Analyzing the potential of municipal solid waste-to-energy in ASEAN

Key technologies and policy enablers

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Agenda

Waste in ASEAN

WTE technologies and ASEAN status quo

Creating an enabling policy ecosystem

- Enabling revenue streams
- Enabling investment and development
- Enabling regulations and institutions

Concluding thoughts

This file photo shows a woman scouring through a pile of waste on the side of a road in Bac Ninh, east of Hanoi on 16 December 2019. (AFP Photo)

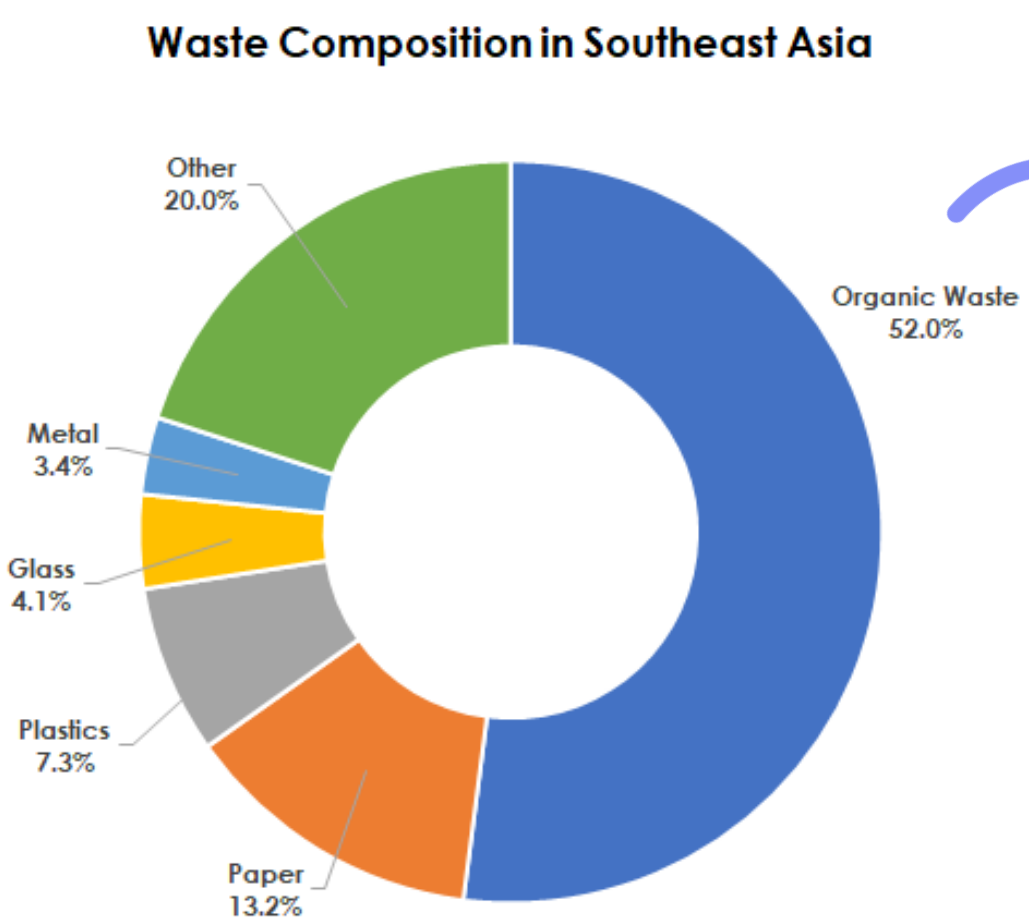
What is similar about these two pictures?

Southeast Asia generates
an estimated
675,000 tons of
Municipal Waste daily

or the equivalent of
1 Petronas tower
every single day

Source: UNEP (2017)

Where does the waste go?



>50%

ends up in open dumping landfill

↓

Anaerobic Decomposition

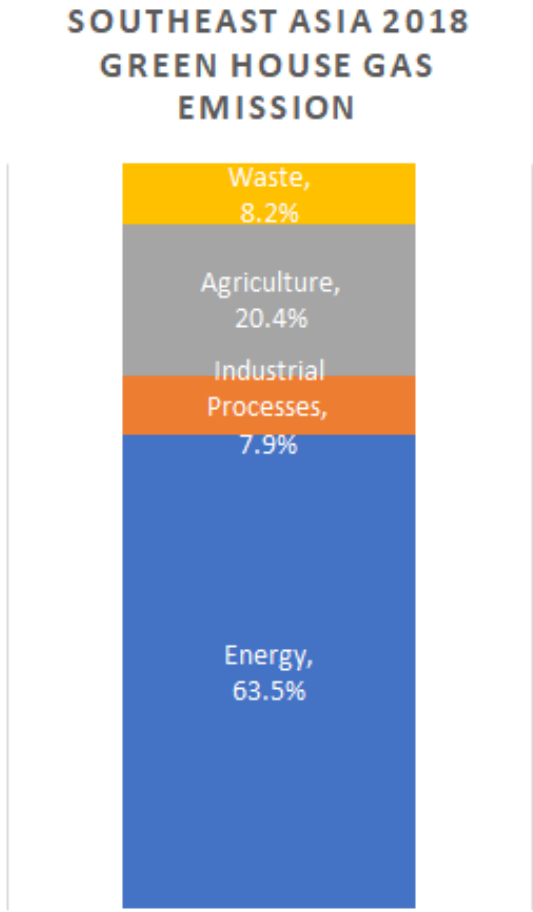
↓

Methane (CH_4)

Which is

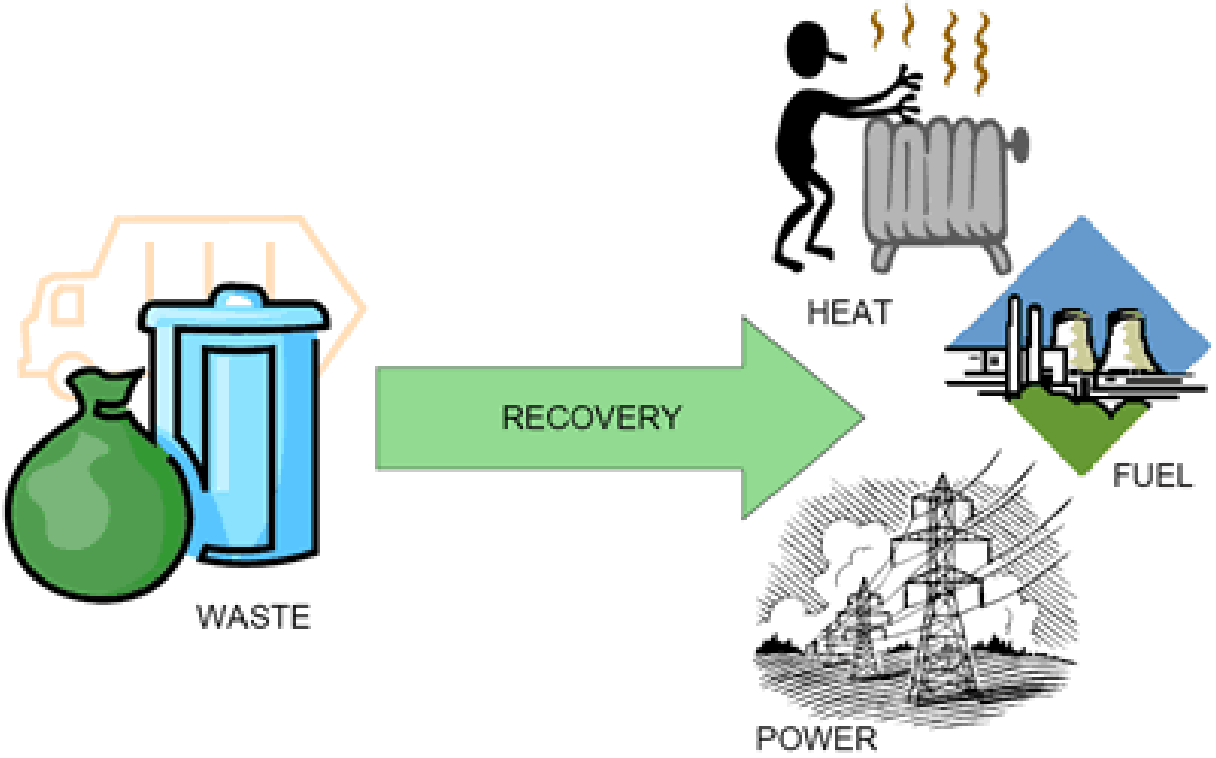
28x

More potent than CO_2 gas

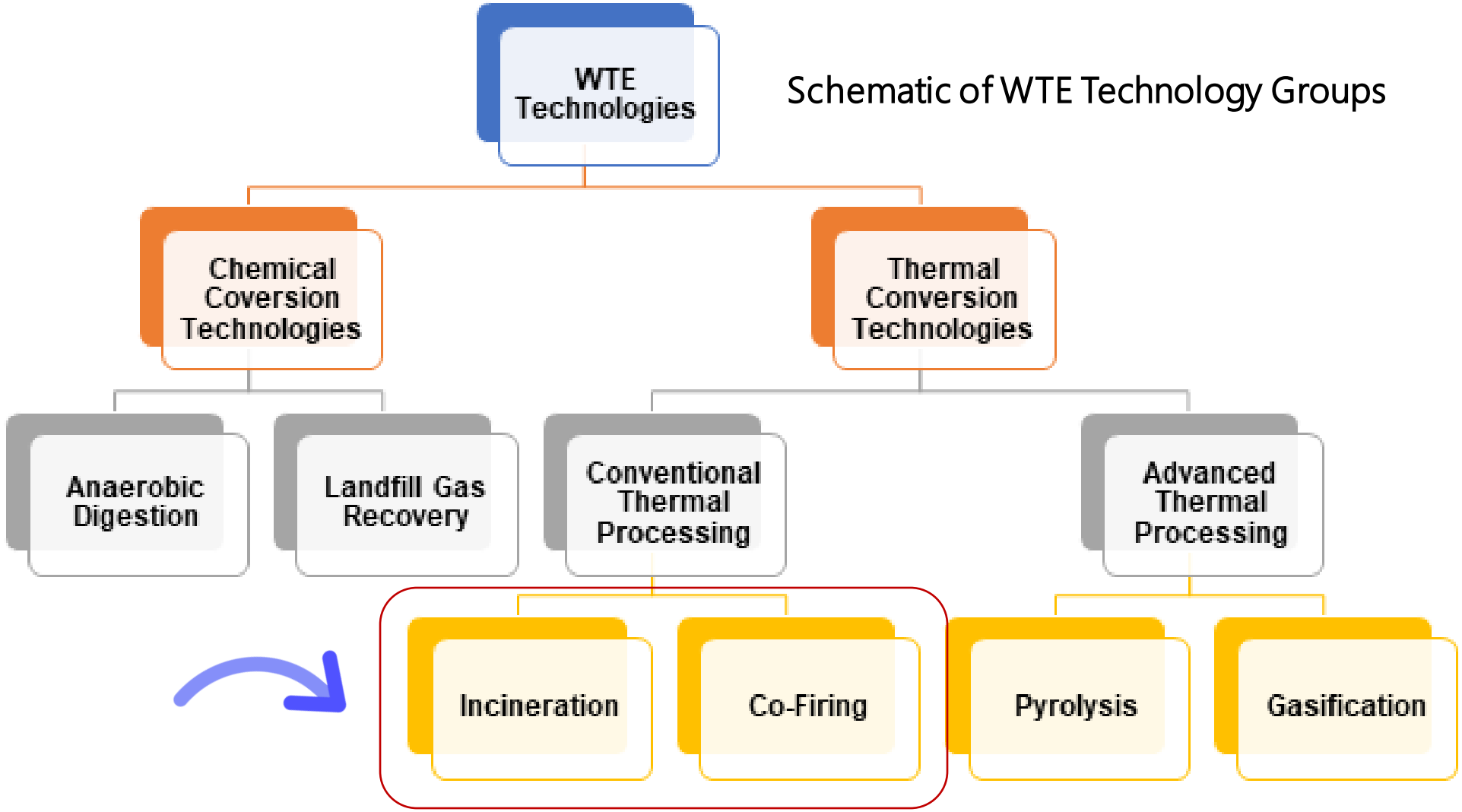


Source: Word Research Institute (2018), https://www.climatewatchdata.org/, UNEP (2017)

Waste-to-Energy Technologies



WTE Technologies

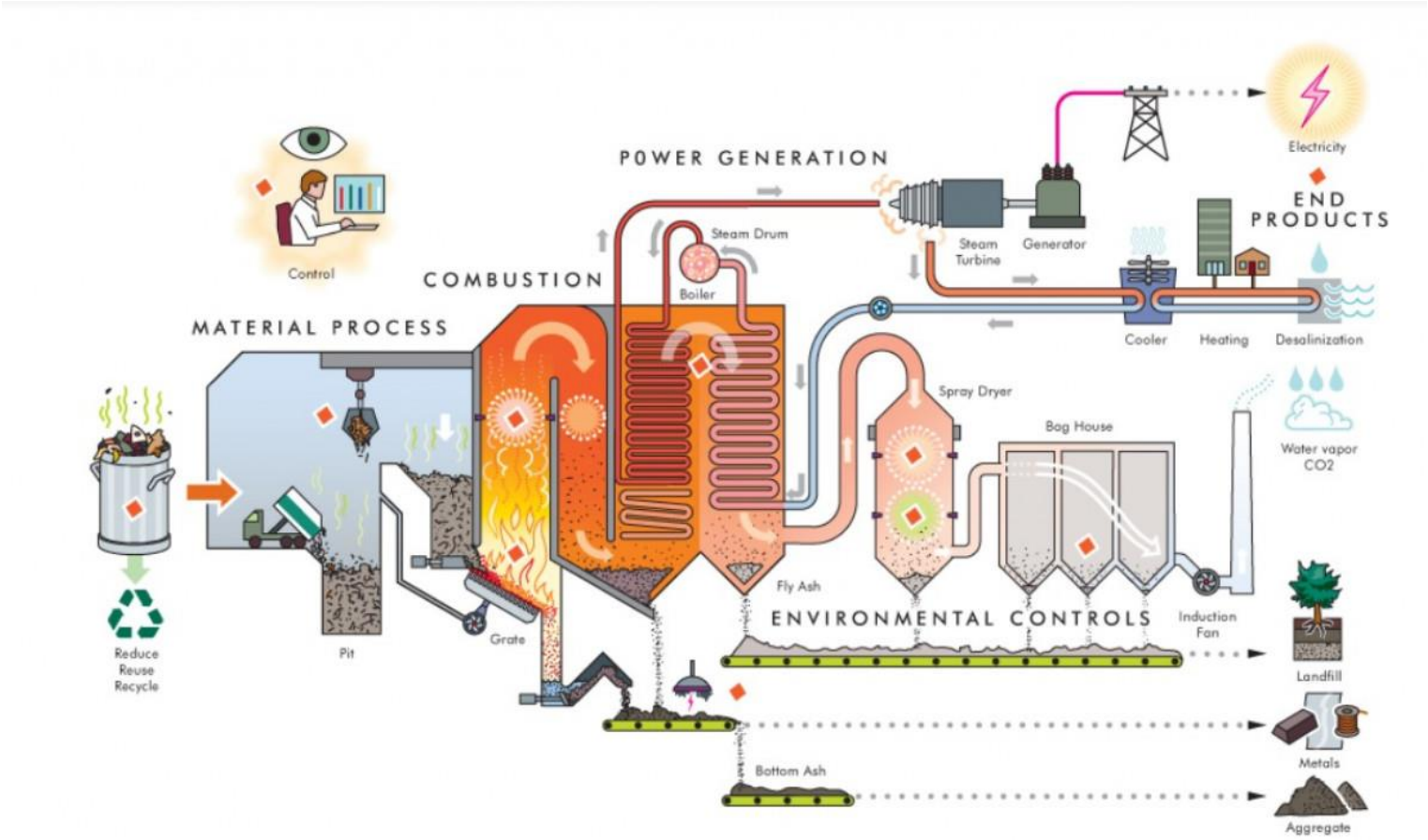


Schematic of WTE Technology Groups

Source: Adapted from (Bhada Tala, 2007)

Case Study 1 Incineration: TuasOne, Singapore

Municipal Solid Waste Incineration Plant Process



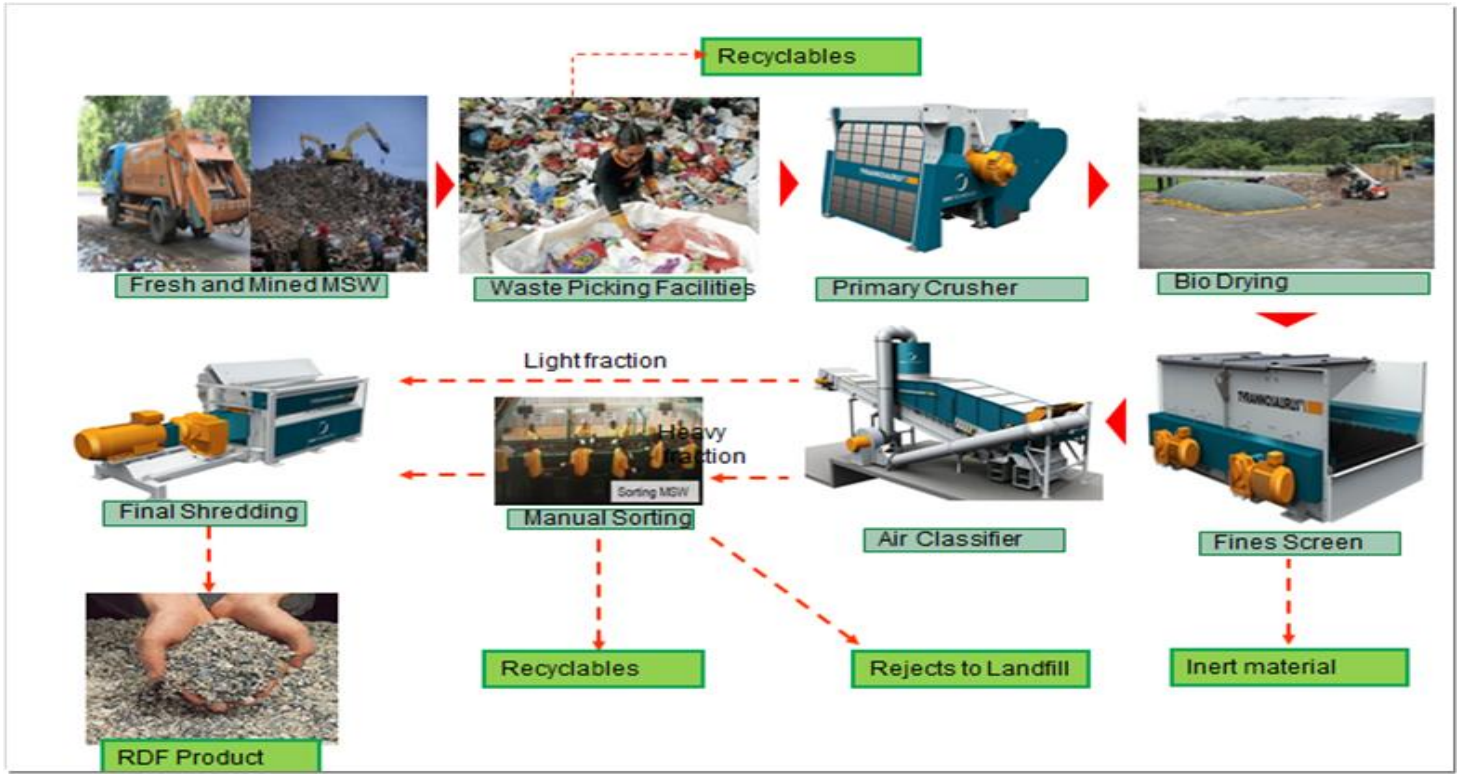
Maximize Energy Recovery
3600 tons/day >> Generate 120MW of electricity>> 3600tons CO2-eq reduction

Minimize Residue to Landfill
Waste volume reduction around 90%. Recovery of ferrous metals from bottom ash.

Source: Deltaway

Case Study 2 Co-Firing: Cilacap-Indonesia

Municipal Solid Waste to RDF Technology Process in Co-firing Plant

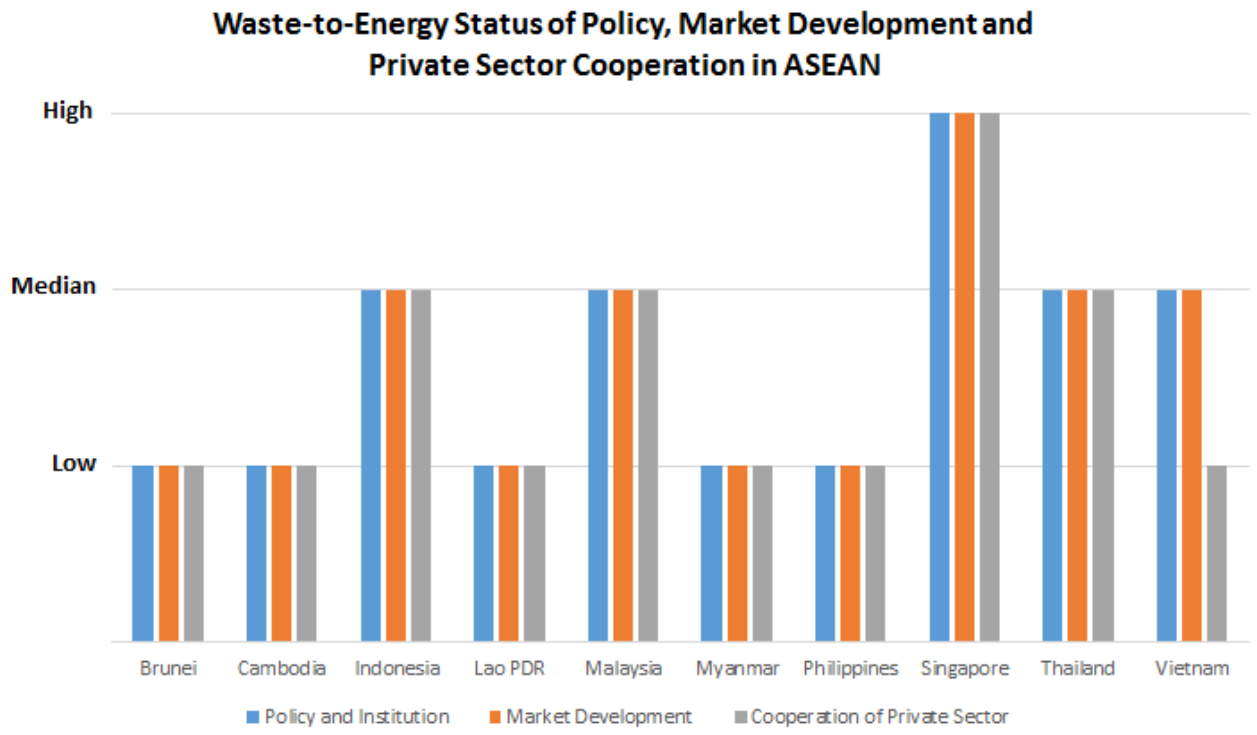


Reduction in Coal consumption
120 tons/day or 3,600 tons/month of waste and will produce around 40-50 tons of RDF

Reduction in gas emissions at about 1.61 kg of CO2 per kg of utilized RDF compared to conventional combustible materials (coal)

Source: Holcim, 2013

ASEAN WTE potential comparison: In terms of policy and institution, cooperation of private sector, market development



The ranking for low-median-high was primarily based on the United Nations Environment Programme (UNEP) and the World Bank.

Mature

- Singapore

Developing

- Indonesia
- Malaysia
- Philippines
- Thailand
- Vietnam

Emerging

- Brunei Darussalam
- Cambodia
- Laos
- Myanmar

Legend:

- **Emerging** – no actual installed WtE capacity and energy potential from waste not yet fully studied.
- **Developing** - with actual WtE installation but of small capacity (<50MW), energy potential is known.
- **Mature** – with actual WtE installation (>50MW) and plan is in place to capture remaining potential.

Sources: Hoornweg, et al. (2012), Tun, M., et al. (2020), UNEP (2017)

ASEAN WTE potential comparison

Country	Waste generation (Tons/yr by 2025)	Status of WTE Tech	Installed WTE Capacity	Energy Potential from WTE
Singapore	3,353,255	Mature	256.8MW from 4 plants	10.8MW planned, **0.21TWh** 2030 potential
Thailand	20,685,645	Developing	44.3MW	400MW from COD from 2021 planned, **2.41TWh** 2030 potential
Vietnam	26,611,785	Developing	-	**2.85TWh** 2030 potential
Philippines	28,388,240	Developing	-	267MW target by 2030, **3.02TWh** 2030 potential
Malaysia	18,854,075	Developing	13.8MW biogas + 5MW incineration	400MW from MSW, 11.7MW planned, **1.06TWh** 2030 potential
Indonesia	55,451,165	Developing	2MW	234MW from 12 plants in 2022, 810MW target by 2025, **7.71 TWh** 2030 potential
Brunei	202,210	Emerging	-	-
Cambodia	-	Emerging	-	-
Laos	1,516,210	Emerging	-	-
Myanmar	7,669,380	Emerging	0.76MW	-

Source: Tun, M., et al. (2020)

Creating an enabling policy ecosystem

1

Enabling potential revenue streams

2

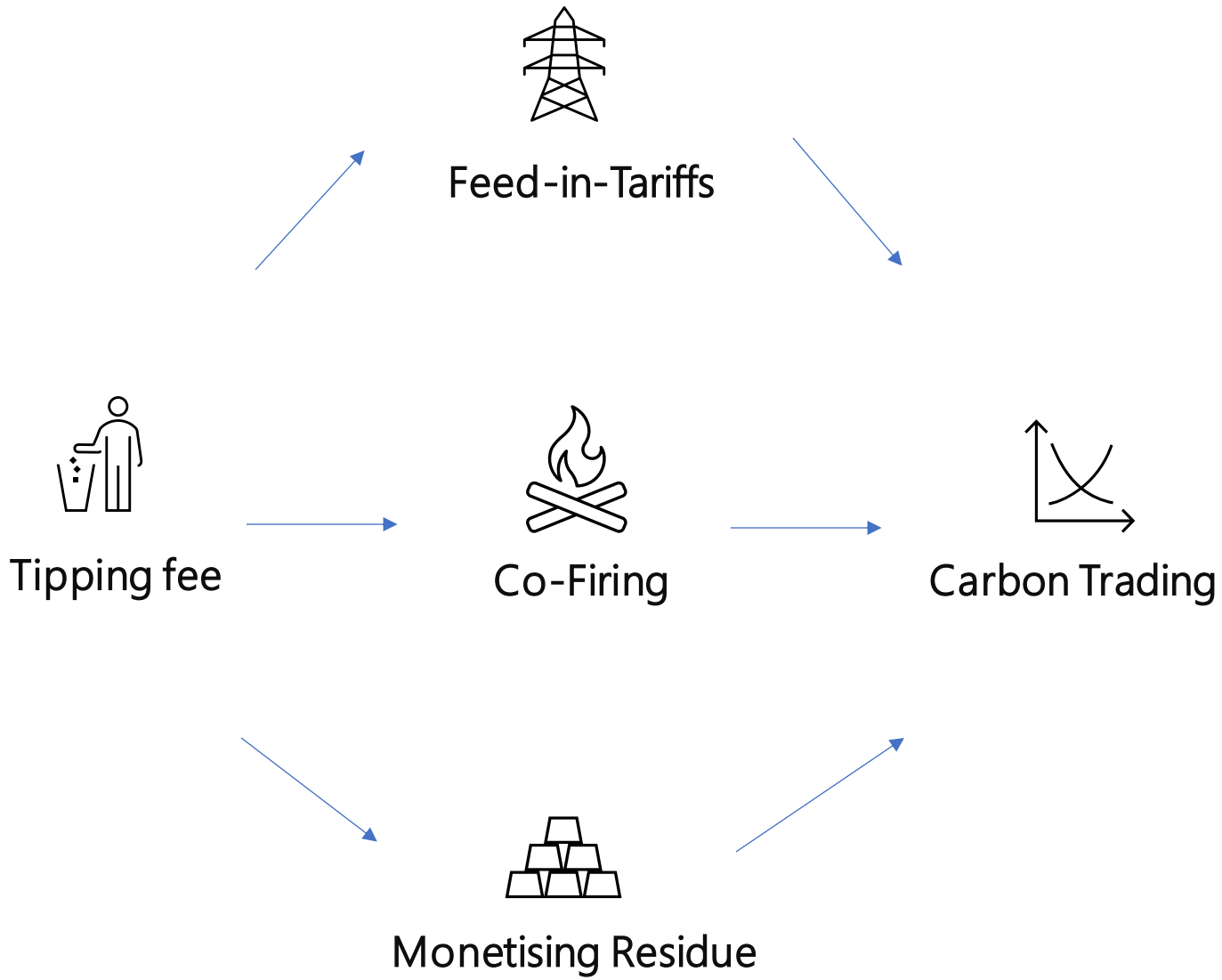
Enabling investment & development of WTE

3

Enabling a suitable regulatory and institutional environment

1

Enabling potential revenue streams



1 Enabling potential revenue streams

Tipping fees	• Standard fee rates quite low in many ASEAN countries (approx. US9.23/ton in Thailand, US$12/ton in Maylaysia and the Philippines) • Higher rates in Indonesia (approx. US$34/ton) and Singapore (ranging US$57-72/ton)
Feed-in-Tariffs	• WTE tariffs available in Indonesia (13.35 UScents/KWh), Thailand (16-20 UScents/kWh) & Vietnam (10 UScents/kWh) • Biomass tariffs (WTE included) available in Malaysia (ranging 9.38 – 10.4 UScents/kWh) & Philippines (12.75 UScents/kWh)
Co-Firing	• Co-firing aims to utilize waste products or biomass to repla coal in coal-fired powerplant. Planned ratio of 1-10% in Indonesia. • RDF Cilacap for cement kiln -> 20$/tonne
Monetising Residue	• The residue from incinerators can be used as cement additi for construction materials such walkways, and bricks.
Carbon Trading	• Internationally certified WTE plants may enter voluntary carbon trading markets and produce tradable carbon credi • They can also support local companies with renewable ene certificates.

FIT Development in ASEAN

Consistency in policy regarding rates is important, has fluctuated in ASEAN

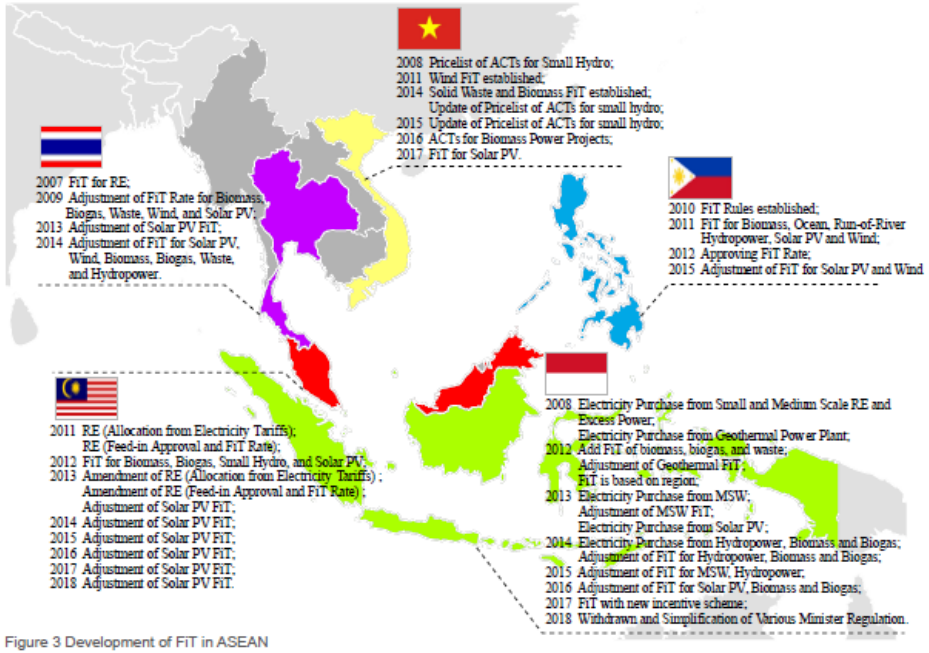


Figure 3 Development of FiT in ASEAN

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Examples from ASEAN

- **Southeast Asia:** Co-firing can replace 10% of 331M tonnes of coal consumption in Southeast Asia, equivalent to 33M tonnes worth 3.3B USD.
- **Singapore:** Tuas South Incineration Plant, the largest in Singapore uses the residue, known as NEWSand, as non-structural concrete.

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ASEAN carbon pricing, markets

- So far, only **Singapore** has an economy-wide carbon tax and is launching the CIX soon
- **Thailand** had pilots since 2015, **Vietnam** legalized ETS, drafting implementation guidance
- **Indonesia** is proposing a carbon tax by 2024 and **Malaysia** under consideration
- Future of CDM pending at **COP26**

2

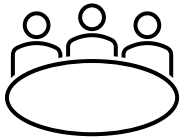
Enabling investment & development of WTE

Barriers to RE financing in SEA

- Small **scale** of investments but high **transaction costs**
- Lack of **equity** funding
- **Knowledge and capacity** gap
- High **cost of debt** finance
- Limited **length** of loan tenure
- Lack of **risk** mitigation vehicles

Public
and multilateral

Public-Private
Partnerships



Private

2 Enabling investment and development of WTE

Public and multilateral

- WTE projects can benefit from **national funding schemes** including **government guarantees of high-risk projects** due to size or new technology, as well as national funding vehicles
- **Multilateral DFIs** provide additional **capacity building**

Public-Private Partnerships

- PPP creates a **transparent risk-sharing** arrangement among parties i.e., project risks are allocated to the most cost-effective parties.
- Countries deploying PPP: Singapore, Indonesia (Nambo BOOT), Vietnam (Can Tho WTE)

Private

- Singapore WTE privatization in 2009 (SWTE, Senoko Waste-To-Energy Plant)
- Vietnam having private investors entered WTE markets e.g., Phu Tho (18MW) developed by Au Viet and United Expert, Xuan Son (15.5MW) by T&T and Hitachi Zosen

National & Multilateral Schemes

- **Indonesian** Viability Gap Fund, Climate Change Trust Fund
- Energy Efficiency Revolving Fund, GuarantCo in **Thailand**
- **Laos** energy and env funds
- Energy Performance Contract Fund, GTFS in **Malaysia**
- EE Financing Programme and Schemes in **Singapore**
- National Council for Sustainable Development **Cambodia**
- **Vietnam** Development Bank

SNV giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

THE WORLD BANK ADB JBIC USAID FROM THE AMERICAN PEOPLE

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An example from Singapore

- KSTP DBOO (2005)
- **Take – or – Pay** Mechanism
- NEA (Singapore's National Environmental Agency) bears **demand** risks & developers would take on **construction & operation** risks only

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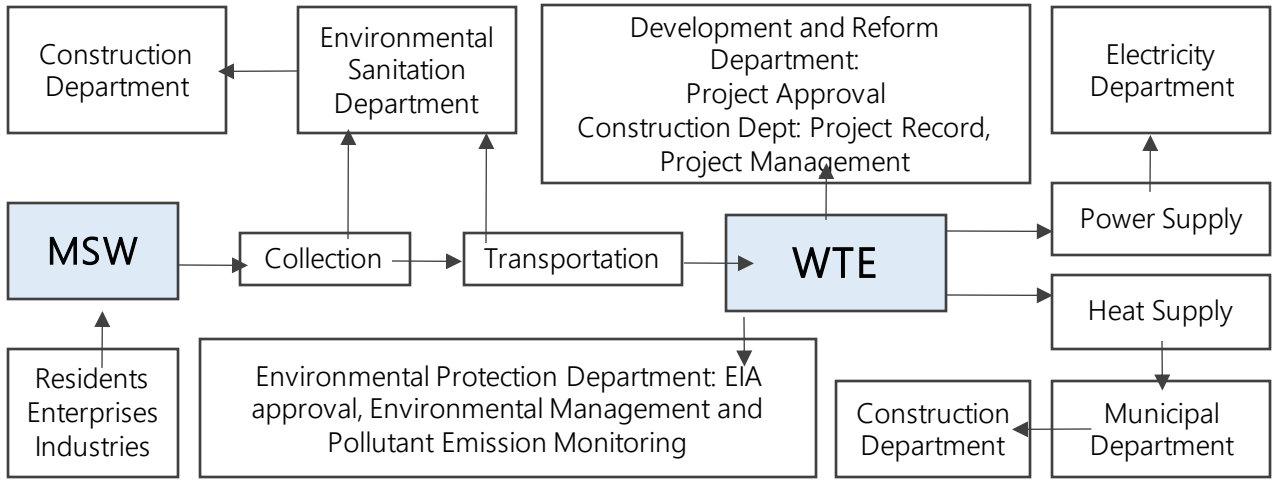
An example from Vietnam

- Soc Son 75 MW – expected to be **Vietnam's largest WTE**
- US$195 million term loan financing from Standard Chartered, Société & other lenders
- Sinosure **credit insurance**
- COD expected within 2021

3

Enabling a suitable regulatory and institutional environment



Waste management

WTE plant quality

3 Enabling a suitable regulatory and institutional environment

Waste management

Waste segregation at source is key

Incentive proposals

- Provision of storage facilities like waste bins to residents to encourage segregation behavior
- Payment for recyclables
- Disposal fee waiver

Legal instruments

- Cash fines
- Court summons
- Exclusion from waste management services access

WTE plant quality

- **Site considerations:** planning, buffer zone, international standards, avoiding fragile or protected areas, urban settlements, address resettlement concerns, NIMBY
- **Compliance to standards:** local emissions, strict regulation, investment in products and resources i.e. filters
- **Carbon neutral WTE:** technologies that are cleaner and more efficient, restricting incineration to non-fossils
- **Residue management:** Ash disposal, mandates for recycled infrastructure materials

Setting priorities among incentive options

There is no one size fits all

- Option selection depends on national & local factors
- A simple scheme to put in place to incentivize first
- Stringent instruments to follow

3 Enabling a suitable regulatory and institutional environment

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Japan: A very special case

- Extremely high landfill prices
- Extensive waste transport ban
- Municipalities dispose own waste
- Many small plants, relatively small quantities of waste per plant
- Sufficient time available for maintenance – on average plants operate 280-300 days a year
- Focus on small volume of residue
- Extensive **public education**

In Summary

Key WTE technologies

Chemical
Anaerobic Digestion
Landfill Gas Recovery

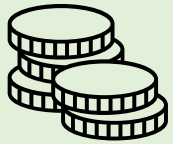
Thermal
Conventional Thermal
- Incineration
- Co-firing

Advanced Thermal
- Pyrolysis
- Gasification

Viability & Practicability

Chemical: Common in Asean
Thermal: New to Asean except Singapore, **high capital** (high-tech facilities needed), not viable yet

Key policy enablers to establish WTE could include



Enabling revenue streams

- **Gate/tipping fees** that are competitive with landfill rates
- Clear and stable **feed-in-tariffs** commensurate with local circumstances
- Collaborations with industry to enable usage of **refused-derived fuel** for co-firing
- Promoting research and take-up of products utilising **WTE residues**
- Building capacity and legislation to enable **carbon trading, pricing and certification**, within and across borders

Enabling investment and development

- Coverage of WTE in **national renewable energy schemes**, with public and **multilateral support** to kick-start investment and build capacity/knowledge
- Introduction of **Public private partnership (PPP)** could play a role as catalyst investment to enhance awareness and increase willingness for private sector to come in

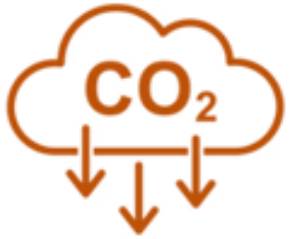
Enabling regulations and institutions

- **High-level coordination** among all departments and ministries involved in town planning, waste management, utilities, WTE
- WTE as part of a **comprehensive waste management policy** aligned with circular economy
- Putting in place **enforcement and incentives** to handle waste sorting, drying
- Putting in place **standards and officers** able to conduct emissions and quality audits
- Strong **public education** and outreach

Enabling policy and technology for waste-to-energy will empower ASEAN countries to realize a triple bottom line

140M tonnes

Annual reduction in greenhouse gases



90% waste vol reduction

Less community landfills

$13.66B

WtE market value in Asia-Pacific by 2023

15%

Annual market growth rate

References: Klinghoffer, N.B., et al. (2013), Tun M., et al. (2020)

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