

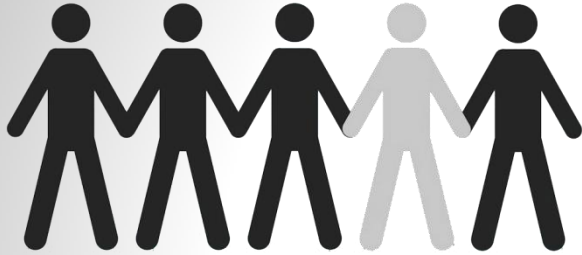
DESIGNING RESILIENT WASTE SYSTEMS



Outline

- General aspects about waste systems and future technologies
- Recycling, Reusing, Rethinking focusing more in the U.S. issues
- Moving San Diego Waste forward
- Wastewater systems

Quick Facts



Approximately **7 Billion** people

2.6 trillion pounds of garbage



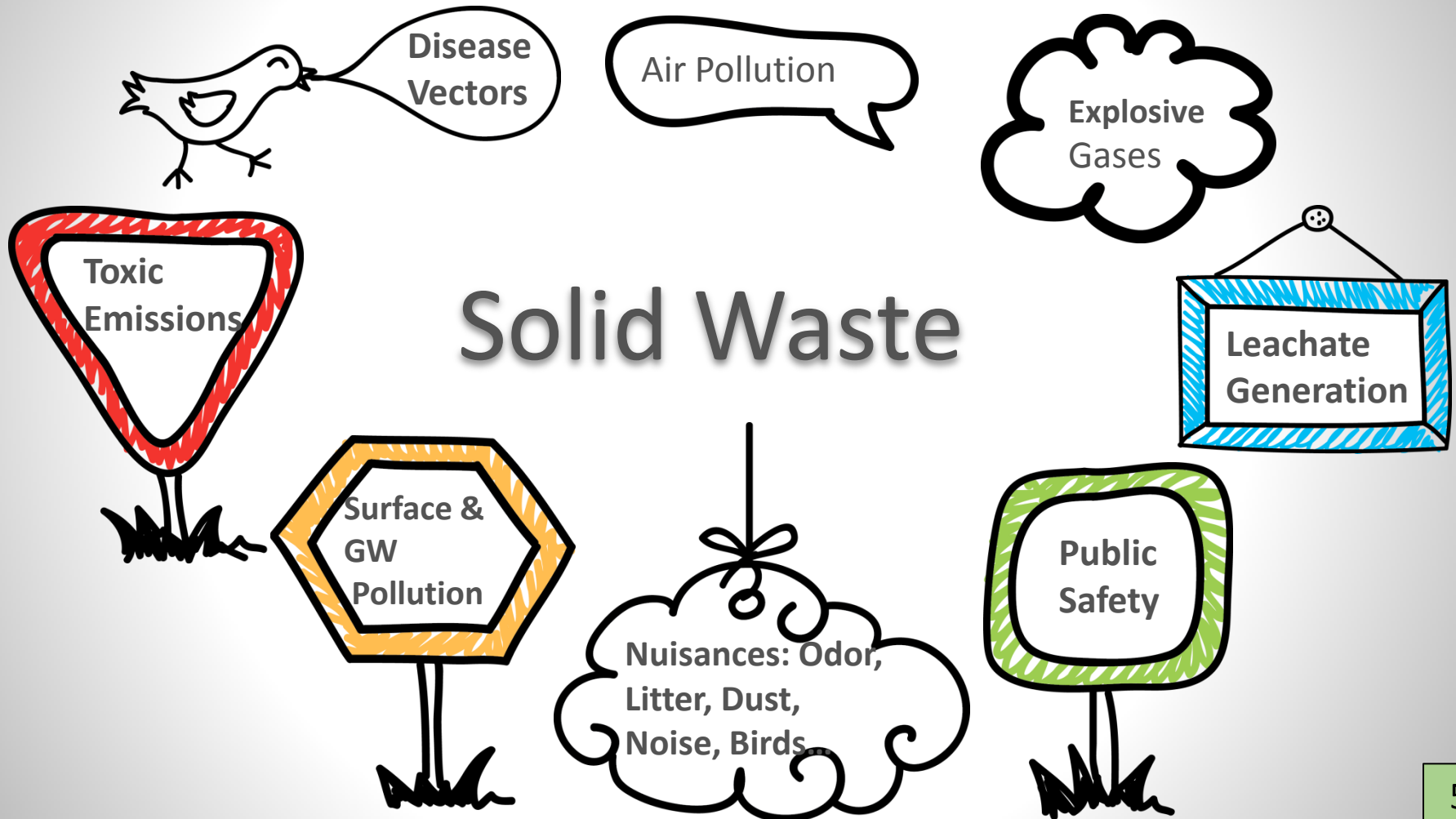
The weight of about **7,000**
Empire State Buildings



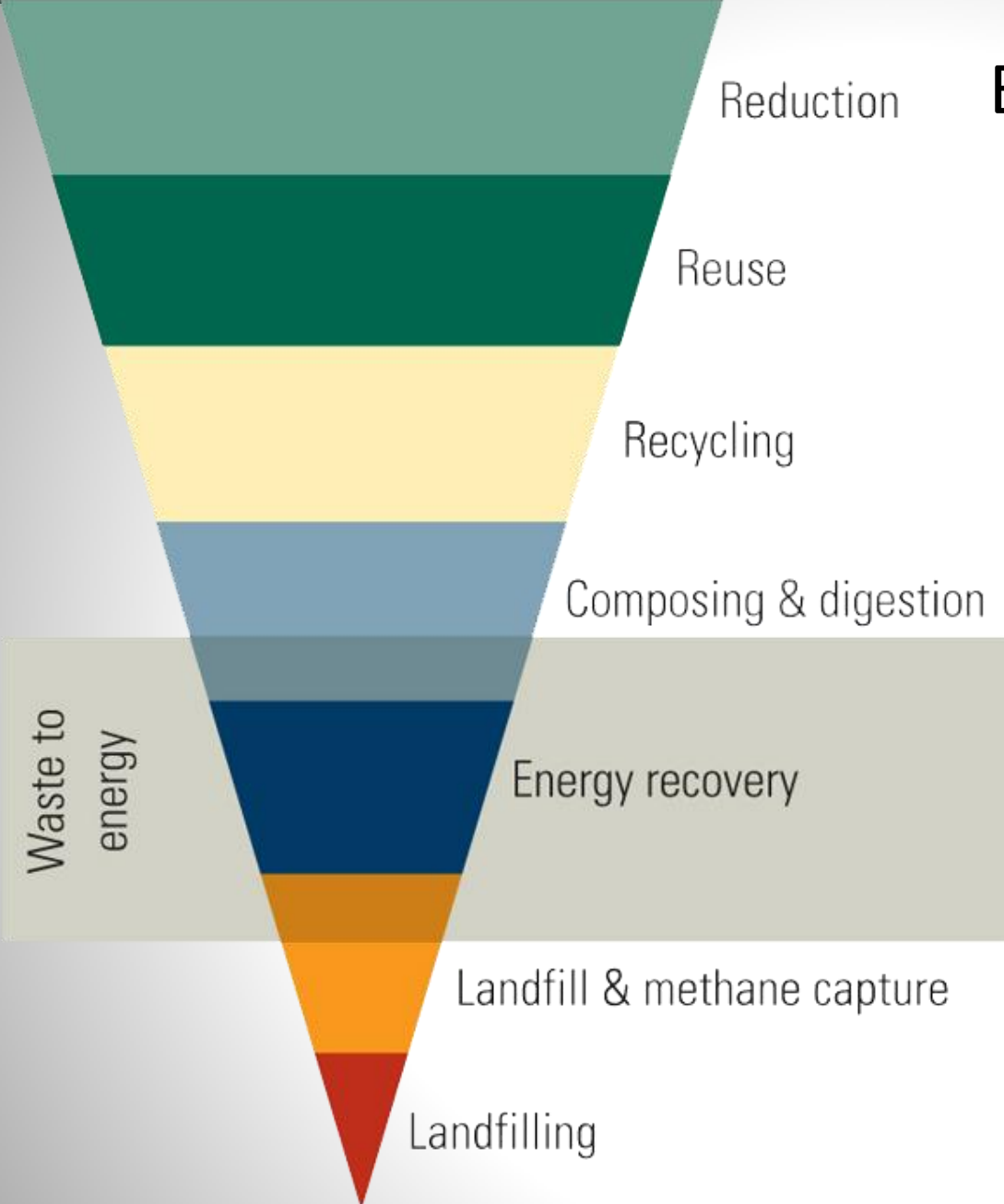
The Consumers



Environmental Concerns Associated with Solid Waste

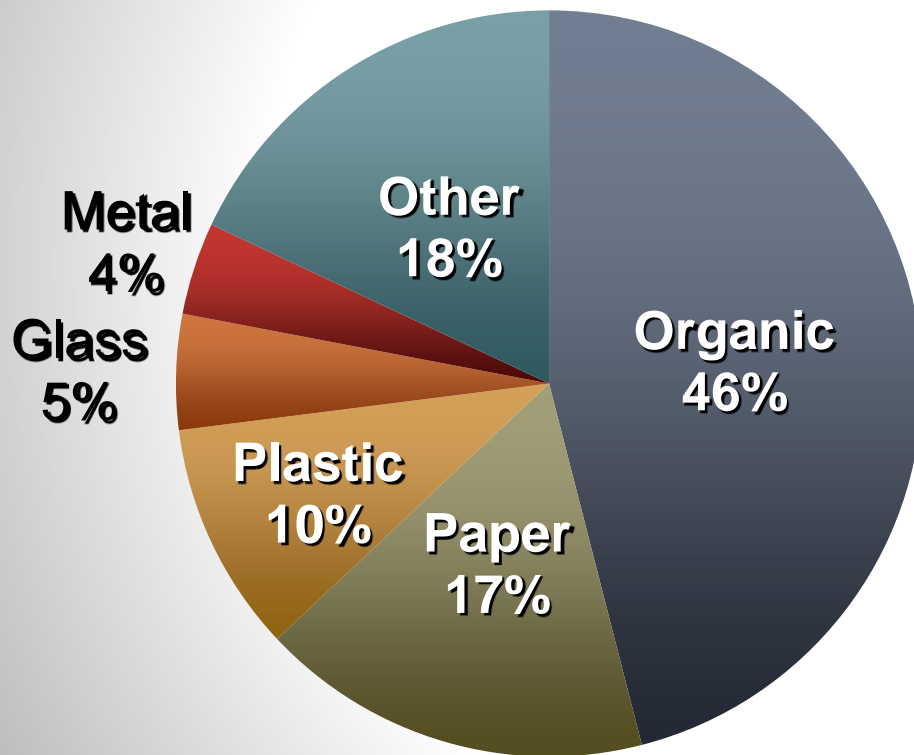


Environmental Hierarchy for Solid Waste Management



- Preferred methods of handling waste: ranging from reduction of waste generation at the top of the scale, to landfill and methane capture

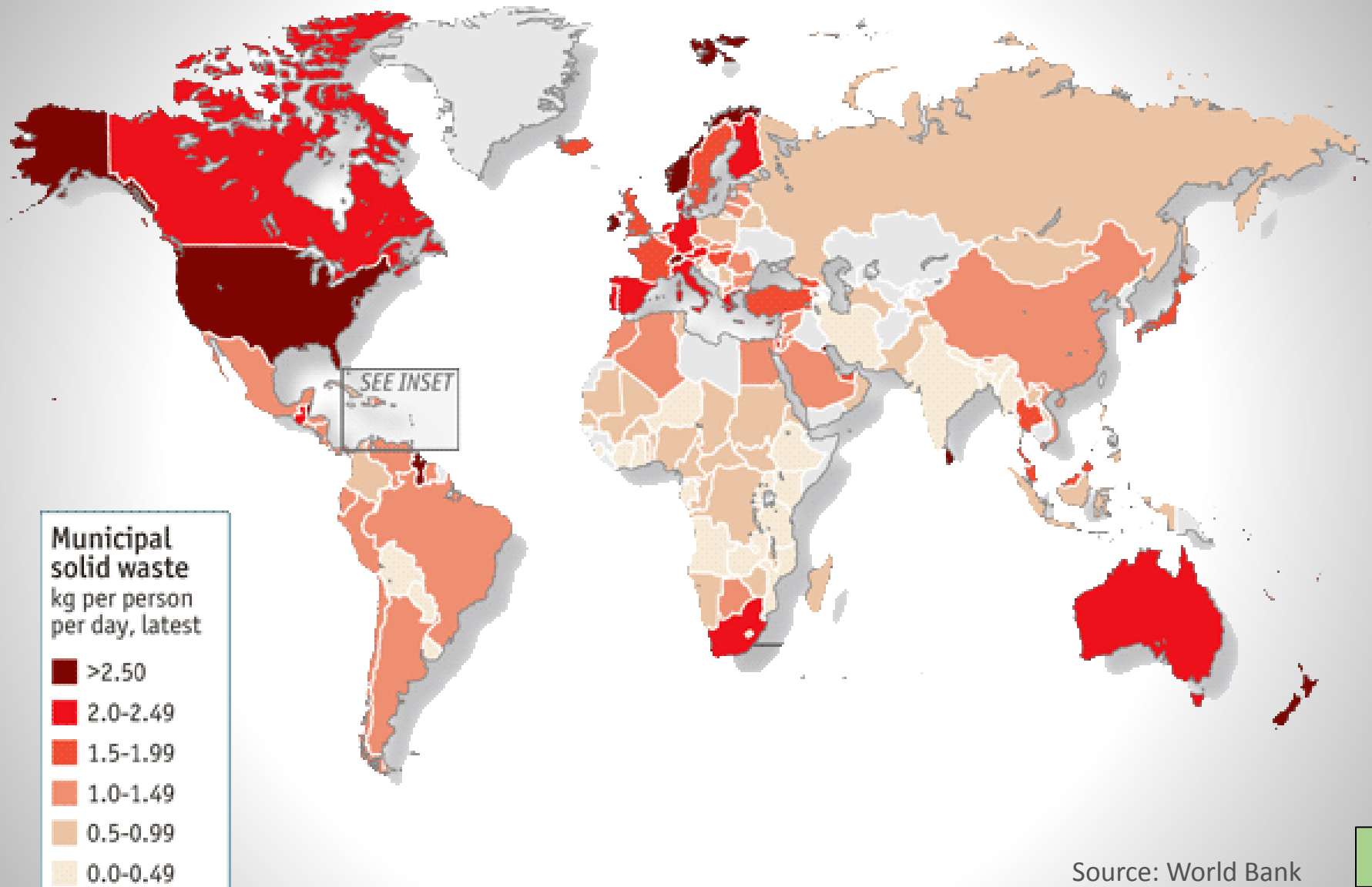
WHAT'S IN THE GLOBAL GARBAGE CAN?



Source: World Bank

- Mostly food and paper
- Organic trash (food we eat, food animals eat, horticultural waste) makes up about half of global solid waste
- In US, Retail-level losses represented 10% (43 billion pounds) and consumer-level losses 21% (90 billion pounds) of the available food supply.

World Scenario



Source: World Bank

INTO THE TRASH IT GOES



Total: **122 pounds** of food thrown out each month for a family of 4 people in US

Source: United States Department of Agriculture, Census Bureau

FOOD WASTE IN U.S. COULD SAVE

- 25% of all freshwater used in U.S.
- \$165 Billion per year (more than \$40 Billion from households)
- \$750 million per year just to dispose of the food
- 33 million tons of landfill space



Waste-to-energy (WTE) technologies



Convert the chemical energy stored in residues associated with human activities into heat, steam, and electricity.



GOALS

- **Renewable** energy source
- **Reduces** carbon emissions
- **Reduces** methane generation from landfills.

U.S. SITUATION

- 86 facilities in the United States (2,720 mW per year)
- No new plants have been built in the US since 1995
- They Processed more than 28 million tons of waste per year

Source: EPA

Municipal solid waste electricity generating capacity by state, 2011



Solid Waste and Emissions



Municipal Solid Waste

Consist of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our homes, schools, hospitals, and businesses.

Source: U.S. EPA



Credit by Greenprophet



Credit by Dennis doyle/getty

Improperly managed solid waste poses a risk to human health and the environment.

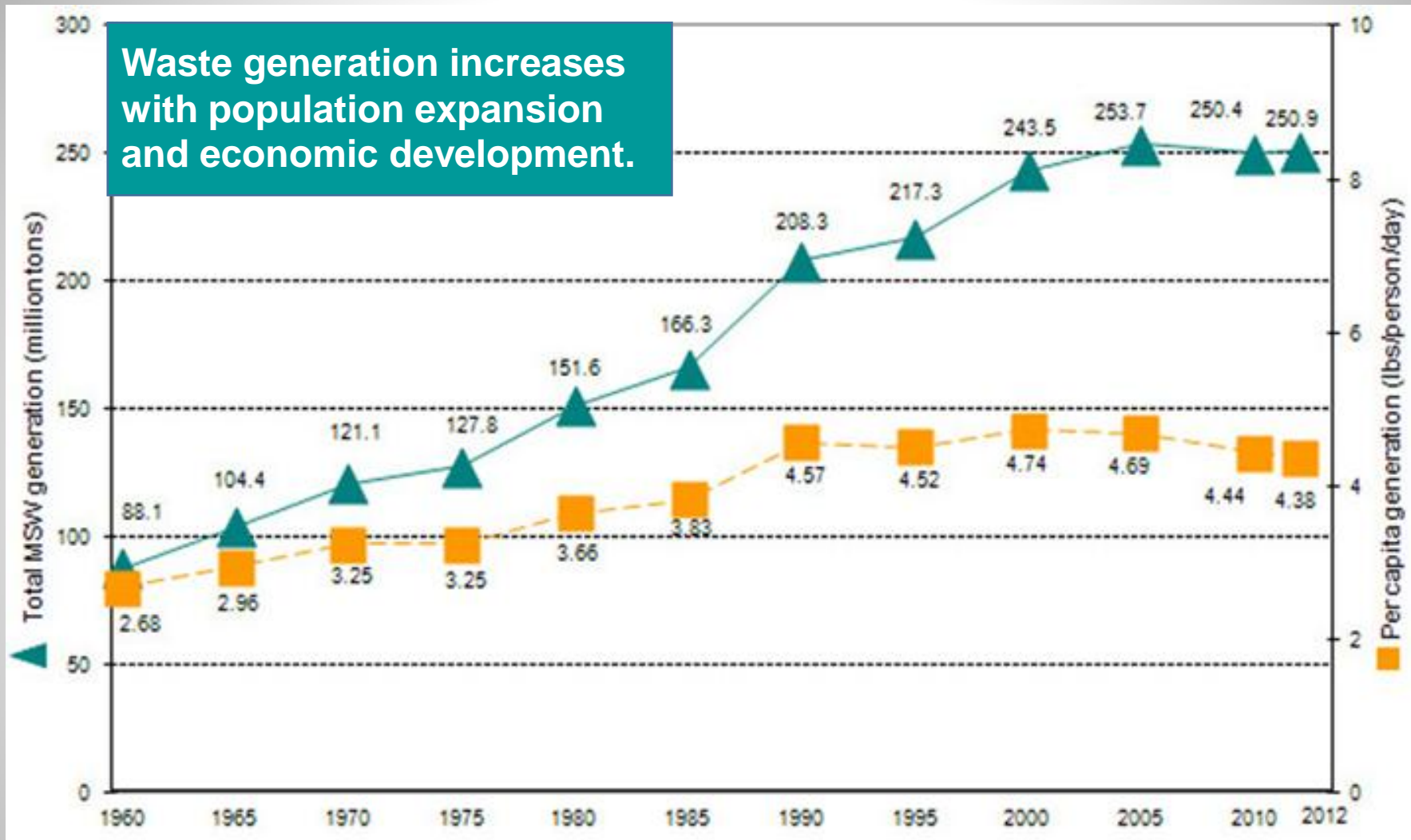


Credit by Newsela staff

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Municipal Solid Waste Generation Rates in USA, 1960 to 2012

Waste generation increases with population expansion and economic development.



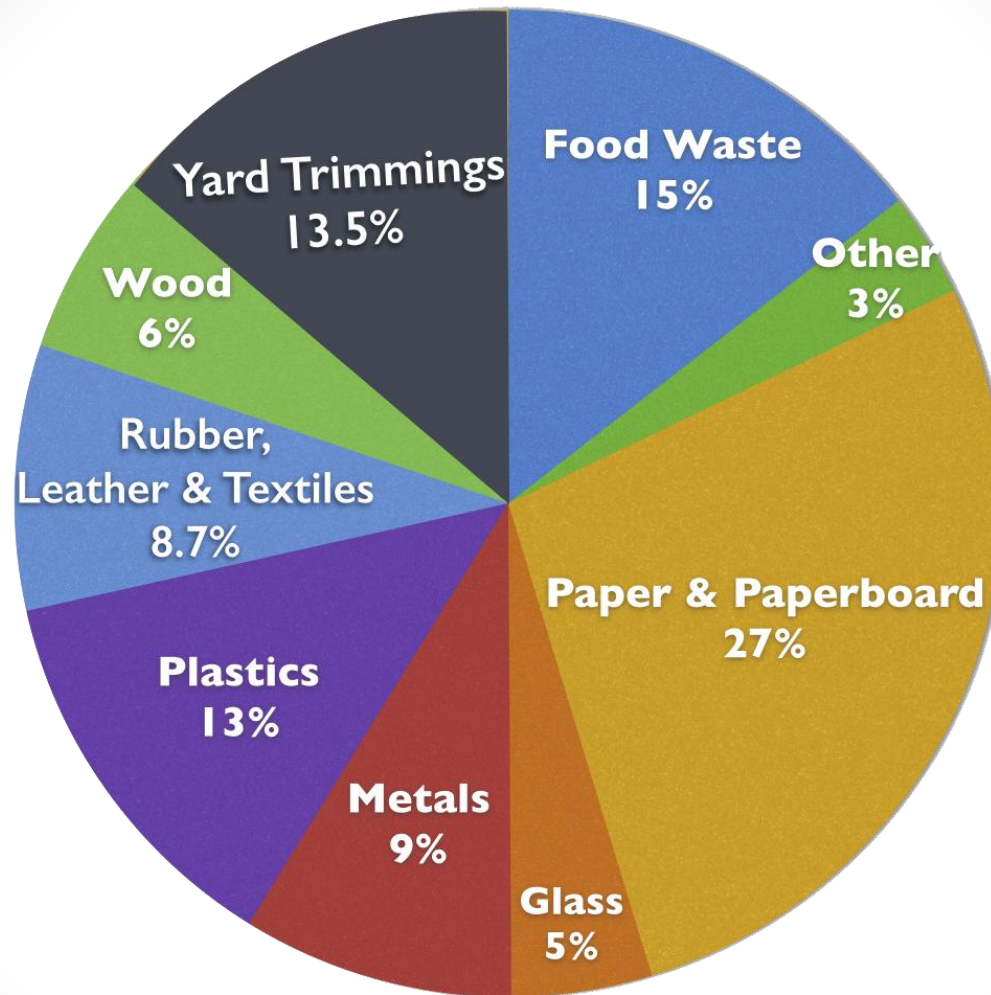
▲ Total MSW generation

■ Per capita generation

Source: U.S. EPA

Total MSW Generation (by material) in USA, 2012

251 Million Tons (before recycling)



Source: U.S. EPA

In 2010, the United States *disposed of some*

2,439,000 TONS

of waste generated from *electronic devices*.

649,000

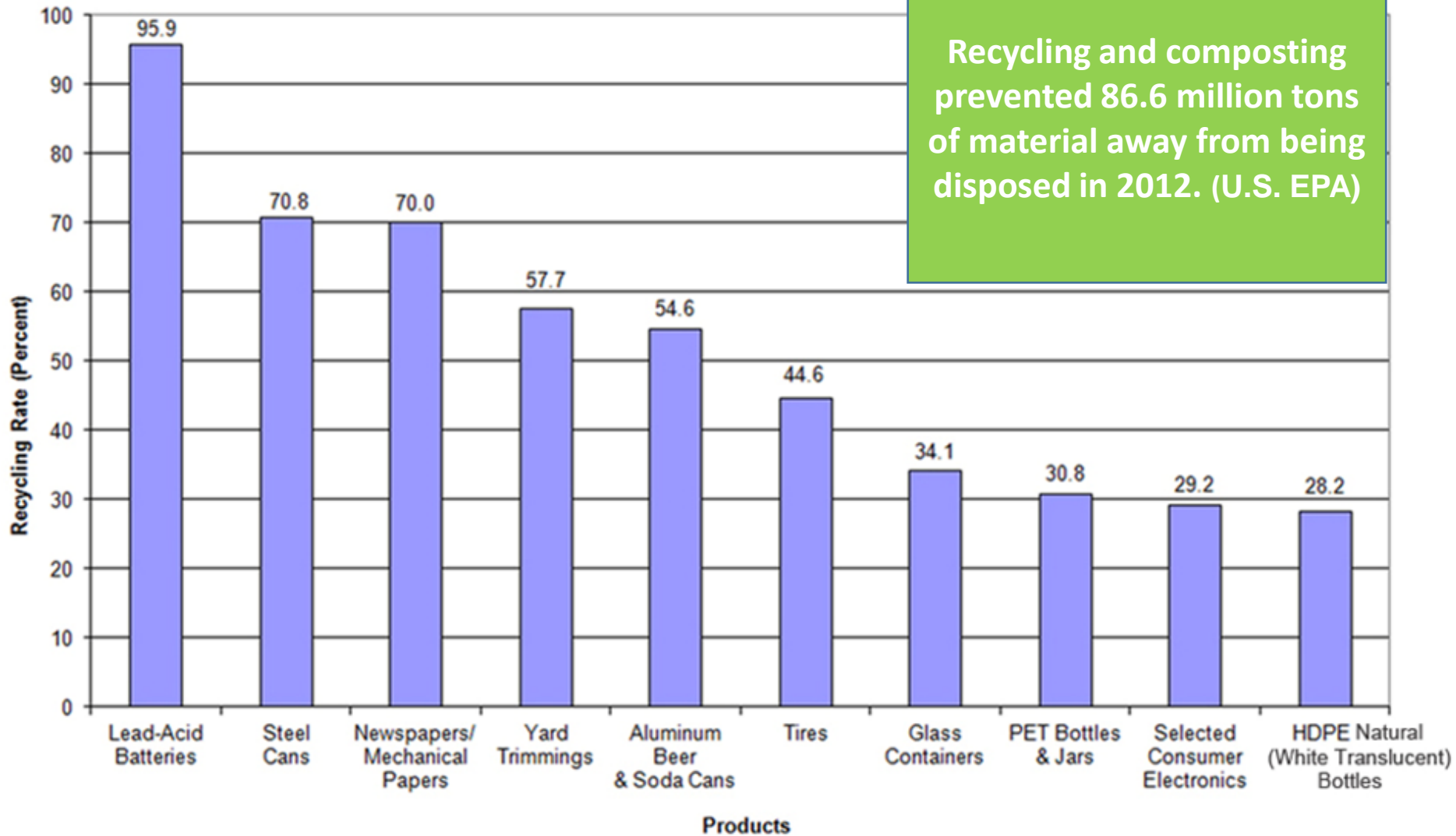
of these tons were recycled,

while an astounding

1,790,000

were thrown in landfills or incinerated.^[1]

Recycling Rates of Selected Products, 2012 in USA



* Does not include combustion with energy recovery.

Source: U.S. EPA

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The Decomposition Time Line

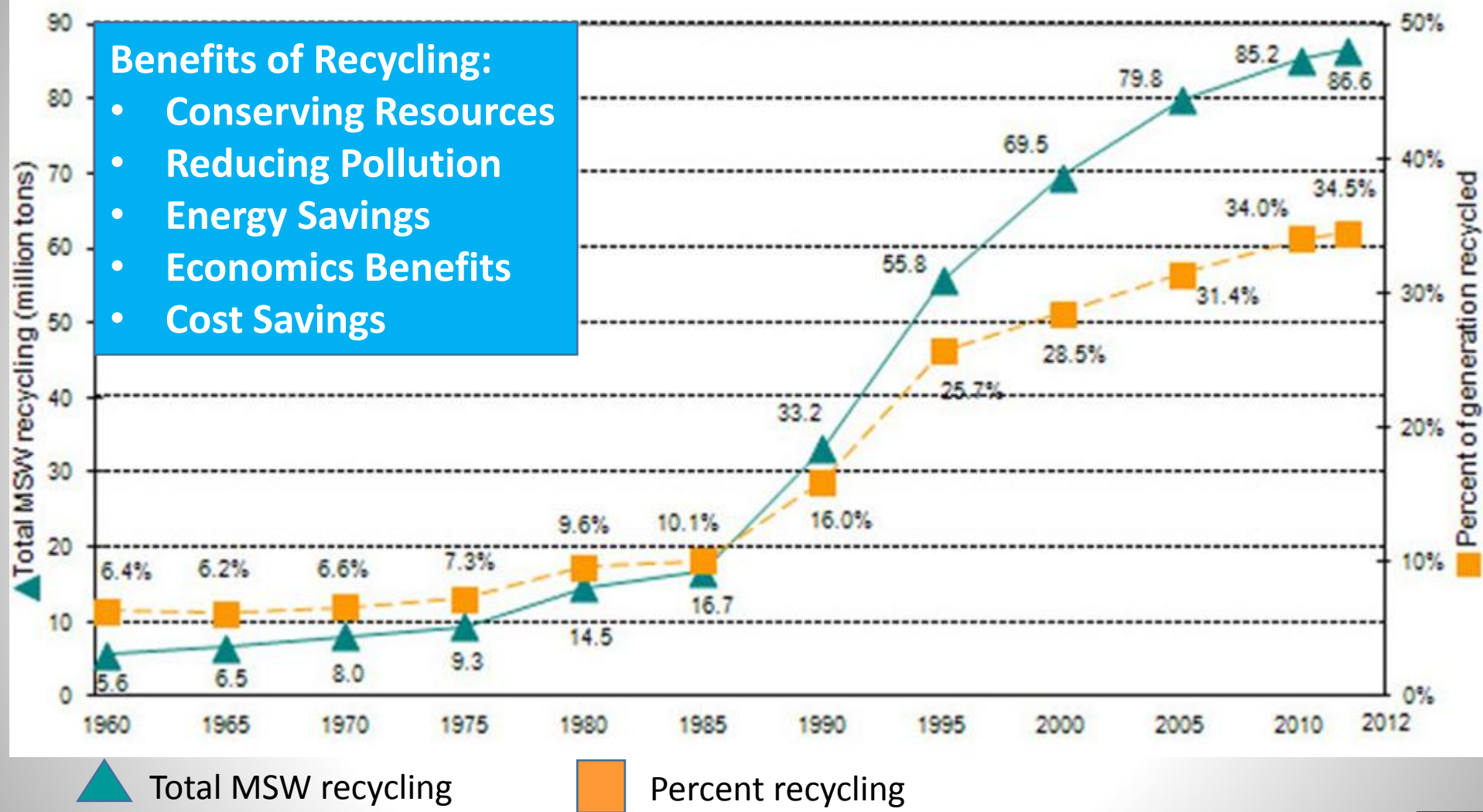


Source: Hillside Outdoor Education School

MSW Recycling Rates in USA, 1960 to 2012

Benefits of Recycling:

- Conserving Resources
- Reducing Pollution
- Energy Savings
- Economics Benefits
- Cost Savings

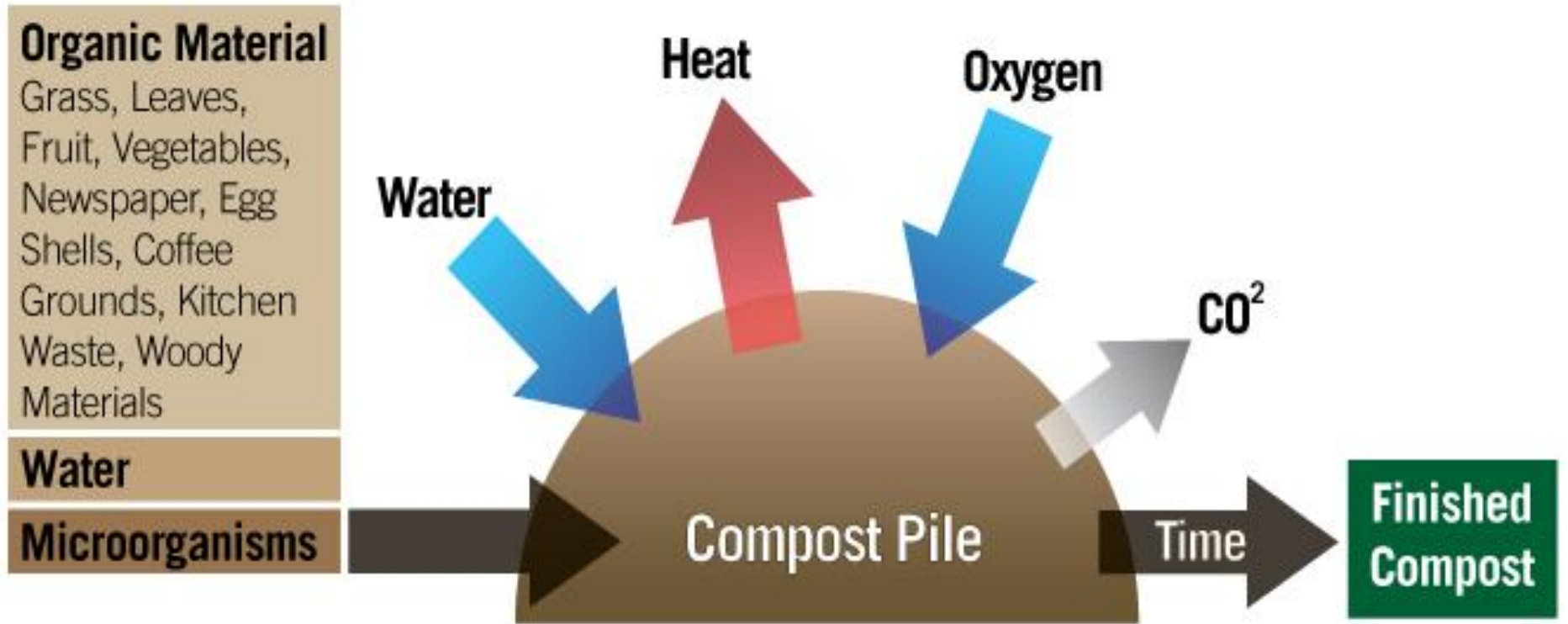


Source: U.S. EPA

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Composting

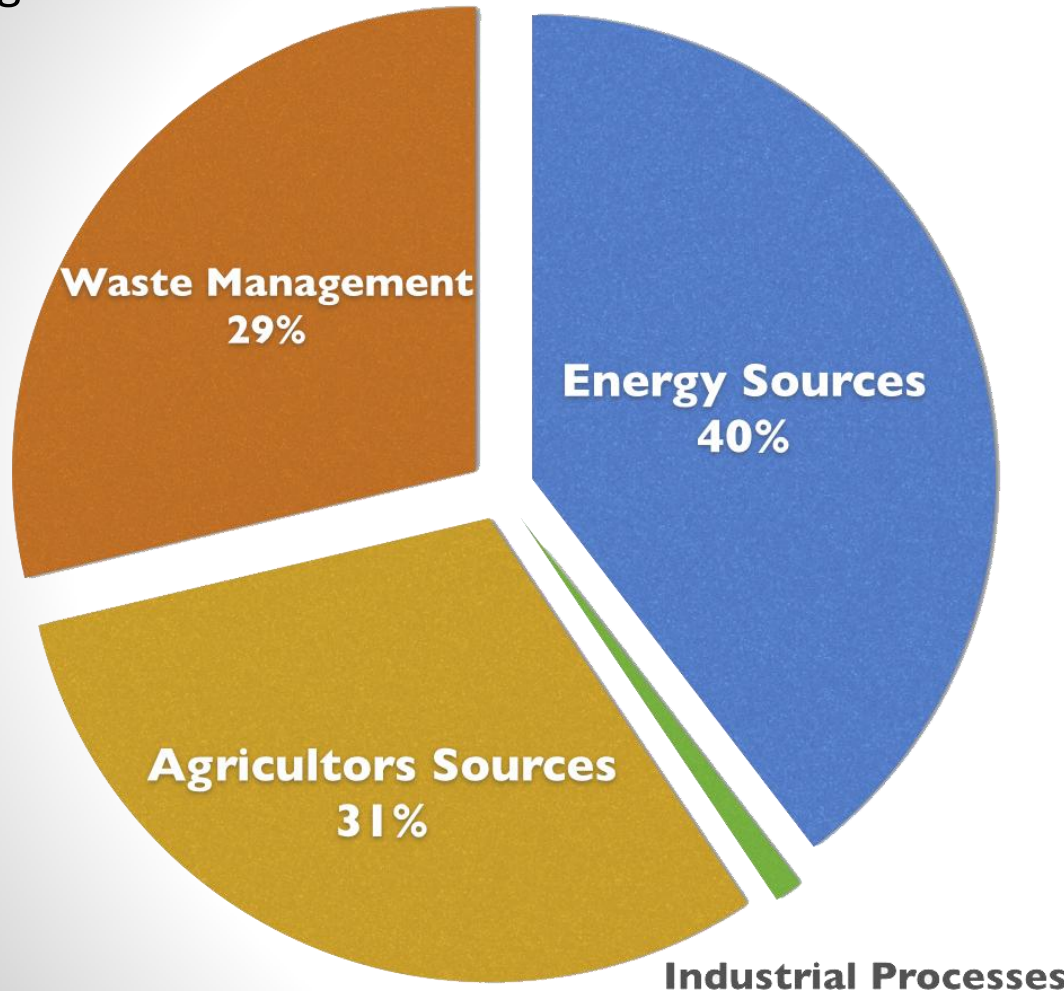
The U.S. EPA estimates that each American throws away an average of 1.3 pounds of food scraps. Only 3% of food scraps in the U.S. are composted. Composting reduces the amount of waste each of us sends to the landfill.



Source: Farm to Table Guam

Methane Emission by Source

The contribution of methane emissions from landfills compared to all other anthropogenic sources of methane emissions is shown below (EPA)



When organic waste decomposes in landfills and uncontrolled dumps, it produces methane (one of the major greenhouse gases contributing to climate change).


Source: U. S Energy Information Association

Greenhouse Gas

How strongly a particular greenhouse gas could affect the Earth's climate:

- ✓ The length of time that the gas remains in the atmosphere,
- ✓ Each gas's unique ability to absorb energy,

As compared to an equivalent mass of carbon dioxide (which is defined by a global warming potential equal to 1).

Greenhouse gas	Average lifetime in the atmosphere	100-year global warming potential
Carbon dioxide	see below*	1
Methane	12 years	28 
Nitrous oxide	121 years	265

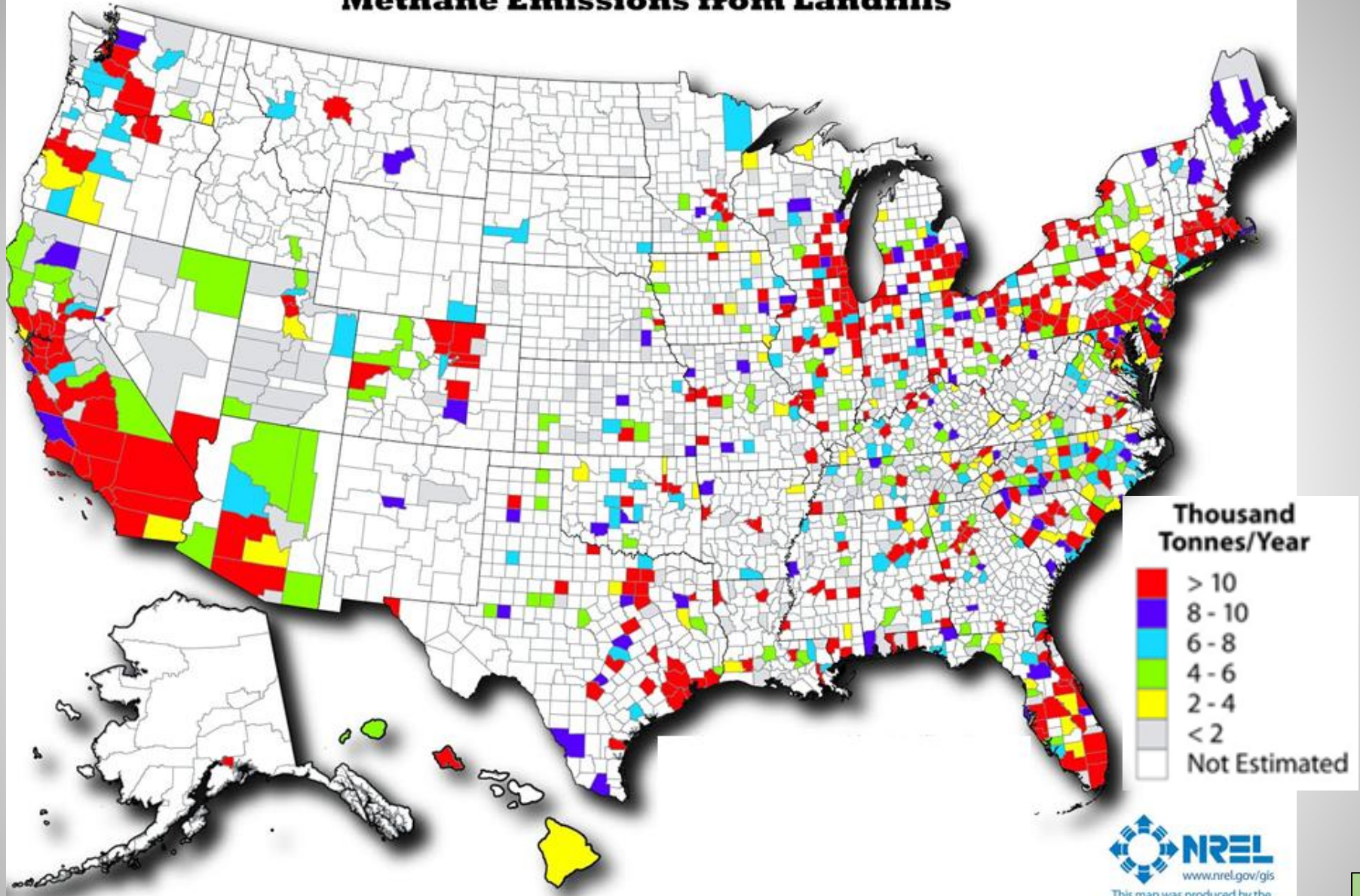
** Carbon dioxide's lifetime is poorly defined because the gas is not destroyed over time, but instead moves among different parts of the ocean–atmosphere–land system.*

Source: U.S. EPA

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Biomass Resources of the United States

Methane Emissions from Landfills



Author : Billy Roberts - September 23, 2009

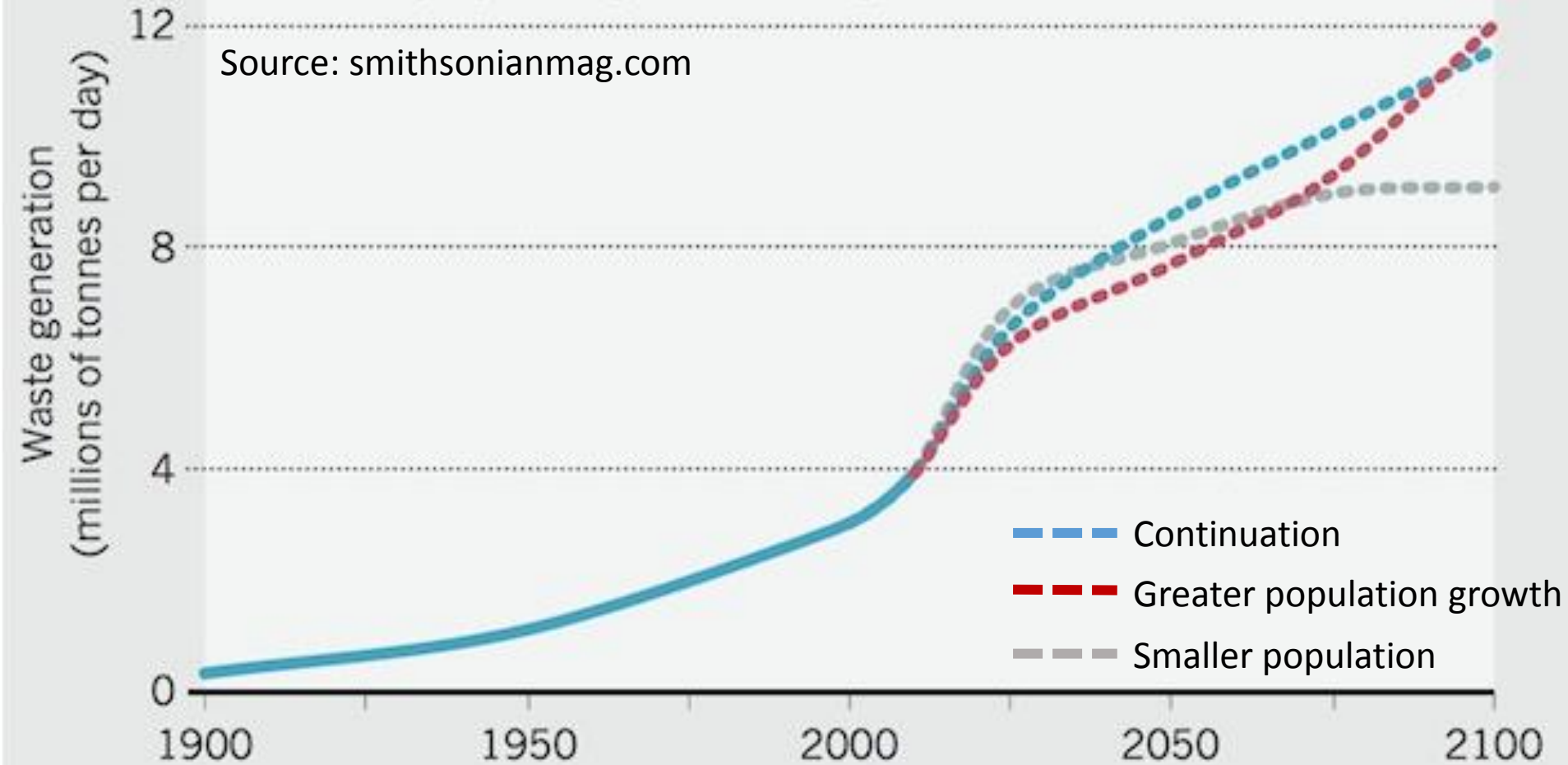


This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

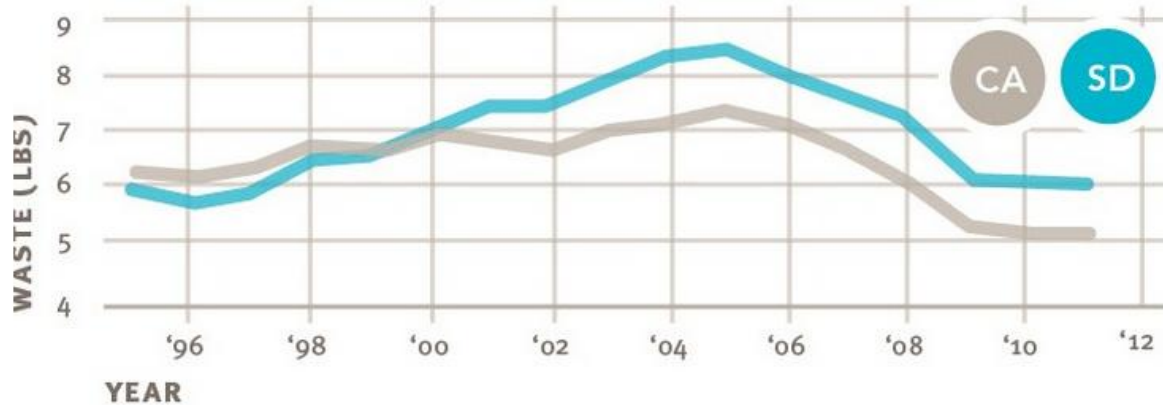
San Diego Waste Management



Global Waste Generation



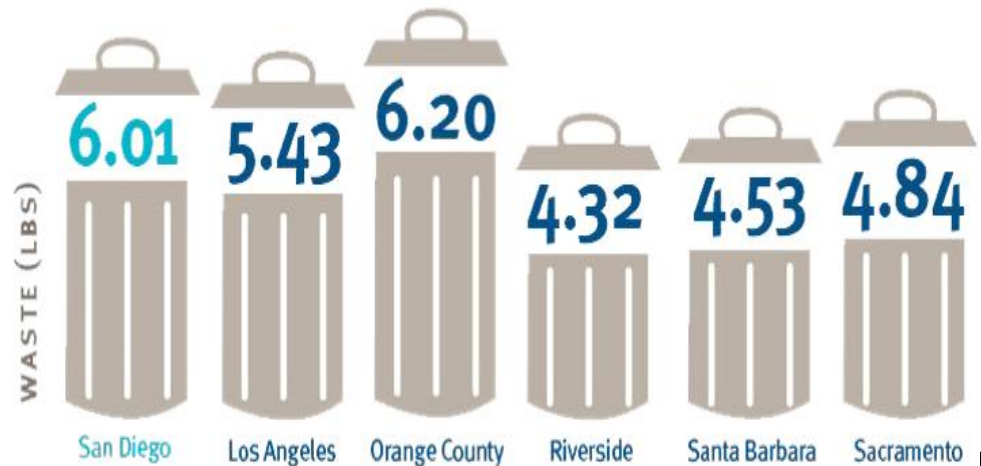
Average Waste



← Average waste disposal in San Diego County is declining since 2005

SOURCE: EQUINOX CENTER, 2012; CALIFORNIA DEPARTMENT OF RESOURCES RECYCLING & RECOVER, 2012

But San Diego County's average daily per capita waste disposal is still higher than the surrounding counties



8 R's

Recycle

To make into
something
else

Reduce

Use less
Don't waste
Turn off

Reuse

To use again

8 R's

Recover

Energy & materials
recovery
upcycle

Refuse

Don't consume
what you don't
need

Rethink

Mindful
consumption
balance between
objects & care for
earth

Regift

Share & be part of
the gift economy

Repair

Fix & upgrade your
objects rather than
throwing them
away

Food Recovery in San Diego

If 15% of currently
wasted food which is
still edible is diverted

666 Tons

goes to food banks

1.1 million Meals

(at 1.2 lbs per meal)

**2.5 Meals to
448,000 People**

\$2.9million

(at \$2.68 per meal)

Source: Biocycle.net

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What Is a Brown Bin?

OLD SYSTEM



Green



Blue

NEW SYSTEM



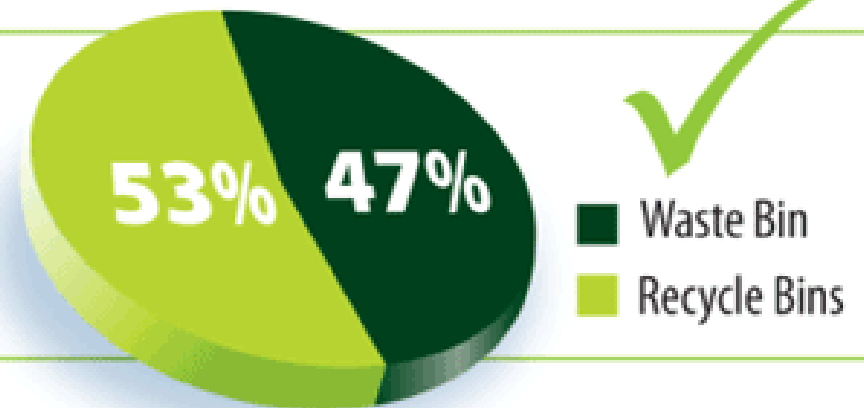
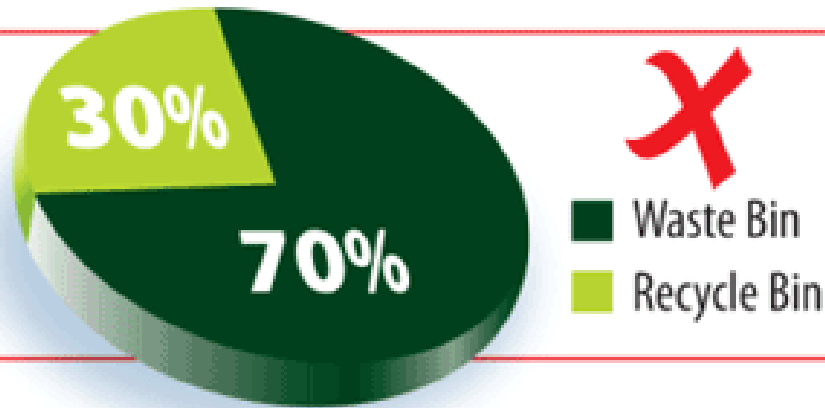
Green



Blue



Brown



Source: aesirl

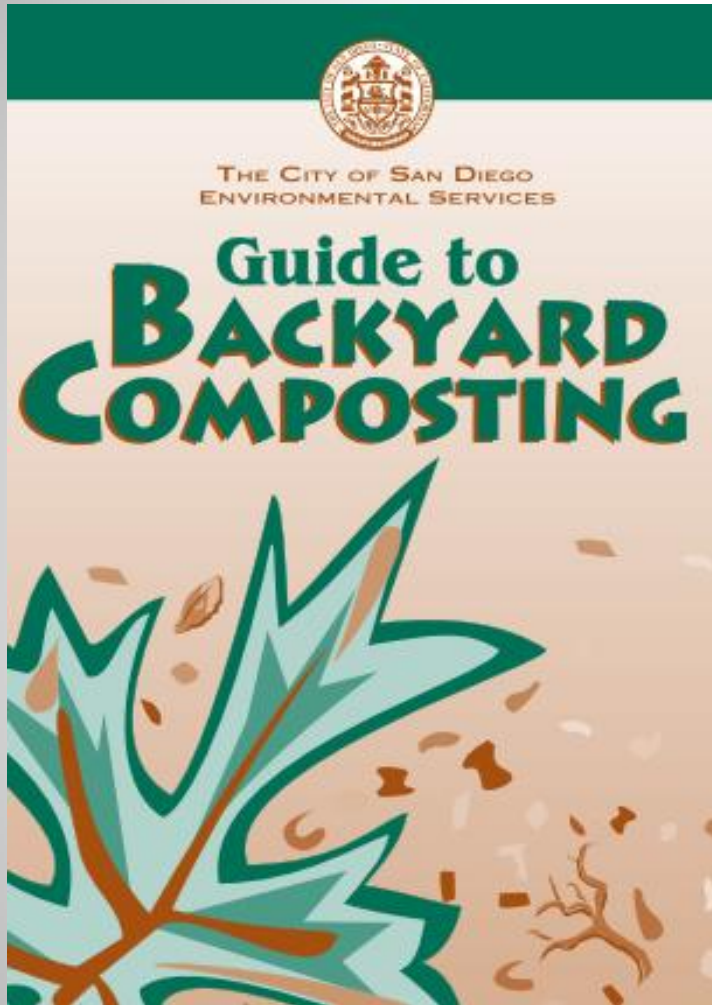
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What Can You Put in?



Source: aesirl

Backyard Composting



Source: sandiego.gov

- Compost Bin Voucher Program
 - ✓ Soil Saver (\$30 off)
 - ✓ Can-O-Worms (\$40 off)
 - ✓ Terra Dual-Batch Tumbling Composter (\$50 off)
- Master Composter Course & FREE Workshops

Packaging

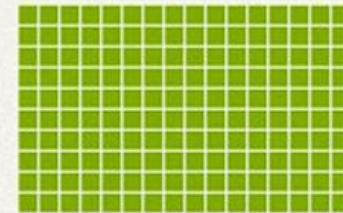


Over-packaging

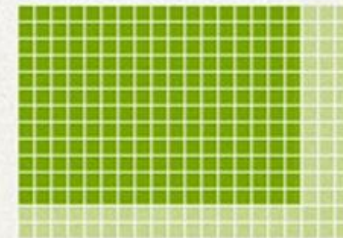


Reduction in packaging

2007 iPhone



2012 iPhone



By reducing iPhone packaging by 28 percent from 2007 to 2012, we ship up to 60 percent more boxes in each airline shipping container. That saves one 747 flight for every 416,667 units we ship.*



Source: mashable.com

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No More Plastic Bags!

- Less than 5% of plastic grocery bags are recycled in the U.S.
- Every square mile of ocean contains about 46,000 pieces of floating plastic bags.



- Plastic bags can take up to 1,000 years to break down.
- Treat to wildlife
- Re-enters to environment

No More Plastic Bags!



Plastic bag ban in San Francisco



The first city in San Diego County to adopt a plastic bag ban



Using a reusable bag at grocery store in Granada, Spain

San Diego plan: Zero waste by 2040

Source: sandiego.gov

- Hope to recycle 100% waste by 2040.
- Increase recycling rate 68% (current) to 75% (by 2020)
- Miramar Landfill, is almost full and scheduled for closure in 2022.
- Sessions for designing a Zero Waste Plan.



Session	Session 2	Session 3	Session 4
Title	Overview and Analysis of Stakeholder Input	Draft Plan Presentation for Consultation and Feedback	Finalizing the Draft Plan for City Council
Date	Aug. 27 th , 2014	Sep. 10 th , 2014	Sep. 22 nd , 2014
(time)	(6 p.m. – 7:30 p.m.)	(6 p.m. – 7:30 p.m.)	(9:30 am – 11:30 am)
	Aug. 28 th , 2014	Sep. 11 th , 2014	Sep. 23 rd , 2014
	(9:30 am – 11:30 am)	(9:30 am – 11:30 am)	(6 p.m. – 7:30 p.m.)

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WASTEWATER

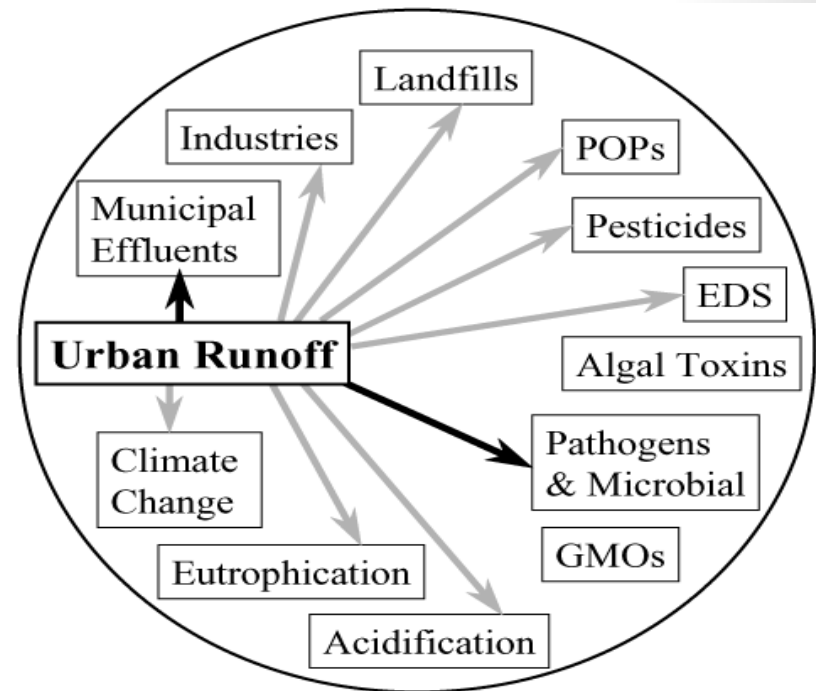
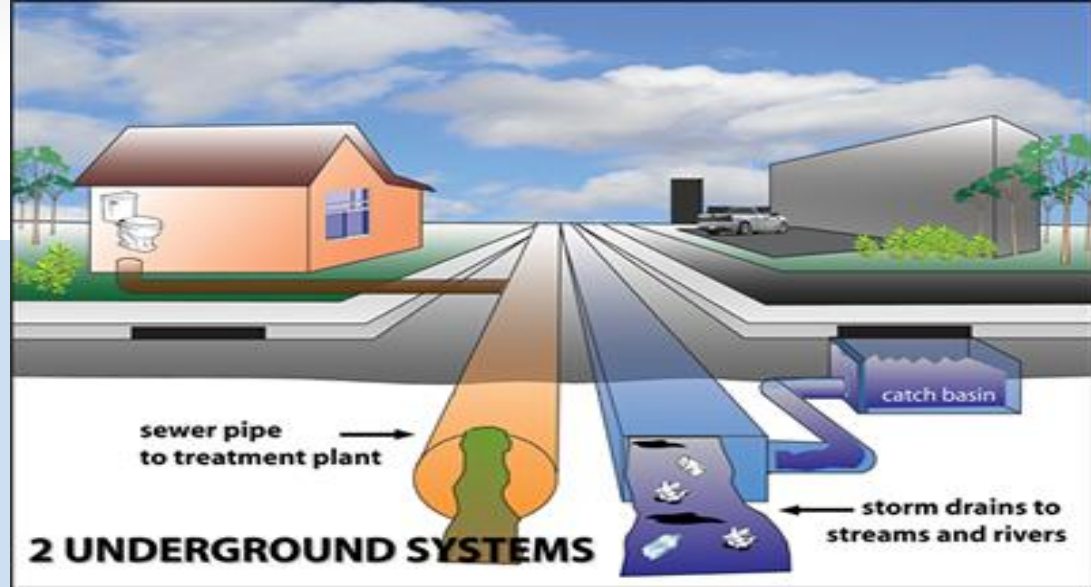


SAN DIEGO

Urban Storm Runoff

Oil and grease from parking lots and roads, pesticides and other toxic chemicals can contaminate storm water.

Non-point source pollution causes public health risk and safety concerns.



Source: City of San Diego



Source: City of San Diego

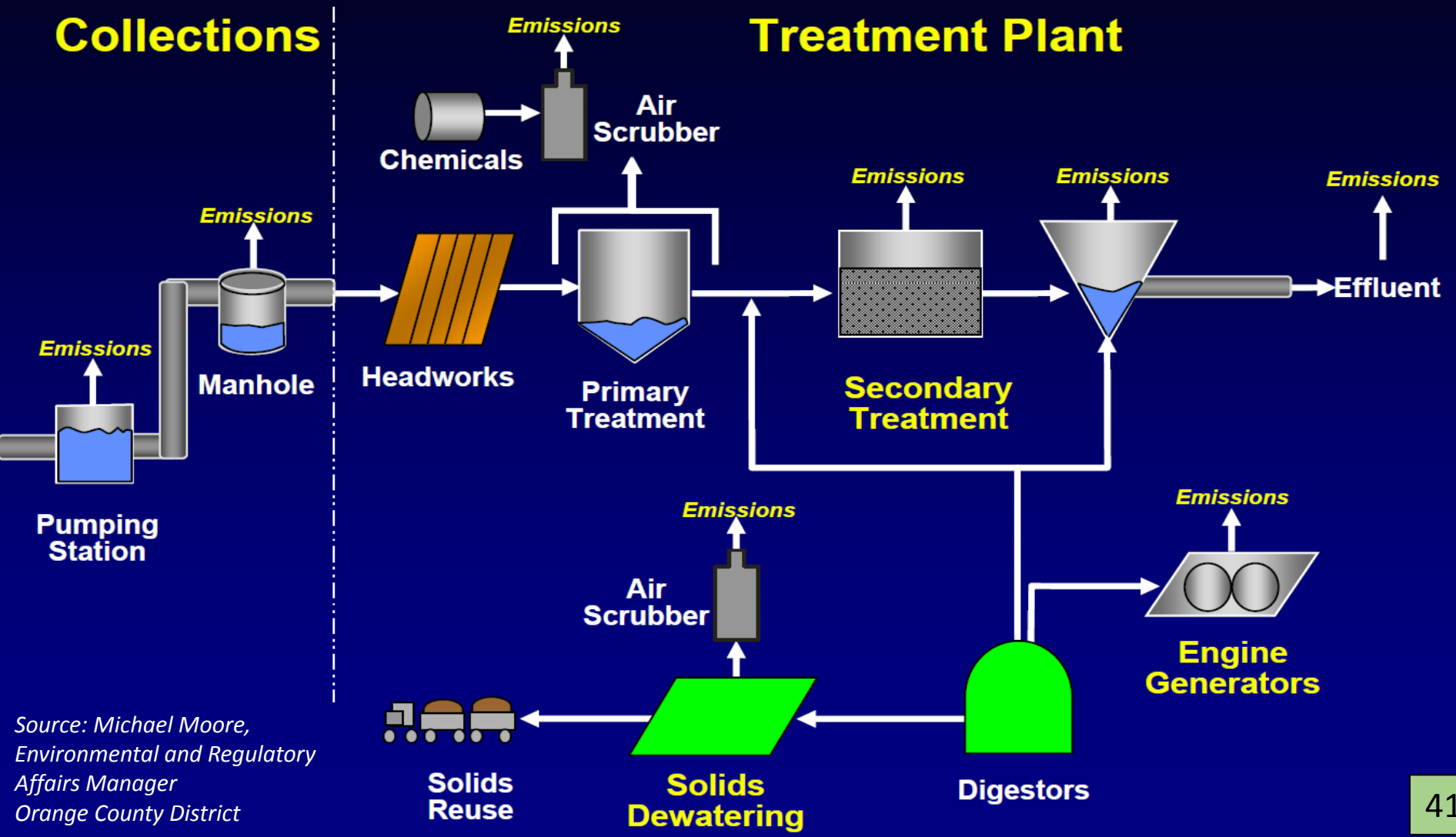
Wastewater

Any water that is adversely affected in quality by anthropogenic influence

Now: 180M gallons of WW/day
2050: 340M gallons of WW/day

- Point Loma Wastewater Treatment Plant
- South Bay Ocean Outfall
- North City Water Reclamation Plant
- South Bay Water Reclamation Plant
- Metro Biosolids Center
- Pump Stations

Potential GHG Emission Sources



Source: Michael Moore,
Environmental and Regulatory
Affairs Manager
Orange County District

Treatments	Expected Direct GHG Emissions
Primary	None
Secondary	CH ₄ , from anaerobic treatment processes (i.e., lagoons)
Advanced	N ₂ O, from Nitrification - Denitrification process
Solids Handling	CH ₄ , from sludge handling such as digestion or from incomplete combustion of digester gas and emissions from offsite operations
Effluent Discharge	N ₂ O, from denitrification of nitrogen species originating from wastewater effluent in receiving water

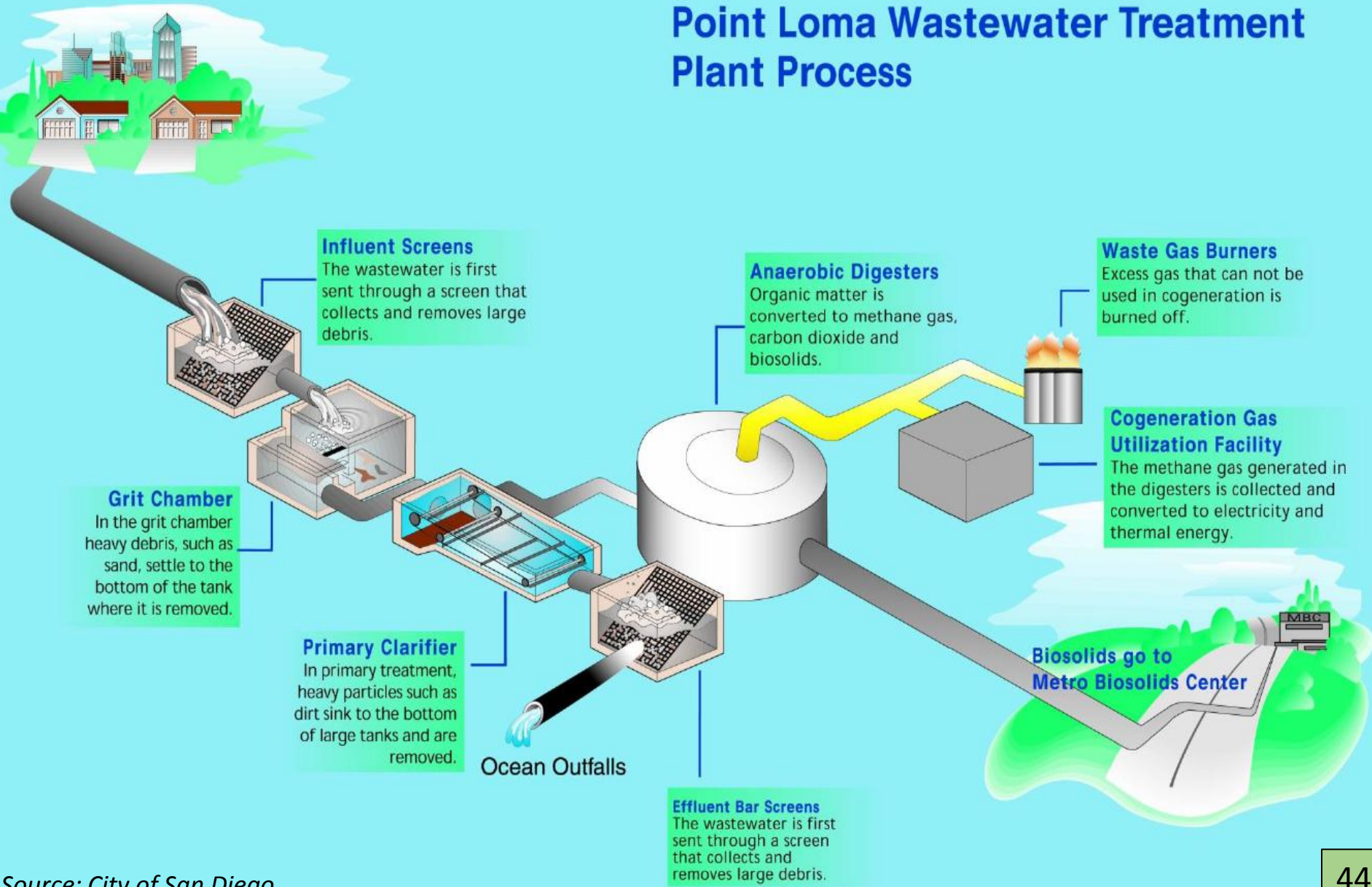
Source: Michael Moore

Point Loma Wastewater Treatment Plant

- The plant has a treatment capacity of 240 million gallons per day
- City of San Diego received a waiver in 1995, 2002, 2010 from Secondary Treatment requirements of CWA.
- Methane gas is removed from the digesters and is used to power two Caterpillar engines in the plant's Gas Utilization Facility, the Plant is energy self-sufficient.

Source: City of San Diego

Point Loma Wastewater Treatment Plant Process



Source: City of San Diego

Metro Biosolids Center

- Thickening and Digestion of the raw sludge generated at the NCWRC
- Dewatering of the wet biosolids from NCWRC and PLWTP
- Cogeneration – utilization of methane gas to power Wastewater Branch facilities
- Currently, biosolids are used as soil amendments, landfill, and landfill cover.



Source: City of San Diego

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BUILDING RESILIENT CITIES

GENI Global Energy
Network Institute

San Diego and Mexico Border



Tijuana Sewage Spill led to the closures of border beaches including Imperial Beach



The city of Tijuana is now producing cleaner wastewater day to day than the biggest U.S. city in the region - Dave Gibson, executive officer of the San Diego Regional Water Quality Control Board

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New York City Resiliency

- Overview

- New York Department of Environmental Protection (DEP)
- 14 Wastewater Treatment Plants & 96 Pumping Stations
- 1.3 Billion Gallons of Wastewater per day
- Removes 85 – 95% of pollutants



- Risk Analysis

- Risk assessed based on 100-year floodplain & 30 inch sea level rise.
- All Waste water treatment plants & 60% percent of pumping stations at risk
- \$1 Billion of equipment at risk from storm surge or flood.
- Cumulative damages over next 50 years could rise to \$2 Billion.
- Protective costs: \$315 million

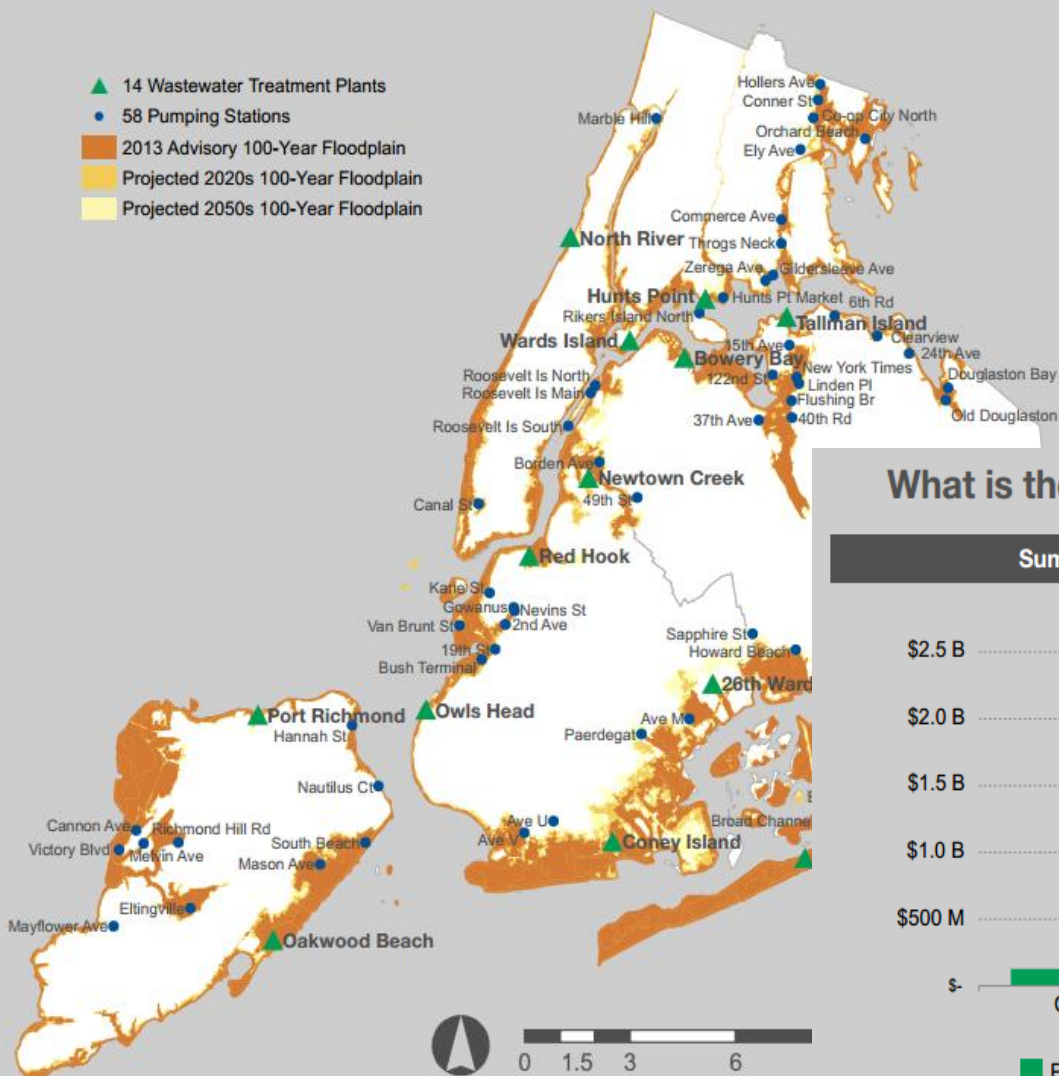


Source: NYC Wastewater Resiliency Plan, Executive Summary

What is at risk?

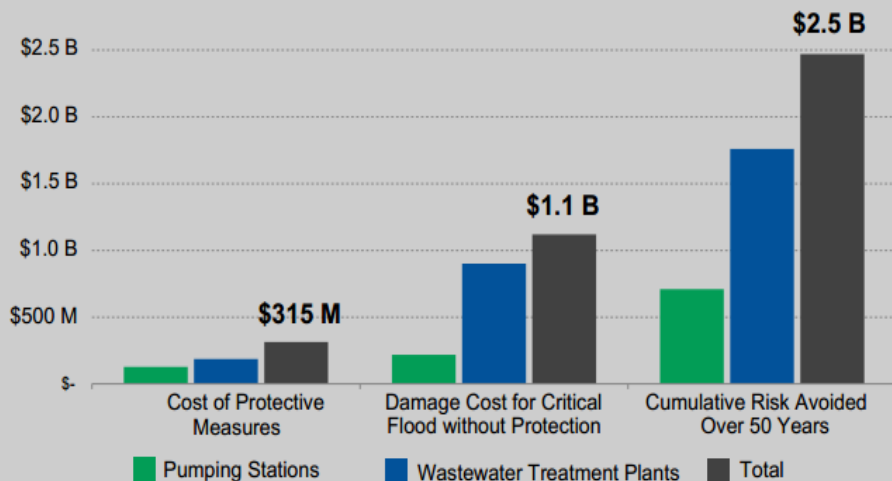
Wastewater Facilities At-Risk of Storm Surge Inundation

- ▲ 14 Wastewater Treatment Plants
- 58 Pumping Stations
- 2013 Advisory 100-Year Floodplain
- Projected 2020s 100-Year Floodplain
- Projected 2050s 100-Year Floodplain



What is the cost?

Summary of Estimated Costs for Wastewater Infrastructure



Source: FEMA; CUNY Institute for Sustainable Cities

Source: NYC Wastewater Resiliency Plan, Executive Summary

Lessons from Hurricane Sandy

- Exceeded \$95 million in damages to Wastewater treatment plants.
- Failure of most electrical systems associated with plants.
- 562 million gallons of untreated and diluted sewage mixed into storm water and sea water.
- 42 of 96 pumping stations affected.



Source: NYC Wastewater Resiliency Plan, Executive Summary

Climate Framework

- **Climate Analysis**

- What can NYC expect for future?

- **Risk Analysis**

- Which infrastructure will be affected by flood events?

- **Adaptation Analysis**

- What can be done to protect at risk infrastructures? At what cost?



Source: NYC Wastewater Resiliency Plan, Executive Summary

Resilient Design Standards



Elevate Equipment

on pads or platforms, to a higher floor, to the roof, or to a new elevated building.



\$\$\$\$



Flood-Proof Equipment

by replacing pumps with submersible pumps and installing watertight boxes around electrical equipment



\$\$\$



Install Static Barrier

across critical flood pathways or around critical areas.



\$\$\$

Source: NYC Wastewater Resiliency Plan, Executive Summary



Seal Building

with water-tight doors and windows, elevating vents and secondary entrances for access during a flood event.



\$\$

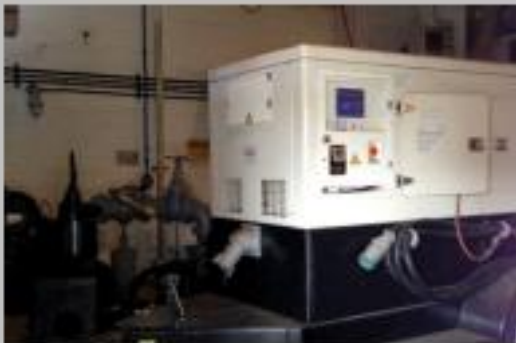


Sandbag Temporarily

around doorways, vents, and windows before a surge event.



\$



Install Backup Power

via generators nearby or a plug for a portable generator.

Does not protect equipment, but ensures rapid service recovery

\$\$\$

Recycling Waste Water

- 1st large scale reclamation plant
- Treats 30 million gallons of wastewater per day
- Non-potable water used for irrigation



North City Reclamation Plant located in Mira Mesa.
Source: City of San Diego Public Utilities

Advanced Water Purification Facility



Advanced water facility in north county San Diego (La Jolla). The filtration systems are shown.

Source: purewatersd.org

- Purifies water even more than reclamation plant!
- 3 Filtrations:
 1. Membrane filtration
 2. Reverse osmosis
 3. UV/advanced oxidation



Benefits:

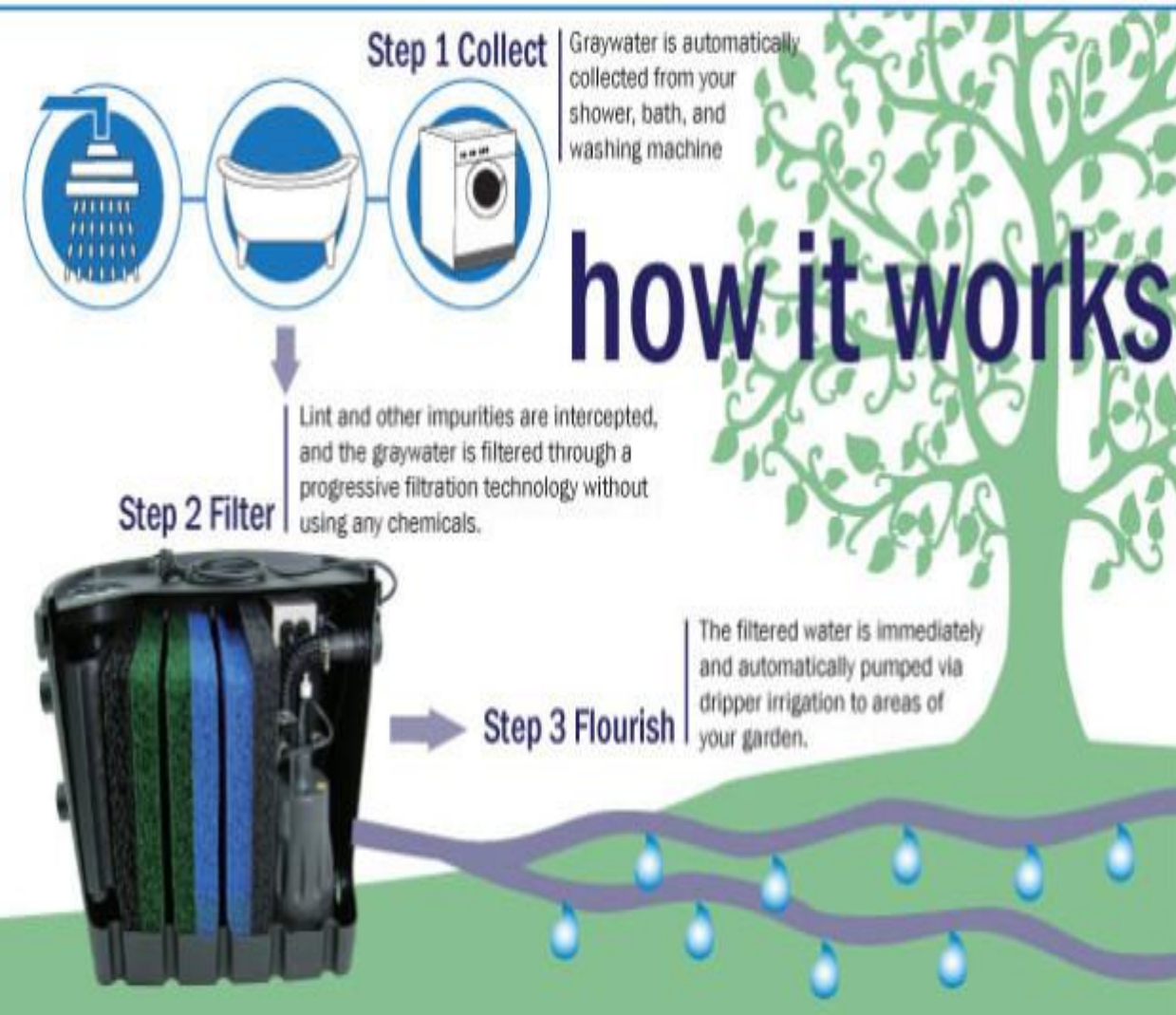
- 💧 Local supply
- 💧 Less cost and energy than imported water

Source: *City of San Diego*



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Greywater System



- Greywater is untreated household wastewater which has not come into contact with toilet waste.

Source: City of San Diego

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CONCLUSION



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Further Information

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