Generation dispatch analysis for Karnataka: 2029-30

Preliminary Results

23-24 Nov 2020
Outline

Modelling inputs

Scenarios

Preliminary results

Conclusion
Modelling Inputs
Generation capacity

- State thermal (6100 MW) – Unit details
- State hydro (3782 MW) – Station details
- State gas (370 MW) – Station details
- Solar – 9386 MW
- Wind – 9820 MW
- Central Generating Stations (CGS) – State share: 5934 MW
Generation - Technical details

- Unit wise capacity, Heat rate, Fuel price
- Fixed & Variable cost
- CGS share
- Spinning reserves
- Storage capacity
- Minimum generation level (Technical minimum)
- Ramp up and ramp down rates
- Minimum up-time and down-time hours
- Start up cost
- Hydro operational characteristics (Monthly min, average & max)
- Inter-state transmission capacity
## Installed capacity – State generation and IPP

<table>
<thead>
<tr>
<th>Generation plant name</th>
<th>Composition</th>
<th>Total capacity (MW)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State thermal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raichur thermal power station</td>
<td>$7 \times 210 + 1 \times 250$</td>
<td>1,720</td>
<td>Existing</td>
</tr>
<tr>
<td>Bellary thermal power station</td>
<td>$2 \times 500 + 1 \times 700$</td>
<td>1,700</td>
<td>Existing</td>
</tr>
<tr>
<td>Yermarus thermal power station</td>
<td>$2 \times 800$</td>
<td>1,600</td>
<td>Existing</td>
</tr>
<tr>
<td><strong>State hydro</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharavathy generating station</td>
<td>$10 \times 103.5$</td>
<td>1,035</td>
<td>Existing</td>
</tr>
<tr>
<td>Nagjhari power house</td>
<td>$6 \times 150$</td>
<td>900</td>
<td>Existing</td>
</tr>
<tr>
<td>Varahi hydro electric project</td>
<td>$4 \times 115$</td>
<td>460</td>
<td>Existing</td>
</tr>
<tr>
<td>Gerusoppa hydro electric project</td>
<td>$4 \times 60$</td>
<td>240</td>
<td>Existing</td>
</tr>
<tr>
<td>Other hydro projects</td>
<td>-</td>
<td>1,021</td>
<td>Existing</td>
</tr>
<tr>
<td><strong>State gas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yelahanka combined cycle power plant</td>
<td>$1 \times 370$</td>
<td>370</td>
<td>Existing</td>
</tr>
<tr>
<td><strong>IPP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Udupi power corporation limited</td>
<td>$2 \times 600$</td>
<td>1,200*</td>
<td>Existing</td>
</tr>
</tbody>
</table>
## Installed capacity – CGS and bilateral share

<table>
<thead>
<tr>
<th>Generation plant name</th>
<th>State share (MW)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramagundam thermal power plant</td>
<td>481</td>
<td>Existing</td>
</tr>
<tr>
<td>Talcher super thermal power station</td>
<td>356</td>
<td>Existing</td>
</tr>
<tr>
<td>Simhadri super thermal power plant</td>
<td>178</td>
<td>Existing</td>
</tr>
<tr>
<td>Neyvelli thermal power station</td>
<td>570</td>
<td>Existing</td>
</tr>
<tr>
<td>Vallur thermal power station</td>
<td>156</td>
<td>Existing</td>
</tr>
<tr>
<td>Tuticorin thermal power station</td>
<td>202</td>
<td>Existing</td>
</tr>
<tr>
<td>Mejia thermal power station</td>
<td>200</td>
<td>Existing</td>
</tr>
<tr>
<td>Koderma thermal power station</td>
<td>200</td>
<td>Existing</td>
</tr>
<tr>
<td>Kudgi super thermal power station</td>
<td>1295</td>
<td>Existing</td>
</tr>
<tr>
<td><strong>Godhna thermal power station</strong></td>
<td><strong>816</strong></td>
<td><strong>Planned</strong></td>
</tr>
<tr>
<td>Madras atomic power station</td>
<td>37</td>
<td>Existing</td>
</tr>
<tr>
<td>Kudankulam nuclear power plant</td>
<td>454</td>
<td>Existing</td>
</tr>
<tr>
<td>Kaiga nuclear power plant, unit 1 to 4</td>
<td>289</td>
<td>Existing</td>
</tr>
<tr>
<td><strong>Kaiga nuclear power plant, unit 5 and 6</strong></td>
<td><strong>700</strong></td>
<td><strong>Planned</strong></td>
</tr>
<tr>
<td>Bilateral</td>
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<td></td>
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<tr>
<td>Priyadarshini Jurala hydroelectric project</td>
<td>117</td>
<td>Existing</td>
</tr>
<tr>
<td>Tungabhadra hydroelectric project</td>
<td>14</td>
<td>Existing</td>
</tr>
</tbody>
</table>
Total Installed capacity

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Installed Capacity (MW)</th>
</tr>
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<tbody>
<tr>
<td>Coal</td>
<td>10674</td>
</tr>
<tr>
<td>Hydro</td>
<td>3782</td>
</tr>
<tr>
<td>Nuclear</td>
<td>1480</td>
</tr>
<tr>
<td>Gas</td>
<td>370</td>
</tr>
<tr>
<td>Solar</td>
<td>9386</td>
</tr>
<tr>
<td>Wind</td>
<td>9820</td>
</tr>
</tbody>
</table>

- Coal: 30%
- Solar: 26%
- Wind: 28%
- Hydro: 11%
- Nuclear: 4%
- Gas: 1%
Storage capacity

• Battery storage
  • 200 MWh

• Pumped Hydro Storage (PHS)
  • Sharavathi : 2000 MW/∼12000 MWh
  • Saundatti : 1200 MW/ ∼9600 MWh
Load, Solar and Wind profiles

- Load profiles: Hourly
  - State load as single zone (19th EPS)

- RE profiles: Hourly
  - Solar profiles generated using CSTEP’s CSTEM-PV tool
  - Wind profiles generated using NREL’s SAM tool
State demand Curve

Peak demand: 18,328 MW
Solar profile

May month

Generation in MW

Time in hours

www.cstep.in
Wind profile
Scenarios
## Scenarios

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Description</th>
</tr>
</thead>
</table>
| Base case       | **Installed capacity**  
All the state owned existing generation plants, existing CGS state share and planned state share from upcoming CGS generation  
**Solar and wind capacity**  
Solar and wind capacity as per Karnataka Renewable Energy Development Limited (KREDL) plan  
State demand as per 19th EPS  
No state generation retirement  
With inter-state transmission lines |
| Scenario 1      | Base case with battery storage and PHS                                                                                                                                 |
| Scenario 2      | Base case with battery storage, PHS and Raichur thermal power station (RTPS) retirement                                                                 |
Preliminary results
Preliminary Results

• Day profile - Hourly
  • Peak load, Peak Solar and Wind, Peak of Solar + Wind

• Seasonal profile - Hourly
  • Summer – Apr to May
  • Rainy – Jun to Sep
  • Autumn – Oct to Nov
  • Winter – Dec to Feb

• Annual results
  • Capacity factor
  • Hydro and VRE curtailment
  • Energy Mix
  • Production cost breakup
Day dispatch – base case

Peak demand: 12th Feb @ 8.30 AM

Light demand: 01st Jun @ 3.30 AM
Day dispatch – base case

Peak Solar: 21st May @ 1.30 PM

Peak Wind: 17th Jul @ 4.30 PM
Day dispatch – base case

Peak of Solar + Wind: 21st Jun @ 1.30 PM
Seasonal dispatch – base case

Summer – Apr to May

Rainy – Jun to Sep
Seasonal dispatch – base case

Autumn – Oct to Nov

Winter – Dec to Feb
Day dispatch – scenario comparison

Peak demand: 12th Feb @ 8.30 AM
Day dispatch – scenario comparison

Light demand: 01st Jun @ 3.30 AM

Scenario 1

Scenario 2
Day dispatch – scenario comparison

Peak Solar: 21st May @ 1.30 PM

Scenario 1

Scenario 2
Day dispatch – scenario comparison

Peak Wind: 17th Jul @ 4.30 PM
Seasonal dispatch – scenario comparison

Summer – Apr to May

Scenario 1

Scenario 2
Seasonal dispatch – scenario comparison

Rainy – Jun to Sep

Scenario 1

Scenario 2
Seasonal dispatch – scenario comparison

Autumn – Oct to Nov

Scenario 1

Scenario 2
Seasonal dispatch – scenario comparison

Winter – Dec to Feb

Scenario 1

Scenario 2
RE curtailment

Base case

Scenario 1

Scenario 2
Hydro curtailment

Base case

scen1234_KN_IsGS_altHR - Hydro Curtailment by Month-Hour - KN - 2030 - 1
VRE curtailment
Generation and PLF – base case
Generation and PLF – scenario 1
Generation and PLF – scenario 2
Production cost

Production cost

Cost (crores INR)

Basecase
Scenario1
Scenario2

Capacity cost
Fuel Cost
Conclusion
Conclusion

• Except in case of peak demand supply is generally able to meet projected demand

• Based on evolution of demand, storage will be essential to meet peak demand for 2030

• Retirement of RTPS as per CEA plan, will necessitate further capacity addition

• Opportunity for further upscaling VRE deployment
Thank you