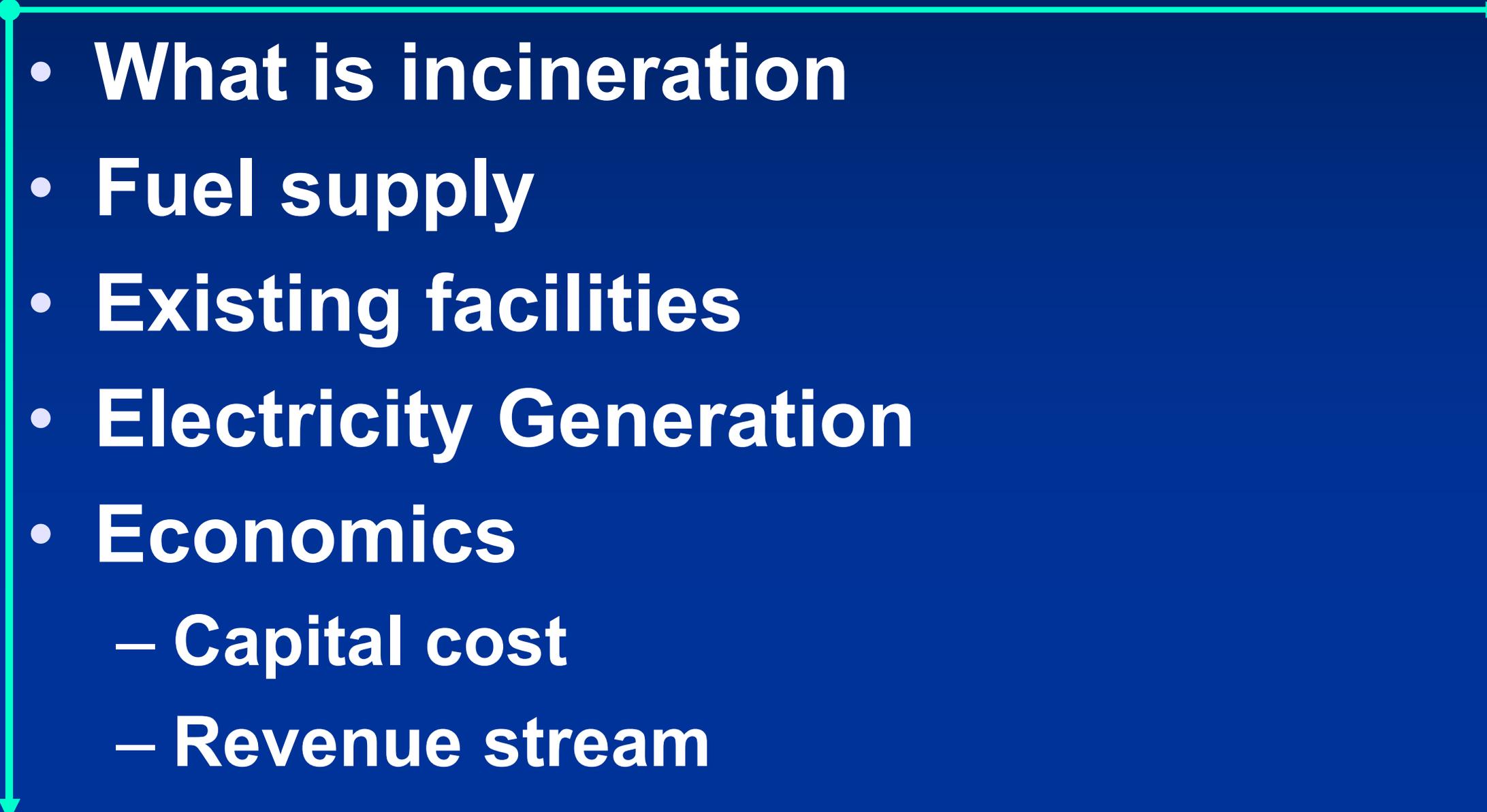


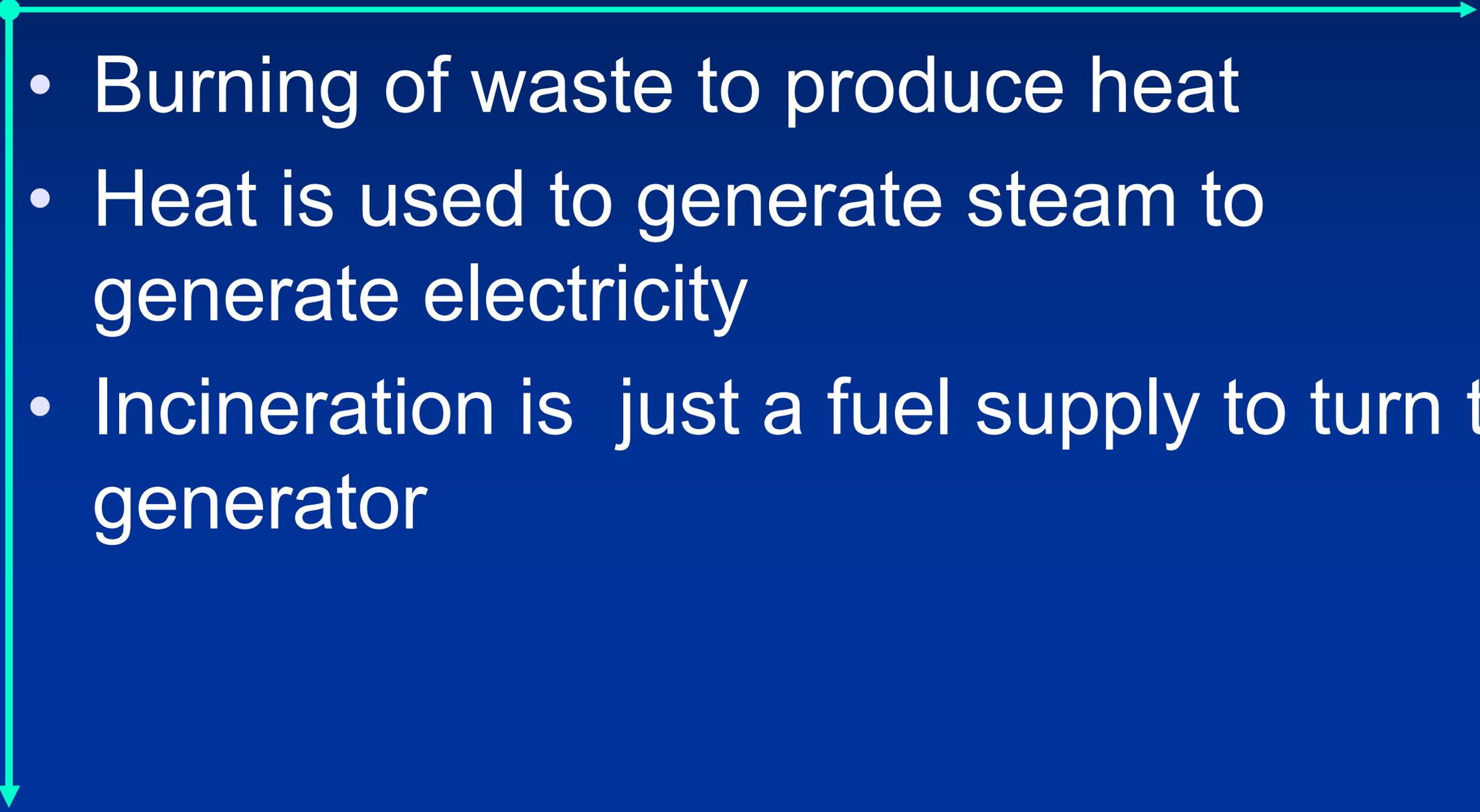
Generating Electricity Through Incineration, Opportunity or Threat for Thailand



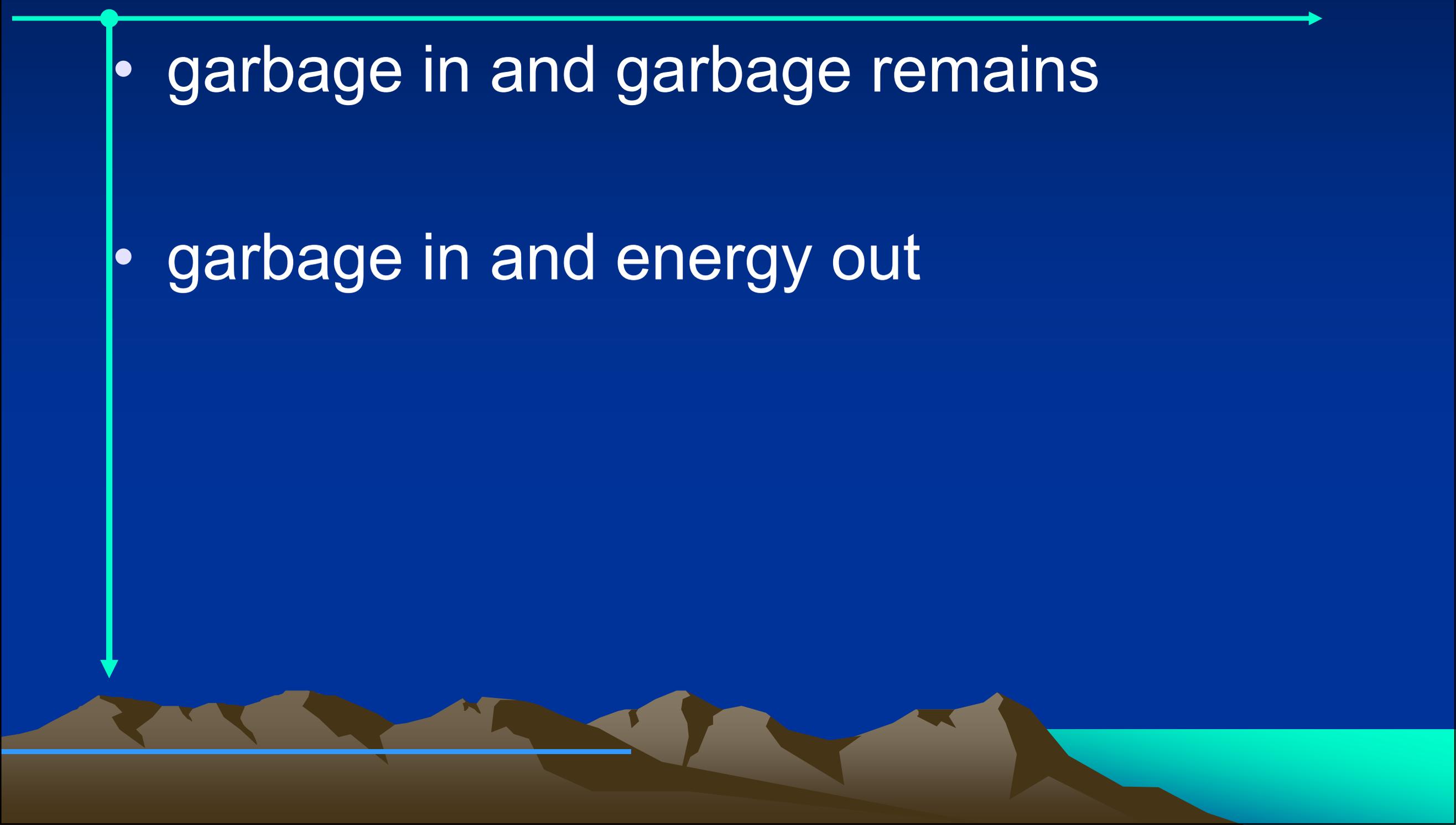
Talk Outline

- 
- **What is incineration**
 - **Fuel supply**
 - **Existing facilities**
 - **Electricity Generation**
 - **Economics**
 - **Capital cost**
 - **Revenue stream**
 - **Environmental Issues**
 - **Thailand Challenges**

Incineration

- 
- Burning of waste to produce heat
 - Heat is used to generate steam to generate electricity
 - Incineration is just a fuel supply to turn the generator

Incineration

- 
- garbage in and garbage remains
 - garbage in and energy out

Potential and limitations of incineration technologies

Potential

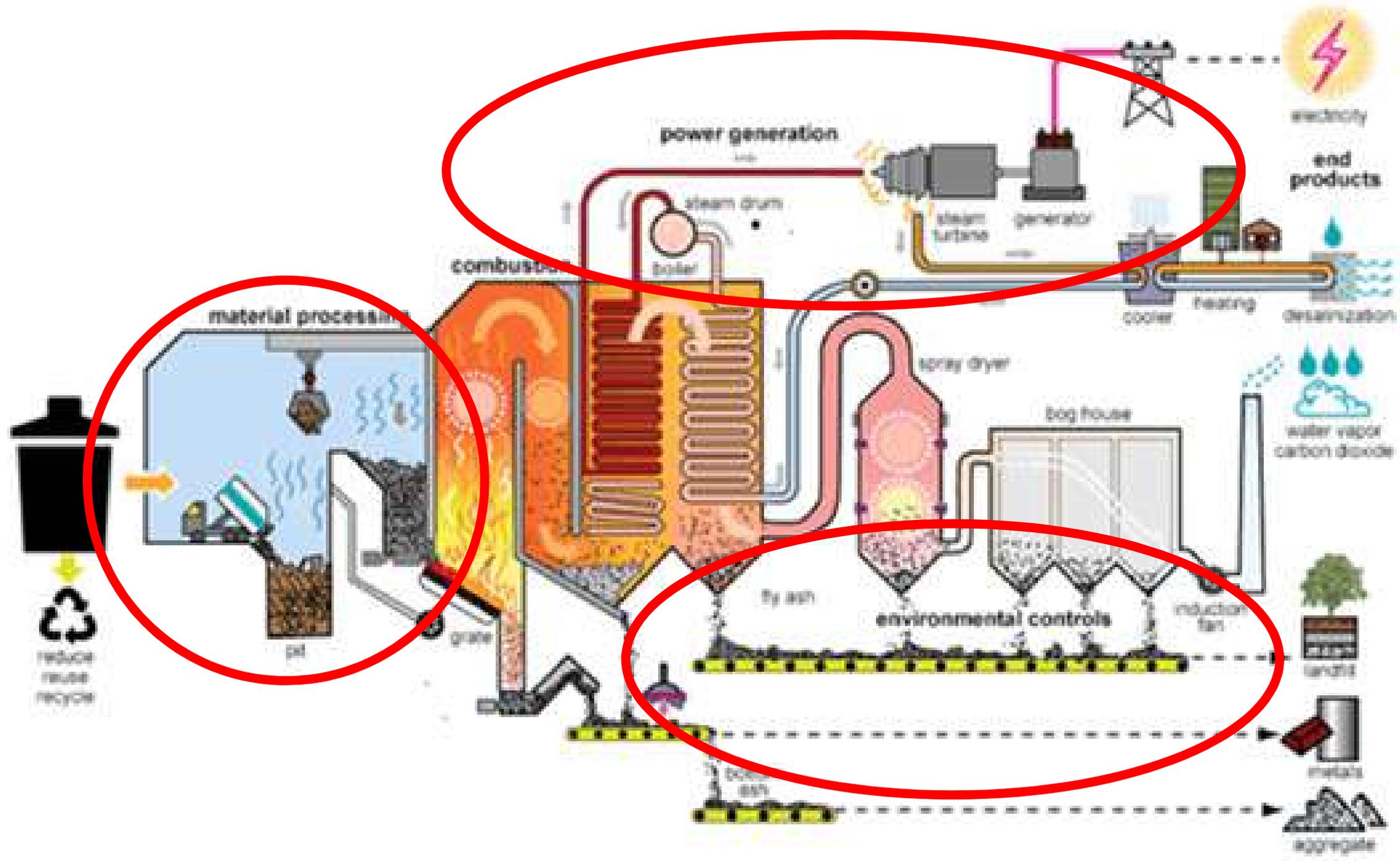
- Energy recovery from organic wastes
- Small footprint
- *Only long-term solution for large cities/municipalities (???)*
- Volume and weight reduced (approx. 90% vol. and 75% wt reduction)
- Cost can be offset by heat recovery/ sale of energy

Limitations

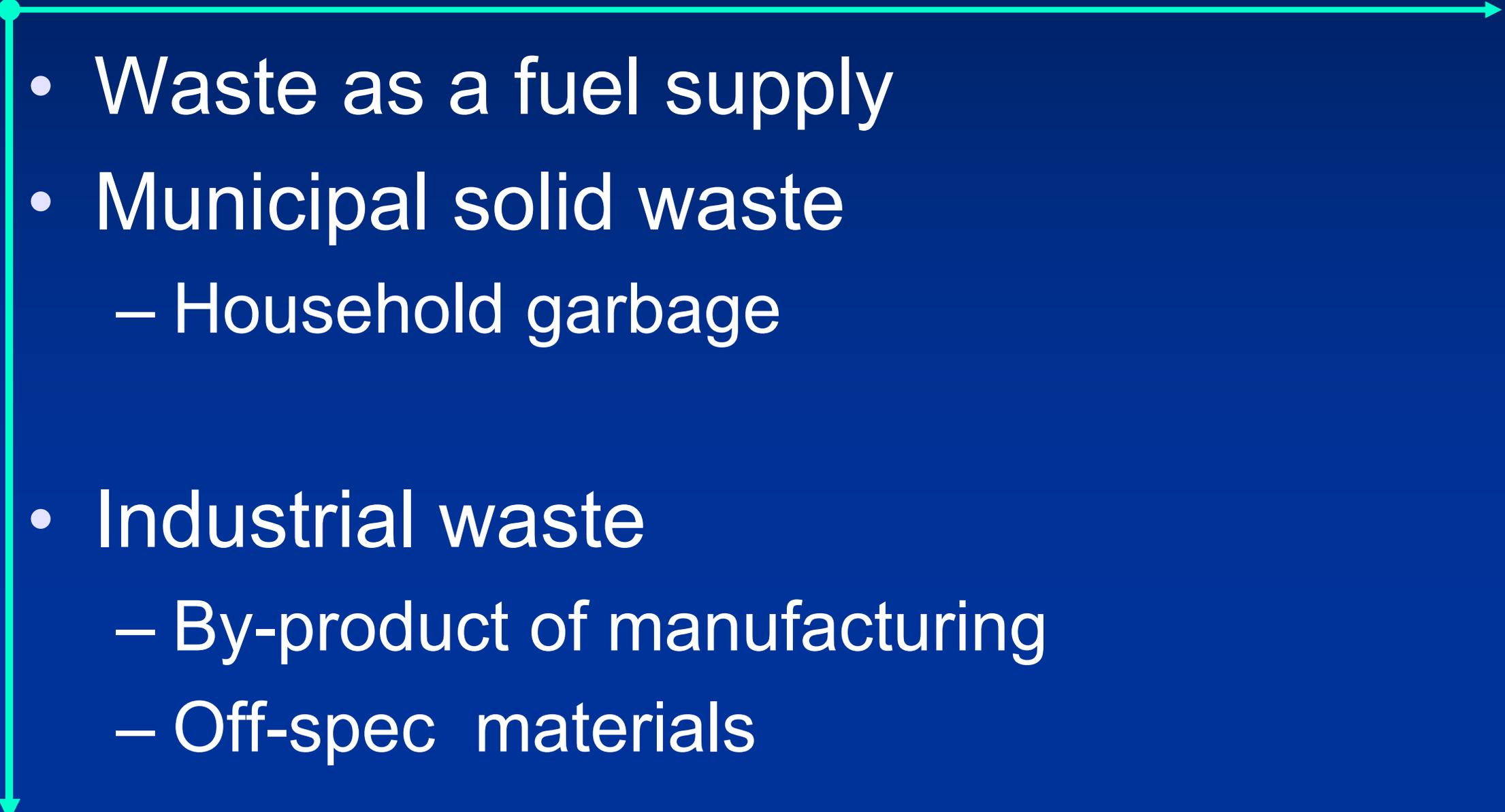
- High investment and operating cost
- Environmental threats
- Strong opposition from the public/stakeholders
- Skilled operators are required
- Maintenance/upkeep

Source: Chart Chiemchaisri, KU

A mass burn waste-to-energy plant



Fuel Supply

- 
- Waste as a fuel supply
 - Municipal solid waste
 - Household garbage
 - Industrial waste
 - By-product of manufacturing
 - Off-spec materials

Waste Composition

Source / type	Composition	
Municipal solid waste (MSW)	Residential	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, tyres), household hazardous wastes, e-wastes.
	Industrial	Housekeeping wastes, packaging, food wastes, wood, steel, concrete, bricks, ashes, hazardous wastes.
	Commercial & institutional	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes, e-wastes.
	Construction & demolition	Wood, steel, concrete, soil, bricks, tiles, glass, plastics, insulation, hazardous waste.
	Municipal services	Street sweepings, landscape & tree trimmings, sludge, wastes from recreational areas.

Fraction	Net Calorific Value (MJ/kg)
Paper	16
Organic material	4
Plastics	35
Glass	0
Metals	0
Textiles	19
Other materials	11

Sources: Hoorweg & Bhada-Tata (2012); ETC/SCP (2013)

Source: ISWA (2013)

DEDE 2014

Performance on Alternative and Renewable Energy Policy

TYPES OF ENERGY	Unit	Target 2021	2013	Q ₁
Electricity	MW ktoe	13,927	3,788 1,341	3,969 360
Solar	MW	3,000	823.46	960.95
Wind	MW	1,800	222.71	222.71
Small Hydro Power	MW	324	108.80	112.05
Biomass	MW	4,800	2,320.78	2,351.28
Biogas	MW	3,600	265.23	274.94
MSW	MW	400	47.48	47.48
New energy	MW	3	-	-
Heat	ktoe	9,800	5,279	1,345
Solar ¹	ktoe	100	4.54	1.7
Biomass	ktoe	8,500	4,694	1,198.31
Biogas ²	ktoe	1,000	495	120.45
MSW	ktoe	200	85	24.54

DEDE

โรงไฟฟ้าพลังงานทดแทนในประเทศไทย RENEWABLE ENERGY POWER PLANT IN THAILAND	
ประเภทโรงไฟฟ้า POWER PLANT TYPES	กำลังการผลิต CAPACITY เมกะวัตต์ (MW)
 โรงไฟฟ้าก๊าซชีวภาพ BIOGAS POWER PLANT	163
 โรงไฟฟ้าชีวมวล BIOMASS POWER PLANT	1,027
 โรงไฟฟ้าพลังน้ำขนาดเล็ก MINI-HYDRO POWER PLANT	91
 โรงไฟฟ้าพลังน้ำขนาดใหญ่ LARGE HYDRO POWER PLANT	3,406
 โรงไฟฟ้าพลังงานลม WIND POWER PLANT	194
 โรงไฟฟ้าพลังงานแสงอาทิตย์และโซลาร์รูฟ SOLAR POWER PLANT AND SOLAR ROOFTOP	811
 โรงไฟฟ้าเผาขยะชุมชน MUNICIPAL WASTE INCINERATION POWER PLANT	18
 โรงไฟฟ้าพลังงานความร้อนใต้พิภพ GEOTHERMAL POWER PLANT	-
กำลังการผลิตรวม (เมกะวัตต์) TOTAL CAPACITY (MW)	5,710

เดือนมีนาคม 2557

Note : On grid capacity as of March, 2014

Koh Samui



Koh Samui



Koh Samui

- The garbage problem in Koh Samui is directly related to the breakdown of the incinerator in 2012
- Mayor Ramnate said at present the island's 30-rai landfill already holds mountains of garbage of over 200,000 tons, while 150-200 tons keep coming in daily for disposal. (Sept. 2017)

Samui Incinerator

- A long time ago, was invited to tour the plant. Operation was almost perfect, the operators and staff knew their job.
- The cost of operating and maintaining the plant was around **8 M USD a year**, but no revenue was coming in and the plant was falling into disrepair, not enough garbage.
- Another problem was the design of the doors to the "pit" where the trucks dumped the garbage, the trucks did not seal to the opening, so when the pit door were opened the odor quickly wafted out of the plant. Local residents were not happy, especially on a hot, rainy day.

Samui-Dioxins

Dioxin Hotspot Report - Case Study of Municipal Waste Incinerators in Phuket and Samui

Dioxin Measurement from Samui Waste Incinerator Stack by SGS (Thailand):

Date	Dioxin (total) Standard = 30 ng/Nm ³		Dioxins and Furans-TEQ Standard = 0.5 ngTEQ/Nm ³	
	Measured	Adjust O ₂ 7%	Measured	Adjust O ₂ 7%
May 7, 2003		202.1		0.9
August 2, 2003	4254	7301	21.19	36.37
December 12, 2003	1,329	2,309	12.30	21.37
January 21, 2004	1,469	2,552	14.77	25.67
May 19, 2004	1,712	2,867	16.57	27.76

Koh Samui

- The garbage pile will soon be officially declared as a Tourist-Attraction.
- A wildlife preserve, where Rats can live in their natural environment, not having to live in Hotel-and Restaurant Kitchens anymore.
- Entrance fee will be 400 Bht for Tourists

๔๐ บาท ไทย.

Phuket- Company website

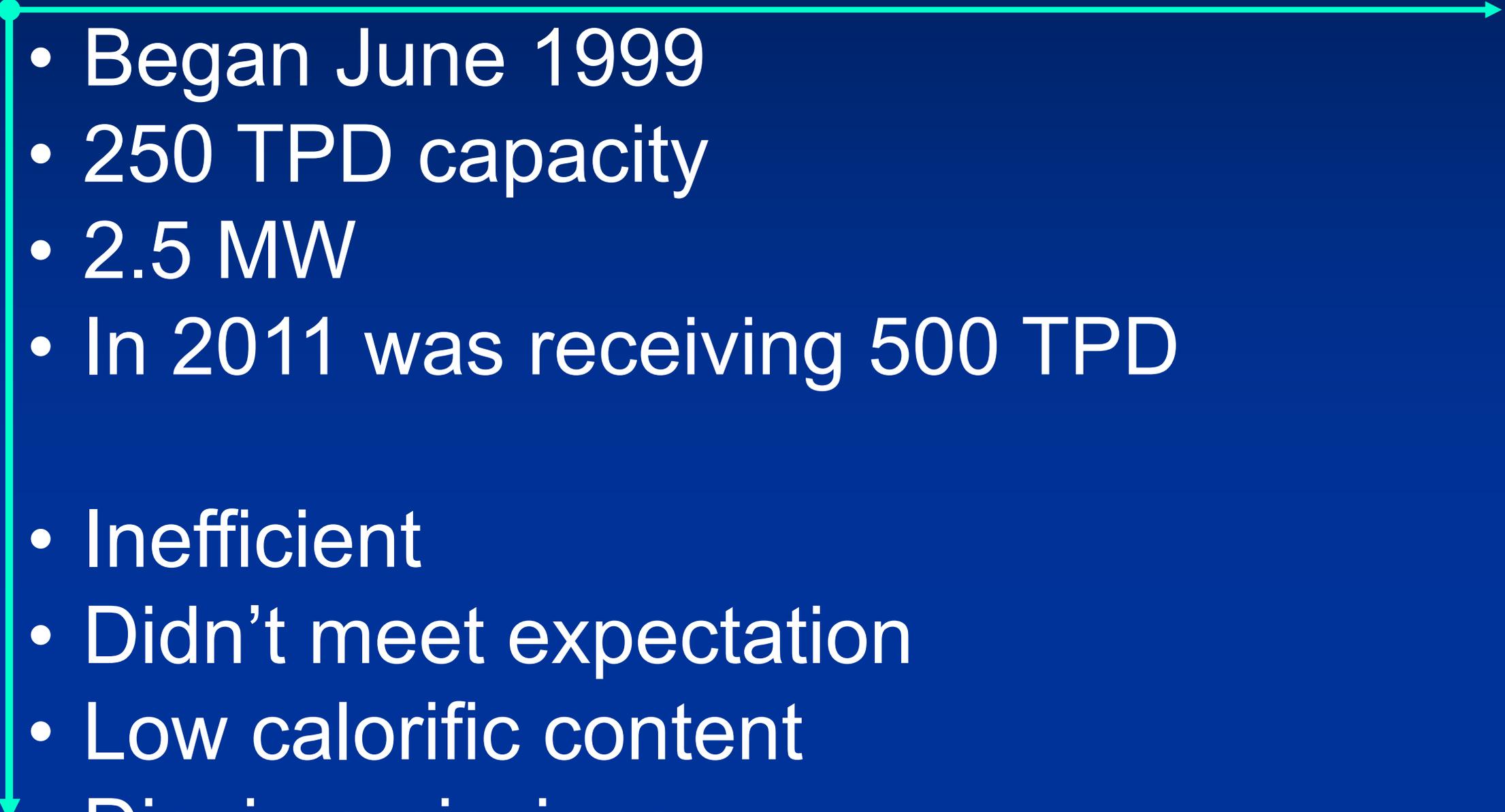
- Incinerator 1

Type: Incineration Plant
Area: Phuket
Kind of Fuel: 86,200 tonnes of Municipal Solid Waste
Power Capacity: 24 MW
Owner: PJT Technology Co Ltd
Shareholders:
Activity since: 1998

- Incinerator 2

Type: Incineration Plant
Area: Phuket
Kind of Fuel: 233,300 tonnes of Municipal Solid Waste
Power Capacity: 14 MW (2 x 7 MW)
Owner: PJT Technology Co Ltd
Shareholders:
Activity since: 2012

Phuket 1

- 
- Began June 1999
 - 250 TPD capacity
 - 2.5 MW
 - In 2011 was receiving 500 TPD

 - Inefficient
 - Didn't meet expectation
 - Low calorific content
 - Dioxin emissions

Phuket Incinerator 1

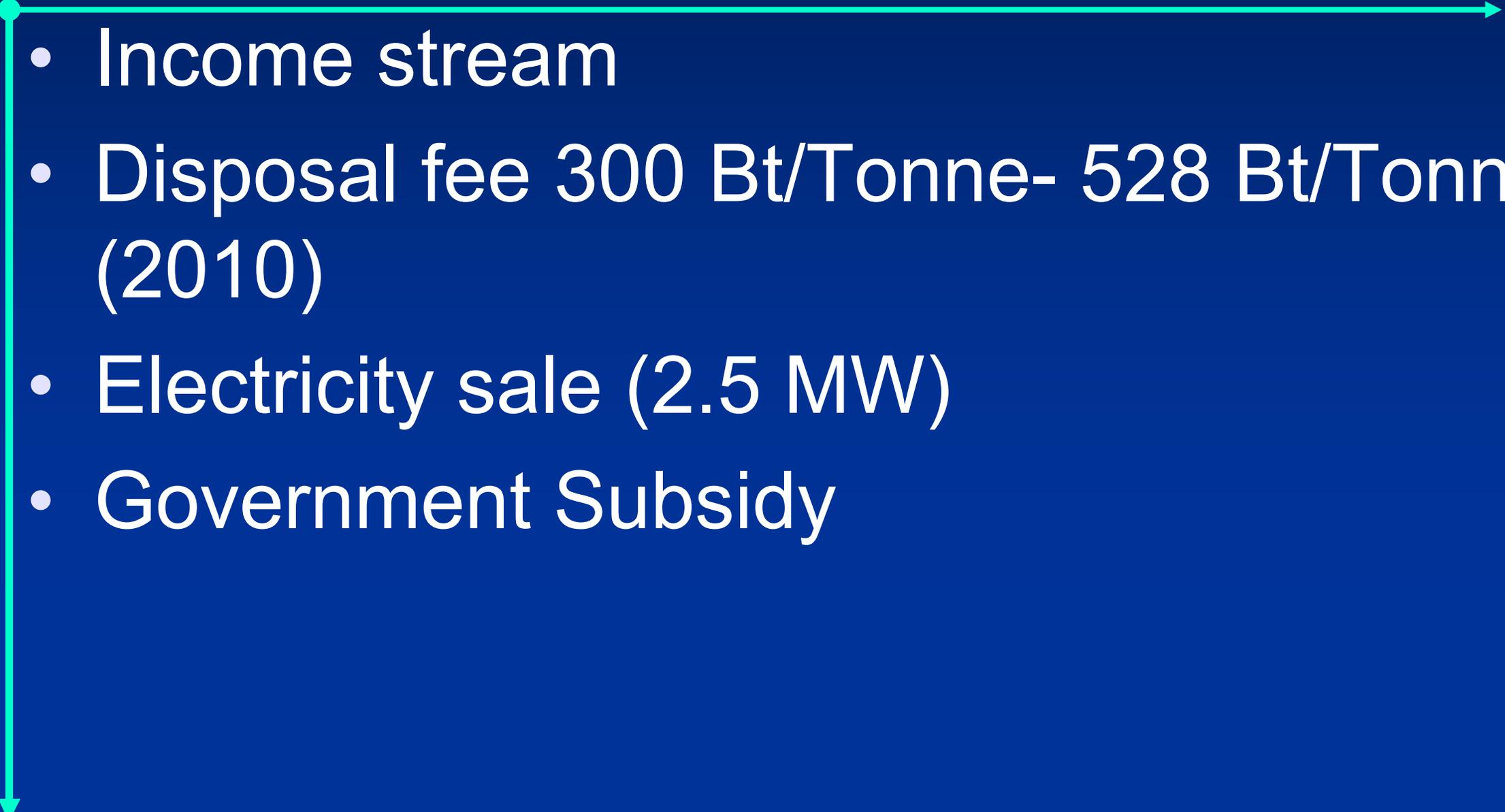
- 
- Income stream
 - Disposal fee 300 Bt/Tonne- 528 Bt/Tonne (2010)
 - Electricity sale (2.5 MW)
 - Government Subsidy

Table 2: Balance Sheet of the Plant for 2003 and 2004

	<i>Amount(1000xBaht)</i>	
	<i>2003</i>	<i>2004</i>
Incomes		
· Subsidy from Government	39,000	53,000
· Disposal Fee	17,032	18,775
· Electricity Sale	2,222	6,085
Total Incomes	58,254	77,860
Costs		
· Operation Contract	37,125	38,416
· Water supply	589	515
· Electricity	642	1,719
· Fuel(Diesel)	970	315
· Lime	3,384	3,446
· Other chemicals	502	577
· Laboratory expenses	1,398	1,437
· Insurance	1,342	1,379
· Spare parts	8,919	26,399
· Ash Disposal(Landfill)	671	690
Total Costs	55,542	74,894
Surplus	2,713	2,966
<i>Disposal fee covering operation cost (Baht/ton)</i>	<i>657.73</i>	<i>818.07</i>
<i>Number of day of operation(day)</i>	<i>320</i>	<i>320</i>
<i>Total Waste amount (Ton/day)</i>	<i>320.21</i>	<i>364.03</i>
<i>Total Waste loaded to incinerator(Ton/day)</i>	<i>253.33</i>	<i>262.85</i>

Phuket Incinerator 1

- 
- 1995 140 TPD
 - 788 M Baht (24 M USD 1995)

 - 1998 236 TPD
 - 24 MW

 - 2.5 MW

Phuket Incinerator 2

- 2012 640 TPD
- 14 MW
- Cap cost??????

Hat Yai

- The incinerator plant in Songkhla can eliminate 250–300 tonnes of waste per day, producing 4.5MW of electricity per day

Location:	Hatyai, Songkhla
Share:	50%:50% with Electricity Generating PCL (EGCO)
PPA:	6.5 MW
Waste Quantities:	300 TPD
Status:	COD on December 2014

Hat Yai

- Dec. 2016

In Hat Yai, residents around a garbage incinerator have had enough after breathing foul-smelling air and toxic smoke for more than two years.

Their complaint proved even more urgent after tests found excessive quantities of toxic substances including dioxin, hydrochloride and cadmium in the environment.

But as the one in Hat Yai suggests, it can serious environmental problems when poorly managed.

Post 9 Dec 2016 SOMCHAI POOMLARD

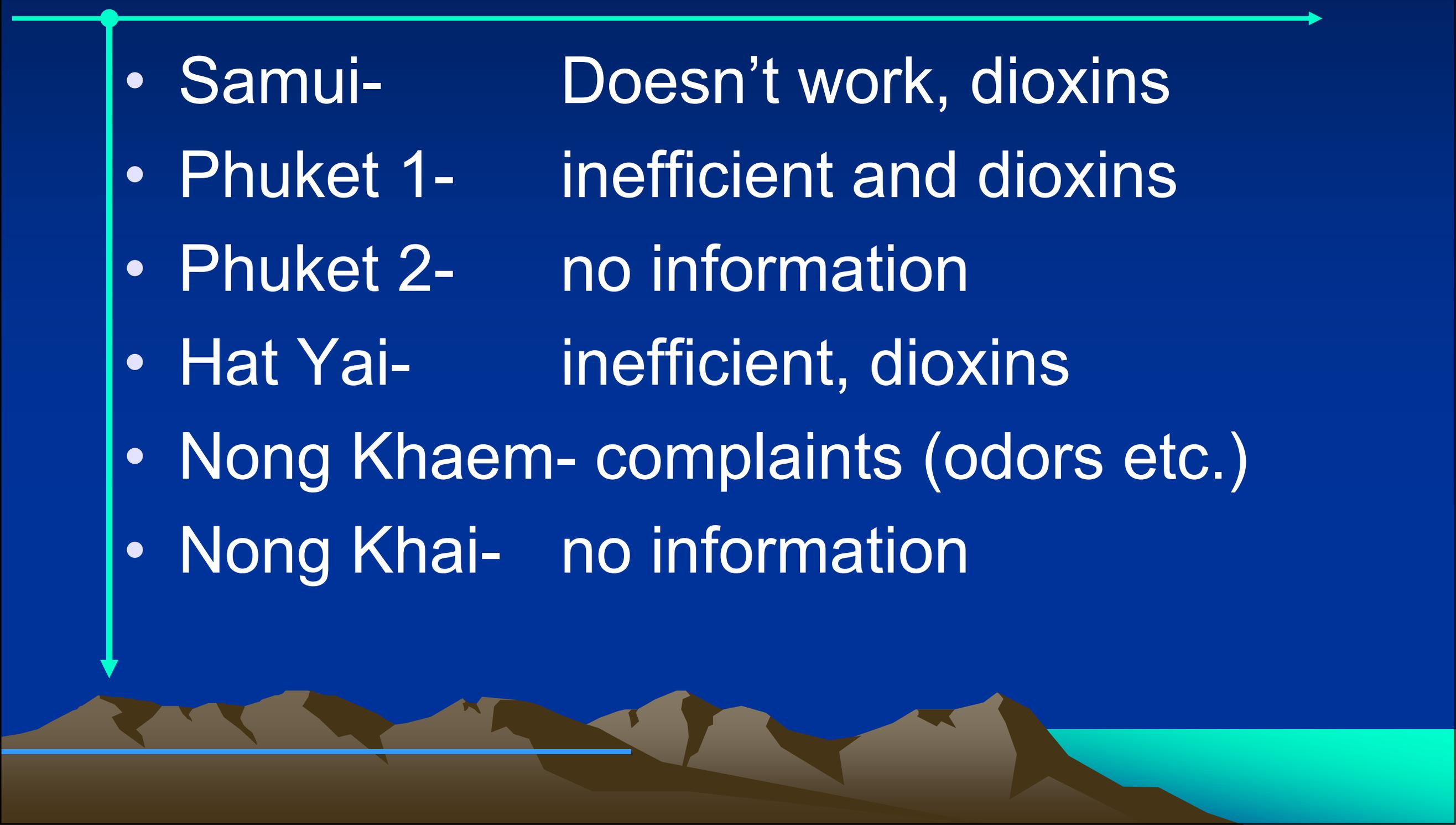
Nong Khaem Incinerator

- Bangkok
- This plant, which has operated since May 2016, has a capacity to burn 300 to 500 tonnes of garbage per day to produce electricity up to 9.8 megawatts The company has a 20-year concession from the Bangkok Metropolitan Administration (BMA) to burn the city's waste It is the third plant of its kind in Thailand after those in Hat Yai and Phuket *February 01, 2017 By Pratch Rujivanarom The Nation*
- Serious odour complaints from residents.
- Bangkok produces > 8,000 TPD of waste
 - Need 16 of these plants for Bangkok

Nong Khai Incinerator

- 
1. Client: KPN Green Energy Solution Co., Ltd.
 2. End user: Nongkhainayu Co., Ltd.
 3. Processing capacity: 370 t/d, 6 MW
 4. Location: Nong Khai Province, Thailand
 5. Delivery: March 2018

Thailand Incinerators

- 
- Samui- Doesn't work, dioxins
 - Phuket 1- inefficient and dioxins
 - Phuket 2- no information
 - Hat Yai- inefficient, dioxins
 - Nong Khaem- complaints (odors etc.)
 - Nong Khai- no information

Incinerator Costs

Incinerator	Cap- Cost	Capacity (Tpd)	Electricity
Samui	472 M Baht	140	1.5 MW (est.)
Phuket 1	788 M Baht	250	2.5 MW
Phuket 2	???????	360-720	14 MW
Hat Yai	???????	300	4.5-6.5 MW
Nong Khaem	900 M Baht	300-500	9.8 MW
Nong Khai	???????	370	6.0 MW

- Cap cost for incinerator is \$US 8,000,000/MW (280 M Baht)
- 500-600 Kwh/tonne of waste burned
 - 100 TPD=50,000 kwh= 2 MW

Feed in Tariff

Size	FIT (Bt/kwh)
> 3Mw	5.78
1-3 MW	6.52
<1 Mw	7.05

Incinerator Income

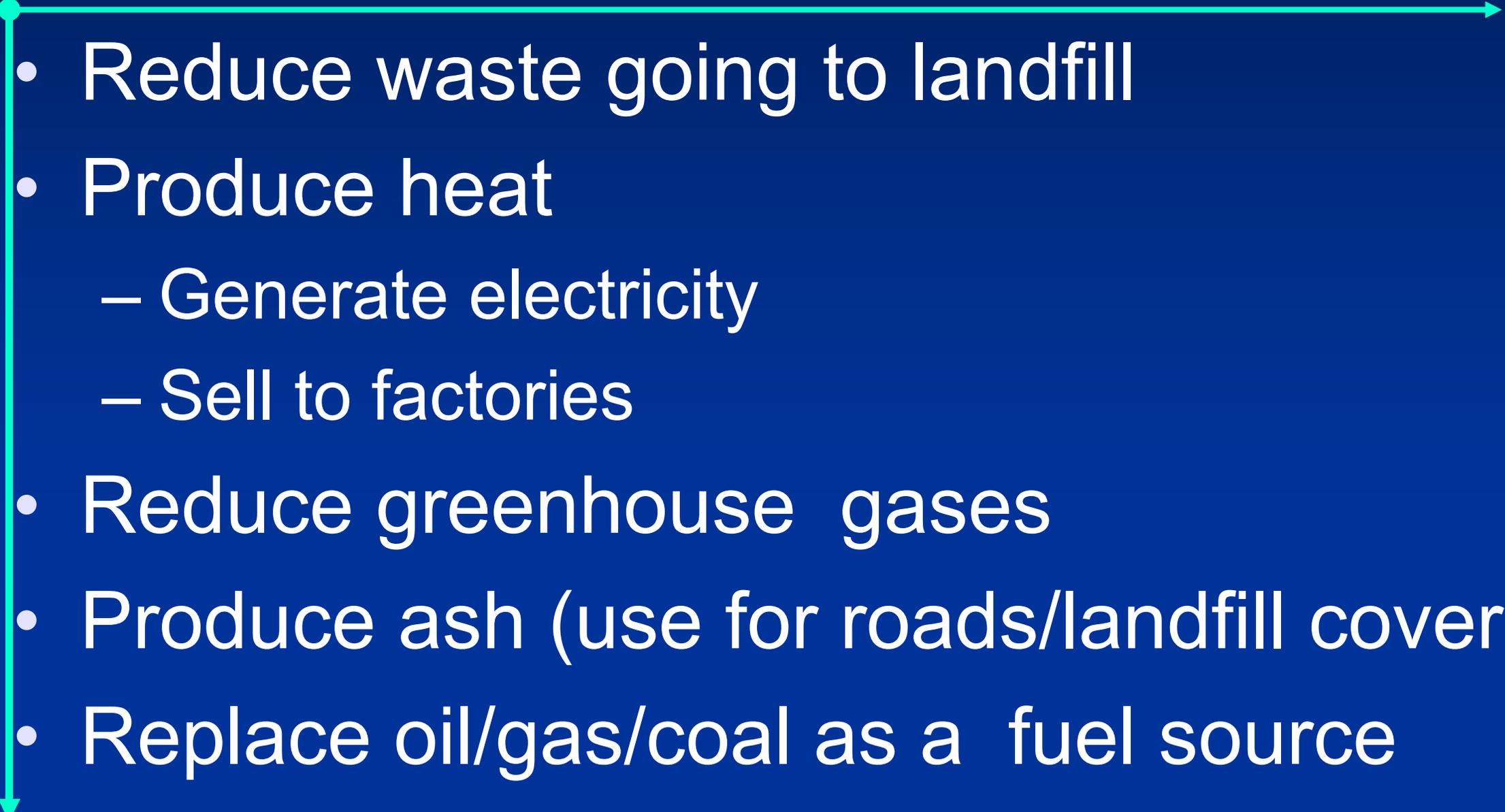
Site	Capacity (MW)	Rate (Bt/kwh)	Income Electricity (yr)	Cost/income
Samui	1.5	6.52	79,804,800	5.91
Phuket 1	2.5	6.52	133,008,000	5.92
Phuket 2	14	5.78	660,307,200	
Hat Yai	5.5 (avg)	5.78	259,406,400	
Nong Khaem	9.8	5.78	462,215,040	1.95
Nong Khai	6	5.78	282,988,800	

Income assumes:

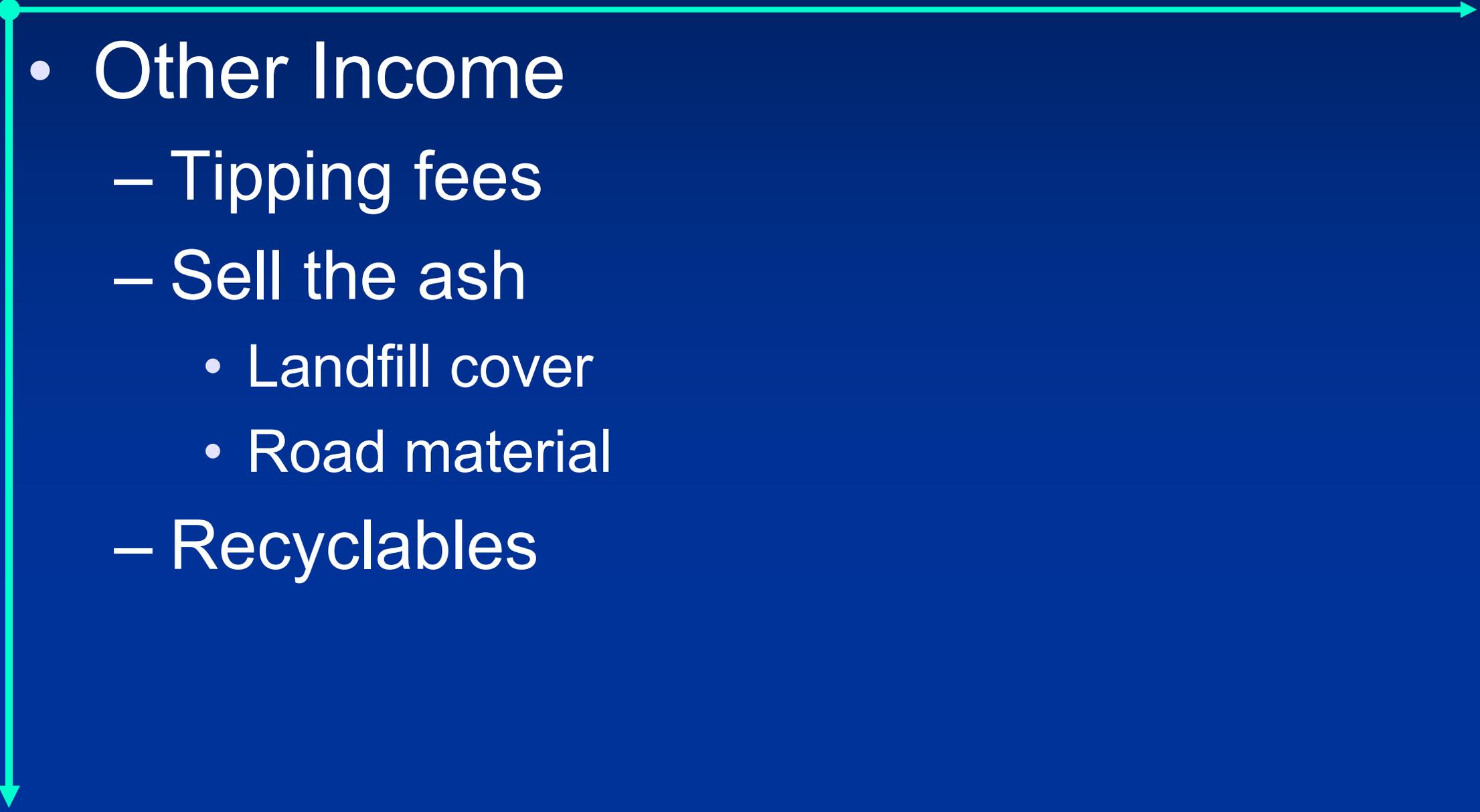
340 days/year

24 hrs/day

Benefits of Incineration

- 
- Reduce waste going to landfill
 - Produce heat
 - Generate electricity
 - Sell to factories
 - Reduce greenhouse gases
 - Produce ash (use for roads/landfill cover)
 - Replace oil/gas/coal as a fuel source
- 

Incinerators in Thailand

- 
- Other Income
 - Tipping fees
 - Sell the ash
 - Landfill cover
 - Road material
 - Recyclables

Opinion of the Independent Financial Advisor Regarding the Proposed Asset Acquisition

Phillip Securities (Thailand) Public Company Limited

9 June 2015

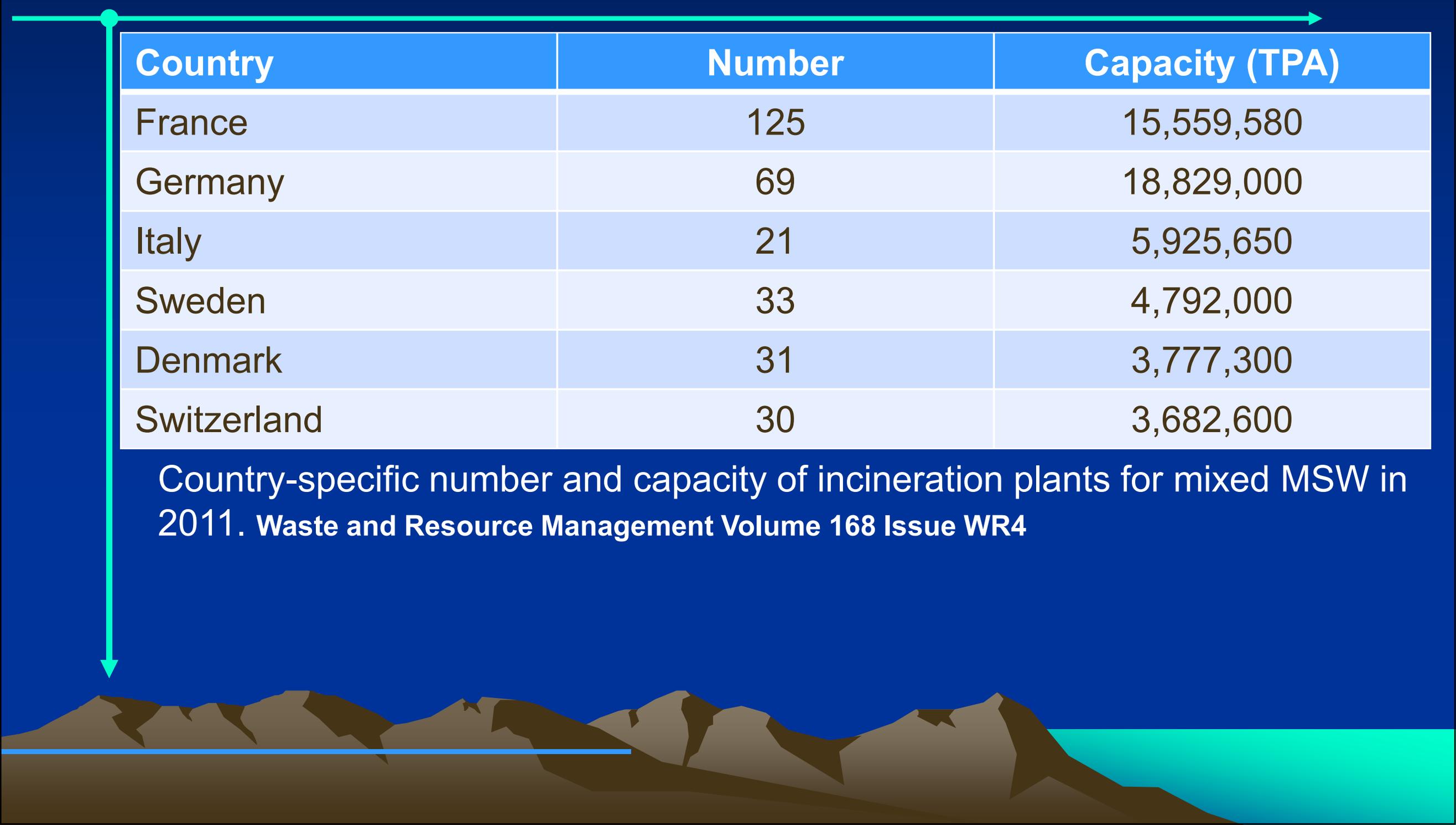
This project which produce electricity from refuse-derived fuel with capacity not exceeding 10 megawatt with the total capital budget of Baht 1,469,118,159

After considering the aforesaid information and reasons, the IFA viewed that the shareholders should vote **not to approve** the company entering the asset acquisition transaction.

This analyses was for a public listed company. Does not take into account

- Waste management
- Social impacts
- Environmental impact

Incinerators in Europe



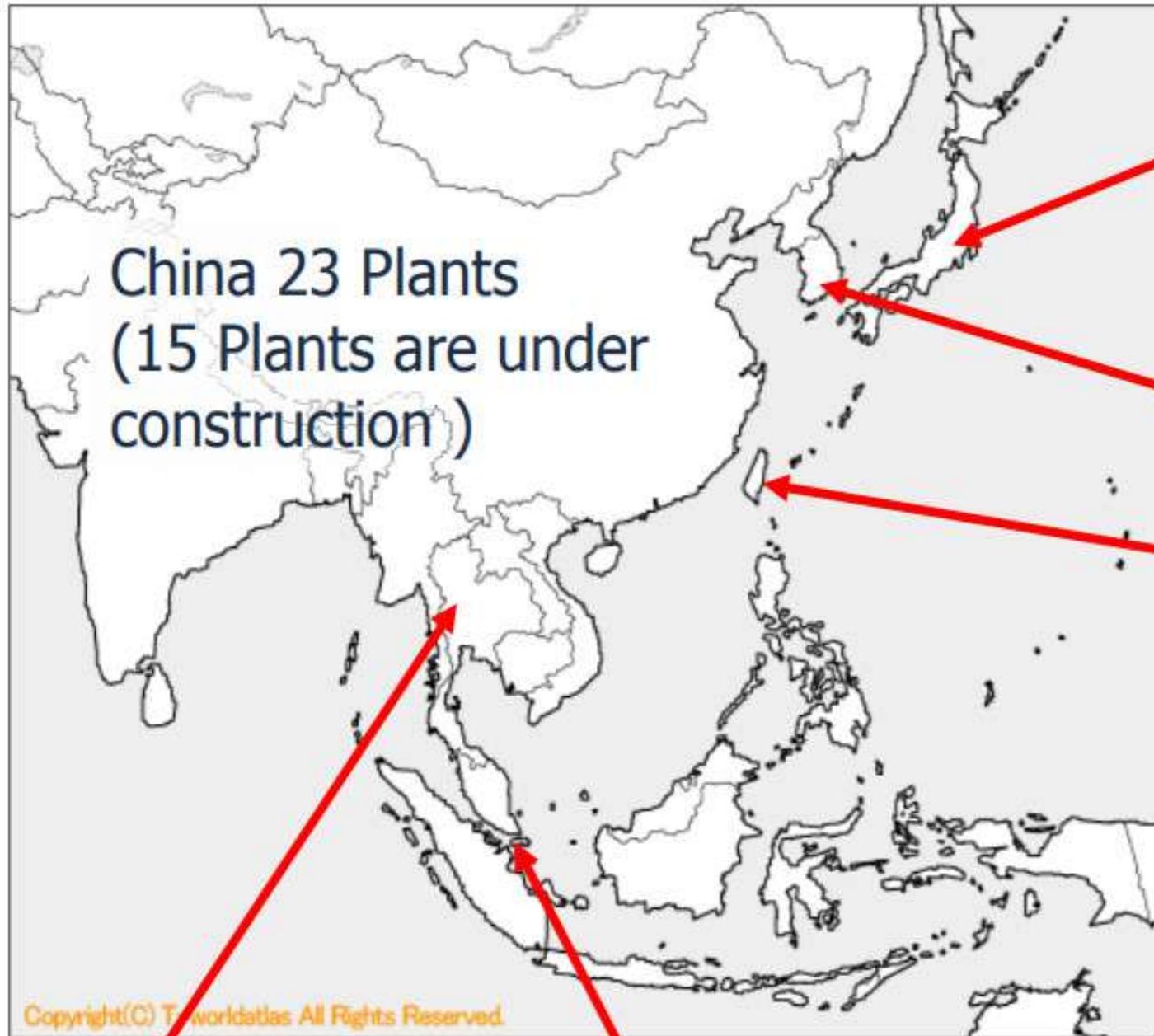
Country	Number	Capacity (TPA)
France	125	15,559,580
Germany	69	18,829,000
Italy	21	5,925,650
Sweden	33	4,792,000
Denmark	31	3,777,300
Switzerland	30	3,682,600

Country-specific number and capacity of incineration plants for mixed MSW in 2011. Waste and Resource Management Volume 168 Issue WR4

Incinerators in Asia

- In Japan, the major waste treatment method is incineration, and the number of incinerators was 1,161 in 2014
- In Korea 35 WTE Plants with 57,131 KWH exported to the grid in 2010
 - Korea uses a lot of heat for heating
- Thailand has 4 MSW incinerators with max of 14 MW (and lots of problems)

Waste to Energy Plant built by Japanese Company



Japan 800 Plants
For electricity 304 Plants
(1,673MW) (2009)

Korea 15 Plants

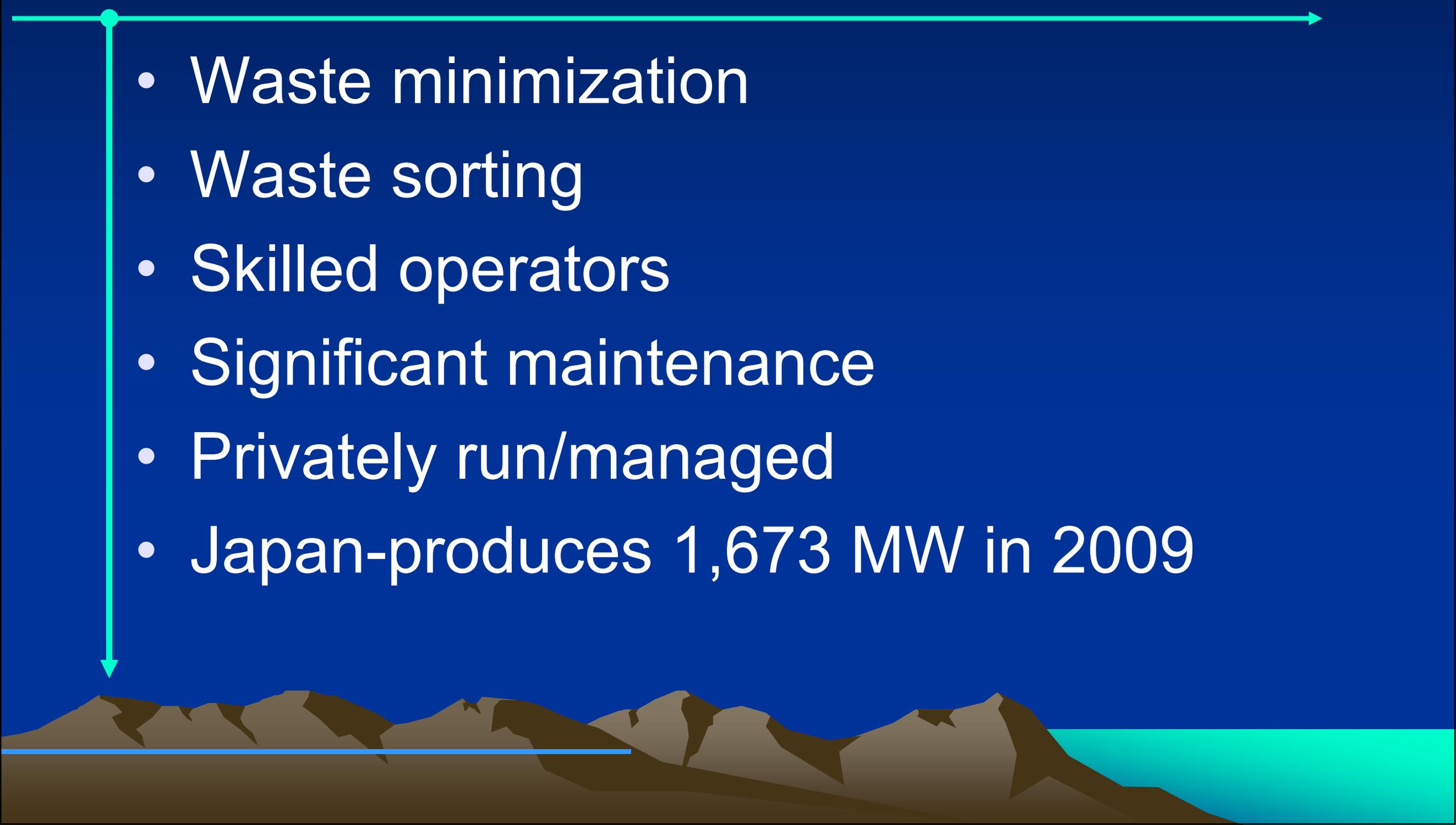
Taiwan 24 Plants



Thailand 1 Plants Singapore 3 Plants

CHENGDU, China

Successful Countries

- 
- Waste minimization
 - Waste sorting
 - Skilled operators
 - Significant maintenance
 - Privately run/managed
 - Japan-produces 1,673 MW in 2009

Incinerators in Thailand

- Problems with fuel supply
 - Too wet
 - Not sorted
- Problems with operations
 - Maintenance
 - Not hot enough
 - Skilled operators needed
- Environmental problems
 - Due to above reasons

Summary

- Incineration has potential to provide significant electricity to the grid and solve Thailand's waste problem
- There are significant threats from incineration
 - Environment, financial, social

IF OTHER COUNTRIES CAN DO IT..... WHY CAN'T THAILAND?



Samut Prakarn

Dump fire

2008

Issues in Thailand

- The Natural Resources and Environment Ministryalso disclosed that a checklist of more than **300 items** was required before a project licence would be issued

Source: Norway-Asia Business Review

Harvey Brock

14 Dec. 2016