China’s economic growth relies to a great extent on thermal power – a heavy water user. Yet, some of the country’s waterways are already in deficit. China’s “Big Five” power utilities are all highly exposed to water disruption in their 500GW of plants. Investment to reduce risk of disruption could total $20bn and remove 10GW of capacity from the electrical system.

Key findings of Bloomberg New Energy Finance’s analysis on Chinese utilities’ water exposure include:

- The total volume of water withdrawn by the Chinese power sector will grow from 102bn m³ in 2010 to 124bn m³ in 2030, according to our BNEF central forecast. This growth will be driven by a three-fold increase in water-intensive thermal power generation between now and 2030 which looks set to outweigh incremental gains in cooling cycle efficiency at ‘refurbished’ plants.

- In a Business as usual scenario, power sector withdrawals could reach 190bn m³ in 2030 and constitute more than 25% of the national overarching cap of 700bn m³ set by the government. Given that some regions are already in water deficit today, the projected increase in power-related water withdrawals could quickly become unsustainable.

- The fundamental problem in China is that regional demand for electricity is inversely correlated with the distribution of freshwater resources. Northern China is home to over 60% of the country’s thermal power capacity, but has just 20% of the country’s renewable freshwater supply.

- All of China’s “Big Five” state-owned power enterprises are highly exposed to water supply disruptions across their combined 500GW of assets. Huaneng and Datang are currently the most vulnerable, with both companies having 84% of their capacity tied up in thermal power assets located in moderately to severely water-scarce regions. By comparison, Guodian is the least exposed member of China’s ‘Big Five’, with 65% of its generating capacity at risk.

- Geographic and technological diversification is the best way for Chinese utilities to cope with the sector’s looming water crisis. Thermal power plants built in wet regions such as Guangxi, Fujian and Jiangxi will be less susceptible to operational disruptions than assets in the dry North. Non-thermal power generators such as wind and solar PV do not depend on water and will therefore be an increasingly attractive option for utilities.

- New thermal plants will mainly be equipped with closed-cycle and air cooling loops, which withdraw less water than once-through systems. However, these technologies decrease the thermal efficiency of power plants by 3-10% and result in higher greenhouse gas emissions per megawatt-hour.

- Water conservation and carbon emissions reductions may be conflicting objectives for China’s power utilities - and meeting both goals will require a high-level, coordinated policy approach for water and energy.

- If the number of water-related power disruptions increases dramatically, the government could force the plants with once-through technologies to retrofit. Such retrofits would come with substantial costs: 100GW of plants retrofitted, at a cost of $20bn and overall capacity reductions of 10GW due to lower efficiency in retrofitted plants. China’s power utilities, it seems, cannot avoid being in hot water.

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Thermal power generation versus water scarcity by province in China, 2010 and 2030

Freshwater scarcity rating:
- Water deficit
- Severe scarcity
- Moderate scarcity
- No scarcity

Source: Bloomberg New Energy Finance, National Bureau of Statistics of China. Note: We define 'water scarcity' using a criticality ratio. A region is water-scarce if annual freshwater withdrawals amount to 20-40% of the renewable resource, and severely water-scarce if they surpass 40%. If annual withdrawals exceed the renewable supply, the region is said to be in water deficit. Annual freshwater withdrawals by province were calculated using 2011 data. The average renewable water resource reflects the mean annual renewable freshwater supply in the period 2004-11.

Thermal power capacity in water scarce regions by utility (% of total generation capacity)

<table>
<thead>
<tr>
<th>Utility</th>
<th>Water deficit</th>
<th>Severe scarcity</th>
<th>Moderate scarcity</th>
<th>No scarcity</th>
<th>Non-thermal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huaneng</td>
<td>24%</td>
<td>42%</td>
<td>18%</td>
<td>11%</td>
<td>6%</td>
</tr>
<tr>
<td>Datang</td>
<td>20%</td>
<td>36%</td>
<td>28%</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>China Power Investment</td>
<td>14%</td>
<td>55%</td>
<td>7%</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Huadian</td>
<td>10%</td>
<td>47%</td>
<td>10%</td>
<td>24%</td>
<td>10%</td>
</tr>
<tr>
<td>Guodian</td>
<td>22%</td>
<td>20%</td>
<td>23%</td>
<td>30%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance, National Bureau of Statistics of China, Platts. Note: Regional freshwater withdrawals were calculated using 2011 data, while the mean renewable water resource in each province was determined as the average of annual renewable supplies in the period 2004-11. Generation capacities were summed over all power assets in commercial operation in 2008, including those using saline water for cooling.