Karnataka power system model with high RE share in 2030

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Objective

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

Production cost analysis for Karnataka state for FY 2029-30
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

**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.
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

- BAU
- BAU_hiRTPS
- BAU_hIRE
- BAU_hIRE_haRTPS
- BAU_hisol
- BAU_hisol_hiRTPS

**State thermal**

**Solar**

**Wind**

**PLF**

- BAU
- BAU_hiRTPS
- BAU_hIRE
- BAU_hIRE_haRTPS
- BAU_hisol
- BAU_hisol_hiRTPS

**State thermal**

**IPP**

**Gas**
## Scenario observations

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

![Cost Comparison Graph](https://via.placeholder.com/150)

- Fixed cost (₹/kWh): 2.11, 2.11, 2.10, 2.07, 2.09, 2.07
- Variable cost (₹/kWh): 2.18, 2.14, 1.63, 1.65, 1.95, 1.94
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