WASTE TO ENERGY

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Sustainable Waste Management

1. Avoid producing waste by reducing consumption and packaging. (Reduce)
2. Reuse.
3. Recycling, composting organic waste.
4. Combusting the post-recycled waste for energy.
5. Landfilling.

How is waste managed and disposed globally today?

37 % Is disposed in landfills.

33 % Is openly dumped.

13.5 % Is recycled.

11 % Is treated through incineration.

5.5 % Is composted.

How is municipal waste disposed and treated in Europe today?

48%

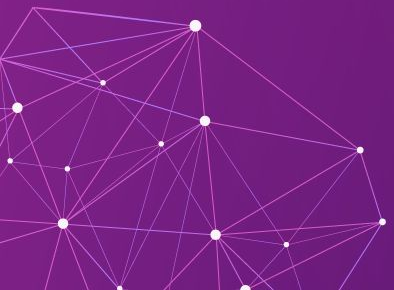
Is recycled and composted.

28%

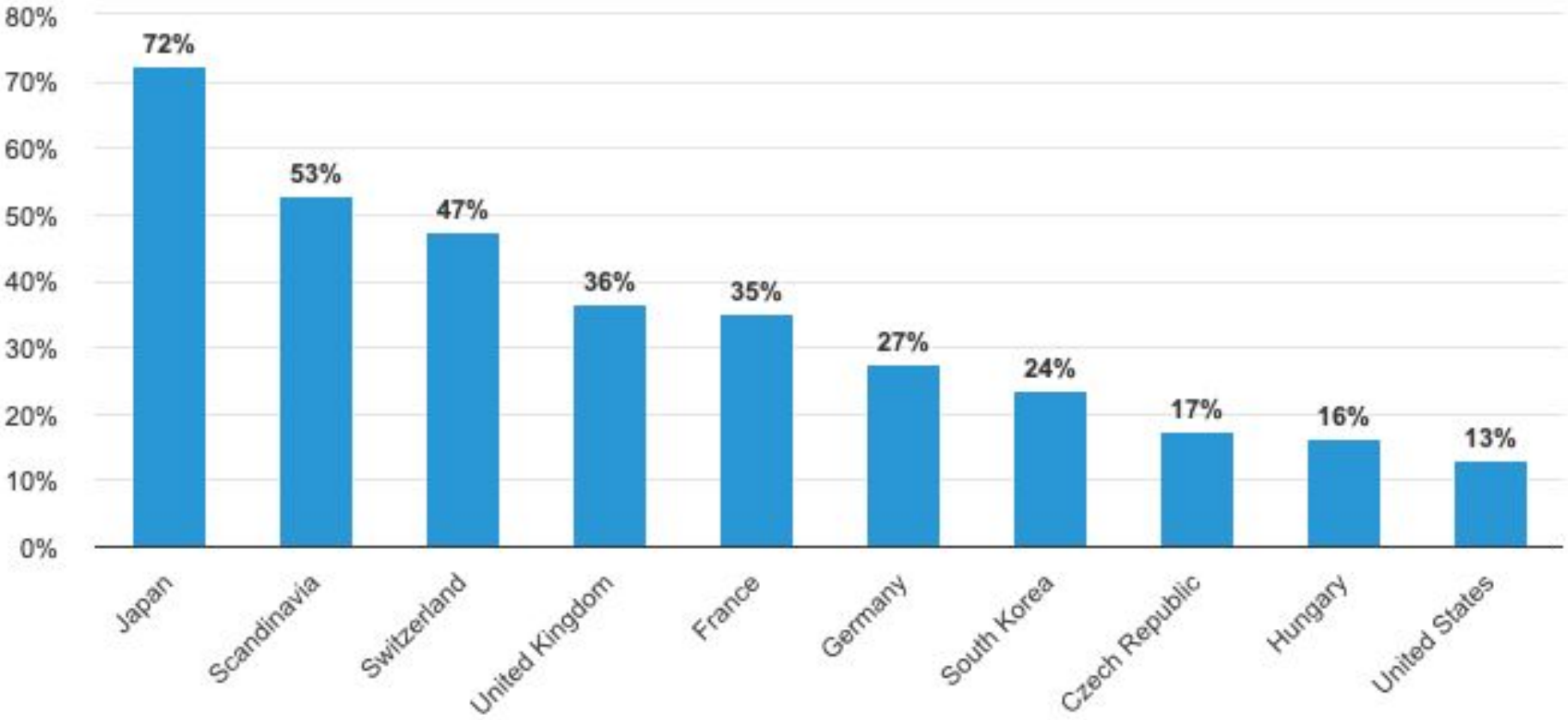
Is treated through WtE technology.

24%

Is landfilled.



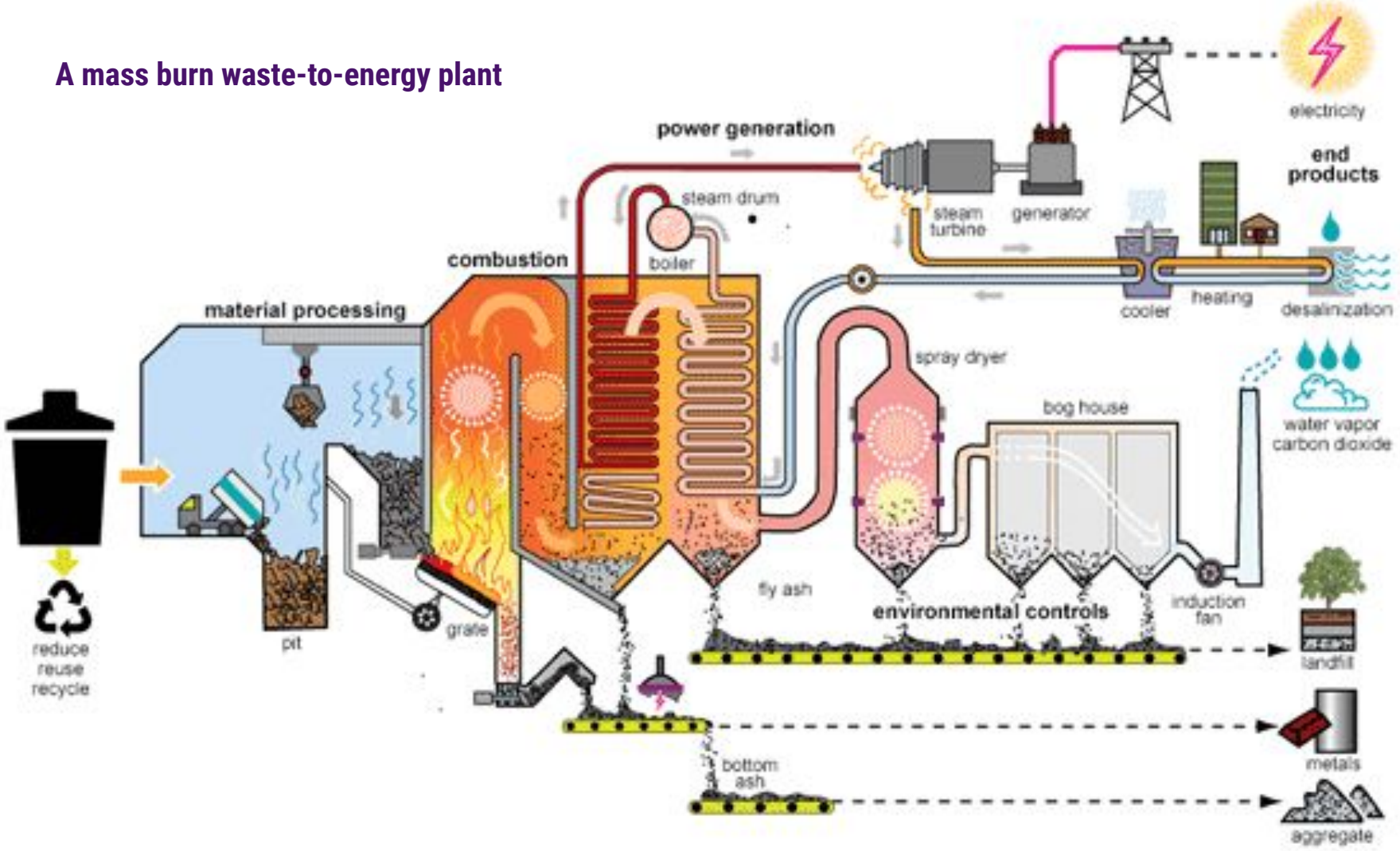
Percent of total municipal solid waste that is burned with energy recovery in selected countries



What is Waste-to-Energy?

Waste-to-Energy plants burn household and similar waste that could not be prevented or recycled.
From this waste the plants generate energy which can be in the form of steam, electricity or hot water. The electricity is fed into the grid and distributed to the end-users.
Waste-to-Energy is a hygienic method of treating waste, reducing its volume by about 90%.

A mass burn waste-to-energy plant



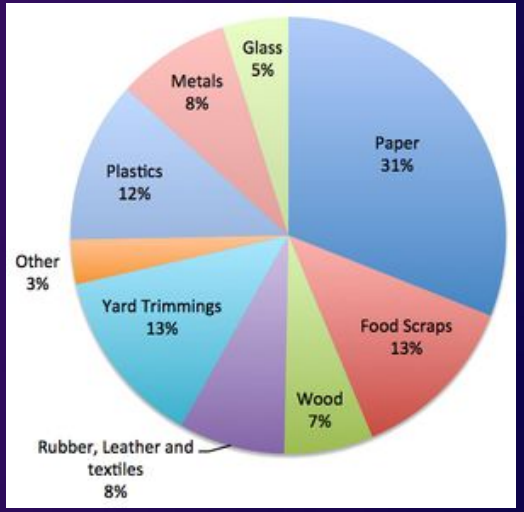
The role of Waste-to-Energy

It turns the non-recyclable waste into secure energy and valuable raw materials in an environmentally safe manner.

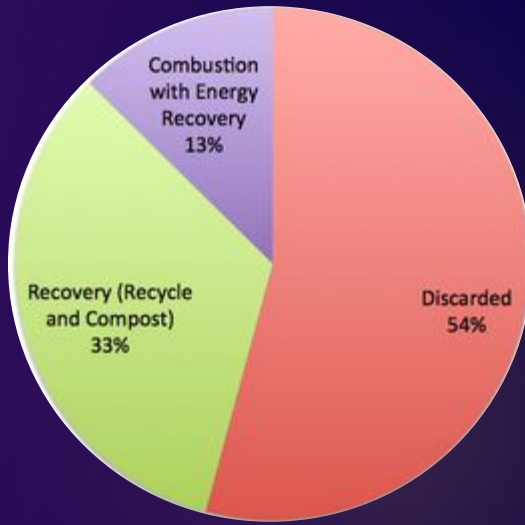
The energy produced in Waste-to-Energy plants also contributes to climate protection and security of energy supply, by replacing fossil fuels.

It keeps the circle clean by dealing with unwanted components in the material cycles (act as a pollutant sink, fulfilling a hygienic task for the society).

United States' Potential in WtE



- In 2010, Americans generated nearly 250 million tons of municipal solid waste (MSW). Of that waste, 65 million tons were recovered through recycling and 20 million tons were composted. 136 million of the remaining 165 million tons of waste were discarded in landfills. The rest, 29 million tons (12%), was combusted for energy recovery.
- The US has been making gains in reducing the amount of waste sent to landfills. In 1960, 94% of the waste went to landfills; today the number has been reduced to just 54%.
- In 2010 the biggest export to China was "Scrap and Trash", totaling $8 billion. It is estimated that these transportation costs were over $300 million a year. As of 2005, there are just 89 waste to energy plants in the USA, while Europe has 431. If the United States could reduce the amount of trash sent to landfills to 10%, that would leave 140 million tons to be incinerated. Those 140 million tons, multiplied by 563 kwh, gives us approximately 79 terawatt hours of electricity.



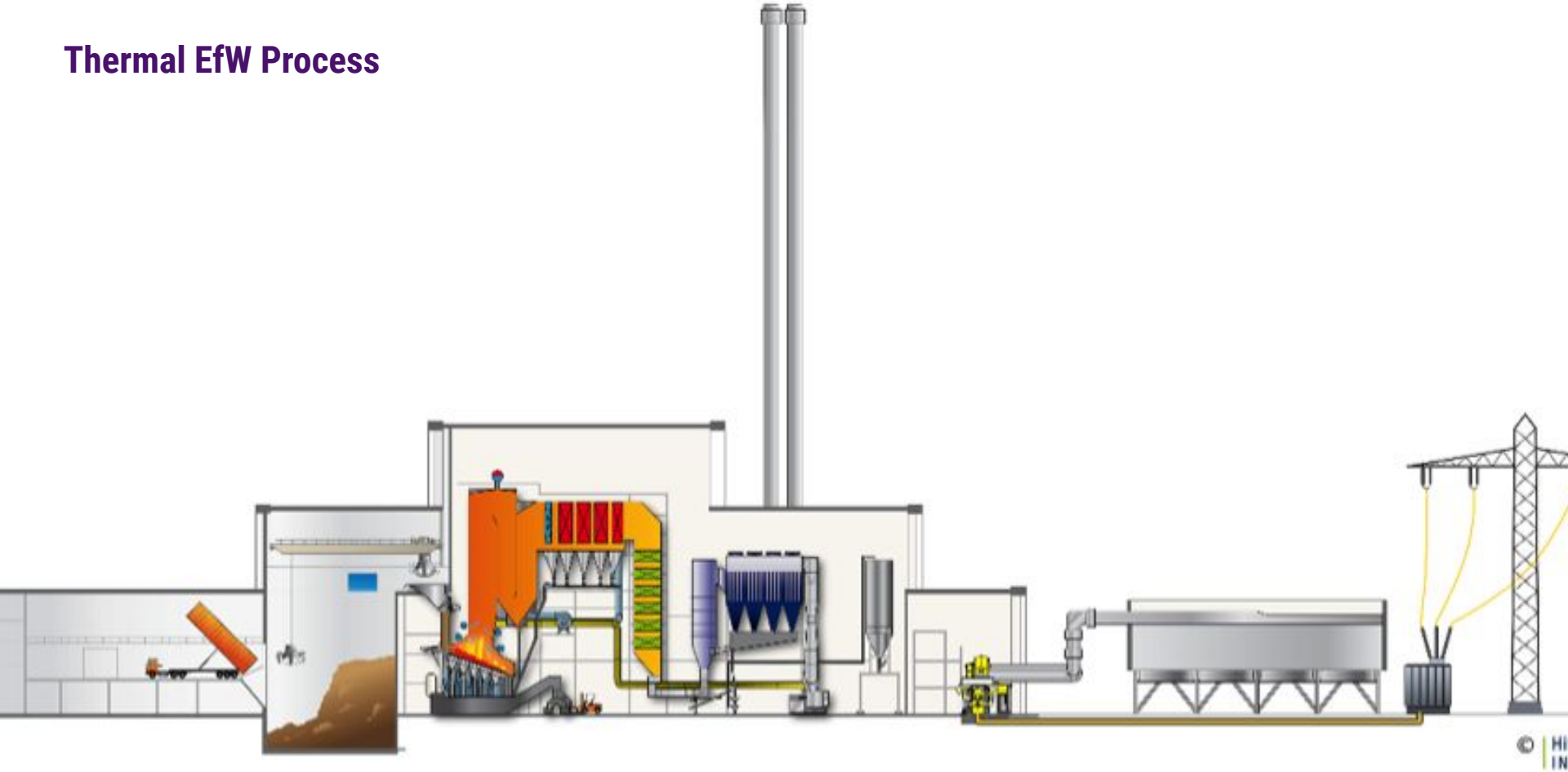
TYPES OF WASTE-TO-ENERGY

Thermal EfW Process

Municipal solid waste is delivered to the site and stored in a bunker. A crane both thoroughly mixes and feeds the waste into the feed hopper. From there it is pushed onto the grate by a ram feeder. A fully integrated control system ensures stable and efficient operation and optimized fire position on the grate. Upon completion of the combustion, the remaining inert ashes fall into the bottom ash extractor, from where they can be taken to a bunker or storage area for metals recovery and for further use.

The gases released from the waste are mixed with secondary air and recirculated flue gases above the grate. This assures complete combustion and lowest CO, NOx and VOC emissions. The recirculation of flue gases also increases the plant's energy efficiency. The energy released is used to produce superheated steam, which is expanded in a turbine generator to generate electricity. Flue gases are then cleaned to strictest standards and are continuously monitored before they are released at the stack.

Thermal EfW Process



Biological EfW Process

- The Kompogas process is based on continuous dry fermentation of organic waste using a horizontal plug-flow digester. The process is both thermophilic and anaerobic. In this process the temperature in the digester is maintained at 55°Celsius. The average moisture of the fermenter's content is around 75% and the retention time is approximately 14 days. The Kompogas process ensures that the organic waste is fully converted to biogas and that the digestate is sanitized with regards to undesired spores, germs and microorganisms.
- The continuous, horizontal plug-flow digester facilitates a high biogas yield and assures highest operating reliability thanks to simple, sturdy design and efficient control systems. A low-speed agitator ensures the optimum biogas conversion. The special design and arrangement of the agitator paddles prevents sedimentation of heavy and undesired matter in the substrate.
- Fermentation involves various upstream and downstream processes. In the feed unit, the organic waste is shredded and metals and other non-digestibles are removed. Subsequently, the substrate is automatically conveyed to the digester. A discharge pump withdraws the digestate. Around one-third is pumped back for inoculation. The rest is either dewatered to produce liquid fertilizer and compost or mixed with green waste using the liquid fertilizer free partial flow process

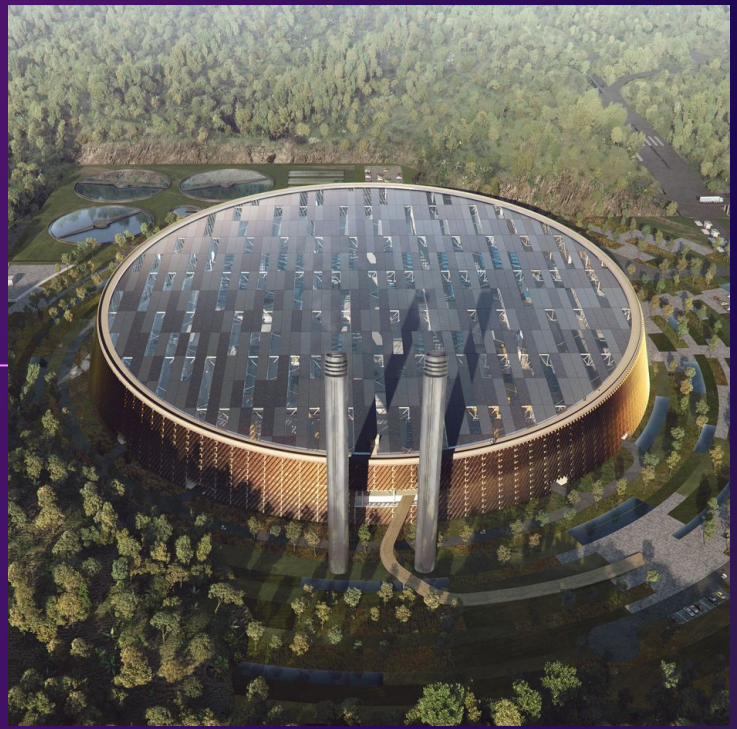
Kompogas® Technology

Biological EfW Process

Waste to Energy Plants

Generate renewable energy

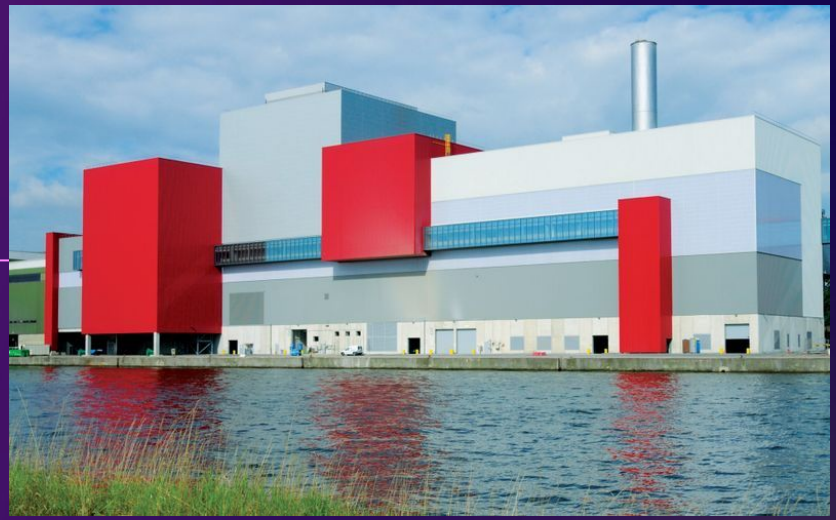
Half of the energy recovered is renewable as it comes from waste of biogenic origin. Plants recover the energy from waste in the form of electricity, heat and cold production with efficiencies of up to 95%.



Waste to Energy Plants

Contribute to a high quality of recycling

Plants act as a pollutant sink by taking out and destroying toxic materials that cannot be recycled, such as flame retardants used in plastic products.



Waste to Energy Plants

Produce secondary raw materials

The processing of bottom ashes leads more and more to mineral and metal recovery such as precious, ferrous and non-ferrous metals, aluminium and brass.

Waste to Energy Plants

Have very low emissions

Plants meet the strictest industrial emissions requirements placed on any EU industry in terms of pollutants monitored, emission limit values and operating conditions. Moreover, the proximity of Waste-to-Energy plants with residential areas fosters the sector's appetite for exemplarity.

Waste to Energy Plants

Reduce greenhouse gas emissions

Waste diverted from landfills prevents methane emissions; energy and materials recovered from waste prevent the extraction of fossil fuels and raw materials.

Waste to Energy: Closing the Loop with Energy and Material Recovery

Hygienisation

Waste-to-Energy's long-standing role is to address the so-called "residual" fraction of waste which is waste of poor quality (e.g. degraded material after several times of recycling), waste that is rejected by the recycling facilities, and polluted waste. This prevents the recycling cycle from the risk to be contaminated with polluted products and diverts the non-recyclable waste from landfills, dumpsites and open fires.

A circular economy does not mean maintaining all materials in circulation at all costs: Bisphenol A – an endocrine disruptor and reproductive toxic substance – is used as a colour developer in thermal paper, which is for example used for sale receipts. Since thermal paper is typically recycled, it contaminates other paper products and, therefore, hampers the whole recycling chain. Through its long-standing role in hygienising the waste, Waste-to-Energy prevents such contaminations, thus contributing to high quality recycling.

Waste to Energy: Closing the Loop with Energy and Material Recovery

Energy Recovery

- Waste-to-Energy plants supply homes, public facilities and businesses with electricity, heating and cooling generated from waste, providing local energy to energy consumers.
- The energy provided by Waste-to-Energy matches supply and demand thanks to the storage of heat, which makes it available at the right time and location. But the technology is further improving thanks to mobile thermal storage, which allows to store the heat and to transport it where it is most needed.
- 300 tonnes of Municipal Solid Waste (MSW) have the potential to generate enough energy to provide drinking water for 100,000 people. This will secure a sustainable, less fossil fuel-dependent, drinking water supply for local citizens.

Waste to Energy: Closing the Loop with Energy and Material Recovery

Material Recovery

Estimates show that, in the Netherlands only, bottom ashes contain gold with a value of approximately €27 million. Tapping into such source of precious metals would allow operators to increase their revenues by opening a new, local stream of secondary raw materials.

Waste to Energy: A Global Carbon Sink For the Waste Sector

Landfill Diversion

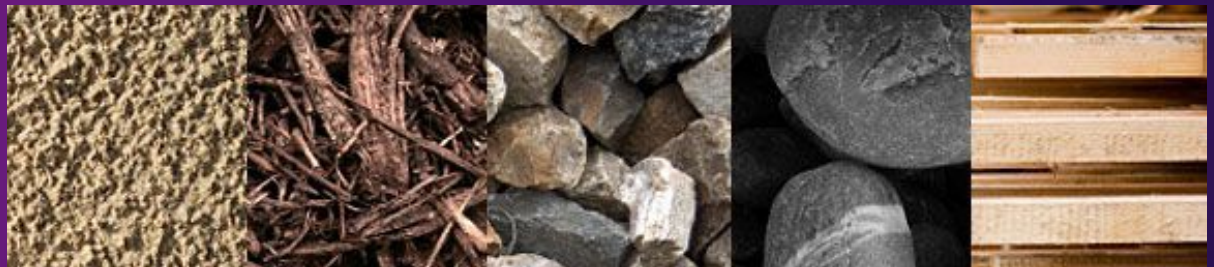
The diversion of residual waste from landfills has the potential to dramatically reduce the emissions of methane (CH_4), a powerful greenhouse gas. Indeed, in the case of landfilling, decomposed waste generates CH_4 which, over a 20-year period, is 86 times more potent than CO_2.

Waste to Energy: A Global Carbon Sink For the Waste Sector

Prevention of extraction of primary raw materials

The improvement of energy and materials recovery from the treatment of residual waste prevents the extraction of virgin fuels and the employment of primary raw materials and their related GHG emissions.

It is estimated that the climate mitigation potential of recovering several types of metals from incineration bottom ashes (IBA) would amount to around 2.6 tonnes of CO_2 per tonne of metal recycled from IBA.



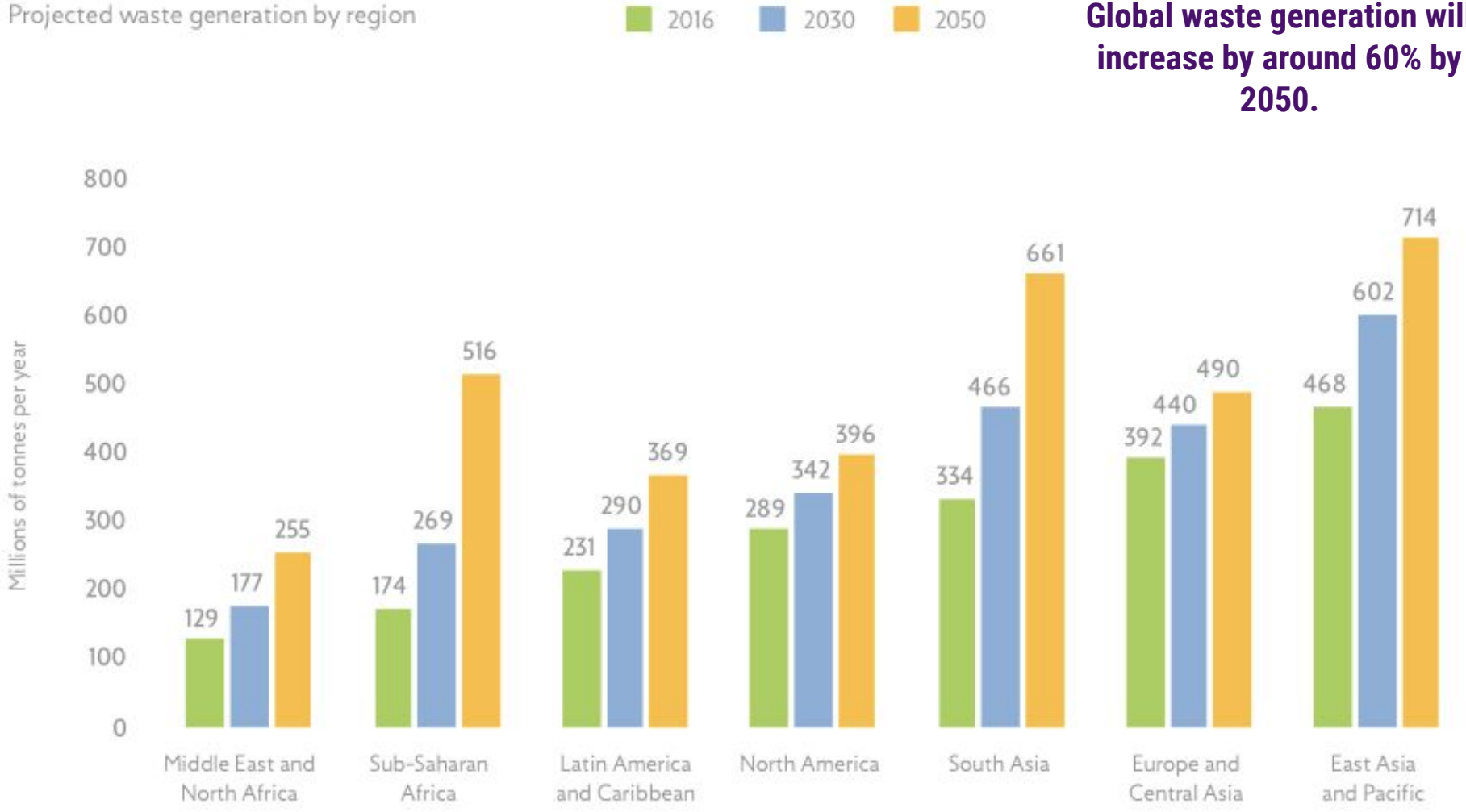
Waste to Energy: A Global Carbon Sink For the Waste Sector

Carbon capture, utilisation and storage

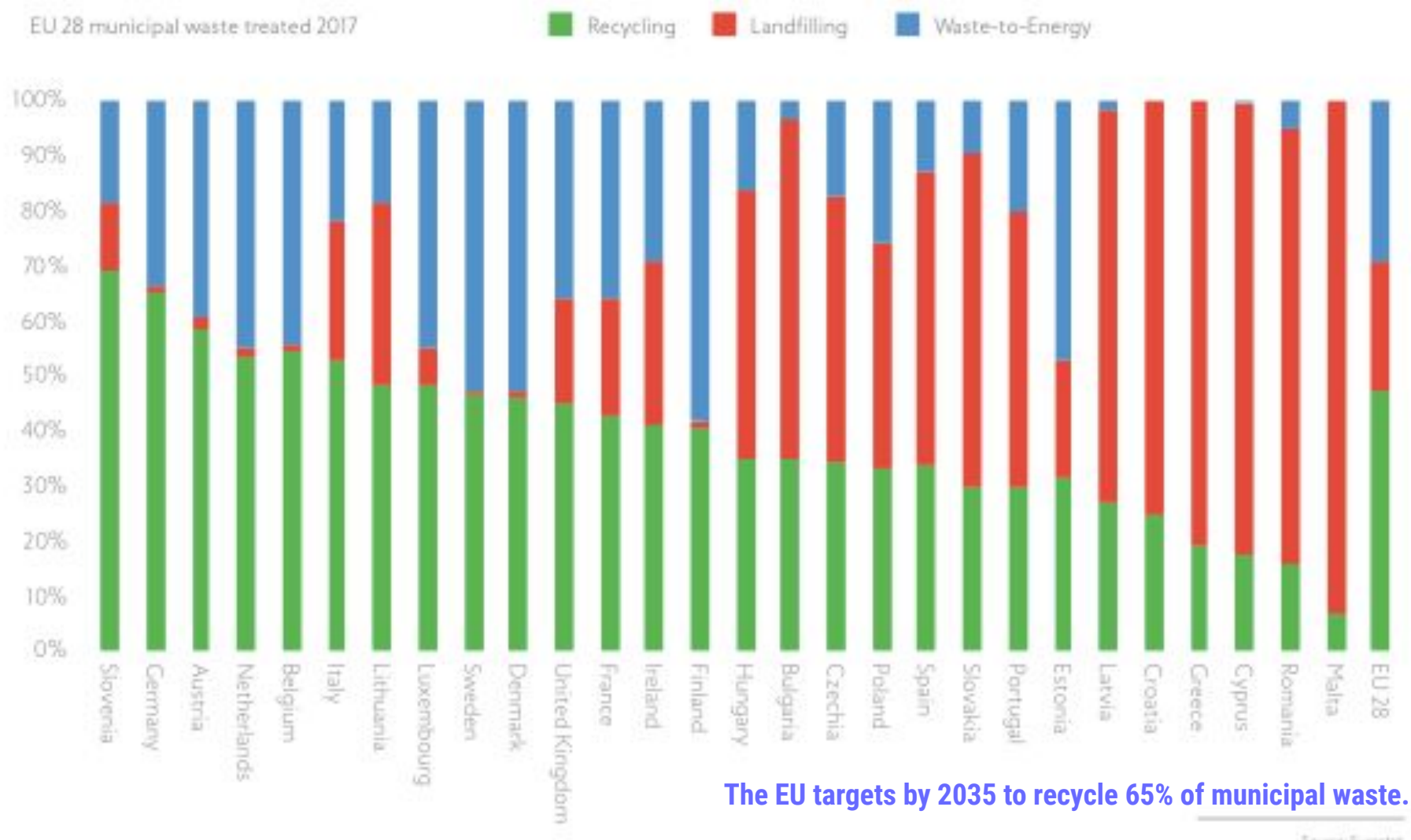
Industrial CO2 capture, storage and utilisation can not only substantially reduce the intrinsic GHG emissions of Waste-to-Energy plants, but also abate GHG emissions from other sectors by making the most of this CO2 by using it as a raw material to manufacture new products, fuels, etc.

As stated in its name, Carbon Capture and Utilisation (CCU) allows to recover CO2 as a source of carbon to use it in the manufacturing process of fuels, carbonates, polymers and chemicals. CCU represents a new economy for CO2, which will be used as a raw material for new products.


THE WASTE-TO-ENERGY PLANT OF THE FUTURE
HYGIENISATION
FLUE GAS TREATMENT RESIDUE PLANT
METALS AND MINERALS
BOTTOM ASH PLANT
ANAEROBIC DIGESTION
HEAT STORAGE
ELECTRICITY STORAGE
HEAT
ELECTROLYSIS
FUEL PRODUCTION PLANT
FUELS
ENERGY RECOVERY
MATERIAL RECOVERY
HOUSEHOLDS
INDUSTRY
POWER GRID



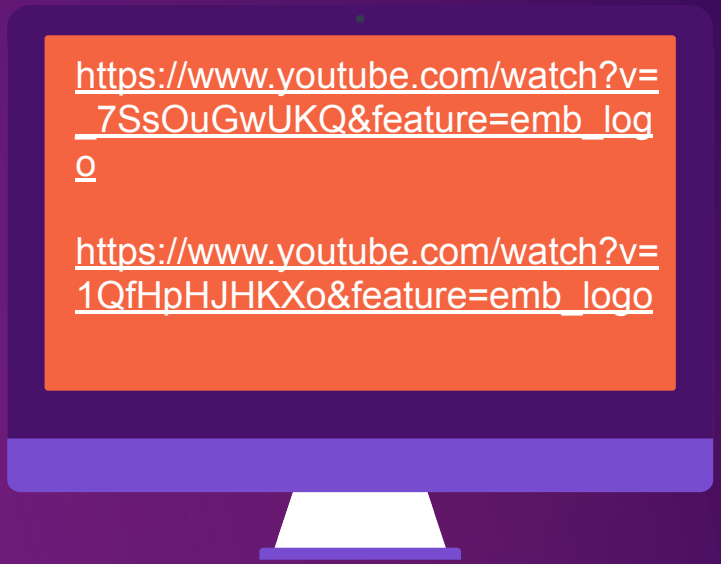
Global waste generation will increase by around 60% by 2050.



The EU targets by 2035 to recycle 65% of municipal waste.

Source: Eurostat

So What?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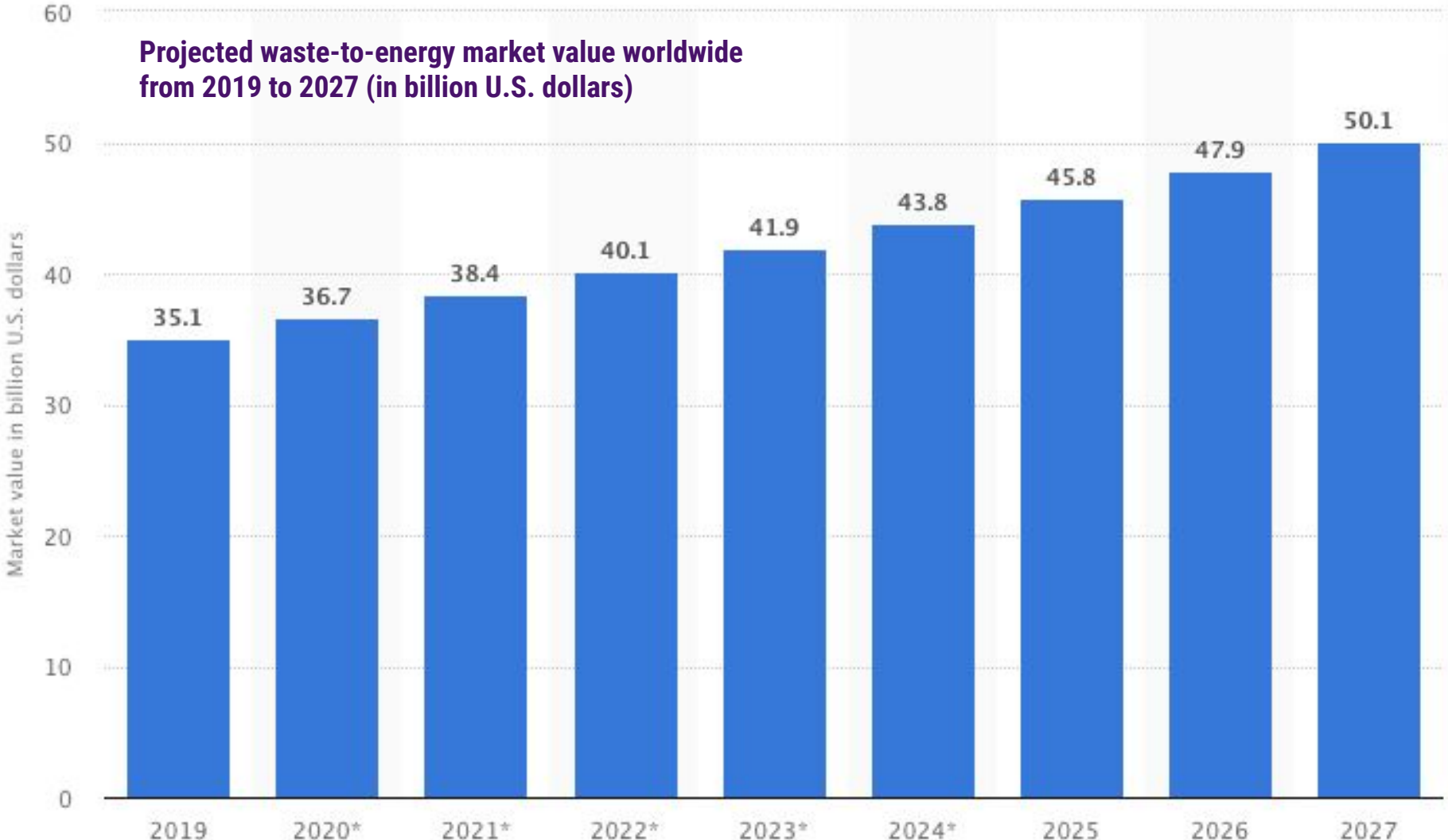
Projected waste-to-energy market value worldwide from 2019 to 2027 (in billion U.S. dollars)



So What?
Policy Recommendations

Promote the waste hierarchy as the enabler of sound waste management policies.

Promote the role of Waste to Energy as the preferred treatment option for residual waste

Minimise the amount of landfilling to the amount strictly necessary

Recognise the value of Waste to Energy for climate change mitigation

Recognise Waste to Energy as a sustainable waste management option

Support the export of sound waste management technologies including Waste to Energy

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