Waste-to-Energy Projects in GMS – as Private Sector Business

Heinrich Seul
CBE Thailand
31 January 2018
Asia is World Leader in Waste Ocean Dumping

Asia’s Urban Waste in 2025: 750 million tons per year
Waste in GSM = 90+% Transport & Dump

Reasons

• Tipping Fee covers Transport – not Treatment
• 3 Year Contracts are no Basis for WtE Investment
Dumping causes massive Pollution & Health Risks

- Leachate to Soil to Groundwater to Biosphere
- Cancer, Leukaemia, Genetic & Autoimmune Defects, Organ Failure

- GLOBAL WARMING
  - Avian Influenza (H5N1), Cholera, Dengue Fever, Enteric & Coli
  - Bacteria, Hanta Virus, Hepatitis, HIV, Leptospirosis, Mad Cow Disease (BSE)

- PERSISTENT ORGANIC POLLUTANTS (POP), POTENTIALLY TOXIC ELEMENTS (PTE)
  - PAH (Polycyclic Aromatic Hydrocarbons), BPA (Bisphenol A), PCB (Polychlorinated Biphenyl), Dioxines, Furan, Benzene, Toluene, Chlorene, Heavy Metals

- ENVIRONMENTAL POLLUTION
  - Phenoless, Toluene, Benzene, Poly Chlorinated Biphenyls, Ammonia, Dioxins, Chlorinated Pesticides, Heavy Metals, Other Chemicals

- Leachate to Soil to Groundwater to Biosphere Cancer, Leukaemia, Genetic & Autoimmune Defects, Organ Failure
RDF Recovery doesn’t change that
How can Incineration be a Solution for GMS?

When in Industrial Nations Incinerators are

- owned by the Public Sector
- Tax funded & Loss making
- Burning a different Type of Waste
- Co-firing Fossil Fuel
- Relying on a safe Disposal Periphery
Emerging Private Sector WtE in GMS.

WtE projects under BOO planned or operating
Typical Public Sector Qualification Criteria.

... appear mostly transaction rooted.

- Proof of Technology
- Proof of Finance
- Guarantee tons of MSW / day
- Not exceeding land area provided
- Not exceeding 10% to landfill
- Lowest Tipping Fee offered wins
- Shortest Project Delivery time wins
- Local Supply Scope Minimum
- National Emissions Standards
... vs. the Structural Barriers to Best Practice ...

- Treatment of Highly Polluted Leachate
- Incomplete Combustion Co-Firing of Diesel or Coal
- No Sorting, No Pre-Treatment
- Spontaneous, unwanted Sothing
- Spontaneous, unwanted Slagging
- Safe Disposal for Incineration Ash
- Safe Disposal for Filterdust
- High, unstable Air Emissions
- Private Sector

All cost and risk for waste supply, composition, variability, waste processing, organics/leachate treatment, power generation and residue landfilling are in private sector scope. Usually no public periphery for wastewater/leachate treatment or hazardous waste landfill is available.
Incineration Waste Japan = Dry & Source Separated

Nakatsugawa City Garbage Collection Guide

Burnable Garbage (燃えるごみ) • • • It is collected twice a week.
Burnable waste should be placed in the designated area by 8:30AM on the morning of its collection day. If the items are too large to fit into the garbage bags, please wait for the "large burnable items" collection day.
- Foodstuffs (if the product contains water, please remove it before disposal). If there is any cooking oil present, please blot with a newspaper to remove from the foodstuff.
- Wood and Bamboo Items: If possible, please compact items as much as possible before disposal. The items should be no bigger than 30cm in height.
- Plastic Garbage: Plastic bottles should not be mixed with the PEI or with the GPS symbol. Also, general waste such as plastic cups, plastic bags and plastic toys.
- Handbags, Plastic Hosepipe, etc. (Please remove any metal contained within these items)
- Please out the newspaper lengths not exceeding 40cm. These items should be placed in the white waste bags available at convenience stores and some supermarkets.

Non-burnable Garbage (燃えないごみ) • • • It is collected once a month.
- Ceramic and glass items: Such as plates, glasses, flowerpots, tea and coffee cups etc. For safety, please wrap these items in an old newspaper before placing them into the refuse bag.
- Electrical waste: Excluding the items listed in the Recyclable Electrical Waste section, all other electrical waste should be disposed on this day. Please remove the electrical cord from all electrical waste before disposal. The cord should be disposed on of the "Hard Goods Garbage" collection day.
- Metal Waste: Such as pans, golf clubs, metal buckets etc. The head of the golf club should be removed if it is not metal and disposed of on the relevant day. The thickness of the metal pipe (not the radius of the whole pipe) should be no more than 3mm. If it exceed 3mm, please dispose of the "Hard Goods" collection day.
- Recyclable goods (再資源化ものを) • • • It is collected once a month.
- Aluminum and steel cans, including 18 liter cooking oil containers. Please wash before disposal. As for the 18 liter containers, please put them in half before disposal. If you are unable to do this, then these items should be disposed of on the "Non-burnable Garbage: Metal Waste" day.
- Glass bottles wine, spirits, glass food jars etc. These items should be separated into their relevant colors (brown is separate from clear which is also separate from blue, black and green bottles).
- PET Bottles. Any plastic bottle with the PEI mark. Once again, the cap should be removed and the bottle washed. The cap should be disposed of on its relevant collection day depending on what material it is made from.
- COSMETIC BOTTLES (GLASS), MINERAL GLASS, and HEAT-RESISTANT GLASS SHOULD BE DISPOSED OF ON the "NON-BURNABLE GARBAGE: CERAMIC AND GLASS ITEMS".
- Other burnable items, such as gasoline, gas bottles and other flammable items.
- Other burnable items, such as gasoline, gas bottles and other flammable items.
- Other burnable items, such as gasoline, gas bottles and other flammable items.
- Other burnable items, such as gasoline, gas bottles and other flammable items.
- Other burnable items, such as gasoline, gas bottles and other flammable items.

Dangerous items/special waste (危険で処理ができないものを) • • •
- Aerosols. (Including spray-paint aerosols, hair sprays, deodorant etc) Please puncture the aerosol container so that the gas escapes before disposal.
- Cigarette lighters
- Fluorescent light tubes, thermometers
- ATTENTION: Gas bottles, fire extinguishers, and car batteries must not be disposed of on this day.
- Hard and/ or Heavy Waste (頑丈无物) • • •
- Sharp edged tools and cutlery: Including scissors and kitchen knives.
- Hard iron/metal objects: Including golf club heads, hammers, dumbbells etc.
- Metal pipes (over 3mm in thickness), or metal lugs.
- Electrical Cords.
- Garden implements and tools: Including hoes and garden scissors etc.

Information Center of Garbage Collection

Environment Center Tel: 0573-66-2544 (Kanikyo Center: Burn up center)
Nakatsugawa City Tel: 0573-66-1111 (Gomoneyoushihishitsu)
Sakasima General Office Tel: 0573-75-2115 (Seikatsu Fukushika)
Pukokusa General Office Tel: 0573-72-2115 (Seikatsu Fukushika)
Takakishi General Office Tel: 0573-65-2111 (Seikatsu Fukushika)
Kashino General Office Tel: 0573-68-2115 (Seikatsu Fukushika)
Hirusa General Office Tel: 0573-65-2115 (Seikatsu Fukushika)
Kawase General Office Tel: 0573-74-2111 (Seikatsu Fukushika)
Tabagusa General Office Tel: 0573-75-2126 (Seikatsu Fukushika)

If we all recycle, we can make the world a cleaner place!
Incineration in Germany = Dry & Source Separated

* German Residual Waste 2009

- Organics: 30%
- Paper: 6%
- Plastics: 5%
- Glass: 3%
- Inert: 1%
- Textile: 4%
- Composites: 4%
- Wood: 1%
- Metal: 1%
- Tissue: 13%
- Other: 2%
- Fine 10mm: 7%
- Middle 50mm: 23%
- 20-30% Moisture
Incineration Waste  GMS* = open to all sources

* Example from Thailand

- Household: 41%
- Street: 16%
- Temp. Disposal Site: 12%
- Market: 12%
- School: 3%
- Shop: 2%
- Car/Bus Station: 3%
- Office: 2%
- Hotel: 6%
- Hospital: 3%

Moisture: 60-70%
Incineration Waste in GMS* = wet & inconsistent

* Example from Thailand

- **Organics**: 55%
- **Paper**: 21%
- **Plastic**: 13%
- **Wood**: 0%
- **Textiles**: 1%
- **Rubber**: 0%
- **Metals**: 1%
- **Glass**: 2%
- **Demolition**: 1%
- **Hazardous**: 1%
- **Other**: 5%
- **Demolition + Hazardous**: 2%
- **60-70% Moisture**
### Types of Solid Waste

<table>
<thead>
<tr>
<th>WASTE TYPE</th>
<th>Composition %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes</td>
<td></td>
</tr>
<tr>
<td>Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes</td>
<td></td>
</tr>
<tr>
<td>Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes, mostly dry and clean</td>
<td></td>
</tr>
<tr>
<td>Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes, relatively wet and dirty</td>
<td></td>
</tr>
<tr>
<td>Wood, steel, concrete, dirt, etc.</td>
<td></td>
</tr>
<tr>
<td>Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.</td>
<td></td>
</tr>
<tr>
<td>Industrial process wastes, scrap materials, off-specification products, slags, tailings.</td>
<td></td>
</tr>
<tr>
<td>Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).</td>
<td></td>
</tr>
</tbody>
</table>

Enter Your Project Waste Composition
These are Your likely Waste Sources

<table>
<thead>
<tr>
<th>SOURCES OF SOLID WASTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
</tr>
<tr>
<td>Single and multifamily dwellings</td>
</tr>
<tr>
<td>Industrial</td>
</tr>
<tr>
<td>Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.</td>
</tr>
<tr>
<td>Commercial</td>
</tr>
<tr>
<td>Stores, hotels, restaurants, markets, office buildings, etc.</td>
</tr>
<tr>
<td>Institutional</td>
</tr>
<tr>
<td>Schools, hospitals, prisons, government centers.</td>
</tr>
<tr>
<td>Construction and demolition</td>
</tr>
<tr>
<td>New construction sites, road repair, renovation sites, demolition of buildings</td>
</tr>
<tr>
<td>Municipal services</td>
</tr>
<tr>
<td>Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater</td>
</tr>
<tr>
<td>Process (manufacturing, etc.)</td>
</tr>
<tr>
<td>Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Crops, orchards, vineyards, dairies, feedlots, farms.</td>
</tr>
</tbody>
</table>

Don’t underestimate the Logistical Challenge*

* Example Bangkok

Bangkok = 4 Tons/Truck/Day
Delivery to a Municipal Landfill VS. Delivery to a Private Power Plant

Solid Wastes Management in Bangkok

Waste generation rate
~ 1 kg/person/day

Collected waste
~ 8,800 tons/day

Waste composition at transfer stations

- Recyclable: 10.29%
- Organic: 50.01%
- Others: 39.70%

Providing Collection Trucks to Replace the Old ones

1. Compaction Truck
   - capacity 5 ton: 1,417 trucks
   - capacity 2 ton: 287 trucks
   - capacity 8 m³: 172 trucks
2. Side loading Truck capacity 1.5 ton: 101 trucks
3. Loading container Truck capacity 6 ton: 170 trucks

Total 2,147 Trucks

*Source: Department of Environment, Bangkok Metropolitan Administration
Today Incineration is the dirtiest form of Energy - How do You want to make it clean?

Solution
Complete Combustion

**Highest NOx Emissions**

**Highest SO2 Emissions**

**Highest CO2 Emissions**

**NOx (lbs/MWh)**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>NOx (lbs/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash incineration</td>
<td>7.0</td>
</tr>
<tr>
<td>Oil</td>
<td>5.0</td>
</tr>
<tr>
<td>Biomass incineration</td>
<td>4.0</td>
</tr>
<tr>
<td>Coal</td>
<td>3.0</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**SO2 (lbs/MWh)**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>SO2 (lbs/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash incineration</td>
<td>10.0</td>
</tr>
<tr>
<td>Oil</td>
<td>6.0</td>
</tr>
<tr>
<td>Biomass incineration</td>
<td>5.0</td>
</tr>
<tr>
<td>Coal</td>
<td>4.0</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Pounds of CO2 Emissions per MWH of Electricity Produced**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Pounds CO2/MWH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSW Incineration</td>
<td>2,988 (1)</td>
</tr>
<tr>
<td>Coal</td>
<td>2,249 (1)</td>
</tr>
<tr>
<td>Oil</td>
<td>1,672 (1)</td>
</tr>
<tr>
<td>MSW Plasma</td>
<td>1,419 (2)</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,135 (2)</td>
</tr>
</tbody>
</table>

Power Generation Process

(1) EPA Document: www.epa.gov/cleanenergy/emissions.htm
(2) Complete Conversion of Carbon to CO2; MSW Material & Heat Balance, Westinghouse Plasma Corp.
Incomplete Combustion = Fossils + Disposal

China – Diesel or Coal up to 70% of Gross Energy

Waste Inconsistency
High

Air Circulation
Limited

Retention Time
Limited or 1 pass

Diesel or Coal Input
High

Solution
Complete Combustion

Up to 40% Highly Polluted Ash with no Haz. Waste Landfills available

Dioxin & Heavy Metals highly mobile

135 tpd Diesel for 1,800 t of MSW 60% MC.
## Waste Leachate is highly polluted with Organics

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNIT</th>
<th>NONTHABURI LANDFILL LEACHATE*</th>
<th>THAI EFFLUENT STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>52,650</td>
<td>120</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/l</td>
<td>47,247</td>
<td>20</td>
</tr>
<tr>
<td>Total Organics</td>
<td>mg/l</td>
<td>25,320</td>
<td>n.n.</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen</td>
<td>mg/l</td>
<td>450</td>
<td>100</td>
</tr>
<tr>
<td>Total Solids suspended</td>
<td>mg/l</td>
<td>27,500</td>
<td>50</td>
</tr>
<tr>
<td>Total Solids dissolved</td>
<td>mg/l</td>
<td>32,500</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Waste Leachate is highly polluted with Heavy Metals

Kamphaeng Saen Landfill Leachate /*US TFS ./. Thai Industrial Effluent Standard

Concentration (mg/l)

<table>
<thead>
<tr>
<th>Element</th>
<th>Concentration (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>25.05</td>
</tr>
<tr>
<td>Zinc</td>
<td>234.46</td>
</tr>
<tr>
<td>Copper</td>
<td>53.3</td>
</tr>
<tr>
<td>Nickel</td>
<td>51.77</td>
</tr>
<tr>
<td>Chrome</td>
<td>79.53</td>
</tr>
<tr>
<td>Mercury</td>
<td>90*</td>
</tr>
</tbody>
</table>

Sources: Faculty of Science, Kasetsart University, Faculty of Engineering, Chulalongkorn University, 2003; *Study in Transfer Station, Flordia, USA, 1999
Leachate is highly polluted with Hormone Disrupting Chemicals:

- Inks, colors
- Food packaging, PVC
- Detergents, plastic
- all plastics, 93% color dev.in receipts
- Pharma
- Tissue, feces

Solution: Complete Combustion

Incinerator Fluegas & Ash are highly polluted - e.g. Dioxin*

* even with fluegas below the limit

<table>
<thead>
<tr>
<th>Incinerator</th>
<th>CDDs/PCDDs in pulverulent gas [ngTEQ/Nm³]</th>
<th>PCDDs/PCDFs in gas phase [ngTEQ/Nm³]</th>
<th>Temperature of combustion gases [°C]</th>
<th>CDDs/PCDDs in ash [µgTEQ/kg]</th>
<th>Incineration temperature [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.015</td>
<td>0.010</td>
<td>60</td>
<td>8.5</td>
<td>650 - 750</td>
</tr>
<tr>
<td>2</td>
<td>0.02</td>
<td>0.012</td>
<td>80</td>
<td>14.5</td>
<td>780 - 850</td>
</tr>
<tr>
<td>3</td>
<td>0.022</td>
<td>0.020</td>
<td>45</td>
<td>20.0</td>
<td>670 - 900</td>
</tr>
<tr>
<td>4</td>
<td>0.027</td>
<td>0.020</td>
<td>55</td>
<td>7.8</td>
<td>750 - 1000</td>
</tr>
<tr>
<td>5</td>
<td>0.047</td>
<td>0.040</td>
<td>75</td>
<td>12.1</td>
<td>500 - 600</td>
</tr>
<tr>
<td>6</td>
<td>0.055</td>
<td>0.040</td>
<td>40</td>
<td>12.5</td>
<td>650 - 850</td>
</tr>
<tr>
<td>7</td>
<td>0.075</td>
<td>0.050</td>
<td>90</td>
<td>15.0</td>
<td>550 - 780</td>
</tr>
<tr>
<td>8</td>
<td>0.09</td>
<td>0.075</td>
<td>105</td>
<td>22.0</td>
<td>600 - 700</td>
</tr>
<tr>
<td>9</td>
<td>0.13</td>
<td>0.12</td>
<td>65</td>
<td>19.0</td>
<td>575 - 800</td>
</tr>
<tr>
<td>10</td>
<td>0.215</td>
<td>0.215</td>
<td>140</td>
<td>29.0</td>
<td>550 - 700</td>
</tr>
<tr>
<td>11</td>
<td>0.32</td>
<td>0.085</td>
<td>40</td>
<td>9.5</td>
<td>780 - 900</td>
</tr>
<tr>
<td>12</td>
<td>0.42</td>
<td>0.15</td>
<td>60</td>
<td>19.5</td>
<td>550 - 700</td>
</tr>
<tr>
<td>13</td>
<td>3.9</td>
<td>2.5</td>
<td>120</td>
<td>9.0</td>
<td>650 - 800</td>
</tr>
<tr>
<td>14</td>
<td>9.7</td>
<td>4.2</td>
<td>80</td>
<td>18.4</td>
<td>600 - 650</td>
</tr>
<tr>
<td>15</td>
<td>12.1</td>
<td>8.5</td>
<td>200</td>
<td>22.5</td>
<td>580 - 650</td>
</tr>
<tr>
<td>16</td>
<td>18.5</td>
<td>11.5</td>
<td>170</td>
<td>43.0</td>
<td>750 - 900</td>
</tr>
<tr>
<td>17</td>
<td>26.0</td>
<td>24.2</td>
<td>270</td>
<td>35.0</td>
<td>600 - 700</td>
</tr>
<tr>
<td>18</td>
<td>32.0</td>
<td>21.5</td>
<td>250</td>
<td>30.0</td>
<td>500 - 850</td>
</tr>
</tbody>
</table>

Residues are highly Heavy Metal polluted while safe disposal is often unavailable.

Solution
Complete Combustion,
Concentration,
Immobilization

Highly Polluted with Dioxin and Heavy Metals
Highly Mobile by Water and Wind

Leachate / Wastewater Treatment Sludge
Emerging Private Sector Projects in GMS – how clean are they?

WtE projects under BOO planned or operating
Today’s typical Proposal Qualification Criteria

… appear mostly transaction rooted

- Proof of Technology
- Proof of Finance
- Not exceeding land area provided
- Not exceeding 10% to landfill
- Guarantee Minimum tons of MSW / day
- Lowest Tipping Fee offered wins
- Shortest Project Delivery time wins
- Local Supply Scope Minimum
- National Emissions Standards
Conclusions: GMS’s Public Sector MUST

1. Enhance Competition for WtE Process Quality

- Source Separate Toxic, Hazardous Materials
- Phase Out permanent Co-Firing of Diesel or Coal
- Implement strict Leachate Discharge Levels
- Subsidize Slagging
- Provide Safe Disposal for Incineration Ash
- Adopt Highest Regional Standard
- Provide Safe Disposal for APC Filterdust
- Conclusions: GMS’s Public Sector MUST 1. Enhance Competition for WtE Process Quality
2. Include the Plant’s Periphery

Distance to Water & Impact of Extraction
Waste & Supply Security

Wastewater  Leachate  Ash

Safe Discharge  Safe Disposal

Fluegas Emission Limits & Monitoring
Distance to Power Grid

Filterdust

Impact of Extraction
3. Define Functional Output Specifications

- Distance to Water & Impact of Extraction
- Minimum Volume & Impact
- Wastewater
- Minimum Volume & Penalty
- Leachate
- Minimum Volume & Limit
- Ash
- Minimum Distance & Impact
- Filterdust
- Minimum Volume & Penalty
- Fluegas Emission Limits & Monitoring
- Minimum Volume & Impact
- Distance to Power Grid
- Minimum Volume & Impact
- Safe Discharge
- Safe Disposal
- Waste & Supply Security
- Minimum Volume & Penalty
- Minimum Volume & Impact
- Minimum Volume & Penalty
Solution 1

**CBE Waste-to-Clean-Energy Plant®**

Specification & Design Program

- **PROCESSING**
  - Localized
  - Remove Incombustibles
  - Release Organics
  - Reduce Pollutants
  - Homogenize

- **COMBUSTION**
  - Complete
  - Maximize Power
  - Minimize Emissions
  - Minimize Residue
  - Complete Destruction of Chemicals

- **RESIDUE**
  - Immobilize
  - Spraying
  - Drying
  - Slagging
  - Vitrification

- **EMISSIONS**
  - Concentrate
  - Fluegas Filters
  - RO for Leachate
  - Additives

Complete Destruction of Chemicals
Remove Incombustibles
Release Organics
Reduce Pollutants
Homogenize
Maximize Power
Minimize Emissions
Minimize Residue
Complete Destruction of Chemicals
Spraying
Drying
Slagging
Vitrification
Fluegas Filters
RO for Leachate
Additives

Solution 1
CBE Waste-to-Clean-Energy Plant®
Specification & Design Program
1. Waste Processing is Critical for WtE Success in GMS

2. Plant Design Reaches Far Beyond Incineration

3. GMS Project Scope has a much wider Focus than elsewhere
Waste Process Engineering is critical for WtE Project Success in GMS, because wet, organic rich MSW, sources, composition are very different from what goes to incineration in technology origin countries.

That's why systems need to be adapted by experienced, independent process engineering and should:

• **select** waste processing and recycling technology best suited to the case
• **engineer** correct design data, process diagram, mass-/energy balance, GA, layout
• **specify** performance goals and terms for supplier qualification and bid review
• **guarantee** system function and performance
• **manage** installation, commissioning, performance test
• **support** operation & maintenance
In GMS Projects must be profitable from clean energy sales alone. Different from tech origin countries waste is inconsistent, from unknown sources and infrastructure for wastewater, leachate, hazardous waste usually missing.

WtE Plant Design in GMS must therefor:

- Optimize Waste Sources, Composition, Heat Value
- Optimize Logistics, Fuel Processing, Storage, Feedin
- Optimize for Clean Net Energy from Waste
- Maximize Plant Online Time and Firm Power Ratio
- Maximize Destruction of Toxics and Biohazards
- Minimize Emissions of Leachate, Fluegas, Dust and Ash
- Immobilize Toxics and Heavy Metals for Environmental Safety
- Maximize Recycling, Minimize Disposal of Metals and Minerals
Step 3 – Create Auditable Project Value

Because GMS local infrastructure, resources, data and experience often differ greatly from tech originating country standards and requirements, projects have to (help) establish these.

Therefor **successful project developers** engage in:

- Waste Composition & Sources Studies
- Logistics & Supply Security Studies
- Assessments of Site & Resources
- Project Concept & Design
- Technology Selection & Specification
- Bids & Proposals
- Performance Guarantees, Contracts & PPA
- Procurement & Transaction
- Performance Test & Start up
- O&M Staff Training, Maintenance Schedules, Supervision
Thank you
For further information
info@cbethai.com    www.cbethai.com