Waste: Part 2

Dumpster Dives:
Special Topics in Waste

THE MYTH OF RECYCLING

WASTE MANAGEMENT IS A PUBLIC SERVICE

INCINERATION MAKES WASTE DISAPPEAR

The Myth of Recycling

THE GARBAGE MAN by Thomas Dambo

They were eight great trolls, the humans they came later.
They were there from the beginning, sworn by faith as nature's saviors.
They were there as humans walked from equator to the glaciers,
Saw them herd and hunt the grazers, become traders and creators.

See, the humans are possessed with making and creating things.
Just to hold them for a blink, and toss them out into the winds.
They don't see the bigger picture; all their goods just make them sicker.
Cause the mixture will grow thicker as it flows down through the river.

And so the trolls spoke up enough! We have to take a stand
Make a plan to wake them up and make them understand
Let's gather trash like artisans, break in and build a Garbageman
And so the trolls all rose their hands and sealed it with a chant

That night they swept the city streets, the forest, beach and creeks.
Scraps, debris and plastic sheets, they brought it in in heaps
They filled the house of humans up, with all the things left wasted
A giant human made of trash, that night they had created

And right then the horizon let the first small beams of light in
The trolls went back in hiding where the humans could not find them
Some humans saw the sighting of the garbageman as frightening
Some saw it as enlightening as a sign to do the right thing

And so the ending in the legend hints a time for a reflection
When you think you know it all, the answer is in the question.
What is a possession? Garbage or a blessing?
Who possesses whom, you choose the ending to the lesson.



The Myth of Recycling

Recycling is the process of converting post-consumer waste into useable products.

Recycling involves:

- Collection
- Sorting
- Processing/Remanufacturing
- Distribution of newly created products

Recycling is a waste *management*, not a waste *reduction*, process.



The Myth of Recycling

The terms “recycled” and “recyclable” are often used interchangeably, but they are fundamentally different.

“Recycled” is a post-production designation, meaning that at least some of the inputs to the product came from discarded waste.

“Recyclable” is a label applied at the time of production and refers to the potential for a product to enter the recycling process. Current FTC guidelines require that a product labeled “recyclable” must meet a “60% access” rule.



The Myth of Recycling

Complicating this conversation are “eco-friendly” and “planet-friendly” labels, examples of misinformation known as “greenwashing”.
“Greenwashing” misleads consumers and contributes to disillusionment which leads to reduced compliance.





The Myth of Recycling

The “Myth of Recycling” refers to two separate but related dynamics:

- The disconnection between the volume of consumer items (e.g., plastics or paper) produced in the world and the amount that is recycled; and
- The dissonance surrounding the public’s support for recycling (87% of Americans support the concept of recycling) versus the public’s actual practice of recycling (only 77% of the US populace actually recycles and only 32% of waste is recycled (2018 data)).

The Myth of Recycling

Recycling as a social practice is inextricably linked to economics. As a product loses value to an owner, that product is discarded as a “waste”. But this waste may have residual value and, if so, it is collected for reprocessing, repurposing or direct reuse.



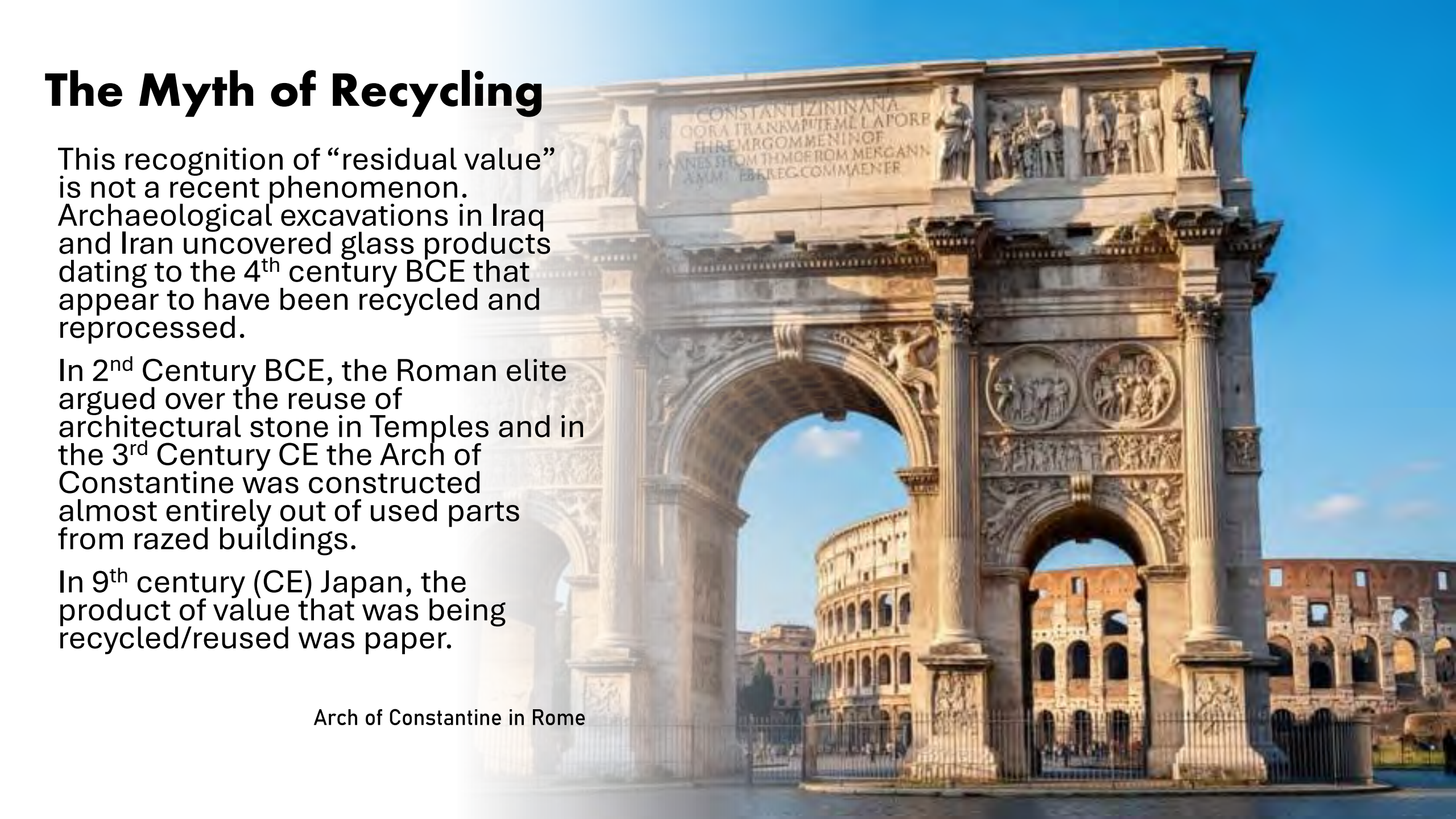
Rag picker in 19th Century New York City

The Myth of Recycling

This recognition of “residual value” is not a recent phenomenon. Archaeological excavations in Iraq and Iran uncovered glass products dating to the 4th century BCE that appear to have been recycled and reprocessed.

In 2nd Century BCE, the Roman elite argued over the reuse of architectural stone in Temples and in the 3rd Century CE the Arch of Constantine was constructed almost entirely out of used parts from razed buildings.

In 9th century (CE) Japan, the product of value that was being recycled/reused was paper.



Arch of Constantine in Rome

The Myth of Recycling

In WW2, shortages of raw materials increased the value of used products and the concept of recycling became intermixed with civic duty/national pride.

Launched just a month after Pearl Harbor (1/10/1942), the Federal government's *Salvage for Victory* program was launched. By some measures, over 80% of all US households participated.



The Myth of Recycling

In the 1960s and 1970s, the rationale for recycling became linked to the environment, implying a social responsibility to both future generations of humans and to the planet. Shortly thereafter, local laws are implemented to require some forms of recycling (Woodbury, NJ implements the first recycling program in the US in 1973).

While emphasis has changed over time (and will likely change in the future), the rationale for recycling are:

- Economic
- Moral/ethical
- Legal



The Myth of Recycling

As of 2025, 30 States have passed mandatory recycling laws, imposing requirements on local municipalities and regional management organizations to formulate and implement recycling programs. **There is no Federal law**.

As of 2025, 85% of the 824 municipalities in the US with populations greater than 50,000 residents had recycling requirements. Only 1%, according to the study, imposed financial penalties for non-compliance.

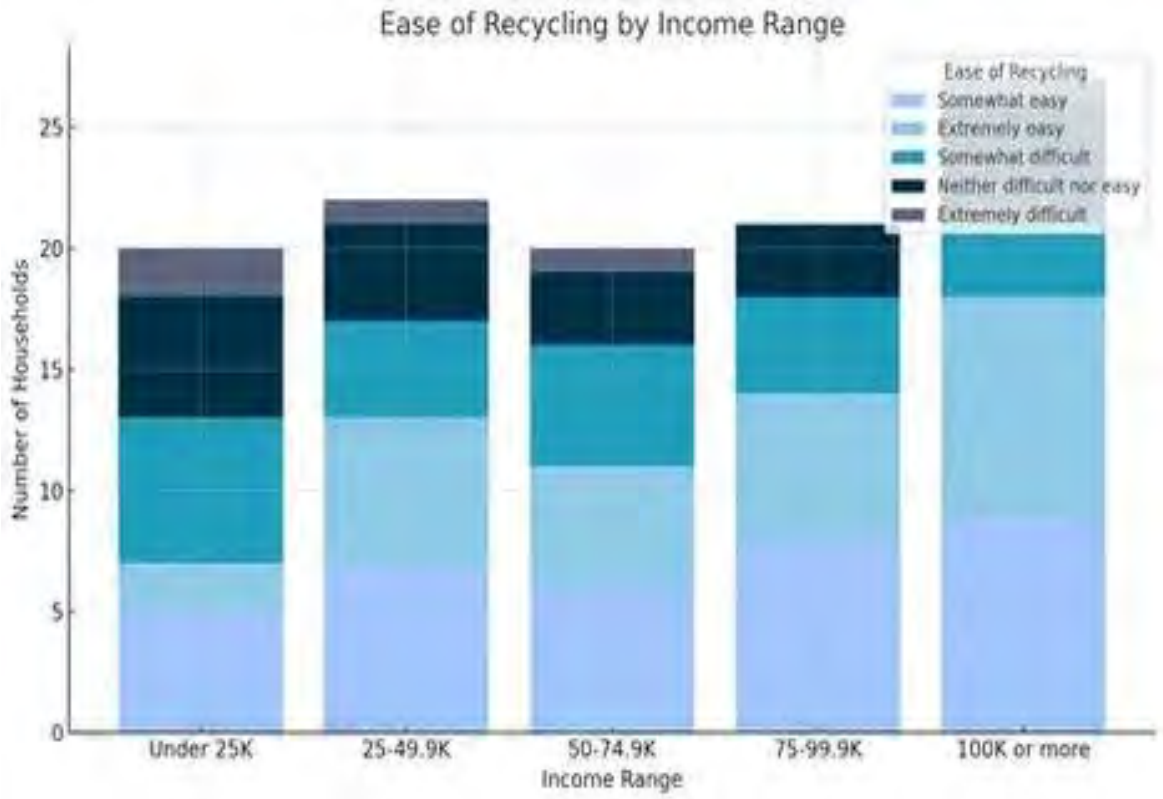
Compliance with local laws is linked to income as well as to ease of compliance (the easier a system can be navigated by the user, the higher the rate of compliance).



The Myth of Recycling

Data suggest that low income neighborhoods and communities of color are afforded fewer recycling services. According to a 2026 study, 52% of census blocks designated low income have no curbside recycling programs*.

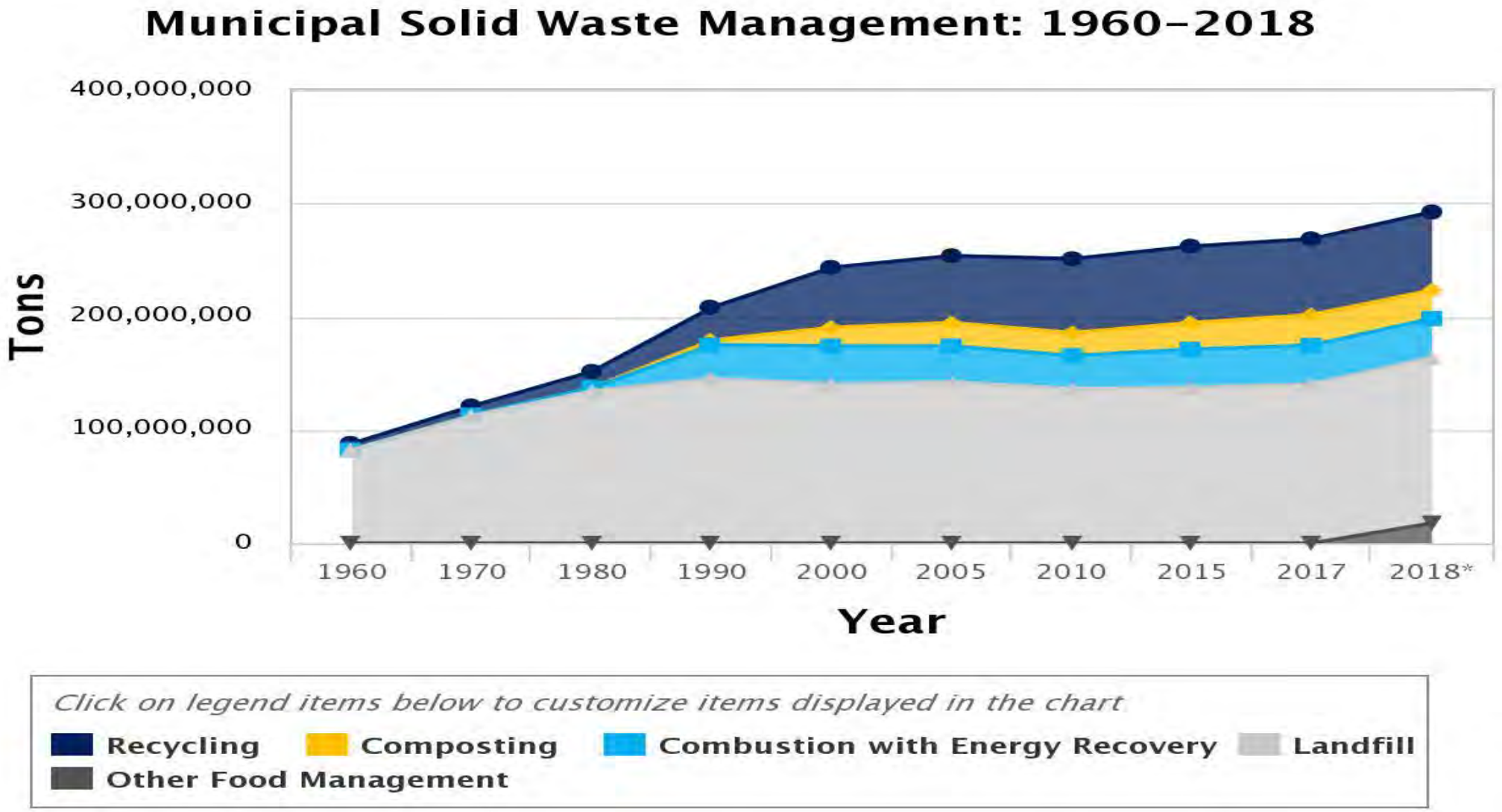
The direct impact is seen in household waste disposal charges; these neighborhoods pay an average of 30% more for waste disposal.



* This is not exclusive to the US. According to Canadian data, 70% of rural Indigenous communities have no recycling program. Low income neighborhoods in Europe have 45% fewer recycling drop-off containers.

Solid Waste Profile: US

Per Capita MSW Generation

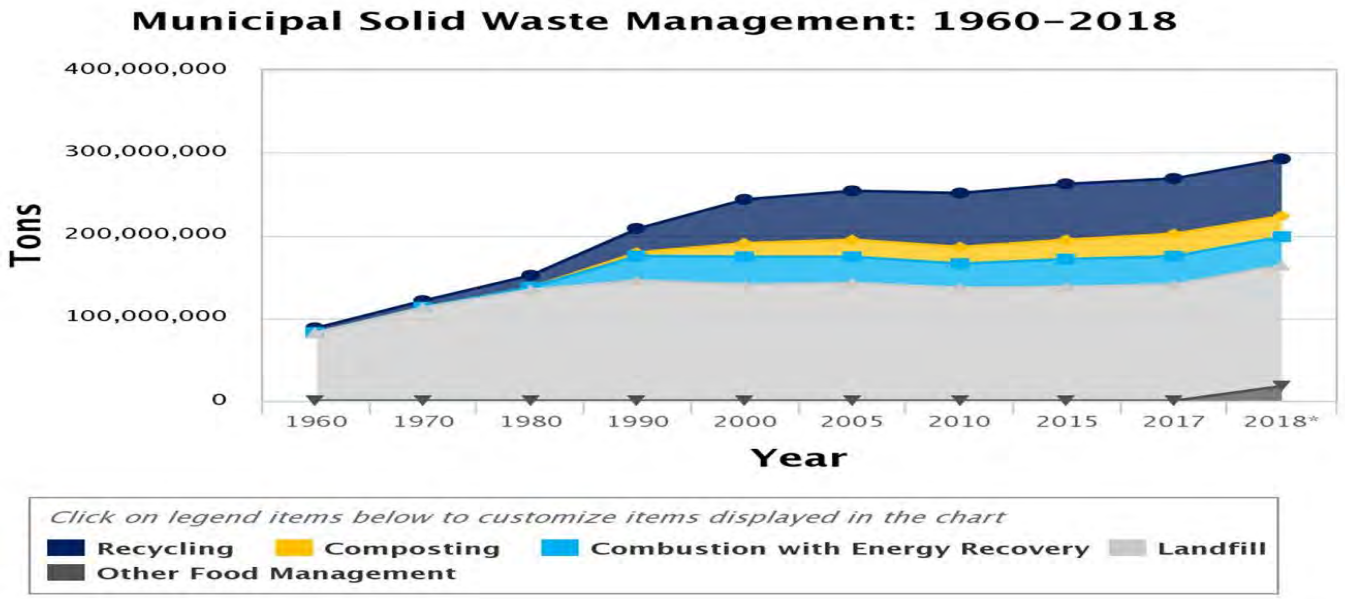


Solid Waste Profile: US

Per Capita MSW Generation

MSW includes all wastes collected and processed at regulated solid waste facilities (both private and public). MSW does **NOT** include:

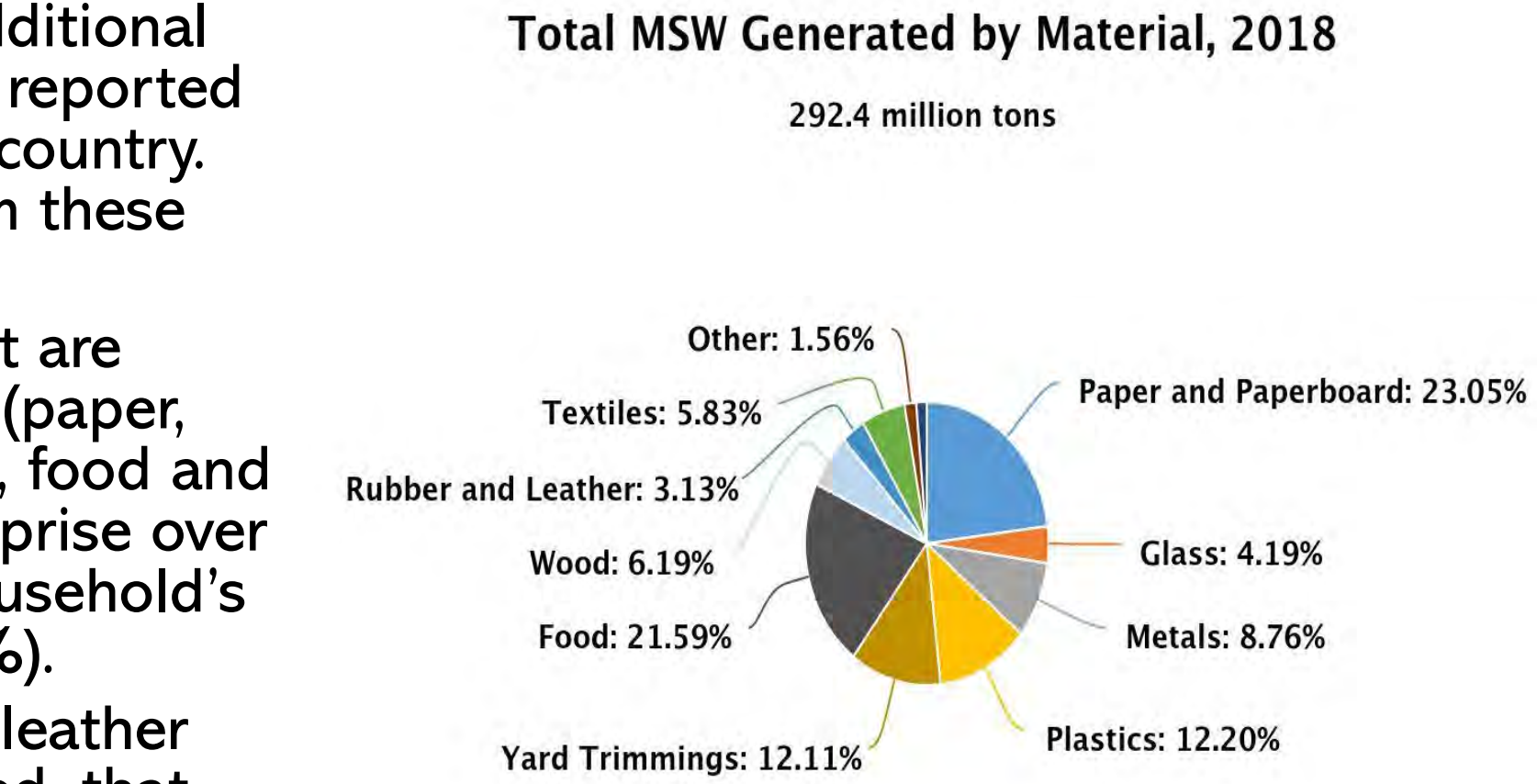
- Litter and Illegal waste
- E-waste
- C&D
- Contaminated soil from remediation sites
- Hazardous wastes



Solid Waste Profile: US

The USEPA provides additional breakdown of MSW as reported by facilities across the country. Note the following from these data:

- Traditional items that are obviously recyclable (paper, glass, plastic, metals, food and yard trimmings) comprise over 80% of a typical household's waste stream (81.9%).
- When wood, rubber/leather and textiles are added, that total jumps to 97%.



Solid Waste Profile: World

The waste profile from Europe is similar in breakdown to the US.

Over 80% of all waste is material that can be recycled.

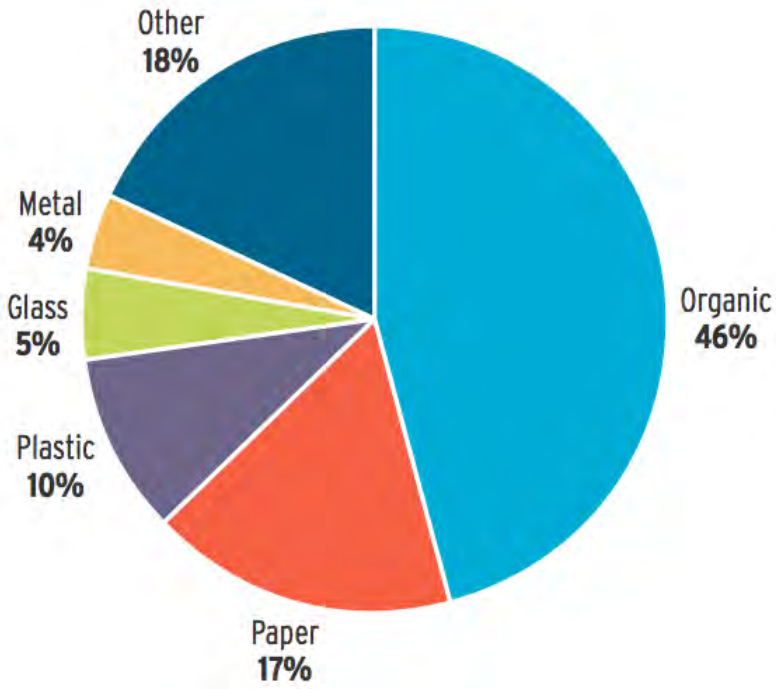


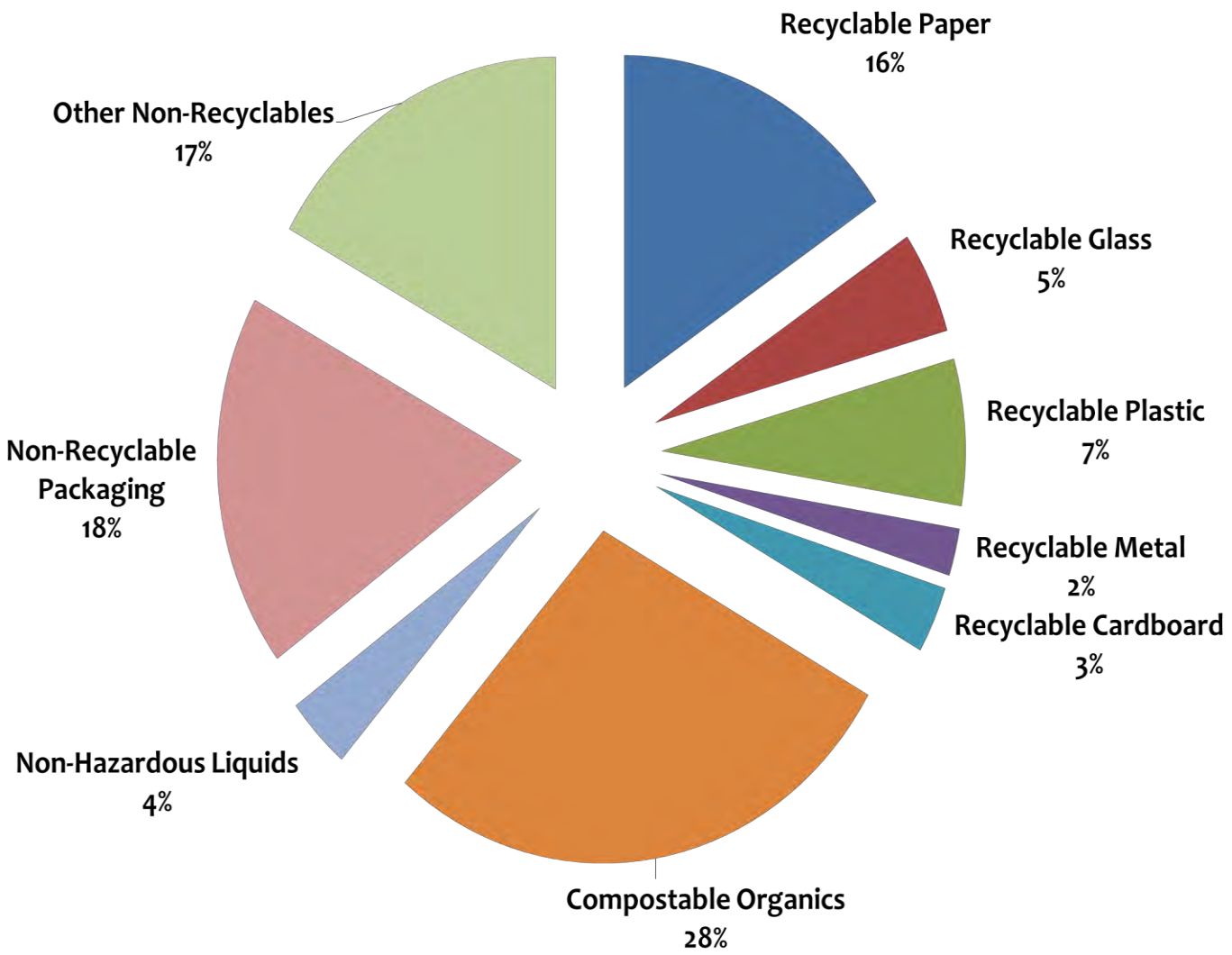
FIG. 7
Global Solid Waste Composition

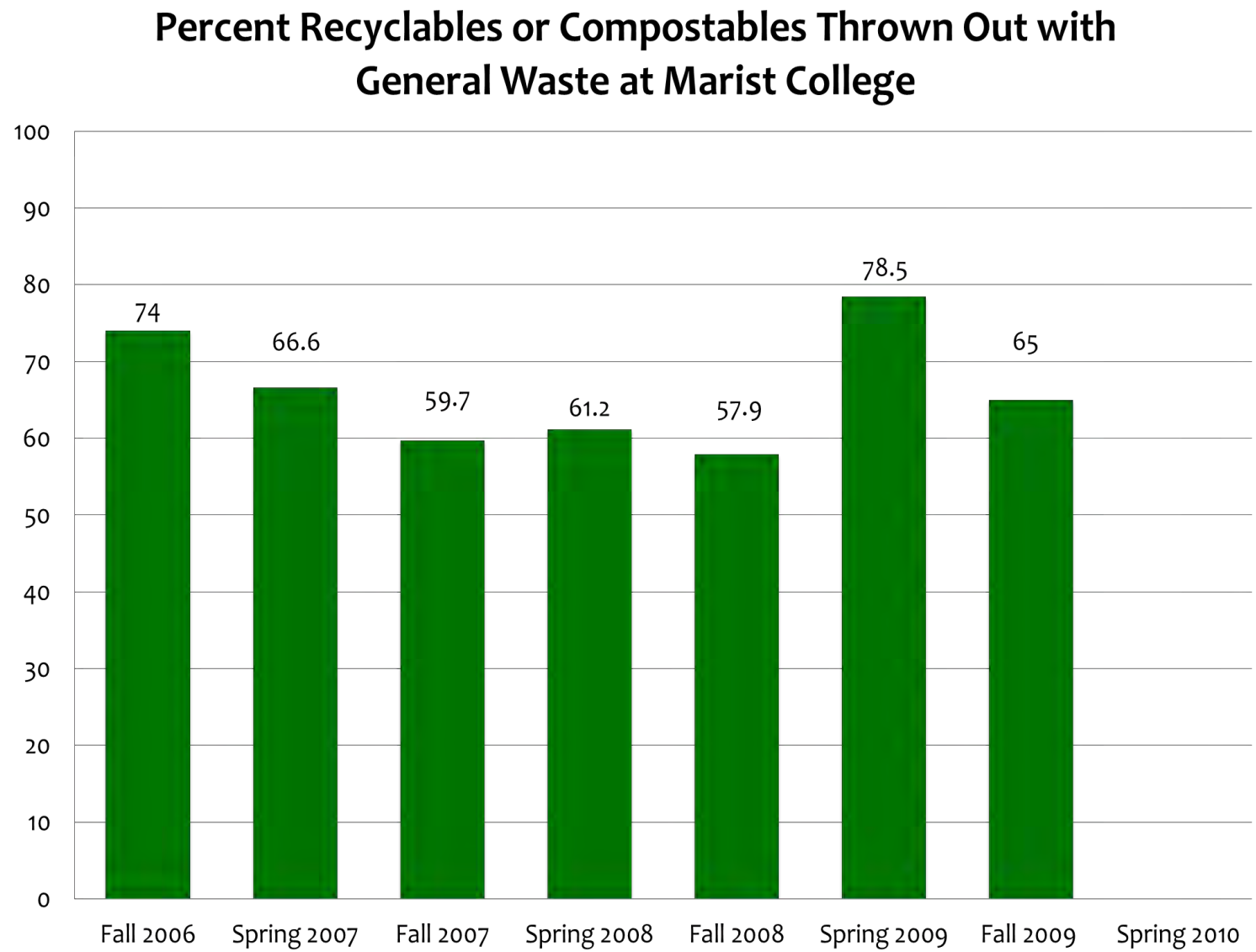
Waste Profile of Colleges

College campuses represent another social structure where recycling should be relatively easy to implement and sustain.

But results are mixed. While most students are supportive of recycling efforts (over 75% in most studies), actual participation as measured in waste surveys falls far short. A 2024 Williams College report found that only 15% of all waste on campus was recycled (down from 18% the previous year). Several studies at Marist College also documented a significant volume of recyclable wastes thrown away.

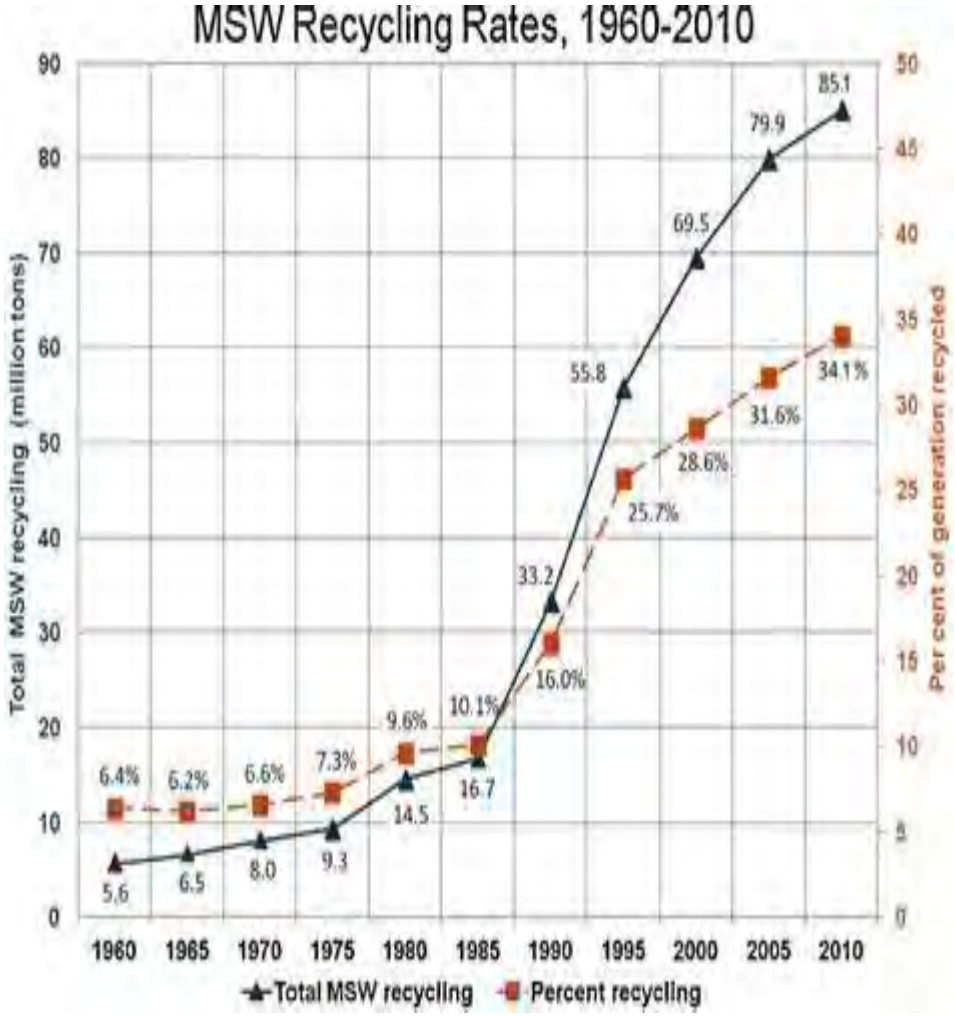
General Marist Waste over 7 Dumpster Dives




Percent Recyclables or Compostables Thrown Out with General Waste at Marist College
100
90
80
70
60
50
40
30
20
10
0
74
66.6
59.7
61.2
57.9
78.5
65
Fall 2006
Spring 2007
Fall 2007
Spring 2008
Fall 2008
Spring 2009
Fall 2009
Spring 2010

Solid Waste Profile: US

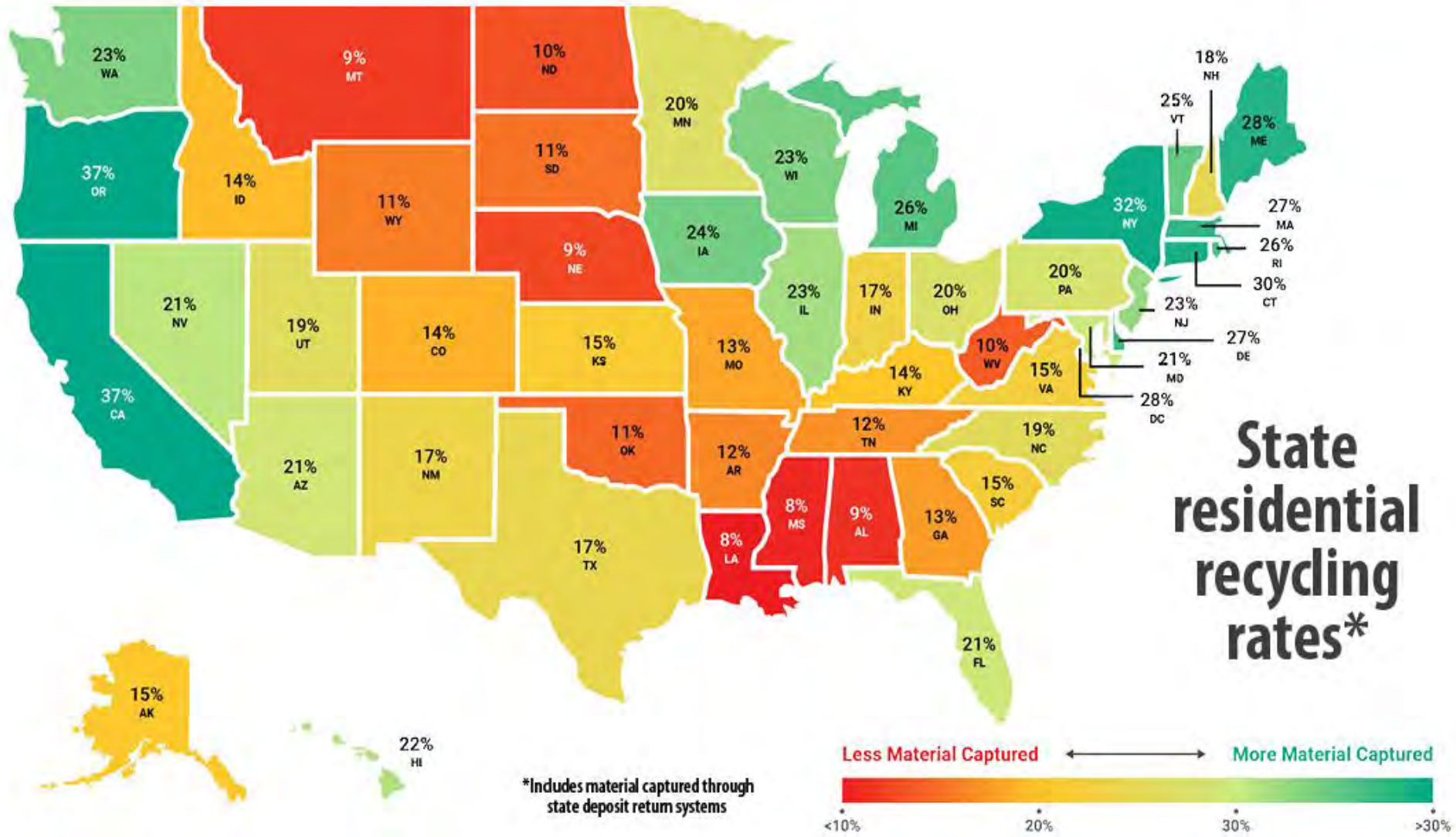
Recycling



Recycling rates and volumes increased nationally in the 1990s into the 2000s. Between 1980 and 2000, the percentage of recycled waste tripled from 9.8% to 28.6% and the volume recycled more than quadrupled (14.5MMT to 69.5MMT).

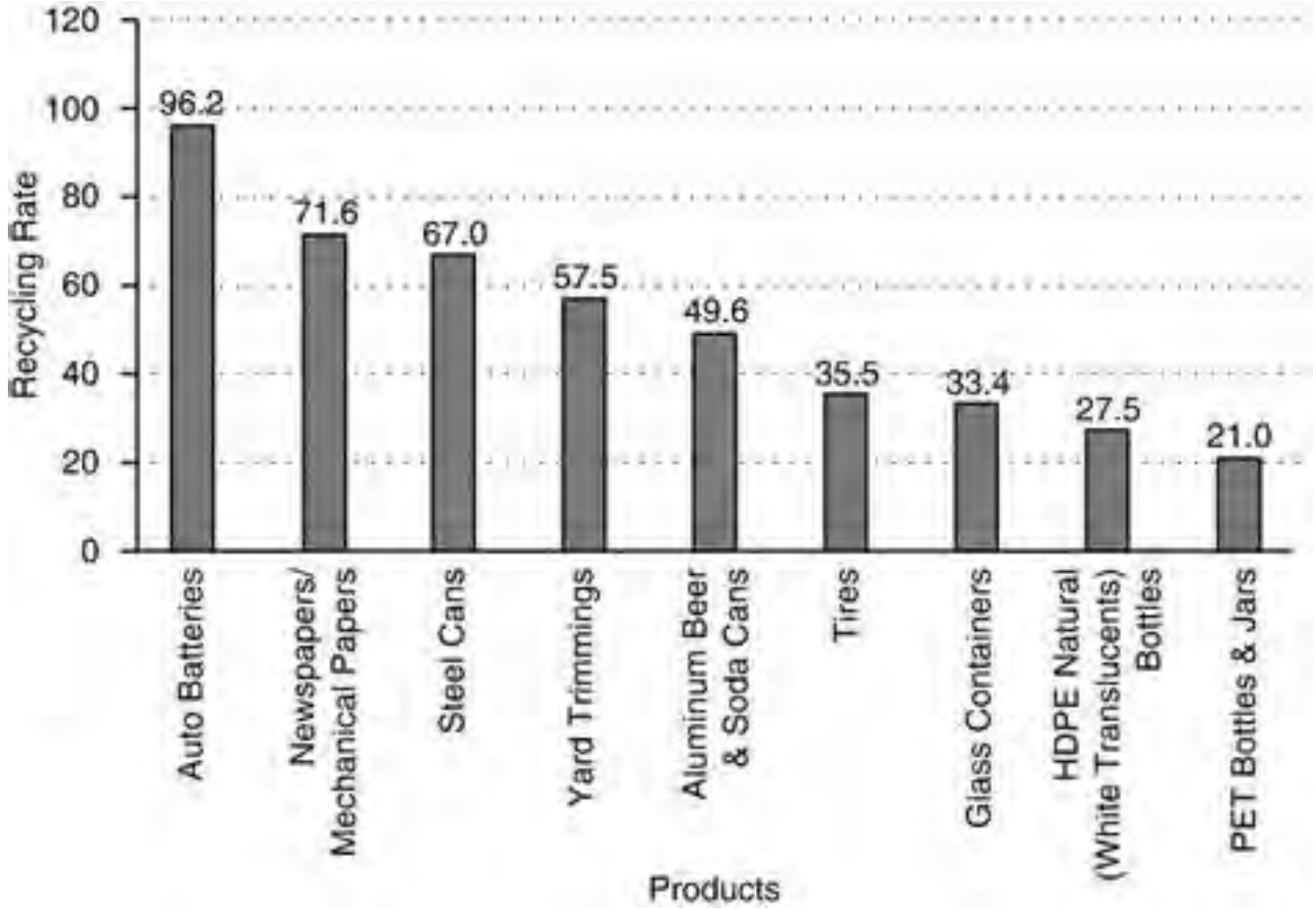
But after that time, the recycling rate increased modestly until 2010 when it plateaued.

Regional Analysis of Recycling Efforts



Solid Waste Profile: US

Recycling



Recycling as a materials recovery strategy has success with certain products but not with most.

Not shown is the recycling rate of textiles, which in the US hovers at around 13% but worldwide is less than 1%.



Solid Waste Profile: US Recycling

Comments on Previous Graphs:

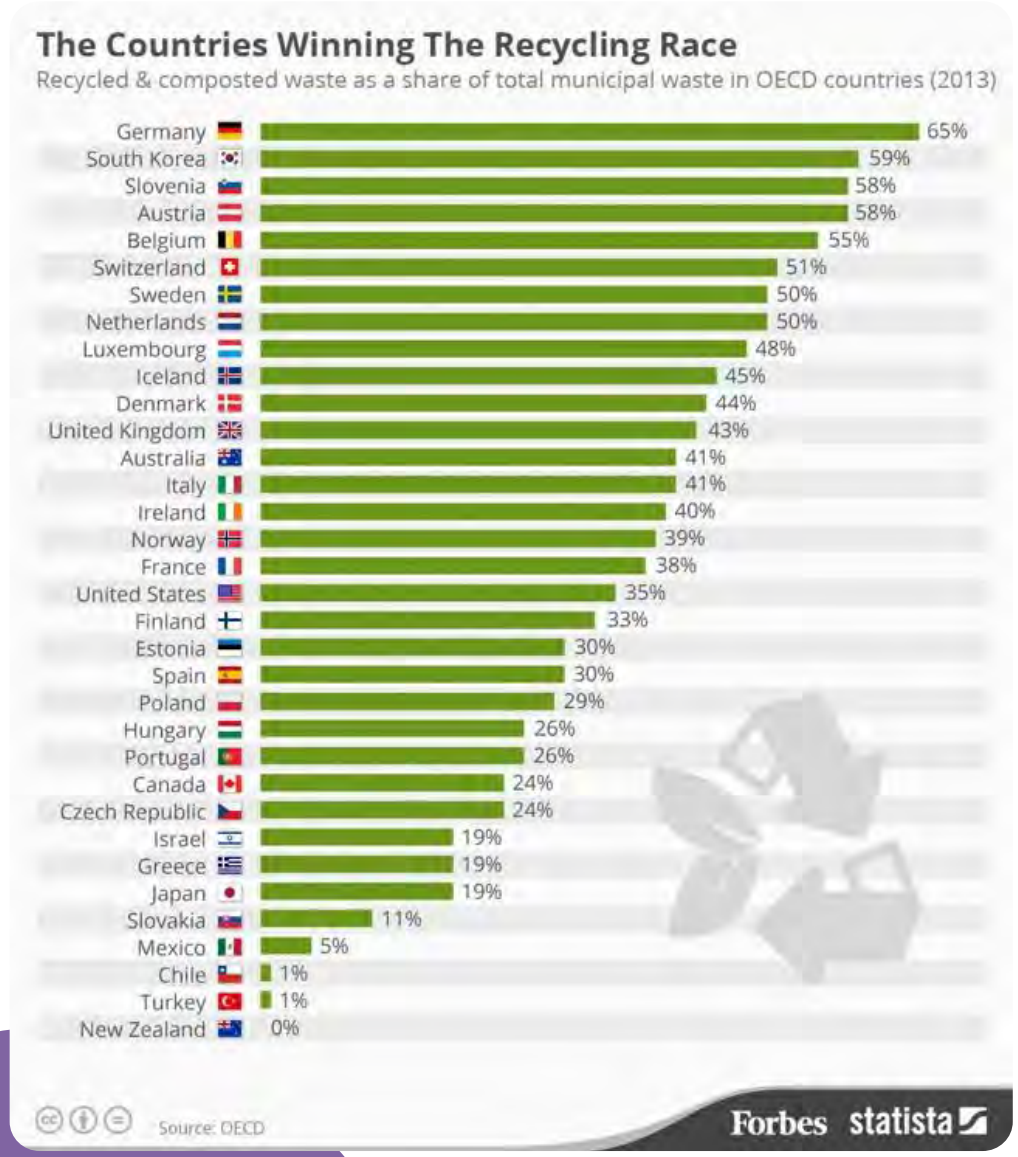
- Most components of MSW can be recycled, but only one-third of everything thrown away is, in fact, recycled. Other waste streams (e.g., nuclear or hazardous waste) have much smaller percentages recycled.
- The specific waste streams with the highest recycling rates are associated with strict regulations and/or limited waste producers.
- Percentage of total MSW recycled has remained relatively constant over the past 15 years (since 2005). Recycling rates were 6% in 1960, rising to a peak level of 35% in 2017 before decreasing slightly to 32% in 2018.
- Recycling rates vary significantly depending on the product and geographically.

The Myth of Recycling

And between 25% and 40% of all material sent to recycling facilities is rejected, often caused by citizens engaging in “wishcycling”. Rejected wastes include:

- Plastics that are not #1 or #2 plastics (some facilities accept #5). Any plastic labeled #3, #4, #6 or #7 is generally rejected.
- Black plastic (e.g., food containers) are often unrecognized by sorting machinery at recycling plants.
- Otherwise recyclable material contaminated by food.
- Coated or treated paper.

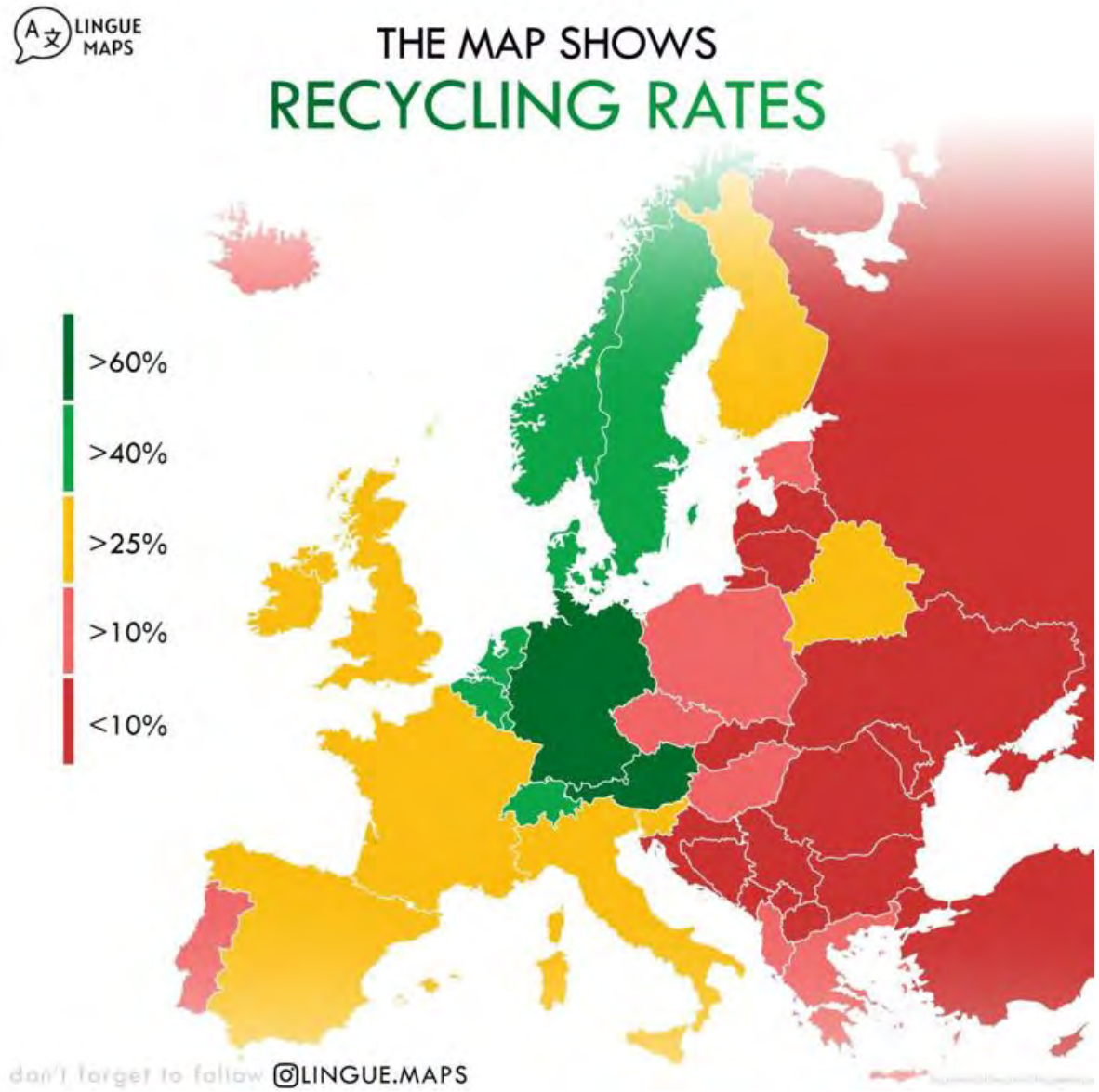




The Myth of Recycling

Worldwide, recycling rates vary significantly, generally mirroring levels of economic development, regulatory sophistication, and available infrastructure.

In nations with minimal infrastructure, any estimate of percent recycled is suspect. In India, for example, only 15-20% of all solid waste is collected so no reasonable estimate of recycled material can be presented.



The Myth of Recycling

The EU remains an area where measurably higher recycling rates are present, in part as a result of economic pressures, strict regulations, incentives to recycling facilities, and public educational outreach.

But even these rates are well below what could/should be.

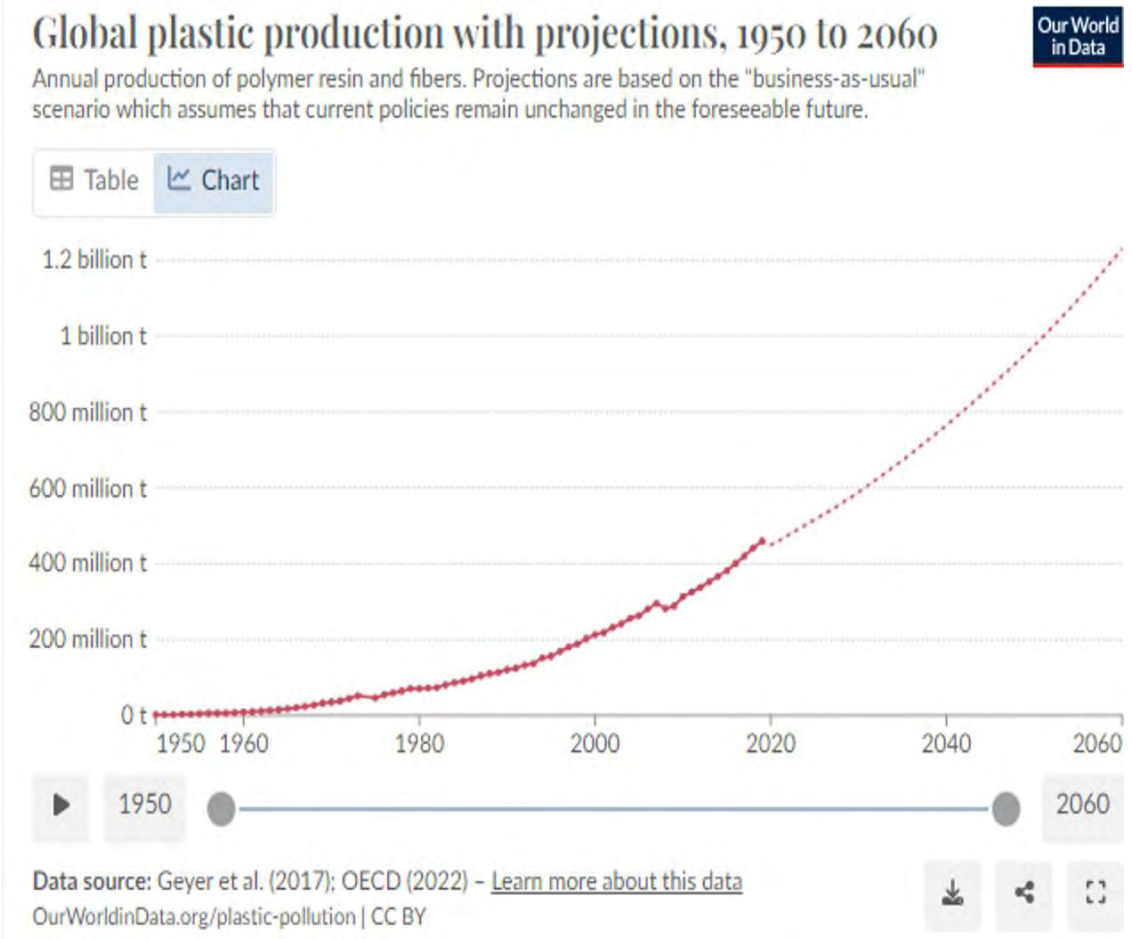
The Myth of Recycling

This “myth” is perhaps most glaring with respect to plastics.

In 2022, approximately 450 MMT of plastics was produced worldwide. Within 40 years, the OECD projects a total of ***1.23 billion tonnes*** will be produced.

The products are organic polymers that are easily managed* and which makes them, ostensibly, easily recycled.

* There is a limited number of producers, the products are easily tracked and accounted for in the marketplace, and they can be easily collected/sorted.



The Myth of Recycling

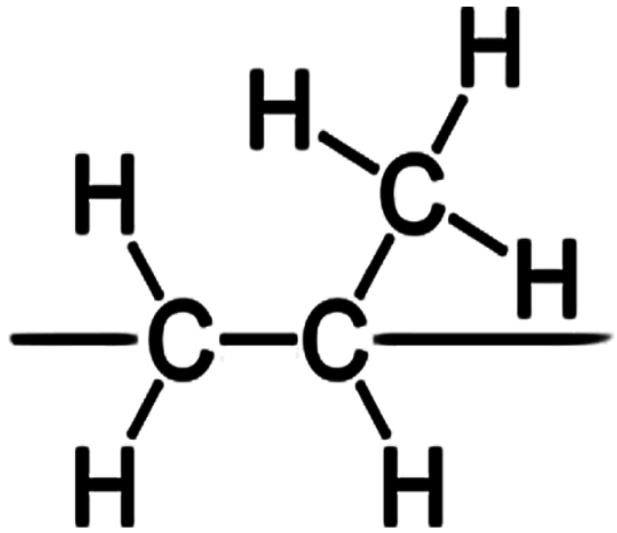
At the same time plastics are a broad collection of products with unique chemical properties (e.g., melting points) and mixed with a myriad of resins and additives, making them particularly difficult to separate and reconstitute. HDPE is a plastic, but so is Styrofoam and polypropylene.

But this is both a technical impediment and an economic one that is easily solved through innovation. Simply said, if the money is provided, the solution will be found.

Polypropylene (pp)
Chemical structure

C_3H_6

EXIR POLYMER Recycled PP Granules and Compounds Manufacturer



The Myth of Recycling

HDPE and PP need to be managed differently, but that is not evident from the information provided to the consumer.

The universal symbol for recycling, known as the “chasing arrows” logo, is stamped on HDPE and PET as often as it is stamped on PP. But that doesn’t mean they’re all recyclable.

Manufacturers can print the logo on just about any product. According to the NY Times*, the “main purpose isn’t to say whether it’s recyclable, but to identify the type of plastic it’s made from”.



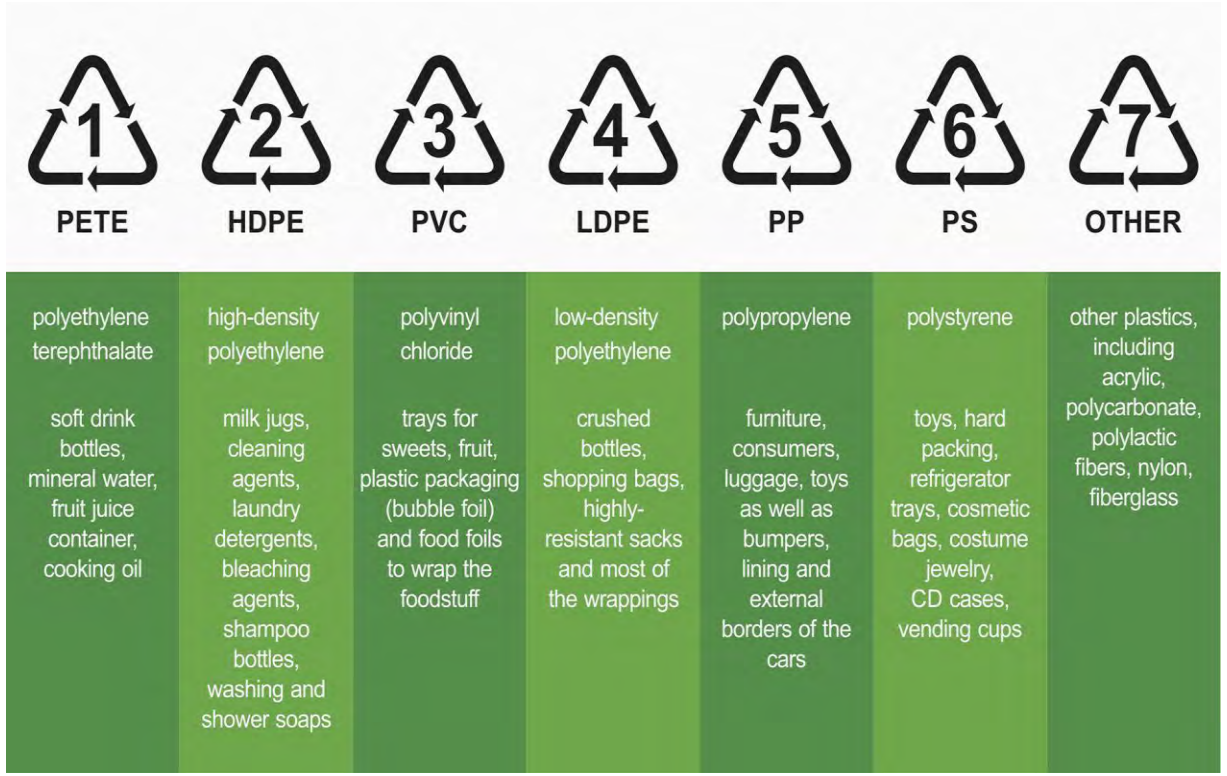
* Source: “Trash or Recycling? Why Plastic Keeps Us Guessing” (4/21/2022)

The Myth of Recycling

There is widespread misunderstanding over what plastics can and cannot be recycled.

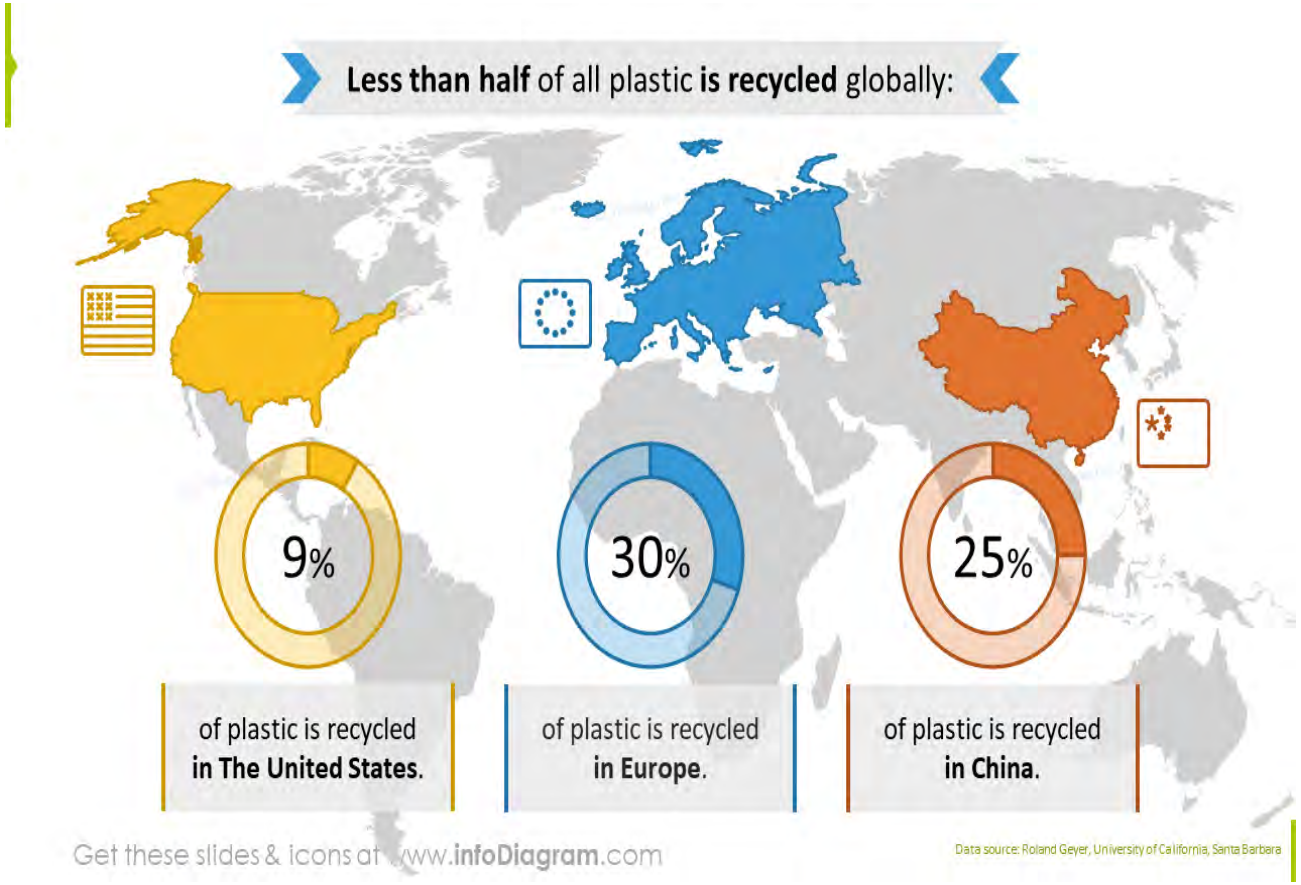
Generally plastic products labeled as “1” or “2” can be recycled, and according to the USEPA roughly 30% of these items enter recycling programs*. An Item labeled #5 is also fully accepted by most recycling programs but only 25% is actually recycled. Most other plastic codes are rejected by recycling programs and some programs fine participants for trying to recycle these plastics, further depressing recycling rates.

* But not necessarily recycled due to the limitations of those programs, the economics of the recycled plastics industry, and/or the physical condition of the item.



The Myth of Recycling

By some measures, the true aggregate recycling rate for plastics in the US is between 5% and 6% from a peak of a dismal 9.5% back in 2014—and that included plastic exported to China. The remaining plastic is landfilled, burned or "leaked" into the environment, often ending up in the ocean.



The Myth of Recycling

According to the USEPA (2018 data):

- 29% of all PET and HDPE bottles were recycled*
- Between 60% and 80% of all plastic that is “recycled” actually gets recycled*; the remainder gets redirected to end-of-life facilities either from poor management or system design errors**
- 16% of all plastic was combusted at MSW incinerators
- **Only 8% of all plastics produced in the US are recycled according to the USEPA (this may be high)**

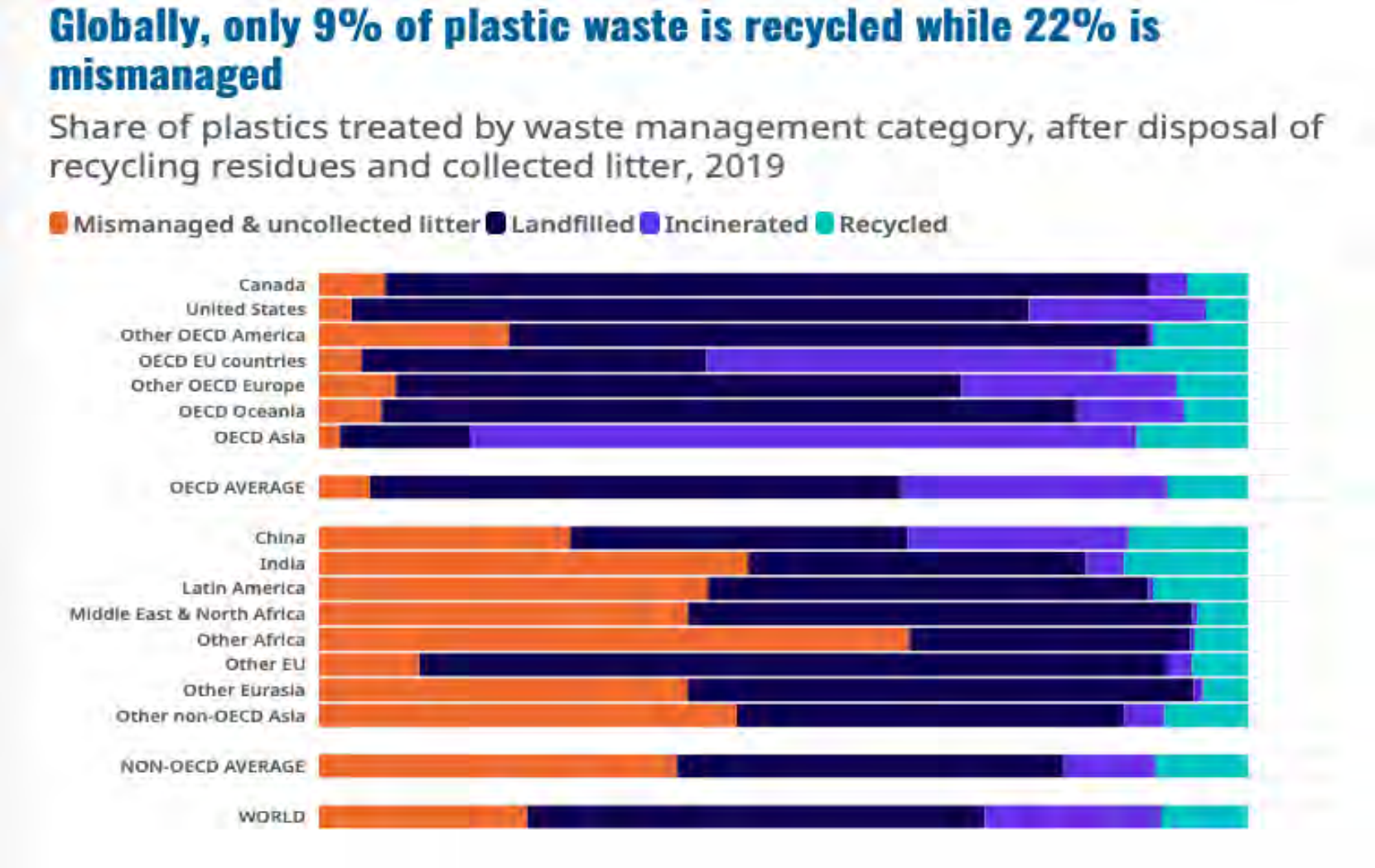


- **Source: Stanford University (3/2022) “How Much Recycling Actually Gets Recycled”**

** **Black plastic, for example, cannot be read by recycling machinery and as such gets discarded.**

The Myth of Recycling

Worldwide, the same pattern is evident from recent studies. Other nations have basic management concerns which could arguably be an impediment to aggressive recycling, but the US and EU do not have that excuse.



The Myth of Recycling

And this paltry recycling rate for almost all recyclable products has remained steady for almost 2 decades.

Actions to increase recycling include:

- Expand products defined as “recyclable”
- Improve accessibility
- Incentivize participation (PAYT)
- Support/subsidize secondary markets

Such actions have been shown to improve recycling rates of other products (e.g., glass and paper).



Photo is of curbside recycling receptacles in Florence, Italy

The Myth of Recycling

Which is to say that the recycling of plastics and almost every other discarded consumer product can be increased, with focused attention and money.

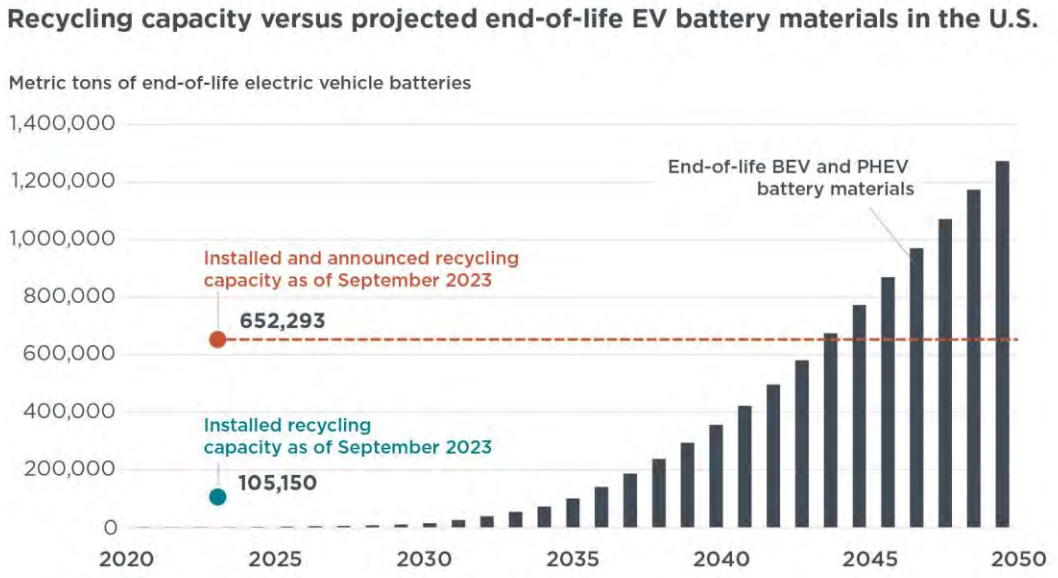
Recycling equipment can be improved to reduce error, more plastics can be produced with requirements for multiple use, and other plastics that are problematic to recycle can be banned.

But many of these solutions require governmental direction or leadership.



The Myth of Recycling

Currently, only 5% of all EV batteries are recycled (IAEA, 2021). But the potential for material recovery (particularly lithium and nickel) and the ability of such recovered metals to be easily reused makes battery recycling critical to the continued production of similarly-constructed EV batteries.



The Myth of Recycling

Part of the problem is endemic to all products that result from the "materials economy": EV producers, in pursuit of innovation and market share are willing to sacrifice long-term impacts associated with their product.

- There is no standard battery production process, which would make recycling easier
- There is no exchange of information on manufacturing processes
- There is no governmental regulations or incentives that would mandate or encourage recycling



E-Waste of the Future: EV Batteries

What this means, to experts, is the concurrent potential and frustration over EV battery recycling. The metals present in the expected E-waste could provide between 30% and 75% of the metals projected to be used in future EV batteries, depending on the efficiency of recycling efforts and the standardization of battery production*.

* Imposing standards on an industry often, but not always, involves selecting a process at the expense of future innovation in that industry. It also often necessitates the sharing of information which is antithetical to capitalism.



The Myth of Recycling

But recycling has several important success stories.

In 1990, only 11% of all used automobile tires were recycled in the US. By 2023, that was 80% in the US and 96% in the EU*. Over 1.5 billion tires are scrapped each year. Used tires are heavily regulated, easily controlled, and have substantial residual value.



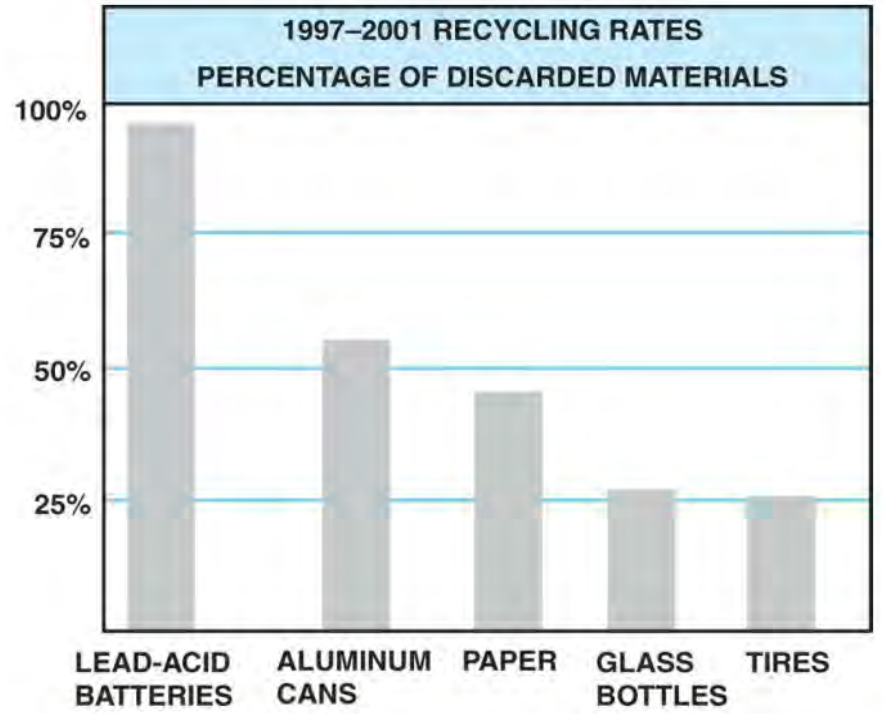
These numbers include those tires used for fuel.

The Myth of Recycling

Similarly, lead acid batteries for automobiles (not EV batteries) have an estimated recycling rate of 99% (USEPA, 2020).

Lead acid battery recycling began in the 1920s, prior to established state or federal regulations (1970s and 1980s).

Figure 5.2 Up to 97% of all lead-acid batteries are recycled.



PEARSON
Hybrid and Alternative Fuel Vehicles
James D. Halderman and Tony Martin
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The Myth of Recycling

In both tires and lead acid batteries, the reasons for such high materials recovery rates include:

- Strict regulations mandating product returns and banning land disposal or incineration.
- Favorable economics surrounding the product's raw materials.
- Consumer incentives for product recovery (deposits).
- Limited number of manufacturers and consistent manufacturing processes.
- Easily transported post-consumer products.



The Myth of Recycling

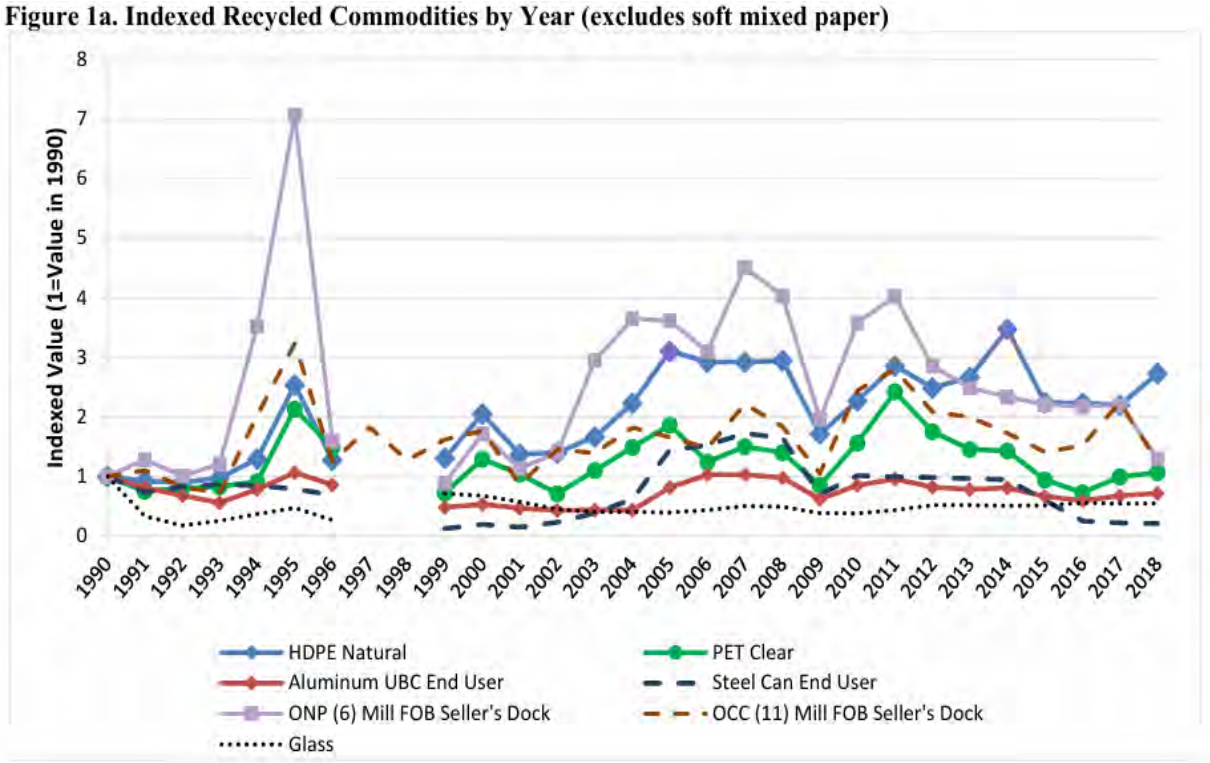
Can recycling rates for other products be increased?



The Myth of Recycling

The price that recycled wastes command in the marketplace will have an impact on collection rates and, ultimately, input rates for that subsequent product production. Those prices have been flat for many years, which means in real terms those prices have been falling. Those entities collecting these recycled products (e.g., paper or glass) are forced to sell these products at a loss.

Plastics are particularly volatile, in large part because of oil prices.



The Myth of Recycling

Which means that those entities mandated to collect the recycled wastes (e.g., municipal sanitation departments) are spending more money managing recycled wastes than regular waste.

Available USEPA data indicate that municipal solid waste costs $100/ton in the Northeast. Processing recycled wastes at a Materials Recovery Facility costs about $130/ton.

In urban areas, this differential is greater. Currently, NYC Department of Sanitation spends $200 more to manage one ton of recycled materials than a ton of landfilled waste.

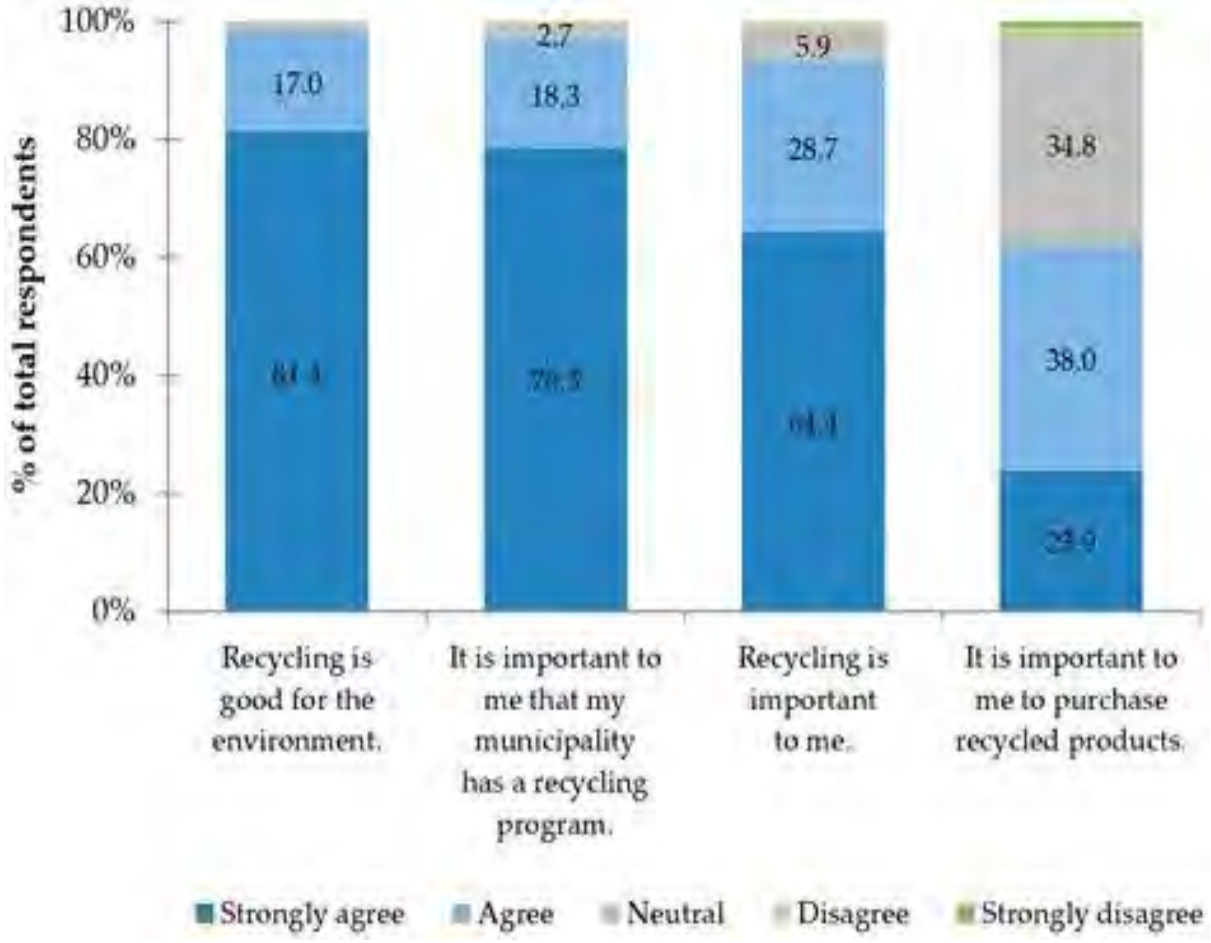


The Myth of Recycling

And, finally, does the general public's commitment to recycling actually get in the way?

In the US, there is a long-standing "recycling bias"; most people wrongly believe that recycling is the most important action you can take. Two surveys in the US (2019 and 2022) confirmed that **most people opt to recycle instead of the more important strategies of reduce or reuse.**

Adding this mindset to the acknowledgement that people recycle poorly creates a feedback loop that has the very real potential of compounding participant's frustration in their personal recycling efforts, spiraling into reduced participation.



The Myth of Recycling: Conclusions

- There is gap between the potential of recycling and the actual results, both nationally and internationally, is substantial.
- Recycling as a social strategy holds incredible potential. If 90% of all household MSW can be recycled but only 34% *actually is*, the massive potential in that difference needs attention. But it cannot be left unsaid that expanding recycling does not reduce the waste pile, it merely redirects a larger percentage of that waste to a different repository. Does this get society closer to sustainability?

The Myth of Recycling: Conclusions

- Governments have substantial influence, through regulations, economic incentives/disincentives, and education, to improve local recycling efforts. Specifically:
  - Governments can require recycling operations to accept more varieties of plastic
  - Governments can impose requirements on product manufacturers to control the wastes resulting from that product
  - Governments can ban hard-to-recycle products
- But the power of the consumer is equally as formidable (but disorganized).
  - Consumers can influence packaging and/or product design
  - Consumers can boycott products
  - Consumers can influence regulators
- The “optics” of recycling are problematic and deserve societal attention: the last “R” has become, for most people, their “go to” justification to claim the mantle of “environmentalist”.