Supply chain issue in developing Bioenergy in Indonesia

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Recommendations

• Quantification of barriers: PEST
  o Policy (regulatory policy: i.e. Energy pricing, RPS, Net metering, Fit-in- tariff, mandate and obligations, tradable RE Certificate, etc.)
  o Economy (fiscal incentives: capital subsidy, grant, rebate, tax incentives, )
  o Social awareness (participation, perception)
  o Technology (user friendliness, cost)

• Supply chain to be managed by industry (solid fuel production)
  o Biomass from wastes (pellet, chip, briquette, etc.)
  o Energy farm (i.e. Leucaena Leucocephala Plantation)
The Bio-energy supply chain

- **Supply side:**
  - Biomass fuel supply and production to be managed by industry
  - Secure continuity of supply, JIT delivery
  - Maintain quality and standard of fuel
  - Economic benefit of bio-energy by quantification of barriers

- **Demand side**
  - Large scale power generation
  - Small scale fuel and power usages
    (rural development, industrialization initiatives)
  - Economic benefit of bio-energy by quantification of barriers
  - Application of BE-CCS

- **MoEMR, Regulation No.4/2012:** on bio-energy generation tariff
Biomass fuel production and services: (conditions: \( \text{ROI} > \text{current interest rates} \), pay back time < 4 years)

<table>
<thead>
<tr>
<th>( \Phi(B) \times 100 )</th>
<th>( P ) (electricity tariff US$/kWh)</th>
<th>( E ) (Interest rates)%/ann.</th>
<th>( S ) (number of costumers)</th>
<th>( T ) (Cost of technology, x100, USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>113.8</td>
<td>5</td>
<td>16</td>
<td>100</td>
<td>83.5</td>
</tr>
<tr>
<td>46.9</td>
<td>6</td>
<td>14</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>50.08</td>
<td>7</td>
<td>12</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>36.6</td>
<td>8</td>
<td>10</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>102</td>
<td>9</td>
<td>8</td>
<td>90</td>
<td>75</td>
</tr>
</tbody>
</table>
Least Square Method

\[ [A] = ([X]^T[X])^{-1} ([X]^T[X])[B] \quad (3) \]

The answer is:

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>( \alpha_1 )</td>
<td>97.31</td>
</tr>
<tr>
<td>( \alpha_2 )</td>
<td>69.35</td>
</tr>
<tr>
<td>( \alpha_3 )</td>
<td>15.95</td>
</tr>
<tr>
<td>( \alpha_4 )</td>
<td>-36.87</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Calc.</th>
<th>Data</th>
<th>error</th>
</tr>
</thead>
<tbody>
<tr>
<td>115,333</td>
<td>113.8</td>
<td>-0.01345</td>
<td></td>
</tr>
<tr>
<td>49,638</td>
<td>46.9</td>
<td>-0.0583</td>
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<tr>
<td>44,496</td>
<td>50.08</td>
<td>0.1115</td>
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</tr>
<tr>
<td>39,354</td>
<td>36.6</td>
<td>-0.075</td>
<td></td>
</tr>
<tr>
<td>101,982</td>
<td>102</td>
<td>0.000176</td>
<td></td>
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</tbody>
</table>
Maintain Biomass Fuel Standards and quality

### RDF Heating Values

<table>
<thead>
<tr>
<th>Combustable Material</th>
<th>MJ/Kg</th>
<th>Moisture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>17-21</td>
<td>10-30</td>
</tr>
<tr>
<td>Straw</td>
<td>19-21</td>
<td>10-40</td>
</tr>
<tr>
<td>Waste wood</td>
<td>16-17</td>
<td>10-30</td>
</tr>
<tr>
<td>Paper</td>
<td>17-18</td>
<td>5-30</td>
</tr>
<tr>
<td>Bark</td>
<td>15-16</td>
<td>10-30</td>
</tr>
<tr>
<td>Sludge</td>
<td>15-17</td>
<td>55-70</td>
</tr>
<tr>
<td>BrownCoal</td>
<td>15-17</td>
<td>25-60</td>
</tr>
<tr>
<td>Stone Coal</td>
<td>29-33</td>
<td>3-5</td>
</tr>
<tr>
<td>Polyethylene (PE)</td>
<td>46</td>
<td>low</td>
</tr>
</tbody>
</table>

Wood pellet: dim. 6 – 10 mm , length 10 – 30 mm. Density: 650 kg/m$^3$ or 1,5 m$^3$/ton. Ash content:0,5%.
Calorific value :4,7kWh/kg or 19.6MJ./kg.
Various Biomass Fuel Consumption using Full Condensing Turbine

- FUEL CONSUMPTION (TON/24H)
- GENERATING OUTPUT (MW)

EFB
- 150
- 247
- 360
- 720
- 938

Bagasse
- 290
- 477
- 706
- 720
- 938

Wood
- 290
- 477
- 633
- 720
- 938

Husk
- 167
- 322
- 429
- 720
- 938
Rice and rice husks and Palm oil production in Indonesia

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**Graph:**
- **Y-axis:** Million tons
- **Legend:**
  - Black: Rice
  - Yellow: Paddy
  - Red: Rice husks

**Graph Description:**

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**Additional Information:**
- **Source:** Daily news, July 2012
- **Author:** Kamaruddin A. Darma Persada University/2012
- **Date:** 26-Sep-12
Rice husks supply chain
Potentials of Rice husks and palm oil fruits shells
Fluidized bed gasifiers as CHP

Mark V, 2007, 500kW COMPACT, (Modular, full scale compliance testing)

Use your own biomass  Generate your own power  Run your own BGES
Thank you