MSW policy and WTE in Thailand

Assoc. Prof. Dr. Sirintornthep Towprayoon
Dr. Komsilp Wangyao
Center of Excellence on Energy Technology and Environment

Global situation

• Approx. 2.5-4 Billion tonnes of waste generated per year (data in 2006)
• MSW is accounted more than half

Current waste generation trend in Thailand

Waste generation rate = 0.64 kg/cap/d in 2005

~1% / year

~5% / year

Revolution of waste management concept

Evolution of Waste Technology concept
### Waste Recycle and Utilization

- **Recycle**: 10798 tpd
- **Sanitary landfill**: 15782 tpd
- **Open dumping**: 14951 tpd

#### Waste Recycle

- **Paper**: 57%
- **Glass**: 19%
- **Plastic**: 15%

The recycling rate has increased approximately 9% per year.

#### Integrated Systems

- **Waste generated**: 15.03 M tons
- **Sanitary landfill**: 15.7 M tons (38%)
- **Open dumping**: 9.32 M tons (36%)
- **Recycle**: 3.3 M tons (26%)
- **Compost and biogas**: 0.249 M tons (7%)
- **Heat and electricity**: 0.126 M tons (4%)

### Current MSW management

- **Waste generate from sources**
- **Waste stream 1**
- **Waste stream 2**
- **Waste stream 3**

#### MSW Disposal Facilities

- **Sanitary Landfill**
  - Working – 97 sites
  - Never Run (due to NIMBY) – 6 sites
  - Stop Operating – 8 sites
  - Under Construction – 16 sites

- **Incineration**
  - Phuket – 250 tons/day
  - Samui Island** – 150 tons/day
  - Lamphun** – 20 tons/day
  - System Stop due to Maintenance

- **Composting**
  - Heat and electricity 0.126 M tons (4%)

**Source**: Surveys of Waste and Hazardous Substances Management Bureau, Pollution Control Department, Nov 10, 2010
Most waste in Thailand has high organic composition, similar to other Asian countries. 

Source: BMA, 2009

Problems encounter

1. Limited allocated budget for solid waste management
2. Lack of co-operation between local authorities
3. Lack of skill personnel in waste management practice
4. Ineffective waste recycling program/regulations
5. Opposition against waste disposal facilities from public/communities
6. Lack of public awareness/participation

Current technology

- Landfill
- Open Dump
- Composting
- Incineration
- Anaerobic Digestion
- Mechanical Biological Treatment
- Sorting Plant

Landfill

Source: Chart: Chiemchaisri, KS
**OPEN DUMPS**

![Open Dumps Image](image1.png)

**Anaerobic Digestion**

Organic Waste Compost and Energy Production Plant, Rayong

70-80 Td

Sorting

Power generated of 625 kW

Gas Collection Tank

Gas Digester

**Local Implementation of Anaerobic Digestion**

- Bingas at SamChuk, Supanburi Province
  - Waste from market and restaurant
  - 23 household use biogas

**Composting**

BMA and some market waste treatment
Static Pile Composting System for Market Wastes (5 tpd)

Production rate 20 ton/day

Organic Fertilized Plant in Nonthaburi

Composting at Nonthaburi Municipality

Incineration
3 incineration plants
Solid Waste Management Programme for Phitsanulok by GTZ


- Reducing municipal solid waste generation rate to not more than 1kg/person/day;
- Utilizing municipal solid waste by at least 30%;
- Increasing coverage of sanitary disposal of municipal solid waste by at least 40%;
- Separating municipal hazardous waste and safely disposing of it by at least 30%;
- Establishing a center for municipal hazardous waste management in each region.

To achieve these targets, integrated waste management is included in the national agenda.

National Integrated Waste Management Policy

- Applying 3Rs for achieving waste reduction & utilization;
- Promoting the integrated waste management system to reduce the landfill areas and generate the renewable energy;
- Encouraging the cooperation of adjacent Local Governments for establishment of waste management facility;
- Endorsing public and private sectors to participate in waste management project.
The draft of the National 3Rs Strategy

i) Production and distribution – enhance proper designing of goods and packages, promote manufacturing and distribution of eco-friendly products, etc.;

ii) Consumption - increase public participation in using reusable, recyclable, and eco-friendly products, etc.;

iii) Reuse, recycling, treatment, and disposal - promote waste separation at source, enhance the use of biodegradable waste for soil amendment and energy use, encourage the use of non-recyclable waste for thermal recovery, etc.

Targets for reduction, reuse, and recycling

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Reduction targets (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012-2016</td>
</tr>
<tr>
<td>1. Waste reduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Utilization of solid waste and recycling materials</td>
<td></td>
</tr>
<tr>
<td>2.1 Material recycling</td>
<td>20</td>
</tr>
<tr>
<td>2.2 Waste to energy (thermal recovery)</td>
<td>5</td>
</tr>
<tr>
<td>2.3 Biodegradable recovery (composting, anaerobic digestion)</td>
<td>5</td>
</tr>
<tr>
<td>3. Total recovery</td>
<td>30</td>
</tr>
<tr>
<td>4. Total achievements (targets 1, 2)</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: Draft of National 3Rs Strategy, PCD, 2011

National Climate Change Strategies

GHG emission from the solid waste treatment in 2000 was 4.89 MtCO2 equivalents which were approximately 2.1% of total GHG emissions

The National Climate Change Strategies include reducing organic waste composition in waste for disposal, upgrading waste disposal technology from open dumping to sanitary landfill, and promoting the 5Rs (reduce, reuse, recycle, refill, repair) for waste management. Waste separation is promoted to enhance waste utilization and resource recovery. Waste to energy and composting are recommended.
Policy Frameworks

Supporting Local Government Clusters to obtain long-term effectiveness of waste management

Clusters of Local Governments

<table>
<thead>
<tr>
<th>CLUSTER SIZES</th>
<th>Numbers</th>
<th>MOU agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGE &gt; 500 tons/day</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MEDIUM 250 – 500 tons/day</td>
<td>206</td>
<td>140</td>
</tr>
<tr>
<td>MEDIUM 100 – 250 tons/day</td>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td>MEDIUM 50 – 100 tons/day</td>
<td>88</td>
<td>65</td>
</tr>
<tr>
<td>SMALL &lt; 50 tons/day</td>
<td>92</td>
<td>57</td>
</tr>
<tr>
<td>Total</td>
<td>301</td>
<td>207</td>
</tr>
</tbody>
</table>

Source: PCD

Policy Frameworks

Endorse the Partnership between Governments and Private Sectors for Implementing Integrated Waste Management

WTE Strategic Approaches

Integrated Waste Management System Specifically for Generating Renewable Energy
Alternative Energy Development Plan: AEDP (2012-2021)

Target on Using Renewable Energy at 28 Percent of Total Energy Consumption by 2021

Energy from waste: MSW

1. Promoting community to collaborate in broaden production and consumption of renewable energy
   – Promote and support producing energy from MSW in the medium and small sizing Local Admin Organizations.
   – Promote and support producing energy from MSW in small communities, for instances: schools, temples, communities, local organizations.

Energy from waste: MSW

2. Amending laws and regulations which do not benefit to renewable energy development
   – Speed up the amendment of Joint Venture (Allowing the Private Sector for Co-working or Implementing the Government Enterprises) Act B.E 2535 to benefit for private sector to co-invest with Local Admin Organization in producing energy from MSW by all types, especially RDF (Refuse-Derived Fuel) type, then to co-generate heat and power in factory, includes promote producing oil derived from plastic waste.
3. Public Relations and building up comprehensive knowledge of people

— Build up the collaboration in targeted area for establishment of waste to energy system, conduct campaign to educate children and juveniles in the detailed waste management for energy and environment at local level.

Source: AEDP (2012-2021)

4. Promoting research work as mechanism in development of integrated renewable energy industry

— Study the RDF (Refuse-Derived Fuel) management
— Research, develop the domestic production of incinerator and the small waste to energy system at capacity not over 50 t/day.
— Develop the standards and appliances for producing oil from plastic waste

Source: AEDP (2012-2021)
Adder Cost approved by the Cabinet on 24th March, 2009

<table>
<thead>
<tr>
<th>Fuel Types / Size</th>
<th>Adder (Baht/kwh)</th>
<th>Extra Adder1 (Baht/kwh)</th>
<th>Extra Adder2 (Baht/kwh)</th>
<th>Period (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Biomass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity ≤ 1 MW</td>
<td>0.50</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>Capacity &gt; 1 MW</td>
<td>0.30</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>2. Biogas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity ≤ 1 MW</td>
<td>0.50</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>Capacity &gt; 1 MW</td>
<td>0.30</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>3. MSW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD / Land Fill Gas</td>
<td>2.50</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>Thermal Process</td>
<td>3.50</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>4. Wind Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity ≤ 50 kW</td>
<td>4.50</td>
<td>1.50</td>
<td>1.50</td>
<td>10</td>
</tr>
<tr>
<td>Capacity &gt; 50 kW</td>
<td>3.50</td>
<td>1.50</td>
<td>1.50</td>
<td>10</td>
</tr>
<tr>
<td>5. Mini Hydro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity 50 kW – &lt; 200 kW</td>
<td>0.80</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>Capacity &lt; 50 kW</td>
<td>1.50</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
</tr>
<tr>
<td>6. Solar PV</td>
<td>8.00</td>
<td>1.50</td>
<td>1.50</td>
<td>10</td>
</tr>
</tbody>
</table>

Notes: 1 = Electricity from Renewable Energy for diesel oil replacing 2 = For 3 Southern Provinces

Electricity generation from waste (MW)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of projects</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incinerator/Gasifier</td>
<td>3</td>
<td>4.22</td>
</tr>
<tr>
<td><strong>Landfill gas to energy</strong></td>
<td>7</td>
<td>21.23</td>
</tr>
<tr>
<td>Anaerobic digestion</td>
<td>5</td>
<td>2.034</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27.484</td>
</tr>
</tbody>
</table>

Source: DEDE – March 2012

Heat generation from waste (ktoe)

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Hotel and canteen</th>
<th>School</th>
<th>Market</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.82</td>
<td>0.64</td>
<td>0.23</td>
<td>0.02</td>
<td>1.71</td>
</tr>
</tbody>
</table>

Source: DEDE – March 2012

Small scale AD in schools

Source: DEDE – March 2012
Community scale AD and RDF production

![AD 0.8 tpd](image1)

![MBT 4.2 tpd](image2)

Source: DEDE – March 2012

Place: Nong Muang, Lopburi

---

### Waste related projects which approved and received LoA

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Project Details</th>
<th>Project lifetime (yrs)</th>
<th>Generated Electricity (MW)</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jansensompong Corporation Rachathewa Landfill Gas to Energy Project</td>
<td>Generate electricity from municipal waste</td>
<td>20</td>
<td>1 MW</td>
<td>Registered to CDM EB</td>
</tr>
<tr>
<td>Biennasia Project Thailand 1</td>
<td>Generate electricity from landfill gas</td>
<td>10</td>
<td>2 MW</td>
<td>Issuance of CERs</td>
</tr>
<tr>
<td>Jansensompong Corporation Panomsarakham Landfill Gas to Energy Project</td>
<td>Generate electricity from landfill gas</td>
<td>10</td>
<td>1.02 MW x 2 Units</td>
<td>Under validation process by DOE</td>
</tr>
<tr>
<td>Chiang Mai Landfill Gas to Electricity Project</td>
<td>Generate electricity from landfill gas</td>
<td>21</td>
<td>1.26 MW x 3 Units</td>
<td>Under validation process by DOE</td>
</tr>
<tr>
<td>Bangkok Ramphathai East Landfill Gas to Electricity Project</td>
<td>Generate electricity from landfill gas</td>
<td>21</td>
<td>1.003 MW x 9 Units</td>
<td>Registered to CDM EB</td>
</tr>
<tr>
<td>Bangkok Ramphathai West Landfill Gas to Electricity Project</td>
<td>Generate electricity from landfill gas</td>
<td>21</td>
<td>6 MW</td>
<td>Registered to CDM EB</td>
</tr>
<tr>
<td>Active Synergy Landfill Gas Power Generation Project Nakhon Pathom</td>
<td>Generate electricity from landfill gas</td>
<td>10</td>
<td>1 MW</td>
<td>Registered to CDM EB</td>
</tr>
<tr>
<td>Rak Ban Roi (RBR) Integrate Municipal Solid Waste Management and Utilisation Facility</td>
<td>Generate electricity from domestic waste biogas (AD)</td>
<td>30</td>
<td>500 kW x 12 Units</td>
<td>Under validation process by DOE</td>
</tr>
</tbody>
</table>

Source: TGO, 2012
Projects that received CERs

- **Bionersis Project Thailand 1**: CERs issued is 21,594 tCO₂e (1 Apr 2010 – 31 Dec 2010)
- **Bangkok Kamphaeng Saen West: Landfill Gas to Electricity Project**: CERs issued is 87,868 tCO₂e (20 Jan 2011 – 2 May 2011)
- **Active Synergy Landfill Gas Power Generation Project Nakhon Pathom**: CERs issued is 75,192 tCO₂e (18 Nov 2010 – 31 May 2011)
- **Bangkok Kamphenng Saen East : Landfill Gas to Electricity Project**: CERs issued is 85,138 tCO₂e (21 Jan 2011 – 31 May 2011) and 2nd CERs issued is 123,736 tCO₂e. (1 Jun 2011 – 31 Oct 2011)

\[ \sum = 269,792 \text{ tCO}_2 \text{e} \]

Source: TGO, 2012
Conclusion

• Waste to energy has been promoted in Thailand due to its composition and the need of renewables to replace fossil according to national policy
• Policy support both upstream (waste recycle and waste separation) and downstream (CDM, adder) process
• High opportunity for WtE in tropical country