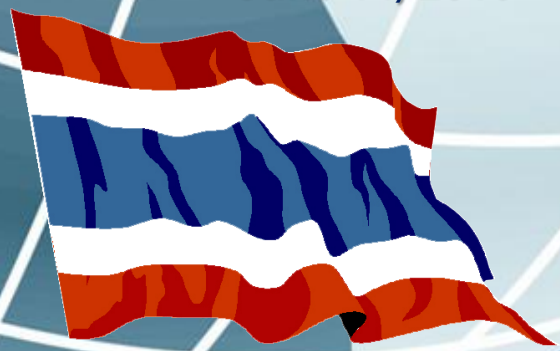
Overcoming Critical Bottlenecks to Accelerate Renewable Energy Deployment in ASEAN+6 Countries

RAMA Garden Hotel, Bangkok, Thailand
June 14, 2016



ASEAN Experience : Thailand

Biomass Conversion Technology for combined heat and power.

FB Fanpage : Somchai Lertwisettheerakul

The Developer in Commercial

Somchai Lertwisettheerakul

Bachelor degree in Personnel Administration, Faculty of Political, Chulalongkorn University.
Master degree in Executive MBA, Kasetsart University

Founder of Suwanabhumi International Airport Waste Management system

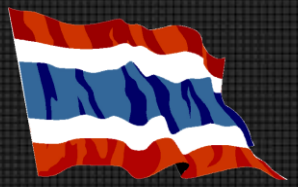
Founder of the 1st commercial plant
"Conversion of waste plastic into fuel oil (Pyrolysis technology) in Thailand"

A pioneer of waste disposal system and converted into electrical power to commercial of GIDEC.

A pioneer of IE3G-MVNO operator in commercial service in Thailand

Deputy Chairman	IEC Business Partner Co.,Ltd.
Senior Executive Vice President	The International Engineering Public Company Limited
Former Managing Director	GIDEC Co.,Ltd.
Former Chief Executive Officer	Cambodia SAMART Communication Co.,Ltd.
Visiting Lecturer	Bachelor and master degree in both private and public university in Thailand
Construction and Consultant	Integrated waste management solution and MSW power plant. (Thailand, Lao, Vietnam and Cambodia)
Board of Director	Office of the Education Council, Ministry of Education
President	The Southern International School Hatyai

2 Fundamental Questions



How & Where

Fundamental led to the ideas

How

How to manage and survive the biomass plants when the supply chain was excerpted ?

Where

Where does your garbage go ?

Biomass Industrial Power Development Policy

Alternative Energy Development Plan (AEDP) 2015:

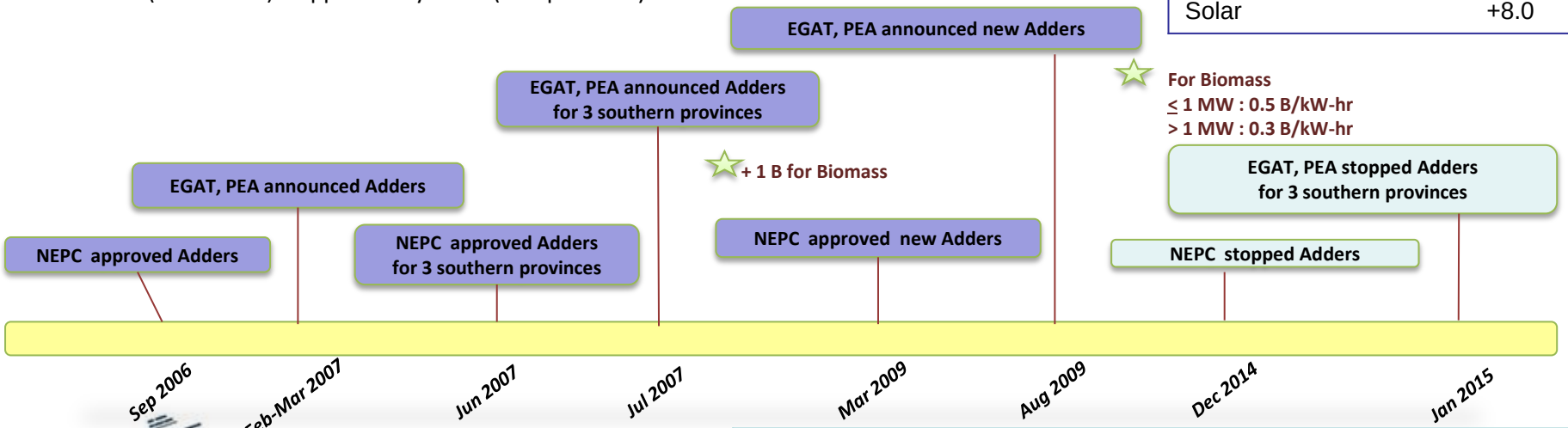
To increase share of MW produced from 9% (2014) to 20% (2036) or 19,635 MW
Biomass shared 5,570 MW (from 2,451.82 in 2014)

Target	Solar	Wind	Small Hydro	Bio-gas	Bio-gas from Biomass	Biomass	RDF	New Type	Big Hydro	Industrial Waste	Total
2021P	3,800	1,800	324	600	3,000	4,800	400	3	N/A	N/A	13,927
2036P	6,000	3,002	376	600	680	5,570	500	0.3	2906	50	19,634

Source: PDP 2015 (2015-2036) – approved by NEPC (14 April 2015)

From Adder to FiT

Fuel / Technology	Adder (THB/kWh)
Biomass	+0.3
Hydro (50-200kWh)	+0.4
Hydro (<50kWh)	+0.8
RDF from MSW	+2.5
Wind	+2.5
Solar	+8.0



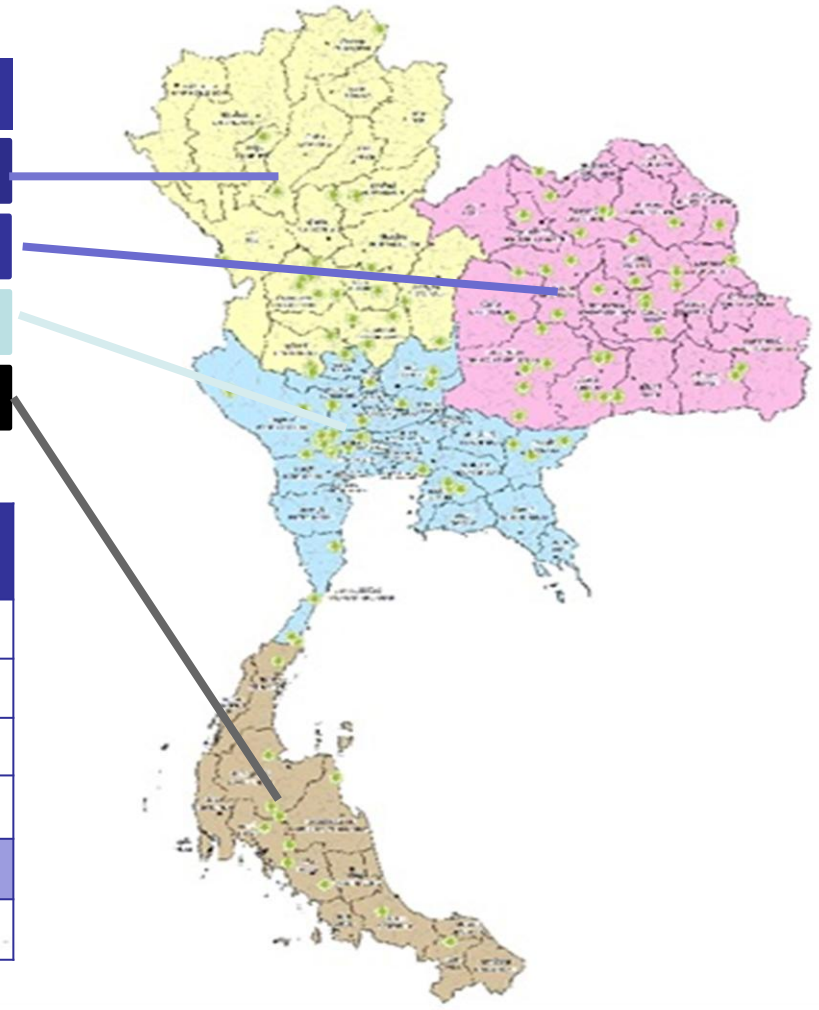
NEPC approved FIT for VSPP in Dec 2014

Biomass VSPP Size	(THB/kWh)	Extra
≤ 1MW	5.35	+0.5 (first 8 years)
> 1-3 MW	4.82	+0.5 (first 8 years)
> 3 MW	4.24	+0.3 (first 8 years)

Biomass Power in Thailand - Implementation

Map of Biomass Power Plants in Thailand

Total Potential Biomass Capacity = 8,800 MW	
Northern	3,100 MW
North Eastern	2,400 MW
Central	2,100 MW
Southern	1,200 MW



Number of Biomass Power Plants in Thailand

Status	SPP (Plants)	MW	VSPP (Plants)	MW
Application Submitted	2	42	1	7
Waiting for PPA	9	184	1	9
Received PPA, not COD	1	38	68	368
COD	30	593	136	828
Total	**42**	**857**	**206**	**1,212**
Application Cancelled	57	796	318	1,969

Source : www.erc.or.th (EGAT as of 30 Mar 2016, PEA & MEA as of 14 Jan 2016

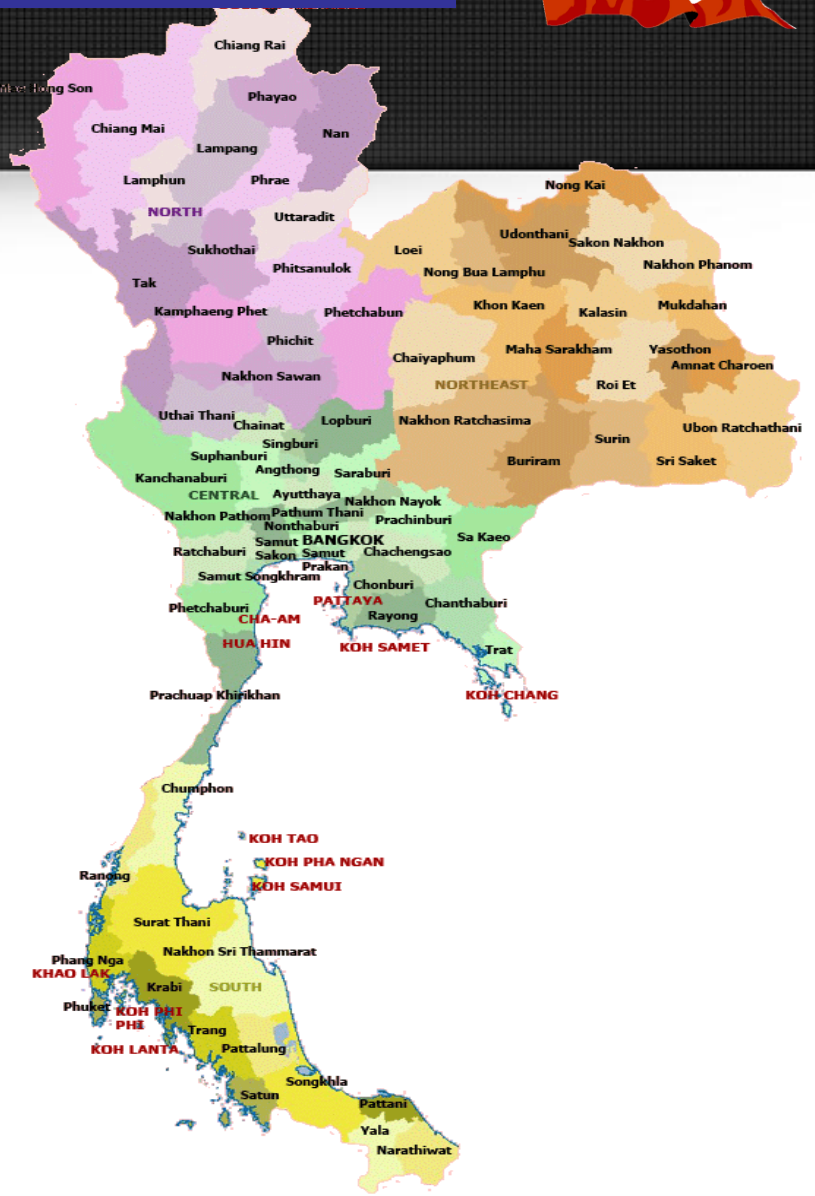
Biomass Power in Thailand – Investment Opportunity

Industrial Facts

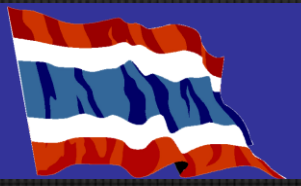
One of the largest paper mill manufacturers to increase the production of electricity using Biomass material from their own production processes .

Impact Facts : Supply chain broken

Many plant -based raw materials from paper mill manufacturer will be affected due to shortage of raw materials in the near future and/or fuels has resulted in material costs will rise.



Biomass Power in Thailand

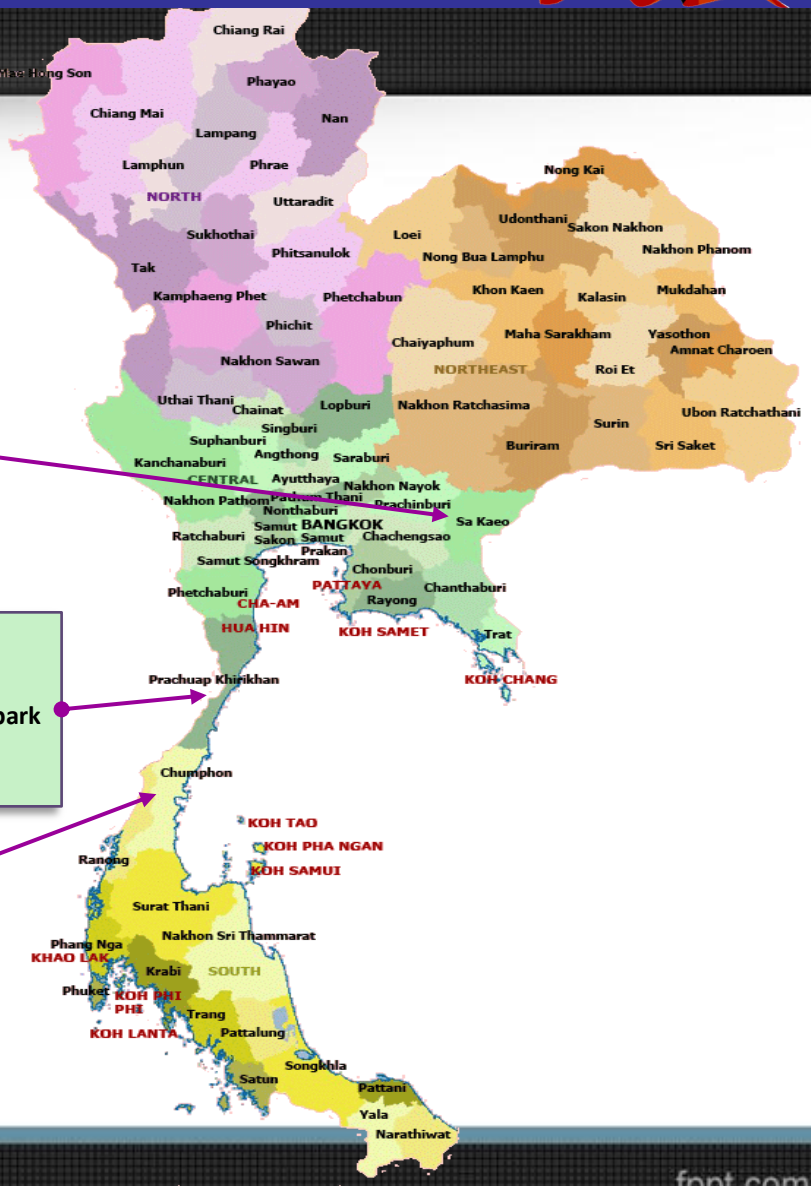


9.8 MW
PPA: 8MW
Feedstock : Euca. wood & bark, EFB (Palm), bagasse and biogas
COD: October 2017
Adder: valid until October 2024

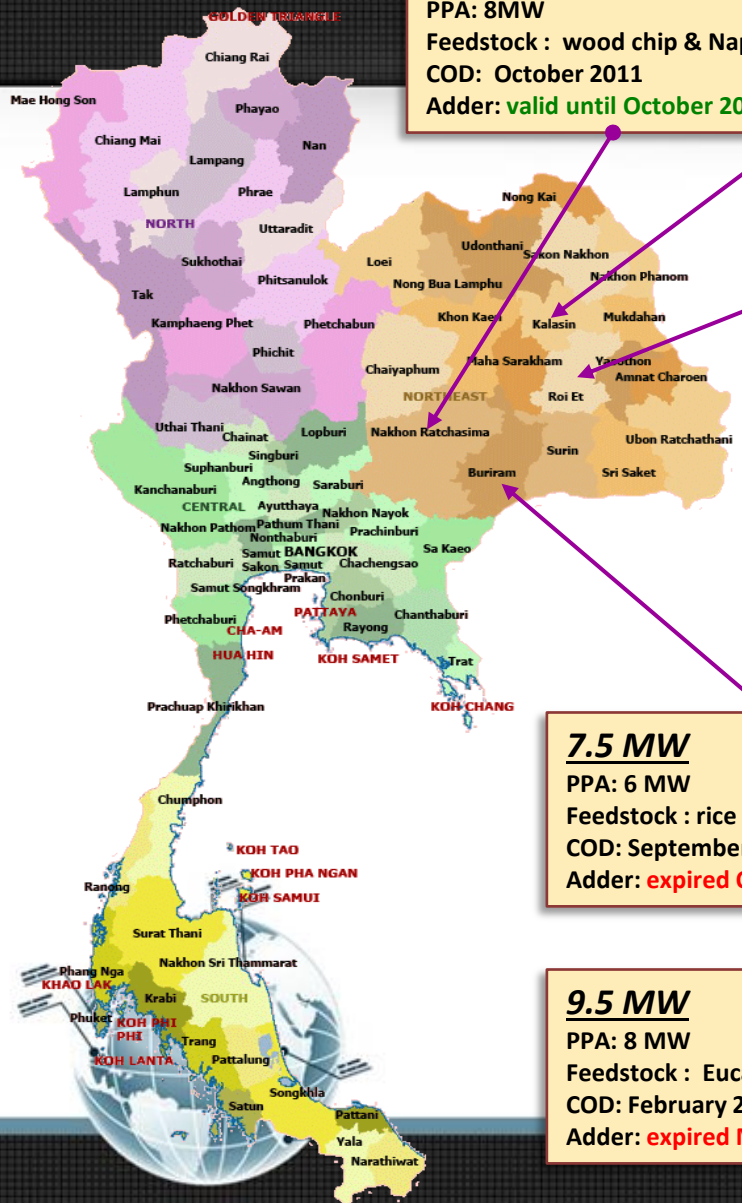
9.5 MW
PPA: 8MW
Feedstock : Euca. wood & bark, EFB (palm), bagasse and biogas
COD: April 2013
Adder: valid until April 2020

9.5 MW
PPA: 8MW
Feedstock: coconut shell & Para bark
COD: Oct 2011
Adder: valid until October 2018

9.5 MW
PPA: 8MW
Feedstock : empty fruit bunch & Para bark
COD: N/A
Adder: N/A



Biomass Power in Thailand



9.9 MW
PPA: 8MW
Feedstock : wood chip & Napier
COD: October 2011
Adder: valid until October 2018

9.9 MW
PPA: 8MW
Feedstock: rice husk, wood chip
COD: March 2012
Adder: valid until March 2019

6MW
PPA: 5 MW
Feedstock : miscellaneous wood, rice husk
COD: March 2008
Adder: expired March 2015

9.9 MW
PPA: 8 MW
Feedstock : rice husk, miscellaneous wood
COD: August 2009
Adder: valid until August 2016

9.9 MW
PPA: 8 MW
Feedstock : wood chip & Euca. bark
COD: September 2015
Adder: valid until September 2022

9.9 MW
PPA: 8 MW
Feedstock : rice husk, miscellaneous wood
COD: March 2009
Adder: expired March 2016

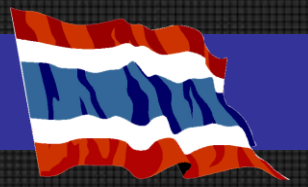
7.5 MW
PPA: 6 MW
Feedstock : rice husk & Euca. bark
COD: September 2005
Adder: expired October 2012

9.9 MW
PPA: 8 MW
Feedstock : rice husk & Euca. wood/bark
COD: August 2008
Adder: expired September 2015

9.5 MW
PPA: 8 MW
Feedstock : Euca. bark & wood chip
COD: February 2008
Adder: expired March 2015

9.9 MW
PPA: 8 MW
Feedstock : Euca. bark 90%, wood 10%
COD: November 2013
Adder: valid until November 2020

Biomass Power in Thailand – Estimated Returns



Target Projects	Investment (THB mn.)	Investment (USD mn.)	Adder IRR (%)	Adder EIRR (%)	FiT IRR (%)	FiT EIRR (%)
1. CET	740.00	21.14	13.30	16.50	17.00	34.30
2. TRCC	750.00	21.43	14.62	15.98	20.18	27.66
3. STUK	920.00	26.28	15.07	18.25	10.04	13.00
4. ABP			14.75	16.66	16.90	30.57
5. SBP	1,200.00	34.29	9.37	7.13	6.73	2.48
6. SGP			8.98	7.83	13.16	14.79
7. IEC-SK	950.00	27.14	12.72	13.92	15.97	19.95
8. KCG	720.00	20.57	15.32	18.23	23.62	43.59
9. BSM I	350.00	10.00	12.30	13.78	17.32	24.67
10. BSM II	1,450.00	41.43	15.21	17.14	19.78	27.66
11. BSM III			15.21	17.14	19.78	27.66
12. BSM IV	790.00	22.57	10.07	10.10	12.67	15.12
13. SABCO	630.00	18.00	10.01	10.16	11.03	14.23
14. KMS	840.00	24.00	14.96	23.32	19.19	68.29

Remarks : Exchange rate: USD/THB = 35

Critical Bottlenecks Settlement

Homogenous Biomass

Issues:

- Lack of feedstock,
- Technology,
- O&M and Grid

Key Success Factors:

Efficient Management of Supply Chain (Diversity)

Efficient O&M Management

Inhomogeneous Biomass

Bio-Organic waste

Municipality Solid Waste (MSW)

Settlement Issues:

- Use of MSW instead or as auxiliary feed stock,
- Technology :
  - Technical modification to burn variety of biomass feedstock (Bio-organic waste)
  - Incineration to Gasification adjustment
  - Integrated technology (Combination between Mass Burn Combustion and Gasification technology)
  - Modify pollution control system
- Community concerns
- O&M and Grid

Technology Evolution

>2000	Plasma Gasification	Waste to Energy
End 1990s	Gasification Technology	Waste Destruction
1970s	Incineration (Stoker, Fluidized Bed, Rotary Klin)	Waste Disposal/Reduction
1970s	Sanitary Landfill	Waste Disposal
<1970s	Dump Site / Landfill	Waste Disposal

Source : Jupiter Consultancy Ltd., UK. “Progress Towards Commercializing Waste Gasification” A World Wide Status Report : Presentation to the Gasification Technology Conference : San Francisco USA 2003

Technology Evolution

Technology Selection	Temp	Systems Used	Priority	Environmental Issues
Plasma Gasification	>10,000 c.	Atmospheric Pressure	Waste Destruction Energy Generation	No GHG No Landfill
Gasification	1,250 c.	Gasification	Waste Destruction Energy Generation	No GHG Ashes
Incineration (Stoker, Fluidized Bed)	1,000 c.	Incineration	Waste Destruction Landfill	GHG, Dioxin/Furan Ashes
Burning (Furnace)	800 c.	Recycle RDF, Furnace	Waste Disposal Landfill	GHG, Dioxin/Furan Ashes
Eng. Or Sanitary Landfill	-	Recycle Raw Waste	Waste Disposal	GHG Leachate
Dump Site / Landfill	-	Recycle Raw Waste	Waste Disposal	GHG Leachate

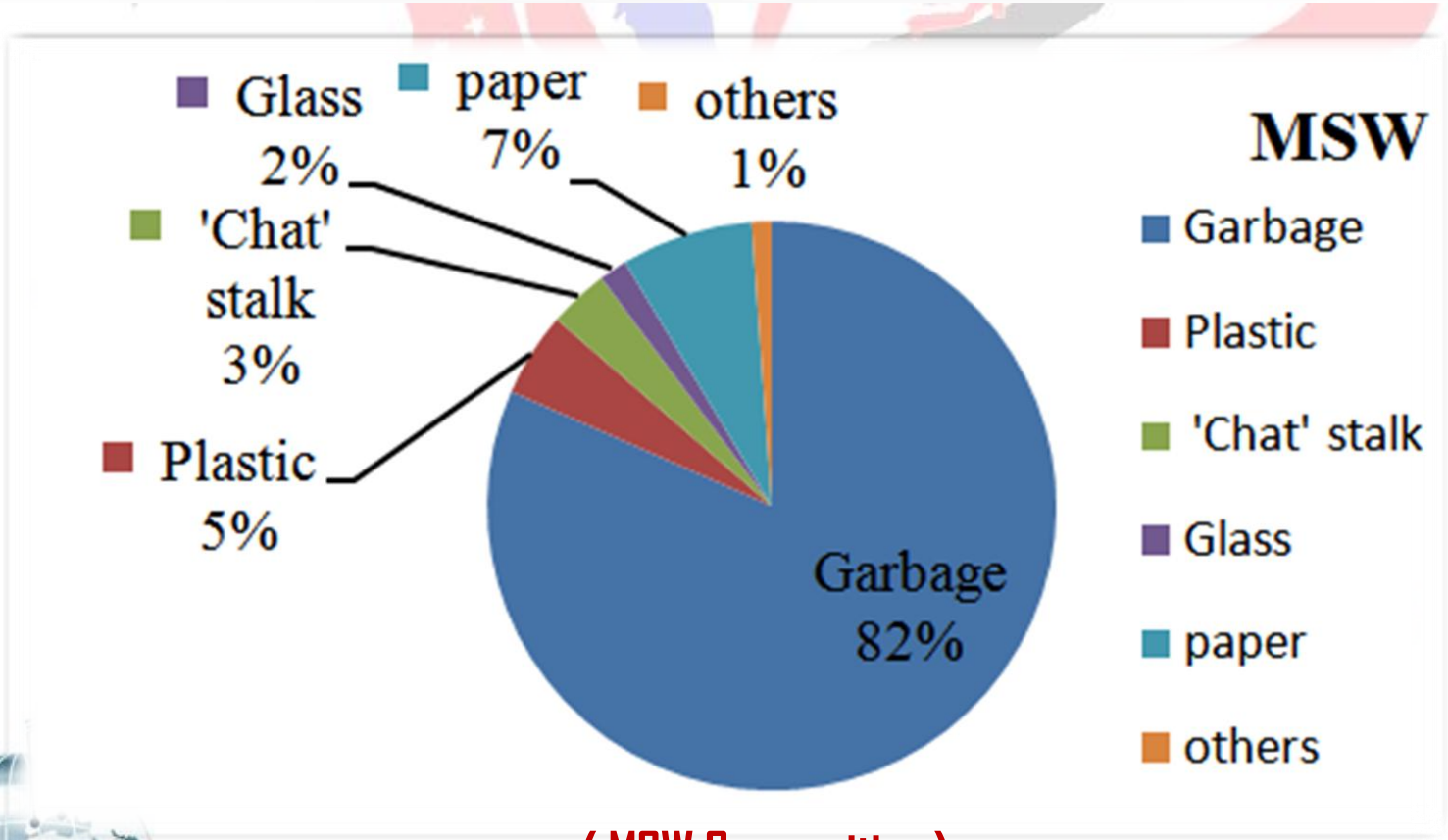
Source : Jupiter Consultancy Ltd., UK. “Progress Towards Commercializing Waste Gasification” A World Wide Status Report : Presentation to the Gasification Technology Conference : San Francisco USA 2003

Global Challenges and Opportunities

- **Challenges**
  - **World Bank (2012):** Global generation of Municipal Solid Waste (MSW) will double by 2025.
  - **World Bank (2012):** MSW will become a bigger problem than climate change.
  - **U.S. Energy Information Agency (2011):** U.S. electricity needs will increase 30% by 2025.
- **Opportunities**
  - **U.S. EPA (2009)**: MSW is the only important waste-to-energy (WTE) materials stream for power production.
  - **SBI Energy (2011):** MSW could supply 10% of global power.
    - Approaches global nuclear reactor power production

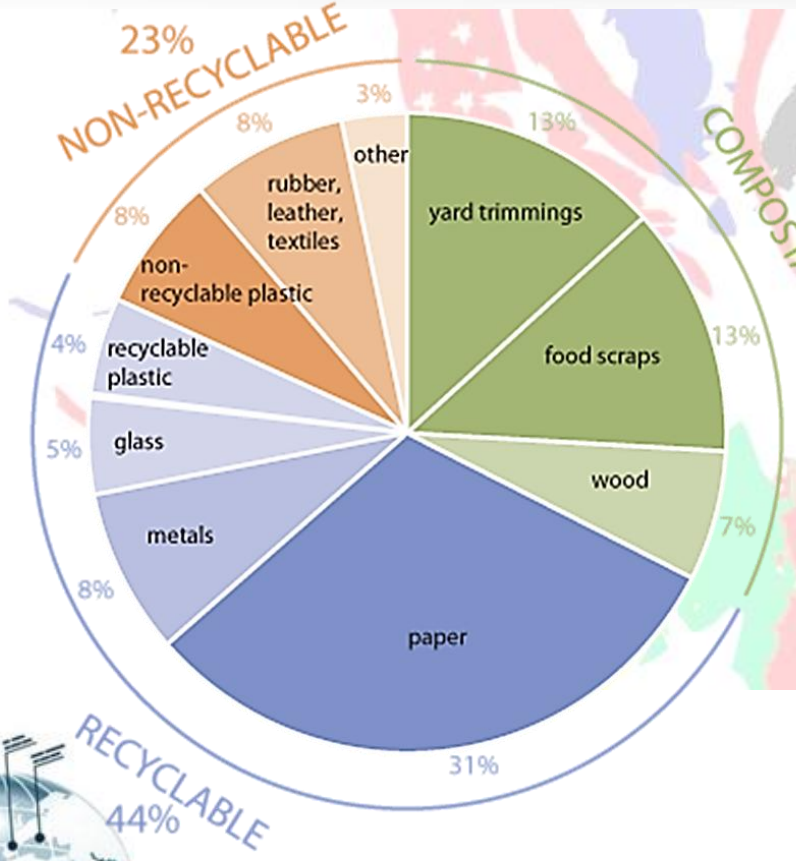
Q : How can we convert "CHALLENGES" becomes "OPPORTUNITIES" ?
Any suitable solution to convert waste to energy ?

SOURCES of Feedstock : MSW (in general)



(MSW Composition)

SOURCES of Feedstock : LFW (in general)



(LFW composition)

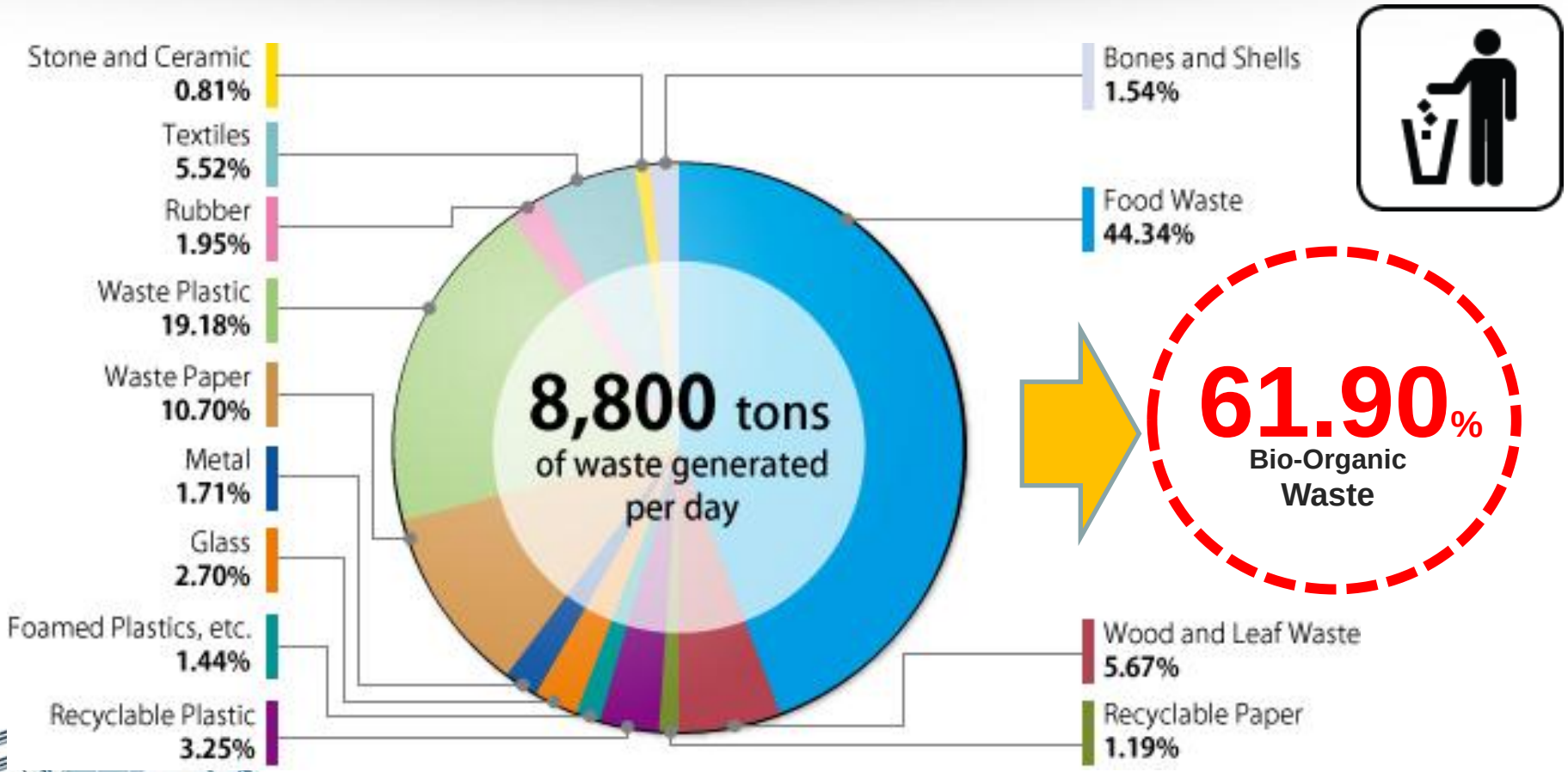
67% **Composing Organic**
As soil condition
(Be improved as fertilizer)

20% **Polymer Waste**
Plastic sheet
Rubber sheet
(High heat value)

13% **Hard Waste**
Non-fermented waste
(Recycling and landfill)

MSW Compositions as Biomass form

http://www.slideshare.net/CRLAsia/swga-presentation-chart-chiemchaisri



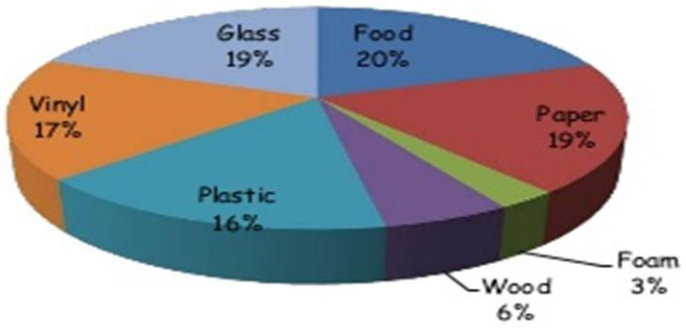
Waste composition of Bangkok, Thailand (2009)

MSW Characteristic

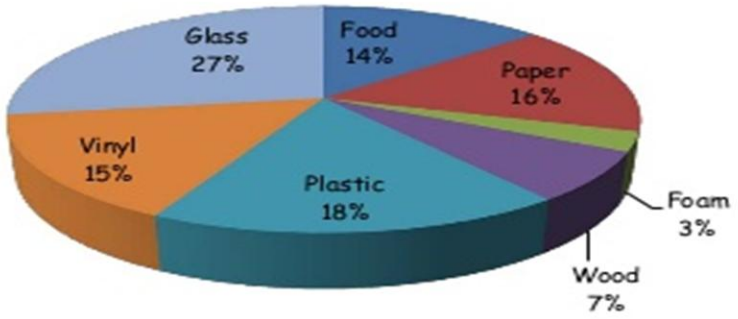
http://www.slideshare.net/CRLAsia/swga-presentation-chart-chiemchaisri

Waste Composition & Characteristics

Wet Composition



Dry Composition



Volatile Solids	79.19	%
Carbon (C)	43.99	%
Oxygen (O)	4.81	%
Hydrogen (H)	48.41	%
Nitrogen (N)	2.24	%
Phosphorus (P)	0.16	%
Sulfur (S)	0.39	%

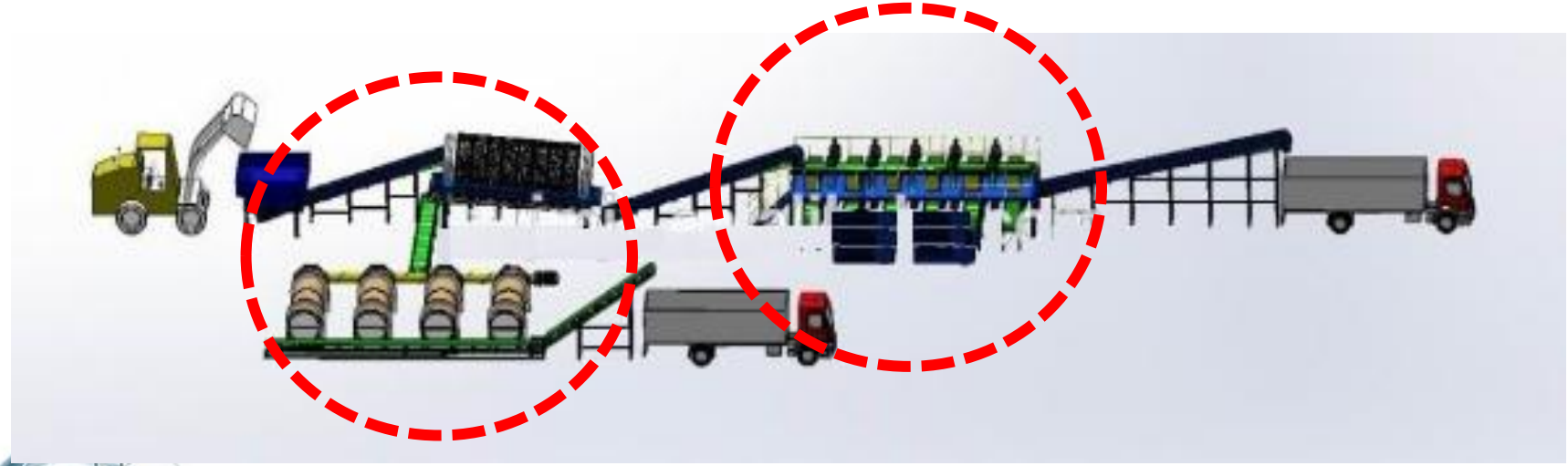
The waste composition represents average MSW characteristics of Thailand

Waste composition
Bangkok, Thailand (2009)

Commercial Solution in Thailand

Sorting/Front End system

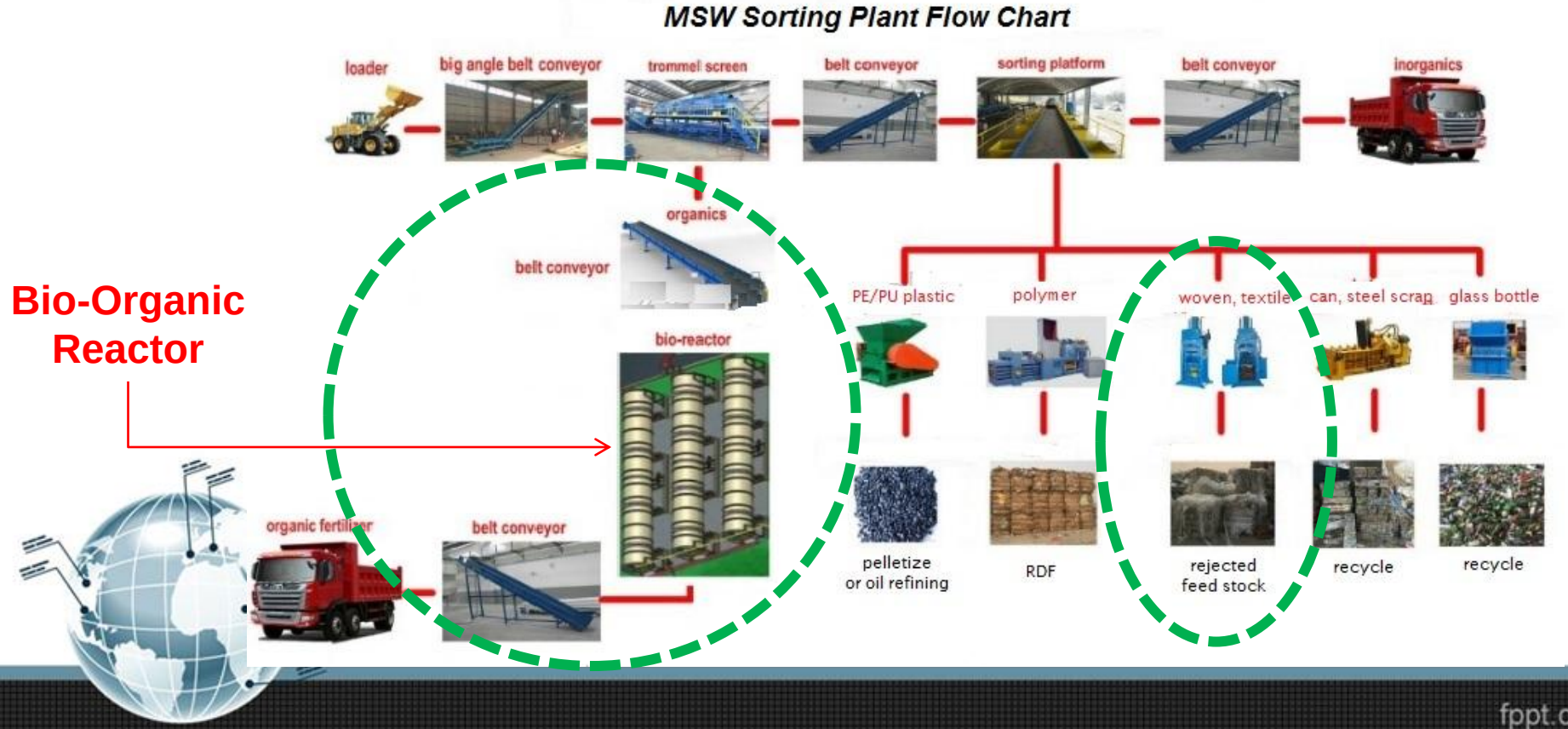
- **To implement the Sorting system**
- **Bio-Organic fertilizer production**
- **Waste plastic recycling (pellet and/or oil refining) production**



Commercial Solution in Thailand

Bio-Organic fertilizer production

- Bio-Organic waste sorting
- Waste plastic recycling (pellet and/or fuel oil) production



Commercial Solution in Thailand

การจัดการขยะรูปแบบใหม่ เน้นผลิตพลังงาน

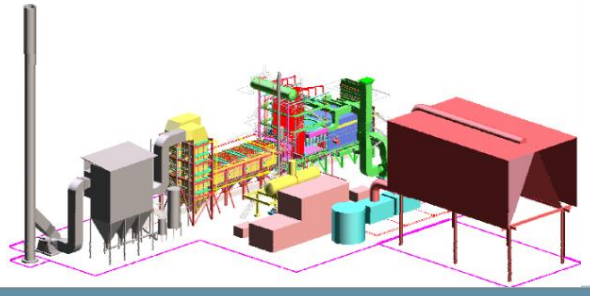
นำขยะไปเผาเพื่อผลิตพลังงาน โดยแบ่งเตาเผาเป็น 3 ขนาด

Small plant
under 50 TPD

Medium plant
50-300 TPD

Large plant

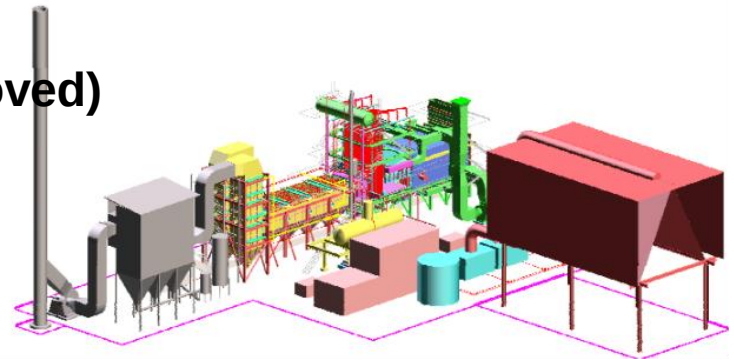
Roadmap : new model of waste manage
Waste to Energy Focus



Commercial Solution in Thailand

High Thermal Operation in Thailand : Over 300 TPD

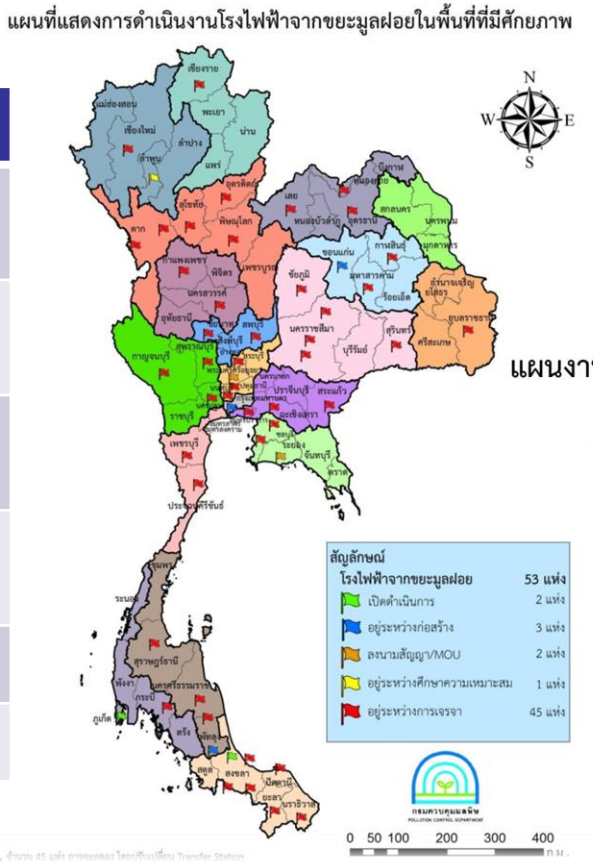
- 2 x plants of Incineration technology
  - Phuket
  - Bangkok
- 1 x plant of Multi-stage PyroCombustion Gasification
  Hatyai, Songkla
- 1 x plant of Pyrolysis Gasification
  - Nonthaburi (under process/EIA approved)



Commercial Solution in Thailand

High Thermal Operation in Thailand

Status	No.of plants
Commercial launched	3 (Phuket / Hatyai / Bangkok)
Under construction	2 (Kon Kaen / Pattalung)
MOU signed	2 (Ayudhaya / Rayong)
Under feasibility study	1 (Lampoon)
Under negotiation	45
Total :	53



Commercial Solution in Thailand

4 Major parts of High Thermal Operations

Part 1 : Front End system (RDF plant)

Sorting system and waste preparation

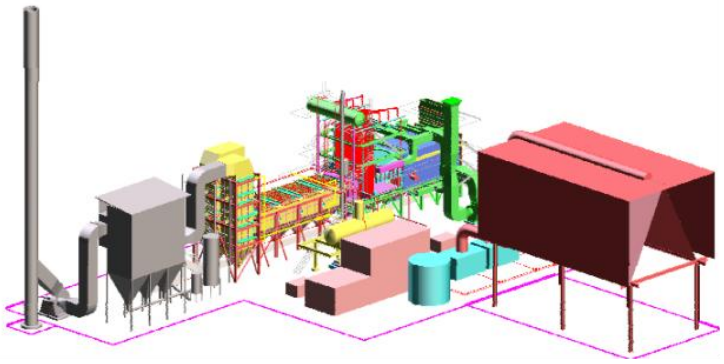
Part 2 : Energy Recovery

Disposal and heat exchange system

Part 3 : Pollution control

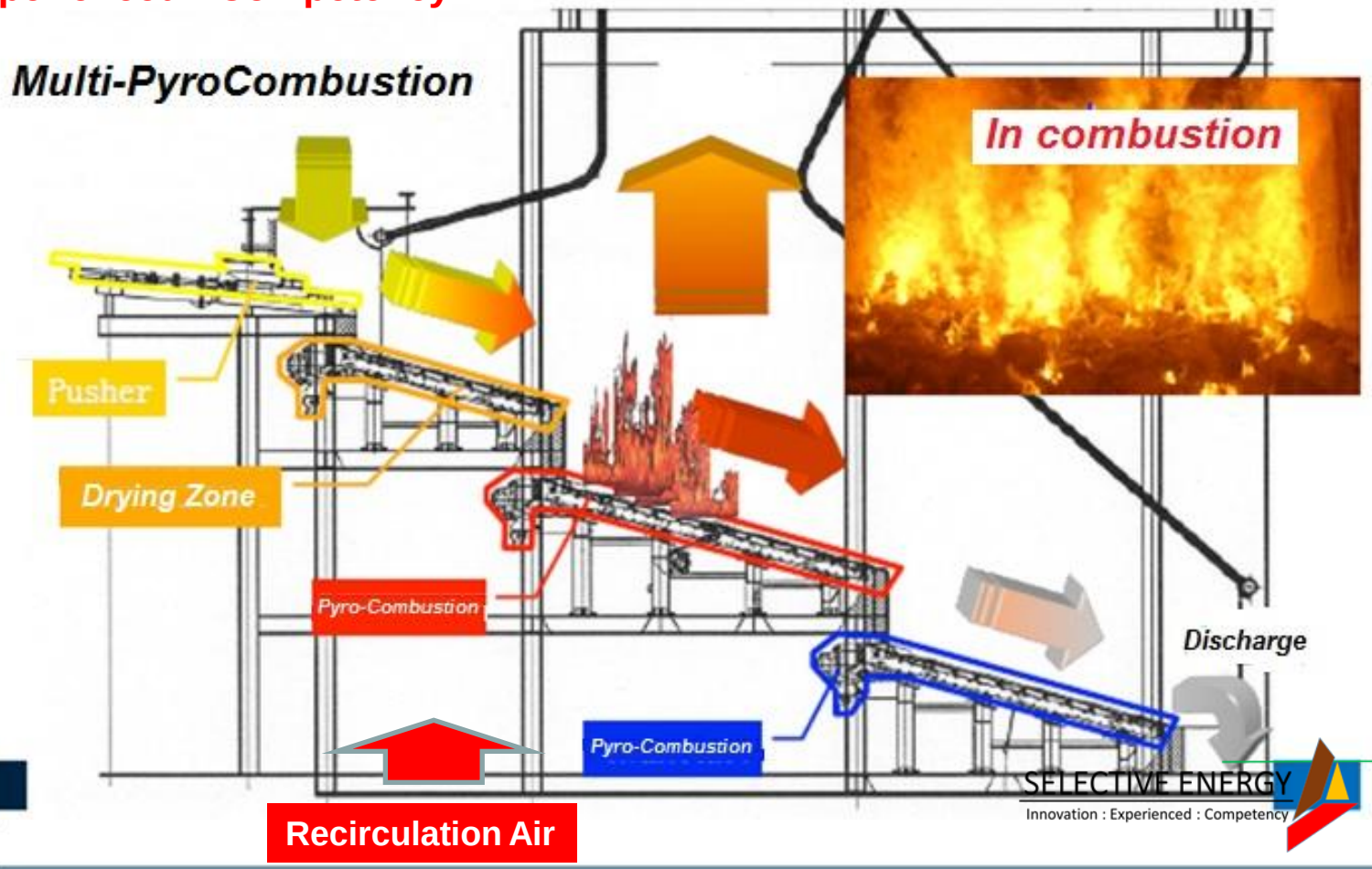
- Emission
- Waste water treatment
- Discharge management

Part 4 : Facilities system

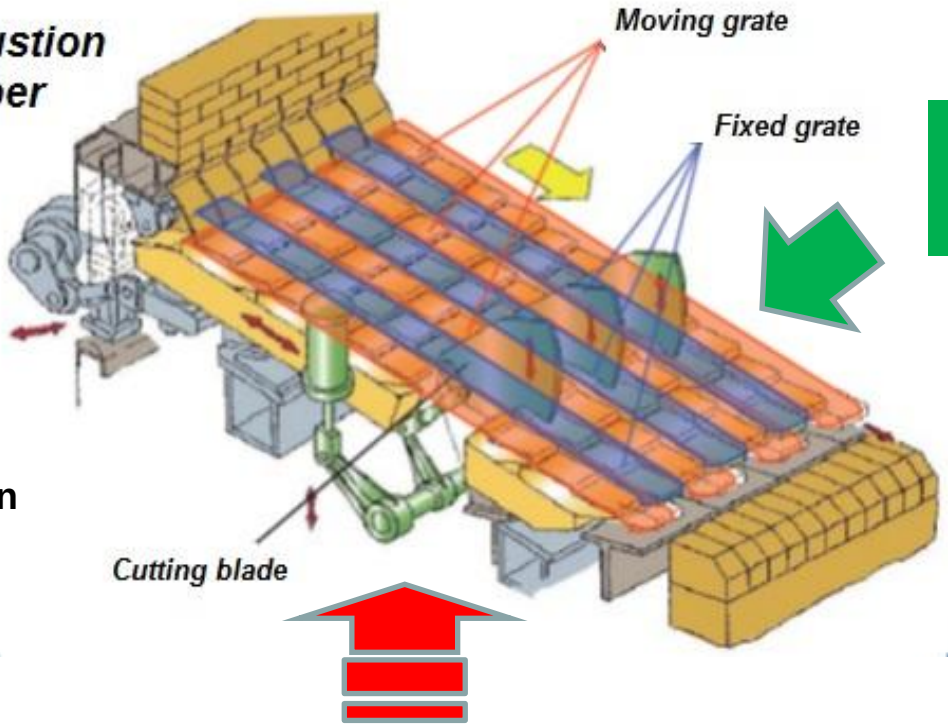


High Thermal Solution

Innovation : Experienced : Competency



High Thermal Solution



Integrated Pyro-Combustion Technology

Reversible system
For better combustion performance

Recirculation Air

SELECTIVE ENERGY
Innovation : Experienced : Competency

High Thermal Solution

The 1st Pyro-Combustion Gasification in Thailand

MSW Power Plant

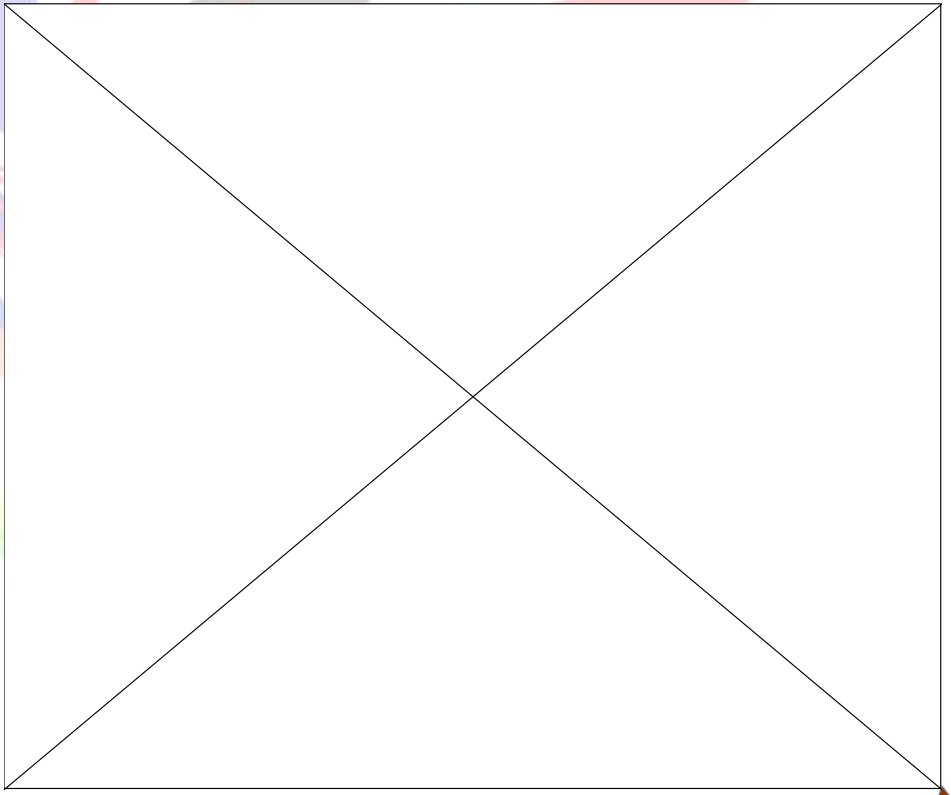
Hatyai, Songkla, Thailand.

SELECTIVE ENERGY

Innovation : Experienced : Competency

High Thermal Solution

Vertical
Pyrolysis
Gasification



SELECTIVE ENERGY
Innovation : Experienced : Competency

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