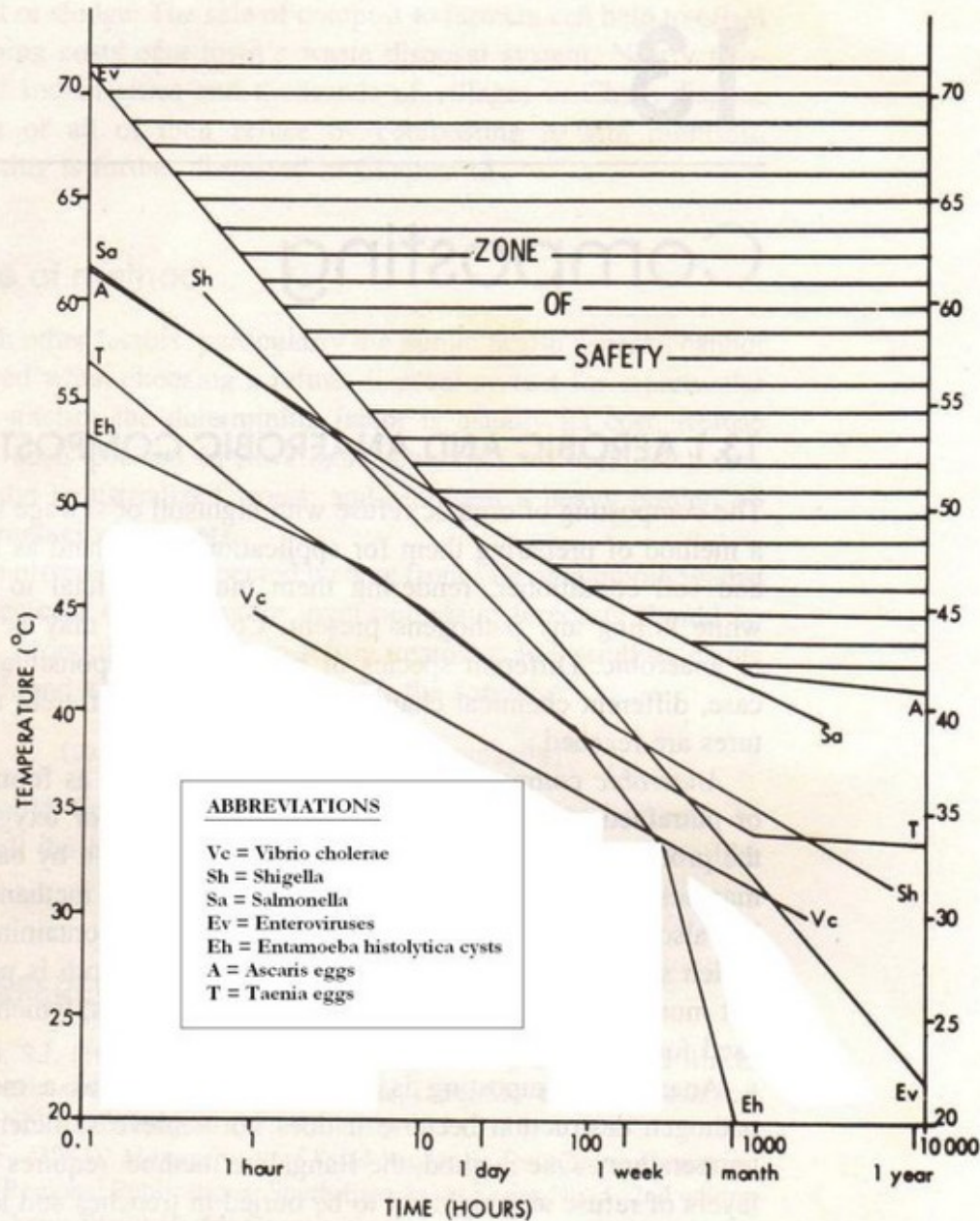


Sustainability in Civil Engineering

IX. Waste

Controlling pathogens in biowaste: time-temperature diagram



- Parasite cysts (*Ascaris*) are hardiest pathogens
- Options for energy & nutrient recovery:
 - Drying + incineration
 - Anaerobic digestion [biogas]
 - Composting
- “If done correctly a composting toilet produces a couple buckets a year of very rich and safe compost for the garden.”
 - Cf. Queens Botanical Garden and *The Humanure Handbook*

Food waste

- ~1/3 of food produced is wasted, spread across all stages; 20% of USA landfills
- After reducing waste, energy-cascading and nutrient-preserving options are
 - Feed to livestock
 - Anaerobic digestion
 - Mushroom feedstock
 - Compost and add to soil

Milestones in NYC waste management

- 1849: Crackdown on feeding garbage to pigs
- 1885: First 'cremator' opens, Governor's Island
- 1895: George E. Waring, Jr. takes over the City Street Cleaning Department, instills order
- 1933: Supreme Court rules against ocean dumping
- 1948: Fresh Kills Landfill opened
- 1969: Plastic trashbags become standard
- 1981: Garbage strike
- 1987: Garbage barge (medical waste)
- 1996: Williamsburg incinerator stopped by environmentalists and neighbors (env'l justice)
- 2001: Fresh Kills Landfill closes
- 2019: LL 199: regulate commercial waste handling

Initiatives in NYC

- “Zero” waste by 2030 (reduce generation 15% and landfill/incineration 50%)
- Single-stream recycling (on hold)
- Organics pickup for composting (LL146: mandatory for restaurants; expansion on hold)
- Styrofoam ban (2019), plastic-bag ban (2020)
- BYOB and junk mail opt-out promotions

Challenges

- Much collected material isn't profitable to recycle
 - China... stop accepting contaminated recyclable shipments
- Wasteful products are outside city control
 - Previous zero waste targets missed (San Francisco in 2003 enacted a 2020 goal, scaled back in 2018 to C40 goal)
- Few incentives for residents to recycle
 - “The last unmetered utility”

The disposable society

- 1934: First sanitary landfill, Fresno, CA (later Superfund site)
- 1961: Disposable diapers
- 1964: Plastic milk jugs
- 1977: Plastic grocery bags
- 1990s: Bottled water, e-waste

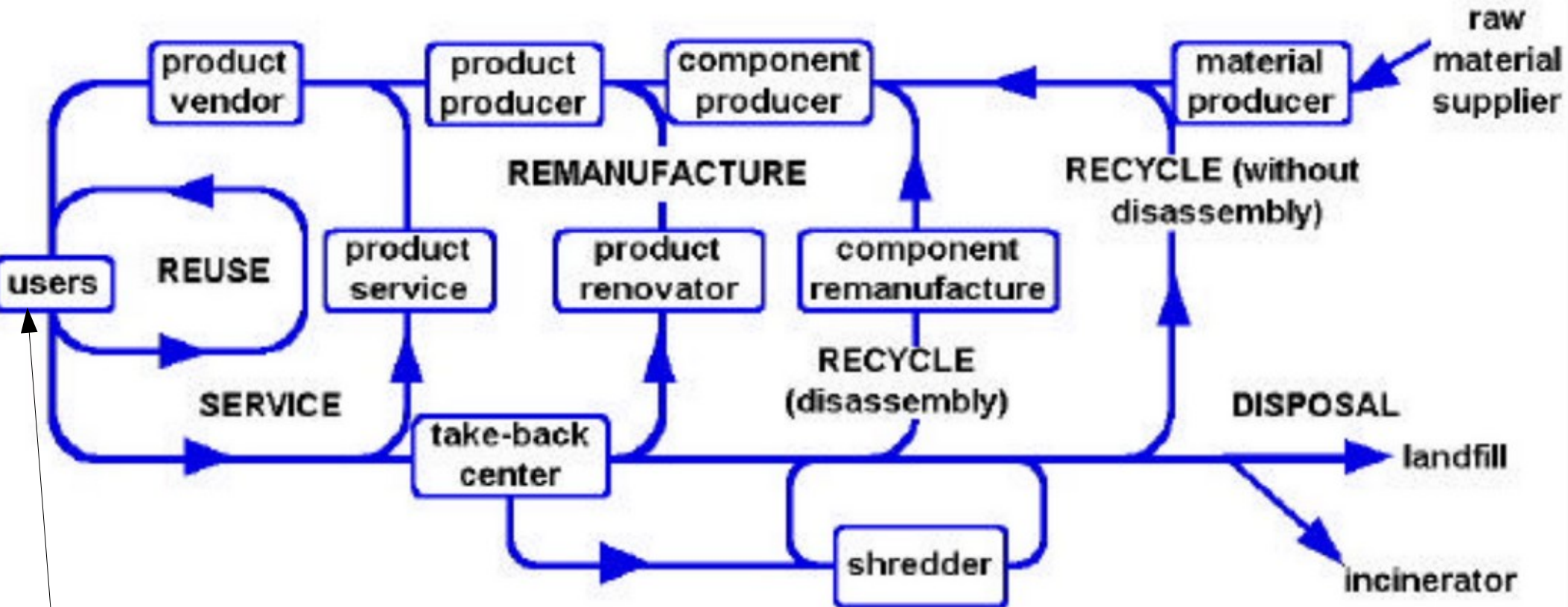
Effective municipal waste reduction

- 2 kg/person/day (USA), 1/3 recycled or composted, 1/8 incinerated, rest to landfill; Contents: 28% paper, 14% food, 13% grass, 12% plastic
- Divert organic materials
- Charge for the full cost of disposal
- Ban/tax styrofoam, plastic bags
- Container deposit systems

Structural changes

- Shift from (bans on) throwaway products
- Producer takeback responsibility, especially for complex/hazardous products that individuals and municipalities cannot handle (e.g. electronics): Japan (2001), EU (2003), NY (2010 – mandatory recycling program paid by fees on producers)

The comet diagram: loop closing



Also *refuse* (to acquire) and *reduce*

zero-waste as a goal
(ecology analogy)