Rural Electrification through Small Hydro Power in China

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Accra, Ghana, 2 Nov 2012
China’s First Hydropower Station, 1912

SHI LONG BA hydropower station
Turbine

Imported from Germany
CONTENT

1. Historical Processes

2. Small Hydro & Rural Electrification

3. Rural Electrification through SHP & Rural Dev.
1 Historical Processes
Power system
## Definition of small hydro

<table>
<thead>
<tr>
<th>Period</th>
<th>Def. by size (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>1960s</td>
<td>&lt; 3.0</td>
</tr>
<tr>
<td>1970s</td>
<td>&lt; 12.0</td>
</tr>
<tr>
<td>1980-90s</td>
<td>&lt; 25.0</td>
</tr>
<tr>
<td>2000-2012</td>
<td>&lt; 50.0</td>
</tr>
</tbody>
</table>
Structure of Electricity Supply (county-level and below) --- 1993

- Small hydro: 53%
- Small thermal: 37.10%
- Diesel: 9.80%
- Wind/solar/geothermal: 0.10%
Historical Processes

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>R.E. bureau</td>
<td>RE bureau</td>
<td>Dissolution</td>
<td>RE bureau</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **1950**: 10 factories
- **1960**: 60 factories
- **1970**: 100 factories
- **1980**: Serialization
- **1990**: Automation
- **2000**: 400V, local use
- **2010**: 110kV, Connected local grids

**400V, local use**
- 10kV
  - 35kV, county local grids
- 110kV Local grids

**Lighting**
- Lighting & food process
  - & irrigation & county enterprise
- County level electrification
- Regional electrification

**Training of professionals**

- 109
- 209
- 335
- 409
- 460

- Central government loans: 11.60%
- Foreign direct investment: 11.70%
- Local government electricity levy, SHP income: 27.10%
- Private investment: 41.60%
- Private investment: 7.90%
6. Rate of access to electricity

<table>
<thead>
<tr>
<th>Stage</th>
<th>Period</th>
<th>Key features</th>
<th>Access to electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1949-1978</td>
<td>Slow by steady Dev.</td>
<td>63.28</td>
</tr>
<tr>
<td>II</td>
<td>1979-1998</td>
<td>Rapid expansion &amp; large scale Dev.</td>
<td>98.94</td>
</tr>
<tr>
<td>III</td>
<td>1998-2011</td>
<td>Consolidation and upgrading</td>
<td>99.61</td>
</tr>
<tr>
<td></td>
<td>- 2015</td>
<td>5 million people left</td>
<td>100</td>
</tr>
</tbody>
</table>
Small Hydro & Rural Electrification
Why Small Hydro for R.E. in China?
Resources

42.3% of hydropower and 48.5% of small hydropower are exploitable potential.

- 2012: 230 GW for hydropower, 62 GW for small hydropower
- 2020: 350 GW for hydropower, 75 GW for small hydropower
- Exploitable potential: 540 GW for hydropower, 128 GW for small hydropower
Distribution - decentralized dev.

Sites: river  Rural areas

Local government (county) responsible for SHP development.
• Small hydro turbines have a total of 26 models in series, 83 kinds of products, applicable in the head range of 2 ~ 1000 meters.
• Auxiliaries including governor, exciter, valve, control panel and automatic components etc. all being produced in China.

- Completely done in manufacturer, trucked to the site
- Less Time and Cost on site
## Comprehensive utilization

<table>
<thead>
<tr>
<th>Dam /Reservoir</th>
<th>Diversion Type /without reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply</td>
<td>low unit cost</td>
</tr>
<tr>
<td>Flood control</td>
<td>little relocated people</td>
</tr>
<tr>
<td>Irrigation</td>
<td>small engineering quantity</td>
</tr>
</tbody>
</table>
Why Small Hydro?

• **Technology perspective**
  – Resources
  – Distribution
  – Serialization
  – Comprehensive utilization
## Challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>capital investment</td>
<td>Serialization</td>
</tr>
<tr>
<td>seasonal variation</td>
<td>Various raised fund</td>
</tr>
<tr>
<td></td>
<td>Local Grids; connected with large grids</td>
</tr>
<tr>
<td></td>
<td>Water-thermal/wind/polar</td>
</tr>
<tr>
<td>Project-Specific</td>
<td>Training</td>
</tr>
<tr>
<td></td>
<td>Serialization</td>
</tr>
</tbody>
</table>
New challenges for China

Management
Renovation
Certification

Security
Efficiency
Environment
Rural Electrification through SHP & Rural Dev.
Benefits of R.E. through SHP

• Access to electricity;
• Agriculture;
• Comprehensive utilization of water resources;
• Medium and small river improvement;
• Rural economic development;
• Employment;
• Health;
# Internal Demand

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed capacity at end of year (MW)</th>
<th>Average annual growth rate</th>
<th>Electricity consumption in the year (kWh)</th>
<th>Average annual growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>3.6</td>
<td></td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>6380</td>
<td>29.38%</td>
<td>59.28</td>
<td>31.74%</td>
</tr>
<tr>
<td>1998</td>
<td>44150</td>
<td>10.72%</td>
<td>495.50</td>
<td>11.82%</td>
</tr>
<tr>
<td>2002</td>
<td>51680</td>
<td>4.02%</td>
<td>721.20</td>
<td>9.48%</td>
</tr>
<tr>
<td>1950-2002</td>
<td>20.19%</td>
<td></td>
<td>22.36%</td>
<td></td>
</tr>
</tbody>
</table>

*County enterprise*
• 90% of the rural households have access to electricity.
• On average, per capita electricity consumption is around 200 kWh.
• 98%
• 500 kWh.
Favorable policies for SHP-RE

• “the one who invests owns and operates”
• “revenue from electricity for development of electricity”;
• a preferential rate of value added tax rate of 6% instead of the normal 17%;
• the connection of small local grids to larger grids.
• Policies designed to protect electricity supply areas for small hydropower
CONCLUSIONS

• Put it under the time axis
• Put it under the rural electrification
• Put it under the rural development

• It is small hydropower in China.
Thank You!

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