ASTSWMO State Solid Waste Managers Conference

Life Cycle Thinking and Solid Waste: A State's Perspective

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Tom McCall
Governor of Oregon, 1967-1975

"Come visit us again and again . . . but for heaven's sake, don't come here to live."
(January 1971, Interview with Terry Drinkwater, CBS News)

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Three Examples of Life Cycle Analysis Applied to Solid Waste

- Oregon Governor's Advisory Group on Global Warming
- Energy Benefits of Recycling
- DEQ E-Commerce Packaging Study

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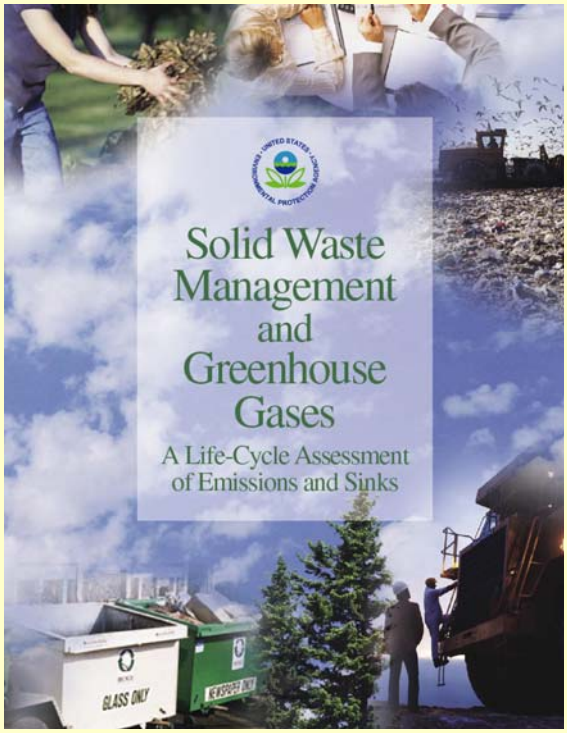
Global Warming



EPA Climate Change and Waste Resources:

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

WARM and other tools:
http://epa.gov/climatechange/wycd/waste/tools.html

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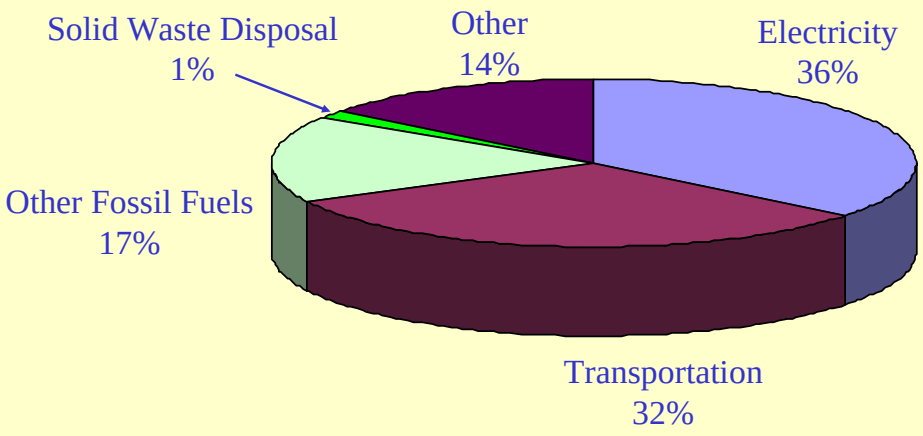
Oregon Greenhouse Gas Emissions Inventory, 2000 (Conventional Accounting)



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Key Findings: Global Warming

- Conventionally, landfills and incinerators contribute ~1% of Oregon's greenhouse gas emissions.
- But "upstream" (production-related) emissions of these materials are ~10 times higher (possibly more).
  - Greenhouse gas benefits of prevention and recycling are primarily "upstream"

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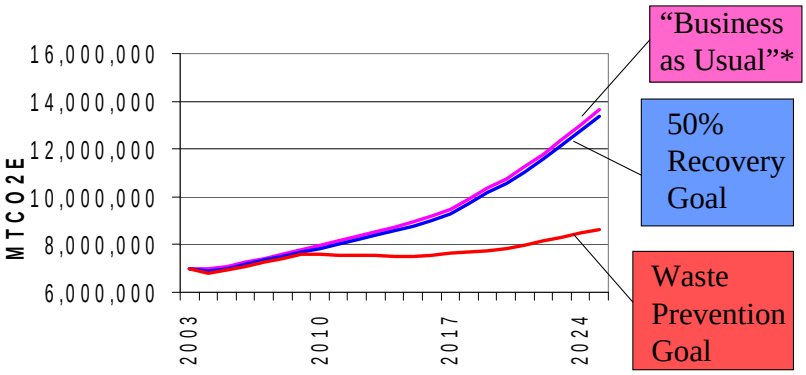
Key Findings: Global Warming (continued)

- Conventional accounting/inventories mask the full impact of materials
  - Upstream emissions are spread across other categories (industrial energy use, transport)
  - Many emissions aren't even accounted for (out-of-state and foreign production)
    - 1997: net embodied CO_2 emissions in US trade: + 0-5% of national inventory
    - 2004: net embodied CO_2 emissions in US trade: + 5-21% of national inventory

Key Findings: Global Warming (continued)

- Greenhouse gas potential of recycling is large
  - "Counting recovery" in Oregon in 2005 reduced emissions by 3.3 million metric tonnes of CO_2 equivalent
    - 4.6% of statewide emissions
    - Equivalent of removing 710,000 "average" passenger cars
- Curbside vehicle emissions are relatively small
  - 100 tons of mixed curbside recyclables: ~4 $MTCO_2E$ from on-route collection emissions compared to -235 $MTCO_2E$ net (system)
- Greenhouse gas potential of waste prevention is even larger

Year 2004 Forecast of Materials-Related Greenhouse Gas Emissions



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

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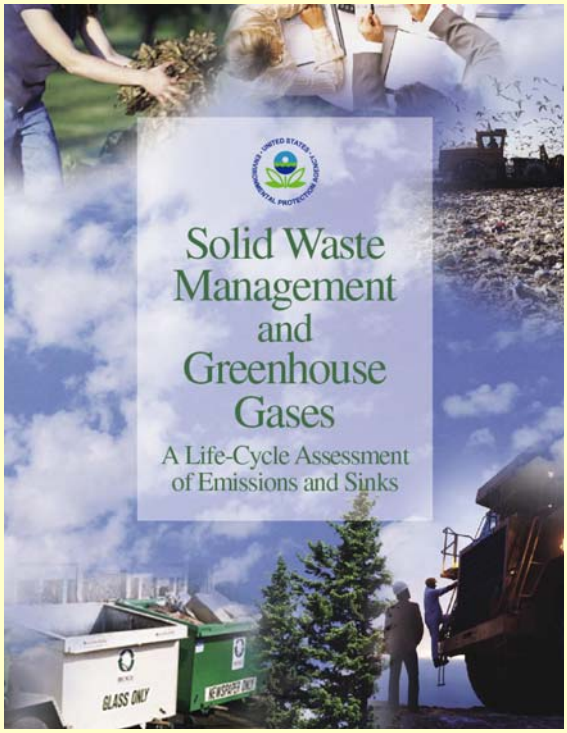
Energy



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Key Findings: Energy

- Again, fuel use by collection vehicles is relatively unimportant.
  - 100 tons of mixed curbside recyclables: ~54 MM BTU for on-route collection compared to ~1,440 MM BTU saved by industry using those recyclables
- Long-haul also not very significant

Focus: Transport to Markets

Question: When are Markets "Too Far" to Justify Long-Haul?

Material	Production Savings (MMBTU ton collected)	"Break-Even Point" (miles) Truck	Rail	Freighter
Aluminum	177	121,000	475,000	538,000
LDPE	61	41,000	162,000	184,000
PET	59	40,000	157,000	178,000
Steel	19	13,000	52,000	59,000
Newspaper	16	11,000	43,000	49,000
Corrugated	12	9,000	33,000	38,000
Office Paper	10	7,000	27,000	31,000
Boxboard	6.5	4,400	17,400	19,800
Glass (to bottles)	1.9	1,300	5,100	5,800

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Production energy only. Ignores other forms including collection phase and waste management alternatives

Some assumptions regarding back-haul and trucks not fully loaded

The Choice of End-Markets Matter (sometimes)

Glass Bottles in Ontario, Oregon (Idaho border)

Bottles to aggregate (local market)

- Net savings per ton collected: ~0.2 MMBTU
  Excludes local processing, transport; assumes displaced virgin aggregate 30 miles distant

Bottles to Portland (bottle plant)

- Net savings per ton collected: ~2.1 MMBTU

Bottles to California via Portland (fiberglass)

- Net savings per ton collected: ~3.2 MMBTU

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Key Findings: Energy (continued)

- Energy savings potential of recycling is large
  - Recycling in Oregon in 2005 saved ~30 trillion BTUs of energy
    - ~2.6% of total statewide use
    - Equivalent of ~237 million gallons of gasoline
- Again, benefits are primarily upstream, not downstream

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E-Commerce Packaging

A Common Question: To Box, or To Bag?

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Bags and Boxes

- Boxes have recyclability and recycled-content advantages over most types of bags.
- But bags have waste prevention advantages over boxes (for non-breakable items), due to lower weight.
- Different types of bags and void fills for boxes exist – can we state with any certainty that one general approach is better than the other, from a cross-media perspective?

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DEQ Life Cycle Inventory Analysis: Background

- Commissioned by Oregon DEQ and co-funded by Metro (Portland) and the U.S. EPA Environmentally Preferable Purchasing Program.
- Study is an inventory analysis (not an impact analysis) of 26 different packaging options for mail-order non-breakable items.
- Consultant team:
  - Life Cycle Analysis: Franklin Associates (Kansas)
  - Packaging Engineering: Pack Edge Development (Oregon)
  - Critical Review Panel: Mary Ann Curran (EPA ORD), Dr. Joyce Cooper (U. of Washington) and Dr. Gregory A. Keoleian (U. of Michigan)
- Study available at: www.deq.state.or.us/lq/sw/packaging/resources.htm

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DEQ Packaging Study: Materials Evaluated

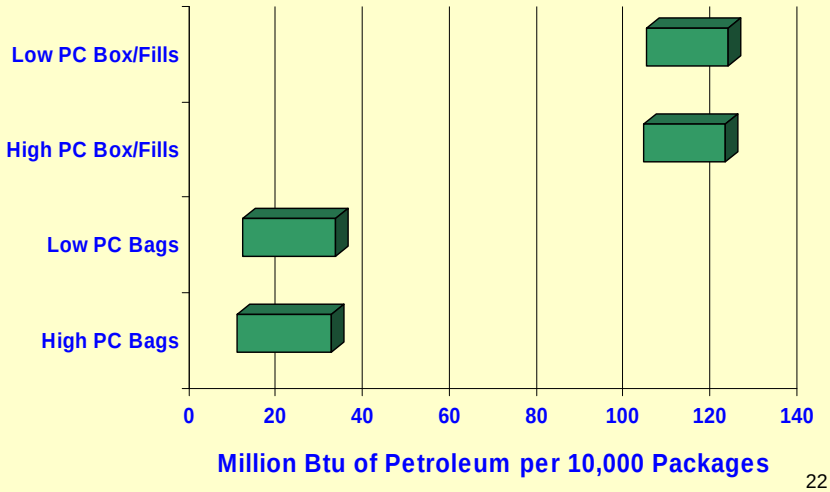
Corrugated box*

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.

Results: Petroleum



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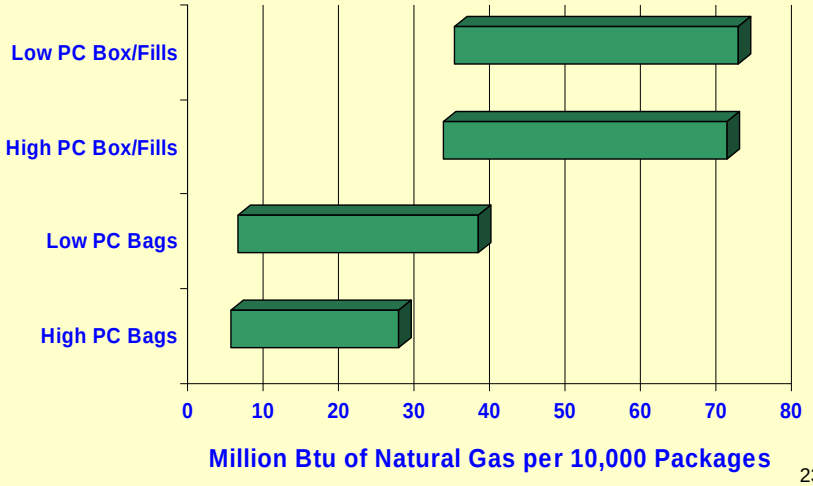
Results: Natural Gas



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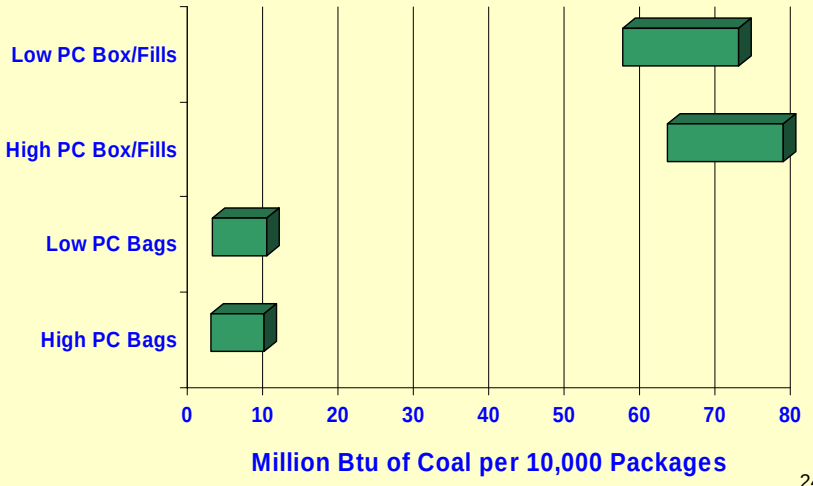
Results: Coal



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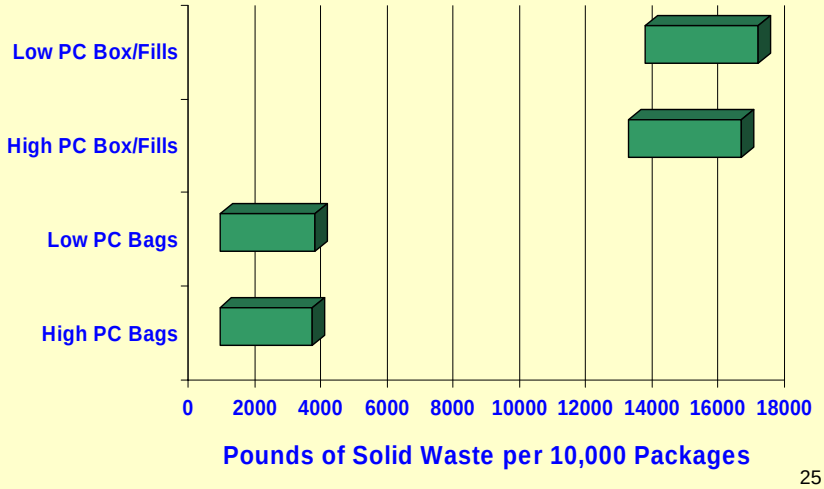
Results: Solid Waste



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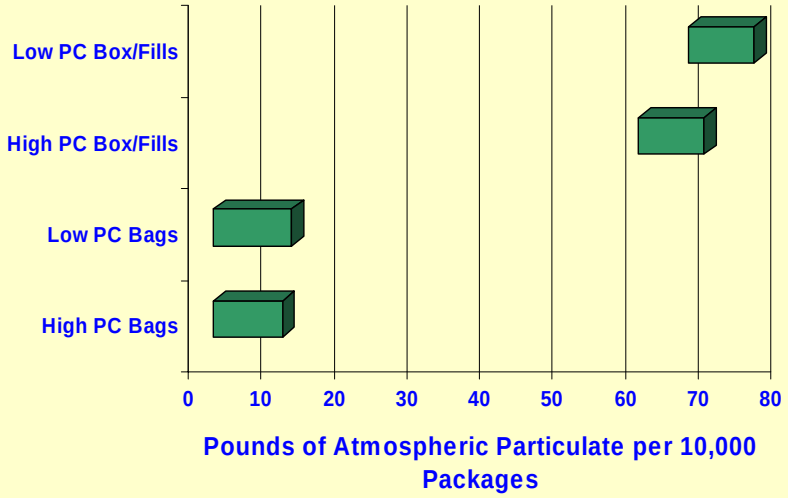
Results: Atmospheric Particulate



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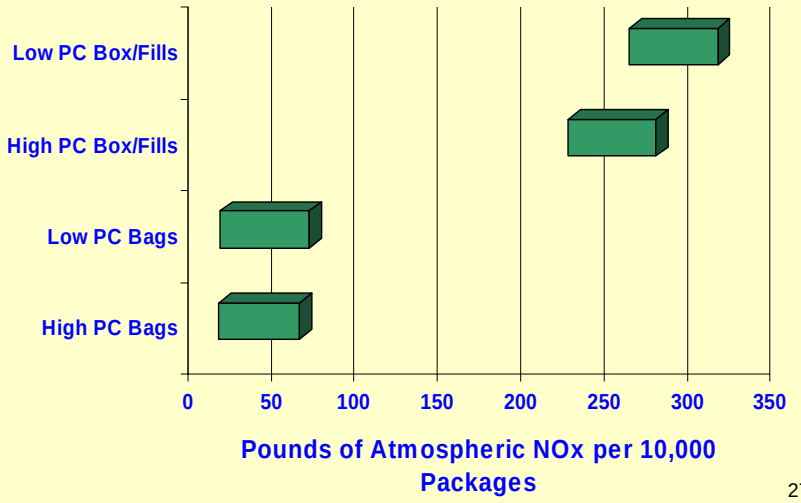
Results: Atmospheric NOx



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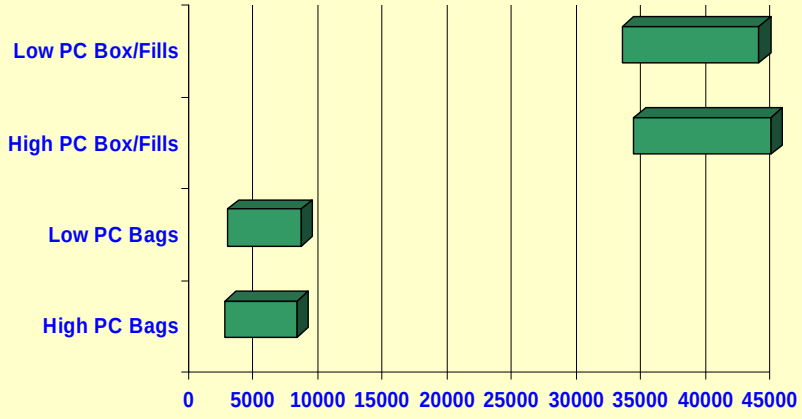
Results: Atmospheric Fossil Derived Carbon Dioxide*



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

Pounds of Atmospheric Fossil Derived CO2 per 10,000 Packages

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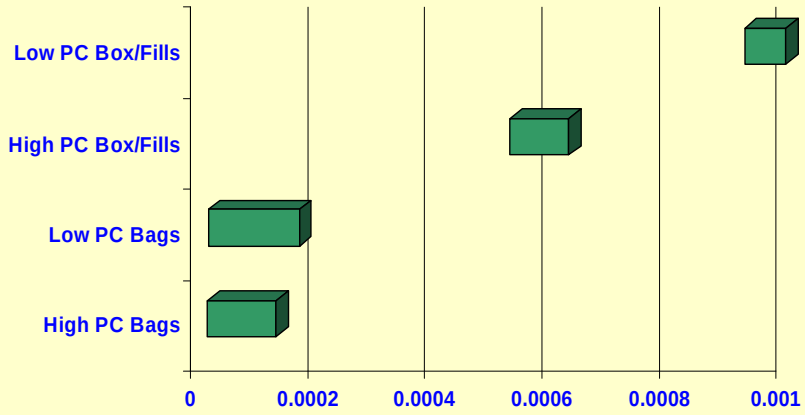
Results: Atmospheric Mercury



Pounds of Atmospheric Mercury per 10,000 Packages

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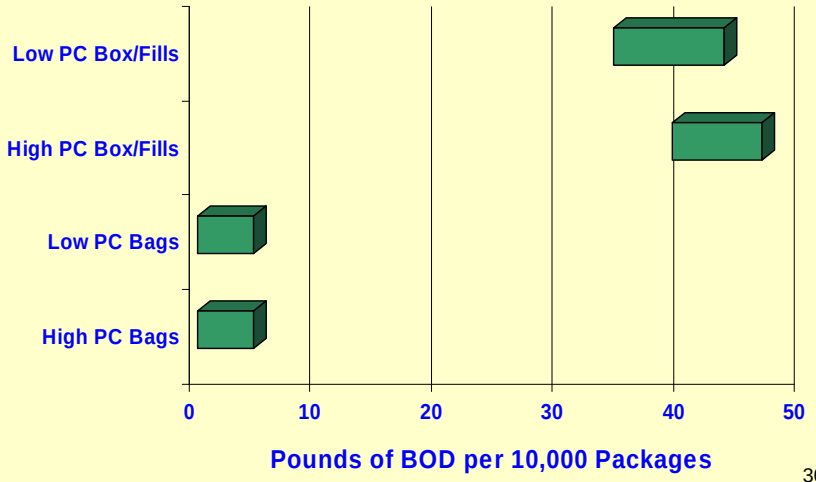
Results: Biological Oxygen Demand



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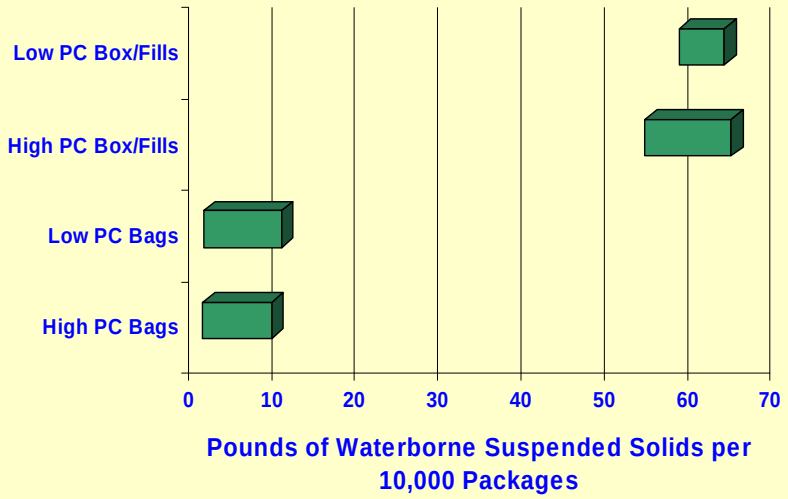
Results: Waterborne Suspended Solids



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Mass Matters!

- Weight of materials used is a critical factor:
  - All bags evaluated have lower burdens than boxes (in most categories) because of their much lower weight.
  - This confirms (indirectly) the relative ranking of waste prevention and recycling in the waste management hierarchy.
- Recyclability and recycled content are not always the best predictor of life cycle energy use or emissions:
  - The manufactured loose fill option with the highest post consumer content (molded pulp) also has the highest use of non-renewable fuels.
  - BUT, once you've chosen a packaging material, increasing post-consumer content and recycling opportunities can have benefits.

Caveats and Disclaimers

- Please read the foreword and preface of the report.
- Please don't . . .
  - . . . interpret the study as being "anti-paper"
  - . . . interpret the study as being "anti-box"
  - . . . interpret the study as being "anti-recycling" or "anti-recycled content"

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DEQ/Metro Packaging Waste Prevention Project: Other Results

- Net savings: $994,000 and 493 tons of waste/year.
- Estimated the energy savings from some packaging waste prevention actions.
  - Rejuvenation box reuse: ~1 billion BTU/year.
  - Norm Thompson use of shipping bags: ~21 billion BTU/year (~14 billion BTU/year from non-renewable fuels).

Closing Thoughts

Closing Thoughts

- The hierarchy generally makes good sense
  - Prevention (and reuse) before recycling
  - Recycling before composting
  - Recovery before landfilling
- Benefits of focusing upstream, reducing focus on landfill avoidance
- Life cycle analysis and a focus on energy and greenhouse gases provides waste programs with tools and a framework useful for:
  - Prioritizing efforts
  - Communicating with public and policy makers
  - Conducting critical analysis of options to achieve real environmental benefits
- Life cycle inventory analysis and tools are becoming easier to use . . . thank you again, EPA!

Thank You

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Links to Additional Resources

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