Karnataka power system model with high RE share in 2030

STEP - STEP

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Objective

Analyse energy mix for Karnataka under different scenarios

Production cost analysis for Karnataka state for FY 2029-30

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) 	Renewable generation >Hourly solar and wind profiles >Lumped solar and wind plant ates, rnataka nodel ridPath)			
> Hydro operational characteristics (monthly minimum, average, and maximum) Mode (GridPateriotics)				
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



···· Load + Storage Charging — Load 20,000 Storage Gas Curtailment_Variable Solar 15,000 Wind Dispatch (MM) Imports Hydro 10,000 Coal Nuclear 5,000 0 10 15 20 Hour Ending

hiRE Peak demand





scen1234_KN_ISGS_altHR_stor_hire - Dispatch Plot - KN - Stage 1 - Timepoints 20292186-20292928



hiRE July month

Generation and PLF



Scenario observations

Scenarios/Particulars	BAU	BAU_halfRT PS	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