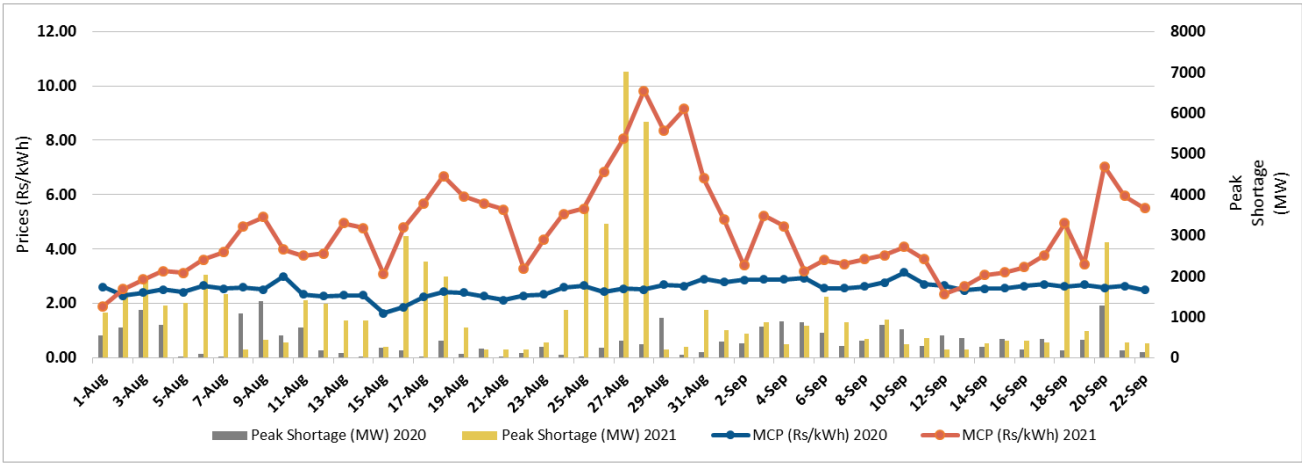
Months	MCV (GWh)				MCP (Rs/kWh)			
	2018	2019	2020	2021	2018	2019	2020	2021
Jan	3389	3287	4815	5584	3.20	3.33	2.86	3.18
Feb	3340	2856	4291	5124	3.23	3.08	2.91	3.39
Mar	3956	3476	3985	6573	4.02	3.12	2.46	4.07
Apr	4058	4073	3692	5710	3.98	3.22	2.42	3.70
May	4970	3776	5580	4364	4.67	3.34	2.57	2.83
Jun	4985	4214	4174	4317	3.73	3.32	2.35	3.06
Jul	4061	4800	4487	4247	3.46	3.38	2.47	2.95
Aug	4026	4679	4484	6660	3.34	3.32	2.43	5.06
Sep	5730	3535	4781		4.69	2.77	2.69	
Oct	6675	3391	5503		5.94	2.71	2.74	
Nov	3411	3403	4860		3.59	2.85	2.73	
Dec	3066	4345	5605		3.30	2.93	2.83	

Source: IEX Market Snapshot.

The volumes traded on the power exchange also have gone up, with August 2021 recording highest volume traded and also highest market clearing price.

Analysis of daily MCP and MCV at IEX and the peak demand shortages (in MW) from 1 August to 22 September 2021 reveals that there is correlation (though not very strong) between the increase in peak demand shortages and rise in daily power prices. The analysis also reveals there are other factors driving high prices at power exchange.

Figure 1: Daily Prices at IEX and Peak Demand Shortage



Source: IEX Market Snapshot & NLDC Daily Reports.

Prices have almost doubled in 2021 compared to 2020. Last year, the minimum price was Rs1.64/kWh, the maximum Rs3.15/kWh and in the period 1 August to 22 September the average was Rs2.54/kWh. This year, the minimum price was Rs1.90/kWh, the maximum Rs9.81/kWh and the average for the corresponding period was Rs4.64/kWh.

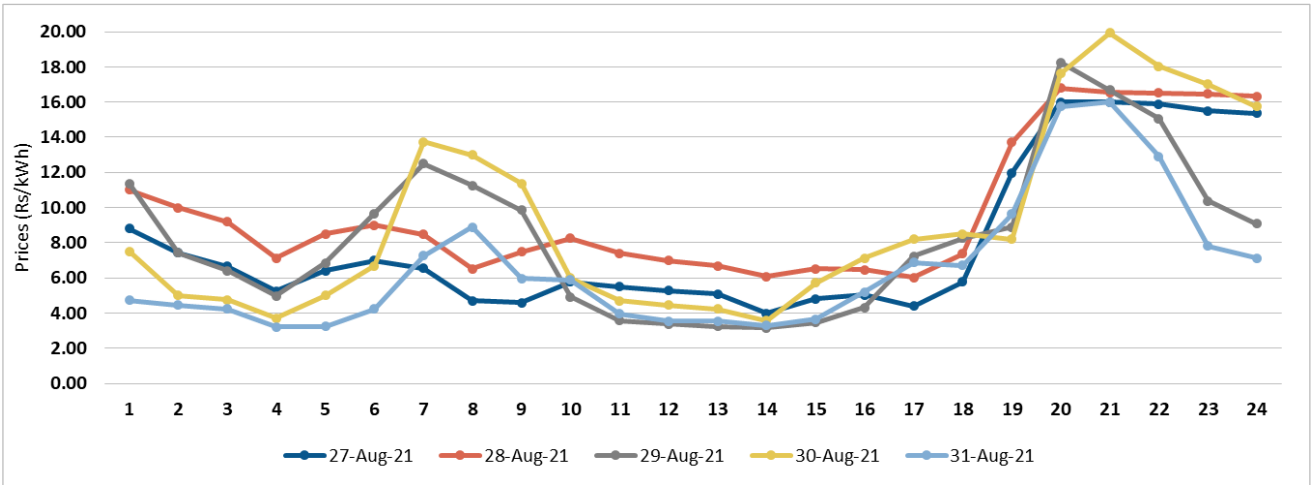
In 2021, the peak demand shortage is much higher than in 2020 leading to higher prices, but even on days when the peak demand shortage was low, the prices at exchange were higher and vice versa. So, there have been exceptions when the shortages were low, but the prices even exceeded the highest expensive generating resource, thereby implying that shortages were not the only driver of higher power prices.

Prices have stabilised again in September.

On a few days in August 2021, hourly prices at IEX even exceeded Rs19/kWh. However, prices have stabilised again in September. The graph below presents hourly prices at IEX in the last week of August as well as the frequency of different price intervals.

Prices stabilised in the first two weeks of September 2021. However, the peak demand shortages increased substantially on 20 September leading to high prices at exchange. Demand shortages reduced substantially in the following two days, yet the prices at exchange still exceeded Rs5.5/kWh.

Figure 2: Hourly Prices at IEX



Source: IEX Market Snapshot.

Table 2: Incidence of Hourly Prices in Different Price Intervals

Price Interval (Rs/kWh)	26-Aug-21	27-Aug-21	28-Aug-21	29-Aug-21	30-Aug-21	31-Aug-21	1-Sep-21	2-Sep-21	3-Sep-21	4-Sep-21	5-Sep-21	6-Sep-21	7-Sep-21	8-Sep-21
0 - 5	13	6		8	7	11	17	21	15	17	21	21	21	21
5 - 10	5	12	16	8	9	10	5	3	7	5	3	3	3	3
10 - 1 5	6	1	3	6	3	1	2		2	2				
15 - 20		5	5	2	5	2								

Price Interval (Rs/kWh)	9-Sep-21	10-Sep-21	11-Sep-21	12-Sep-21	13-Sep-21	14-Sep-21	15-Sep-21	16-Sep-21	17-Sep-21	18-Sep-21	19-Sep-21	20-Sep-21	21-Sep-21	22-Sep-21
0 - 5	19	19	21	24	24	23	23	22	20	17	22	7	13	18
5 - 10	5	5	3			1	1	2	4	7	2	13	7	3
10 - 1 5												4	4	3
15 - 20														

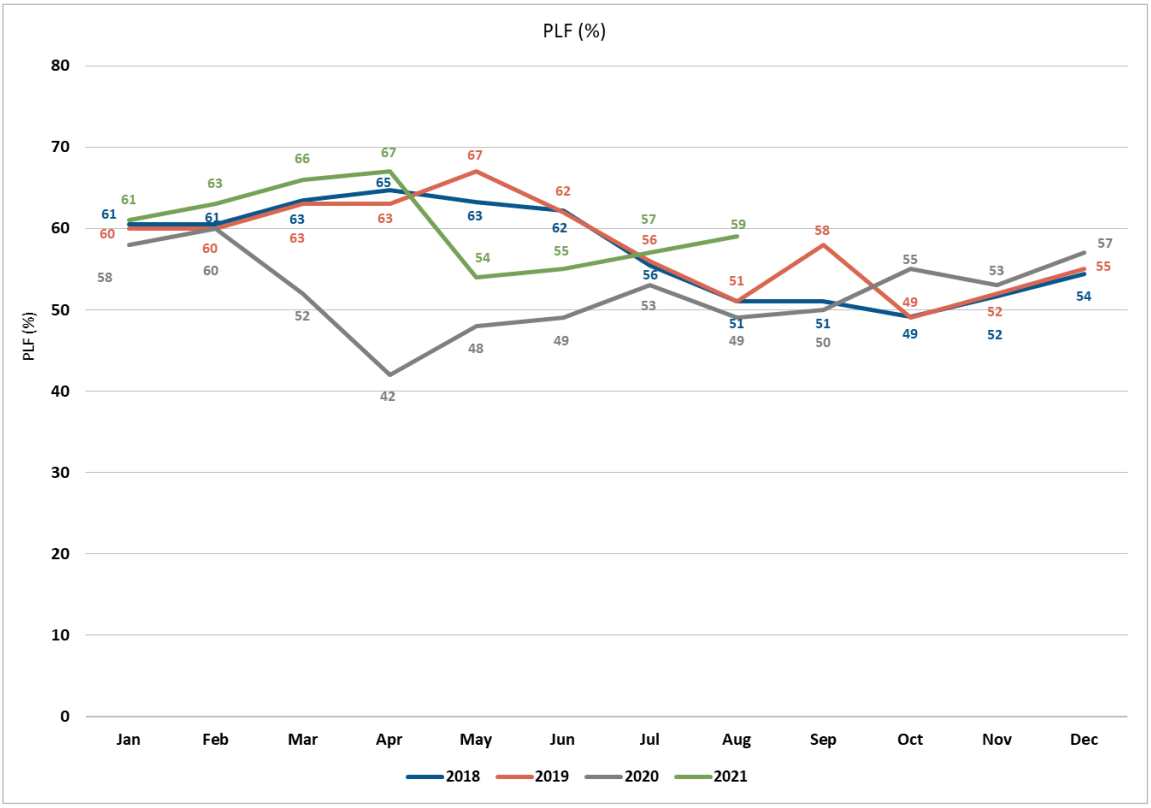
Source: IEX Market Snapshot.

The analysis reveals that prices shot up substantially on those few days, peaking for 4-5 hours, and stabilised again in early September in the range of Rs3-3.5/kWh, with some surge in prices from 20-22 September.

Declining Plant Load Factors of Thermal Power Plants

With decreasing electricity demand and increasing share of renewable energy generation in FY2020/21, plan load factors (PLF) of thermal power plants declined further. The average annual PLF was 57% in 2018 and 58% in 2019, declining to 52% in 2020. With revival in electricity demand, average PLF for 2021 (until August) is 60%.

Figure 3: PLF of Thermal Plants



Source: CEA Executive Summary & National Power Portal.

The PLFs declined in 2020 compared to 2019 and 2018 levels. In 2019, PLFs fell from January to April, increasing by 6% in May and 14% in September compared to 2018. However, in 2020 the fall was 3% in January and in April 33%, before increases beginning in October. In April 2021, PLFs were 60% higher year on year (though in April 2020 lockdown hit demand severely) but only 6% higher than in April 2019.

In August, when the high prices were discovered at exchange, the PLFs of thermal plants was highest at 59% compared to 51% in 2020 and 49% in 2019.

Coal Stock Position Turning Precarious

IEEFA analysis shows coal stocks hit a new record high of 132 million tonnes (Mt) at the end of FY2020/21 and exceeded the average of the previous five years in every month of the financial year, ranging from 86% higher in October to 28% higher in March.[1] Despite lower domestic coal production in 2020, Coal

Coal stocks hit a new record high of 132 million tonnes at the end of FY2020/21.

[1] IEEFA. India Coal Stockpiles at Record High at Close of Financial Year 2020-2021. April 2021.

India Ltd. (CIL) and Singareni Collieries Company Limited (SCCL) increased their pithead stockpiles to a combined record of 103 Mt. India having reduced its reliance on imported coal and replaced it with domestic coal, CIL was standing at about two months' supply.

Table 3: Coal Consumption in Million Tonnes (MT)

Months	Domestic (MT)				Imported (MT)				Total Receipt (MT)				Total Consumption (MT)			
	2018	2019	2020	2021	2018	2019	2020	2021	2018	2019	2020	2021	2018	2019	2020	2021
Jan	50	51	52	51	4.3	5.5	5.6	3.9	54	57	58	55	53	52	54	59
Feb	45	48	51	50	4.0	5.2	6.6	3.4	49	53	58	53	48	47	53	54
Mar	51	54	52	59	4.3	6.4	4.6	3.1	56	61	57	62	56	55	49	65
Apr	49	49	39	55	3.7	6.4	3.4	4.3	53	55	43	59	53	55	38	64
May	50	50	40	55	4.9	6.4	4.8	3.7	55	57	44	59	56	59	45	53
June	48	48	39	51	4.4	5.7	2.7	3.3	52	54	41	54	51	56	45	54
July	46	46	41	50	4.4	5.0	3.9	2.1	51	51	45	52	50	53	51	57
Aug	44	42	42		4.9	5.3	3.3		49	48	45		51	50	48	
Sep	43	37	44		4.8	5.2	4.0		48	43	48		52	47	52	
Oct	49	42	48		6.6	6.0	4.6		56	48	53		56	49	54	
Nov	50	47	49		5.1	6.6	4.3		55	54	54		52	47	49	
Dec	51	51	50		5.5	6.0	4.1		56	57	54		52	51	55	

Source: CEA Fuel Supply Report.

India's total coal consumption declined by 1% in 2019 and 5% in 2020 year-on-year basis. Domestic production declined by 1% and 5% respectively. Imported coal consumption increased by 22% in 2019 but declined by 25% from 70Mt to 53Mt in 2020. Comparing the coal stock position for the first seven months of each year, total coal consumption increased by 21% in 2021 compared to 2020, by 7% over 2019 and by 11% over 2018. This reflects the increase in PLF of thermal power plants in 2021 relative to the previous years.

The increase in domestic coal consumption is similar to that in total consumption, India having reduced its reliance on imports and substituting domestic coal. CIL was sitting on surplus coal stocks to run power plants at the end of FY2020/21, though the stock situation has turned precarious with increasing electricity demand and reduced coal imports.

Analysis of the daily coal stock position reveals a deterioration as more plants reported supplies were critical. On 1 August, 23 plants with installed capacity of 33GW had critical coal supplies. By 9 September, this increased to 92 with installed capacity of 112GW and by 22 September, 102 with installed capacity of 123GW.

Table 4: Coal Stock Position for Coal Linkage Based Thermal Power Stations in the Country

Daily	Requirement for the day	Actual Stock				Critical(*)/Super Critical(**) as per number of days	Critical(*)/Super Critical(**) as per Capacity (MW)
		In '000 Tonnes'			In Days		
		Indigenous	Import	Total			
1-Aug	1791	23343	629	23973	13	23	32712
2-Aug	1781	23187	645	23832	13	21	29012
3-Aug	1774	23053	630	23683	13	25	31252
4-Aug	1774	22731	621	23353	13	24	30922
5-Aug	1787	22434	621	23054	13	22	26322
6-Aug	1797	22147	606	22753	13	28	31272
7-Aug	1819	21811	599	22410	12	30	35012
8-Aug	1842	21344	580	21923	12	32	37762
9-Aug	1870	20790	596	21386	11	33	42202
10-Aug	1895	20281	604	20898	11	35	44947
11-Aug	1914	19828	602	20431	11	37	44717
12-Aug	1933	19240	594	19833	10	43	52077
13-Aug	1957	18751	610	19362	10	46	60617
14-Aug	1987	18308	602	18910	10	48	64377
15-Aug	1994	17933	587	18519	9	48	65122
16-Aug	1984	17376	587	17963	9	52	66627
17-Aug	1991	16775	575	17350	9	55	72337
18-Aug	2003	16314	568	16882	8	57	75097
19-Aug	2006	15878	567	16445	8	58	77417
20-Aug	1999	15535	555	16090	8	61	82557
21-Aug	1984	15087	553	15640	8	63	85127
22-Aug	1958	14794	526	15320	8	66	89867
23-Aug	1954	14484	523	15008	8	68	91407
24-Aug	1933	14189	511	14700	8	68	89037
25-Aug	1919	13816	502	14317	7	69	91617
26-Aug	1912	13494	471	13965	7	69	88887
27-Aug	1907	13222	430	13651	7	70	89897
28-Aug	1911	12974	403	13377	7	69	87937
29-Aug	1910	12804	365	13169	7	73	92417
30-Aug	1913	12612	358	12970	7	74	95527
31-Aug	1909	12423	334	12757	7	78	100327
1-Sep	1892	12232	314	12546	7	79	98467
2-Sep	1890	12082	278	12359	7	83	101097
3-Sep	1898	11949	273	12221	6	85	106237
4-Sep	1909	11542	238	11781	6	86	108907
5-Sep	1909	11506	233	11740	6	86	109327
6-Sep	1913	11384	195	11578	6	87	110167
7-Sep	1918	11155	182	11337	6	89	110877
8-Sep	1918	11076	160	11236	6	91	111347
9-Sep	1913	10989	146	11135	6	92	112297
10-Sep	1909	10950	139	11089	6	91	109297
11-Sep	1898	11020	128	11148	6	91	109057
12-Sep	1882	11143	122	11265	6	91	109827
13-Sep	1856	11165	116	11281	6	89	105127
14-Sep	1834	11108	110	11218	6	90	104727
15-Sep	1825	11063	104	11167	6	90	103797
16-Sep	1826	10865	97	10963	6	88	102957
17-Sep	1825	10599	129	10728	6	88	104627
18-Sep	1828	10205	137	10342	6	89	109117
19-Sep	1847	9870	133	10003	5	95	114467
20-Sep	1873	9453	134	9586	5	100	119087
21-Sep	1899	9159	137	9296	5	99	120987
22-Sep	1891	8883	117	9000	5	102	122847

Source: CEA Daily Coal Stock Reports, National Power Portal.

Most plants had coal stockpiles for 1 to 5 days -- the requirement for thermal power plants is to maintain coal supplies for 21 days or at least 15. In FY2020/21, thermal power plants reduced coal stocks anticipating neither shortages or difficulties with rail shipments given the absence of passenger traffic. Subsequently, electricity demand and passenger traffic alike have increased.

Moreover, the coal producers have to contend with the annual monsoons in August and September, when mines get flooded, reducing coal supplies to thermal power plants.

Adding to the woes of thermal power plants, daily coal stock position data reveal a reduction in both indigenous and imported supplies. CIL had coal stocks but supply was regulated on account of outstanding dues or supplies were to the tune of payment made. Further, poor road conditions added to delivery issues. This indicates that in most cases, the issue of supply was at the thermal power producer end than the issue of coal stock shortage at CIL end.

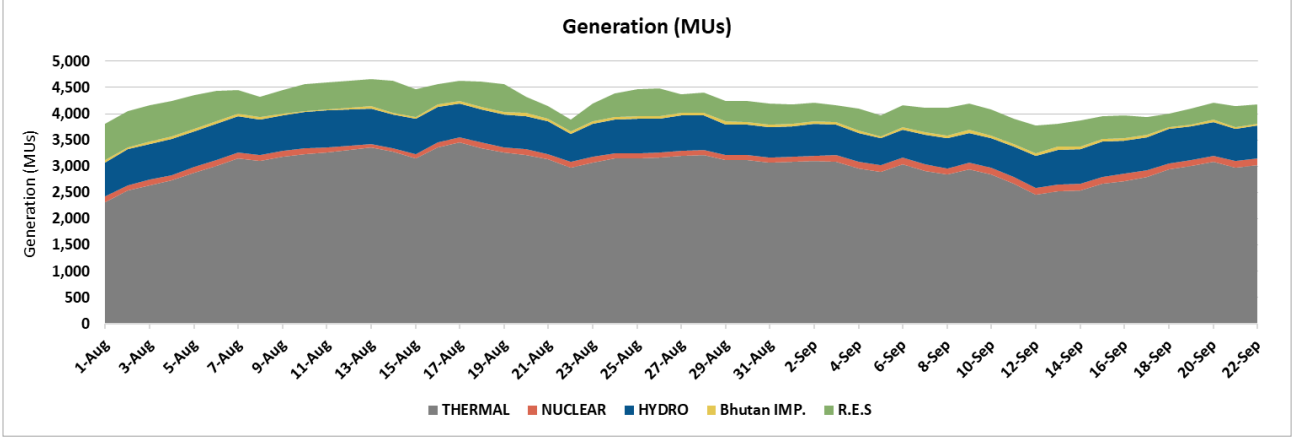
Daily coal stock position data reveal a reduction in both indigenous and imported supplies.

The coal stock position had not changed since mid-August, and prices on power exchange softened in early September. The situation on the coal stock piles worsened in the third week of September, leading to high prices at power exchange on 20-22 September.

Falling Renewable Energy Generation

Analysis of daily generation data reveals that thermal generation remained constant during 1 August to 22 September. There was a decline in hydro and renewable energy generation on days of high electricity prices at power exchange.

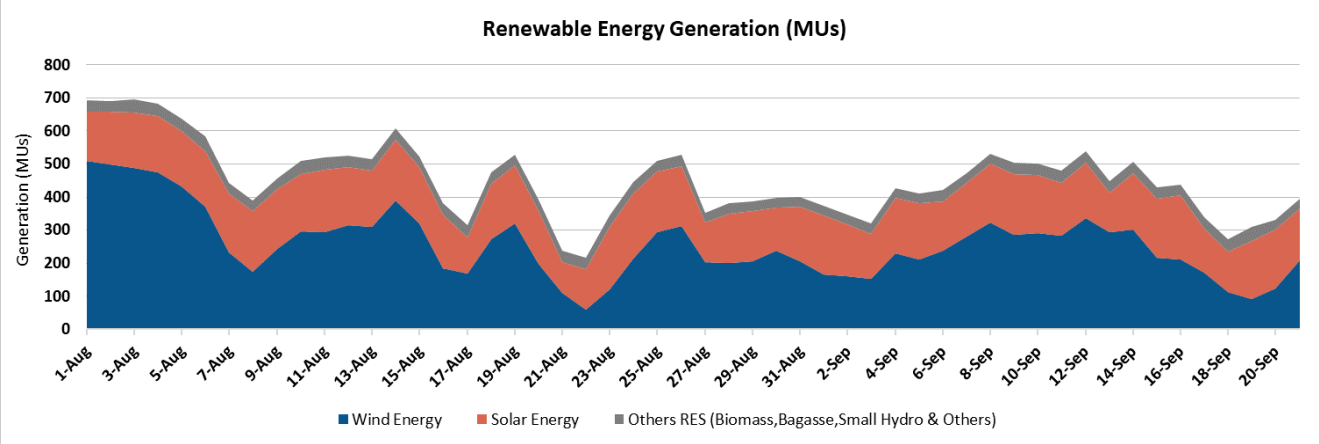
Figure 4: Daily Energy Generation by Different Sources



Source: CEA Daily Generation Reports.

Within renewable energy generation, the decline in availability of wind power generation led to high prices at power exchange. About 74% of total wind power is generated in June- September[2] but lack of wind led to a decline in generation in August and the third week of September.

Figure 5: Daily Renewable Energy Generation by Different Sources



Source: CEA Daily Generation Reports.

Increasing Coal Prices

The increase in prices at power exchange in August grabbed the attention of policy makers. Power Minister R.K. Singh and the power secretary intervened and suggested reducing the benchmark of 14 days of coal stocks to 10 days for identifying and diverting coal to plants with extremely depleted stocks.[3]

Coal prices are inflationary and have been rising in the past few months.

Further, the government asked plant with captive mines to ensure maximum use of these mines by the power plants. Plants with imported coal PPAs were asked to redirect coal to generators with low stocks.

Imported coal prices are inflationary and have been rising in the past few months. The prices stabilised in the beginning of 2020, then suppressed demand due to the pandemic pushed prices down. Free on Board (FOB) prices for thermal coal with a calorific value (CV) of 6000kcal/kg hovered at about US$100/tonne(t) in early 2019 then fell to US$65/t a year later. Through 2020, thermal coal traded closer to US$50/t, a 50% decline, only to rebound last November to the levels of the previous year.[4]

[2] Mint. India's wind power generation down 40% during peak season. October 2020.
[3] PIB. MOP. Shri RK Singh takes review of thermal power plants. September 2021.
[4] IEA. Coal 2020. Analysis and Forecast to 2025.

Indonesian coal with a calorific value of 4200kcal/kg was hovering around US$36/t in the beginning of 2020, fell to US$22.5/t in September 2020, to rebound in November to US$29/t.

In 2021, international coal prices are on a rising trajectory. Resurgent demand after the pandemic -- especially in emerging Asian markets such as China and India, but also in Japan, South Korea, Europe and the US -- has led to rising prices. On the supply side, restriction of imports from Australia to China and smaller disruptions in exports from major producers Indonesia, South Africa and Russia, also has led to higher prices.

Figure 6: Coal Price (US$/t)

Source: Trading Economics.

The coal market continued its upward trend in September 2021, with futures reaching $181 per metric ton for the first time on record, boosted by soaring demand for electricity and power, particularly from China and India, amid tight supplies and strong prospects for winter demand.

With such high coal prices in the international market, increasing reliance on coal imports will increase the thermal power prices in India, leading to higher prices for the ultimate consumers.

Coal India is also planning to raise domestic coal prices by 10-11% to tide over cost push, wage revision. A 10% price hike would result in a 20-30 paisa/kWh jump in power price.[5] In the coming months, generation from plants using domestic coal supplies will also undergo price revision, thereby making it expensive.

Renewable Energy Generation Along With Battery Storage Will Soften the Prices

Analysis reveals that coal availability and peak demand shortages were not the main drivers of high prices at power exchange in August and September. Peak demand shortages have increased in 2021, thereby requiring despatch of higher cost

[5] The Economic Times. CIL might hike coal prices by 10-11% to tide over cost push, wage revision. September 2021

generation source to meet the demand. However, there were days when peak demand shortage was higher and the prices at exchange were low.

Thermal PLF was also high in August relative to the previous month and previous years. Coal stock turned critical for more plants but overall thermal generation was constant across all days in August. IEEFA notes that the issue was really not a coal shortage or even a production problem, primarily, but a failure to plan in time for a sharp increase in demand.

Further, imports with current spot market prices at an all-time would increase the cost of generation for the power plants using such coal. The likely revision of domestic coal prices could result in price increases of 10-11%. Given that coal prices are inflationary and factoring in high volatility, increasing reliance on coal will further push electricity prices up.

The high prices to some extent can be attributed to decline in renewable energy generation, in particular wind and hydro. Increasing renewable energy generation along with other flexible sources can address the issue of peak shortages as the load profile is also changing in India, with high demand occurring during the day.[6]

IEEFA notes that the challenge of India's growing daily peak demand does not require investment in excess baseload thermal capacity. Instead, the electricity system needs flexible and dynamic generation solutions in the form of battery storage, pumped hydro storage, peaking gas-fired capacity and flexible operation of its existing coal fleet.

As per recent analysis by Ember,[7] 27GW of proposed coal power plants are not needed to meet India's growing electricity demand and that these power plants are unnecessary and expensive and threaten renewables goals. They will require an estimated US$33bn of investment and will lock consumers into expensive contracts. In fact, substituting 27GW of coal with battery storage will save the Indian power system US$6bn a year in terms of reduced power purchase cost.

The electricity system needs flexible and dynamic generation solutions.

Renewable energy is deflationary. The IEA predicts the levelised cost of energy (LCOE) of solar will reduce dramatically, down to US$15/MWh (~Rs1.1/kWh) by 2040 from US$35/MWh (~Rs2.6/kWh) in 2019.[8] Further, the cost of battery storage globally also has dropped drastically, a stand-alone lithium-ion battery set-up falling from US$1,100/kWh in 2011 to US$137/kWh in 2020 – with a further projection to

[6] ETEnergy World. Understanding India's latest record in peak power demand. July 2021.
[7] Ember. India's Zombie Threat. September 2021.
[8] IEEFA. Solar is the new ruler of the Indian electricity market. November 2020.

drop by another 55% to US$58/kWh by 2030.[9]

The increase in future demand can be met through renewable energy along with flexible generation sources plus battery storage, the prices of which are higher for now and likely to go down in future. Government should accelerate deployment of such sources to help meet peak demand and also balance the grid at a lower cost. Given the downward cost trajectory, they will be cost effective and militate very high prices at power exchange during peak hours.

[9] BNEF. Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh. December 2020.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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