State of Washington Beyond Waste Implementation Working Group

Materials Management, Climate and Waste: Making the Connections

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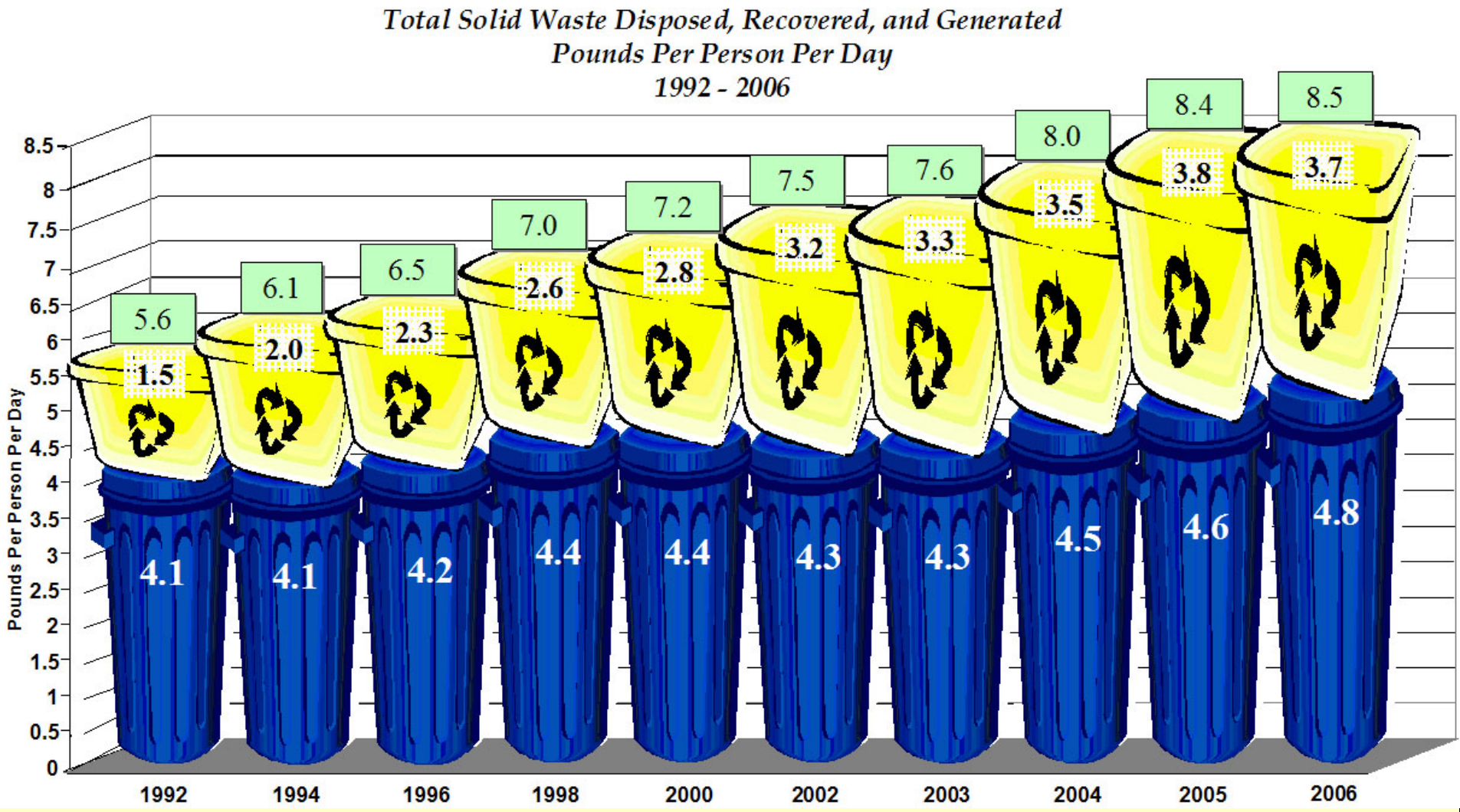
Overview

- Oregon's experience
- The fundamentals
  - Life cycle thinking, emissions factors, and EPA's "WARM" model
  - Caveats
  - Nomenclature basics
- Implications for "beyond waste" policy and programs

Recycling is Up in Oregon, But So is Waste Generation



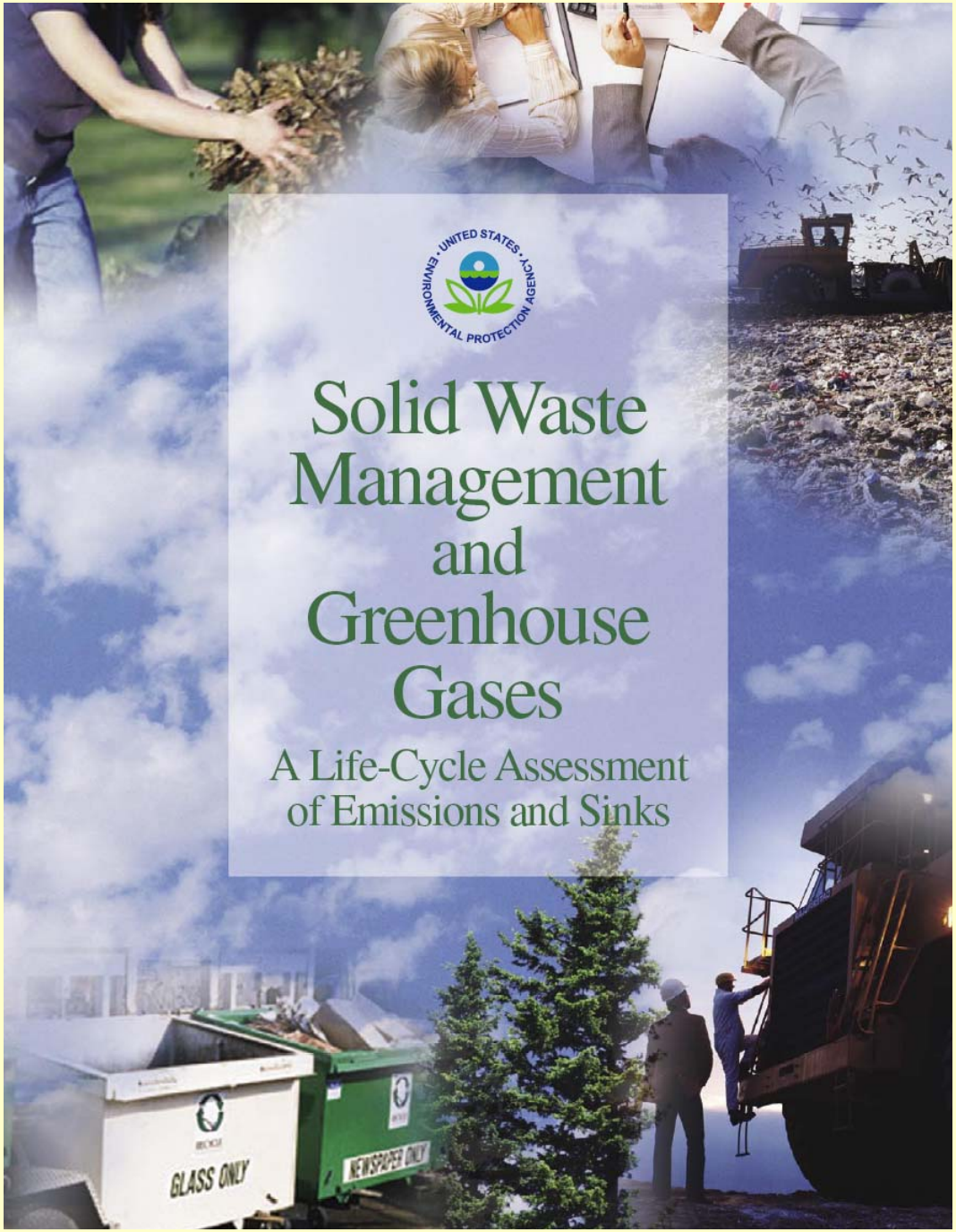
Key 0.0 = Generated = Recovered = Disposed

Recovery + Disposal = Generation

Oregon Governor's Advisory Group on Global Warming (2004)

- Charge to 7 Technical Subcommittees:
  - Forecast emissions to 2025 under a "business as usual" scenario
  - Identify policy and program options to reduce emissions
  - Estimate greenhouse gas impacts of these options
  - Estimate cost and other impacts of these options

See www.oregon.gov/ENERGY/GBLWRM/Strategy.shtml

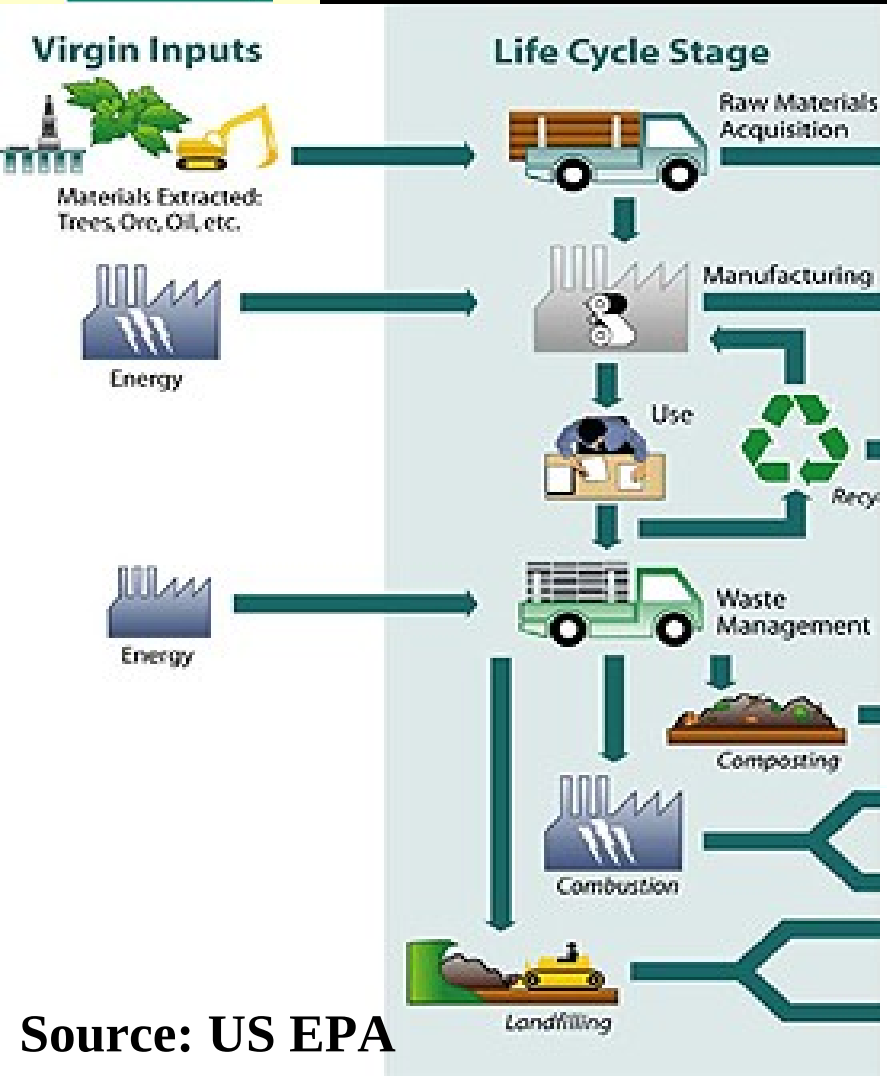


EPA Climate Change and Waste Resources:

Report:
http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html

WARM (WAste Reduction Model) and other tools:
http://epa.gov/climatechange/wycd/waste/tools.html

Greenhouse Gas Sources and Sinks Associated with the Material Life Cycle



Source: US EPA

EPA Emissions Factors: Some Caveats

- Significant uncertainty, variability:
  - Quantity and timing of methane releases
  - Effectiveness of gas controls
  - Energy use/savings between individual end-markets, countries
  - Forestry-related benefits
  - Others
- Some compost benefits not quantified
- “Inventories” and “options analysis” not the same (e.g. carbon storage in landfills)

Nomenclature Basics

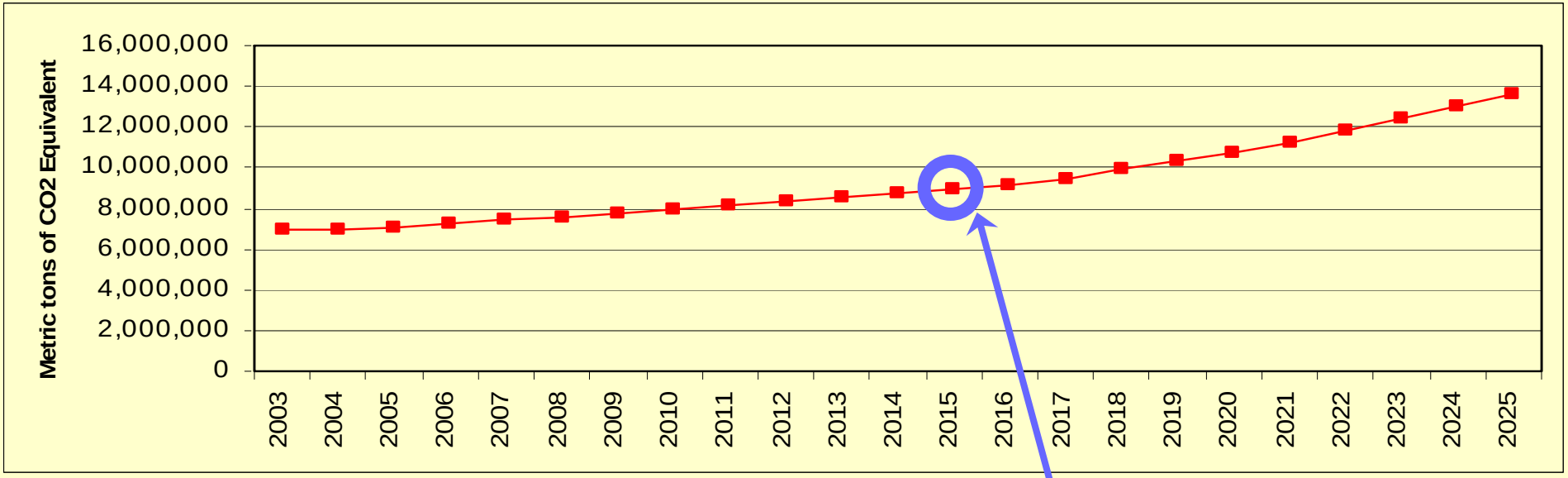
- Greenhouse gases are typically expressed in terms of "carbon dioxide equivalent" (CO_2e):
  - 1 g CO_2 = 1 g CO_2e
  - 1 g CH_4 (methane) = 21 g CO_2e
  - 1 g N_2O (nitrous oxide) = 310 g CO_2e

  Note: These are 100-year equivalencies
- Emissions are sometimes reported as "carbon equivalent" (CE)
  - 1 g CO_2e = (12/44) g CE
  - 1 g CE = (44/12) g CO_2e
- Never report results as "X units of greenhouse gases"!
- "Biogenic" $CO_2 \neq$ "Anthropogenic" CO_2

Greenhouse Gas and Energy Benefits of Recycling

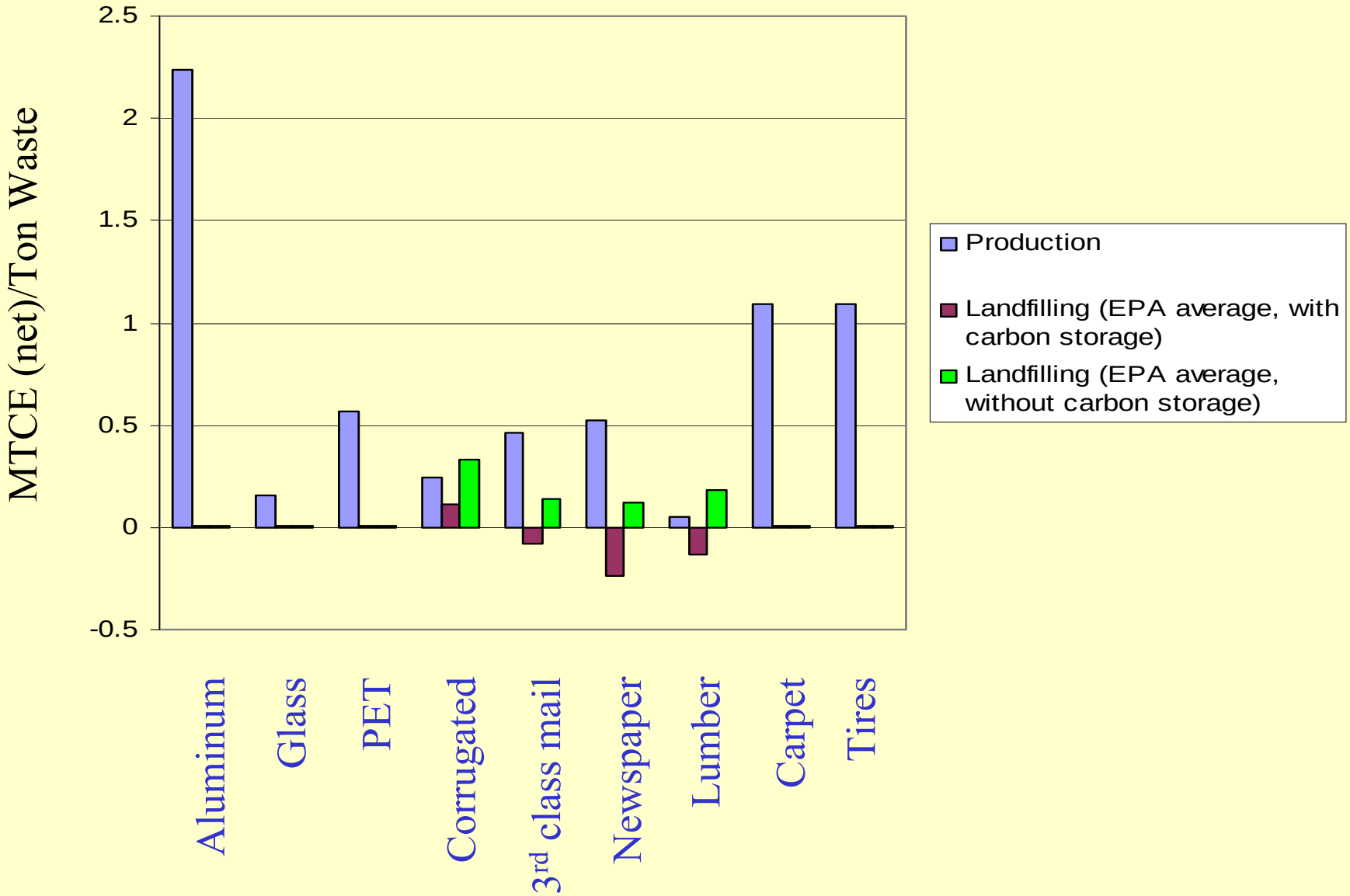
- Recovery in Oregon in 2006 reduced greenhouse gas emissions by ~3.5 million tons of CO2e
  - ~5.1% of total statewide emissions
  - Equivalent of 740,000 “average” passenger cars
- Recycling in Oregon in 2006 saved ~27 trillion BTUs of energy
  - ~2.4% of total statewide use
  - Equivalent of ~214 million gallons of gasoline

Year 2004 "Business as Usual" Forecast of GHGs for Materials and Waste (Oregon)

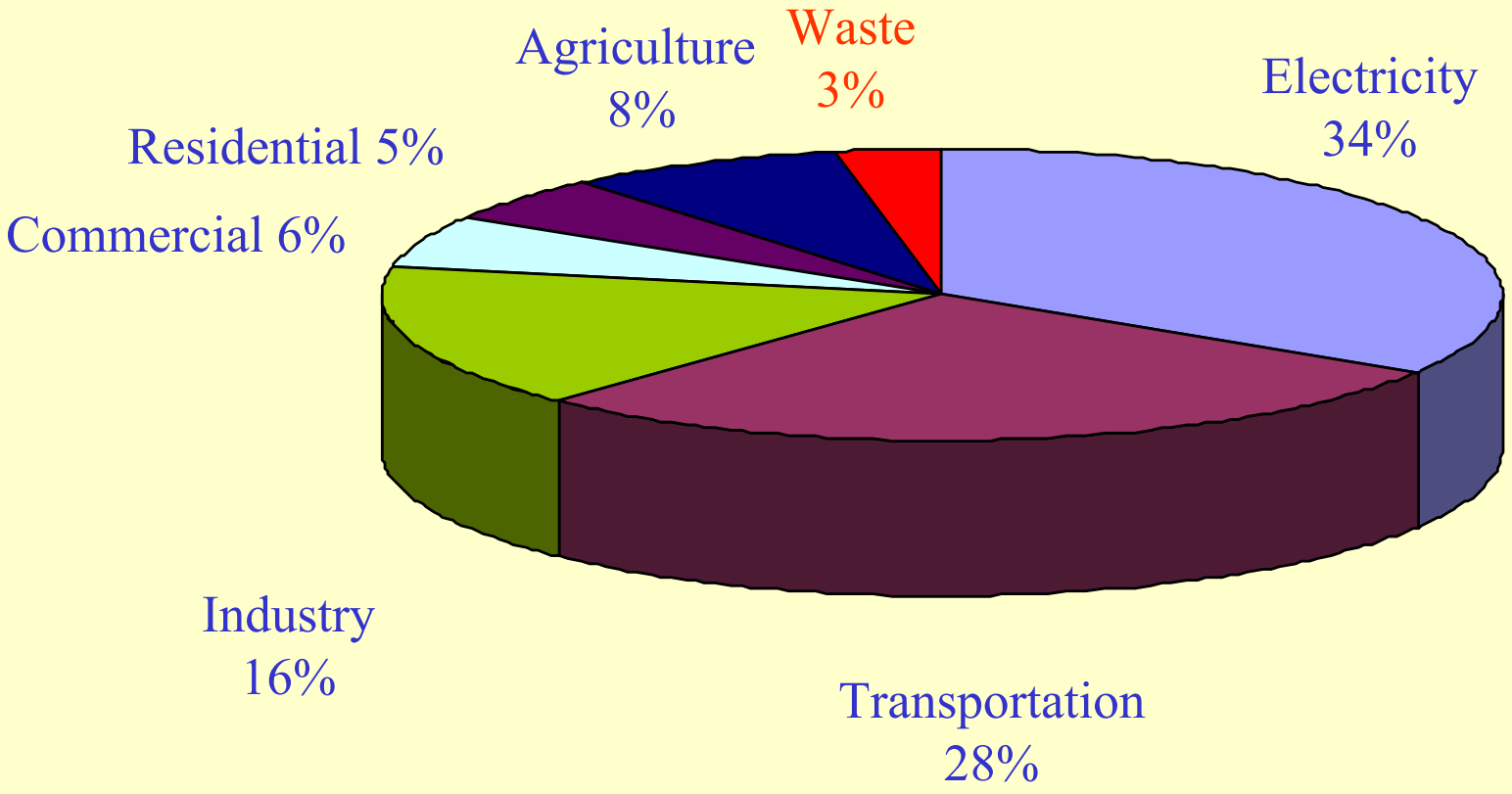


Material Production	10.9 $MMTCO_2E$
Recycling (manufacturing)	-1.0 $MMTCO_2E$
Recycling (forest related offsets)	-2.1 $MMTCO_2E$
Composting	-0.1 $MMTCO_2E$
Combustion (emissions)	0.3 $MMTCO_2E$
Combustion (energy recovery)	-0.6 $MMTCO_2E$
Landfilling (net of energy recovery, carbon storage)	1.4 $MMTCO_2E$
Total (2015)	**8.9 $MMTCO_2E$**

For many materials, production emissions > disposal emissions

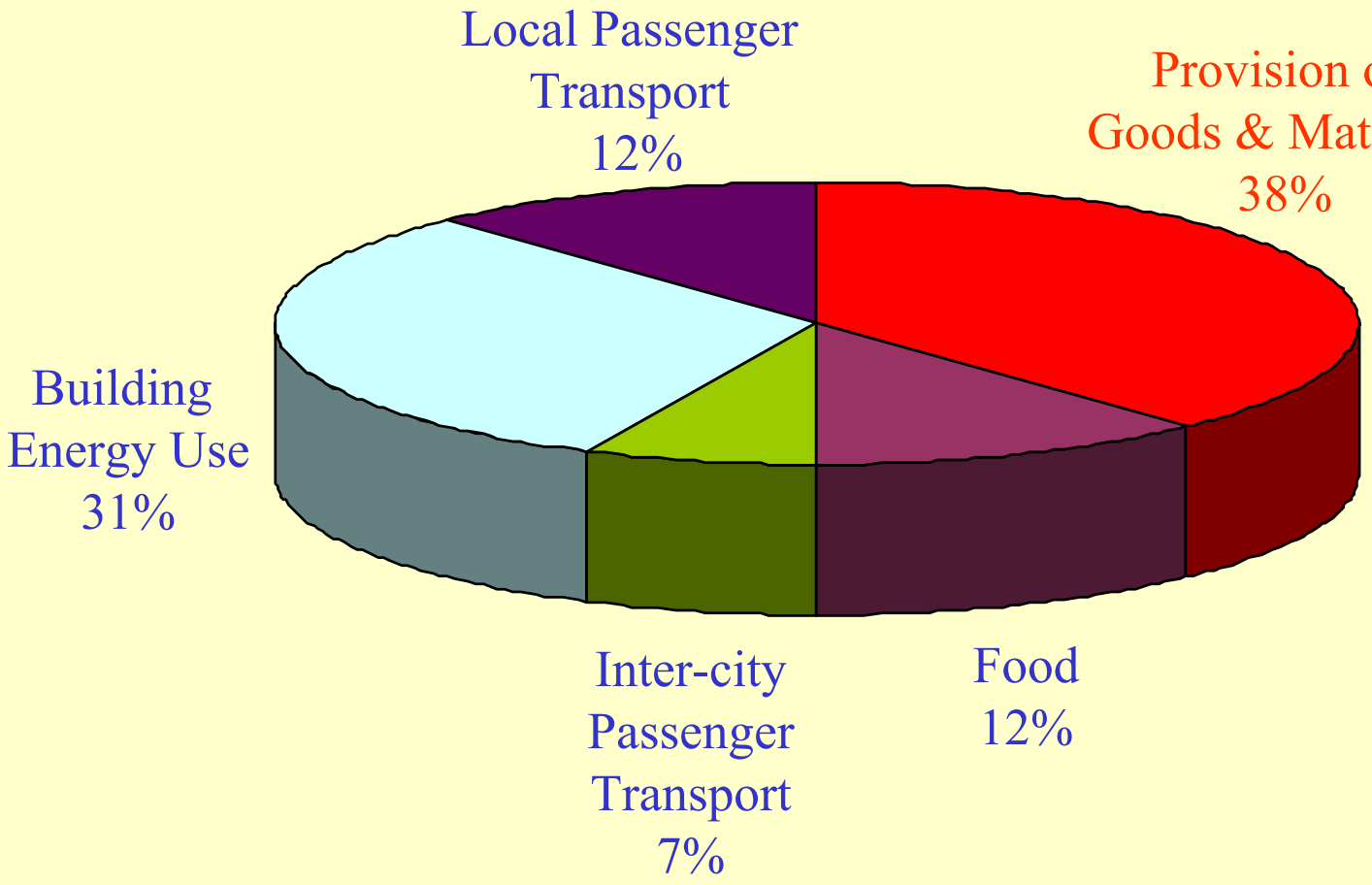


US Greenhouse Gas Emissions (2005): Conventional View



Source: US EPA

US Greenhouse Gas Emissions (2005): Alternative View

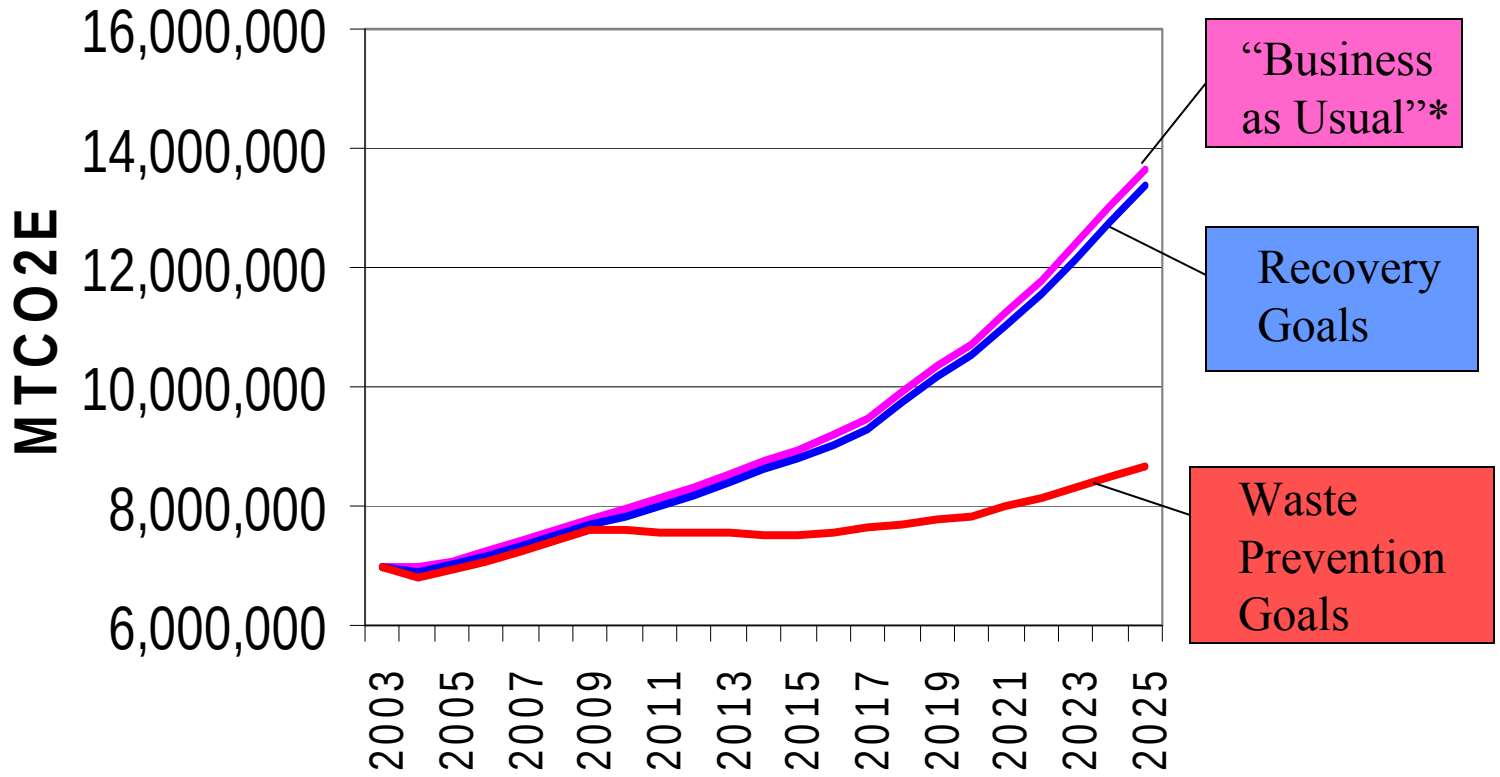


Source: US EPA (Preliminary)

Prevention and reuse are generally better than recycling

- Prevention: see www.deq.state.or.us/lq/pubs/docs/sw/WPSBkgd02.pdf
- Reuse:
  - Reusing a personal computer saves 5 - 20 times more energy than recycling it.
  - Reusing a corrugated box saves 3 - 4 times more energy than recycling it.

Year 2004 Forecast of Oregon's Materials-Related Greenhouse Gas Emissions



*Per-capita waste generation continues to grow, recovery rate stays at 47%

DEQ E-Commerce Soft Goods Packaging Study: Materials Evaluated

Corrugated box* with:

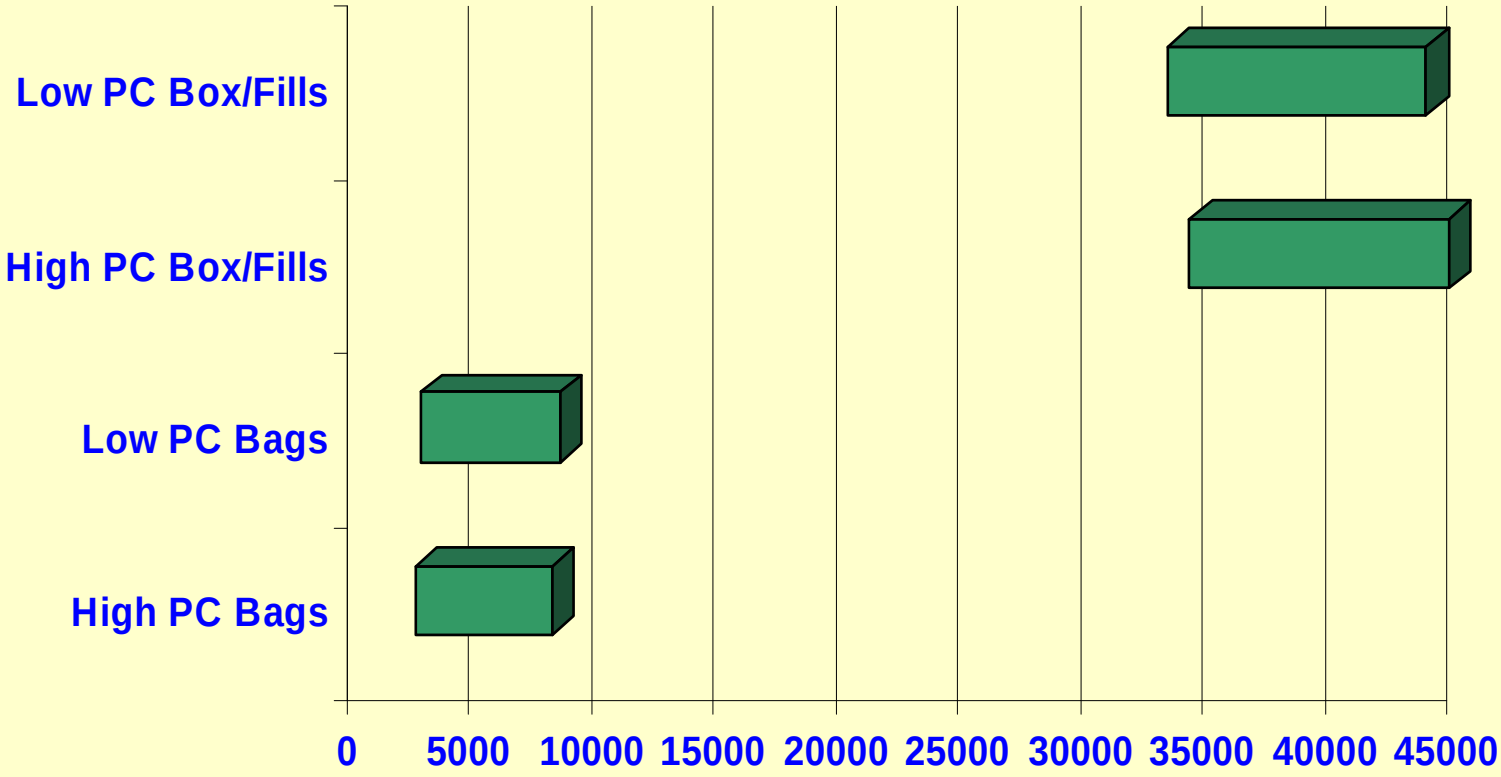
Void Fill (for boxes)
Polystyrene loose fill*
Corn starch loose fill
Molded paper loose fill
Inflated "air pillows"*
Newsprint dunnage*
Kraft dunnage*
Shredded office paper
Shredded boxes

Alternatives:

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.

Results: Atmospheric Fossil Derived Carbon Dioxide*



*Landfill, waste incineration, and forestry-related emissions not included.

DEQ Waste Prevention Strategy

- Defines priorities for DEQ's work in waste prevention for the next 10 years.
- Short-term (3-year) workplan.
- Adopted December 2007.

www.deq.state.or.us/lq/sw/wasteprevention/wpstrategy.htm

Waste Prevention Strategy: Four Focus Areas

1. Design, construction, remodeling and demolition of buildings
2. Business waste (short-term focus on packaging)
   - Support SPC (MERGE), Wal-Mart Packaging SVN, others
   - E-commerce outreach
   - Bioplastics research
   - Drinking water LCA
3. Consumer outreach
4. “Foundation” research and analysis

Evaluation of policy/program options: Frequency of recycling collection

100 tons of "average" curbside recyclables in Oregon:

Collection Fleet

~ 4 MTCO2E emissions from on-route collection vehicles (and diesel production)

Displacement of Virgin Resources

~ 235 MTCO2E savings (net) when these recyclables displace virgin feedstock in production

Change from Weekly to Every-Other-Week Collection of Recyclables

Reduce emissions <50%

→ ~ 2 MTCO2E **decrease** in emissions

Reduce tonnage recycled 9-20%

→ ~ 21 to ~47 MTCO2E **increase** in emissions

Less frequent collection increases global emissions

What about self-haul (such as return to retail)?

- Self-haul can have significant impacts.
- Example:
  - Delivering 10 pounds of mixed plastics for recycling in an average car reduces emissions equivalent to driving the car 17 miles.
- Strategies:
  - Increase quantity of materials collected per trip.
  - Decrease extra/additional trips/miles through co-location of collection points.
  - Remember that greenhouse gases aren't our only environmental concern.

Long-haul is not a limiting environmental factor for many recyclables

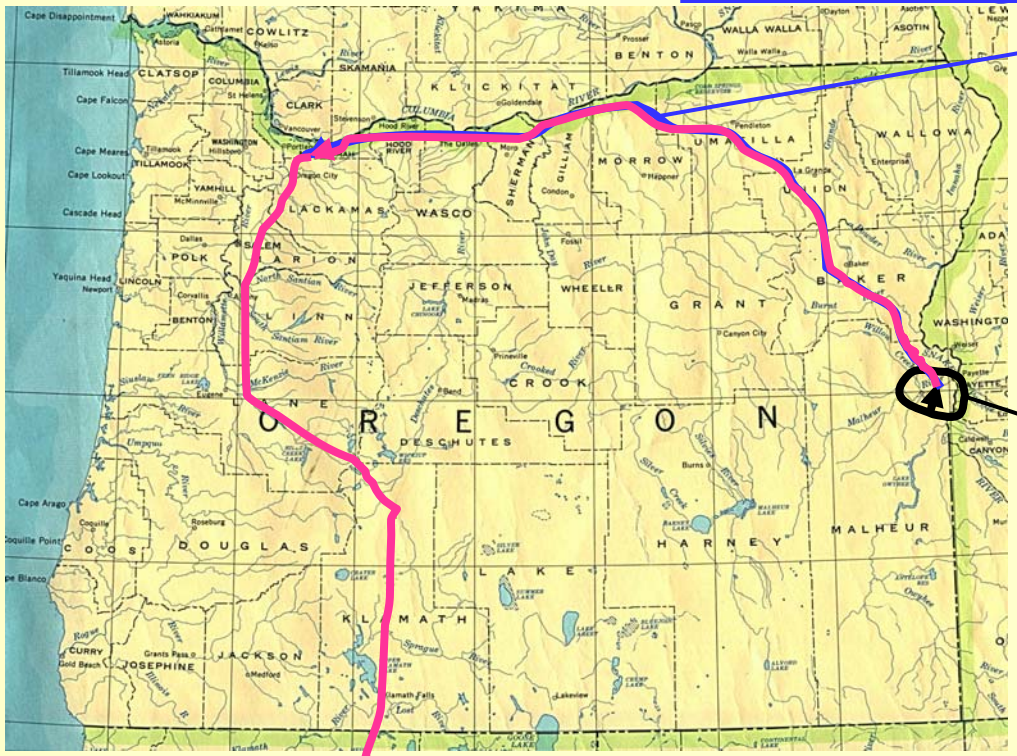
Material	Production & Forestry Savings (MTCE/ton collected)	"Break-Even Point" (miles) Truck	Rail	Freighter
Aluminum	3.44	116,000	451,000	524,000
Corrugated	0.79	27,000	104,000	120,000
Newspaper	0.68	23,000	90,000	104,000
Steel	0.48	16,000	63,000	73,000
LDPE	0.36	12,000	47,000	55,000
PET	0.33	11,000	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)

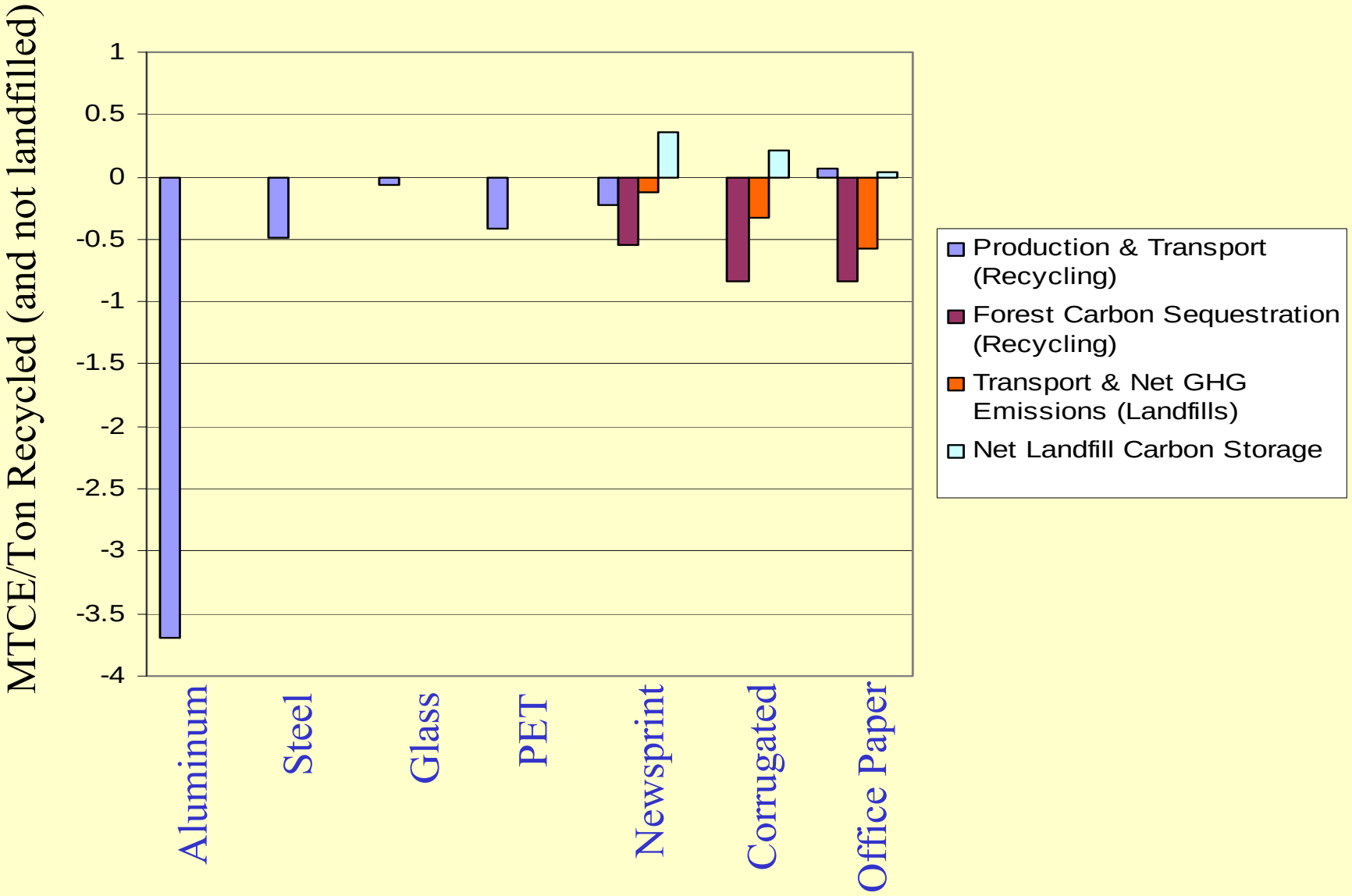
Cullet to Bottle Recycling (Portland)
Net Energy Savings: ~2.1 MMBTU/ton



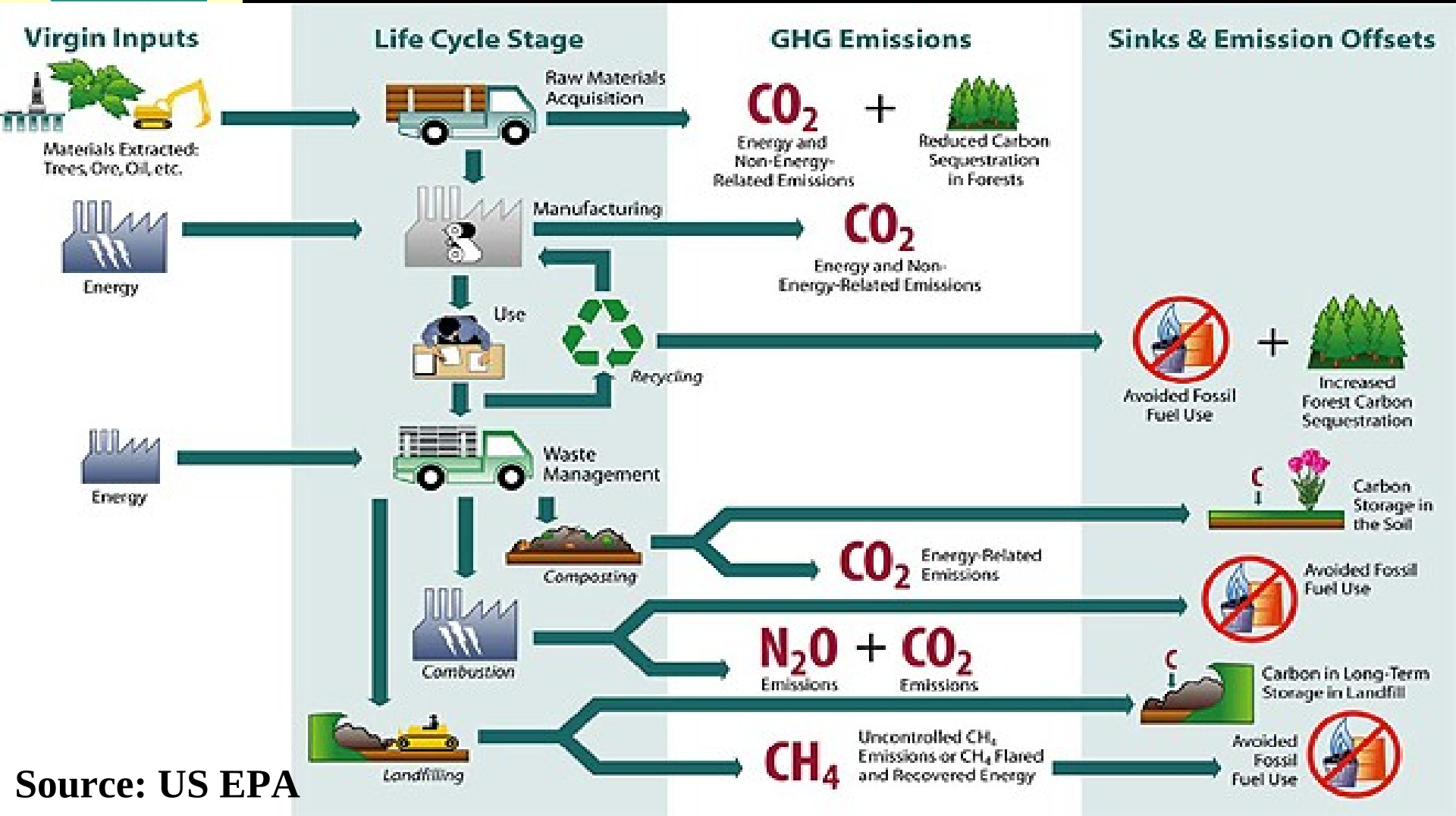
Cullet to Aggregate Recycling (Local)
Net Energy Savings: ~0.2 MMBTU/ton

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

Recycling benefits vary by material



Composting: A Cautionary Tale!



Source: US EPA

Key Findings

- "Upstream" emissions dominate (for most materials/wastes)
- The impacts of goods is much larger than conventionally recognized by most GHG inventories . . . and these impacts are likely growing.
- Waste prevention is very important
- Recycling is beneficial
  - Collection-related emissions are surprisingly insignificant
  - So are long-haul transportation emissions
  - Benefits tend to be driven by virgin feedstock displacement (energy and forestry, not disposal avoidance)
  - Benefits can vary by end use

Key Findings, continued

- Recycled content does not consistently correlate with reduced GHG emissions
- Composting can also have greenhouse gas reduction benefits
- Among engineering controls, conversion of CH_4 to CO_2 provides a greater benefit than energy recovery . . .

  . . . although energy recovery can add benefits.
- Public perception to the contrary, degradability in a landfill is not necessarily a good thing!
- GHG benefits are becoming much easier to estimate.

West Coast Forum on Climate Change, Waste Prevention, Recovery and Disposal

Sponsored by EPA Regions 9 (CA, AZ, NV, HI) and 10 (OR, WA, AK, ID)

www.epa.gov/region10/westcoastclimate.htm

- Climate Change 101: The Basics, State Overviews

  June 26, 1:00 – 3:30 PDT
- Climate Change 201: Compost and Landfill Issues

  July 16, 1:00 – 3:30 PDT
- Climate Change 301: Accounting Systems, Modeling, and Economic Incentives

  August 5, 1:00 – 3:30 PDT

Thank You!

For more information:

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