New and renewable energy application and its future in Thailand

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Ministry of Energy, Thailand

Expert Group Meeting on Sustainable Application of Waste-to-Energy in Asian Region in Busan, Republic
Content

- Waste-to-energy Situation
- Biomass-to-energy Situation
- Alternative Energy Development Plan
- Supporting Scheme for waste & biomass-to-energy
Waste-to-energy Situation
Situation of MSW management in Thailand

Community-based waste generation
27.04 m. ton/year

Per capita
1.14 kg/person/day
Country wide
74,073 tons/day

Waste recovery
5.76 m. tons/year

Appropriate sanitary disposed system
9.59 m. ton/year

Improper disposed methods/activates
11.69 m. ton/year

Remaining waste
10.13 million

Source: PCD
National Waste Management Master Plan (2016-2021)

**Direction**

3R Principle: Reduce Reuse Recycle:
- Appropriate management, waste centralization disposal, waste-to-energy

**Public Participation & Social Sensibility**

**Goals**
- Zero remaining waste 100% by 2019
- Zero infectious waste 100% by 2020
- Zero industrial hazardous waste 100% by 2020
- Municipal hazardous waste reduction > 30% by 2021
- Waste separation at source > 50% by 2021
- Minimize municipal solid waste > 75% by 2021

**Solid waste and hazardous waste management measurement**

1. Waste minimization at source
   - Separation & recovery
   - SCP concepts: environmental friendly production, consumption & services

2. Capacity Enhancement
   - Waste collection, transportation and disposal
   - Solid waste disposal centre
   - Waste collection and disposal site
   - Law and regulation improvement
   - Law enforcements

3. Management Promotion
   - Public awareness & consciousness building
   - Knowledge enhancement
   - Treatment and disposal technology
   - Databased development
   - Management incentives & motivations

Source: PCD
WTE Technology in Thailand

- Landfill gas to energy
- Anaerobic Digestion
- Incineration
- Gasification
- Refuse derived fuel
WtE Projects

Incineration (MSW)

- PJT, Phuket 14 MW
- C&G, Bangkok 9.8 MW
- Alliance Clean Power, Khonkaen 4.9 MW
WtE Projects

Incineration (RDF)

- TPI, Saraburi: 20 + 60 MW
- ETC, Saraburi: 9.4 MW
- REEP, Samut Prakarn: 9.9 MW
Landfill gas to Energy

Kamphaeng Saen West and East, Nakhonpatom
2x8 MW

Bantan, Chiang Mai
1 MW
Electricity from pyrolysis oil

ACECO, Ayutthaya
3 MW
### Use of RDF in cement kiln in 2016

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount (ton)</th>
<th>Energy (ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF</td>
<td>94,456</td>
<td>43.28</td>
</tr>
<tr>
<td>Used tire</td>
<td>31,735</td>
<td>25.15</td>
</tr>
<tr>
<td>Total</td>
<td>126,191</td>
<td>68.43</td>
</tr>
</tbody>
</table>
Barriers for solid waste management

- Limited allocated budget for solid waste management
- Lack of co-operation between local authorities
- Lack of skill personnel in waste management practice
- Opposition against waste disposal facilities from public/communities
- Lack of public awareness/participation
Biomass-to-energy Situation
1. Promoting higher potential biomass
   • Rice straw
   • Sugarcane leaves
   • Cassava rhizome
   • Oil palm leaves and bunch
   • Corncob & stalk
   • Wood chips & Pellets

2. Promoting plantation of fast growing crops for power generation
Napier grass Project

Encourage community enterprise for energy crop production

Contract between community enterprise & biogas plant

Secure income for farmers

All stakeholders generate income from biogas utilization

Energy security in Thailand

Objective

Power generation 3,000 MW

CBG for transportation

Replace LPG
**Biomass Plan under AEDP 2015**

**Encourage biomass utilization**
- Replace fossil fuel using in local industry and in community
- Increase the utilization of unutilized biomass
- Improve the energy efficiency in agro industry (e.g. sugar mill, palm oil mill)

**R&D**
- Encourage biomass transformation: pellet
- Biomass to liquid technology
- New biomass technology (e.g. hydrothermal gasification, torrefaction)

**Promotion & Support**
- Update and provide biomass potential map
- Develop biomass excellent center
- Financial support
- Develop the biomass collection and transportation system
- Conduct the correct understanding to people
- Reduce complicate permit procedures
- Solve the bottleneck problem of national grid
- Promote plantation of fast growing trees
**Biomass Power Plant**

**PHUKAEW BIO-ENERGY**
**CHAIYAPHUM PROVINCE**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Thermal Power Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Capacity</td>
<td>80.3 MW (Install)</td>
</tr>
<tr>
<td></td>
<td>45.2 MW (Sell to EGAT, PEA)</td>
</tr>
<tr>
<td>Boiler</td>
<td>High Pressure Boiler 70 bar Eff. 90-92%</td>
</tr>
<tr>
<td>Fuel</td>
<td>Bagasse, Rice Husk, Bark</td>
</tr>
<tr>
<td>Generate Electricity</td>
<td>About 445,000,000 kWh/year</td>
</tr>
<tr>
<td>COD</td>
<td>6 September 2004</td>
</tr>
</tbody>
</table>
Biomass Power Plant

Thermal Power Plant

ROI ET GREEN
ROI ET PROVINCE

<table>
<thead>
<tr>
<th>Technology</th>
<th>Thermal Power Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Capacity</td>
<td>9.9 MW (Install)</td>
</tr>
<tr>
<td></td>
<td>8.8 MW (Sell to EGAT)</td>
</tr>
<tr>
<td>Fuel Consumption</td>
<td>Rice Husk 85,000 ton/year</td>
</tr>
<tr>
<td>Generated</td>
<td>58,600,000 kWh/year</td>
</tr>
<tr>
<td>PPA</td>
<td>21 year</td>
</tr>
<tr>
<td>COD</td>
<td>29 May 2003</td>
</tr>
</tbody>
</table>
### Biomass Power Plant

#### Gasification System

**SUPREME RENEWABLE ENERGY**

**CHIANG RAI PROVINCE**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Fixed Bed Downdraft Gasification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Capacity</td>
<td>160 kW (Install)</td>
</tr>
<tr>
<td></td>
<td>130 kW (Sell to PEA)</td>
</tr>
<tr>
<td>Fuel</td>
<td>Corn Cob, Waste Wood</td>
</tr>
<tr>
<td>Generate Electricity</td>
<td>About 905,000 kWh/year</td>
</tr>
<tr>
<td>Gas Cleaning System</td>
<td>Wet Scrubber and Biomass Filter</td>
</tr>
<tr>
<td>Product</td>
<td>Biomass Ash (Fertilizer)</td>
</tr>
<tr>
<td>COD</td>
<td>18 August 2009</td>
</tr>
</tbody>
</table>
Barriers for utilizing Solid Biomass to energy

- It is difficult to collect / transport / store.
- Unpredictable the quantities of biomass.
- Cost of biomass is not stable.
- Cost of transport is high.
- Protests by communities
AEDP 2015 - Targets

Overall Targets

30% Renewable Energy in total energy consumption by 2036

Electricity

19,684.4 MW

Heat

25,088 ktoe

Fuel

11.3 MLPD Ethanol
14 MLPD B100
+0.53 MLPD Pyrolysis Oil
+4,800 TPD of CBG

RE share 14.47% (Oct 2017)
Benefit of AEDP 2015

**Economic**
- Decrease import energy
- Increase income from CO₂ trading

**Environment**
- Reduce CO₂ emission
- Alleviate global warming

**Society**
- Increase employment
- Healthier society
Target & Current capacity from Waste under AEDP 2015

**MSW : electricity generation (MW)**
- Target: 500
- Current Capacity: 188.47

**Industrial Waste: electricity generation (MW)**
- Target: 50
- Current Capacity: 37.43

**MSW : heat generation (ktoe)**
- Target: 495
- Current Capacity: 68

Data: DEDE, Nov 2017
### Biomass (Electricity)

<table>
<thead>
<tr>
<th>Target</th>
<th>Current Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,570 MW</td>
<td>3102.28 MW</td>
</tr>
</tbody>
</table>

### Biomass (heat)

<table>
<thead>
<tr>
<th>Target</th>
<th>Data: DEDE, Nov. 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>22,100 ktoe</td>
<td>535 ktoe</td>
</tr>
</tbody>
</table>
Other Supporting Measures

- Exemption of
  - import duty on equipment or machines
  - income-corporate taxes resulting from selling RE or saving energy for periods up to 8 years

- ESCO Fund
- Data Support
  - Resource data maps
- BOI
- FiT
Feed-in Tariff (FiT) for VSPP in 2015

<table>
<thead>
<tr>
<th>Installed Capacity (MW)</th>
<th>FiT (THB/kWh)</th>
<th>FiT Premium (THB/kWh)</th>
<th>Supporting Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biobased Fuel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste-to-Energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1 MW</td>
<td>3.13</td>
<td>3.21</td>
<td>6.34</td>
</tr>
<tr>
<td>&gt; 1-3 MW</td>
<td>2.61</td>
<td>3.21</td>
<td>5.82</td>
</tr>
<tr>
<td>&gt; 3 MW</td>
<td>2.39</td>
<td>2.69</td>
<td>5.08</td>
</tr>
<tr>
<td>Landfill organic waste</td>
<td>5.60</td>
<td>-</td>
<td>5.60</td>
</tr>
<tr>
<td>Biomass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1 MW</td>
<td>3.13</td>
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</tr>
<tr>
<td>&gt; 3 MW</td>
<td>2.39</td>
<td>1.85</td>
<td>4.24</td>
</tr>
<tr>
<td>Biogas from</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wastewater/manure</td>
<td>3.76</td>
<td>-</td>
<td>3.76</td>
</tr>
<tr>
<td>Biogas from energy crops</td>
<td>2.79</td>
<td>2.55</td>
<td>5.34</td>
</tr>
</tbody>
</table>

(1) FiT<sub>V</sub> is subjected to be adjusted by core inflation
(2) Includes 3 Southern provinces (Yala, Pattani, Narathiwat) and 4 districts in Songkhla province
**Electricity generation from industrial waste**

### FiT for Industrial waste

<table>
<thead>
<tr>
<th>Capacity (MW)</th>
<th>FiT (Baht/kWh)</th>
<th>Period (year)</th>
<th>FiT Premium (Baht/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FiT&lt;sub&gt;F&lt;/sub&gt;</td>
<td>FiT&lt;sub&gt;V,2550&lt;/sub&gt;</td>
<td>FiT&lt;sup&gt;(1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>General technologies</td>
<td>3.39</td>
<td>2.69</td>
<td>6.08</td>
</tr>
<tr>
<td>Plasma technologies</td>
<td>3.39</td>
<td>2.69</td>
<td>6.08</td>
</tr>
</tbody>
</table>

- 7 projects have been accepted.

- PPAs 37.43 MW.

- SCOD: 31 December 2019

Note: (1) FiT rates will be used for projects that COD by 2017. After 2017, FiTv rates will continuously increase by core inflation.

(2) Projects in Yala, Pattani Naratiwat and 4 districts in Songkla; Chana, Tepa, Sabayoi, and Natawee
New scheme
For
Renewable Energy
Power purchase programs

VSPP: Very Small Power Producer (less than 10 MW)
SPP: Small Power Producer (10-50 MW)

SPP Waste to Energy
SPP Hybrid Firm Program
VSPP Semi Firm Program
### Feed-in Tariff for Solid Waste

#### FiT for SPP project

<table>
<thead>
<tr>
<th>Capacity (MW)</th>
<th>FiT (Baht/kWh)</th>
<th>Period (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FiT&lt;sub&gt;F&lt;/sub&gt;</td>
<td>FiT&lt;sub&gt;0,2560&lt;/sub&gt;</td>
</tr>
<tr>
<td>&gt; 10 - 50 MW</td>
<td>1.81</td>
<td>1.85</td>
</tr>
</tbody>
</table>

- Projects have to be approved by cabinet or Ministry of Interior.
- Contract of waste disposal with the municipalities
- Non-firm contract
- No competitive bidding
- Locate on municipality land area
- SCOD within 2020
### FiT for SPP Hybrid Firm

Consider the initial cost of mixing various sources of RE (Hybrid)

<table>
<thead>
<tr>
<th>Installed capacity (MW)</th>
<th>FiT (THB/kWh)</th>
<th>Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$FiT_F$</td>
<td>$FiT_{v,2560}$</td>
</tr>
<tr>
<td>SPP Hybrid Firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed capacity &gt;10-50 MW</td>
<td>1.81</td>
<td>1.85</td>
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**Note:** FiT rates will be applied for projects that COD within 2017. After that, $FiT_v$ rates will continuously increase by core inflation.

- All kinds of fuel types: Mix-sources (Hybrid) $\geq$ 1 type(s)
- Contracted capacity: $<10 – 50$ MW
- Firm all year (Peak 100% and Off-peak 65%)
- Installation of Energy Storage System is allowed.
- SCOD 2020-2021
- competitive bidding
- Target: 300 MW
### FiT Rate for VSPP semi-firm

**Type:** biomass or biogas (sewage/waste) or biogas (energy crops)

**Only 1 type of energy source; Installation of Energy Storage System is allowed.**

**Contracted capacity:** < 10 MW

**Firm (Peak 100% and Off-peak 65%) for 6 months (Covering Mar-Jun)**

Other 6 months are Non-firm.

**FiT rates by each type of fuel with competitive bidding**

**FiT Premium only for Firm-duration**

**Target:** 269 MW

<table>
<thead>
<tr>
<th>Installed Capacity (MW)</th>
<th>FiT (THB/kWh)</th>
<th>Period (years)</th>
<th>FiT Premium (THB/kWh)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>FiT&lt;sub&gt;F&lt;/sub&gt;</td>
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<td>FiT&lt;sup&gt;(1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>1) Biomass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Installed Capacity ≤ 3 MW</td>
<td>2.61</td>
<td>2.21</td>
<td>4.82</td>
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<td>4.24</td>
</tr>
<tr>
<td>2) Biogas (sewage/waste)</td>
<td>3.76</td>
<td>-</td>
<td>3.76</td>
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**Note**

(1) FiT rates will be used for projects that COD within 2017. After 2017, FiTV rates will continuously increase by core inflation.

(2) Projects in province Yala, Pattani, Narathiwat and 4 districts in Songkhla, i.e. Chana, Tepa, Saba Yoi and Nathawee District
Thank you for your attention