International Environmental Technology Center

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Waste to Energy: Considerations for Informed Decision Making and Contributing to Achieve the Sustainable Development Goals

Kawasaki Eco-Business Forum
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The International Environmental Technology Centre’s vision is for countries to implement sustainable solutions to environmental challenges, with focus on holistic waste management.

IETC assists countries to identify and implement sustainable technological solutions to environmental challenges

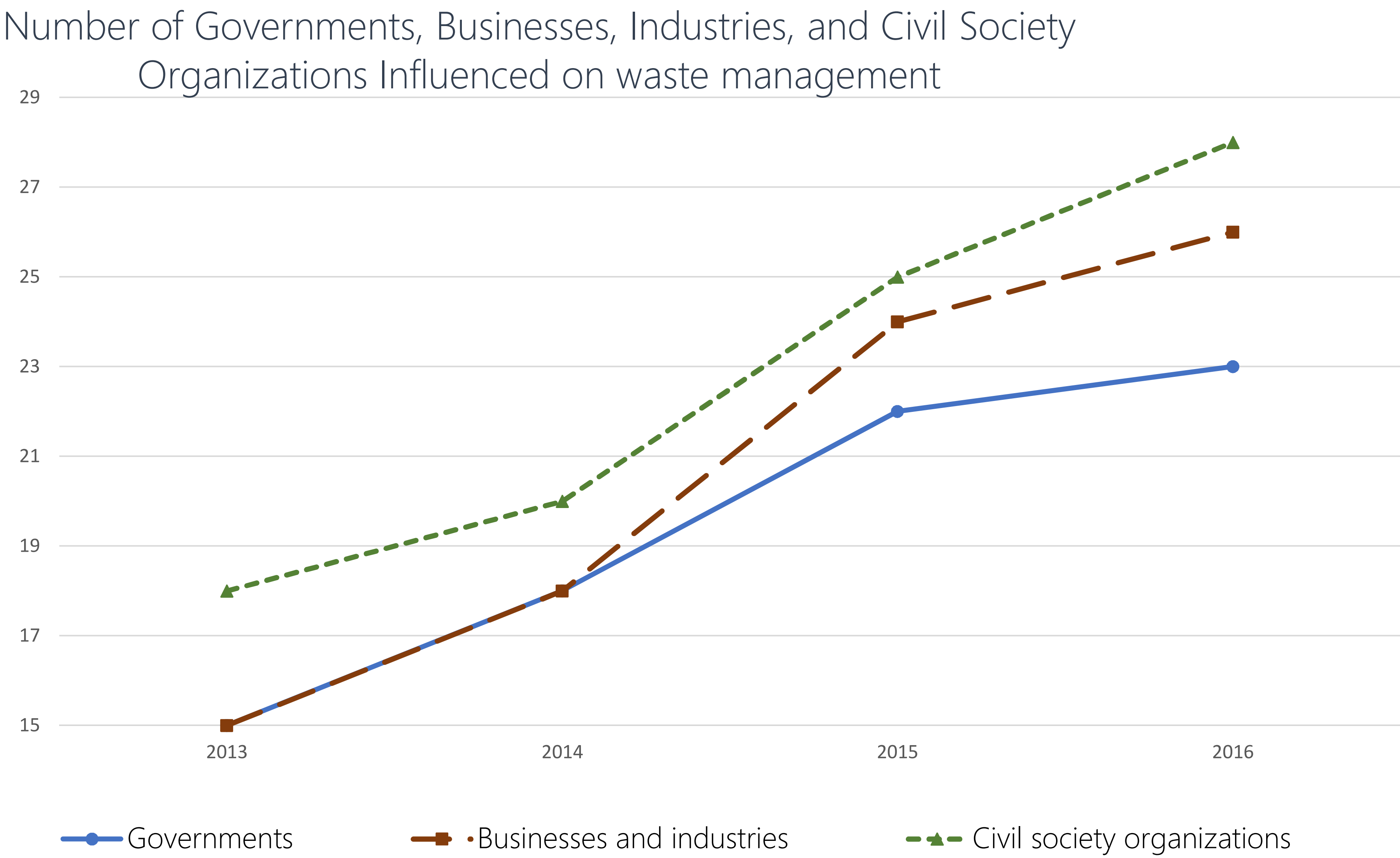
UNEP (2019) IETC Annual Report 2018
www.unenvironment.org/ietc/report/ietc-annual-report-2018

IETC Publications:
Waste Management Outlooks and Thematic Reports

- Global, Regional and Thematic Waste Management Outlooks
- Thematic Reports
- Compendia of Technologies and Guidelines

www.unep.org/publications/

IETC: Results

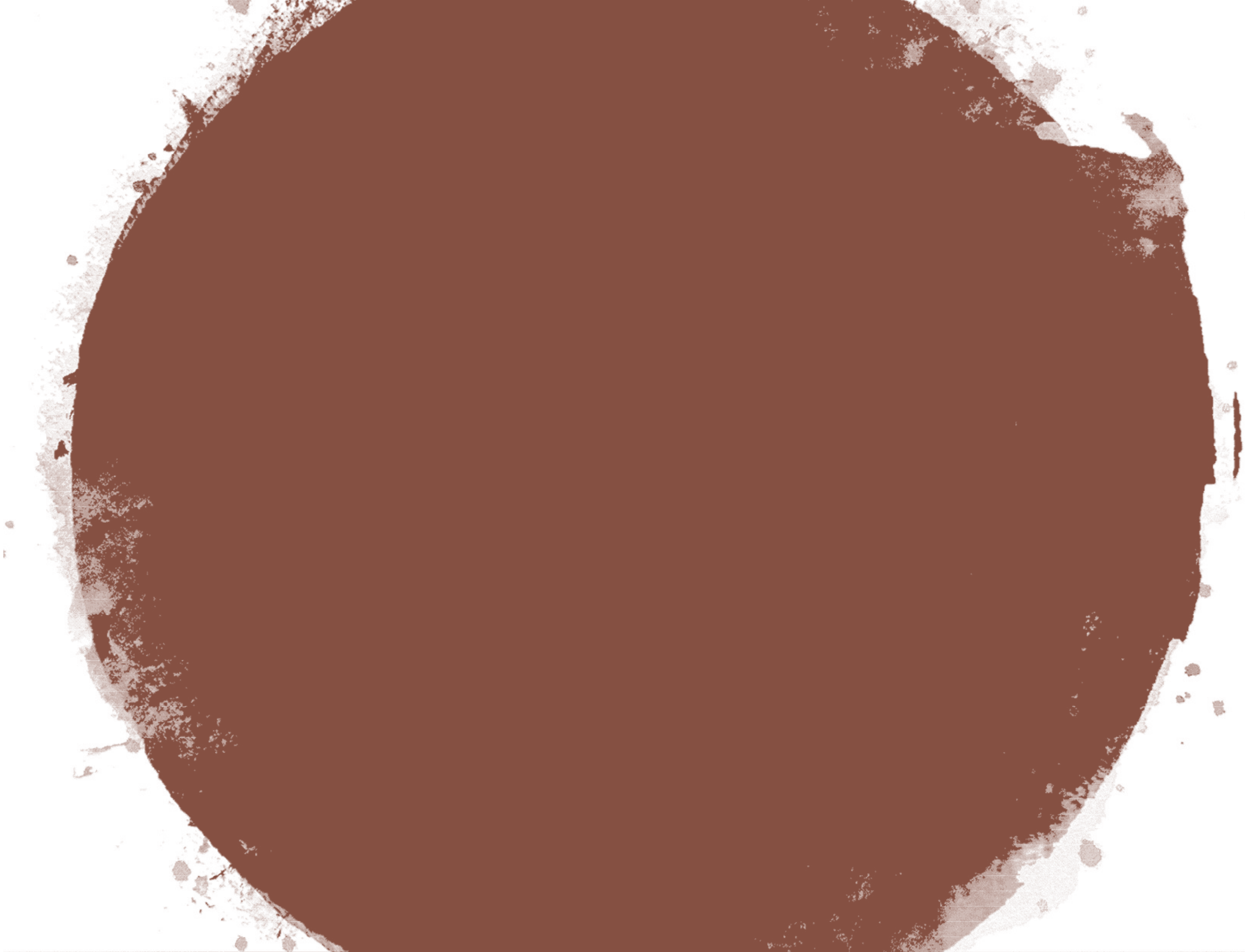


IETC support to countries around the world

Many cities and countries are working with IETC
to improve Waste Management Governance

UNEA 4 Resolutions (3/2019)

UNEP/EA.4/Res. 6 **Marine plastic litter and microplastics**
UNEP/EA.4/Res. 7 **Environmentally sound management of waste**
UNEP/EA.4/Res. 8 **Sound management of chemicals and waste**
UNEP/EA.4/Res. 9 **Addressing single-use plastic products pollution**



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.

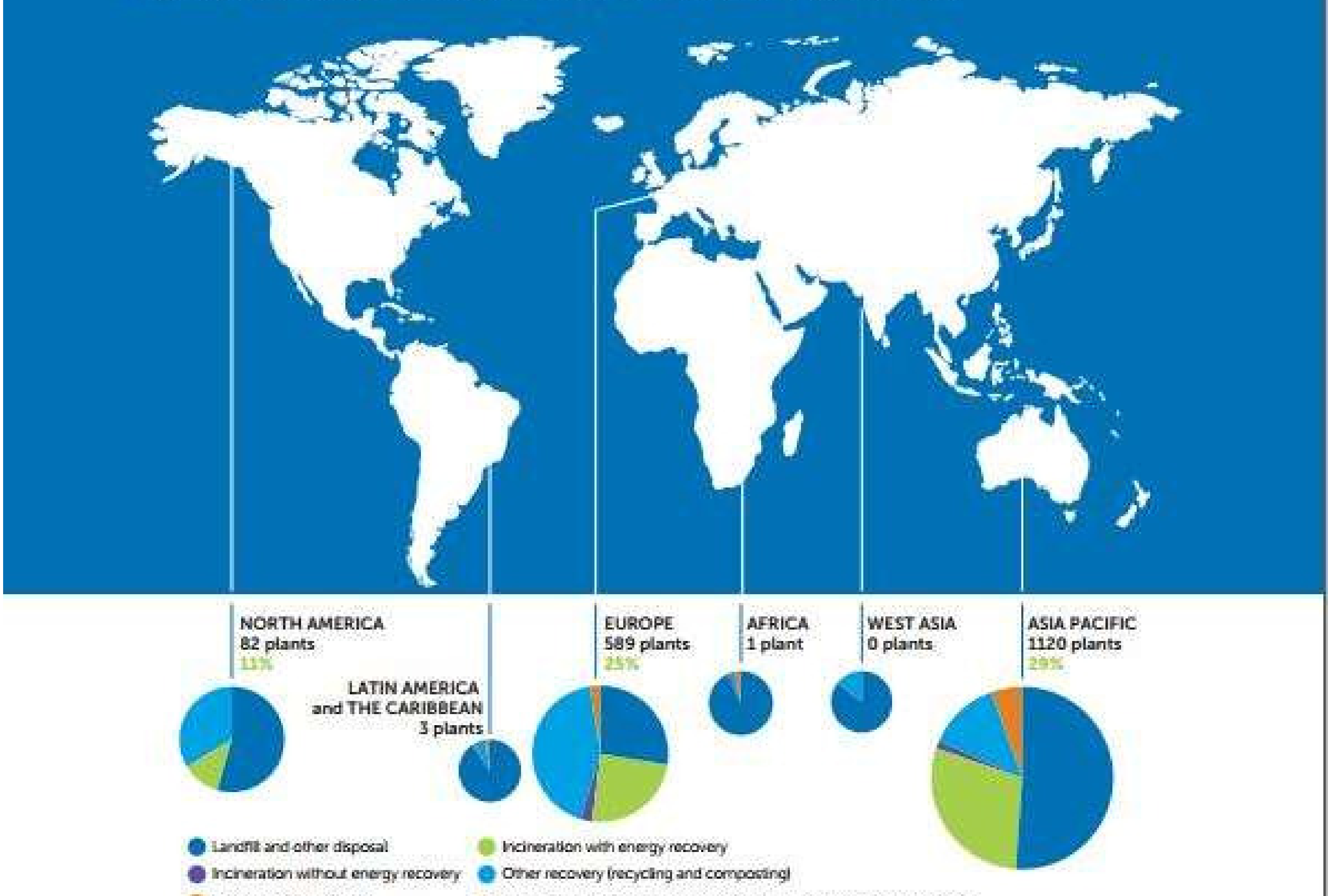
BOTTOM ASH

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.

Figure 1.8 MSW incinerated with energy recovery and number of thermal WtE plants (by region)



The size of the pie charts represents the number of WtE plants by region.

Figure 1.9 Top 11 countries with the most thermal WtE plants, including amount of waste incinerated with energy recovery

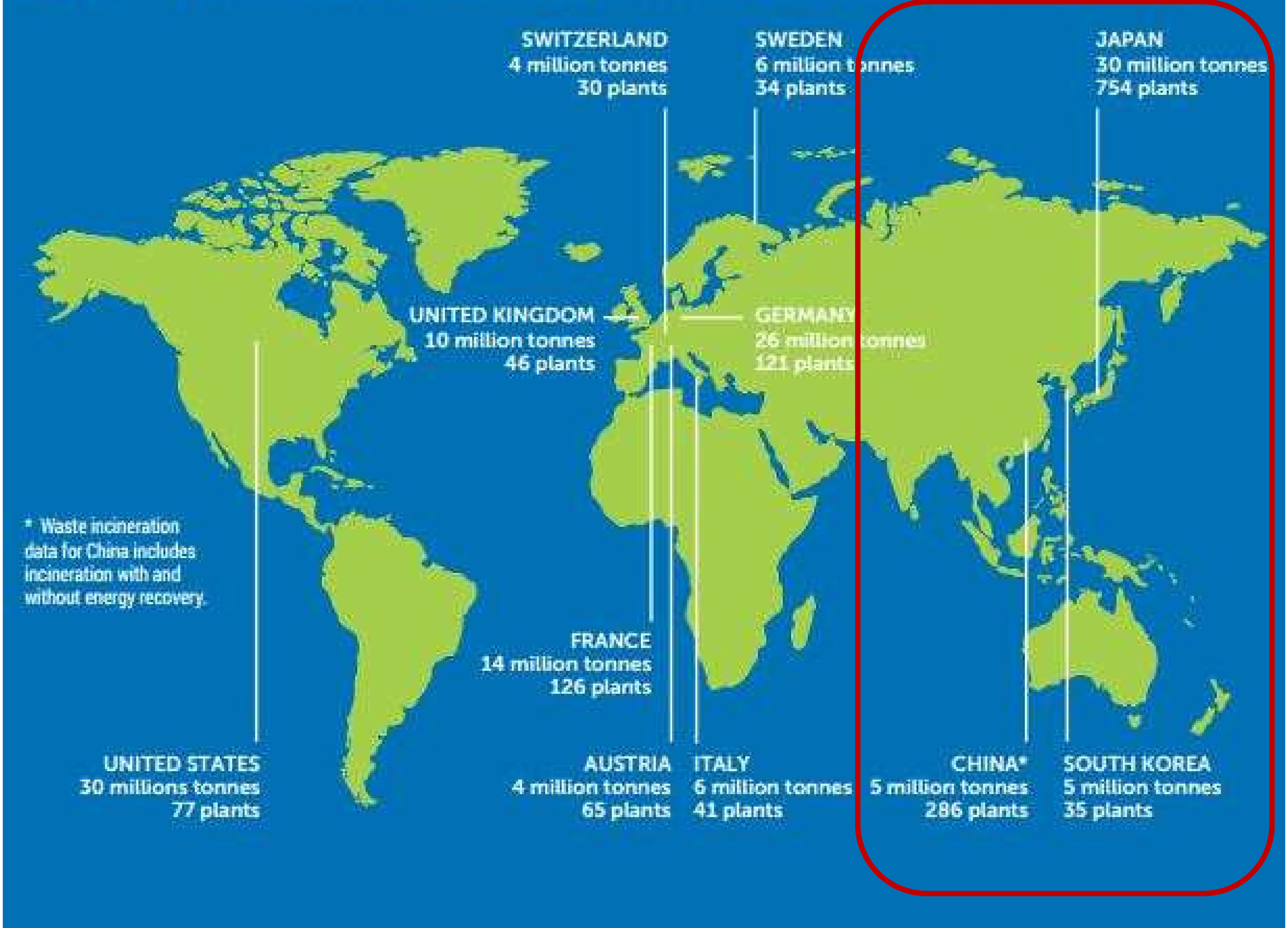
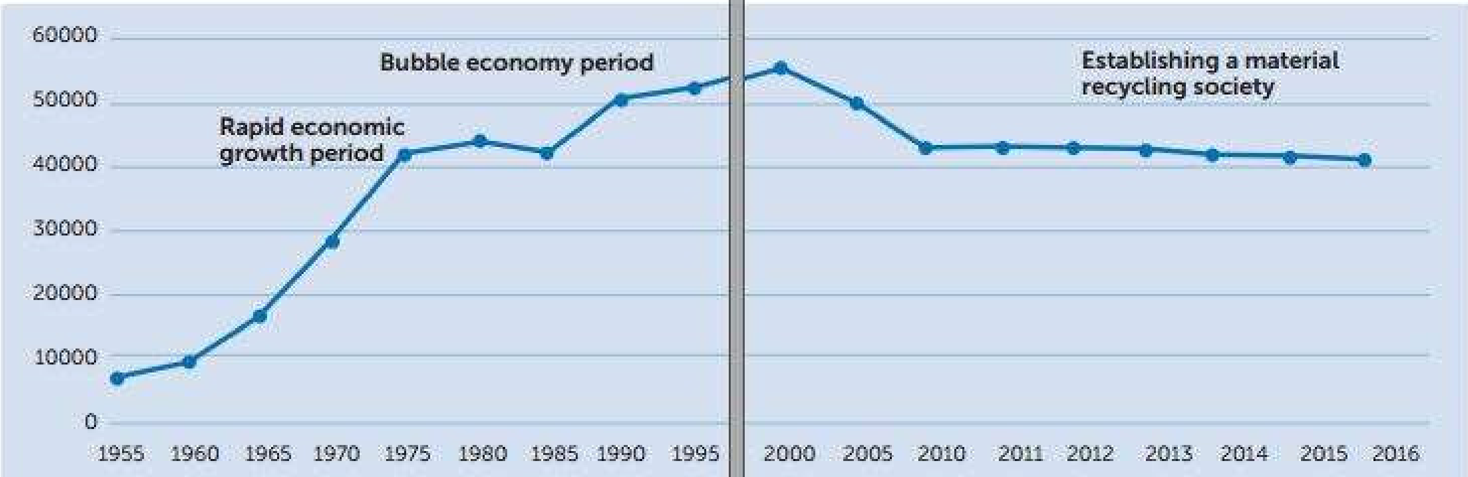


Figure 2.8 MSW treatment methods in selected countries[4]

Japan – History and Trend

Figure 1.5 MSW generation in Japan[23]



MSW generation in Japan has been gradually decreasing in recent years. Japan, however, has produced substantial plastic packaging during this time, and is now generates the second largest am[illegible]ount of plastic packaging per capita (UNEP 2018).

Figure 1.7 Number of waste incinerators with and without energy recovery in Japan[4]

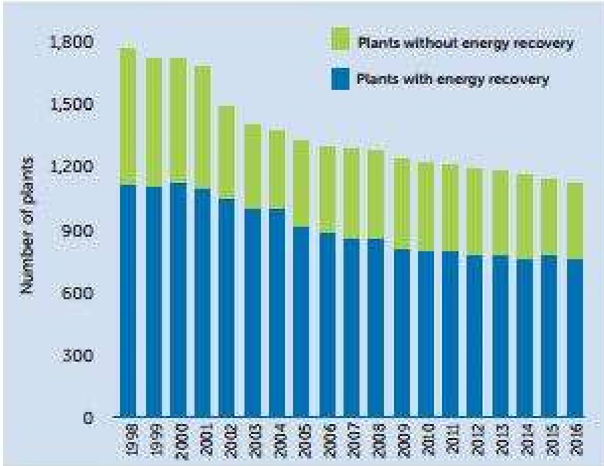


Figure 1.6 Plastic production in Japan

Source: Japan Plastics Industry Federation 2019

The production of plastic waste increased by more than 13-fold from 1960 to 1980 in Japan.

LESSONS LEARNED

Waste management progress in Japan provides a good example of energy recovery for less developed countries. Technological advancement allows developing countries to choose the less polluting thermal WtE technology, compared to what was available to them in the past. In concert with these new technologies, waste management strategies should be implemented based on local needs and subjected to periodic review and adjustment. It is important to note that the waste hierarchy is not a ladder for a waste management system. Developing countries should consider leapfrogging and adopting a top-down approach to introduce the 3Rs in their waste management systems before considering thermal WtE recovery options.

Developing vs. Developed Countries

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.

Figure 2.1 Net calorific value of different waste types found in MSW (World Energy Council 2016a)

Figure 2.2 MSW composition in developing countries (World Bank 2018)

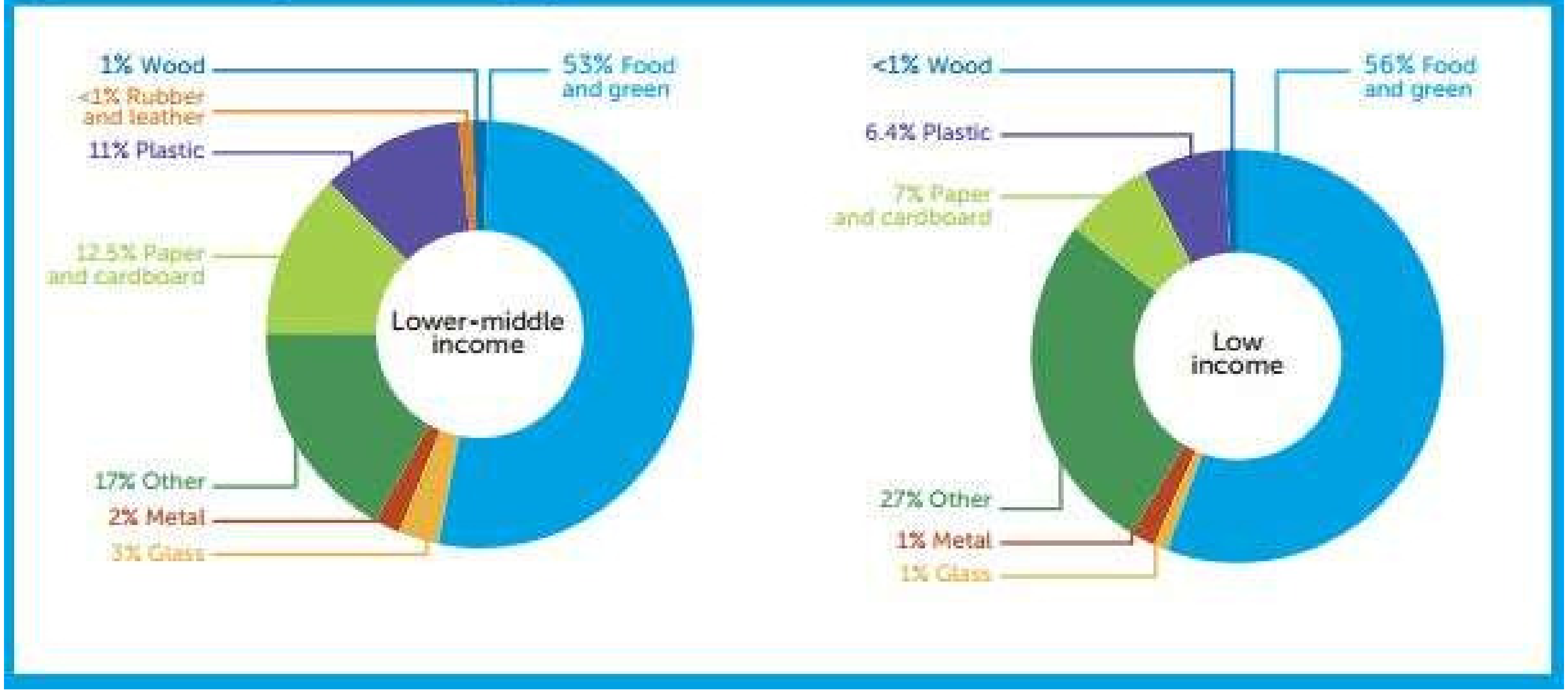
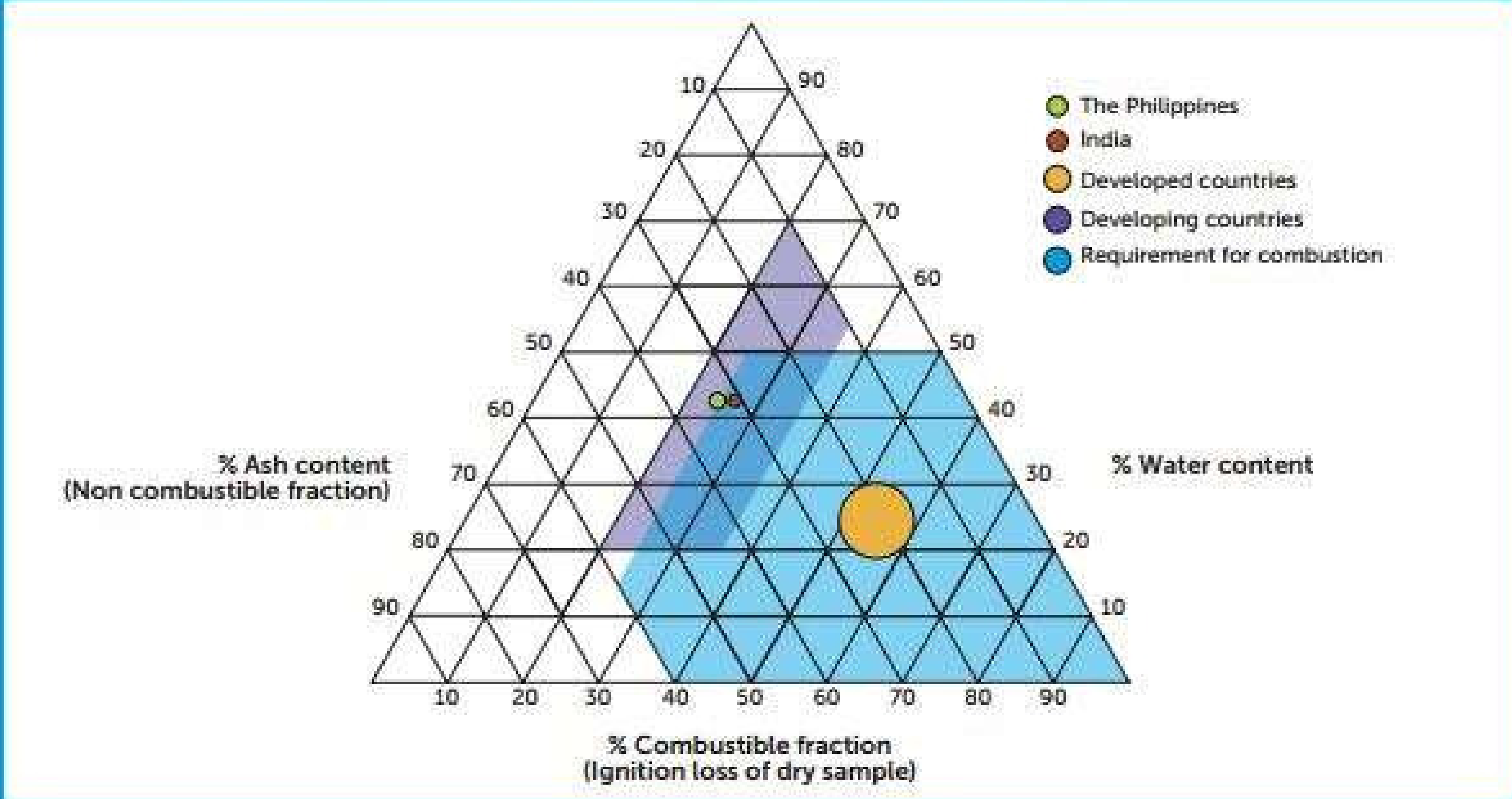


Figure 2.3 Tanner triangle for combustibility assessment of MSW (in percentage by weight)[1]



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.

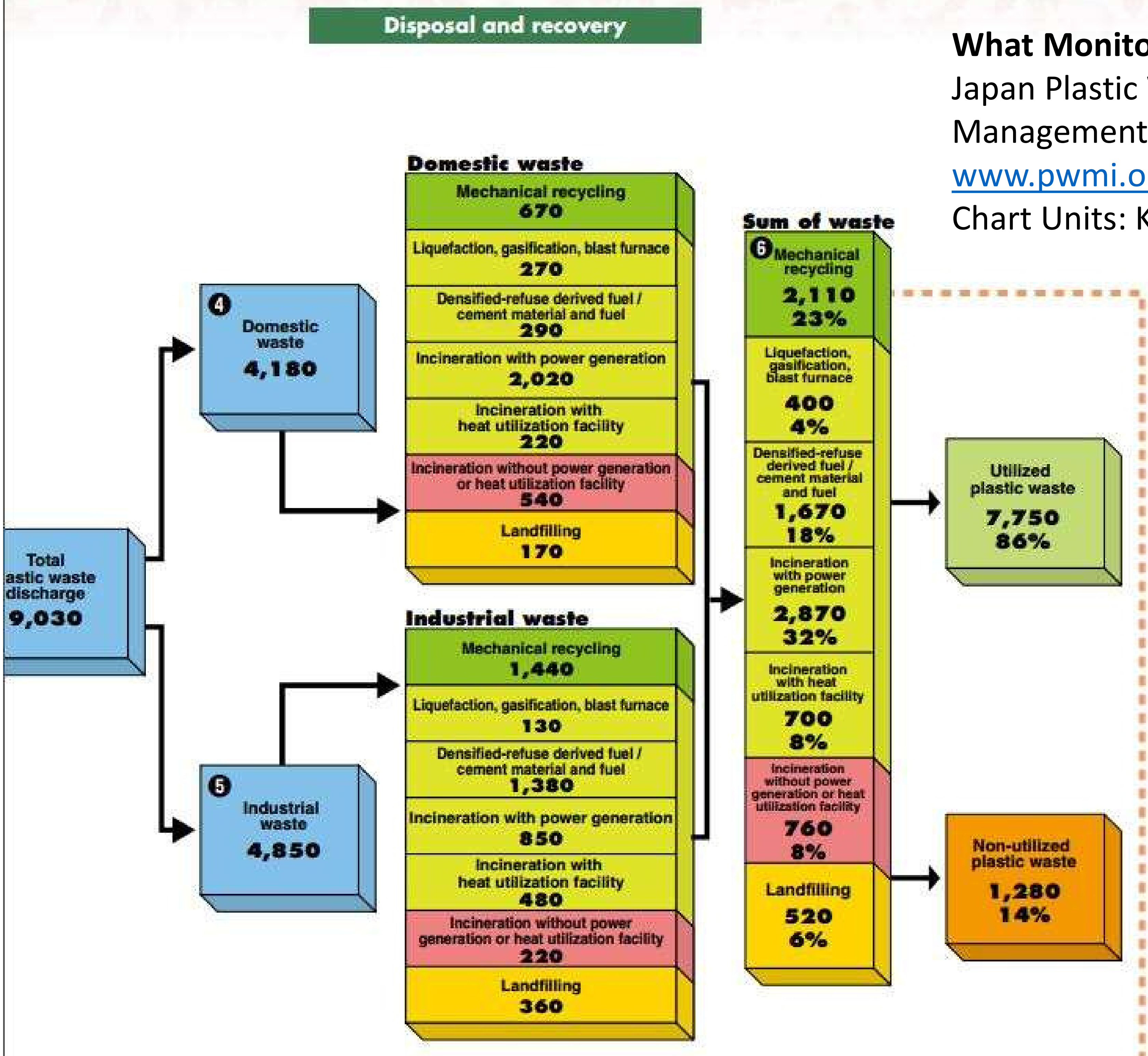
The transition to WtE can impact the informal recycling sector.

What Monitoring can look like!

Japan Plastic Waste Management Institute

www.pwmi.org.jp

Chart Units: Kilotons in 2017



Climate vs Plastic

Climate Change	Plastic Pollution
Scientific understanding is robust **Impacts** are enormous	Scientific understanding is low Impacts are unknown
Monitoring is global and sustained	Monitoring is nonexistent Research surprises are common
Mitigation is mostly Global **Adaptation** is mostly Local	Mitigation is mostly Local Adaptation is unspoken default

Climate vs Plastic
Constraints and Solutions

Climate Change	Plastic Pollution
Technology is a limiting constraint. Carbon Capture and Storage? Unproven.	Technology exists. Myriad solutions.
Funding is a limiting constraint. Mostly public sector. Global carbon tax? Unpalatable.	Funding is in the private sector. Cost-Benefit. Promising.
Societal Constraints are limiting. Local, national, global and difficult. Differentiated responsibility. Demographics. Consumerism.	Societal Constraints are mostly local. Difficulty is unknown. "Zero" plastic is unachievable and undesirable. Asymptotic.

Achieving the SDG' s

SUSTAINABLE DEVELOPMENT GOALS

11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement 12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.5.1 National recycling rate, tons of material recycled

~~Achieving~~ Monitoring the SDG’s

The SDG’s are obviously unachievable. Consider Goal 1 “End poverty in all its forms everywhere (by 2030)” or Target 15.2 By **2020**, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. A more reasonable verb than ‘achieve’ is probably “monitor”.

Demonstrating how actions we were carrying out anyway are contributing to the SDG’s (mapping exercises) is just beancounting. A more interesting mapping would be to demonstrate what the advent of the SDG’s has added to already existing actions.

“Zero waste” is asymptotically difficult – the last little bit is the hardest. If every person/country were to achieve 50% less waste, it would be easier, and a better outcome, than if a few ideal people/countries come close to zero.

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