THAILAND’S BIOGAS DEVELOPMENT

BLUEPRINT - OPPORTUNITIES FOR GROWTH

By

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1. Energy situation summary in Thailand 2012
2. Related Energy Policies
3. Alternative Energy Development Framework
4. Green Electricity
5. Biogas Development in Thailand
1. Energy situation summary in Thailand

2012 (preliminary)

Thailand’s final energy consumption in 2012

Increased 3.9% from the previous year

73,316 ktoe
1. Energy situation summary in Thailand

2012 (preliminary)

Final energy consumption in 2012

- **Petroleum Products**: 35,187 ktoe
- **Electricity**: 18,900 ktoe
- **Coal & Its Products**: 7,900 ktoe
- **Renewable energy***: 4,800 ktoe
- **Natural Gas**: 2,700 ktoe

The greatest proportion

- **Petroleum product consumption**: 48.0%
- **Total** 73,316 ktoe

* Including solar, fuel wood, charcoal, paddy husk, bagasse, agricultural waste, MSW and biogas.

** Including fuel wood, charcoal, paddy husk and agricultural waste.
Final energy consumption by Economic sector

Total Energy Consumption in 2012 = 73,316 ktoe

Final energy consumption by economic sector

- Commercial: 7.23%
- Agriculture: 5.17%
- Residential: 15.12%
- Transportation: 35.78%
- Industry: 36.70%

Total Energy Use 2.0 million barrels (oil equivalent) per day = 1.9 trillion baht

Energy import value in 2012 = 1.125 trillion baht (Sharing 18% of GDP)

=> 77% of import value = Crude Oil
2. Related Energy Policies

The 11th National Economic and Social Development Plan (NESD: 2012-2016)

1. Promoting the just society

2. Developing human resources to promote lifelong learning society

3. Balance of **Food** and **Energy** security

4. Stable economy based on knowledge and enabling factors

5. Linkages of economic and security in the regions

6. Sustainable management of **Natural resources** and **Environment**

*Source: www.nesdb.go.th*
3. **Balance of Food and Energy security**

- Developing **natural resources** to strengthen the agricultural base
- Enhancing the agricultural **productivity and value creation**
- Promoting **job and income security** for farmers
- Developing **bio-energy security** to support the national development and agricultural sector
- Improving the **agricultural management** to ensure the balance of food and energy
- Enhancing **food and bio-energy security and biomass** at household and Community level

Source: www.nesdb.go.th
5. Managing **Natural resources an Environment towards sustainability**

- Conserving and restoring the natural resource base and the environment
- **Shifting development Paradigm towards the Low Carbon Society**
- Enhancing adaptive capacity to achieve climate-resilient society
- Building immunity from the use of trade measures to protect the environment
- Enhancing Thailand’s role in the global environmental forum and international cooperation
- Preventing and reducing pollution
- Improving the efficiency, transparency and equity of the natural resource and environment management system

Source: www.nesdb.go.th
Shifting development paradigm and driving Thailand towards Low Carbon Society

(1) Restructure production sectors towards low carbon economy
(2) Increase energy efficiency in transportation and logistics
(3) Develop Environmental friendly cities by integrating the culture, society and ecology aspects
(4) Change consumption behavior to achieve low carbon society
(5) Utilize the measures of generating income from Natural resource and Biodiversity conservation.

Source: www.nesdb.go.th
2. Related Energy Policies

5 Energy Policies

- Enhancing energy-related industries & business to be next generation value-creator
- Securing country’s energy supply
- Pricing energy right
- Up-scaling RE mix to 25% in 10 years
- Targeting Energy Intensity Reduction by 25% (based on 2010 level) within 20 years.

Miss. Yingluck Shinawatra
Thailand’s Prime Minister
3. Alternative Energy Development Framework

Committed to the development of low-carbon society

10 years Alternative Energy-Development Plan (AEDP-Master Plan 2012-2021)

Private-Led Investment

Target 25% of RE (excl. Large Dams, Imported Hydro & Traditional Biomass) in Total Energy Consumption By 2021

New energy
- Ocean & Tidal: 2 MW, 3 MW
- Geothermal: 1 MW
- Solar: 2,000 MW, 3,200 MW
- Wind: 1,200 MW, 1,608 MW

Hydro power plant
- Small: 324 MW
- Micro: 1,284 MW
- Pumped-Storage: 1,608 MW

Bio-energy
- Biomass: 3,630 MW
- Bio-gas: 600 MW
- MSW: 160 MW

Biofuels
- Ethanol: 9 ML/day
- Bio-diesel: 5.97 ML/day
- 2nd - Gen. Biofuels: 25 ML/day

Excl. Large Dams & Imported Hydro
Excl. Traditional Biomass

Renewable fuel 44%
### Benefit Gain for Thailand

<table>
<thead>
<tr>
<th>Benefit Gain for Thailand</th>
<th>AEDP for 25% in 10 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Aspect</strong></td>
<td></td>
</tr>
<tr>
<td>* Percentage of Fossil Substitution</td>
<td>25 % (excluding NGV)</td>
</tr>
<tr>
<td>* Power Generation from Renewable Energy</td>
<td>9,201 MW</td>
</tr>
<tr>
<td>* Thermal Generation (ktoe)</td>
<td>9,333</td>
</tr>
<tr>
<td>** Percentage of Oil Substitution</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Economic Aspect (unit: million USD/year)</strong></td>
<td></td>
</tr>
<tr>
<td>* Reducing Oil Import</td>
<td>18,516</td>
</tr>
<tr>
<td>* Promoting Investment from Private Sector</td>
<td>14,258</td>
</tr>
<tr>
<td><strong>Environmental Aspect</strong></td>
<td></td>
</tr>
<tr>
<td>* CO₂ Reduction</td>
<td>76 mt/yr in 2012</td>
</tr>
<tr>
<td>* Revenue Gained from Selling Carbon Credit</td>
<td>742 million USD</td>
</tr>
</tbody>
</table>

**1 USD = 31 Baht**
Strategies for AEDP

- Promote RE on the Community scale
- Encouraging Private Investment
- Improve Relevant Infrastructure
- Promote R&D as a tool for RE industry
- Promote better understanding
- Modifying outdated rules and regulations
### Strategies for AEDP

<table>
<thead>
<tr>
<th>Solar</th>
<th>Wind</th>
<th>Biomass</th>
<th>Biogas</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Promote solar PV rooftop</td>
<td>• Small-wind for community</td>
<td>• Dedicated Energy Crops</td>
<td>• Waste-water and animal farms</td>
</tr>
<tr>
<td>• Develop “Smart-grid” system</td>
<td>• Promote wind for water-pumping in Agri-sector</td>
<td>• Agricultural wastes ➔ Focusing on “Bagasse” from Sugar Mills</td>
<td>• Biogas network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• CBG-Compressed Biogas-for transportation</td>
</tr>
</tbody>
</table>
Measures for promoting AEDP

**Measure for RE Promotion**

1. **BOI - Investment Incentives**
   - Renewable energy maps
   - Data from demonstration site
   - Renewable energy potential info

2. **Investment Grant**
   - 1. Biogas
   - 2. Solar hot water
   - 3. MSW

3. **“Energy Soft Loan”**
   - Revolving funds for Renewable energy and energy conservation

4. **ESCO Venture Capital Fund**

5. **Future change of “Adder” to Feed-in Tariff (FIT) Policy**

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**Offices giving licenses**
- ONEP EIA
- ERC-DIW
- Local Admin

**Private Investor**

- Technical support
- Subsidy request

- Banks
- Loan

**Electricity authorities**

**Consumers**

**CDM**

**Note**
- **EPPO**: Energy Policy and Planning Office (www.eppo.go.th)
- **BOI**: The Board of Investment of Thailand (www.boi.go.th)
- **DEDE**: Department of Alternative Energy Development and Efficiency (www.dede.go.th)
Performance on Alternative and Renewable Energy Policy as of 2012
(Energy in Thailand: Fact & Figure 2012; www.dede.go.th)

<table>
<thead>
<tr>
<th>TYPES OF ENERGY</th>
<th>unit</th>
<th>Target 2021</th>
<th>As of 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>MW</td>
<td>9,201</td>
<td>2,786</td>
</tr>
<tr>
<td></td>
<td>ktoe</td>
<td>1,138</td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>MW</td>
<td>2,000</td>
<td>376.72</td>
</tr>
<tr>
<td>Wind</td>
<td>MW</td>
<td>1,200</td>
<td>111.73</td>
</tr>
<tr>
<td>Small Hydro Power</td>
<td>MW</td>
<td>1,608</td>
<td>101.75</td>
</tr>
<tr>
<td>Biomass</td>
<td>MW</td>
<td>3,630</td>
<td>1,959.95</td>
</tr>
<tr>
<td>Biogas</td>
<td>MW</td>
<td>600</td>
<td>193.40</td>
</tr>
<tr>
<td>MSW</td>
<td>MW</td>
<td>160</td>
<td>42.72</td>
</tr>
<tr>
<td>New energy</td>
<td>MW</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Heat</td>
<td>ktoe</td>
<td>9,335</td>
<td>4,886</td>
</tr>
<tr>
<td>Solar</td>
<td>ktoe</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Biomass</td>
<td>ktoe</td>
<td>8,200</td>
<td>4,346</td>
</tr>
<tr>
<td>Biogas</td>
<td>ktoe</td>
<td>1,000</td>
<td>458</td>
</tr>
<tr>
<td>MSW</td>
<td>ktoe</td>
<td>35</td>
<td>78</td>
</tr>
<tr>
<td>Biofuels</td>
<td>million litres / day</td>
<td>39.97</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>ktoe</td>
<td></td>
<td>1,270</td>
</tr>
<tr>
<td>Ethanol</td>
<td>million litres / day</td>
<td>9</td>
<td>1.4</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>million litres / day</td>
<td>5.97</td>
<td>2.7</td>
</tr>
<tr>
<td>New Energy Replacing Diesel</td>
<td>million litres / day</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>%AE</td>
<td></td>
<td>25%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

(Energy in Thailand: Fact & Figure 2012; www.dede.go.th)

Install capacity of renewable power generation*

<table>
<thead>
<tr>
<th>Types of Energy</th>
<th>MW</th>
<th>ktoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>376.72</td>
<td>42</td>
</tr>
<tr>
<td>Wind</td>
<td>111.73</td>
<td>12</td>
</tr>
<tr>
<td>Small Hydro Power</td>
<td>101.75</td>
<td>27</td>
</tr>
<tr>
<td>Biomass</td>
<td>1,959.95</td>
<td>951</td>
</tr>
<tr>
<td>Biogas</td>
<td>193.40</td>
<td>87</td>
</tr>
<tr>
<td>MSW</td>
<td>42.72</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,786.27</strong></td>
<td><strong>1,138</strong></td>
</tr>
</tbody>
</table>

7.6% Of Total power capacity in Thailand
MAP OF BIOGAS POWER PLANT IN THAILAND

http://www.dede.go.th

<table>
<thead>
<tr>
<th>PROVINCE</th>
<th>ANIMAL WASTE</th>
<th></th>
<th>INDUSTRIAL WASTE WATER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QUANTITY (ton)</td>
<td>ENERGY POTENTIAL (ktoe)</td>
<td>QUANTITY (ton)</td>
<td>ENERGY POTENTIAL (ktoe)</td>
</tr>
<tr>
<td>WHOLE KINGDOM</td>
<td>15,752,666</td>
<td>347.71</td>
<td>973,763,500</td>
<td>553.29</td>
</tr>
<tr>
<td>NORTHERN</td>
<td>2,695,665</td>
<td>60.88</td>
<td>94,814,630</td>
<td>53.88</td>
</tr>
<tr>
<td>NORTHEASTERN</td>
<td>6,284,765</td>
<td>129.60</td>
<td>412,699,196</td>
<td>234.49</td>
</tr>
<tr>
<td>CENTRAL</td>
<td>5,335,743</td>
<td>123.73</td>
<td>388,180,745</td>
<td>220.56</td>
</tr>
<tr>
<td>SOUTHERN</td>
<td>1,436,493</td>
<td>33.50</td>
<td>78,068,929</td>
<td>44.36</td>
</tr>
</tbody>
</table>

Data from: Annual Report “Thailand Alternative Energy Situation 2011”
www.dede.go.th
### 5. BIOGAS Development in Thailand

<table>
<thead>
<tr>
<th>Target</th>
<th>Phase I (2012-2016)</th>
<th>Phase II (2017-2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (MW)</td>
<td>350 (MW)</td>
<td>600 (MW)</td>
</tr>
<tr>
<td>Heat (ktoe)</td>
<td>713 (ktoe)</td>
<td>1,000 (ktoe)</td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td><strong>197.95 MW</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Heat</strong></td>
<td><strong>450.46 ktoe</strong></td>
<td></td>
</tr>
</tbody>
</table>

*As June 2013*
1. Future focus on biogas production by household and community
2. Implement pilot project "Utilization of biogas in transport sector" (bio-methane technology)

Target groups

- Livestock farm
- Energy crop
- Processed agriculture & industrial waste
  - Palm oil extraction factories
  - Sugar mills & ethanol factories
  - Cassava starch factories
- Chicken & Slaughter
- Large & medium size pig farms

5. BIOGAS Development in Thailand
5. BIOGAS Development in Thailand

Action Plan for Biogas Development of Thailand

**Short Term**

- **Promotion of Proven Technologies**
  - Waste water from industries
    - Tropical Starch, Palm oil, Food Rubber Ethanol
  - Waste water from farms
  - Other (Abattoir, poultry processing Zoo SME)

- **Removal system of COx and H₂S**
  - Household biogas digester (Thai-China)
  - Household biogas digester

**Long Term**

- **Non-Proven Technologies**
  - Support the entrepreneur / Invest overseas
  - Mix Power Plant
  - Industry
    - Biomass, Energy crop, Co-Digestion
  - Local Content
    - (Gas Engine, Gas Flare, Gas Blower other)
  - Alternative raw materials
    - Biomass to Biogas, Waste mixture (Co-Digestion)

- **Bio-methane**
  - Demonstration center
    - Green community
  - Pilot project of Biogas Network
  - Pilot project of Mix Power Plant

- **Other support**
  - Standard
    - Testing Centre
    - Stipulate construction and equipment standards
    - Stipulate design standards
    - Stipulate safety standards
  - Bio-methane management plan
    - Biogas Excellent Center
    - Biogas Network
  - Standard of Bio-methane
    - Develop Biogas database system Website
    - Develop human resource
  - Implement energy curriculum in Education Institutes
## Development Guidelines

1. **Promoting community** to collaborate in broaden production and consumption of renewable energy
   - **Household level**, especially Rural community
   - **Biogas network**

2. **Adjusting incentive measures** for investment from private sector appropriated with the situation
   - Biogas for Compress Bio-Methane Gas (CBG) production

3. **Amending laws and regulations** which do not benefit to renewable energy development
   - **Biogas safety Standard**

4. **Public Relations and building up** comprehensive knowledge of people
   - Conduct public relations via media to disseminate knowledge and news “Biogas Safety Campaign”

5. **Promoting research work** as mechanism in development of integrated renewable energy industry
   - **Mixed wastes** (Co-Digestion)
   - **Energy Crop**
   - CBG for transportation

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### 5. BIOGAS Development in Thailand

**Biogas for power generation**
Status of Heat and Electricity Producing Technologies from Biogas

- Raw Material:
  - Ind. Waste water
  - Farm Waste
  - Bio-crop
  - OFMSW/ Household waste

- Pre-treatment:
  - Mechanical
  - Thermal
  - Enzyme
  - Acid/alkaline

- Conversion Technology:
  - Conventional / Modified Covered lagoon
    - CSTR
    - UASB
    - Hybrid (AFF+UASB)
    - ECSSB
    - Internal Circulation
    - Anaerobic Membrane reactor

- Biogas Cleaning Technology:
  - Bio-scrubber
  - Gasifier
  - Bio-digester
  - Water Absorption
  - Membrane
  - Pressure swing

- Biogas Utilization:
  - Burning for heating
  - Gas engine for EE
  - For vehicle
  - CHP
  - Fuel Cell
  - Adsorption chiller

- Commercial Status:
  - Fully commercial in Thailand
  - Partially commercial in Thailand
  - Under development
  - World Fully commercial
  - World Under commercial
The research and development of biogas technologies

**Group 1**
Research on potentials of raw materials focuses on the overall potential of materials.

**Group 2**
Research on material preparation process before being transformed into biogas involves study on pre-treatment of new materials.

**Group 3**
Research on biogas production technologies focuses on developing production process and improving efficiency of biogas production from a variety of materials.

**Group 4**
Research on ways to improve biogas quality focuses on improving biogas for a variety of application, such as heat and power production, and automobile fuel.

**Group 5**
Research on economics and environmental impact of biogas focuses on the costs and environmental impacts, especially from the pollution created from biogas production.
5. BIOGAS Development in Thailand

- Develop Curriculum, Training and promote the knowledge about biogas
  - 4 curriculums, Training > 1,000 persons

- Biogas production from Manure

- Promote biogas **Power generation** and **Thermal usage** in:
  - Tapioca, rice flour, palm oil, food oil rubber, ethanol,
  - Food processing, paper
  - Animal farm, large medium and small

- Adder for biogas power generation and thermal usage

- Operation of the biogas production and Safety manual for Industries and Farm

- Purification or Upgrading Biogas to Bio-methane

- Biogas production from
  - Biomass (Cassava roots, Pineapple stubble)

- System prototype demonstration project producing biogas in Dusit Zoo

- The development of biogas from pig farms for Transportation utilization project (CBG production 3 tons/day)

- Biogas Network (700 houses in Phatthalung province)
5. BIOGAS Development in Thailand

**Ongoing**

- Database of Biogas potential in Thailand
- **Household biogas digester** (Cooperation with China) 300 units
- Biogas production in four **Zoos**
- Alternative raw materials
  - Mix waste (Co-Digestion), Energy crop
Thank you for your attention

DEDE: Knowledge Base organisation and sustainable development Centre of RE and EE