Renewables Curtailment in China – is there light at the end of the tunnel?

Liutong Zhang
Renewable curtailment in China – All ready to generate but no place to go

RE curtailment in China

<table>
<thead>
<tr>
<th>Type</th>
<th>TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>50</td>
</tr>
<tr>
<td>Solar</td>
<td>34</td>
</tr>
<tr>
<td>Hydro</td>
<td>89</td>
</tr>
</tbody>
</table>

Total curtailment amount in 2015 is equivalent to 2x Singapore’s power consumption

Wind curtailment details

<table>
<thead>
<tr>
<th>Year</th>
<th>Total curtailed wind volume</th>
<th>Curtailment rate (RHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>12.3</td>
<td>-</td>
</tr>
<tr>
<td>2012</td>
<td>20.6</td>
<td>15%</td>
</tr>
<tr>
<td>2013</td>
<td>16.2</td>
<td>10%</td>
</tr>
<tr>
<td>2014</td>
<td>12.6</td>
<td>5%</td>
</tr>
<tr>
<td>2015</td>
<td>33.9</td>
<td>0%</td>
</tr>
</tbody>
</table>

Wind Curtailment rate in selected provinces

Will it get better???
We use four “lenses” to analyze how curtailment will evolve in the future:

**Market Fundamentals**
- (Local) demand growth
- (Local) load profile
- Supply growth & characteristics
- Need for flexible capacity

**Grid Infrastructure**
- Local grid
- Interconnection in the regional grid
- Ultra-high voltage lines
- Characteristics of receiving ends

**Competition & Commercial**
- RE vs coal
- RE vs embedded generation
- RE export vs local generation
- Characteristics of receiving ends

**Policy & Regulation**
- RE targets
- Fuel mix policy
- Environmental policy
- Approvals
It will be a daunting task for China to resolve the power over-capacity issue.

Incremental annual power supply & demand
No supply response to slow-down in demand growth so far…

Reserve margin is at historically high level

Annual average incremental surplus capacity is about 90 GW in 2012-2015, close to the total installed capacity in UK.

Retirement and rationalization of new capacity build is needed to resolve over-capacity – a new realm faced by China.

Source: CEC; TLG research and analysis
Mismatch of supply and demand timing is a key challenge for RE generation, leading to curtailment.

Jilin wind case study

Spring (Mar - May)

- Wind Power Output
- Jilin Typical Day Load

Wind power output (MW)

Power Load (MW)

- Wind Gen (without curtailment) (RHS)
- Average load (LHS)

Average load, MW

- Spring (Mar-May) (Jun-Aug) (Sep-Nov) (Dec-Feb)

Strong wind speed is at the wrong time of the day and the year

Jilin wind case study

Yunnan case study

Excess during normal and wet years

Exported

Provincial demand

Seasonality of hydro-generation poses challenges for power balancing and export arrangement

UHV DC and AC lines expansions will enable power exports from the curtailed regions, but they are also driving new generation capacity additions.

The power re-balancing across provinces/regions in China due to the commissioning of these UHV lines is a key factor to watch.
More RE generation will have to squeeze out something else in an over-capacity and low demand growth market

### Renewables vs Coal

**Annual average generation hours of thermal capacity in China**

Utilization hours

<table>
<thead>
<tr>
<th>Year</th>
<th>Region</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>China</td>
<td>6,500</td>
<td>6,200</td>
<td>6,000</td>
<td>5,800</td>
</tr>
<tr>
<td></td>
<td>Jilin</td>
<td>5,000</td>
<td>4,800</td>
<td>4,600</td>
<td>4,400</td>
</tr>
<tr>
<td></td>
<td>Inner Mongolia</td>
<td>4,500</td>
<td>4,300</td>
<td>4,100</td>
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<td></td>
<td>Xinjiang</td>
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<td>2,600</td>
<td>2,400</td>
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<tr>
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<td>Gansu</td>
<td>2,500</td>
<td>2,300</td>
<td>2,100</td>
<td>1,900</td>
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<tr>
<td></td>
<td>Yunnan</td>
<td>2,000</td>
<td>1,800</td>
<td>1,600</td>
<td>1,400</td>
</tr>
<tr>
<td></td>
<td>Sichuan</td>
<td>1,500</td>
<td>1,300</td>
<td>1,100</td>
<td>900</td>
</tr>
</tbody>
</table>

***How low can coal-fired power generation go?***

### Import vs Local generation

- **Coal + Solar/wind or Large hydro in resource rich regions**
- More exports to Load centres (coastal cities in South and East China) via the UHV lines?
- Local governments do not want more imports to squeeze out more local generation as demand growth slows
Reform and policy changes are under-way, and progress could be slow

**Sector-wise reform and policy changes**

- Reform of transmission and distribution sector: uncertain impact on RE dispatch
- Direct negotiation between generators and large end-users: likely negative for RE
- Continuing on-grid tariff reform: uncertain impact on RE dispatch

**Proposed policies to mitigate curtailment**

- Slow-down approval or halt new solar and wind projects in highly curtailed regions: POSITIVE
- Better planning and coordination of real-time dispatch: POSITIVE
- Increasing flexibility of the system: POSITIVE
- Various RE Targets*: UNCERTAIN
- Wind/solar for heating: UNCERTAIN

* Note: Several Non-hydro RE targets have been discussed in China:
  - Consumption-side: 5-13 percent each province (nation-wide average at 9 percent) in 2020. Non-hydro RE generation needs to almost double from current level.
  - Generation-side: 15 percent non-hydro RE obligation on coal power
RE curtailment – probably will get worse before getting better

- **Slow demand growth**
- **Supply** – Still no visibility on slow-down in new addition
- No easy way to resolve the RE supply and demand mismatch

- More enhancement of local and regional grids
- More UHV DC and AC lines are built and approved
- *BUT Who will take the power?*

- Coal utilization hours will likely continue be squeezed; but will there be early retirements?
- Tension between imports and local generation will increase

- Push on direct purchase will probably favor non-RE projects
- Policy initiatives such as proactively slow-down/haul new build will be most positive to reduce curtailment if implemented

Each provinces face different trends
Quantitative wind curtailment forecast from TLG’s model (for illustration)

Case study: Wind curtailment forecast in Jilin

Indicative and subjected to assumptions
Thank you

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