Overview of Agricultural Bio-energy Development in China

Zhao Lixin
Chinese Academy of Agricultural Engineering
Rome, 12th Dec. 2013
Outline

1. Overview
2. Achievements
3. Preliminary thoughts of indicators testing
## 1. Overview

Energy Production and Consumption

2006~2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total $10^9$ tce</td>
<td>Coal</td>
</tr>
<tr>
<td>2006</td>
<td>2.32</td>
<td>77.8%</td>
</tr>
<tr>
<td>2007</td>
<td>2.47</td>
<td>77.7%</td>
</tr>
<tr>
<td>2008</td>
<td>2.60</td>
<td>76.8%</td>
</tr>
<tr>
<td>2009</td>
<td>2.75</td>
<td>77.3%</td>
</tr>
<tr>
<td>2010</td>
<td>2.969</td>
<td>76.5%</td>
</tr>
</tbody>
</table>

Source: National Bureau of Statistics of China
## Energy Production and Consumption 2010

<table>
<thead>
<tr>
<th>Series</th>
<th>Production</th>
<th>Import</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>Amount</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td>Annual growth rate</td>
<td>Annual growth rate</td>
<td>Annual growth rate</td>
</tr>
<tr>
<td>Coal $(10^9 t)$</td>
<td>3.24</td>
<td>0.146</td>
<td>3.340</td>
</tr>
<tr>
<td>Electricity $(10^{12} kwh)$</td>
<td>4.14</td>
<td>--</td>
<td>4.19</td>
</tr>
<tr>
<td>Oil $(10^9 t)$</td>
<td>0.2</td>
<td>0.239</td>
<td>0.449</td>
</tr>
<tr>
<td>NG $(10^9 m^3)$</td>
<td>94.48</td>
<td>LNG $93410^4 t$</td>
<td>110.0</td>
</tr>
</tbody>
</table>

Source: National Energy Administration of China
China has abundant resources of agricultural biomass resources:

(1) Crop Straw
(2) Animal waste
(3) Energy Crops
(4) Agriculture Products Processing Waste
(1) Crop Straw

On Jan 21st, 2011, MoA issued《National crop straw resources surveying and evaluation report》. Report shows that Chinese total collectable resource of crop straw is about 687 million tons, the utilization rate (as feed, fertilizer, fuel etc.) is 69%.
(2) Animal waste

“The first national survey of pollution sources Bulletin” shows 243 million tones of manure as well as 163 million tones of urine is to be produced annually from industrial livestock and poultry farming, including intensive farms, farming communities and specialized farming households, excluding household farming.
(3) Energy Crops

Herbaceous energy crops such as Sweet Sorghum, Cassava, Sweet Potato, Rape and so on, are suitable for planting in China.

Sweet Sorghum
# Development potential of using cultivated land reserve resource

<table>
<thead>
<tr>
<th>Area</th>
<th>Northeast Region</th>
<th>North China Region</th>
<th>Loess Plateau Region</th>
<th>Mongo Xinjiang Region</th>
<th>Eastern Region</th>
<th>Southern Region</th>
<th>South west Region</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated land reserves resource (10 thousand hectare)</td>
<td>55.9</td>
<td>12.5</td>
<td>88.4</td>
<td>382.2</td>
<td>13.33</td>
<td>12.4</td>
<td>32.3</td>
<td>624.93</td>
</tr>
<tr>
<td>Appropriate energy crops</td>
<td>Sweet Sorghum</td>
<td>Sweet Potato</td>
<td>Sweet Sorghum</td>
<td>Sweet Sorghum</td>
<td>Sweet Potato</td>
<td>Cassava</td>
<td>Cassava</td>
<td></td>
</tr>
<tr>
<td>Ethanol production per unit area (tons per hectare)</td>
<td>3.75</td>
<td>3.03</td>
<td>3.75</td>
<td>3.75</td>
<td>3.03</td>
<td>2.66</td>
<td>2.66</td>
<td></td>
</tr>
<tr>
<td>2010 Using proportion (%)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2010 Development Potential (10 thousand tons)</td>
<td>22</td>
<td>27</td>
<td>145</td>
<td>21</td>
<td>6</td>
<td>16</td>
<td>18</td>
<td>255</td>
</tr>
<tr>
<td>2020 Using proportion (%)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>2020 Development Potential (10 thousand tons)</td>
<td>112</td>
<td>133</td>
<td>725</td>
<td>106</td>
<td>53</td>
<td>138</td>
<td>89</td>
<td>1355</td>
</tr>
</tbody>
</table>

P.S. Yield is conservative estimated considering it is cultivated land reserve resource.
(4) Agriculture Products Processing Waste

**Rice husk** is the largest by-product during rice processing, accounting for 20% of paddy weight. In 2008, China produced about 51.81 million tons rice husk.

**Corn cob** is corn ear stripping corn grain, accounting for 75%-85% of corn ear weight. In 2008, China produced about 41.48 million tons corn cob.

**Bagasse** is sucrose processing waste, and the ratio of bagasse to sucrose is 1:1. In 2008, China produced about 24.83 million tons bagasse.
In 2009, Chinese government announced that “the proportion of non-fossil fuels in primary energy consumption could reach 15% by 2020” at UN Climate Change Summit.

China's 12th Five-Year Plan was released to the public, which clearly declared that clean energy such as biomass energy should be developed vigorously.

China has abundant agricultural biomass resource which could be used to produce bio-energy, in order to make up shortage of energy supply.
2. Achievements

（1）Policy, Regulation and Incentives

Law in China has clear provisions on biomass energy development, such as:

- The Law on Agriculture
- The Law on Renewable Energy
- The Law on Energy Conservation
National Policies:

- Agricultural Biomass Industry Development Plan, 2007
- Suggestions on Promotion of Comprehensive Utilization of Crop Straws, 2008;
- Management Method on Subsidy of Utilization of Crop Straw, 2008
- …
Local Policies:

- Hebei Provincial Management Regulation on New Energy Development and Utilization, 1997
- Gansu Provincial Construction and Management Regulation on Rural Energy, 1998
- Anhui Provincial Construction and Management Regulation on Rural Energy, 1998
- Guangxi Zhuang Autonomous Regional Construction and Management Regulation on Rural Energy, 2001
- Zhejiang Provincial Promotion Method on Biogas Development and Utilization, 2005
- Hunan Provincial Regulation on Rural Renewable energy, 2006
- Shandong Provincial Regulation on Rural Renewable Energy, 2007
- Hubei Provincial Regulation on Rural Renewable Energy, 2010
- Sichuan Provincial Regulation on Rural Energy, 2010
Green Energy Demonstration County

 Counties was awarded the Green Energy Demonstration County by NDRC, MOF and MOA, Oct 2010

 25 Million CNY in form of national subsidy

Target Fields: Biogas, Gasification, Densified Biofuel, Rural energy service system

Duration: 2011~2013
（2）R&D of Bio-energy Technologies

(2.1) Biogas sector has developed fast.

Till the end of 2011:

- 41.70 million rural household biogas digesters installed in China.
- 81.0 thousand agricultural waste biogas projects constructed and established the biogas capacity of 17.1 billion m³ per year.
Biogas Plants

- **Raw materials**
  - Animal manure, crop straws and mixed agricultural wastes
  - Intensive livestock manure is the main raw material

- **Biogas utilization**
  - Farmers’ cooking
  - Power generation
  - Vehicle fuel
(2.2) The solid bioenergy industry has established

- Currently, there are around **100 biopellet plants** in agriculture area to produce **3 million tons** of pellets and briquets, each plant with the annual production capacity of more than **10,000 tons**.

- The standard system of biomass densified fuel is establishing.
(2.3) Biomass power generation technology is well-developed

By the end of 2010, the installed capacity of biomass power generation is about 5.5 million kW.
(2.4) Non-grain ethanol begin to industry and achieve major technological breakthroughs

- Constrained by grain output, China no longer develop grain-based production of ethanol fuels in recent period.
- A bio-ethanol plant based on cassava fermentation was built in Guangxi, with capacity of 200 thousand tons per year.
- At present, annual capacity of biofuel ethanol production reached 1.62 million tons.
- The first cellulosic ethanol industrialization pilot in China was established by Tianguan Group with capacity of 3000 tons per year.
3. Preliminary thoughts of indicators’ testing

Hebei Provinces:

- 53.3 million tons of crop residues per year;
- 13 million tons are not utilized;
- 54.12 million rural population;
- Continental climate.
Hebei Large Scale biogas project

- Biogas yield: 98 million m³/year,
- Straws consumption: 335 thousand ton/year
- Livestock manure consumption: 376 thousand ton/year
- Solid organic fertilizer: 294,000 ton/year
- Liquid organic fertilizer: 869,900 ton/year

Biogas can provide 186,000 households for cooking and heating, provide 2625 buses or taxies for CNG fuel gas.

The total investment: 1.2 billion RMB Yuan.
GBEP indicators test:

- First stage:
  
  Two biogas plants of running (feed stock is crop straw and livestock manure)

- Second stage:
  
  Hebei Large Scale biogas project
Thank you!