Reduce, Reuse, Recycle: “Waste Management” or “Climate Management”?

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Overview

- A life cycle view of materials
- The climate impact of materials and waste
- Waste/discards management
  - Benefits of recycling
- The importance of “reduce, reuse” and purchasing
- Greenhouse gas inventories
Carbon Goggles
A Life Cycle View of Materials

- Electric Power Industry: 34%
- Transportation: 28%
- Industry: 19%
- Agriculture: 8%
- Commercial: 6%
- Residential: 5%

Source: US EPA (2009)
Materials Matter: Systems-Based Geographic Emissions Inventory (2006)

- Building Lighting and HVAC: 25%
- Transportation of People: 24%
- Provision of Goods: 29%
- Provision of Food: 13%
- Use of Appliances and Devices: 8%
- Infrastructure: 1%

Materials (excluding use): 42%

Source: US EPA (2009)
For Materials, “Upstream” Emissions Dominate

Provision of Materials 42%

“Upstream” Processes 32.2%

Freight 7.1%

Landfills & Wastewater 2.2%

Building Lighting and HVAC 25%

Transportation of People 24%

Use of Appliances and Devices 8%

Infrastructure 1%
EPA Climate Change and Waste Resources:

Foundation Paper: [http://www.epa.gov/oswer/docs/ghg_land_and_materials_management.pdf](http://www.epa.gov/oswer/docs/ghg_land_and_materials_management.pdf)

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

WARM Report: [http://www.epa.gov/climatechange/wycd/waste/reports.html](http://www.epa.gov/climatechange/wycd/waste/reports.html)
Greenhouse Gases Over the Product Life Cycle – EPA’s WARM Tool

Source: US EPA
Greenhouse Gas Benefits of Recycling

- Recycling in Oregon in 2010 reduced greenhouse gas emissions by ~3.0 million metric tons of CO2e
  - ~4.3% of total statewide emissions
  - Equivalent of 620,000 “average” passenger cars
  - Benefits are dominated by “upstream” processes (not disposal avoidance)
Long-Haul Is Not a Limiting Factor

<table>
<thead>
<tr>
<th>Material</th>
<th>Production &amp; Forestry Savings (MTCE/ton collected)</th>
<th>“Break-Even Point” (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Truck</td>
</tr>
<tr>
<td>Aluminum</td>
<td>3.44</td>
<td>116,000</td>
</tr>
<tr>
<td>Corrugated</td>
<td>0.79</td>
<td>27,000</td>
</tr>
<tr>
<td>Newspaper</td>
<td>0.68</td>
<td>23,000</td>
</tr>
<tr>
<td>Steel</td>
<td>0.48</td>
<td>16,000</td>
</tr>
<tr>
<td>LDPE</td>
<td>0.36</td>
<td>12,000</td>
</tr>
<tr>
<td>PET</td>
<td>0.33</td>
<td>11,000</td>
</tr>
<tr>
<td>HDPE</td>
<td>0.30</td>
<td>10,000</td>
</tr>
<tr>
<td>Glass (to bottles)</td>
<td>0.07</td>
<td>2,000</td>
</tr>
</tbody>
</table>

“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

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

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

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

• Emissions, emissions avoidance are variable
• Composting food waste has higher per-ton benefits than composting yard debris
• GHG benefits/impacts may be small
  • In Oregon (2009), recycling benefits were ~56 times higher than compost impacts
  • Recycling tonnage was only 3 times higher
  • Recognize high uncertainty in compost results, other (non-climate) benefits of composting
DEQ’s Life Cycle Analysis of Water Delivery

• 3 basic systems:

Full study at:
http://www.deq.state.or.us/lq/sw/wasteprevention/dinkingwater.htm
**Disposal vs. Recycling**

- **Normalized impact (purchase + disposal = 100%)**
  - **Energy Consumption**
  - **Global Warming Potential**

- **Standard Oregon purchase** + disposal
- **Standard Oregon purchase** + 100% recycling

*Half-liter bottle; 0% recycled content; 13.3 grams; local water*
Disposal vs. Recycling vs. Prevention
(Drinking Water Example)

Normalized impact
(purchase + disposal = 100%)

Energy Consumption
Global Warming Potential

- Standard Oregon purchase* + disposal
- Standard Oregon purchase* + 100% recycling
- Tap water in reusable bottle** (1 use and wash/day for 1 year)

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

**Average of aluminum/PET/steel; no recycling; high-water use dishwasher
Best Case Recycling vs. Best Case Prevention

Normalized impact ("best" single-use PET = 100%)

- "Best" single-use PET*
  - Not currently on market. 9.8 grams; 25% recycled content; very short transport; minimal processing of water; 100% recycling.

- "Best" tap water**
  - Steel reusable; used 5 years; used 2 times/day; washed weekly in efficient, full dishwasher; 100% recycling.

*Not currently on market. 9.8 grams; 25% recycled content; very short transport; minimal processing of water; 100% recycling.

**Steel reusable; used 5 years; used 2 times/day; washed weekly in efficient, full dishwasher; 100% recycling.
Protestant (PLA) and Recyclable (PET) Water Packaging – Global Warming Potential (PLA decomposes in landfill)

Darker colors are “upstream” impacts; lighter colors are “downstream” impacts (discards management)
Compostable (PLA) and Recyclable (PET) Water Packaging – Global Warming Potential (PLA inert in landfill)

Darker colors are “upstream” impacts; lighter colors are “downstream” impacts (discards management)
The importance . . . and limitations . . . of waste recovery (recycling, composting)

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

provision of materials 42%

buildings

transporting people

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

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

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

- Common uses of college/university inventories:
  - Identify how the college/university contributes to emissions
  - Support GHG reduction planning (scenario analysis)
  - Establish a baseline and reduction goals
  - Measure change relative to the baseline
  - Communicate all of the above to administration, students, etc.
GHG Inventories: Corporate Reporting and the “Three Scopes”
Oregon University System Emissions FY 2008, by Scope Category Including Embodied Emissions in Supply Chain

Source: Good Company (2009)
Thank You!

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