

Chemistry 321

6. Government Regulations & Waste Management

NOTE: This presentation supplements the content given in Hill, mainly to provide an overview of US waste regulations

6.1. US Government Regulations

- [Clean Water Act](#) (CWA)
- [Clean Air Act](#) (CAA)

These two serve as “umbrella” legislation for:

- [Resource Conservation & Recovery Act](#) (RCRA)
- [Superfund](#)
- [Toxic Substances Control Act](#) (TSCA)
- [Pollution Prevention Act](#)
- [Occupational Safety and Health Act](#) (OSHA)

Clean Water Act (CWA)

- 1972 Origins (despite veto by Nixon!)
- 1977 Amended, became the CWA.
- EPA to implement pollution control programs (eg for industrial wastewater).
- Banned discharge of pollutants into navigable waters
- Funded construction of sewage treatment plants
- List of specific pollutants that are controlled (129 substances in 1982).

Clean Water Act

- Every industrial facilities that discharge into surface waters must obtain a [National Pollutant Discharge Elimination System](#) (NPDES) permit.
- Traditional focus on chemical integrity of water, but now more emphasis on physical and biological aspects.
- If waters do not meet quality standards, then states must develop a "[Total Maximum Daily Load](#)" (TMDL)- this is the amount of a pollutant that a waterbody can receive and still meet standards.
- Many effluents may be treated before discharge, to neutralize them or to remove highly toxic pollutants (use [BATNEEC principle](#)).

Clean Air Act (CAA)

Various laws since 1955, original form 1970, aiming to achieve by 1975 "National Ambient Air Quality Standards" (NAAQS) to protect public health and the environment.

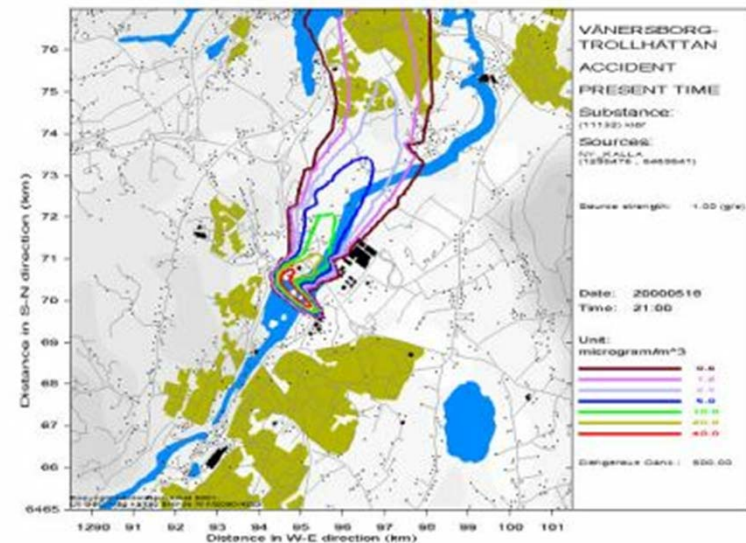
- 1977- amendments/new goals, since many areas had failed to meet deadlines.
- 1990- amendments to include acid rain, ozone/CFC's, air toxics.

Clean Air Act (CAA)

- Emission permits required, with "emissions trading" allowed.
- Limits set for various classes of hazardous air pollutants (HAP's), e.g. "Miscellaneous Organic National Emission Standard for Hazardous Air Pollutants" (MON).

Clean Air Act (CAA)

- [Risk Management Planning](#) (RMP, 1996): to protect communities from accidental release of HAP's. Facilities need to disclose what would happen in the event of a possible accident, and to work towards preventing such an accident.

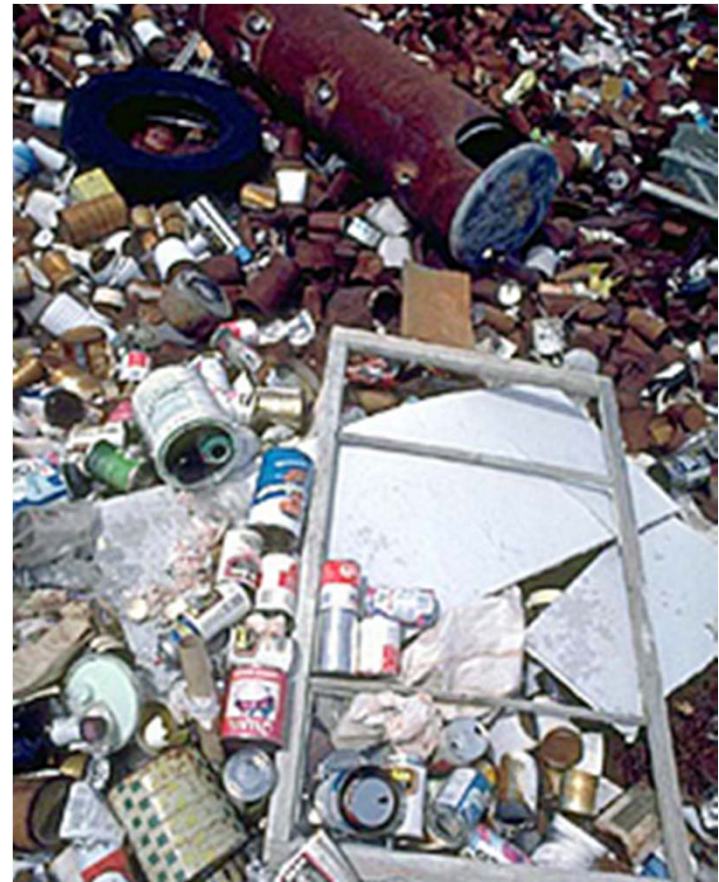


CWA and CAA

- These form legislation that is in effect an “umbrella” for many smaller pieces of environmental legislation, for example on waste management. We will now cover a few of the most important of these.

Resource Conservation & Recovery Act (RCRA): Introduction

- 1976 Introduced, pronounced "rick-rah."
- 1984 Hazardous & Solid Waste Amendments (HSWA). Phased out disposal of hazardous waste in landfills, more stringent rules on hazardous waste management and a program for underground storage tanks.



Resource Conservation & Recovery Act (RCRA)

- Hazardous waste tracked "cradle-to-grave," including generation, transportation, treatment, storage and disposal.
- Also says how best to dispose of non-hazardous waste.
- Only covers waste currently being produced, not historical sites (see Superfund, 11.4.).

Hazardous Waste Identification Rule (HWIR)

- Part of RCRA, deals with 2 separate types of waste, process waste and contaminated media. Contains concentration limits for particular constituents, below which waste is no longer hazardous- a departure from traditional practice.
- Problem if materials deemed "waste" are to be recycled.



6.4. Superfund (CERCLA & SARA)

- 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) introduced, original form of Superfund legislation.
- 1986 SARA introduced, amended to include lessons learnt.
- These acts deal with problems caused by pollution *in the past* (c.f. RCRA)- they mainly deal with long-term problems, but may also tackle immediate problems if necessary.

Superfund

- A trust fund was set up and received funds (ca. \$1.5bn annually) from the petroleum & chemical industries at large until December 1995, when the tax authorization ran out and was not renewed.
- Stresses the need for a permanent solution.
- Sites on the National Priorities List (NPL) are assessed using the Hazard Ranking System (HRS) for their relative risk to human health & the environment.
- Title III of SARA is known as the [Emergency Planning & Community Right to Know Act](#) (EPCRA), includes plans for response to chemical emergencies. Some facilities file reports on all releases of certain chemicals (~650) on the [Toxic Release Inventory](#) (TRI).

Toxic Substances Control Act (TSCA)

- 1976 Introduced.
- Main purpose is to track 75,000 industrial chemicals in the US.
- Supplements other statutes such as the Toxic Release Inventory (TRI) (see 11.4).

Pollution Prevention Act (1990)

- Focuses on reducing pollution through cost-effective changes in production, operation and raw materials use.
- Approach is "Waste Reduction At Source" (WRAS) rather than on waste treatment & disposal. Includes reduction of use of resources such energy, water, etc.

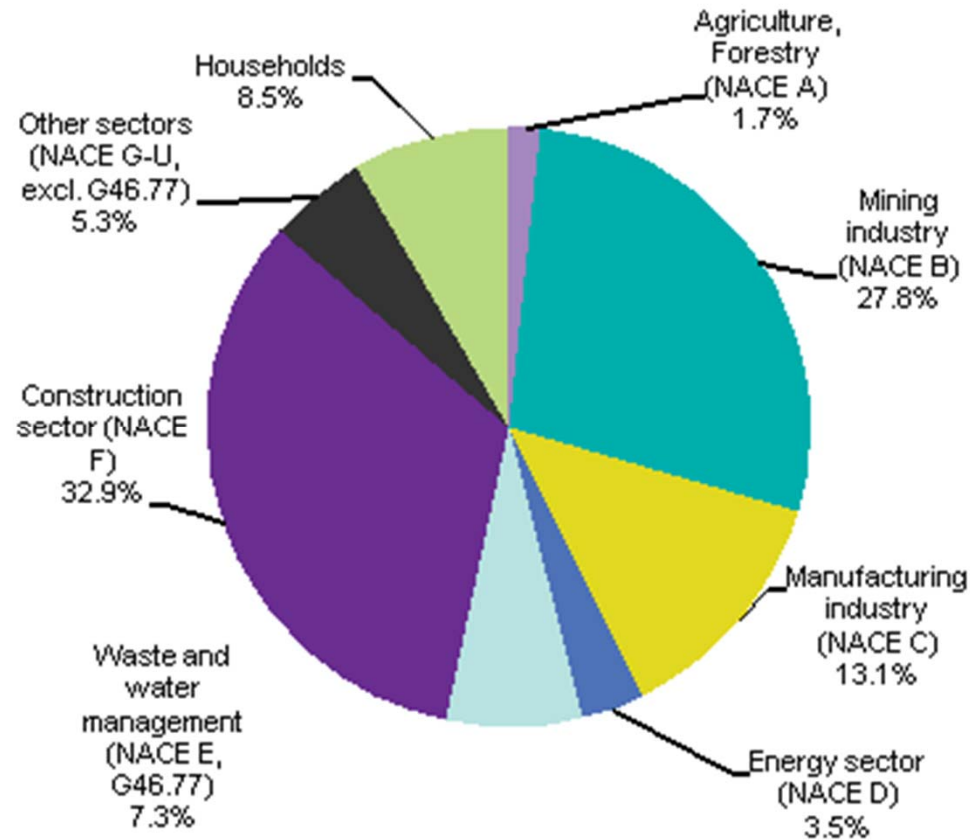
Occupational Safety and Health Act (OSHA)

- Very important *within* the facility, focuses on worker/workplace safety & health, for example by restricting exposure to toxic chemicals.

6.2. Waste Management

- Traditionally done as an afterthought
- With much tighter regulations now, waste management now taken seriously, as both a legal and an economic issue.
- We can classify waste as hazardous and non-hazardous.
- Alternatively may classify as controlled and uncontrolled.

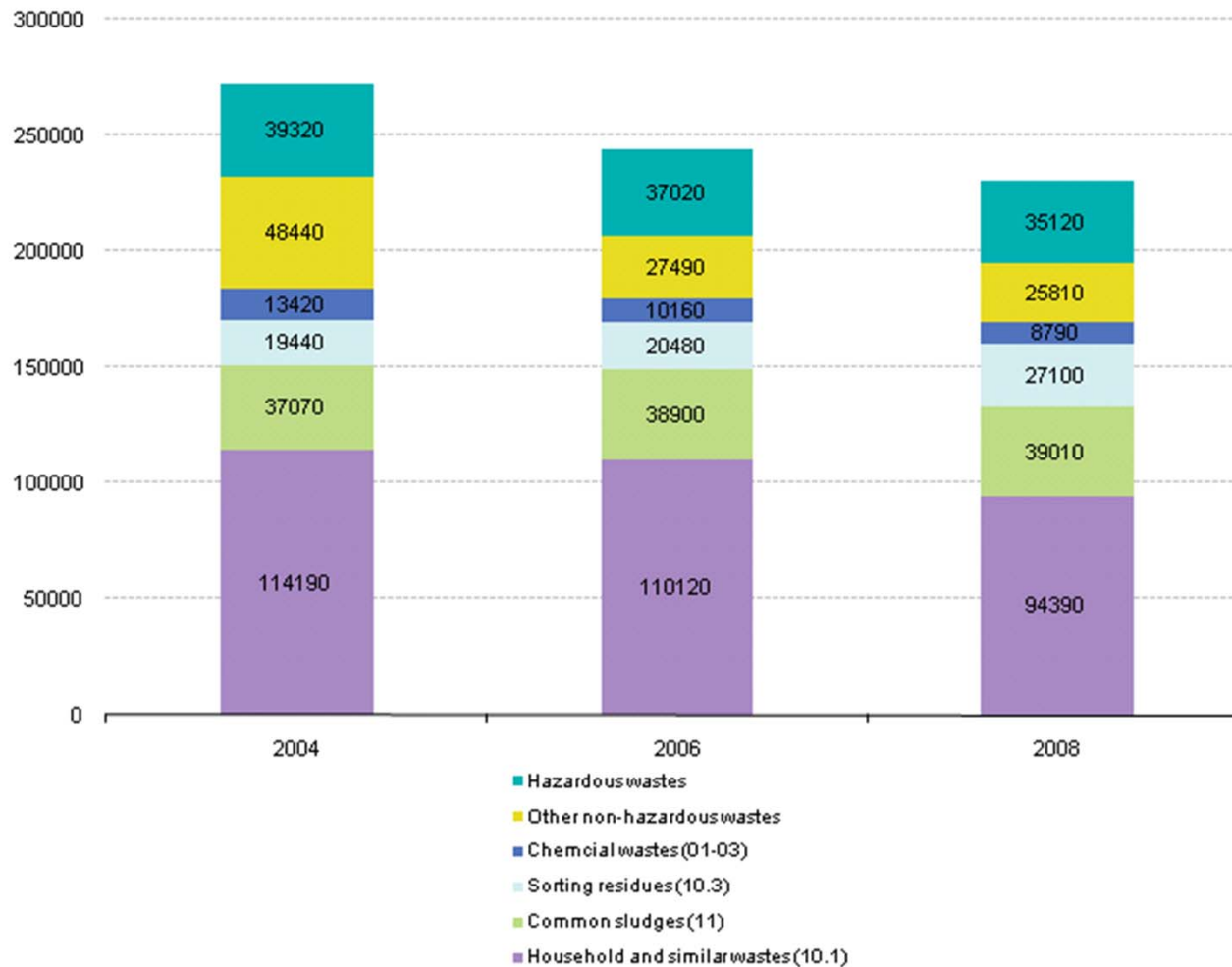
Waste production in the European Union



Graph taken from [EU waste statistics page](#)

Waste production in the European Union

excluding mineral wastes. Population = 503 million



Graph taken from [EU waste statistics page](#)

Waste hierarchy – the three Rs

REDUCE the amount you use (best)

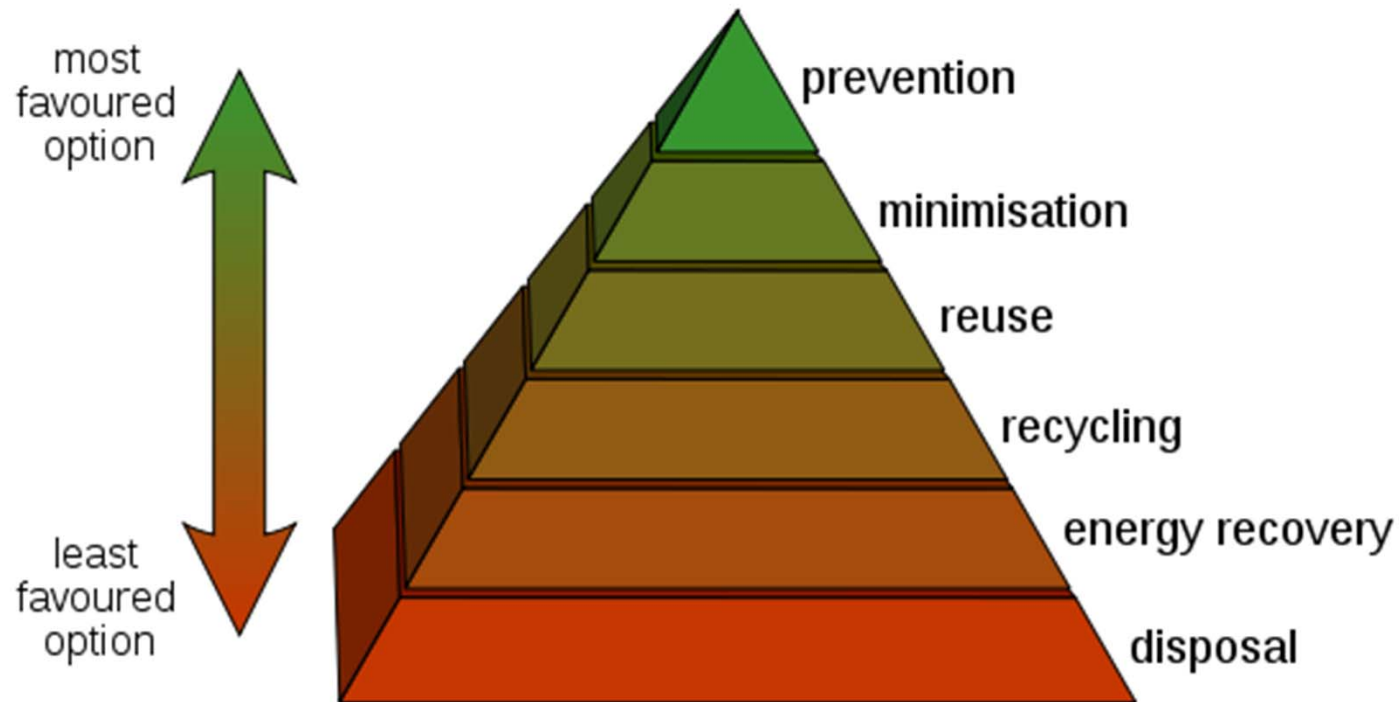
RE-USE things instead of throwing them away

If you can't do the above, RECYCLE suitable materials such as paper, milk containers



Rag and bone man.
[Picture](#) by Aviad2001,
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The waste hierarchy:



Graphic by Drstuey, Stannered, [from Wikimedia Commons](#), CC license

Waste as a resource

- Recycling waste can both reduce waste going into the environment, and also reduce the amount of resources used in manufacturing.
- However, there is a cost- it can be expensive to do the conversion- e.g. to convert old milk cartons back to ethylene gas ready for re-use. Sometimes it may cost more in energy/materials than you save!
- With a focus on recycling R&D, new techniques are being found and developed.

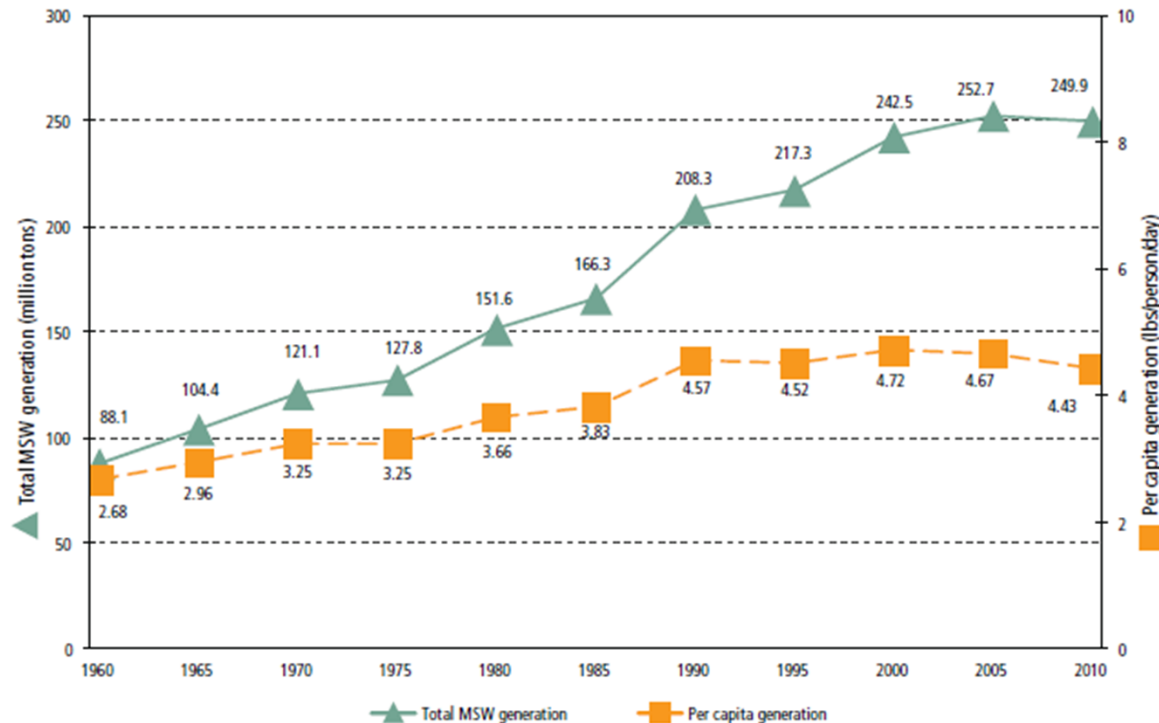
Assimilative capacity of nature

- Part of the natural capital of an ecosystem is its ability to “assimilate” waste (i.e., to absorb and process it).
- If there is too much waste for an ecosystem to handle (e.g. the Hudson?), then the carrying capacity of that ecosystem has been exceeded.
- Either waste prevention/reduction is needed, or waste must be transported to other places.
- The assimilative capacity of the environment must be protected, as it provides a massive economic benefit to humankind.

6.5. Domestic waste

- Municipal solid waste (MSW) production in the US appears to have peaked.

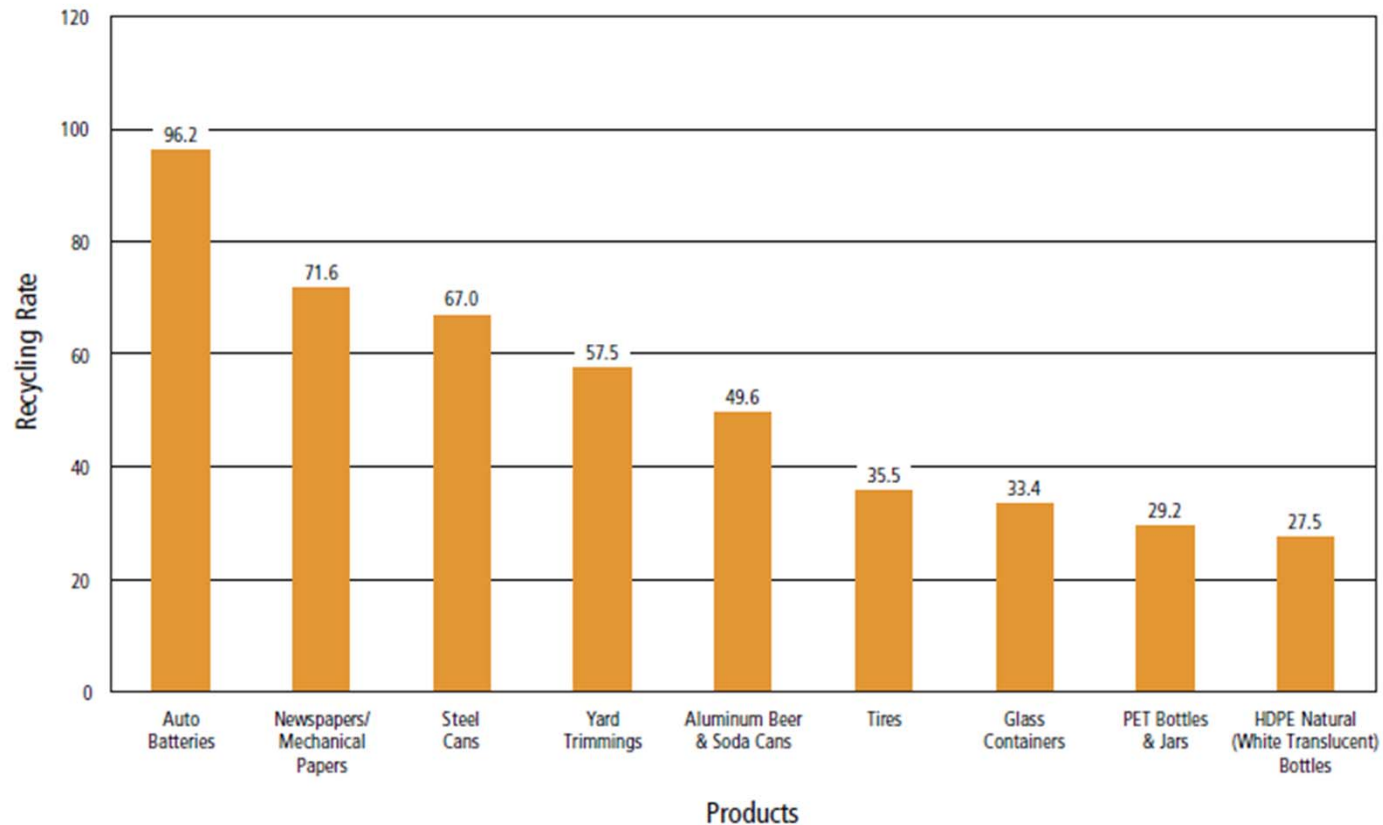
Figure 1. MSW Generation Rates, 1960 to 2010



Graph from [EPA factsheet](#), 2010

Recycling of US domestic waste may be helping

Figure 3. Recycling Rates of Selected Products, 2010*



*Does not include combustion with energy recovery.

Graph [from EPA factsheet](#), 2010

US domestic waste

The EPA estimates that

- Americans generated around 250 million tons of waste, of which around 85 million tons (~34%) was recycled (65 Mt) or composted (20 Mt). 29 million tons was combusted for energy recovery.
- In 1980, 89% of MSW ended up in a landfill; by 2010, this had fallen to 54%.
- Composting rates have increased five-fold since 1990
- Recycling and composting more than 85 million tons of MSW saved the equivalent of over 229 million barrels of oil

Data [from EPA factsheet](#), 2010