TIMES China Model 34 Regions (TCM34R)

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OUTLINE

- Introduction
- Partners
- Modelling features
- Data collection and the most important sources
- Focus of activity
China’s Economic and Social Data on year 2006

<table>
<thead>
<tr>
<th>Region</th>
<th>Including Provinces</th>
<th>Area</th>
<th>Population</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Share %</td>
<td>10^8 Sq.m</td>
<td>Share %</td>
</tr>
<tr>
<td>East</td>
<td>10</td>
<td>32.2</td>
<td>91</td>
<td>9.5</td>
</tr>
<tr>
<td>Center</td>
<td>6</td>
<td>19.4</td>
<td>103</td>
<td>10.7</td>
</tr>
<tr>
<td>West</td>
<td>12</td>
<td>38.7</td>
<td>686</td>
<td>71.5</td>
</tr>
<tr>
<td>North</td>
<td>3</td>
<td>9.7</td>
<td>80</td>
<td>8.3</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>100</td>
<td>960</td>
<td>100</td>
</tr>
</tbody>
</table>

Data from the above table show that in 2006, eastern regions with its area of less 10% of the total, population more than 36%, contribute more than half of the nation’s GDP by consuming around 70% of China’s total energy.
The total energy Consumption of China in 2005 is 2144.79 Million Tce. Among which coal consumption is 2167.2251 million tons, oil 325.35 million tons, and natural gas 46763 million cu.m.

Modelling features

Multi-regional TIMES model:

- 34 regions (administrative Chinese regions)
- 7 sectors with different details
- 12 timeslices (4 seasons, day-night-peak)
- Base year 2005
- Time horizon 2050 (15 periods)
Data collection

A lot of data are available for the TCM34R but:
- often there isn’t coherence between the National and Regional balance;
- in some sectors (e.g. Industry) there is a different structure and detail between national and regional balance;
  The National industry sector is really disaggregated but the regional one describe only the total industry consumption, without sub-sectors;
- this require some assumptions to disaggregate the national data into the regional one, with problem of consistency!
- not always the balance are consistent; the local production not match the resource availability!!

Data collection

- Population
  - regional urban population
  - regional rural population

- GDP
  - for sector
  - for region and industrial sub-sector

- Workers for industrial sub-sector (almost regions)

Some of the previous data are used as drivers for the demand projection
The most important sources

China Statistic Yearbook
China Energy Statistic Yearbook
China Regional Statistic Yearbook
China Electricity & Coal Industry Committee
IEA publications
- Tracking Industrial Energy Efficiency and CO2 Emissions

Focus of activity

Description of objectives and assumption

Focus of modelling on power sector and industry

No description of demand technologies for: residential, commercial, agriculture and transport sectors.

But the TCM34R includes projections of energy demands for all the sectors in an aggregated processes by service.
Focus of activity

Residential and Commercial sector

• described by demand segment:
  - space heating;
  - lighting
  - cooling
  - other appliances (only electricity appliances for residential sector)

• for each demand segment:
  - a dummy technology with an energy intensity input
  - a projection with different drivers

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Focus of activity

Demands of the Residential and Commercial sector

<table>
<thead>
<tr>
<th>Code</th>
<th>Demand Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>COML</td>
<td>Commercial Lighting Demand</td>
<td>MSQM</td>
</tr>
<tr>
<td>COMH</td>
<td>Commercial Heating Demand</td>
<td>MSQM</td>
</tr>
<tr>
<td>COMC</td>
<td>Commercial Cooling Demand</td>
<td>MSQM</td>
</tr>
<tr>
<td>COMO</td>
<td>Commercial Other Demand</td>
<td>MSQM</td>
</tr>
<tr>
<td>RUU</td>
<td>Residential Urban Lighting Demand</td>
<td>POPU</td>
</tr>
<tr>
<td>RUHE</td>
<td>Residential Urban Space Heating Demand</td>
<td>POPU</td>
</tr>
<tr>
<td>RUCK</td>
<td>Residential Urban Cooking Demand</td>
<td>POPU</td>
</tr>
<tr>
<td>RUOT</td>
<td>Residential Urban Other elect. Appliances Demand</td>
<td>POPU</td>
</tr>
<tr>
<td>RUOC</td>
<td>Residential Urban Cooling Demand</td>
<td>POPU</td>
</tr>
<tr>
<td>RRU</td>
<td>Residential Rural Lighting Demand</td>
<td>POPR</td>
</tr>
<tr>
<td>RRRHE</td>
<td>Residential Rural Space Heating Demand</td>
<td>POPR</td>
</tr>
<tr>
<td>RRCK</td>
<td>Residential Rural Cooking Demand</td>
<td>POPR</td>
</tr>
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<td>RRCA</td>
<td>Residential Rural Cooling Demand</td>
<td>POPR</td>
</tr>
<tr>
<td>RROT</td>
<td>Residential Rural Other elect. Appliances Demand</td>
<td>POPR</td>
</tr>
</tbody>
</table>
Focus of activity

Agriculture, Construction and Other Sector

- described by total sector demand:
  - with a dummy technology - energy intensity input
  - a projection using sector GDP

<table>
<thead>
<tr>
<th>AGRI</th>
<th>Agriculture demand</th>
<th>100 MV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONS</td>
<td>Construction demand</td>
<td>100 MV</td>
</tr>
<tr>
<td>OTHE</td>
<td>Other demand</td>
<td>100,000 Tce</td>
</tr>
</tbody>
</table>

Focus of activity

Electricity sector

- Power plants (coal technologies, CO₂ capture, wind potential and nuclear potential)
- Grids: modelling the existing and planned grids
- Modelling the electricity load curve
- Modelling demand side efficiency measures for electricity in a simple way
Focus of activity

Electricity sector by region

- Base year power plants are elaborated by size and by fuel

<table>
<thead>
<tr>
<th>Plant</th>
<th>Power Plant Capacity [MW]</th>
<th>Power Plant Efficiency [%]</th>
<th>Coal Technology</th>
<th>Electricity Production [TWh/yr]</th>
<th>Reliability Factor</th>
<th>Power Plant Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base year</td>
<td>790.9</td>
<td>47.9</td>
<td>$70k</td>
<td>$270</td>
<td>880</td>
<td>0.97</td>
</tr>
<tr>
<td>Future</td>
<td>1.5M</td>
<td>1.2</td>
<td>1.15</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>1.5M</td>
<td>1.0</td>
<td>0.97</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>0.5M</td>
<td>0.9</td>
<td>0.88</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>1.7M</td>
<td>1.5</td>
<td>1.23</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
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<tr>
<td>Future</td>
<td>0.8</td>
<td>0.8</td>
<td>0.83</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>1.5M</td>
<td>1.2</td>
<td>1.15</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>1.6M</td>
<td>0.8</td>
<td>0.83</td>
<td>0.85</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>Future</td>
<td>0.6</td>
<td>0.6</td>
<td>0.65</td>
<td>0.65</td>
<td>0.98</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Focus of activity

Electricity sector

- Future power plants are described by techs:
  - Coal fired power
    - supercritical steam cycles;
    - ultra-supercritical steam cycles;
    - integrated gasification combined cycle;
  - Coal + CO2 capture
  - Co-firing biomass in coal power plants
  - Coal for CHP
  - Hydro power plants expansion potential
  - Wind
  - Nuclear expansion potentials
Focus of activity

Industrial sector

- Iron and steel
- Cement
- Glass
- Chemicals and petrochemicals
- Non-ferrous metal
- Pulp and paper

This sector is described with processes and end-use technologies.

Not yet decided if with or without materials flow