WHAT IS WASTE TO ENERGY?

Waste-to-energy (WtE) refers to a variety of treatment technologies that convert waste to electricity, heat, fuel or other usable materials, as well as a range of residues. Thermal waste to energy, also known as incineration with energy recovery, is a major waste treatment method in some developed countries and the most widely adopted technology that dominates the global WtE market.

INPUTS AND OUTPUTS OF THERMAL WASTE-TO-ENERGY PLANTS

FLUE GAS EMISSIONS

Flue gas emissions contain the greenhouse gases and pollutants from the waste, which requires further treatment before emission to the atmosphere. Emissions may include carbon dioxide, nitrous oxide, nitrogen oxides, ammonia, carbon monoxide, volatile organic compounds, persistent organic pollutants (e.g. furans and dioxins) and some heavy metals.

HEAT

Thermal energy is one of the energy products from the combustion of waste feedstock, which can be used in district heating system in vicinity.

WASTE FEEDSTOCK

Municipal solid waste, sorted or unsorted, is often used as the waste feedstock for thermal WtE plant. During the incineration process, the volume of the waste feedstock can be greatly reduced by 90%.

ELECTRICITY

Electricity is one of the energy products of thermal WtE, which is then transferred to the power grid to power up households.

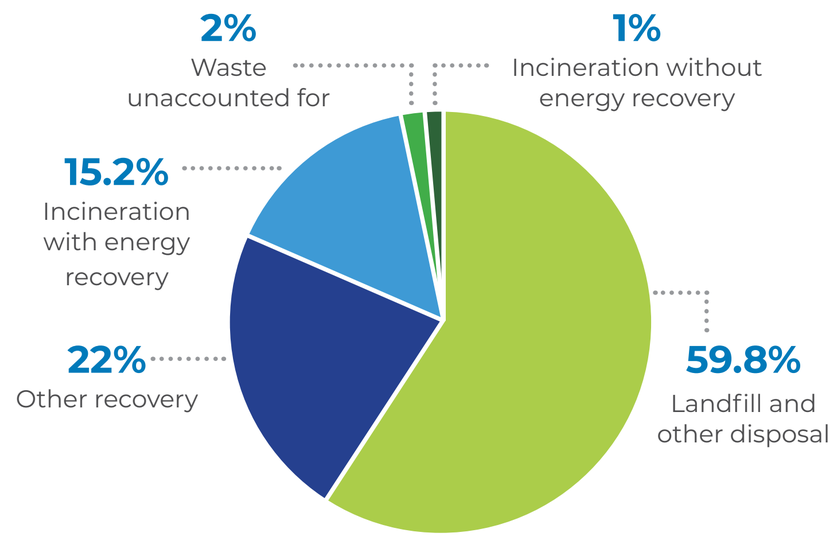
BOTTOM ASH

Bottom ash is the residual material from incineration. It contains the non-combustible fraction of waste feedstock, including stones, glass, ceramic, and metals. The bottom ash may be used for construction purposes after metals are sorted out for recycling.

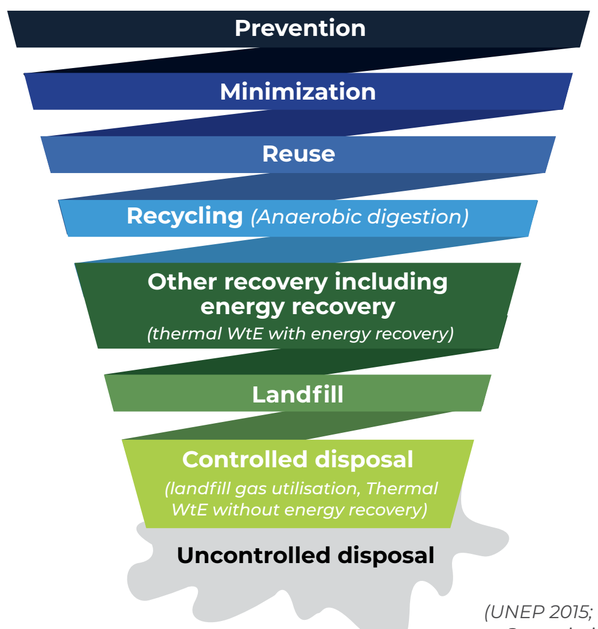
FLY ASH

Fly ash is the fine particulate ash from incineration, which is considered hazardous waste and must be treated accordingly.

GLOBAL AVERAGES

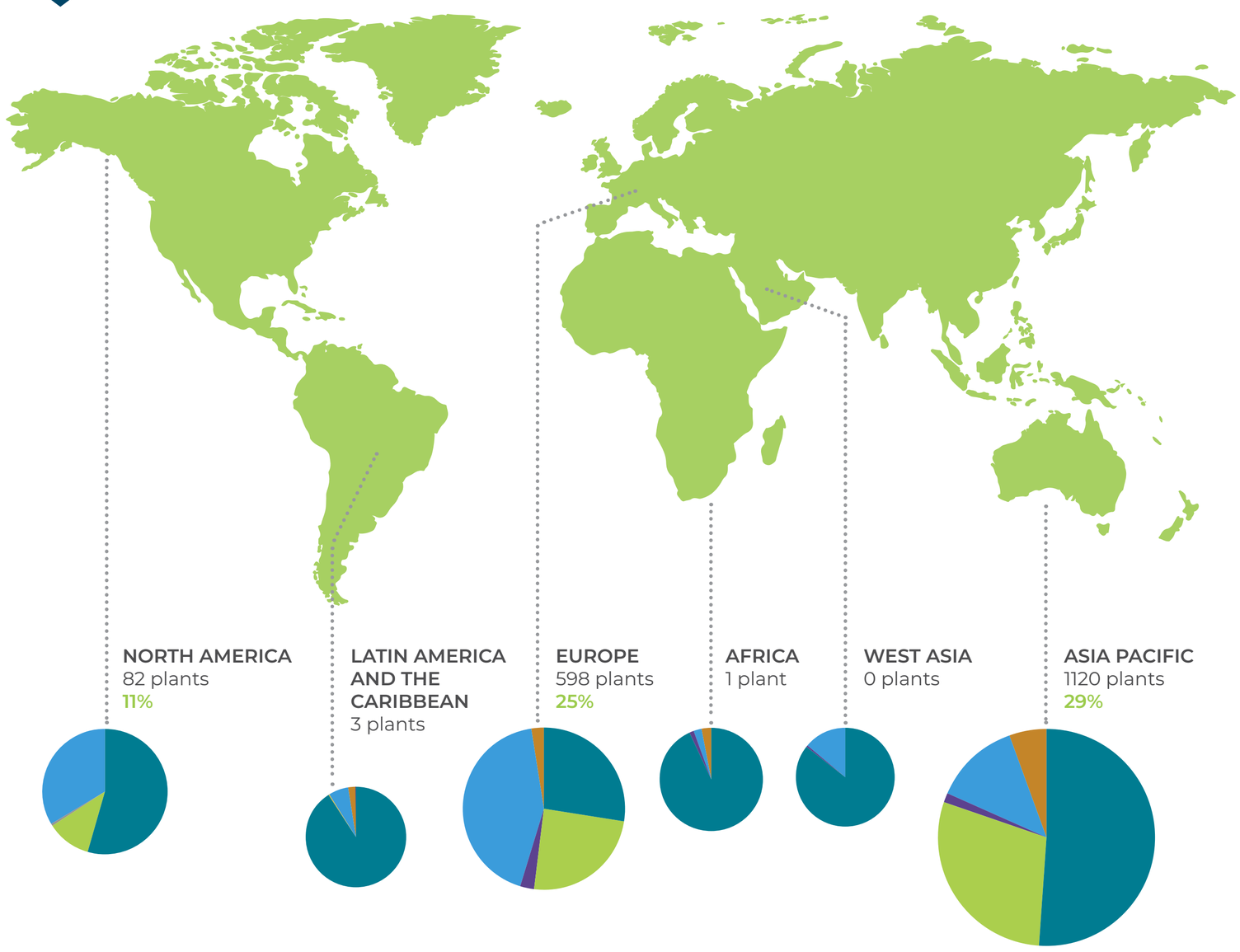


WASTE MANAGEMENT HIERARCHY



(UNEP 2015; European Commission 2017)

CURRENT STATUS OF WASTE TO ENERGY



Biogenic municipal waste accounts for 1% of renewable energy globally.

Over 90 percent of collected waste in Africa and Latin America and the Caribbean is disposed of in landfills and open dumps.

Over 80 percent of thermal waste to energy plants are located in developed countries, led by Japan, France, Germany and the United States.

15 percent of global waste collected is incinerated with energy recovery.

- Landfill and other disposal
- Incineration without energy recovery
- Waste unaccounted for
- Incineration with energy recovery
- Other recovery (recycling and composting)

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The **International Environmental Technology Centre** works with developing countries to implement sustainable solutions to environmental challenges, with focus on holistic waste management.

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Detailed report and summary online at: https://bit.ly/2ETbukd

WASTE TO ENERGY:
Key Considerations

The **waste management hierarchy should be used** for integrated solid waste management systems. **Reduction, reuse and recycling should be prioritized** and incorporated into waste management plans that include thermal WtE recovery options.

Thermal WtE plants with advanced emission control technologies that are well-maintained have **minimum public health impacts**. Nevertheless, mismanaged thermal WtE plants have been shown to produce unsafe emissions, despite advanced emission control technologies.

In developing countries, the **low calorific value and high moisture content of waste** remain critical technical challenges for thermal WtE. Low calorific value of waste should average at least 7 MJ/kg, and never fall below 6 MJ/kg.

A large scale modern thermal WtE plant **requires at least 100,000 tonnes of MSW per year** over its lifetime. As with all large investment projects, thermal WtE can potentially **create lock-in effects** that may lead to plant overcapacity and hamper efforts to reduce, reuse and recycle.

Thermal WtE requires **significant investment for startup, operation and maintenance**. Income from waste disposal and energy sales is often insufficient to cover full investment and operational costs.

A **complete and detailed legislative framework** is a prerequisite for thermal WtE introduction in developing countries. The framework should include strategies for maintenance and plant decommission, a phase out plan, pollution monitoring, guidelines on safe disposal of toxic by-products, medical monitoring and health care for plant workers and the local community, and guidelines for accident management.

Thermal WtE **utilizes the energy value in waste to generate electricity and/or heat**.

Thermal WtE can potentially reduce waste sector greenhouse gas emissions compared to open burning and landfills without methane gas capture and use, **but will not completely abate greenhouse gas emissions**.

Thermal WtE can **reduce the volume** of waste entering landfills by **75–90 per cent**, but it does **not remove the need for landfills**.

Achieving Integrated Sustainable Waste Management requires integration of appropriate collection with different technologies and waste treatment methods and governance systems in the local context.

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WASTE TO ENERGY:
Challenges and considerations for developing countries

WASTE CHARACTERISTICS

Organic waste makes up 53% to 56% of MSW in low and lower-middle income countries, which yields a low calorific value.

Incineration requires a fuel with minimal average calorific value of 7 MJ/kg, and should never fall below 6 MJ/kg for combustion without auxiliary fuel.

ECONOMIC ASPECTS

Thermal WtE requires significant investment for startup, operation and maintenance.

Income from waste disposal and energy sales is usually insufficient to cover the full investment and operational cost of a thermal WtE plant.

LEGAL ASPECTS

Developing countries may lack legislation on internationally recognized emission standards, monitoring and enforcement.

ENVIRONMENTAL ASPECTS

Waste incinerators are one of the leading sources of dioxins and furans globally. Mismanaged thermal WtE plants may produce unsafe emissions.

SOCIAL IMPACT

Public opposition is often a major obstacle for building and operating thermal WtE plants.

Thermal WtE may potentially divert waste away from the 3Rs as plants require feedstock minimums, and due to this recyclable waste is often used.

The transition to WtE can impact the informal recycling sector.

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