



Reducing Environmental Impacts of Packaging and Products

David Allaway, Oregon DEQ

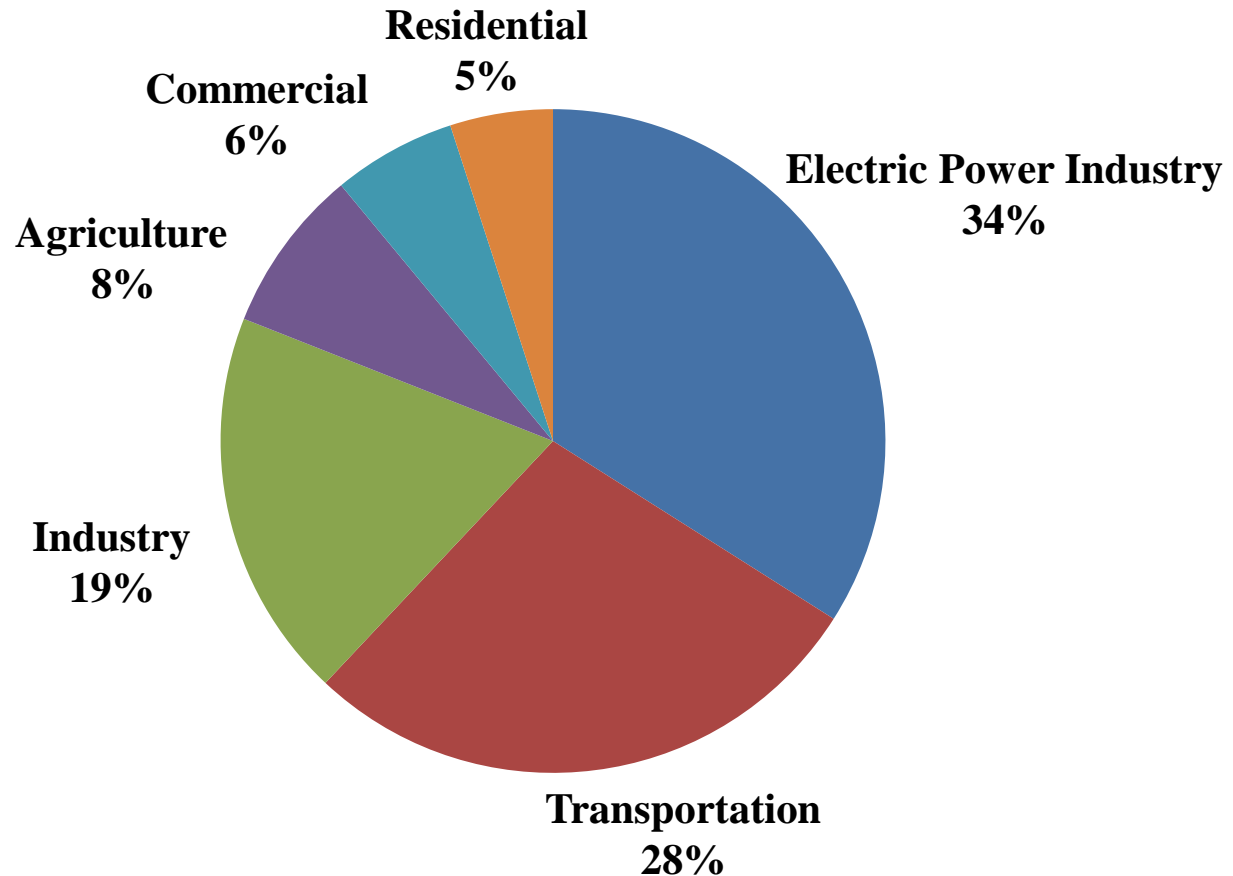
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January 6, 2010

Sponsored by Lane County Waste Management, Master Recyclers and City of Eugene Sustainability Program

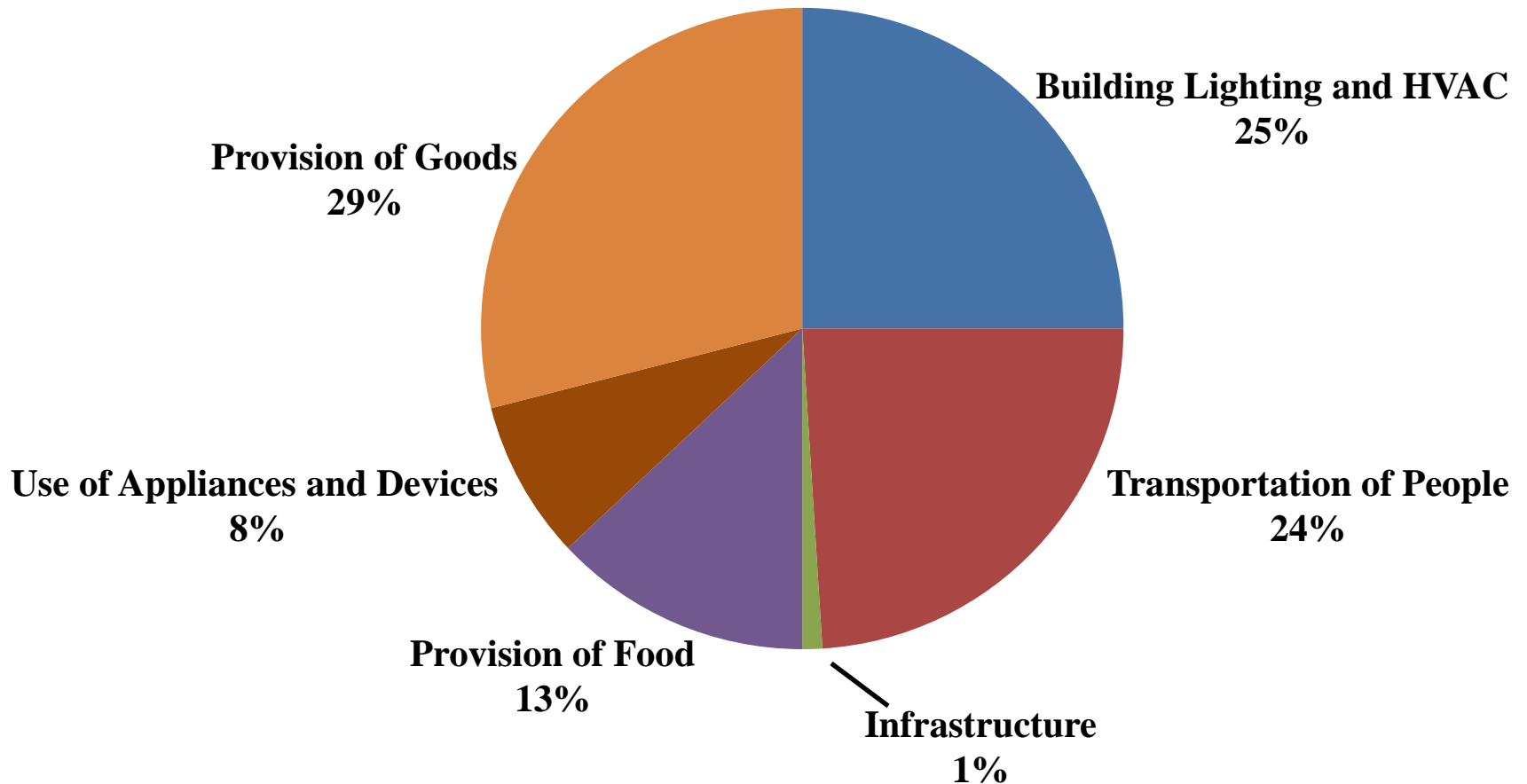


Traditional Sector-Based View of U.S. Greenhouse Gas Emissions (2006)



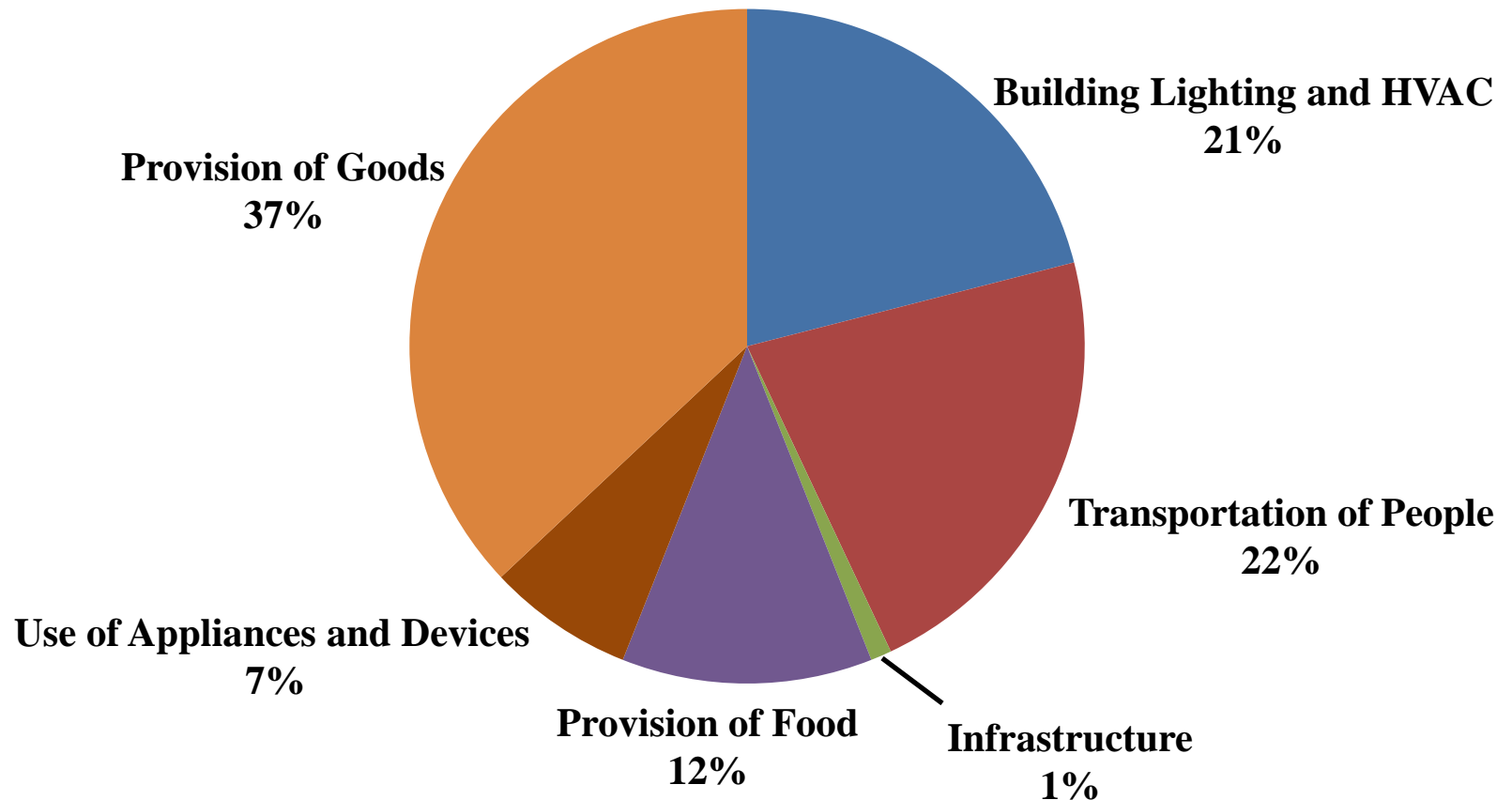


Materials Matter: Systems-Based Geographic Emissions Inventory (2006)





Systems-Based Emissions Inventory, Geographic Emissions *Adjusted for Imports and Exports* (2006)



Source: Joshua Stolaroff/Product Policy Institute (2009), based on EPA (2009) and Weber & Matthews (2007)

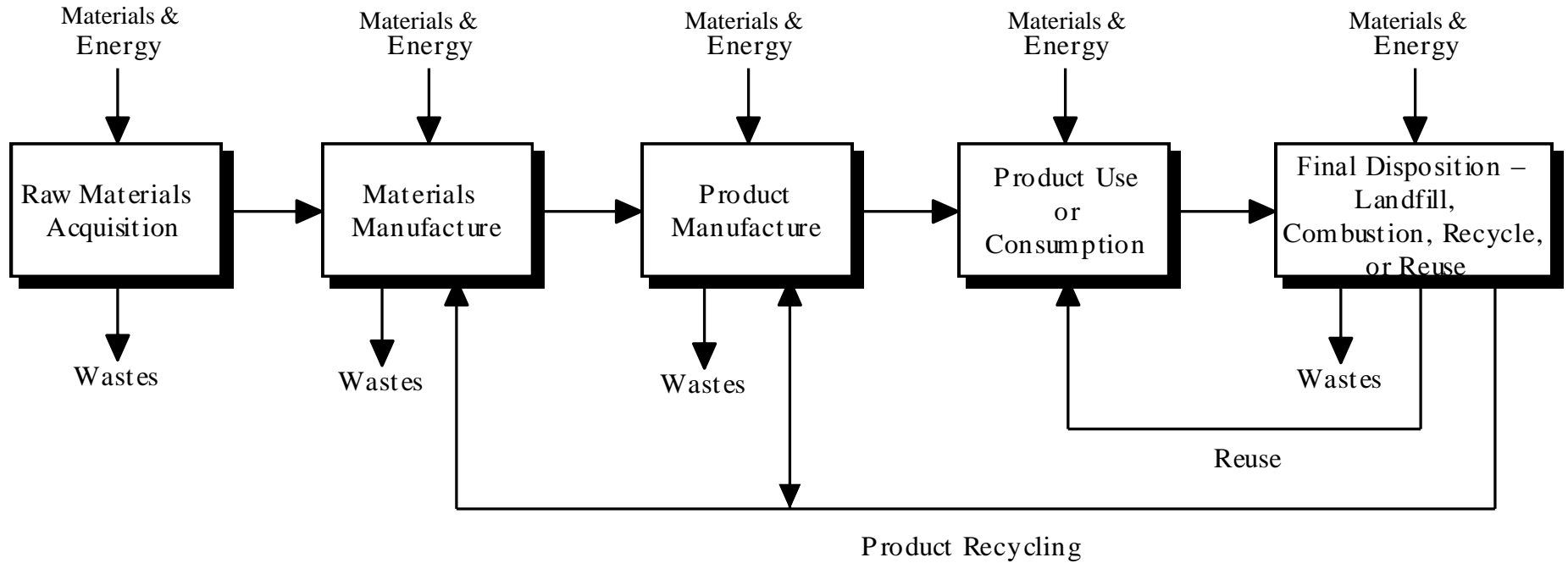


Presentation Overview

- Understanding environmental impacts: Life cycle thinking and analysis
 - “Upstream” and “downstream” impacts
 - Two case studies
- Focus on business activities
 - Greenhouse gas inventories
 - Waste prevention for businesses



A Life Cycle

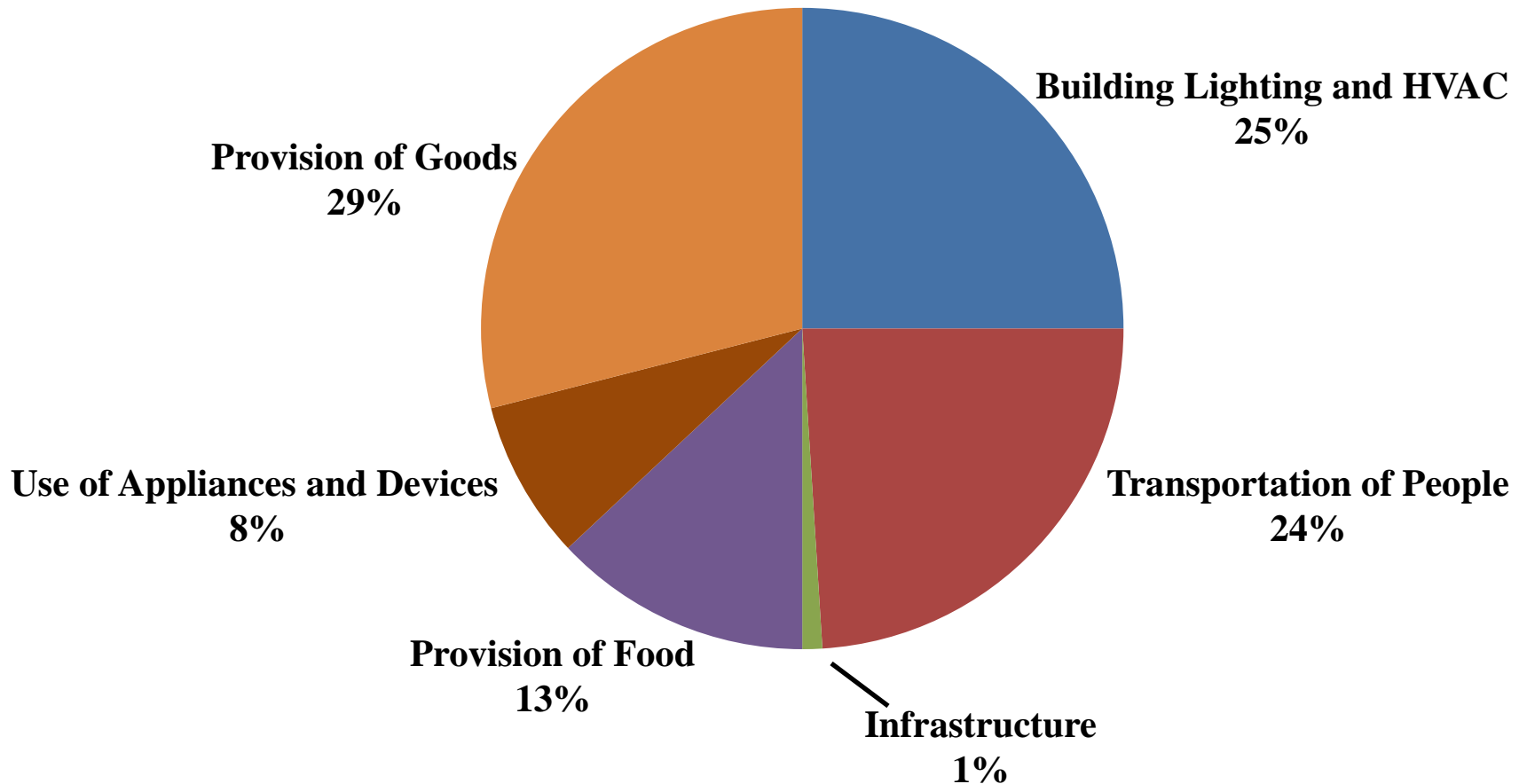


← “Upstream” →

“Downstream” →

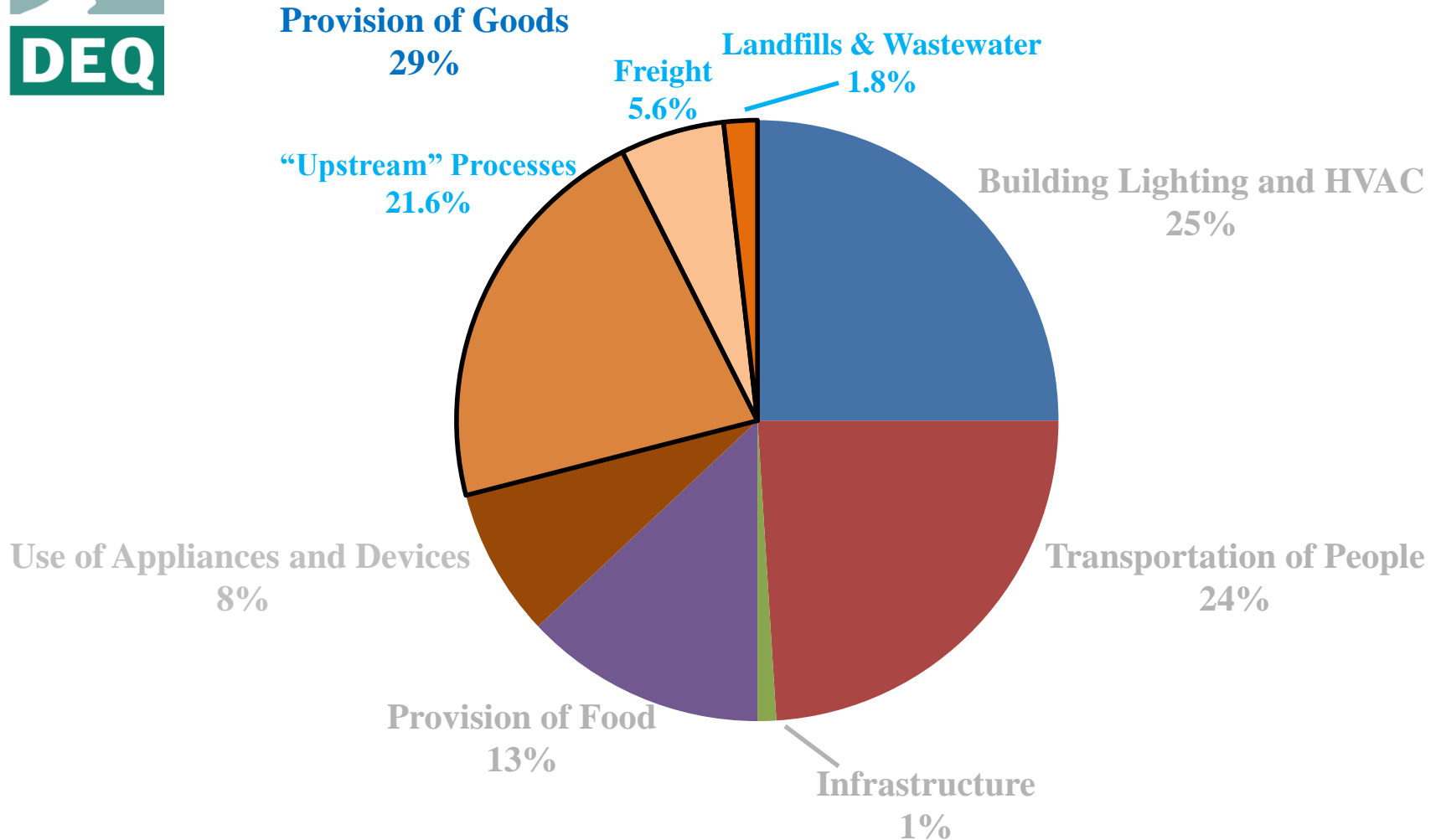


Materials Matter: Systems-Based Geographic Emissions Inventory





For Goods, “Upstream” Emissions Dominate





Tellus Institute Packaging Study (1992): Human Health Impacts

Material	Human Health Cost (\$/ton material)		
	Production	Disposal	Total
Virgin Corrugated Box*	\$95	\$2	\$97
Recycled Content Corrugated Box*	\$86	\$2	\$88
Virgin Aluminum	~\$923	\$5	\$928
Recycled Content Aluminum	~\$71	\$5	\$76

*Assumes ~2 pounds linerboard per 1 pound of medium.



Tellus Institute Packaging Study (1992): Human Health Impacts (continued)

Material	Human Health Cost (\$/ton material)		
	Production	Disposal	Total
Virgin Glass	\$69	\$1	\$70
Recycled Content Glass	\$47	\$1	\$48
Virgin HDPE	\$124	\$4	\$128
Virgin PET	\$327	\$4	\$331
Virgin PVC	\$1,710	\$4	\$1,714

Note: These costs are per-ton, not per-package!



Life Cycle Analysis

- Reducing environmental impacts first requires understanding environmental impacts
- Inventory analysis: accounting of energy and material flows
- Impact analysis: conversion of those flows into “impact categories”
 - Acidification
 - Ecotoxicity
 - Eutrophication
 - Global warming
 - Ozone depletion
 - Smog
 - Human Health
 - Cancer
 - Non-cancer
 - Respiratory effects



LCAs at DEQ

- E-commerce packaging (2004)
- Drinking water delivery (2008 – 2009)
- Residential construction materials and “waste prevention” practices (2009 – 2010)
- Carbon and energy footprints of recycling (2004 – ongoing)
- Low carbon fuel standard (2009 – 2010)
- Consumption-based GHG emissions inventory (2009 – 2010)



Eugene Branch/Cascadia January 2010 Event



**A Lifecycle Analysis of the Average Oregon Home -
Preliminary Results from a DEQ Study**

Jordan Palmeri, Oregon Department of Environmental Quality

Tuesday, January 12th | Eugene, OR

Time: 12p.m.—1:00p.m.

Location:

Tykeson Room, Eugene Downtown Library: 100 W. 10th Ave., Eugene, OR

Cost: Free

Please RSVP

Contact: Jenna Garmon

phone: 541.682.5541 | email: eugene@cascadiagbc.org



CASCADIA
REGION GREEN BUILDING COUNCIL
OREGON | Eugene



E-Commerce packaging





DEQ's E-Commerce 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*

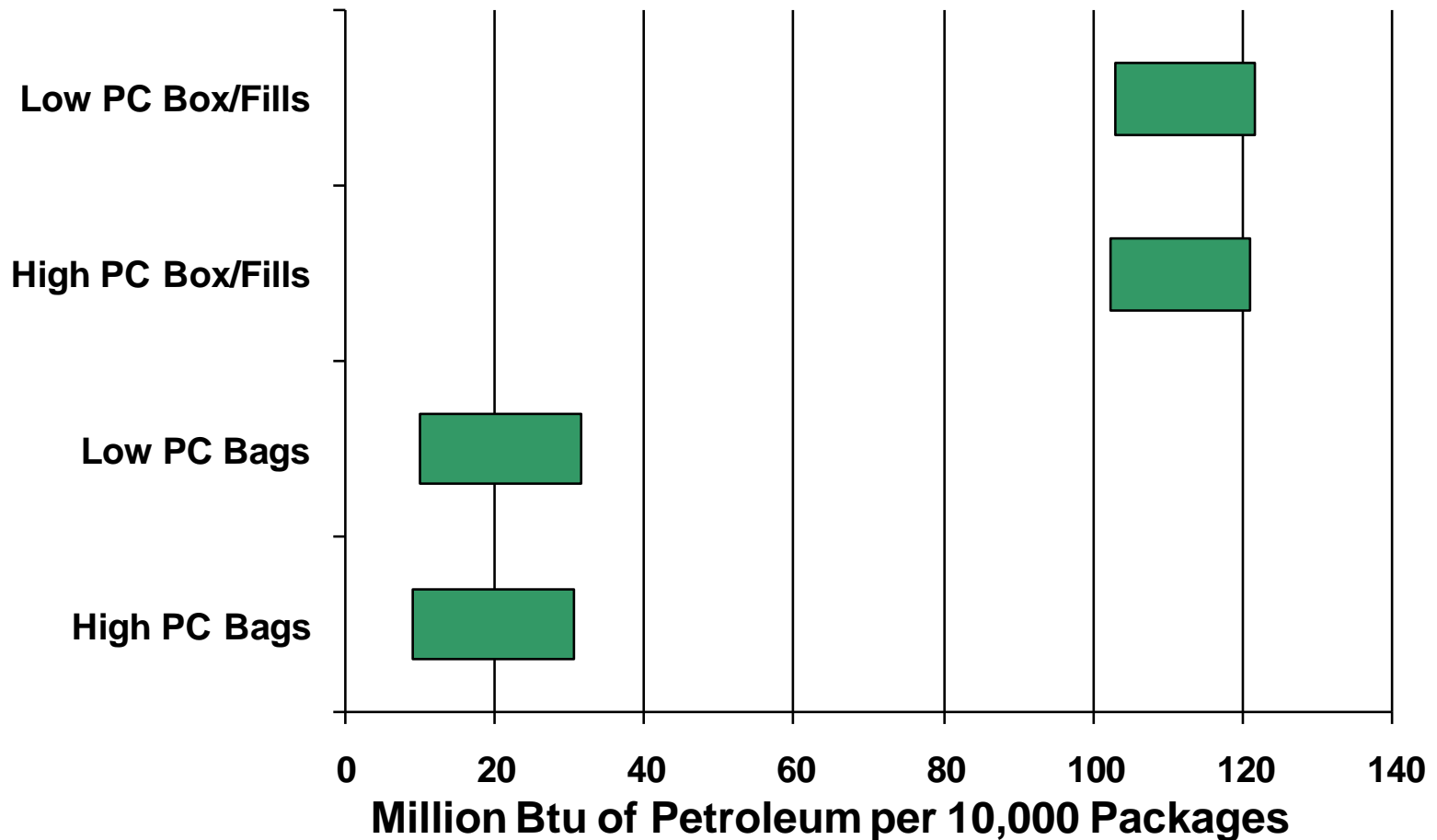
Kraft mailer with poly bubble padding*

Poly mailer with poly bubble padding*

*Different levels of post-consumer content also evaluated.

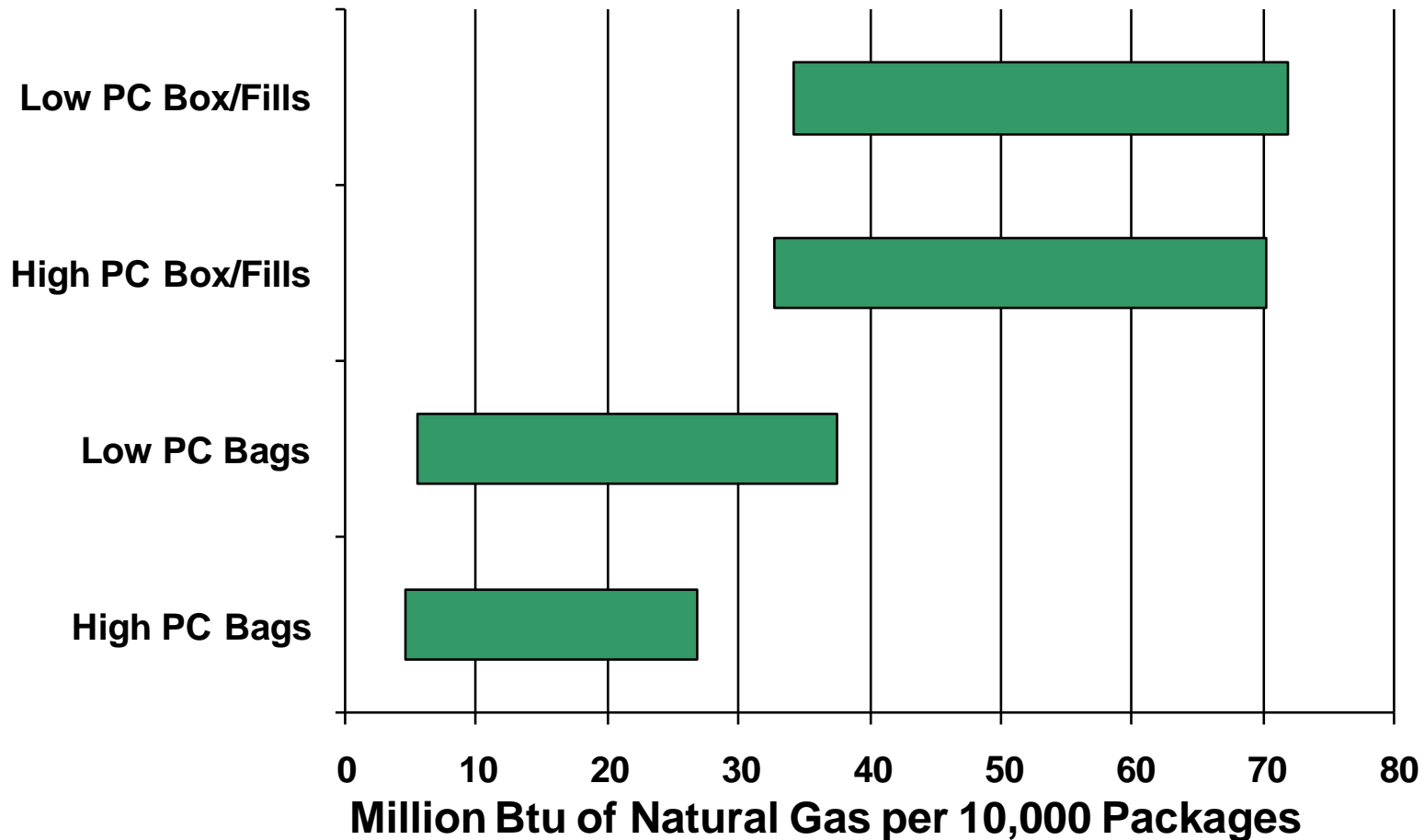


E-Commerce Results: Petroleum



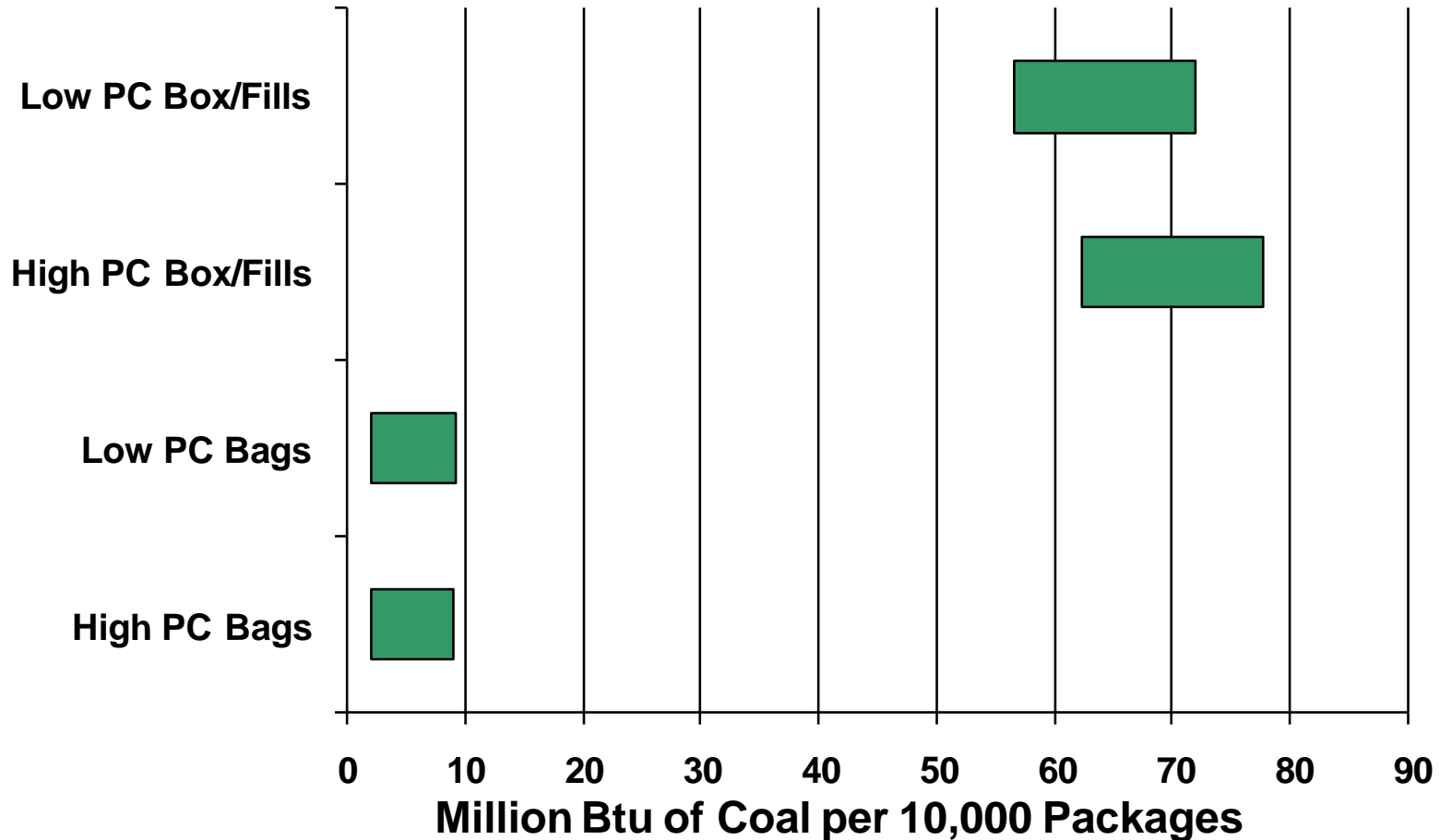


E-Commerce Results: Natural Gas



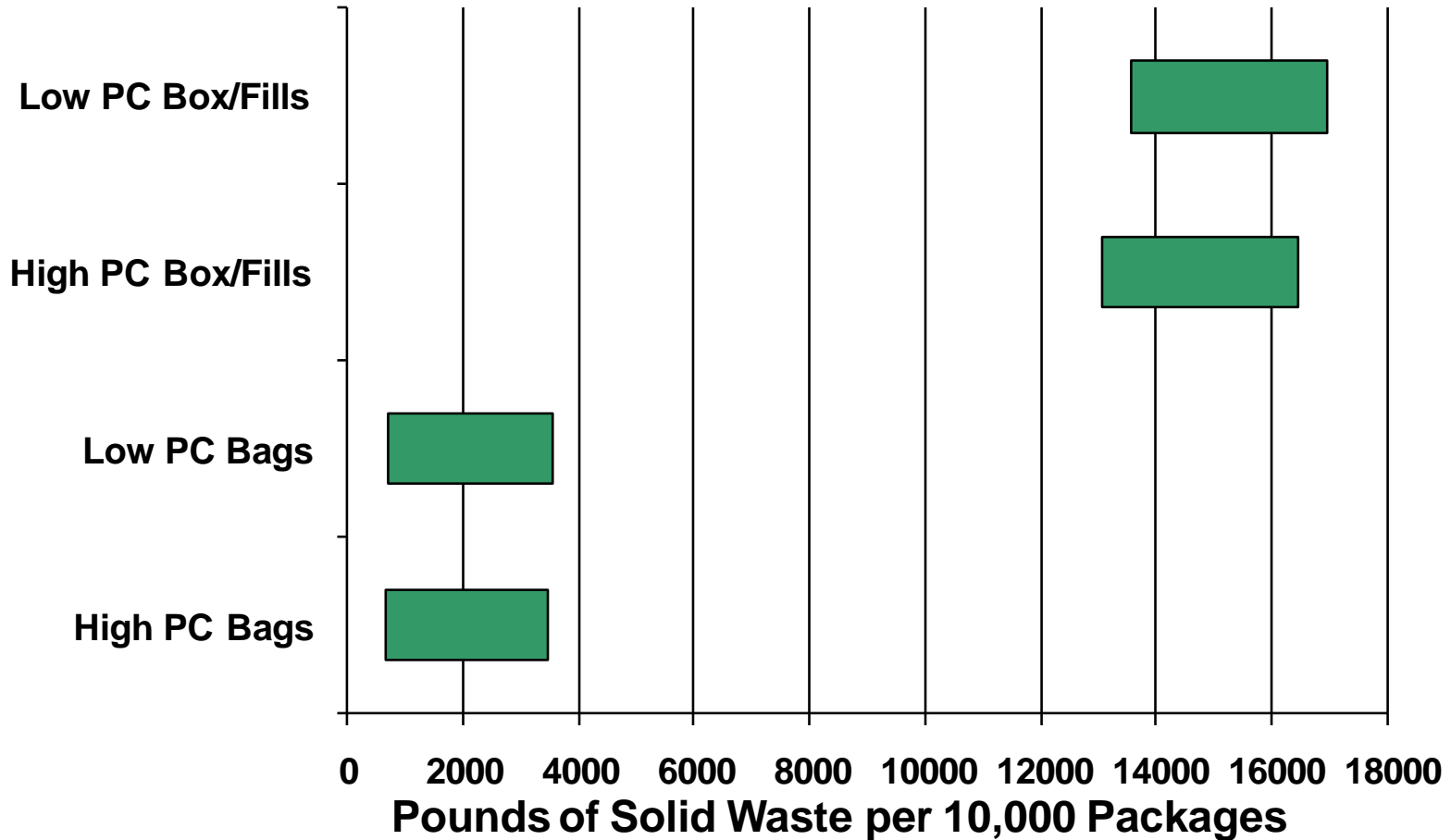


E-Commerce Results: Coal



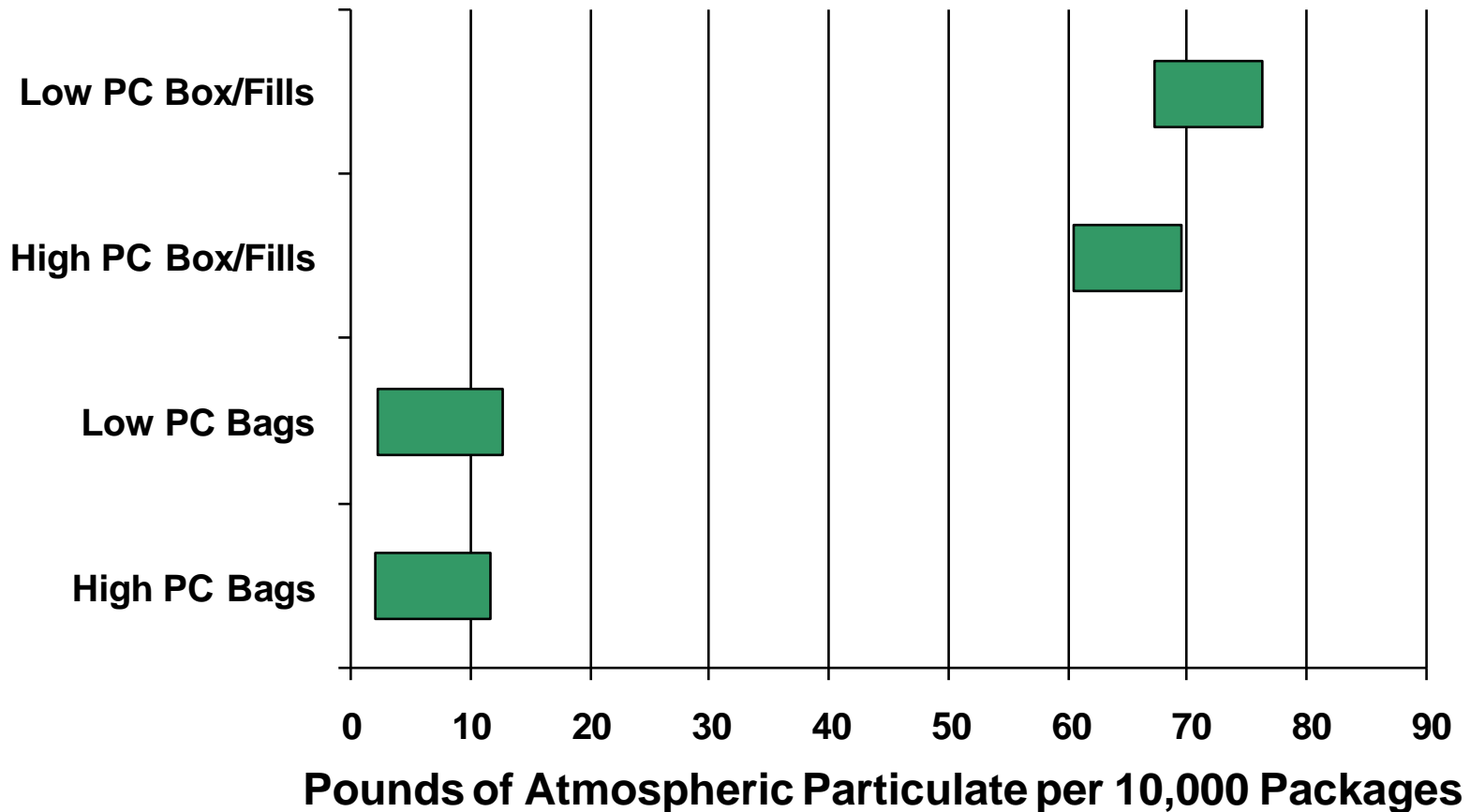


E-Commerce Results: Solid Waste



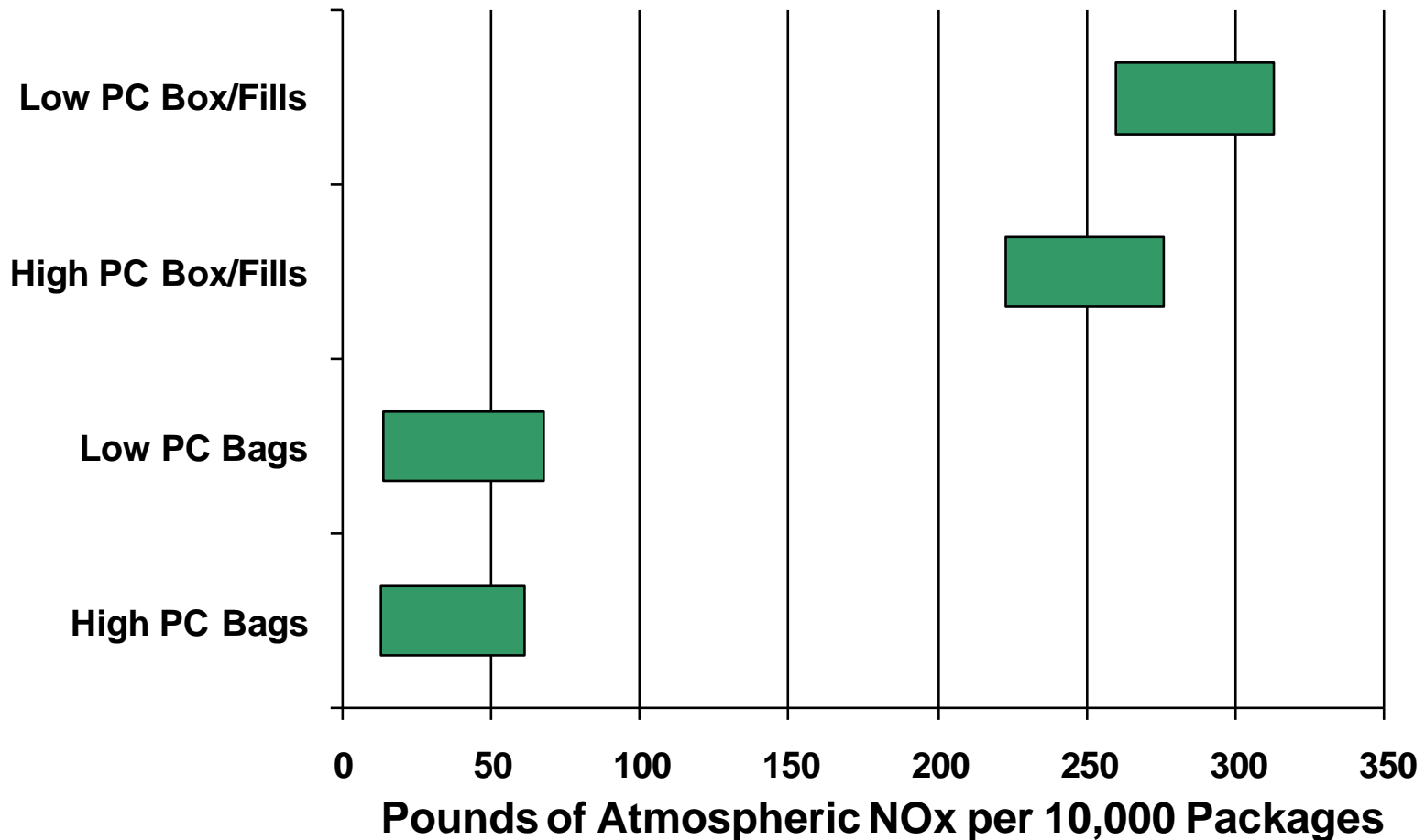


E-Commerce Results: Atmospheric Particulates



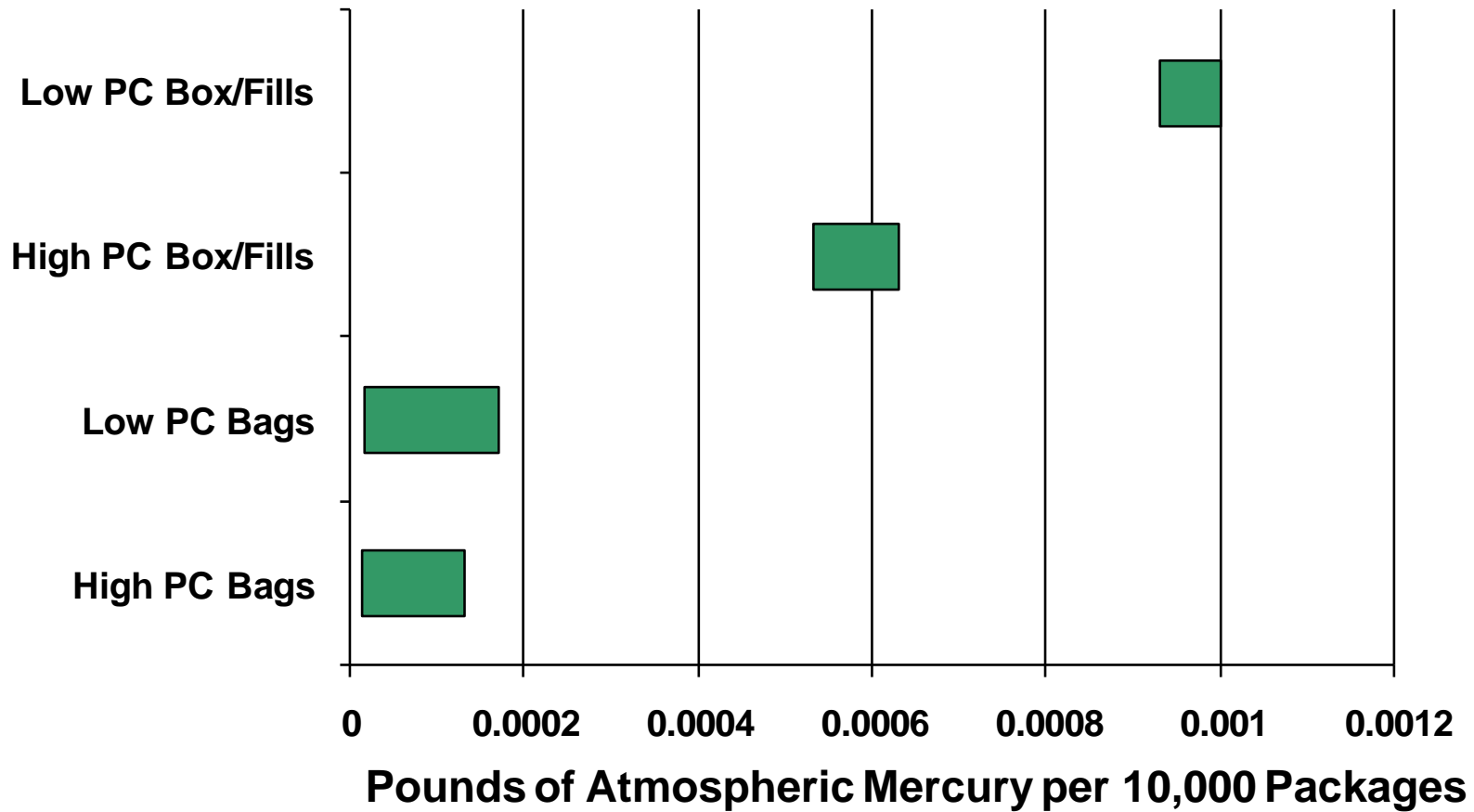


E-Commerce Results: Atmospheric NO_x



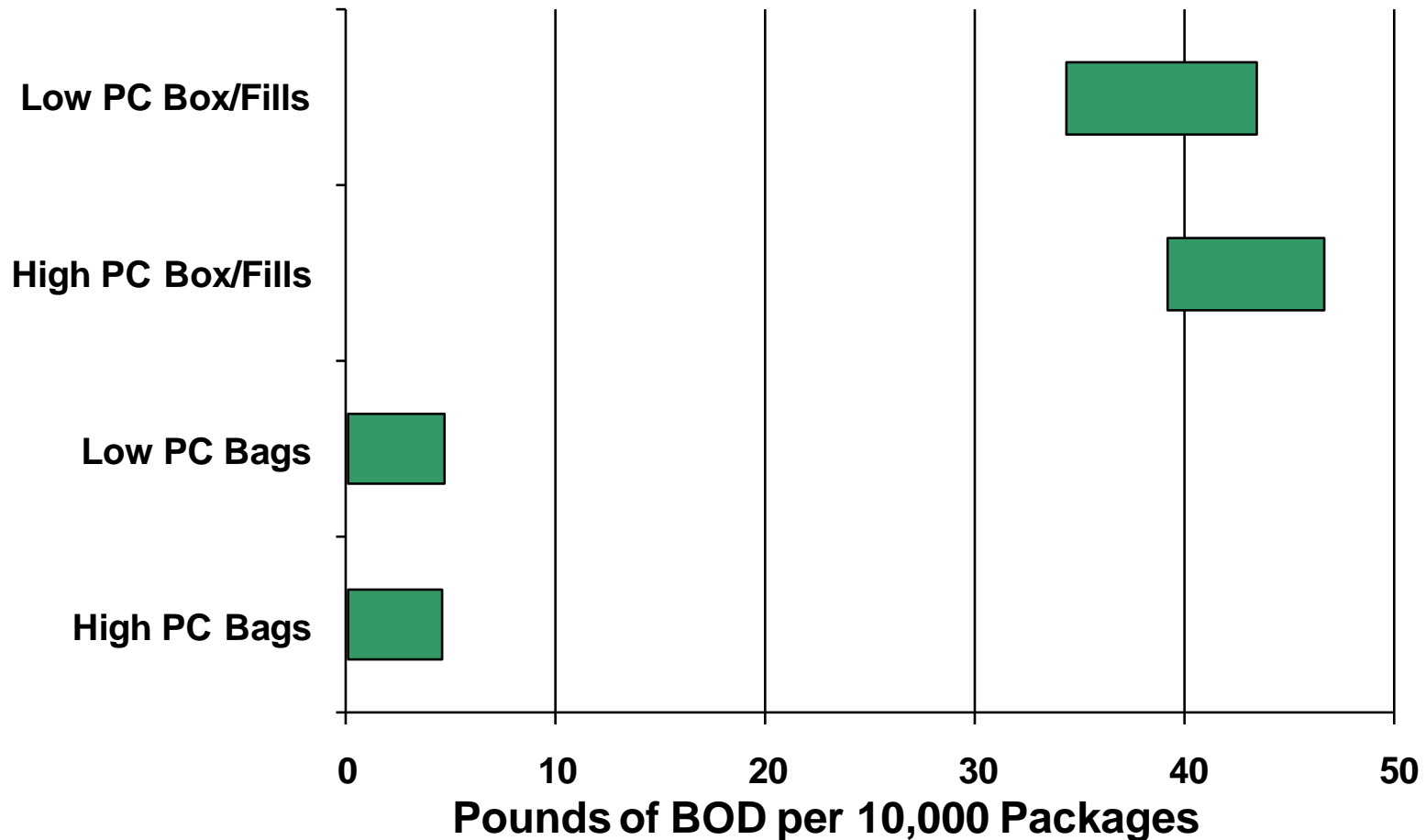


E-Commerce Results: Atmospheric Mercury



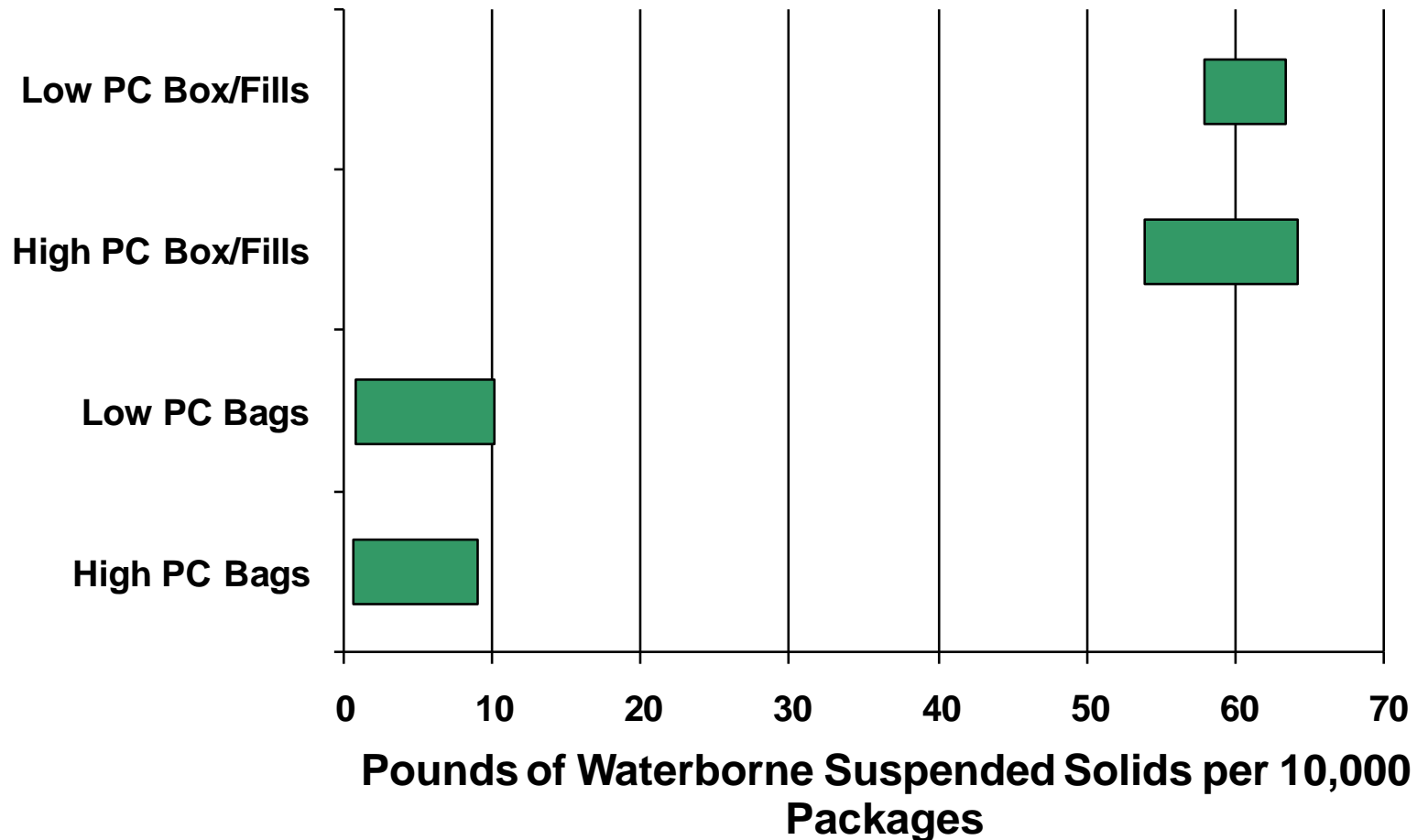


E-Commerce Results: Biological Oxygen Demand



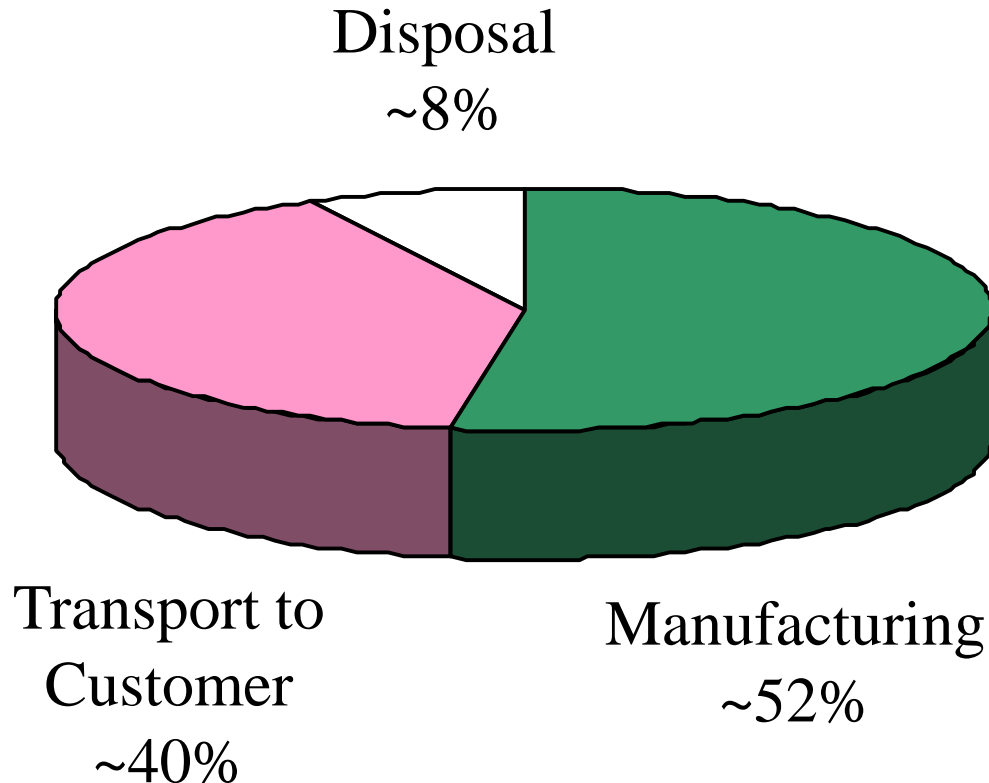


E-Commerce Results: Waterborne Suspended Solids





E-Commerce Results: Life Cycle Greenhouse Gases



Example: Corrugated box (38% PCR content) and newsprint dunnage (10% PCR content).

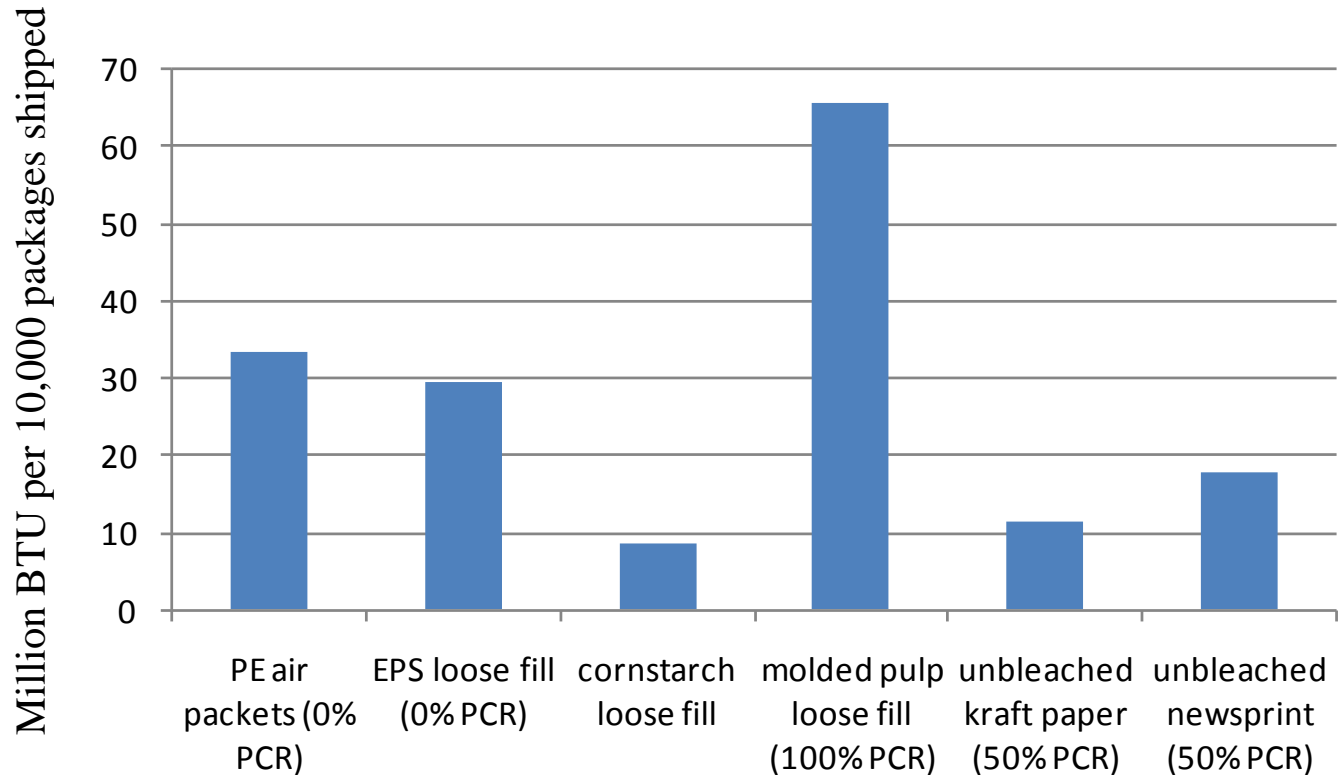
Shipped ~2,000 miles via ground transport

Assume all packaging goes to “average” landfill

Forestry-related emissions and credits not included.



E-Commerce Results: Fossil Fuel Energy Use – Void Fills Only





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:
 - BUT, once you've chosen a packaging material, increasing post-consumer content and recycling opportunities can have benefits.



E-Commerce LCA: A Few Caveats

- Please don't interpret the results as . . .
 - “Anti paper”
 - “Anti box”
 - “Anti recycling”
 - “Anti recycled-content”



DEQ's Life Cycle Analysis of Water Delivery

- 3 basic systems:





Why this study?

- Widespread belief: recycling prevents/avoids/negates the environmental impacts of consumption
 - “I recycle my bottles . . . Isn’t that enough?”
- Existing water studies aren’t specific to North America, lack transparency, and/or aren’t comprehensive
- Oregon’s bottle bill expansion
- Lots of interesting packaging questions



DEQ's LCA of Water Delivery: What's Included

- Energy requirements & associated emissions
- Drinking (and washing) water treatment and transport
- Material production
- Fabrication processes
- Water bottling operations
- Bottled water distribution
- Water cooling
- Container washing
- Wastewater management
- Waste management (recycling, composting, disposal)



DEQ's LCA of Water Delivery: What's Not Included

- Carbonated, flavored waters
- Variability in drinking water quality
- Specific brands/producers
- Some resource flows that are believed to be small/inconsequential (e.g. components <1% by mass, capital, labor) or where data is lacking (e.g. pesticide run-off)



Variables: single-use water bottles

- Bottle material (PET, PLA, glass)
- Bottle weight (mass)
- Bottle volume
- Recycled content (PET only)
- Bottle molding energy
- Cap weight
- Corrugated packaging weight
- Film packaging weight
- Water source type and treatment technologies



Variables: single-use water bottles (continued)

- Distance: bottle molding to filling
- Distance: filling to retail
 - Ocean transport: weight-based or discounted allocation
- Distance: retail to home
- Trip fuel use allocation
- Chilling (at home)
- Recycling rate
- Recycling allocation method
- PLA composting
- PLA landfill decomposition



Variables: tap water

- Type of reusable container (aluminum, PET, steel, glass)
- Container volume
- Lifetime of reusable container
- Recycling of reusable container
- Recycling allocation method
- Chilling
- Container fillings/day and days used between washings
- Dishwasher energy/water use
- Detergents

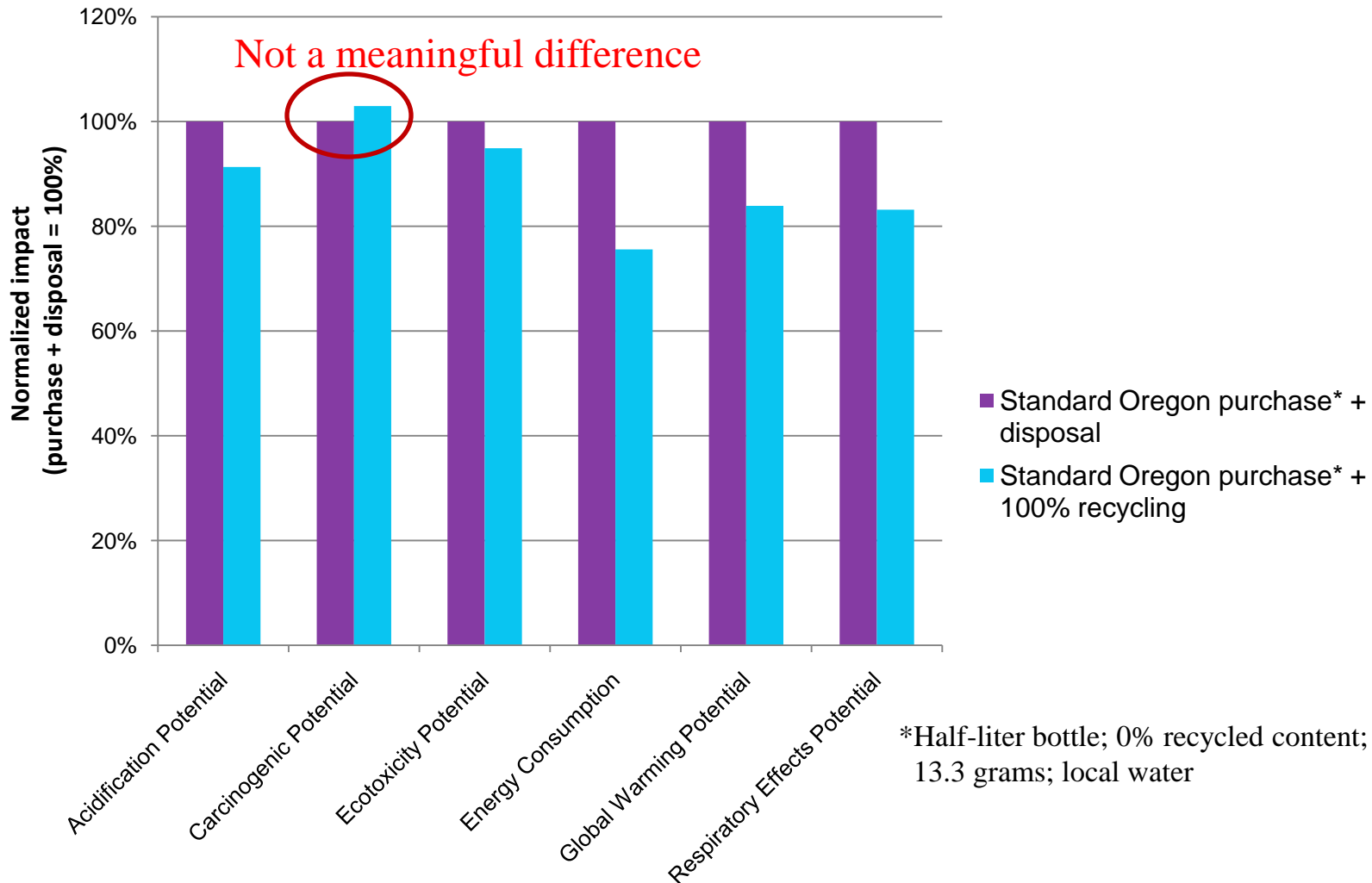


Variables: Home/Office Delivery (5 gallon reusables)

- Same as tap water (for drinking vessel), plus:
- HOD bottle type (PET, polycarbonate)
- HOD bottle weight
- Number of HOD bottle reuses
- Water source type and treatment technologies
- Distance: filling to distribution center
- Distance: on-route
- Chiller base energy use

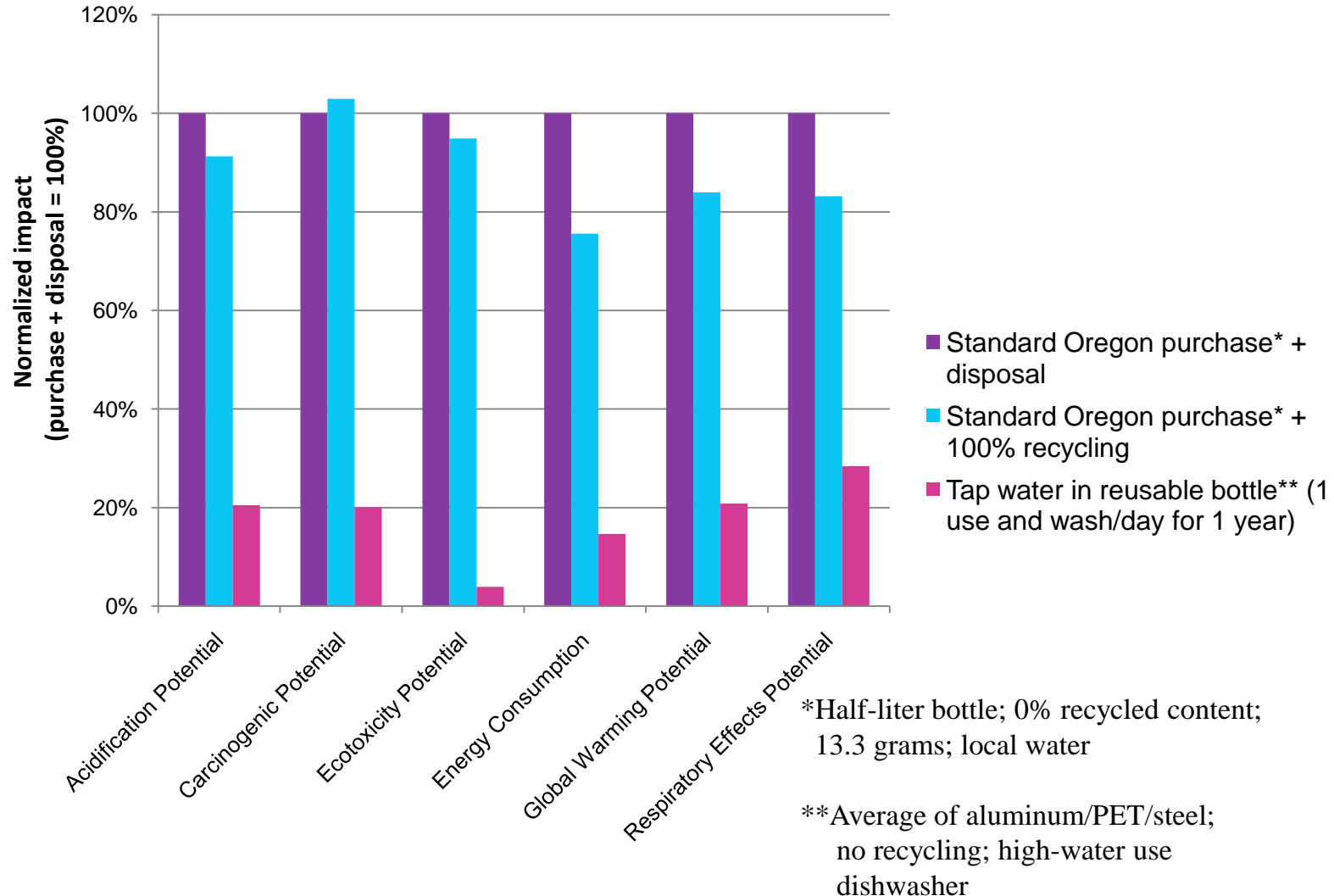


Disposal vs. Recycling



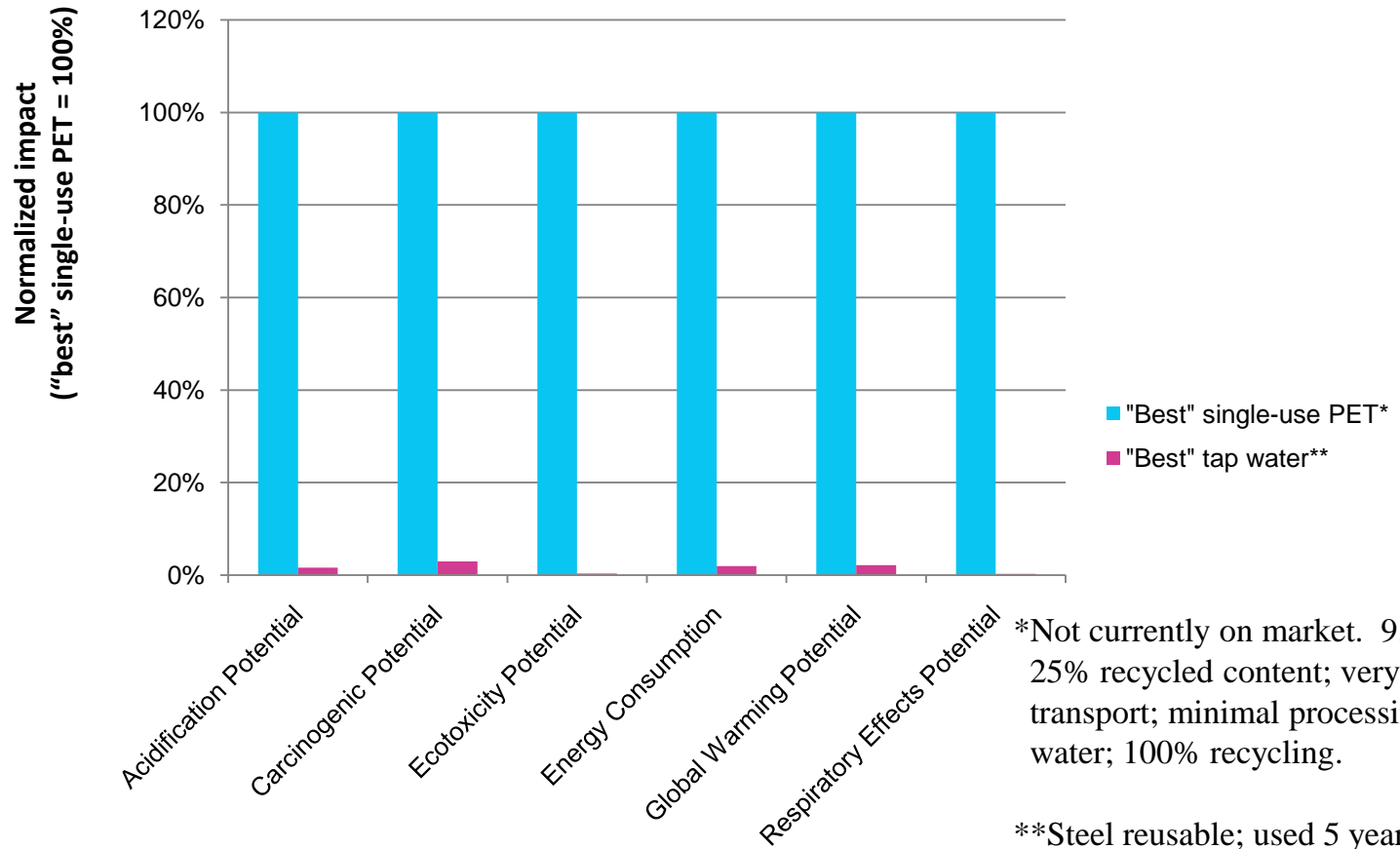


Disposal vs. Recycling vs. Prevention





Best Case Recycling vs. Best Case Prevention

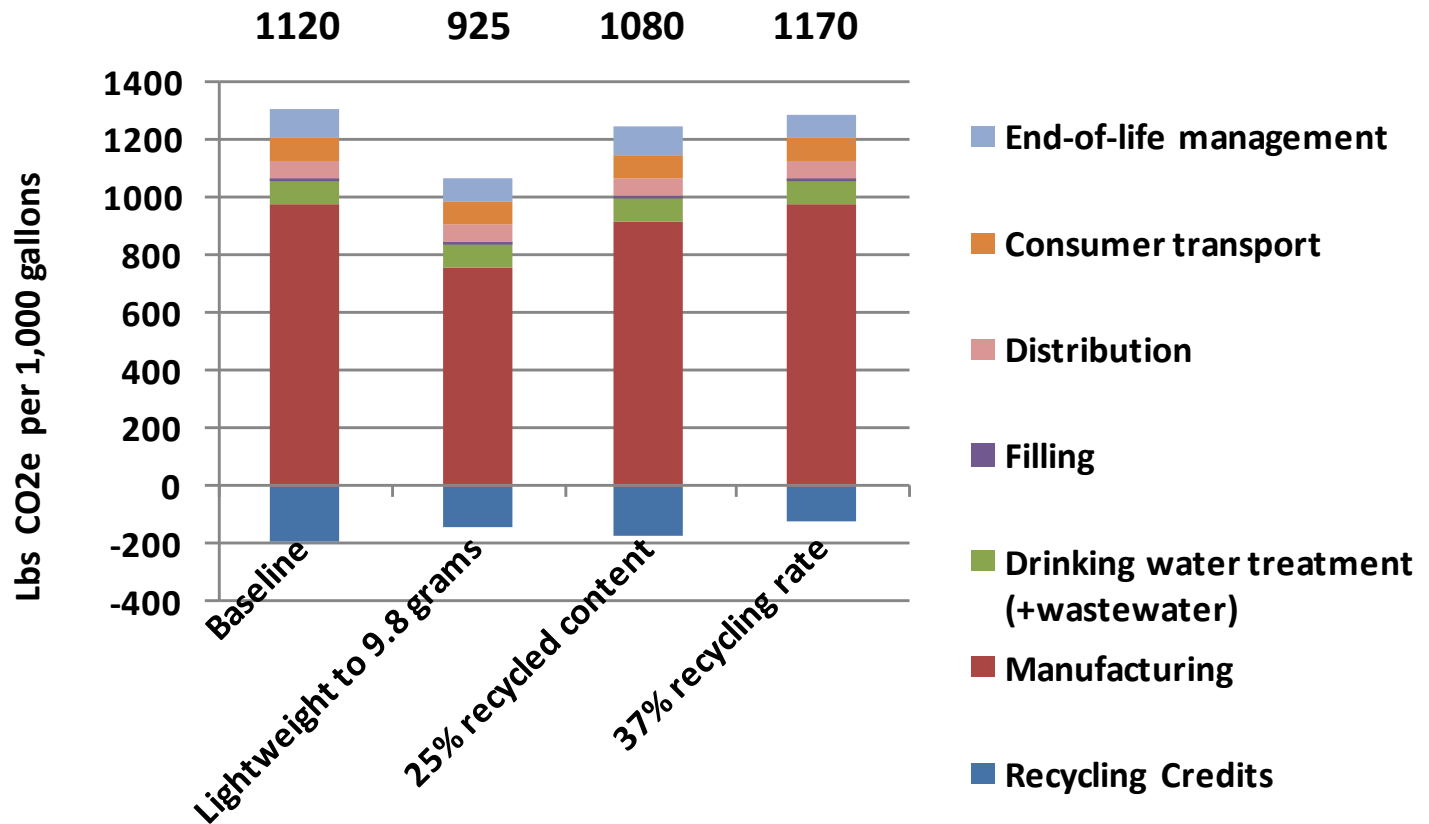


*Not currently on market. 9.8 grams; 25% recycled content; very short transport; minimal processing of water; 100% recycling.

**Steel reusable; used 5 years; used 2 times/day; washed weekly in efficient, full dishwasher; 100% recycling



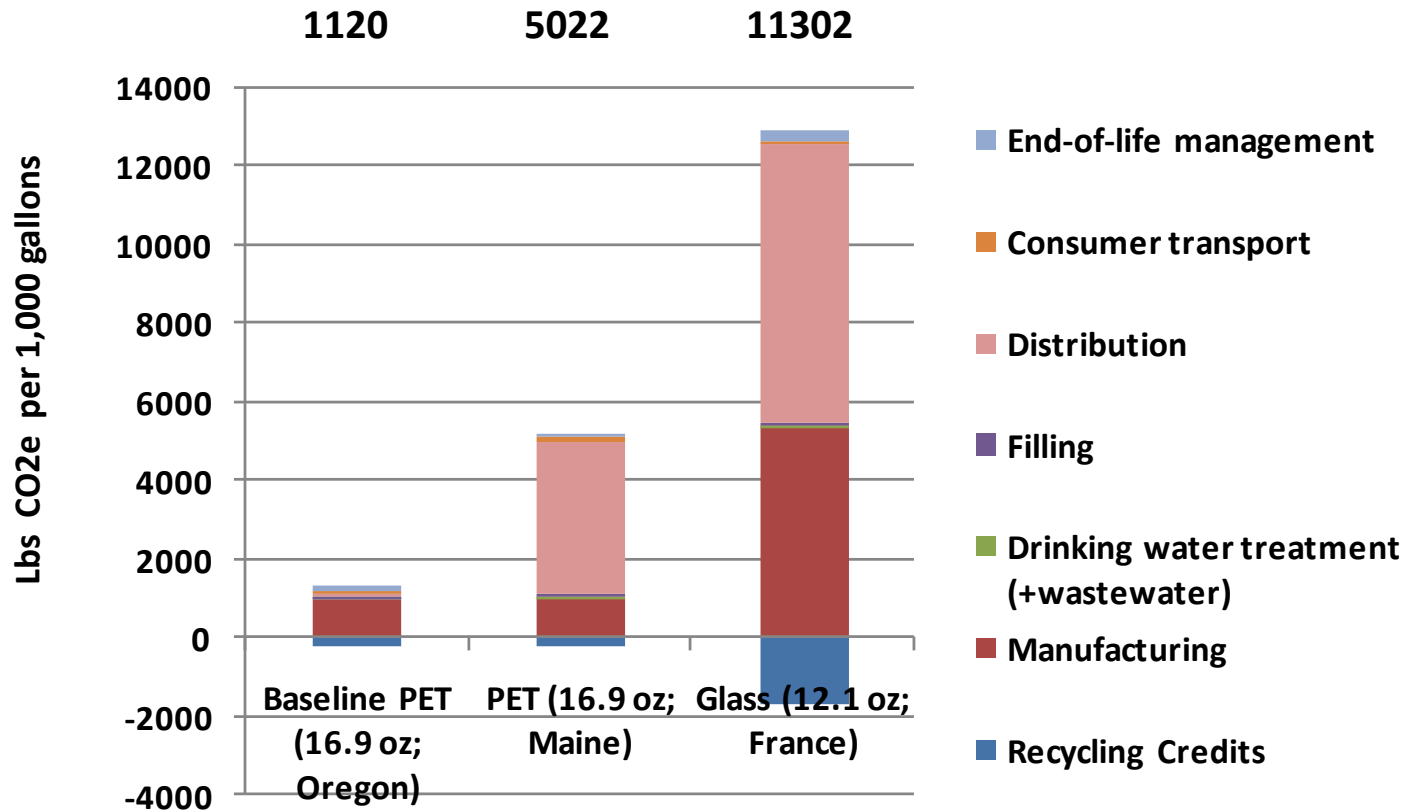
Contribution Analysis (GHGs): Single-Use Bottles



“Baseline” = PET, half-liter, 13.3 g, 0% recycled content, on-site molding, purified municipal water (reverse osmosis, ozone and uv), 50 miles to retail, 5 miles home-to-retail, co-purchase w/24 other products, no chilling, 62% recycling.



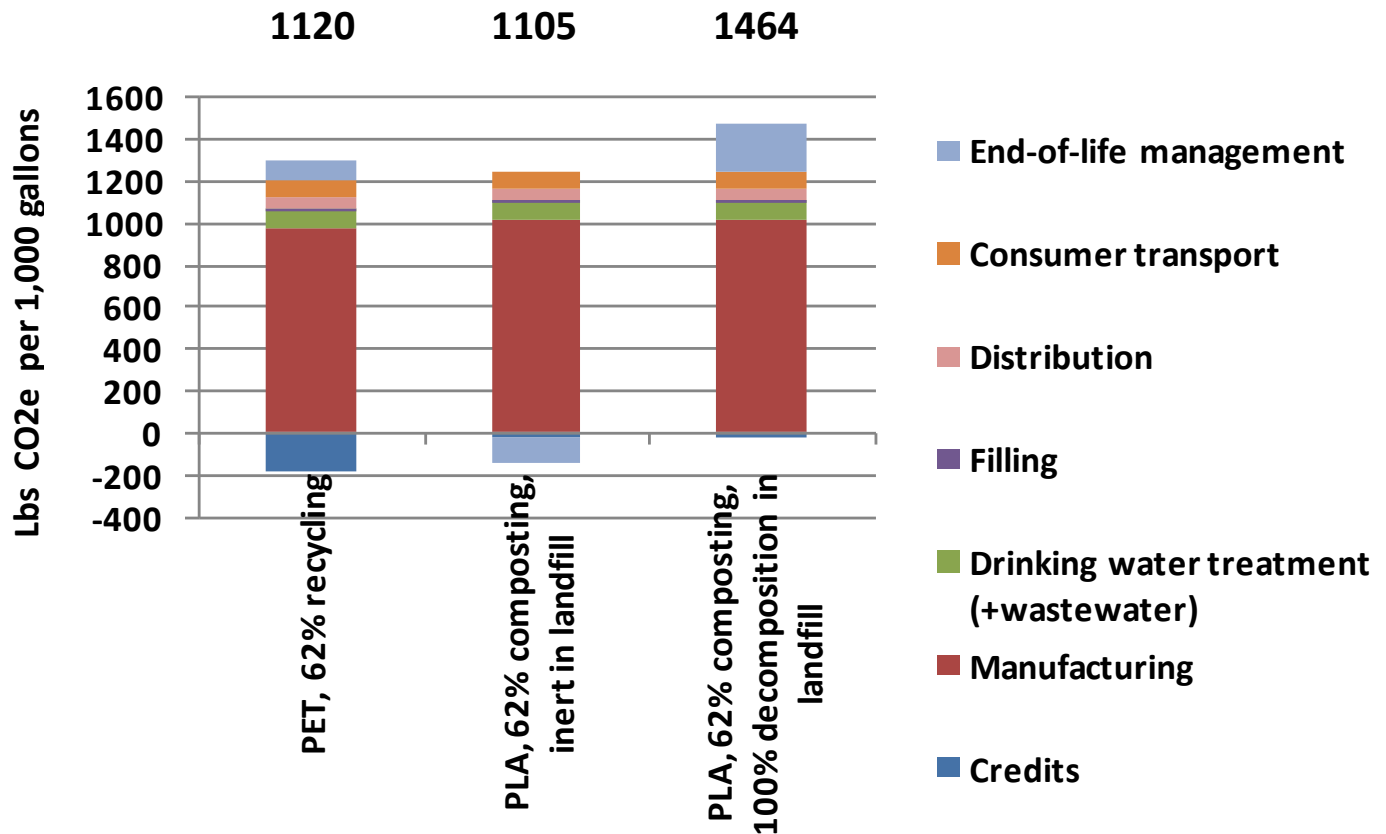
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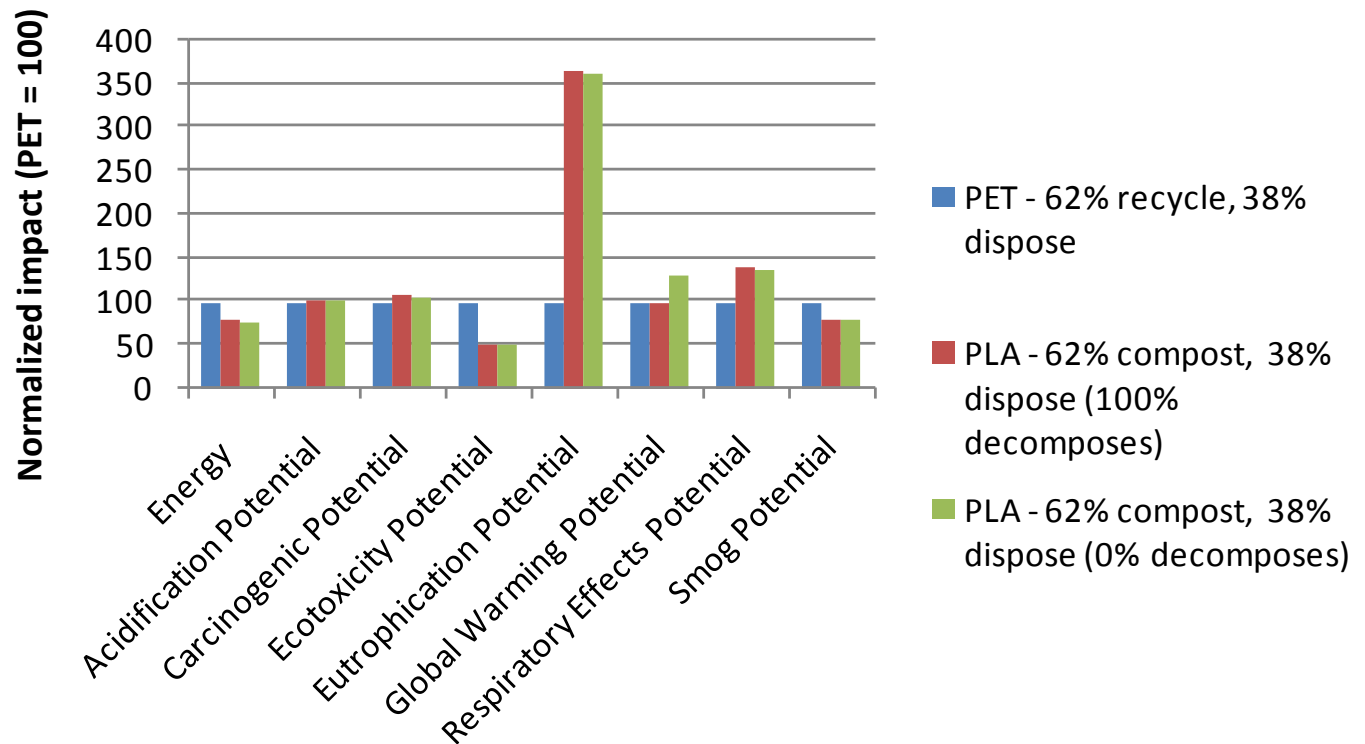
Contribution Analysis (GHGs): Single-Use Bottles



Assumes no cross-contamination between PET and PLA



Comparison of PET and PLA (2006)



Assumes no cross-contamination between PET and PLA



Variables: Single-Use Bottles

Relatively Higher Importance (GHGs):

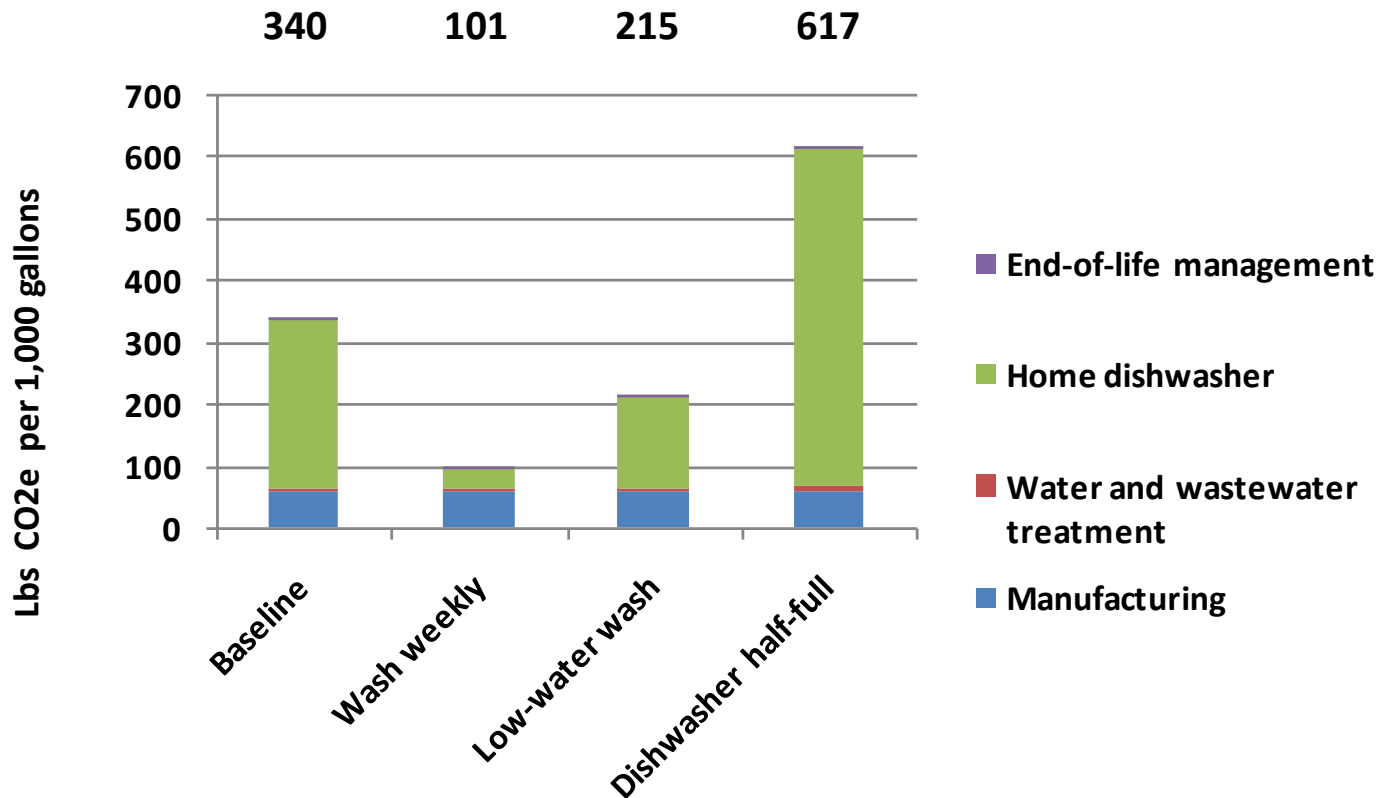
- Transport distance (bottler to retail)
- Consumer driving/shopping behavior
- Bottle mass (lightweighting)
- Volume
- Material choice (PET, PLA, glass)
- Recycling rate (but less so for recycled content?)

Relatively Lower Importance (GHGs):

- Water treatment
- On- vs. off-site molding
- Filling
- Secondary packaging
- At-home chilling



Contribution Analysis (GHGs): Tap Water



Baseline = aluminum 20 oz reusable bottle; use for 1 year, then landfill;
1 filling per day; 1 wash per day; high water use dishwasher run when full;
no chilling



Variables: Tap Water

Relatively Higher Importance (GHGs):

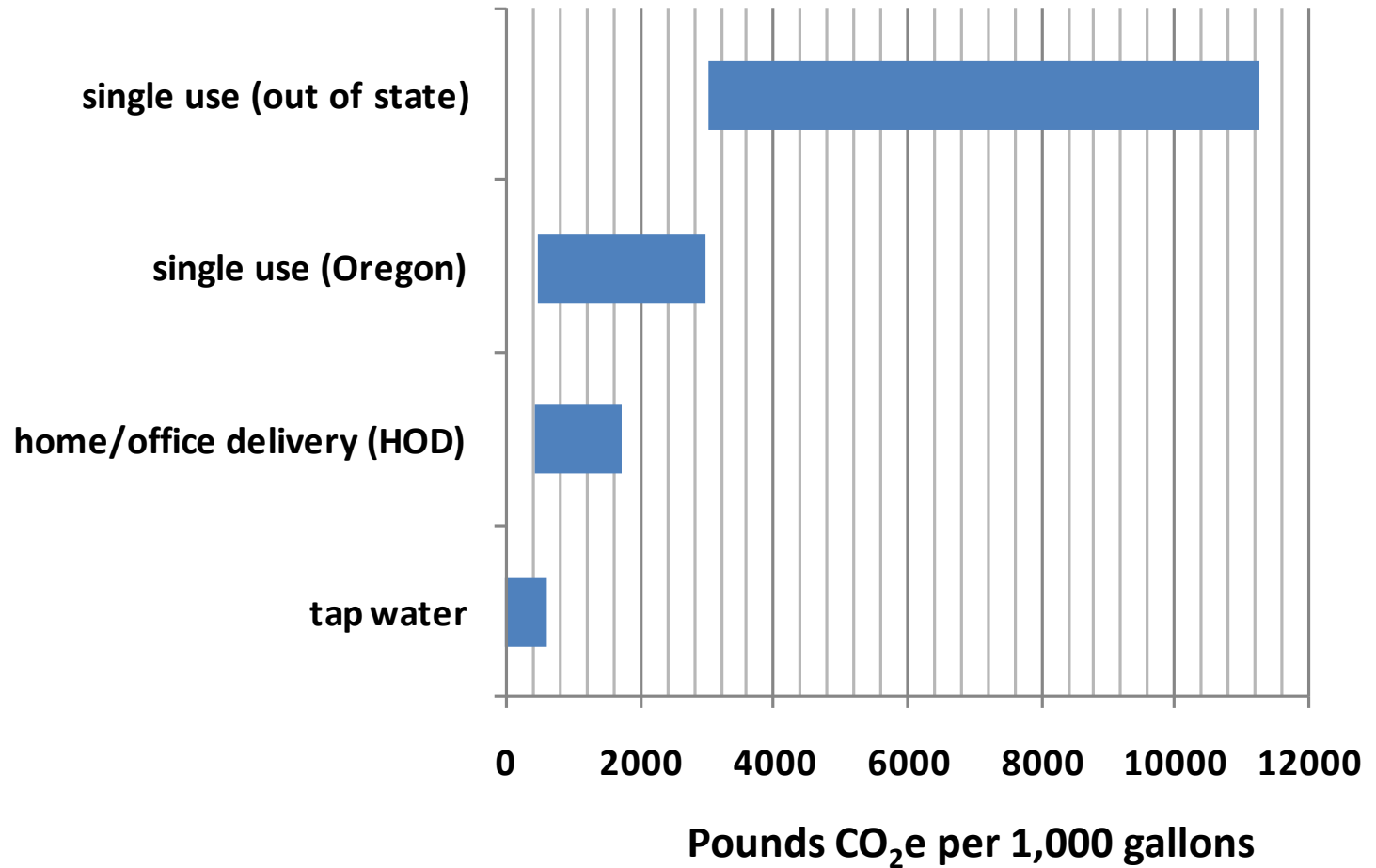
- Frequency of bottle/vessel washing
 - Uses per day
 - Days per wash
- Fullness of dishwasher
- Energy/water use by dishwasher

Relatively Lower Importance (GHGs):

- Bottle/vessel material
- Length of use
- Recycling
- Chilling/ice



Life Cycle Global Warming Potential





A Few More Caveats (Both LCAs)

- Both studies involve products with high freight impacts
 - Freight is often less important
- Both studies focus on packaging materials
 - Products are often more important



A Few More LCA Case Studies

- Laundry detergent packaging
- Ink jet printers
- Oxo-degradable shopping bags

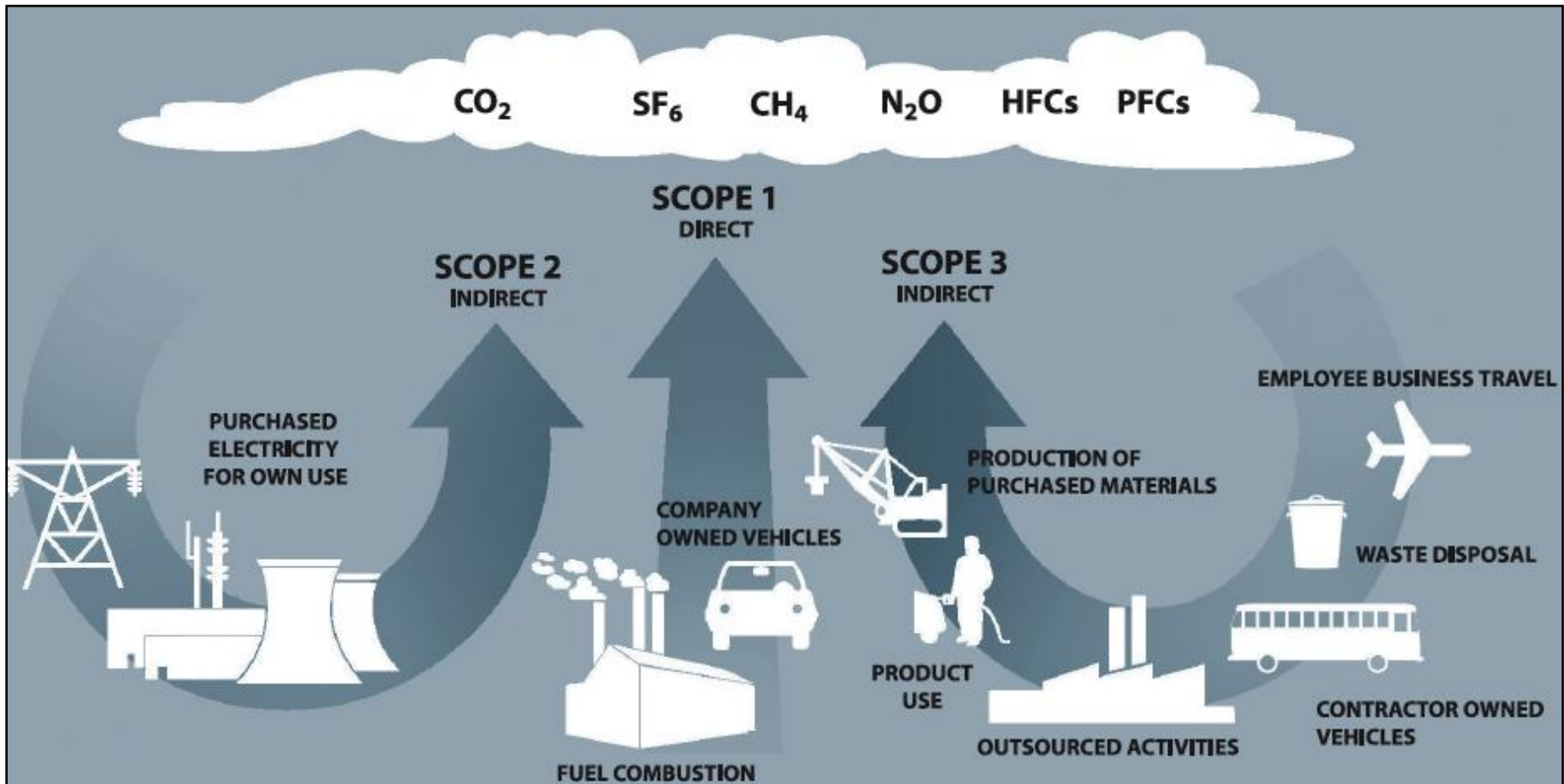


LCA Resources

- ISO standards 14040, 14044
- American Center for Life Cycle Assessment
www.lcacenter.org
 - Life Cycle Assessment X in Portland, November 2010
- US LCI Database <http://www.nrel.gov/lci/>
- EPA <http://www.epa.gov/nrmrl/lcaccess/index.html>
- Consultants

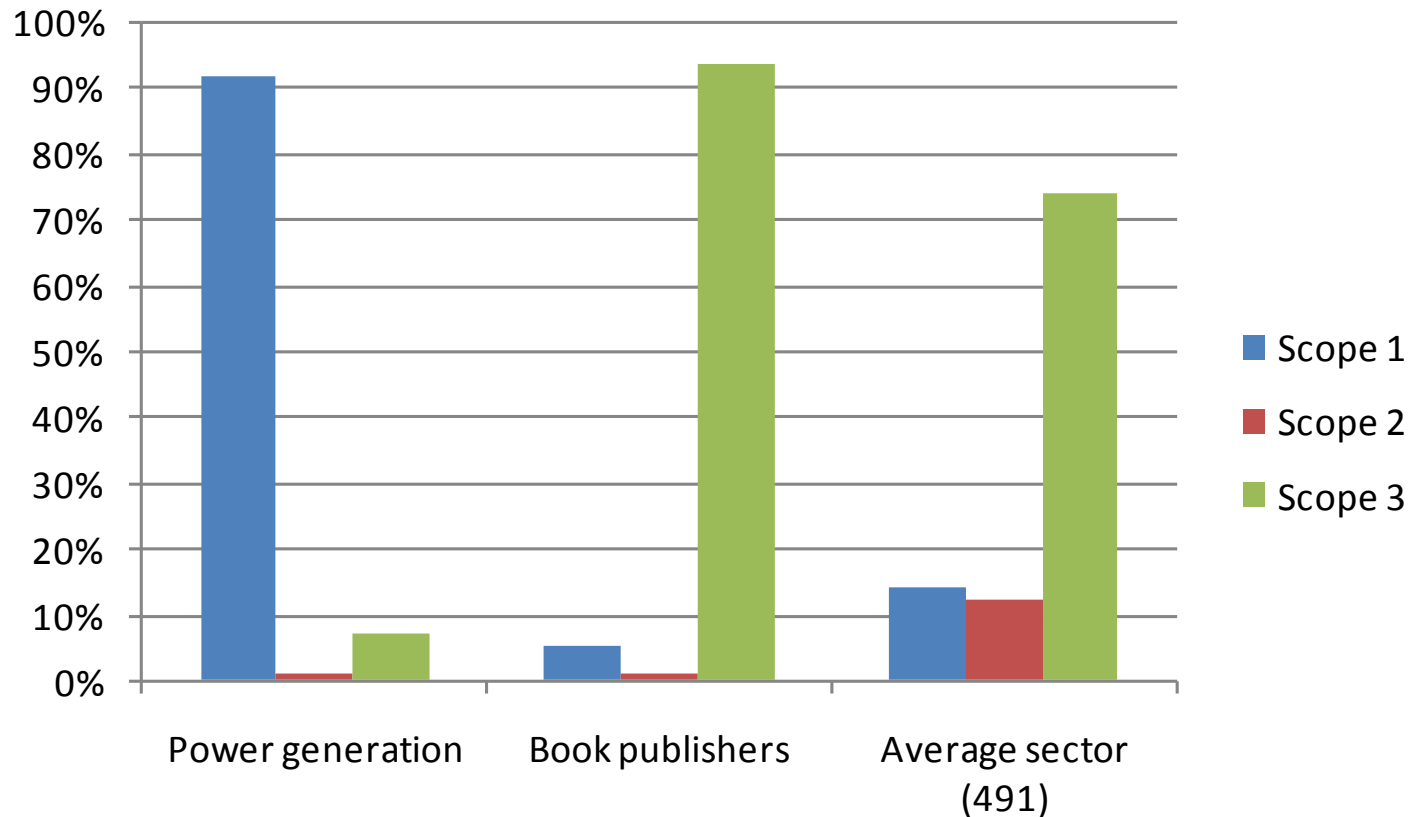


GHG Inventories: Corporate Reporting and the “Three Scopes”



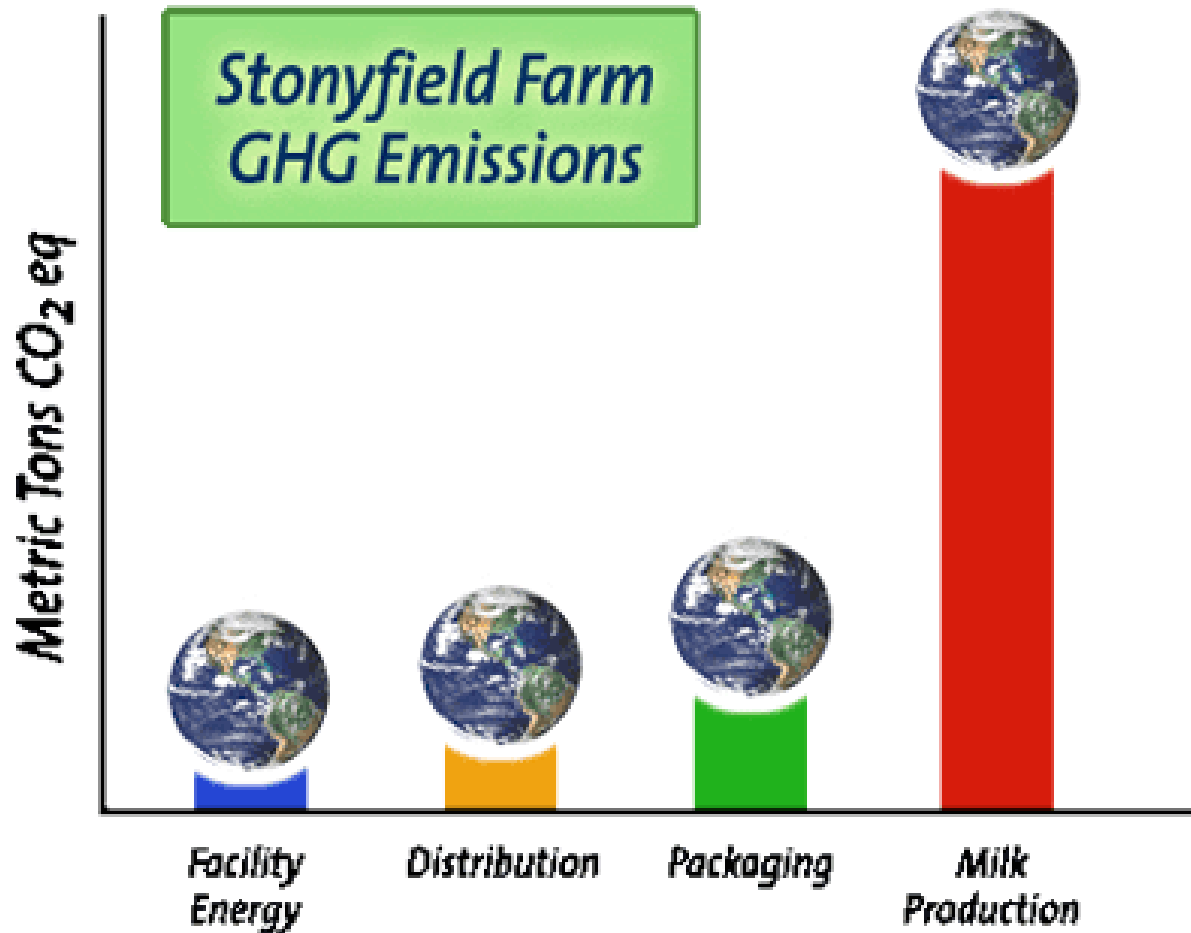


Business Inventories: Scope 1 & 2 Don't Tell the Complete Picture





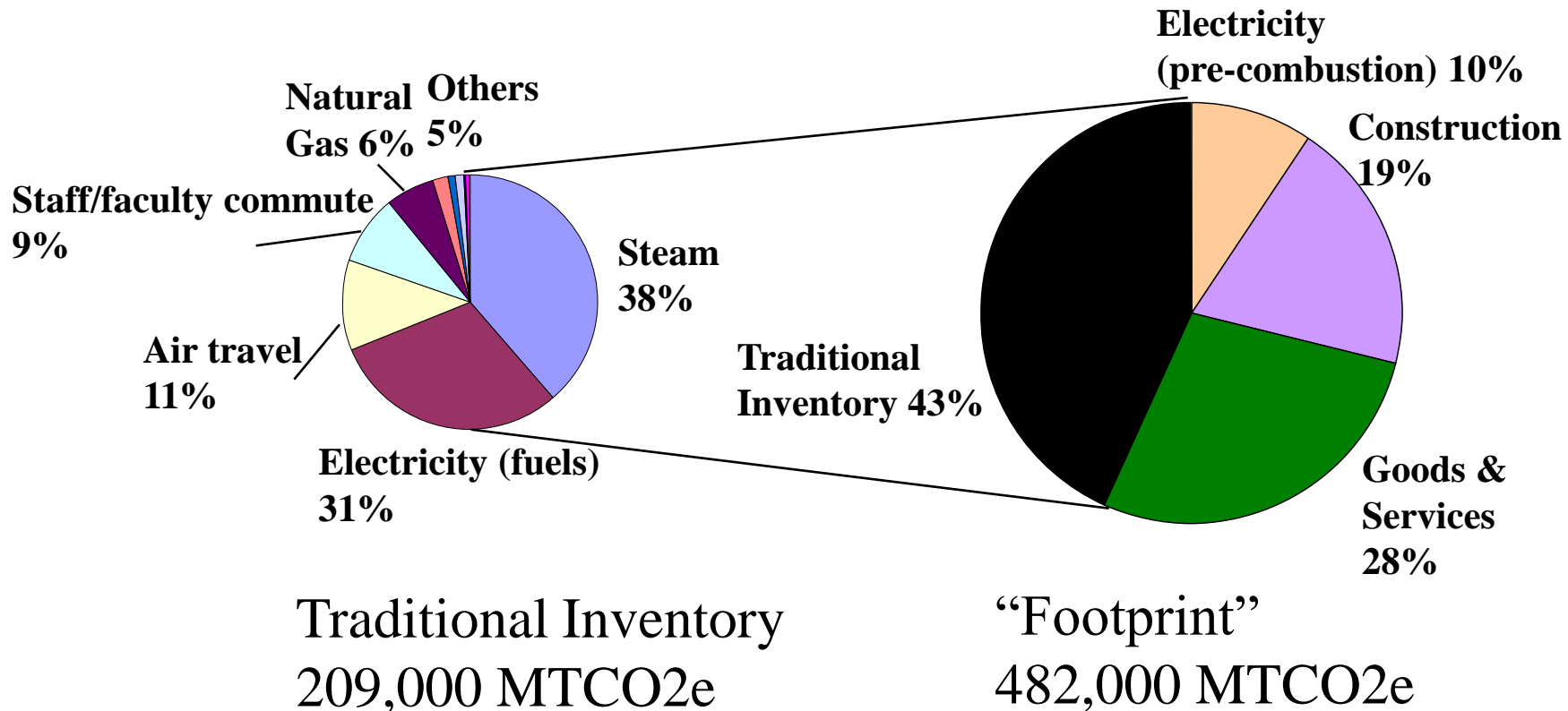
When Inventories are Incomplete, Opportunities for GHG Reductions May Be Overlooked





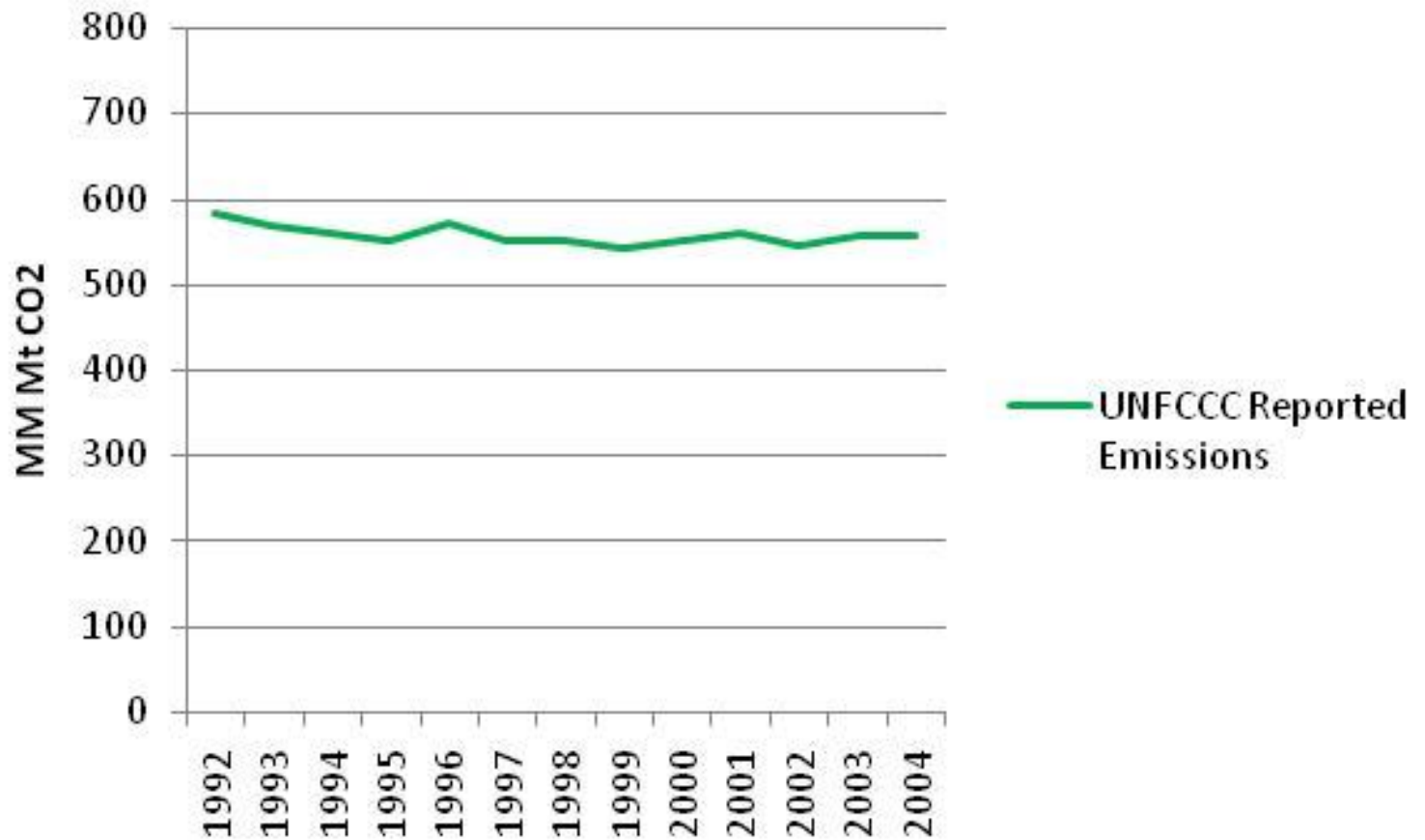
GHG Inventory vs. “Footprint” UC Berkeley

<http://sustainability.berkeley.edu/calcap/inventory-footprint.html>



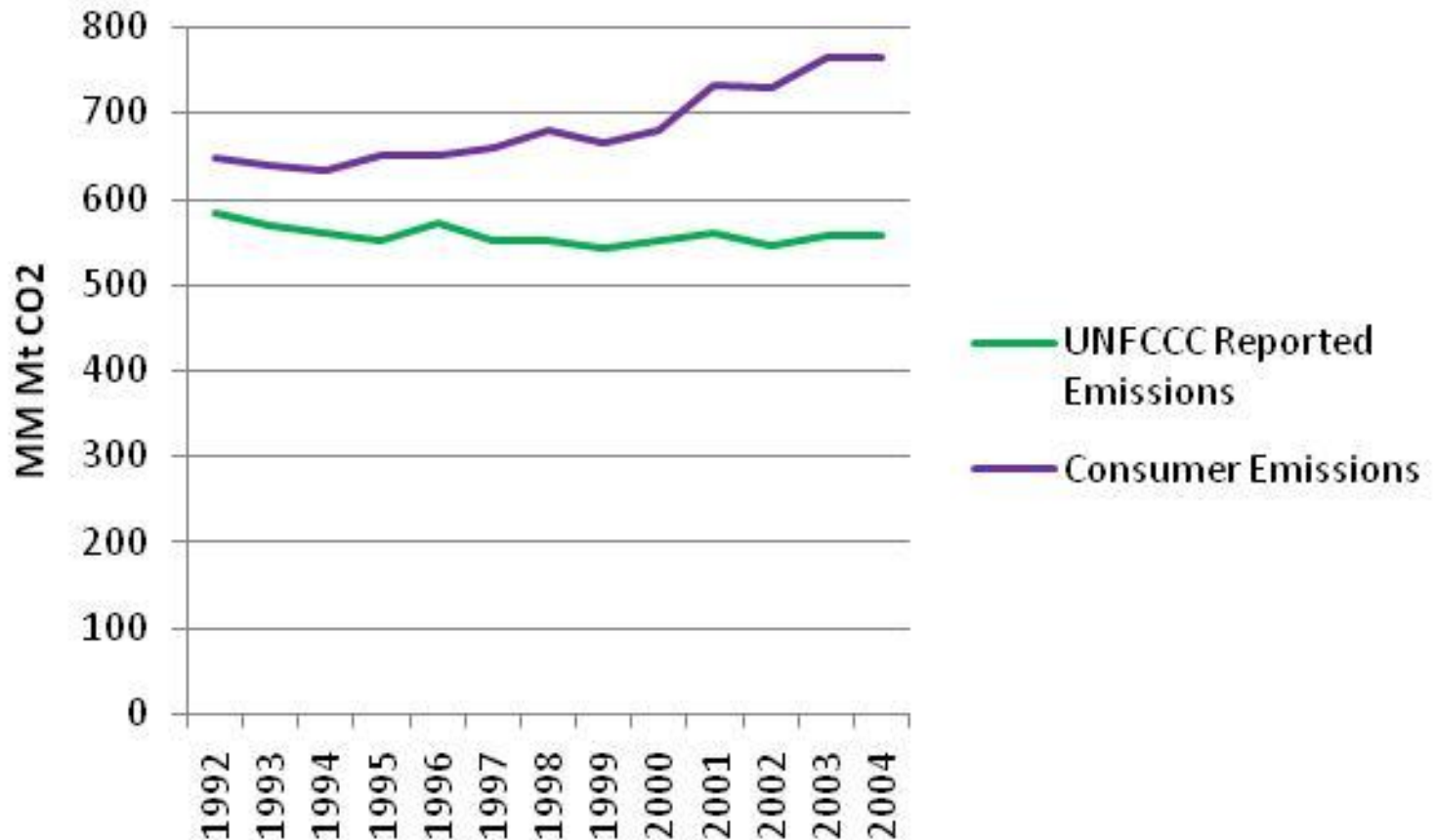


False Positives? United Kingdom Greenhouse Gas Emissions





United Kingdom Greenhouse Gas Emissions – A More Complete Picture





Business Waste Prevention Case Studies

- Norm Thompson (Oregon)
 - “Ship All Together” saves \$400,000 - \$600,000 annually
 - Savings almost doubled when call center script was amended
 - Shipping bags for non-breakable items save \$1.1 million annually
- Williams-Sonoma (Portland store)
 - In-store box scoring reduces void fill use by 40%
 - \$400,000 saved per year if implemented company-wide
 - Bag bottoms instead of double bagging
 - Potential annual savings of \$230,000/year if company-wide
- These and other packaging case studies and resources available at
<http://www.deq.state.or.us/lq/sw/packaging/index.htm>



Business Waste Prevention Case Studies

- Wrigley
 - Eliminating single-stick label reduced sales packaging 37%
 - Additional reductions in display trays and transport packaging



Before



After



Business Waste Prevention Case Studies

- Legacy Health System (Oregon)
 - Eliminate infrequently used items from custom surgical packs
 - Save \$30,000/year
 - Vendor engagement on packaging efficiency
- Stan Wiley Real Estate (Oregon)
 - Changes in “flyer service”
- Davis Wright Tremaine (Oregon)
 - Laser-printed letterhead saves \$5,000/year due to frequent letterhead changes
- Corvallis Chamber of Commerce (Oregon)
 - Reformat membership newsletter as “self-mailer” saves \$2,200/year
- These and other case studies available at <http://www.deq.state.or.us/lq/sw/cwrc/success/index.htm>



Business Waste Prevention Case Studies

- Bell Canada (Ontario)
 - Provide every employee with ceramic cup; stop purchasing disposables
 - Replaced disposable dishes in cafeteria with reusables
 - Replaced single-serve packages with bulk dispensers for juice, milk and condiments
 - On-site composting
 - Replaced paper towels with high-efficiency hot air dryers
 - Gave every employee a sponge!
 - Flooded floors with recycling containers
 - Took away everyone's garbage cans
 - Reduced waste generation by 98%



Thank You!

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