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Materials Management as a Climate Mitigation Strategy

Prepared for the EPA Sustainable Materials Management Web Academy

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Overview

- Materials management: what is it?
  - Waste/discards management as a subset of materials management
- The climate impact of materials and waste
- Waste/discards management
  - Benefits of recycling
- The importance of materials management and the limitations of the “waste management” framework

Materials Management: A Working Definition

- *"Materials management is an approach to using and reusing resources most efficiently and sustainably throughout their lifecycles. It seeks to minimize materials used and all associated environmental impacts."*
  - From EPA, Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices (PDF) (98pp, 1.5MB)

"Waste Management"/"Discards Management" is a Subset of Materials Management

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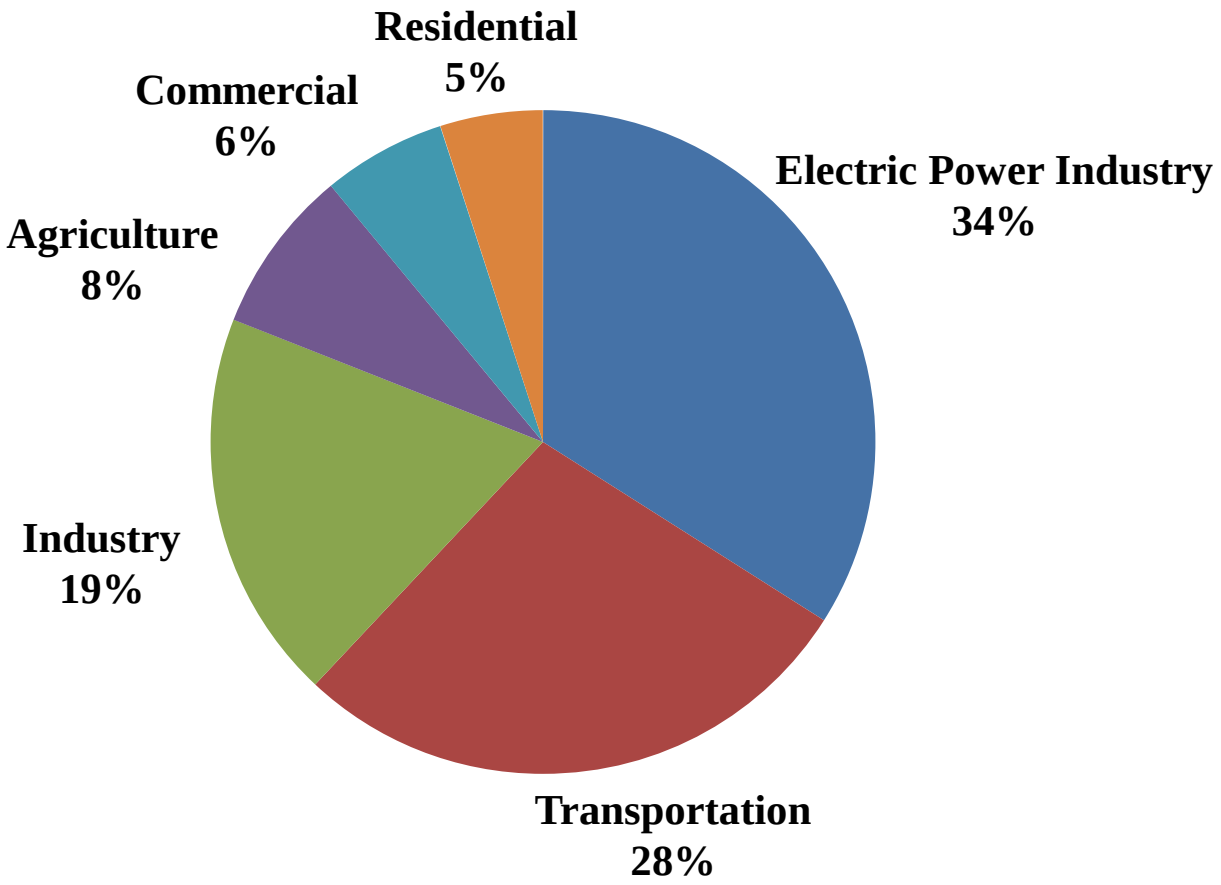
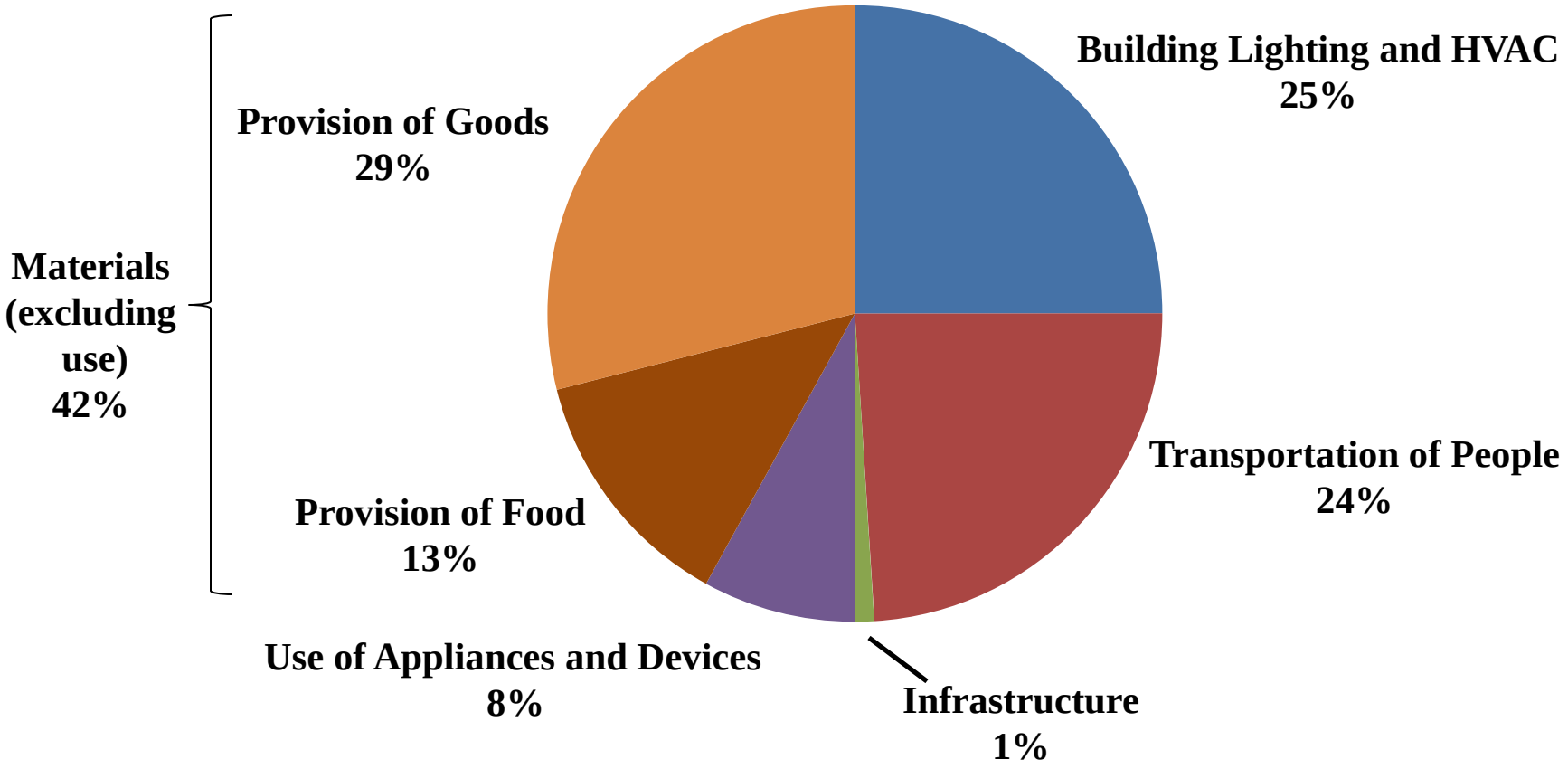
Carbon Goggles

Traditional Sector-Based View of U.S. Greenhouse Gas Emissions (2006)



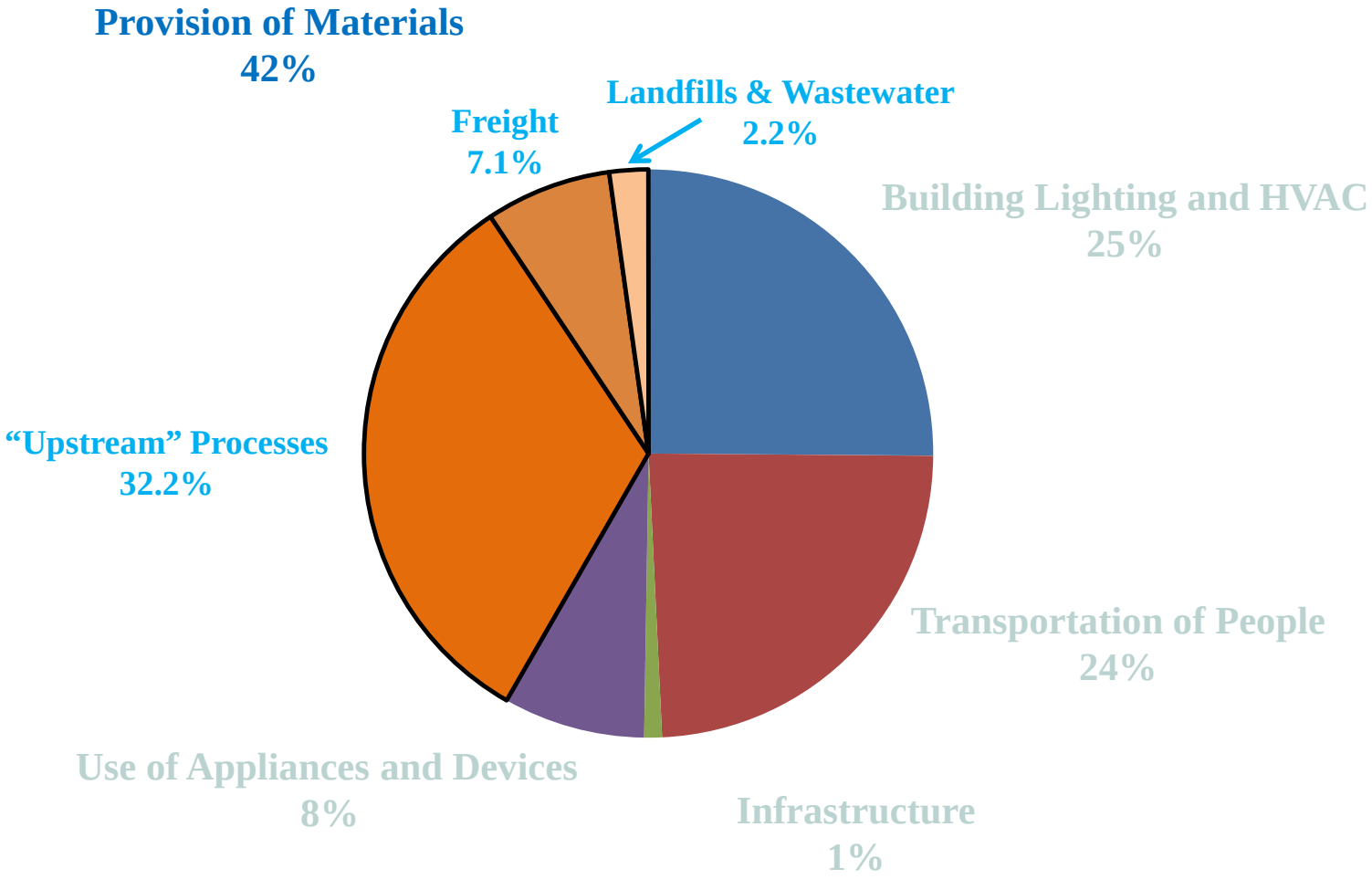
Source: US EPA (2009)

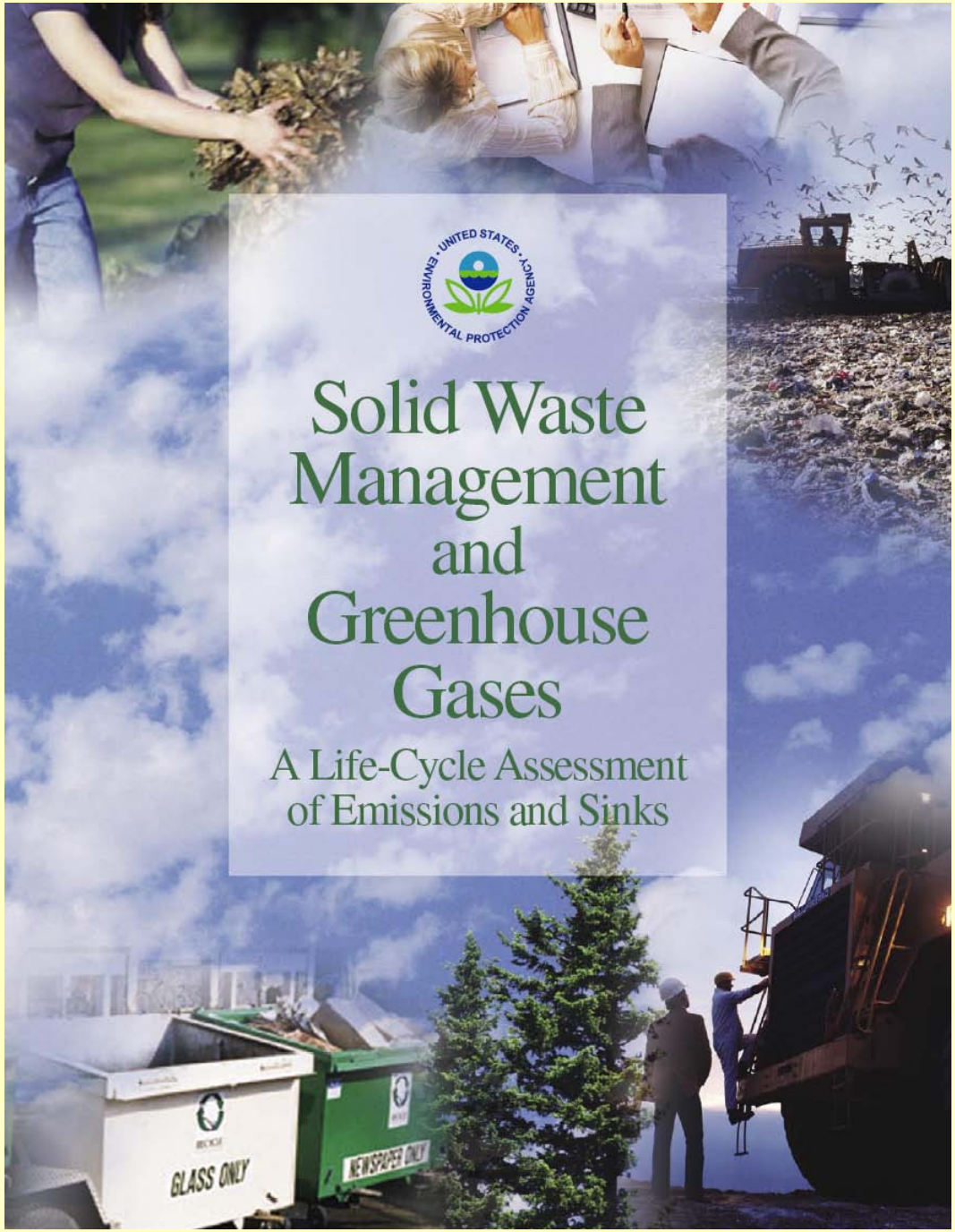
Materials Matter: Systems-Based Geographic Emissions Inventory (2006)



Source: US EPA (2009)

For Materials, "Upstream" Emissions Dominate



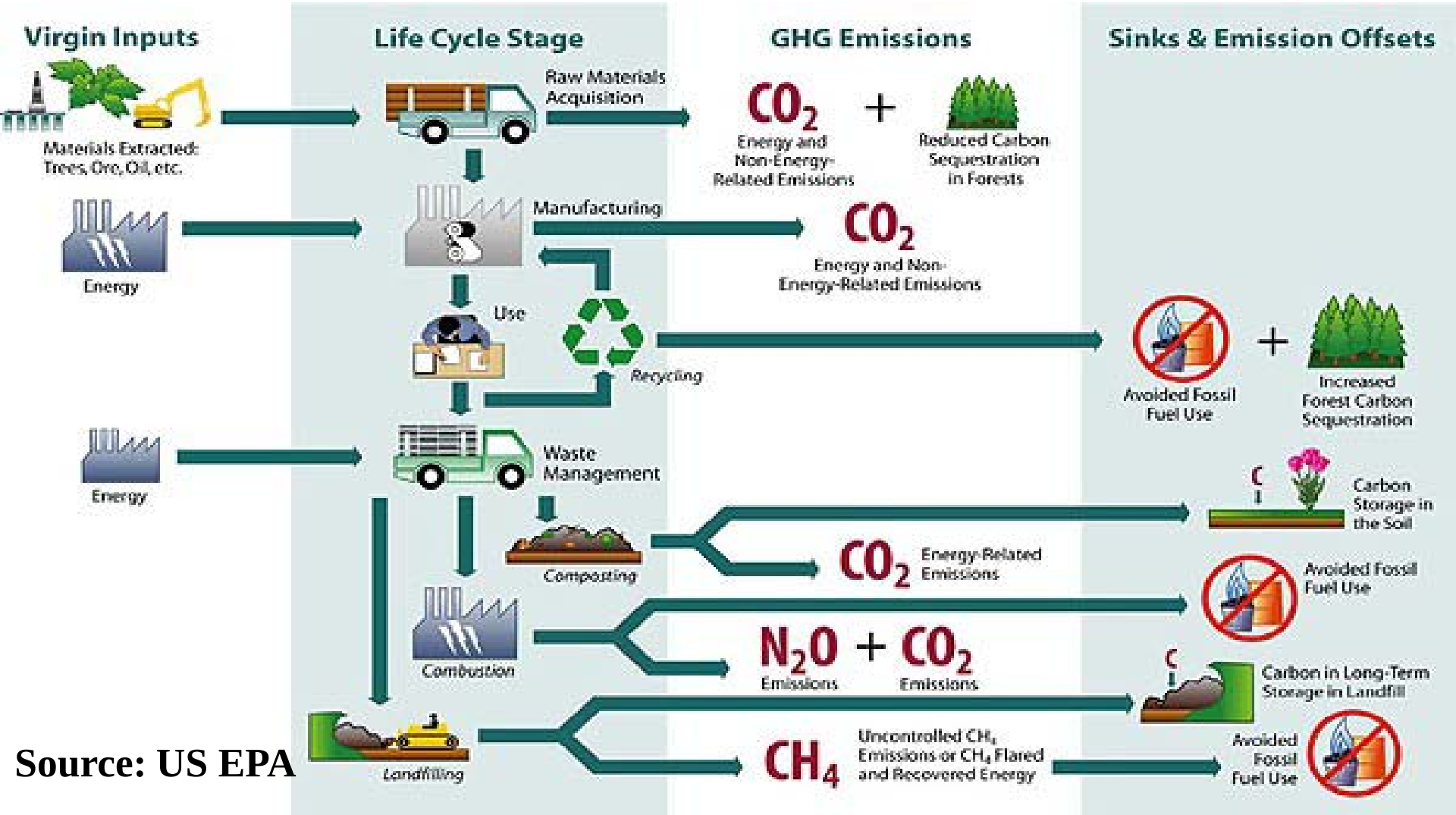


EPA Climate Change and Waste Resources:

Report:
http://www.epa.gov/climatechange/wycd/waste/reports.html

WARM (WAste Reduction Model) and other tools:
http://www.epa.gov/WARM

Greenhouse Gases Over the Product Life Cycle – EPA's WARM Tool



Source: US EPA

Greenhouse Gas Benefits of Recycling

- Recovery in Oregon in 2009 reduced greenhouse gas emissions by ~2.8 million metric tons of CO2e
  - ~3.9% of total statewide emissions
  - Equivalent of 570,000 “average” passenger cars
  - Benefits are dominated by “upstream” processes (not disposal avoidance)

Curbside Recycling (Portland, Oregon)

- For every 100 tons of mixed recyclables collected from households (curbside):
  - 6 $MTCO_2e$ in greenhouse gas emissions from on-route vehicles (including diesel production)
  - 232 $MTCO_2e$ greenhouse gas savings (net) when these recyclables displace virgin feedstock in production

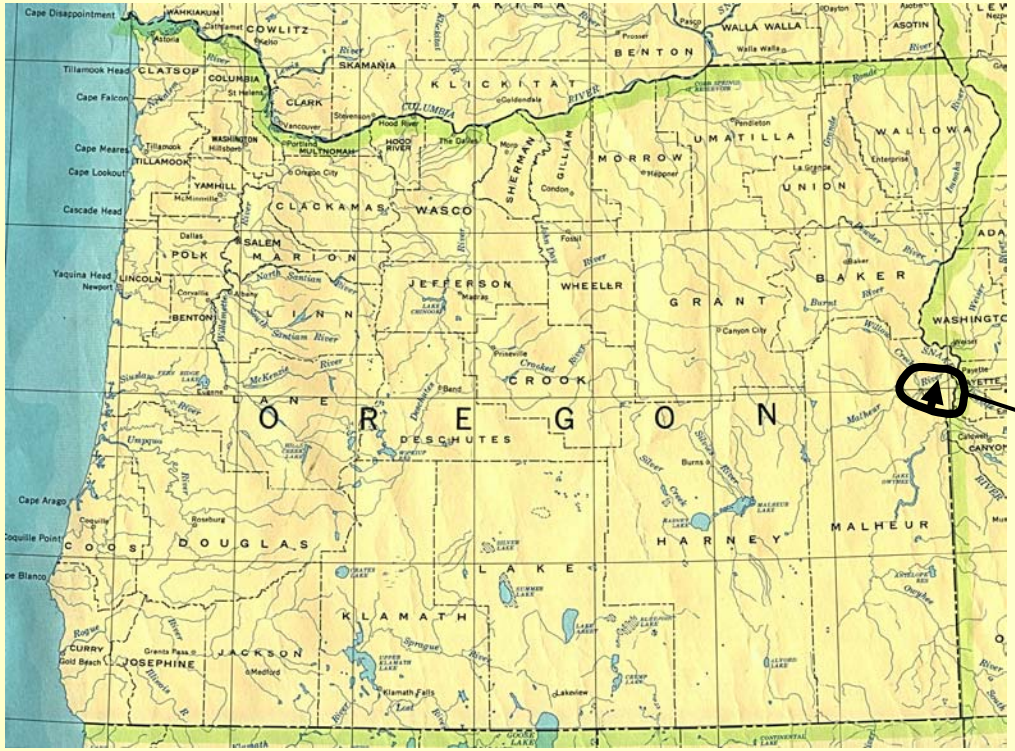
Long-Haul Is Not a Limiting Factor

Material	Production & Forestry Savings (MTCE/ton collected)	"Break-Even Point" (miles) Truck	Rail	Freighter
Aluminum	3.44	116,000	451,000	524,000
Corrugated	0.79	27,000	104,000	120,000
Newspaper	0.68	23,000	90,000	104,000
Steel	0.48	16,000	63,000	73,000
LDPE	0.36	12,000	47,000	55,000
PET	0.33	11,000	43,000	50,000
HDPE	0.30	10,000	39,000	45,000
Glass (to bottles)	0.07	2,000	9,000	11,000

"Break-Even Point" is where GHG emissions transporting the recyclables equals GHG emissions avoided when the recyclables displace virgin feedstocks.

Avoided disposal-related emissions are not included.

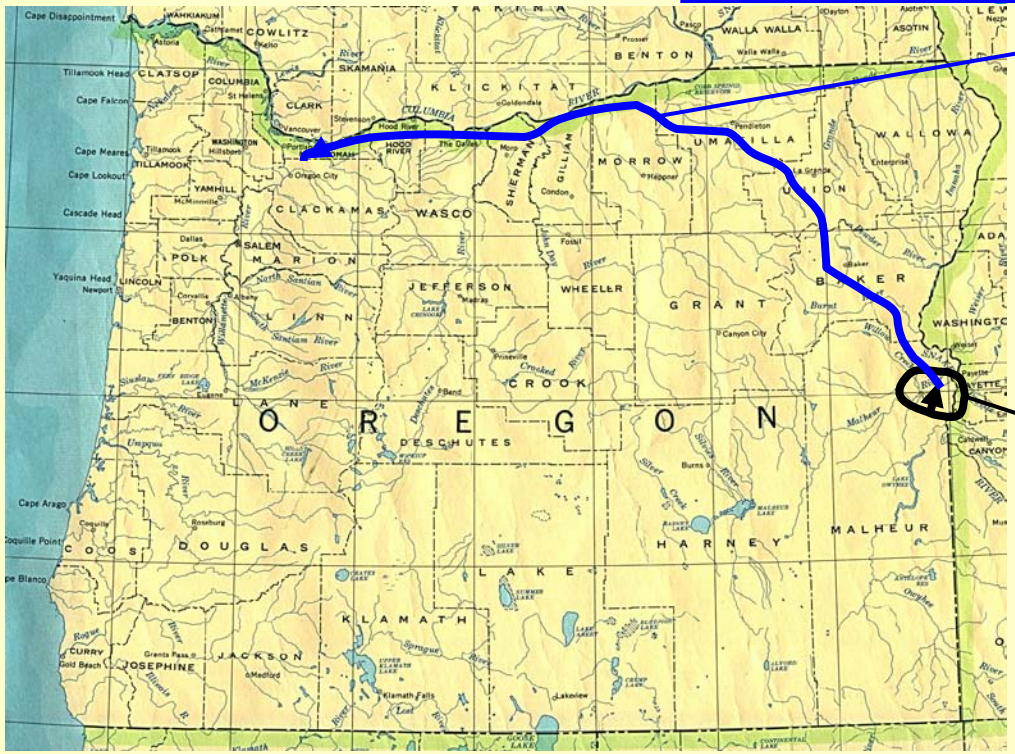
End Markets Matter! (sometimes)



Cullet to Aggregate Recycling (Local)
Net Energy Savings: ~0.2 MMBTU/ton

End Markets Matter! (sometimes)

Cullet to Bottle Recycling (Portland)
Net Energy Savings: ~2.1 MMBTU/ton



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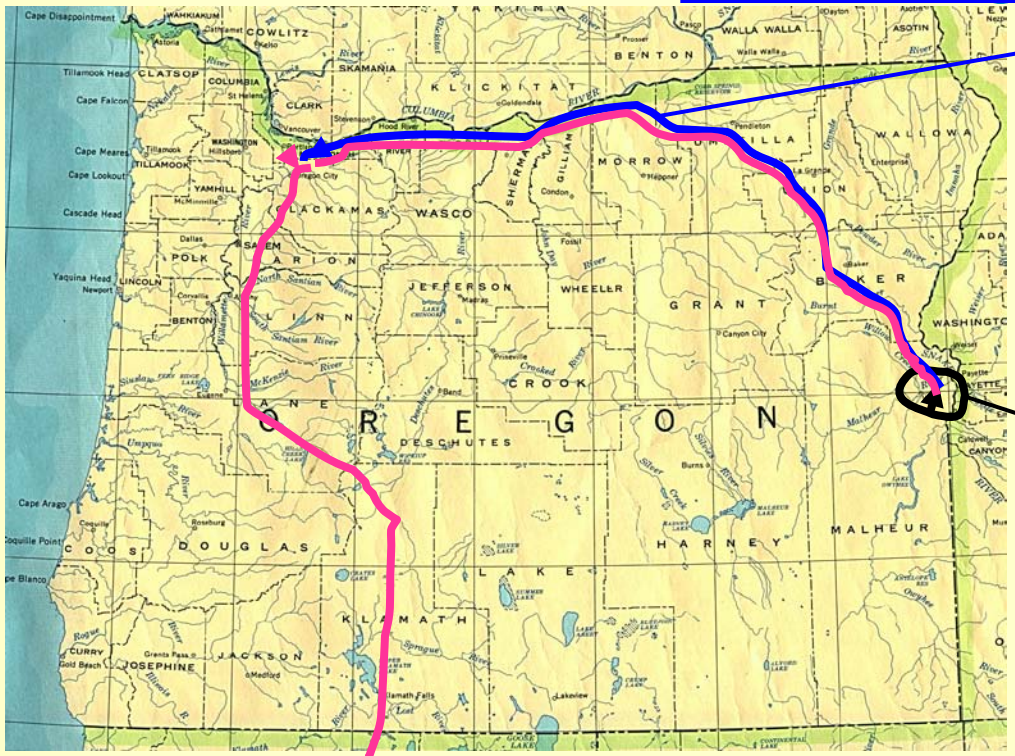
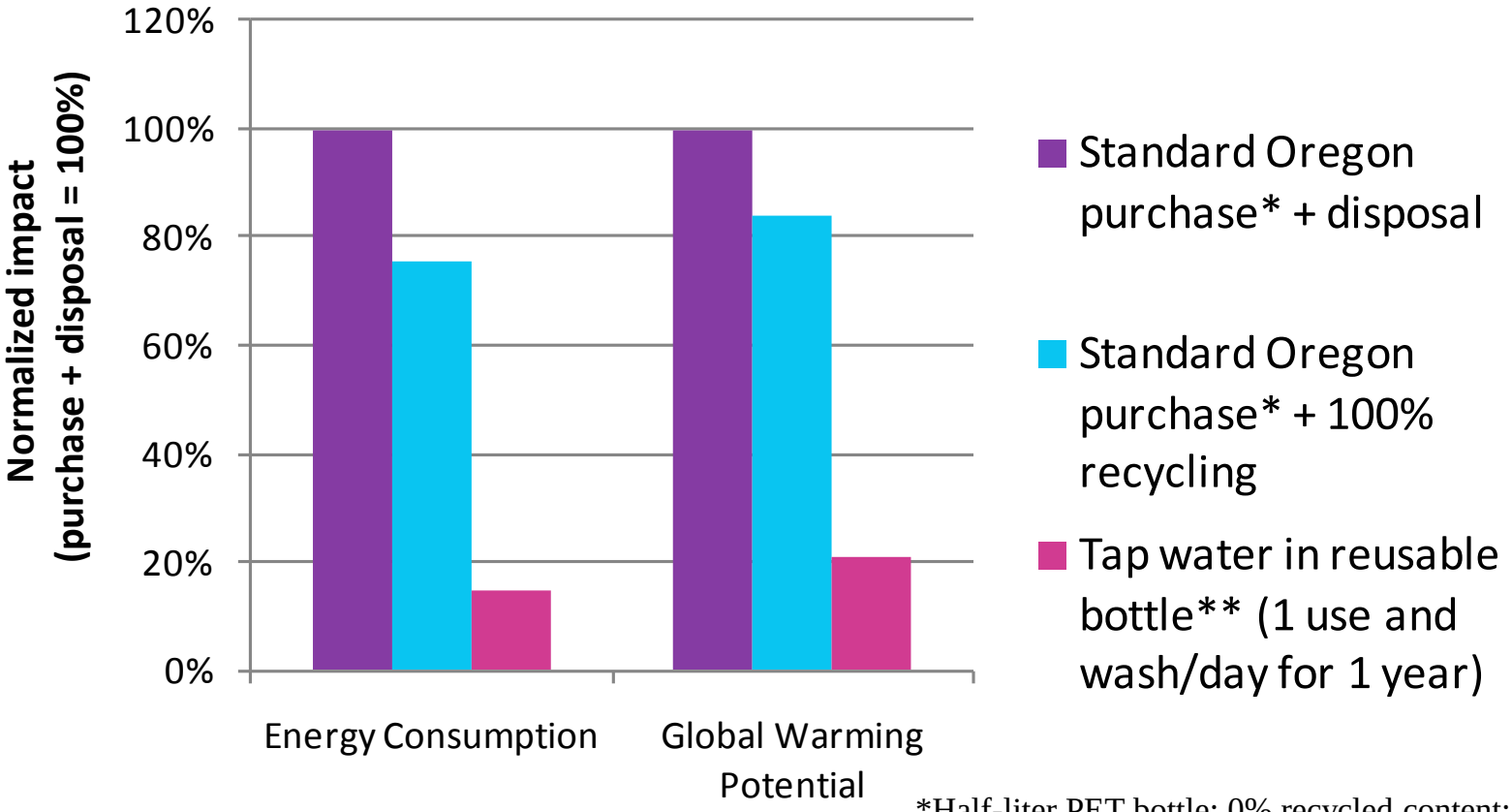


Cullet to Aggregate Recycling (Local)
Net Energy Savings: ~0.2 MMBTU/ton

Cullet to Fiberglass Recycling (California)
Net Energy Savings: ~3.2 MMBTU/ton

Disposal vs. Recycling vs. Prevention (Drinking Water Example)



*Half-liter PET bottle; 0% recycled content; 13.3 grams; local water

**Average of aluminum/PET/steel; no recycling; high-water use dishwasher

From "Discards Management" to "Materials Management"

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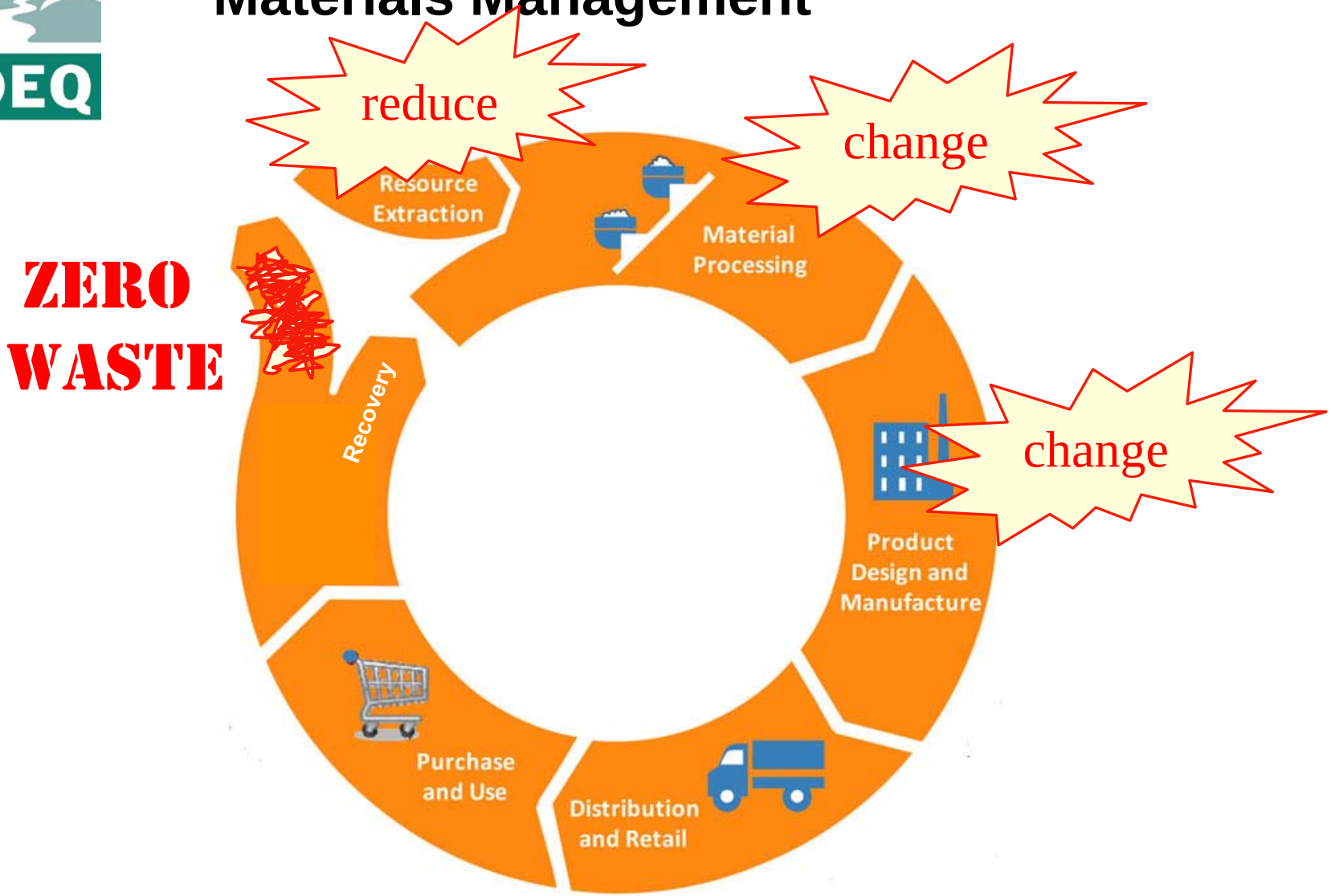
ZERO WASTE

From "Discards Management" to "Materials Management"



From "Discards Management" to "Materials Management"

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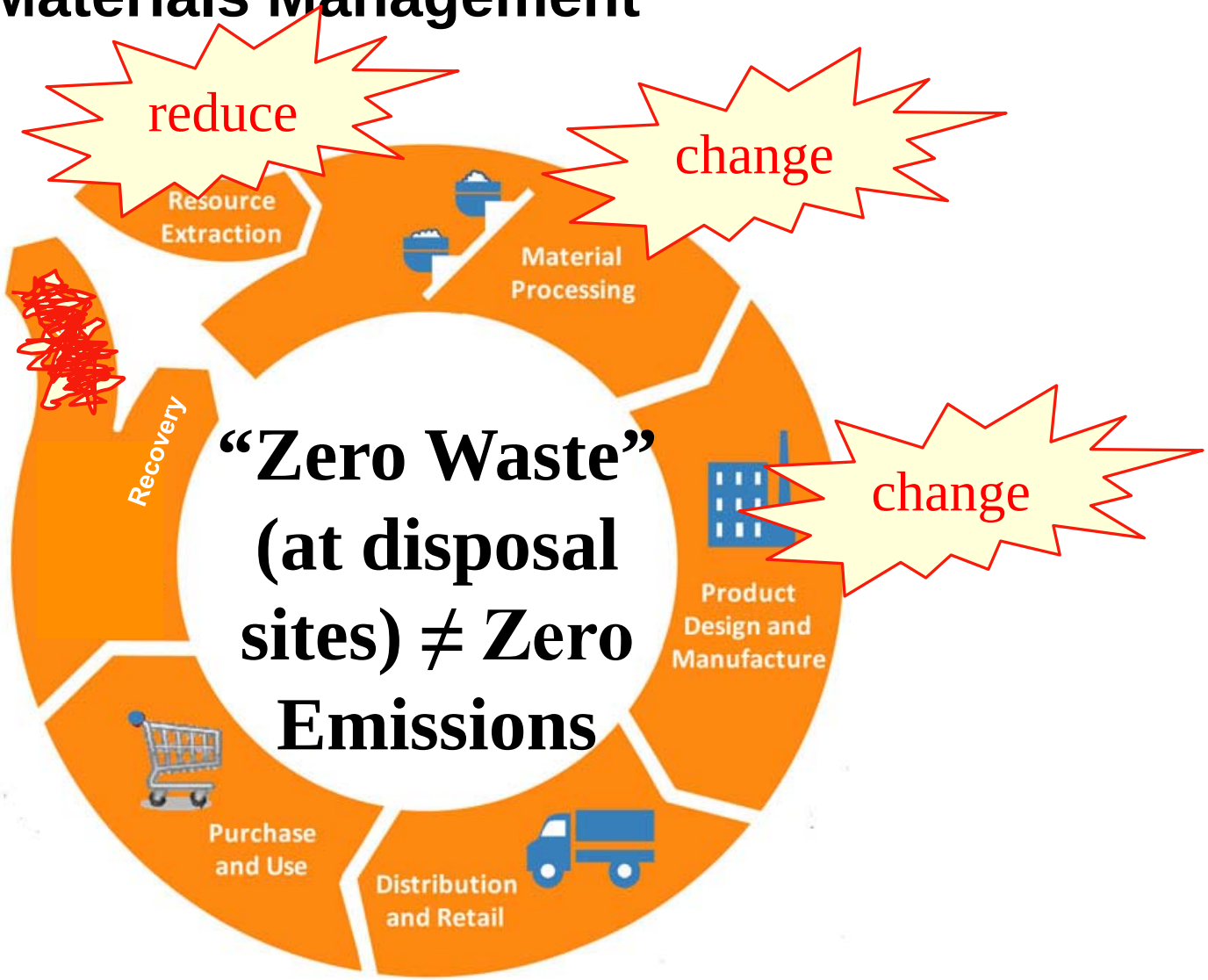
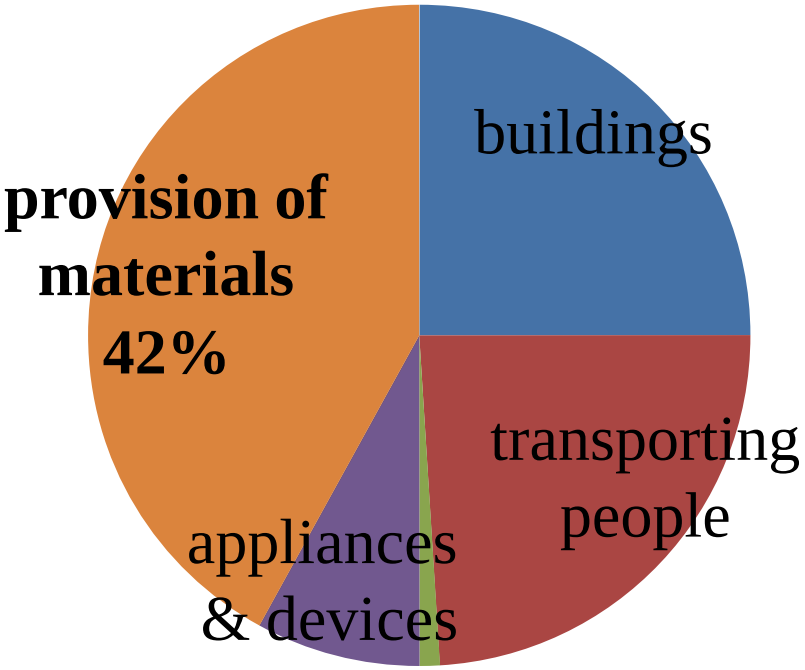


The importance . . . and limitations . . . of waste recovery (recycling, composting)



2006 U.S. GHG inventory with 32% recovery (MSW)

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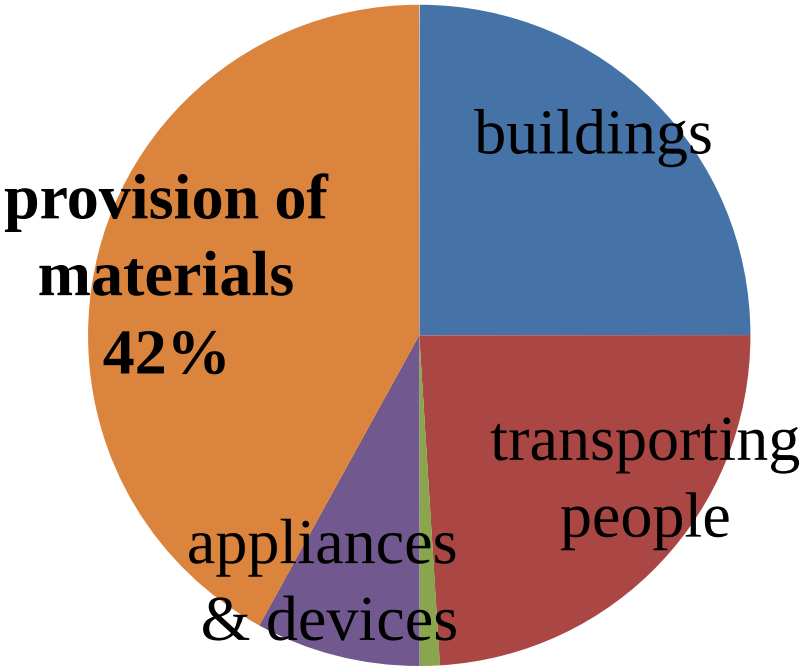

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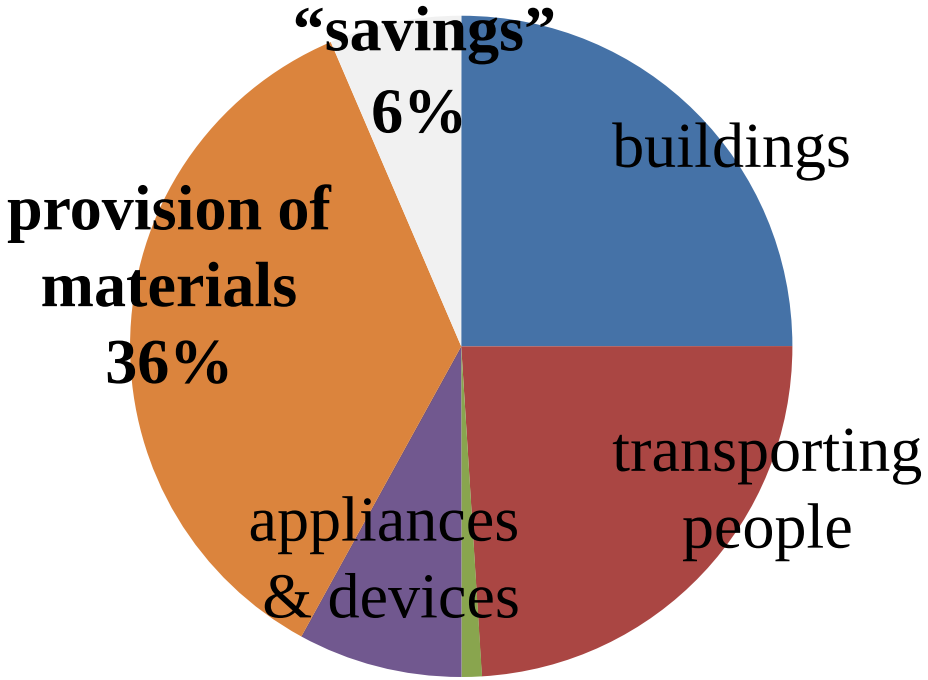
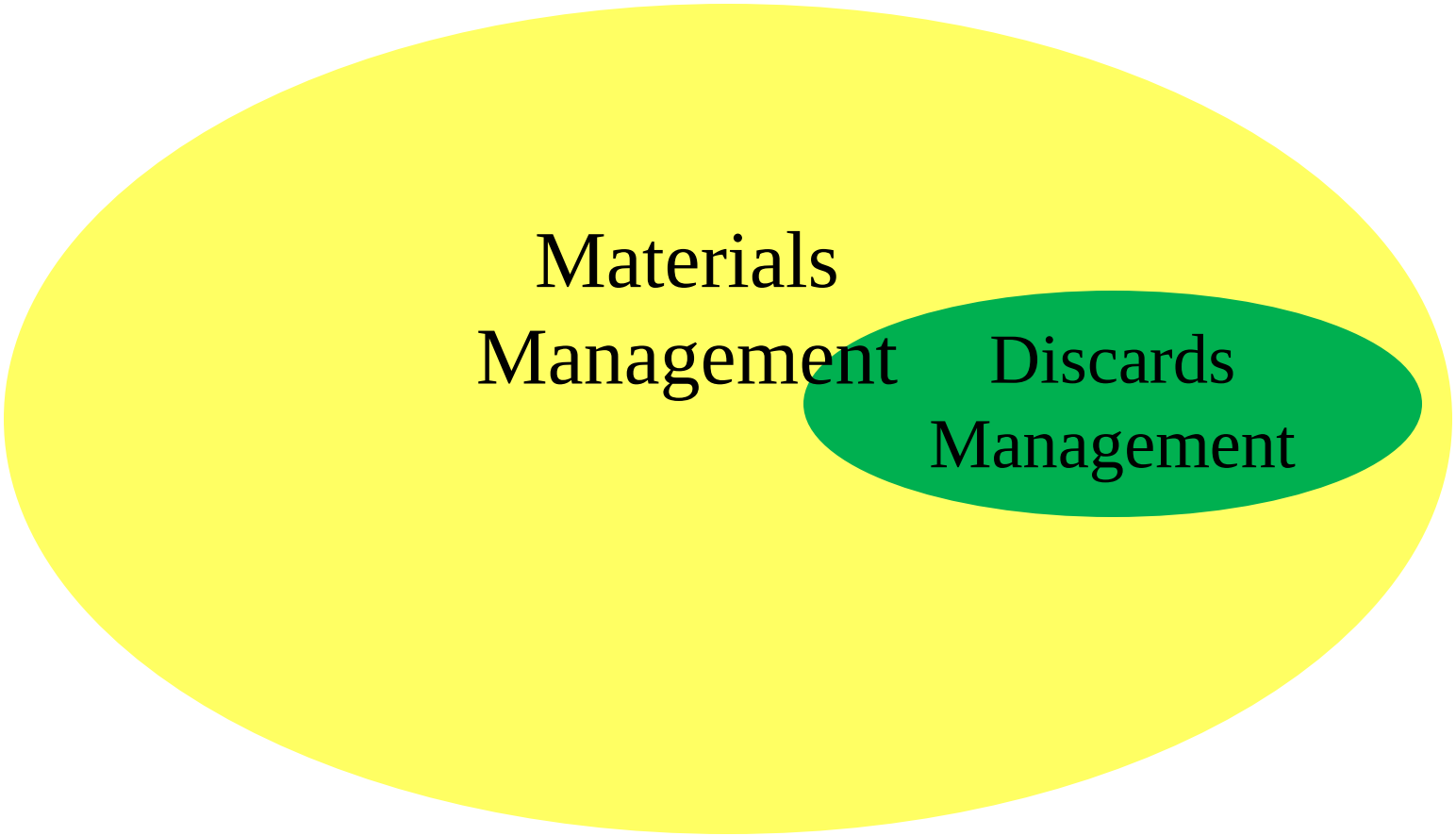


2006 U.S. GHG inventory with very high recovery rate (~95% MSW + >70% C&D)

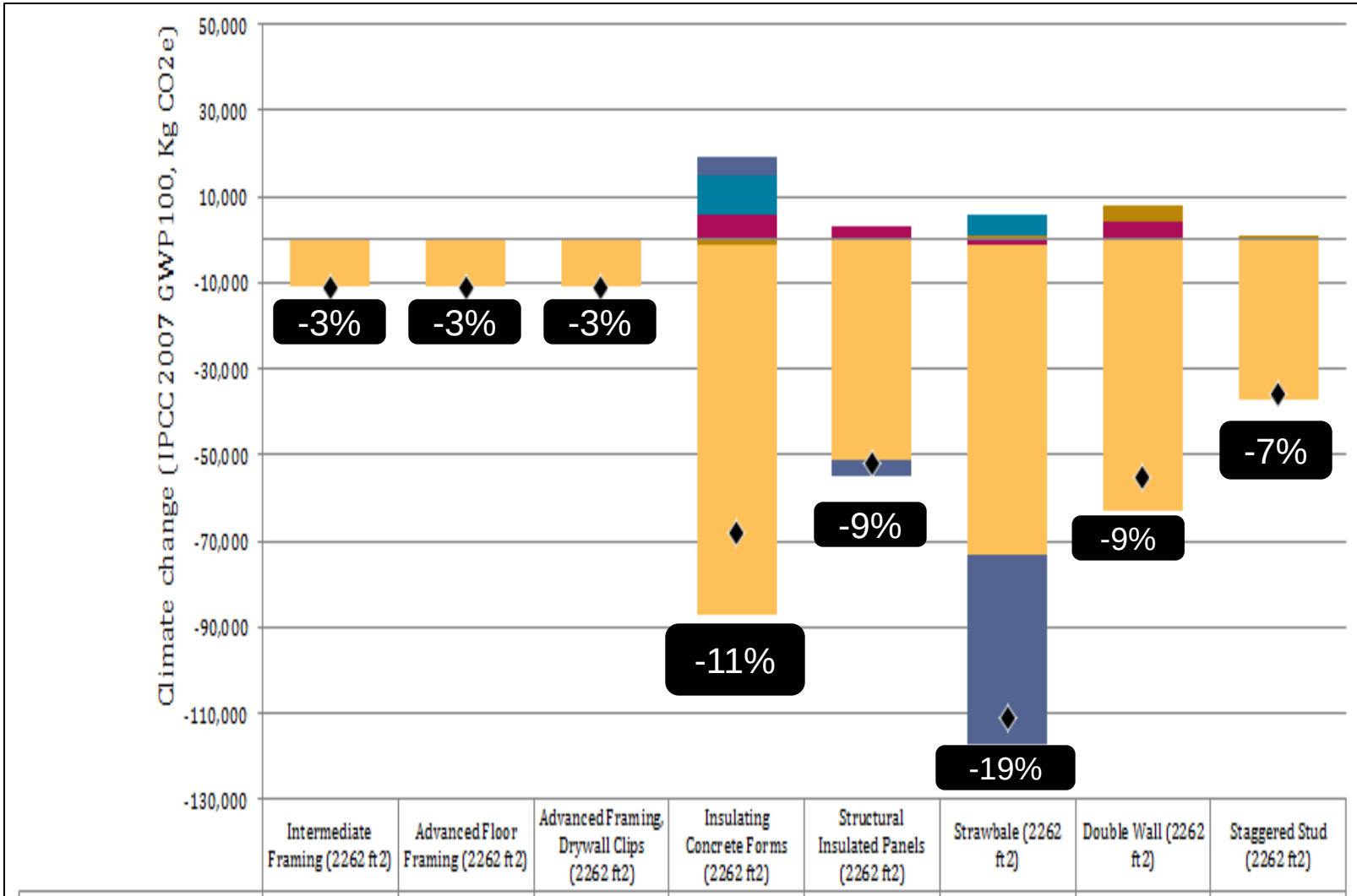
Discards Management is a Subset of Materials Management



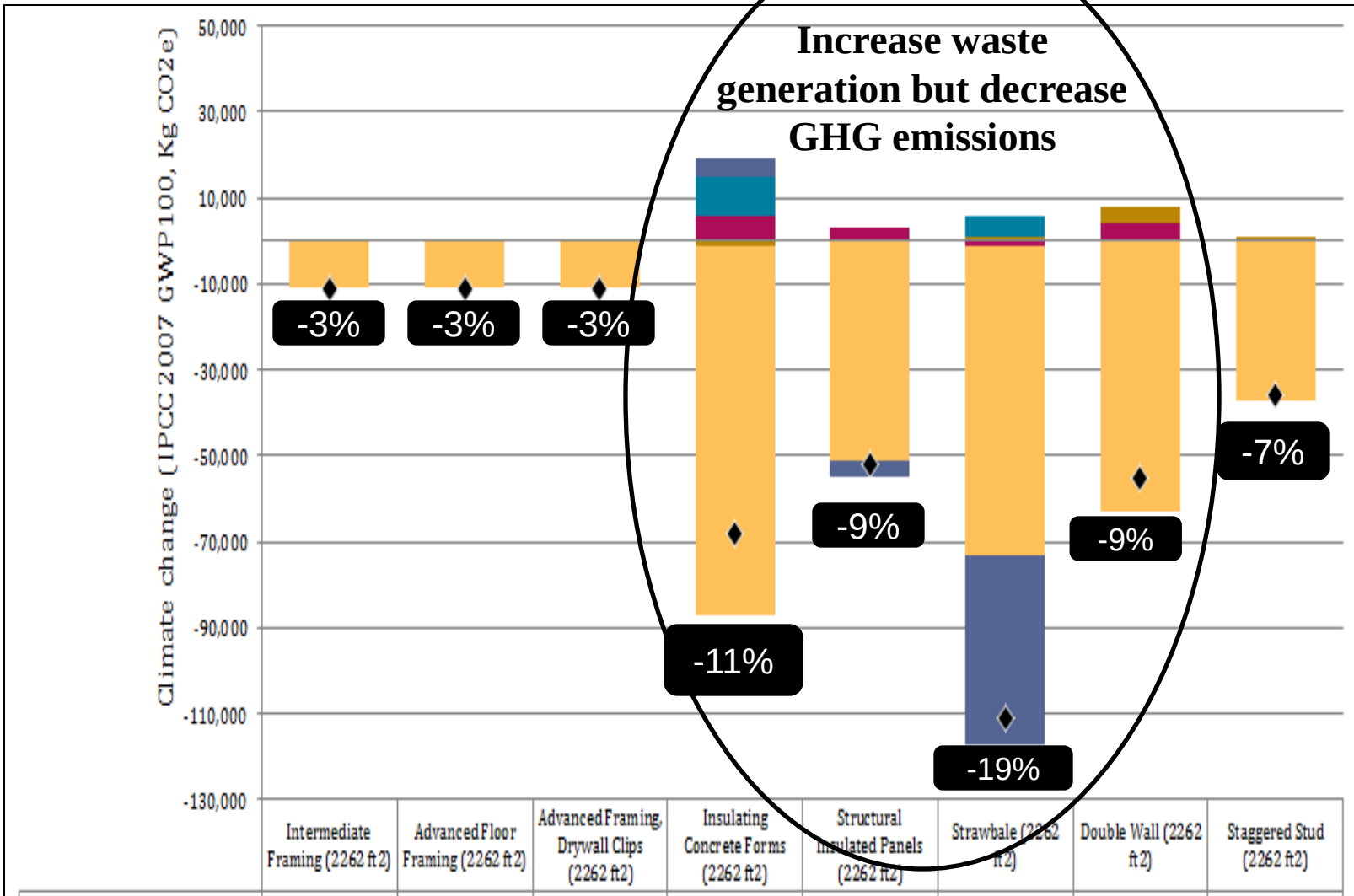
The Importance of a Materials Management Perspective - Examples

- Recycling glass
  - Glass to aggregate and glass to containers are both viewed as “recycling” (disposal avoidance)
  - But the GHG benefits of glass to containers may be ~10 times higher
- Building practices and materials
  - Is recyclable/recoverable material always best?
  - Is using less materials (waste prevention) always best?

Lifecycle GHG Benefits of Wall Framing Options



Lifecycle GHG Benefits of Wall Framing Options



The Importance of a Materials Management Perspective – More Examples

- Appliances
  - The waste hierarchy says: “reuse” is better than “recycling”
  - But replacing (and destroying) inefficient appliances (+ cars, windows, etc.) may be better than reuse
- Packaging
  - Does recyclable packaging necessarily have a lower carbon footprint than non-recyclable packaging? For example:
    - Readily recyclable steel or glass vs. harder-to-recycle aseptic containers
    - E-commerce order fulfillment: cardboard boxes vs. plastic shipping bags

DEQ's E-Commerce Life Cycle Assessment (LCA): Materials Evaluated

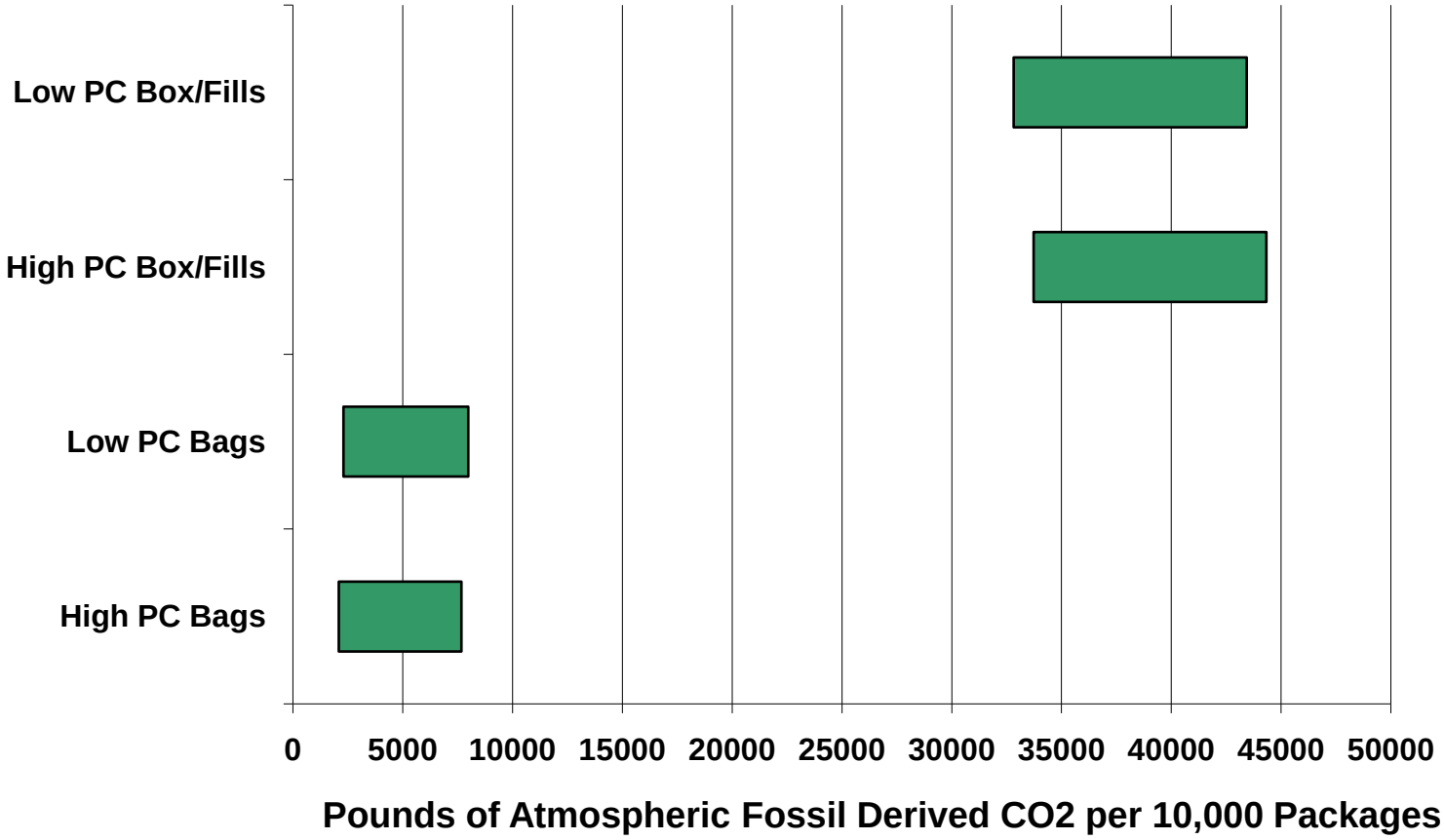
Corrugated box*

Void Fill (for boxes)
Polystyrene loose fill*
Corn starch loose fill
Molded paper loose fill
Inflated "air pillows"*
Newsprint dunnage*
Kraft dunnage*
Shredded office paper
Shredded boxes

Shipping Bags
Unpadded all-kraft mailer*
Unpadded all-poly mailer*
Kraft mailer with ONP padding*
Kraft mailer with poly bubble padding*
Poly mailer with poly bubble padding*

*Different levels of post-consumer content also evaluated.

E-Commerce Results: Fossil-Derived CO2 Emissions



"Upstream" materials management options

- Producer responsibility – redesign of products, cleaner (lower carbon) production
- Supply chain management (e.g., WalMart)
- Carbon footprinting, labeling
- Low-carbon purchasing
- "Sustainable consumption"
- Putting a price on carbon (e.g., carbon tax and/or cap-and-trade)
- Others

Thank You!

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