National Power Summit
Large, Medium Capacity Renewable Generation and Integration Challenges
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Solar Capacity Additions- Background and Key Trends

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- Solar Penetration across the country has seen multi-fold increase in last two years – from **3 GW** in **FY 2015** to **12 GW** in **FY 2017**. **17.79 GW** as on **Sep 17**.

- Solar power prices have dropped by over 60% during the corresponding period.

- Lowest price discovered based on recent bids –
  - **Solar** – **INR 2.44/KWh** (Bhadla Phase- III – May 17 park model), INR 3.47/KWh (TN, Non-solar park)
  - **Wind** – **INR 2.64/KWh** (SECI tender Oct 17)

- International trend in solar prices*

	Price Discovered	Capacity Alloted (MW)	Year of Discovery
UAE	2.42 cents/unit - (INR 1.57/unit)	350	September-16
Mexico	2.7 cents/unit- (INR 1.75/unit)	300	February-17
Chile	2.91 cents/ unit- (INR1.9/unit)	120	August-16

*Source : KPMG Solar beats Coal Cost Publication

Some key implications – Higher Renewable Penetration, Discom perspective (1 of 3)

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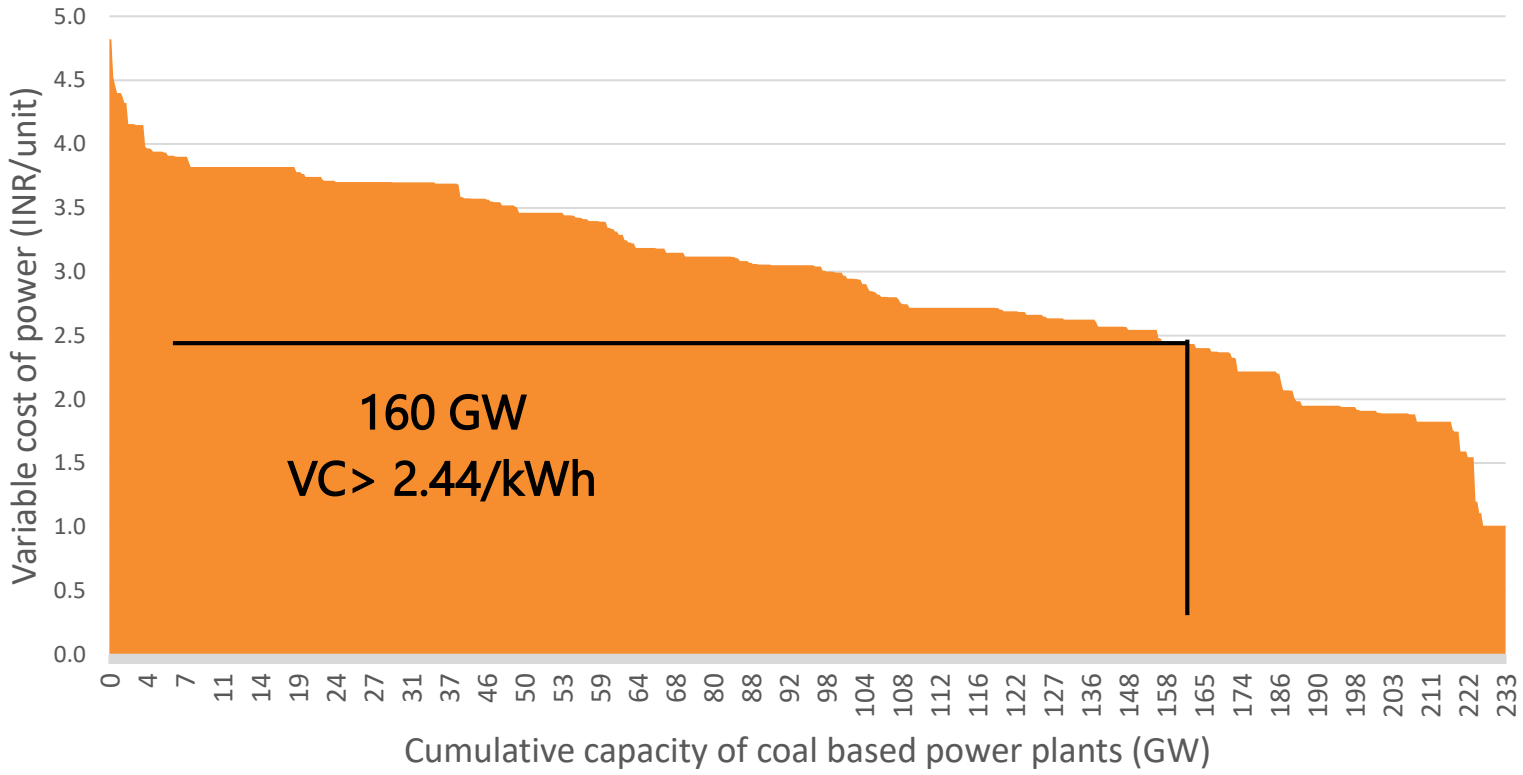
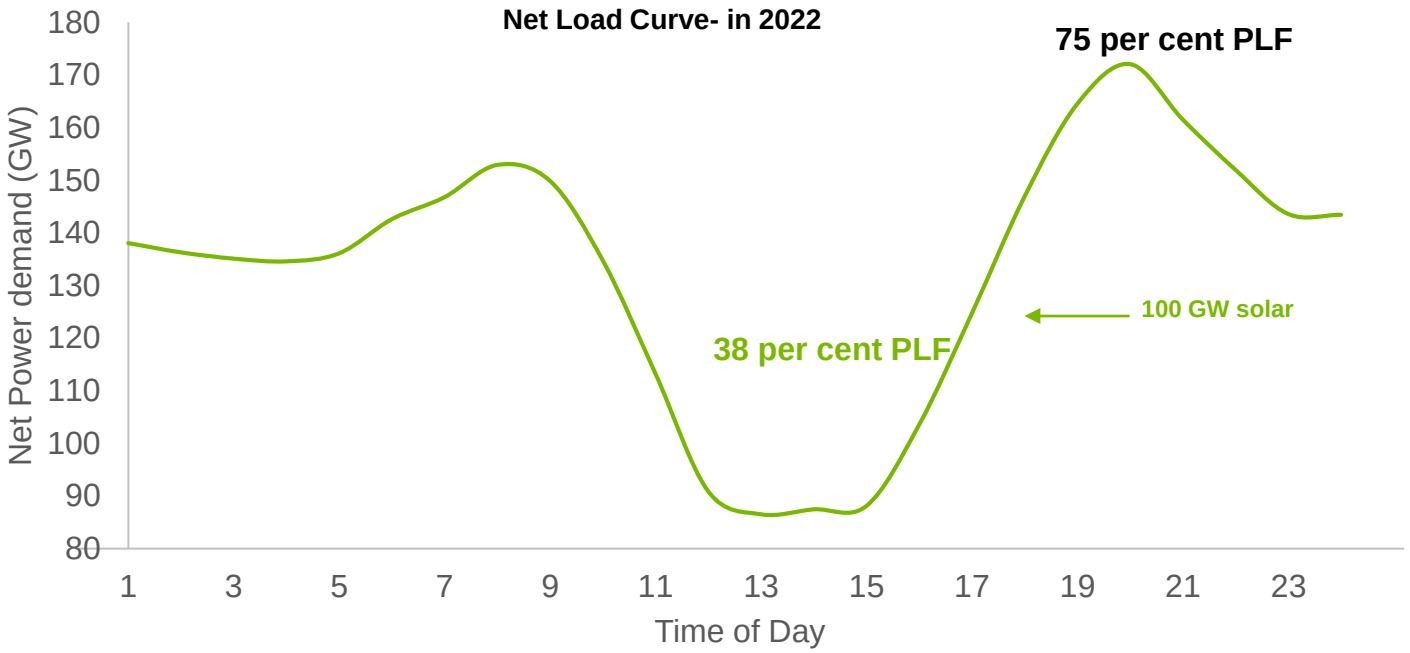


- According to estimates* in **FY 2022**, **160 GW** of coal based capacity is expected to have variable cost in excess of INR **2.44/KWh.**

- This implies large portion of coal based dispatch can be replaced economically by solar

***Source : KPMG Solar beats Coal Cost Publication**

Some key implications – Higher Renewable Penetration, Discom perspective (2 of 3)



- In a scenario of 100 GW solar, thermal PLFs are expected to dip to **49%** in **FY 2022** from the current level of **60%** in **FY 2017**

- Thermal plant **PLF** expected to drop to **38%** during afternoon time slot**..**

***Source : KPMG Solar beats Coal Cost Publication**

Some key implications – Higher Renewable Penetration, Discom perspective (3 of 3)

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- India's coal consumption is expected to increase at much lower rates, - peak coal consumption expected in **2025-27**. @ **630- 660 MTPA**

- A maximum ramp-up capacity of **22 GW/Hr (9% of installed capacity)** as against **10GW/hr** (**5.3% of installed capacity**) presently

- Estimated average increase of **INR 0.38/KWh** of fixed cost due to drop in **PLF for 70% to 60%.**

Though it is highly viable from a commercial perspective for a high solar penetration, we need to be prepared to address the technical grid challenges in grid operation

Other key Impacts – Fixed Cost Recovery by Discoms

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- In TS based on 2018-19 filings it may be observed that fixed costs contribute to about 57% of total costs.
- However revenue recovered is largely variable in nature to the extent of 85%

Description	Volume
Total Power Purchase Cost	100%
Fixed Cost (%)	57%
Variable Cost (%)	43%

Description	Volume
Total Revenue	100%
Revenue through Demand Charges(%)	15%
Revenue through Energy Charges (%)	85%

- Higher renewable penetration will lead to decreased recovery of fixed costs.

The above scenario needs to be corrected to tariff re-balancing and other measures such as additional surcharge for commercial viability of discoms

Grid Integration of Renewables – Potential Solutions (1 of 2)

Balancing Areas & Aggregation	Bundling of Wind generators and solar over large geographic area leads to reduced variability
Forecasting	Advancements in **forecasting techniques** leads to **higher accuracy** in predicting the generation from wind and solar
Power Exchange Market	Market design such as **short dispatch interval**, **larger balancing areas**, ancillary services
Demand Response	DR provides an additional source of power to respond to the variability of the renewables

Grid Integration of Renewables – Potential Solutions (2 of 2)

Based on the capability of a storage technology to discharge and generate power

Improving flexibility of coal based generation through
- Lowering of technical minimum
- Faster ramping-up and ramping down

Key Conclusions

- Grid parity can economically justify solar capacity adoption, however interventions are required on technical front
  - Firstly – Coal plants need to be more flexible to accommodate higher ramp rates and technical minimum needs to be lowered
  - Discoms need to **re-align tariff structure** to better reflect the cost of grid management
- Increase in balancing area for addressing grid balancing issues
- Evaluation of storage solutions, and take appropriate investment decisions

Case Study: Distributed Solar Generation in Telangana Reduces Variability in Generation

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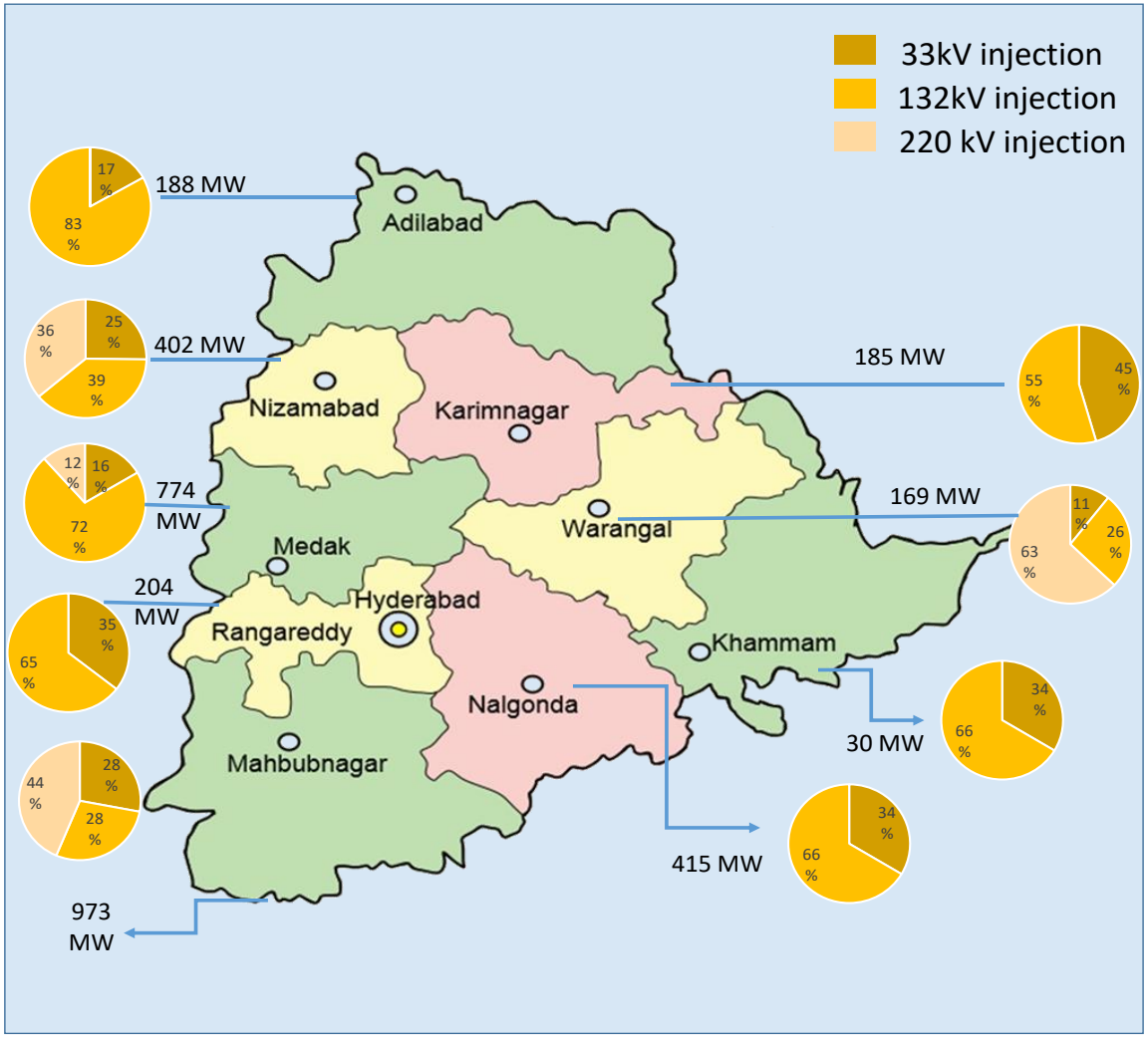
❖ The spread of solar capacities across the districts in Telangana would reduce variability in generation.



- **At the inception of the State of Telangana in June 2014, the installed capacity of solar was a mere 31.7MW.**
- **The current installed capacity of solar stands at 3,200MW (as on 31st Jan 18)**

Key Advantages of the distributed generation model

- Energy saved on an annual basis is around **122 MU (Reduction in transmission loss by 1.31%)**
- Estimated Annual saving of **INR 49 crores**

Avoidance of transmission investments

- Estimated additional investments to the tune of **533 crores** at EHT level avoided

In addition to the tangible financial benefits, the distributed model of solar generation is expected to bring in socio-economic benefits due its spread across remote parts of the state