Karnataka power system model with high RE share in 2030

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Objective

Production cost analysis for Karnataka state for FY 2029-30

- Analyse energy mix for Karnataka under different scenarios
- Explore opportunities for high RE and its impact on the state power system
- Analyse production cost variation with different scenarios

Modelling details

Conventional generation

> Unit wise capacity, Heat rate, fuel price
> Fixed and variable cost
> CGS share
> Spinning reserves
> Storage capacity
> Minimum generation level, ramp up and ramp down rates, minimum up-time and down-time hours
> Start up cost, availability (exogenous)
> Hydro operational characteristics (monthly minimum, average, and maximum)

Renewable generation

>Hourly solar and wind profiles
>Lumped solar and wind plant

Karnataka model (GridPath)

Demand

> Hourly demand profile

Transmission

> Inter-state transmission line
> Thermal rating capacity

Data Source: CEA, POSOCO, KPCL, KERC, SLDC and SRLDC reports

Key assumptions

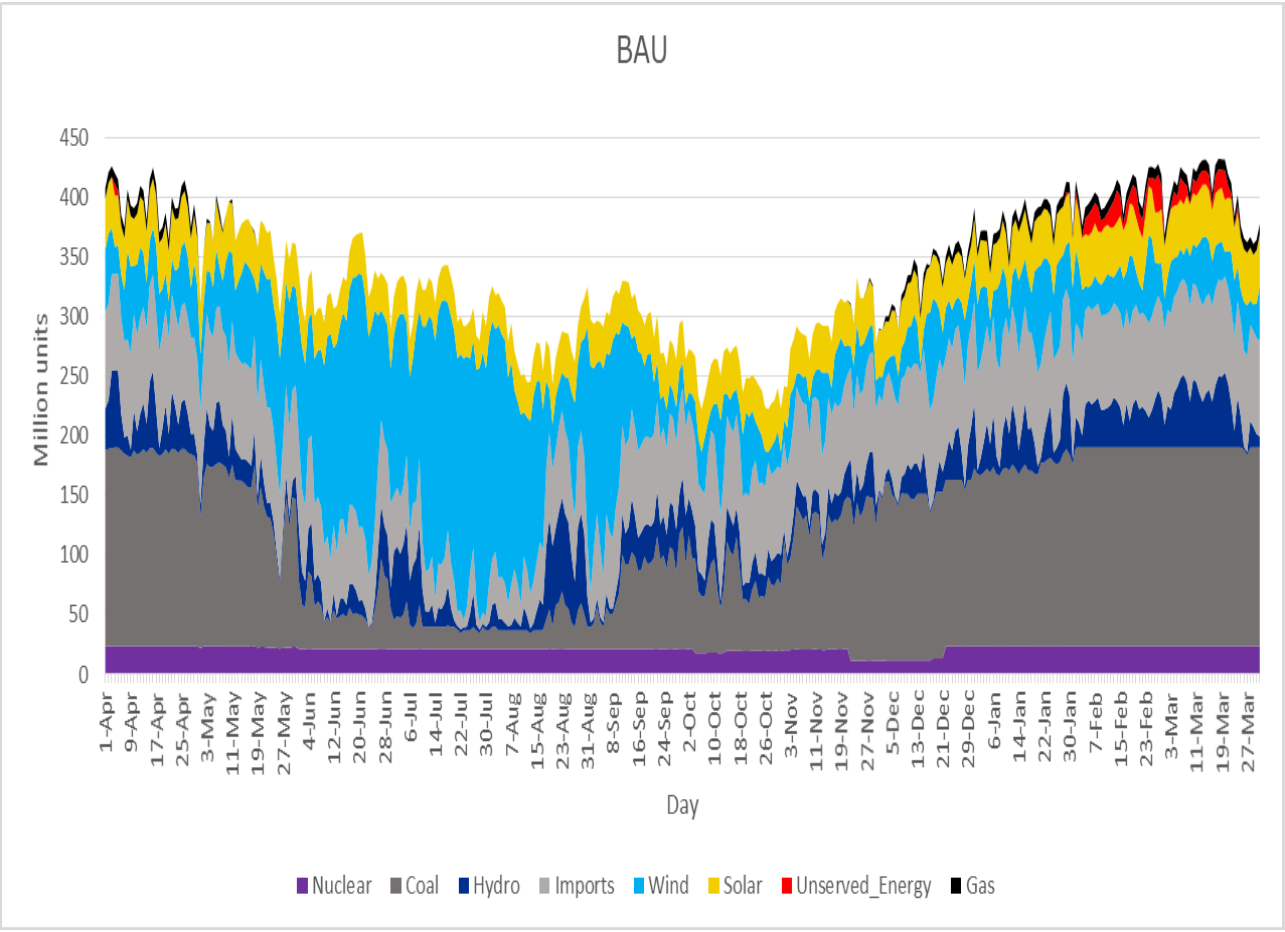
- Solar profiles are generated using CSTEP's in-House CSTEM PV tool.
- Wind profiles are generated using NREL's System Advisory Model (SAM).
- Nuclear plants are modelled as always-committed generators with a minimum generation level of 90%.
- Only Karnataka's share of CGS plants are modelled.
- RPC's planned maintenance for year 2020-21 is replicated for year 2029-30.
- The demand profile for year 2019-20 from SLDC is used and calibrated to match CEA's energy and peak demand forecast for year 2020-21.
- The demand profile for year 2029-30 is extrapolated using the calibrated profile for year 2020-21 and yearly energy demand growth as per 19th EPS.

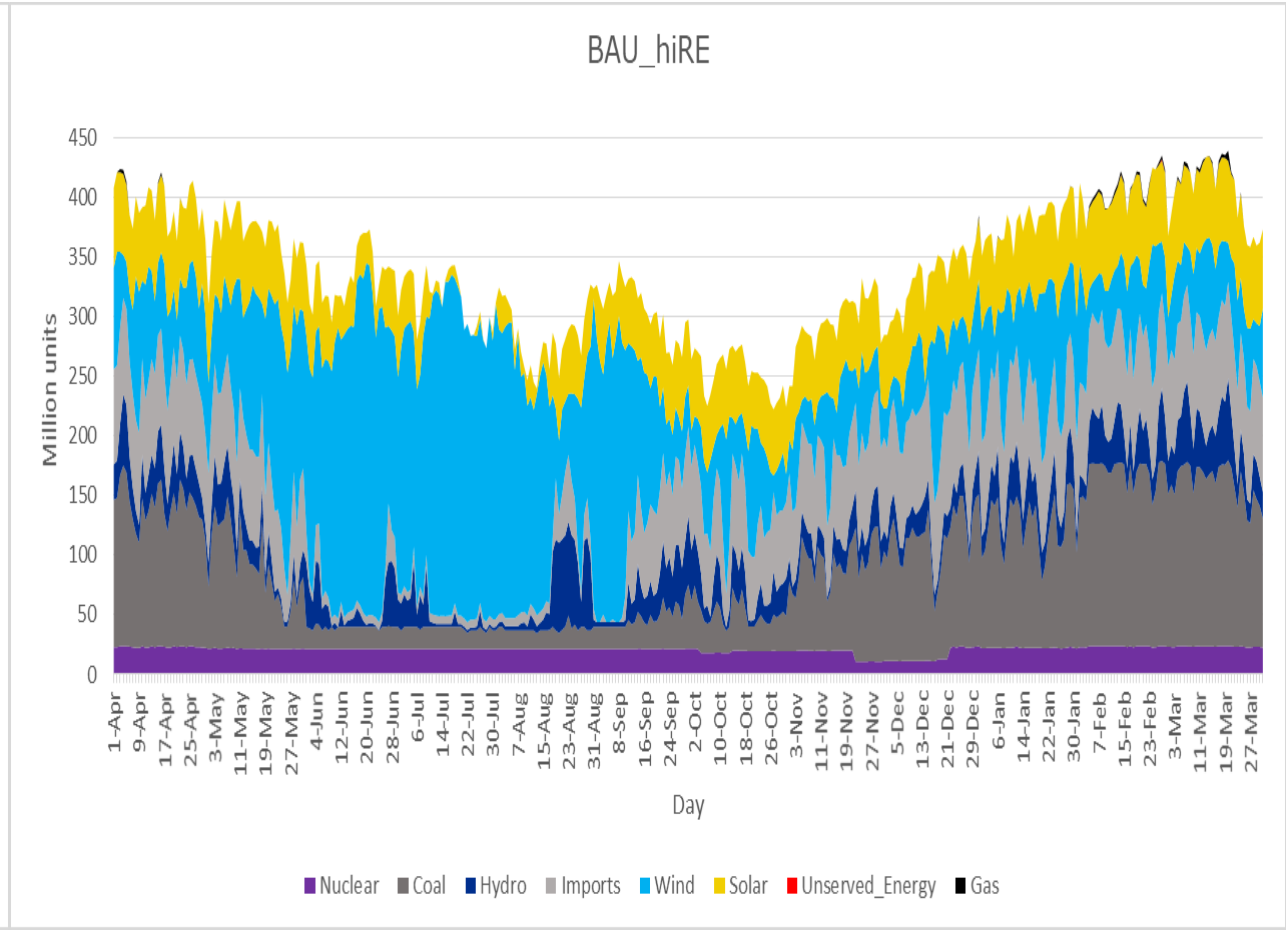
Scenarios

Scenario/ Installed capacity (MW)	BAU	BAU_halfRTPS	BAU_hiRE	BAU_hiRE_half RTPS	BAU_hisol	BAU_hisol_half RTPS
State thermal	6,100	**5,260**	6,100	**5,260**	6,100	**5,260**
CGS share	5,934	5,934	5,934	5,934	5,934	5,934
Gas	370	370	370	370	370	370
Hydro	3,782	3,782	3,782	3,782	3,782	3,782
Solar	9,386	9,386	**14,650**	**14,650**	**14,650**	**14,650**
Wind	9,820	9,820	**15,940**	**15,940**	9,820	9,820
PHES	3,200	3,200	3,200	3,200	3,200	3,200
RTPS retirement	No	**4 x 210**	No	**4 x 210**	No	**4 x 210**

For hiRE and hisol scenarios, solar and wind projections for year 2029-30 have been considered to meet the national target of 450 GW in proportion with the target of 175 GW for year 2021-22

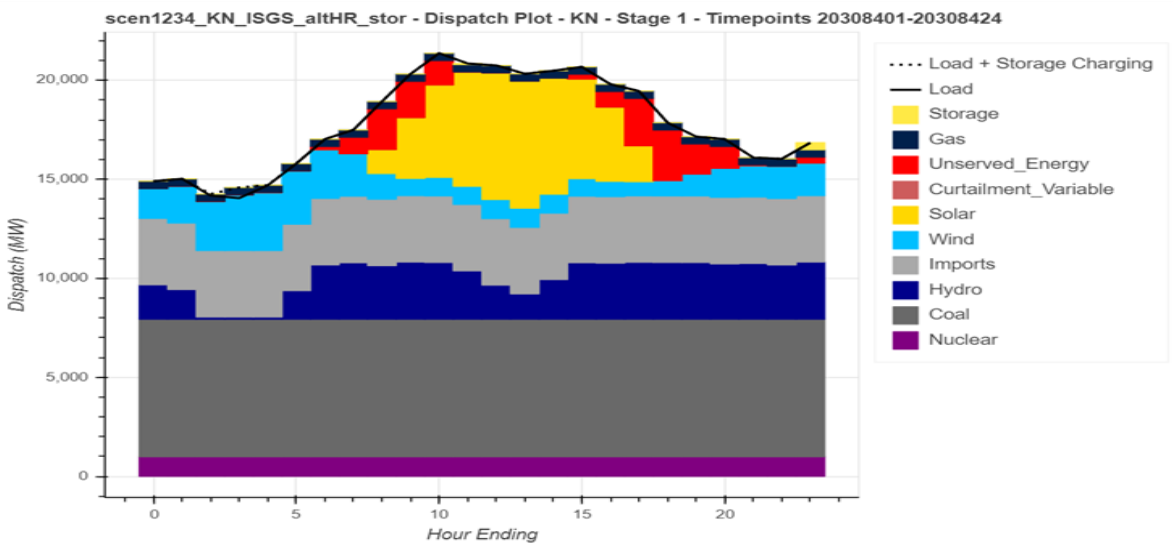
Annual generation dispatch stack



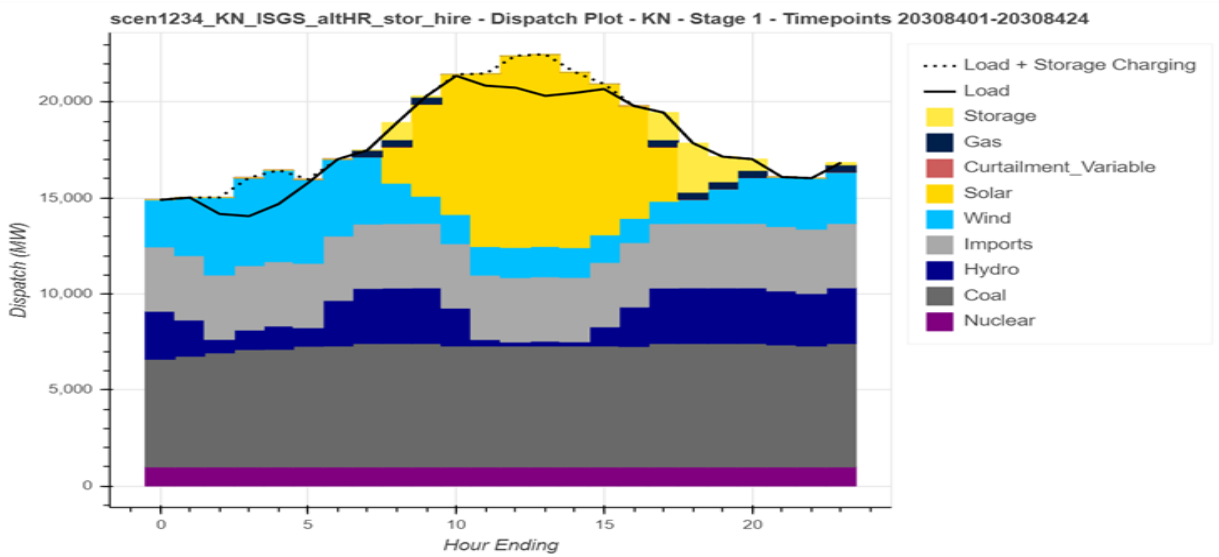


- Unserved energy reduction in hiRE scenario
- Reduction in gas dispatch

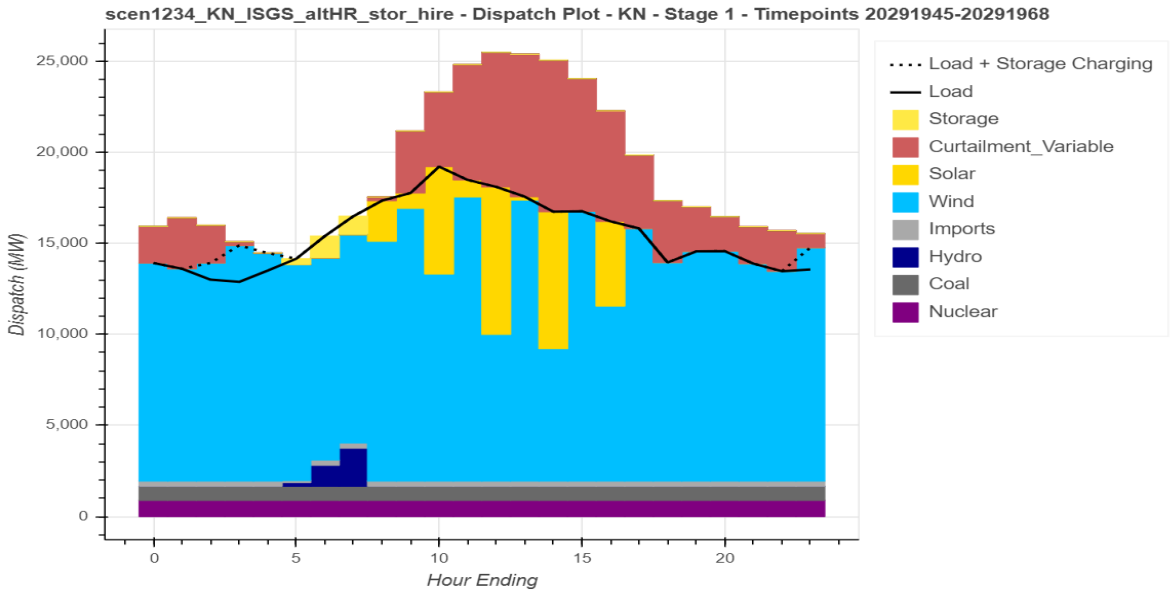
Interesting dispatch plots



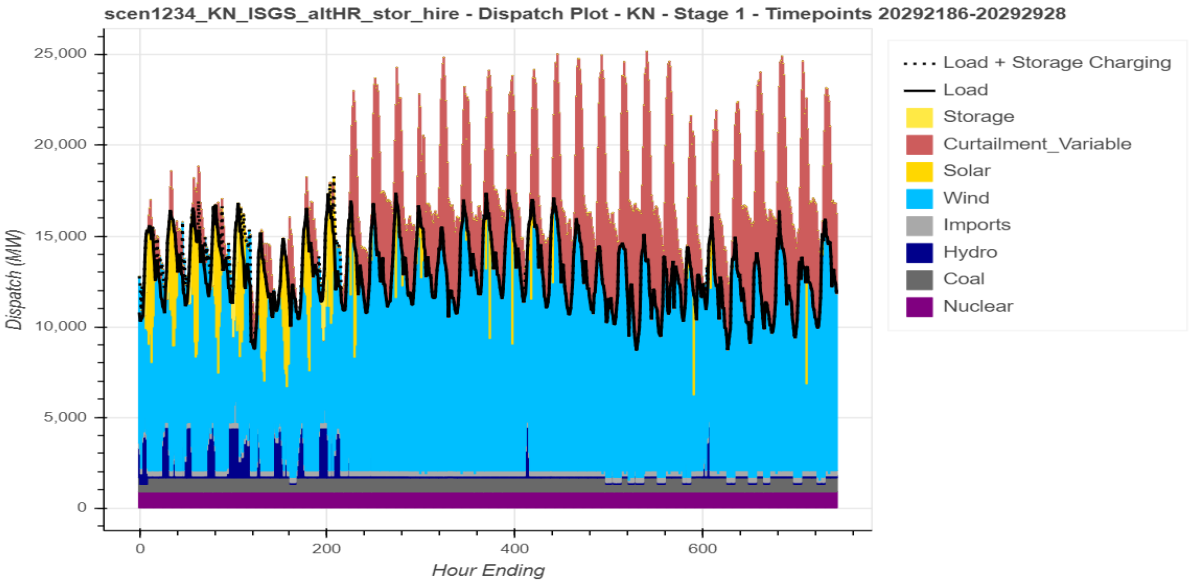
BAU Peak demand



hiRE Peak demand

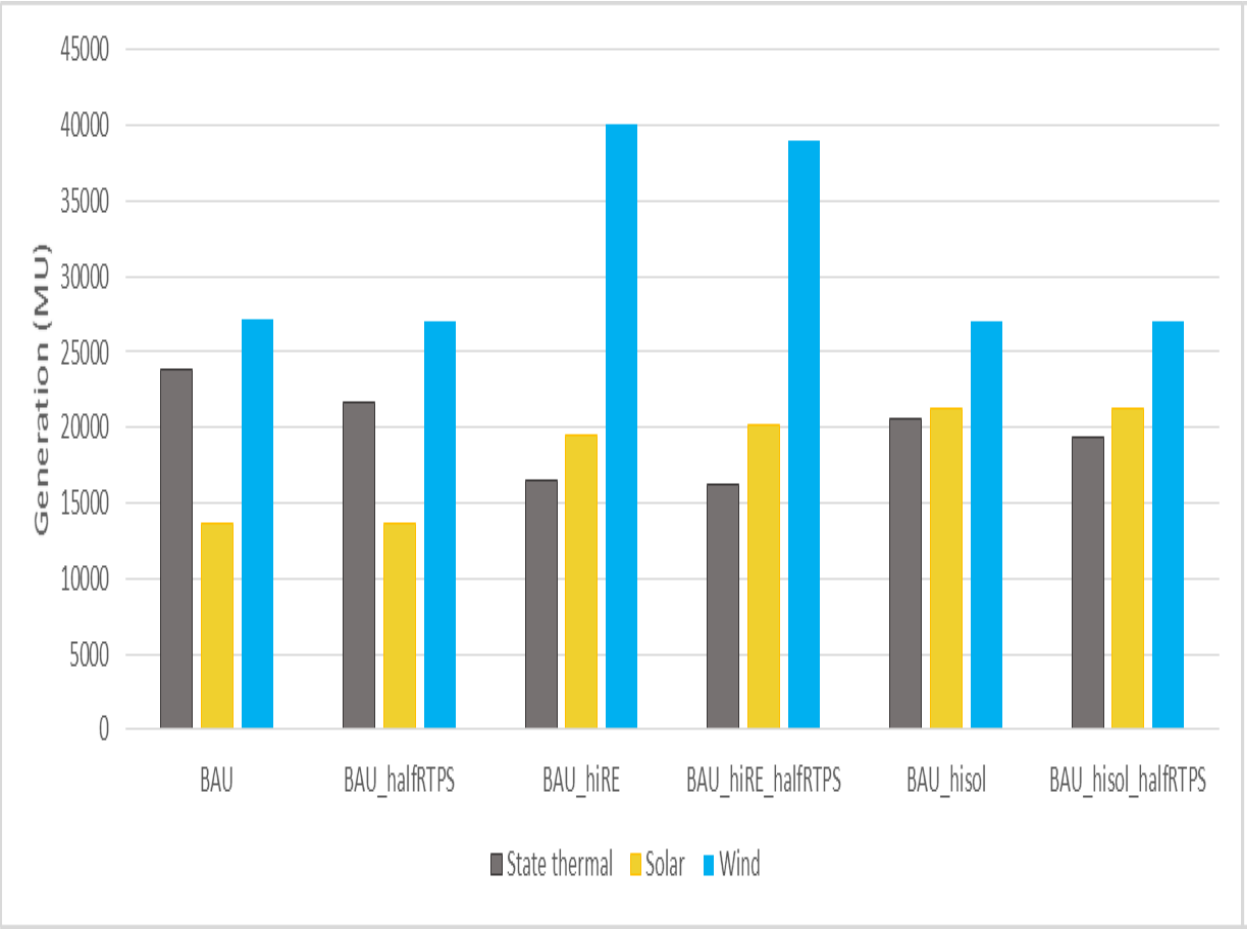


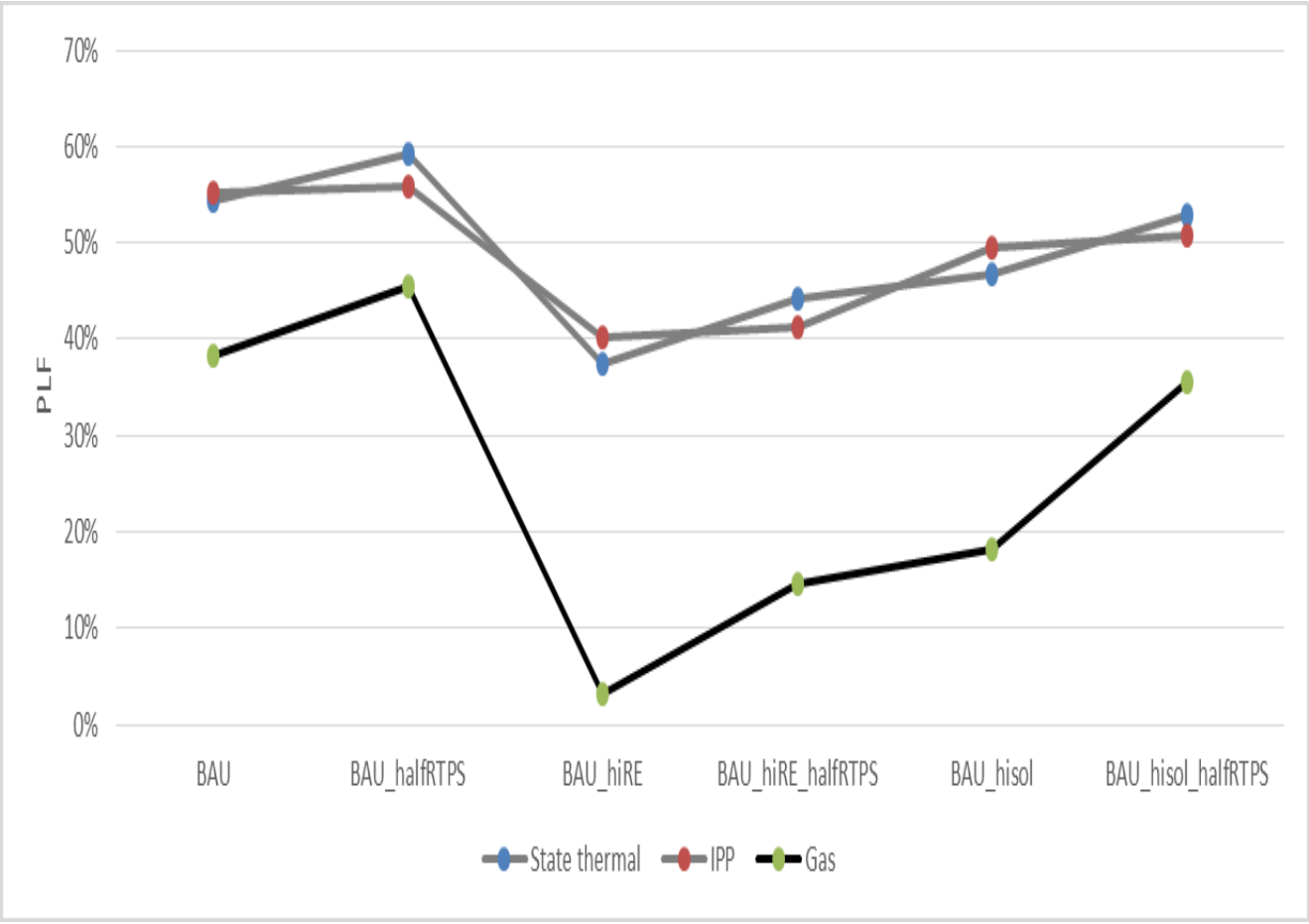
hiRE Peak of Solar+Wind



hiRE July month

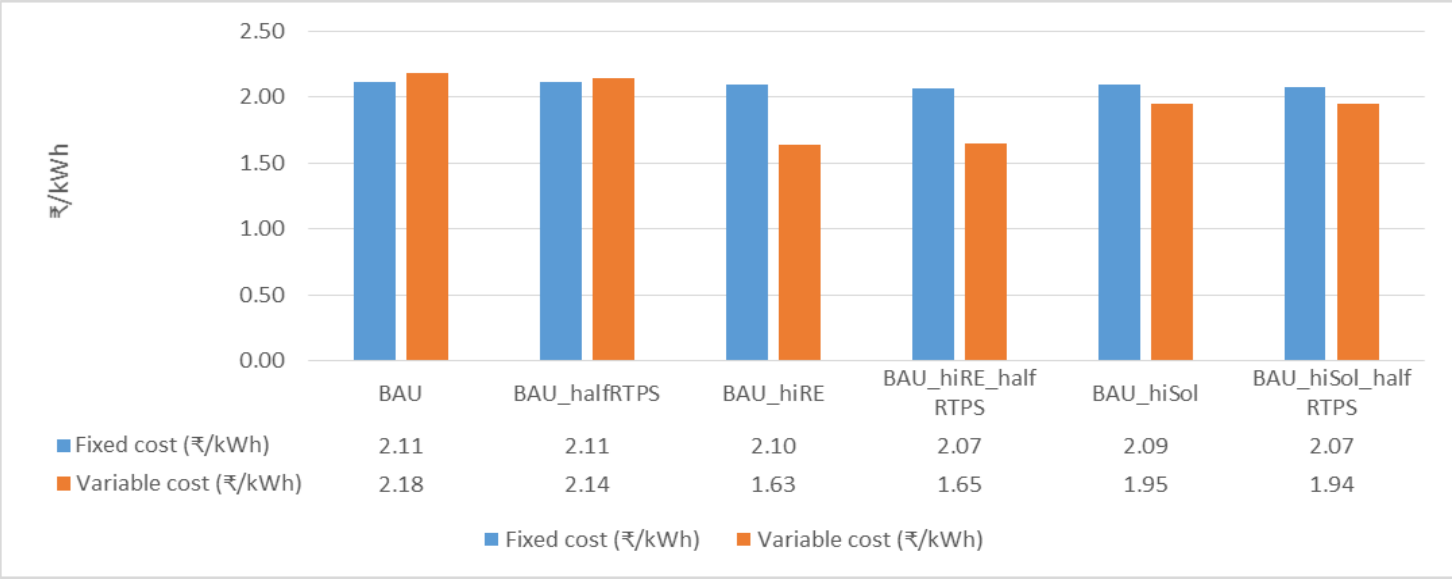
Generation and PLF





Scenario observations

Scenarios/Particulars	BAU	BAU_halfRTPS	BAU_hiRE	BAU_hiRE_halfRTPS	BAU_hisol	BAU_hisol_halfRTPS
VRE curtailment (MU)	25 (0.06%)	27 (0.07%)	5,852 (9%)	6,141 (9.4%)	179 (0.37%)	175 (0.36%)
Hydro curtailment (MU)	0	0	516 (5.2%)	498 (5.1%)	0	0
Unserved energy (MU)	675 (0.6%)	2,421 (1.93%)	2	15	6	469 (0.38%)
RE energy share in total generation	33%	33%	48%	47%	39%	39%



Key insights

- In the absence of high solar and wind (BAU), maximum unserved energy is observed, especially with the retirement of the four RTPS units.
- In the high RE scenario, more solar and wind curtailment is observed.
- In the hiRE scenario, significant hydro curtailment is observed.
- Instead of opting for curtailment, mechanism for inter-state sale of power can be looked in to for the hiRE scenario.
- The hisol scenario is the most feasible option with an RE share of 39% in the energy mix.

Thank You