



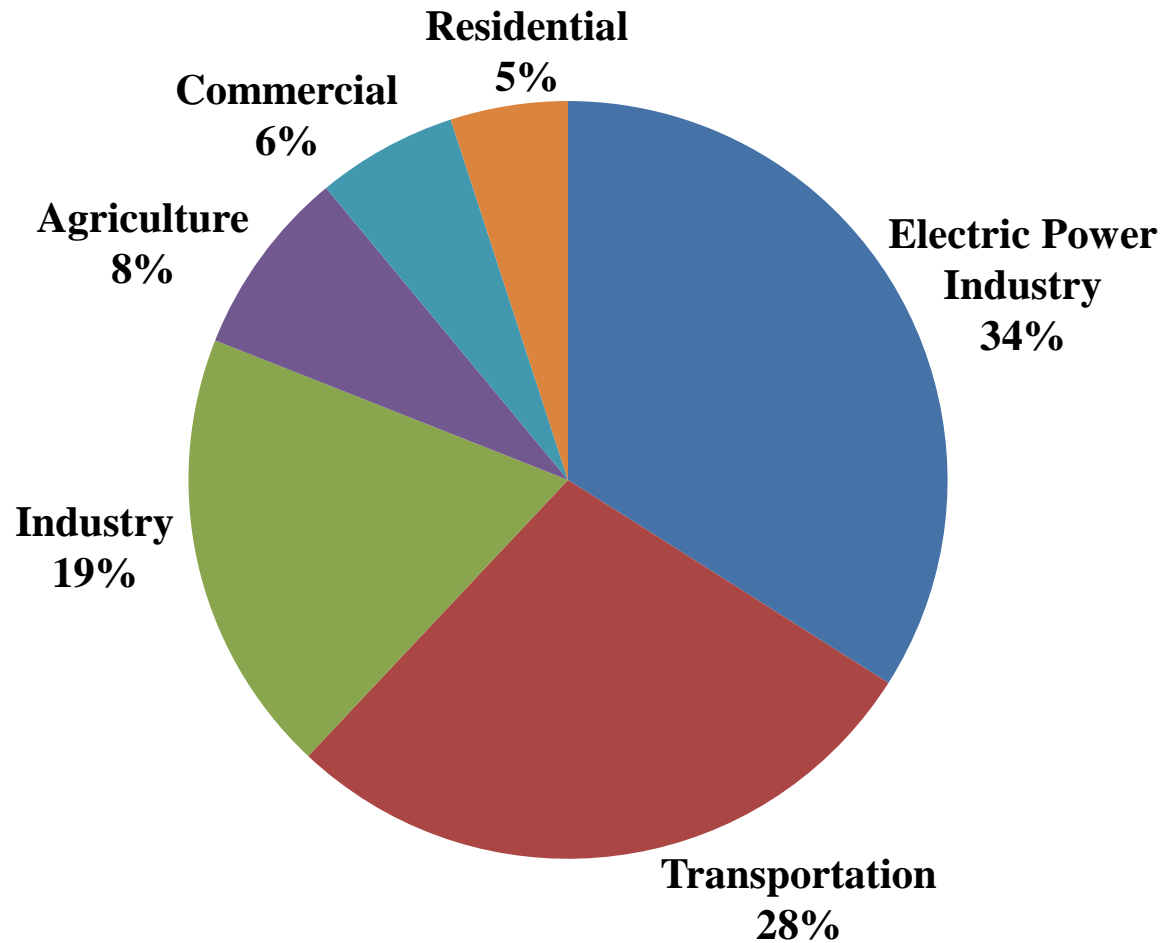
## **Connecting Climate Change Mitigation with Materials, Products, & Waste**

Northeast Waste Management Officials' Association  
March 22, 2010

David Allaway  
Oregon Department of Environmental Quality  
(503) 229-5479  
[allaway.david@deq.state.or.us](mailto:allaway.david@deq.state.or.us)

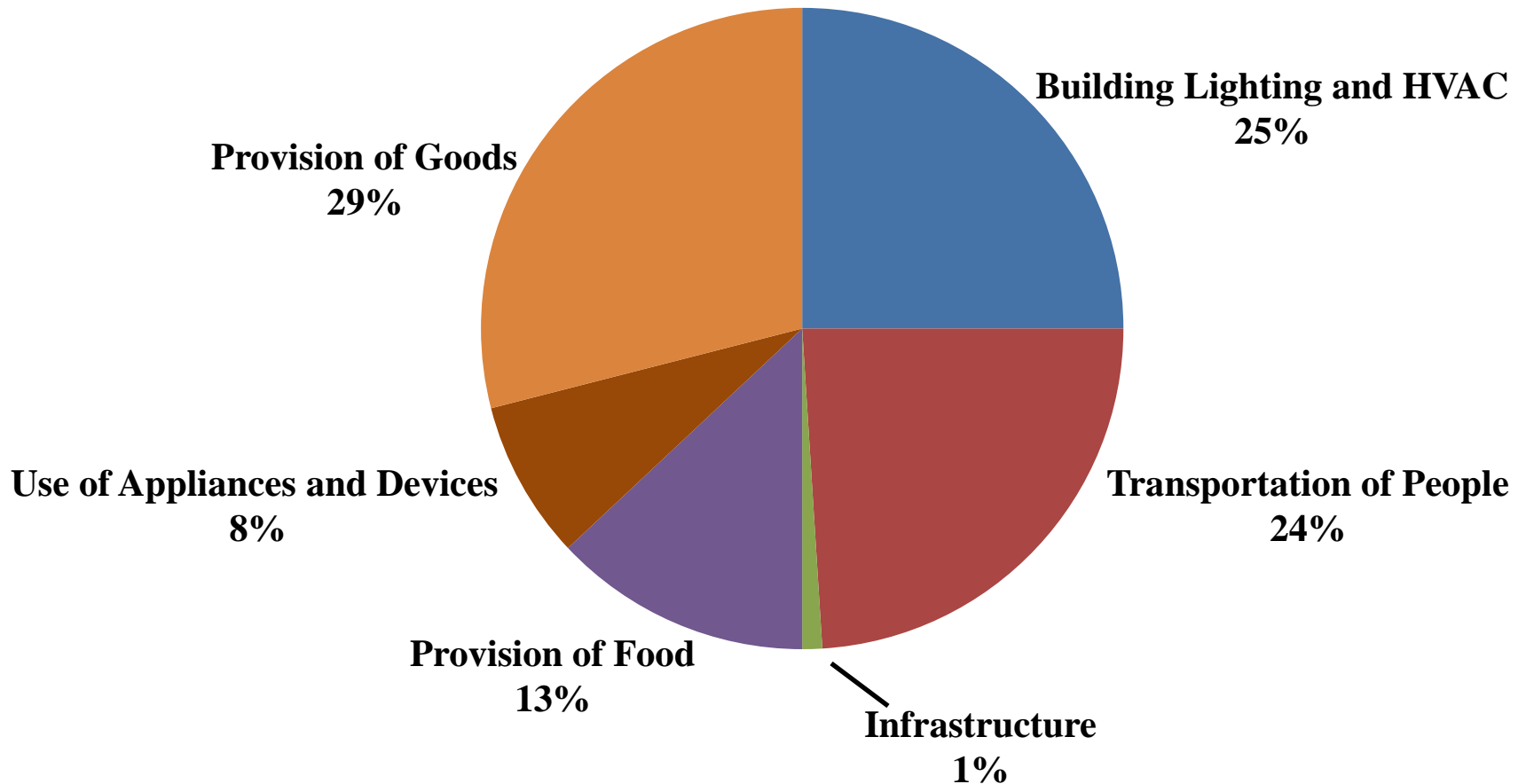


## Sector-Based View of U.S. Greenhouse Gas Emissions (2006)



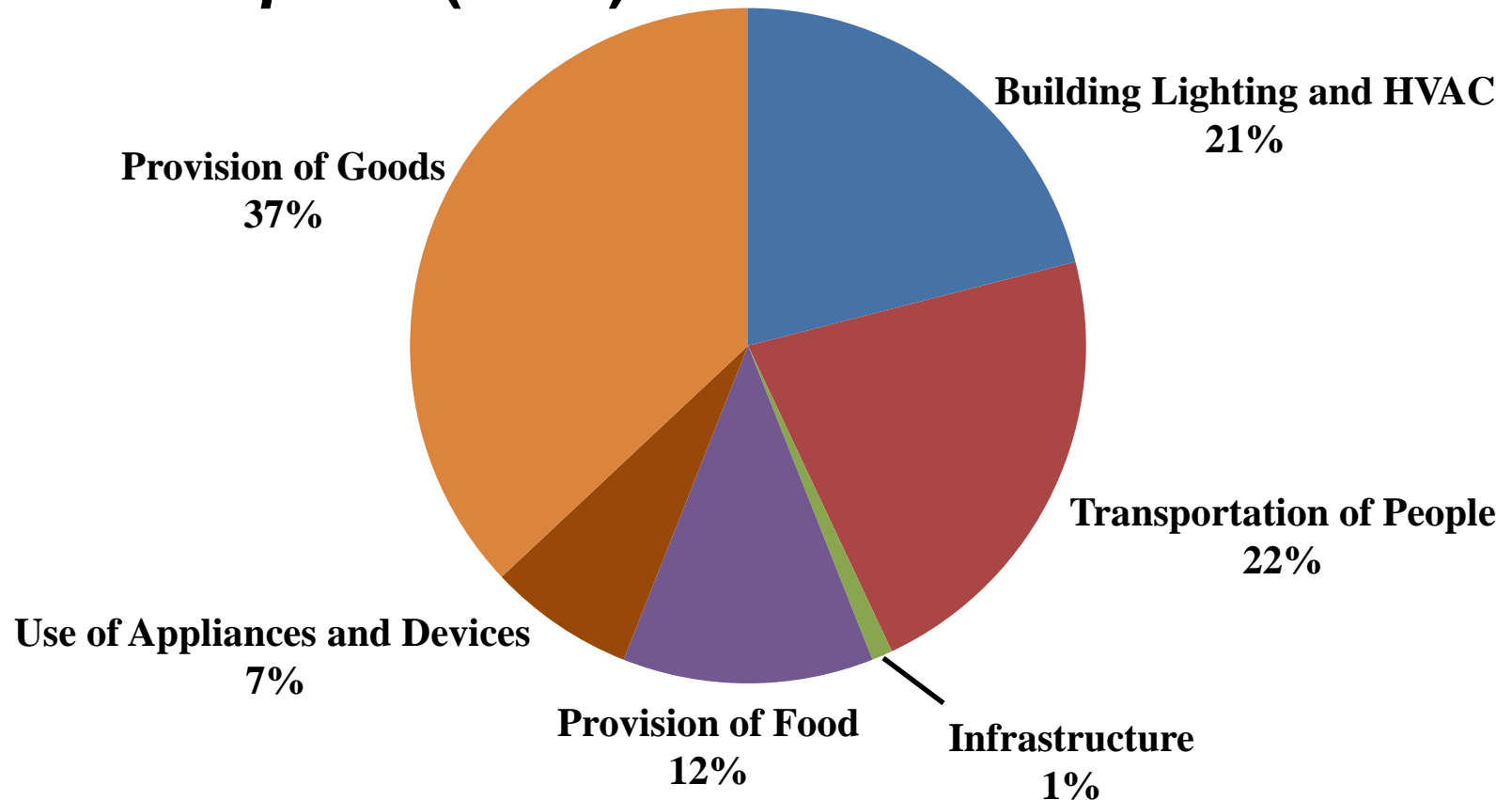


## Materials Matter: Systems-Based View of U.S. Greenhouse Gas Emissions (2006)





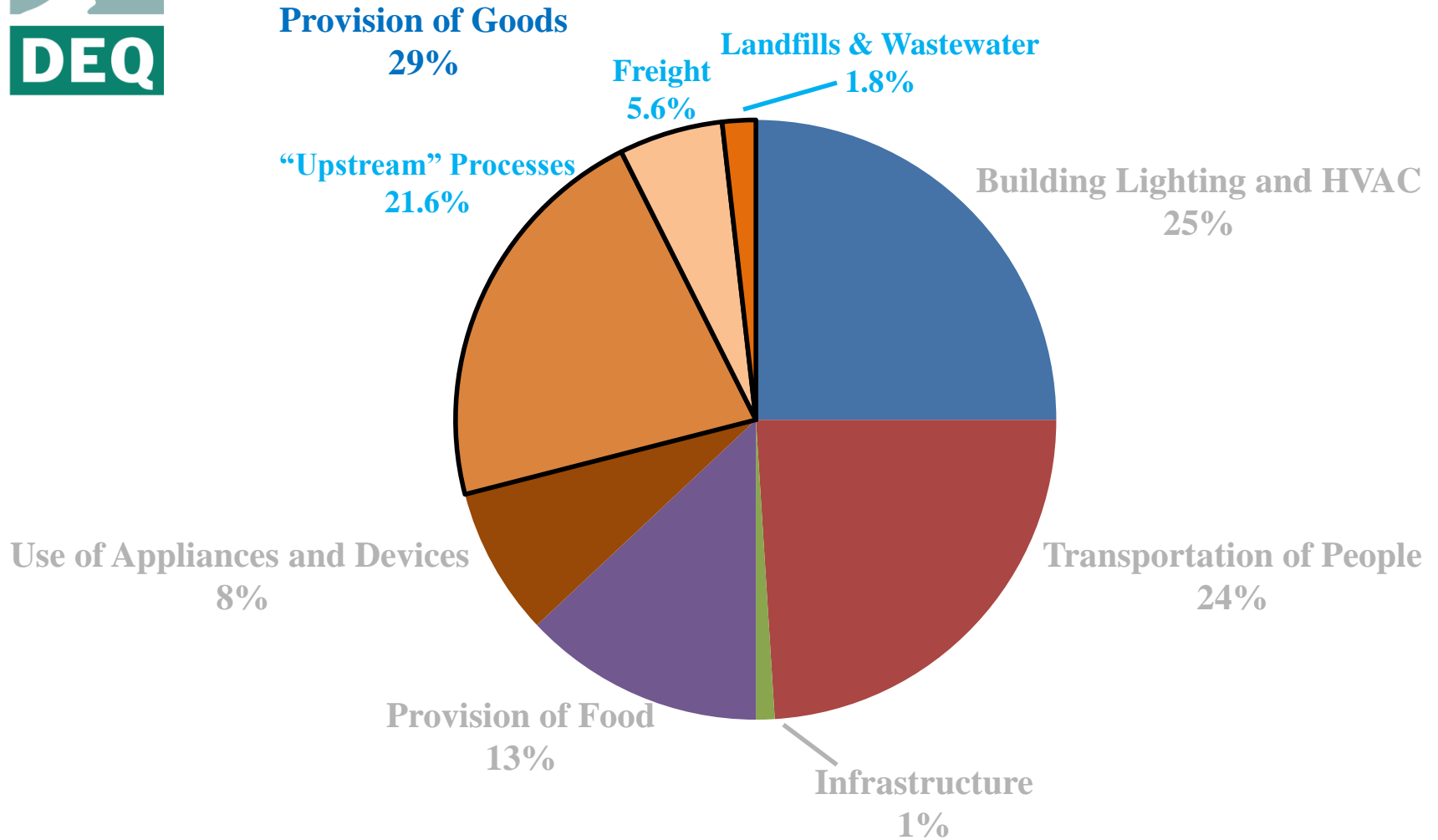
## Materials Matter: Systems-Based View of U.S. Greenhouse Gas Emissions, *Adjusted for Imports and Exports (2006)*



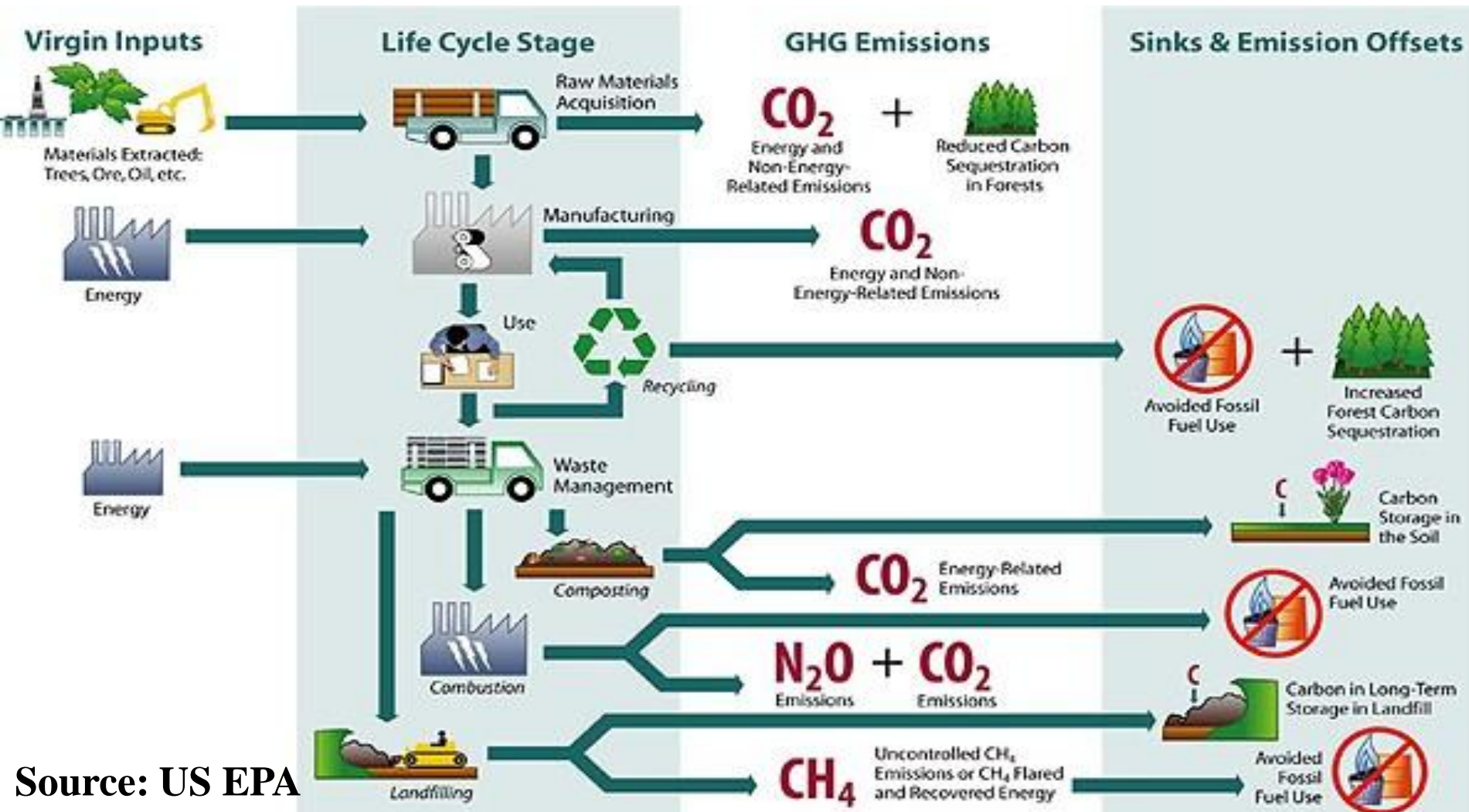
Source: Joshua Stolaroff/Product Policy Institute (2009), based on EPA (2009) and Weber & Matthews (2007)



## For Goods, “Upstream” Emissions Dominate



# Greenhouse Gases Over the Product Life Cycle



Source: US EPA



## Energy and Greenhouse Gas Benefits of Recycling

- Recycling in Oregon in 2008 saved ~30 trillion BTUs of energy
  - ~2.7% of total statewide use
  - Equivalent of ~243 million gallons of gasoline
- Recovery in Oregon in 2008 reduced greenhouse gas emissions by ~3.3 million metric tons of CO<sub>2</sub>e
  - ~4.6% of total statewide emissions
  - Equivalent of 660,000 “average” passenger cars



## Curbside Recycling (Portland, Oregon)

- For every 100 tons of mixed recyclables collected from households (curbside):
  - 6 MTCO<sub>2</sub>e in **emissions** from on-route vehicles (including diesel production)
  - 232 MTCO<sub>2</sub>e **savings** (net) when these recyclables displace virgin feedstock in production



## Long-Haul Is Not a Limiting Factor

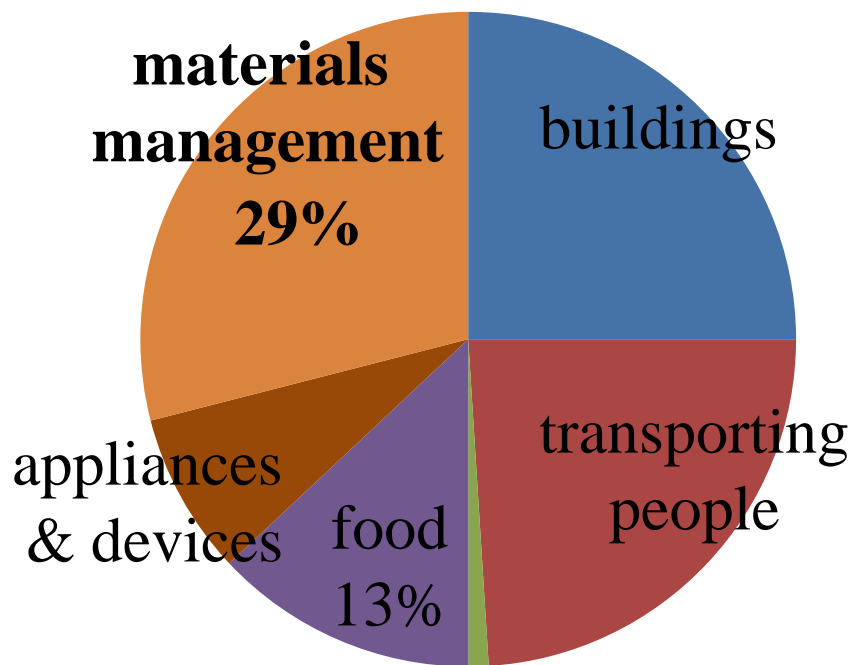
<u>Material</u>	Production & Forestry Savings (MTCE/ton collected)	<u>“Break-Even Point” (miles)</u>		
		Truck	Rail	Freighter
Aluminum	3.44	116,000	451,000	524,000
Corrugated	0.79	27,000	104,000	120,000
Newspaper	0.68	23,000	90,000	104,000
Steel	0.48	16,000	63,000	73,000
LDPE	0.36	12,000	47,000	55,000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

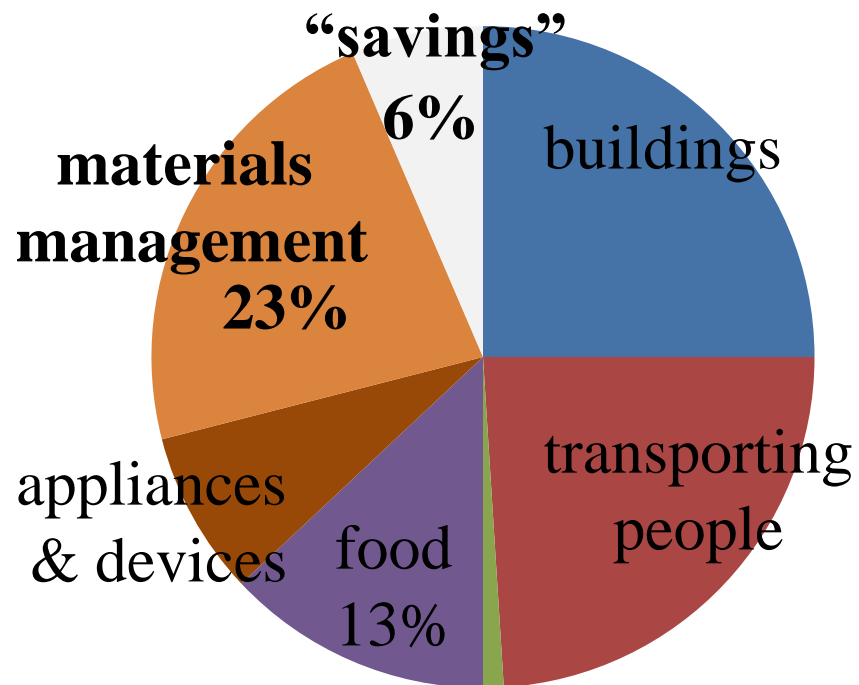
Avoided disposal-related emissions are not included.



## The importance . . . and limitations . . . of recovery



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



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



## Waste Prevention and Reuse

- Typically larger GHG reductions (per-ton) than recycling . . . if reused materials displace production of new materials.
- Two waste prevention examples:
  - DEQ drinking water delivery LCA
  - DEQ e-commerce LCA



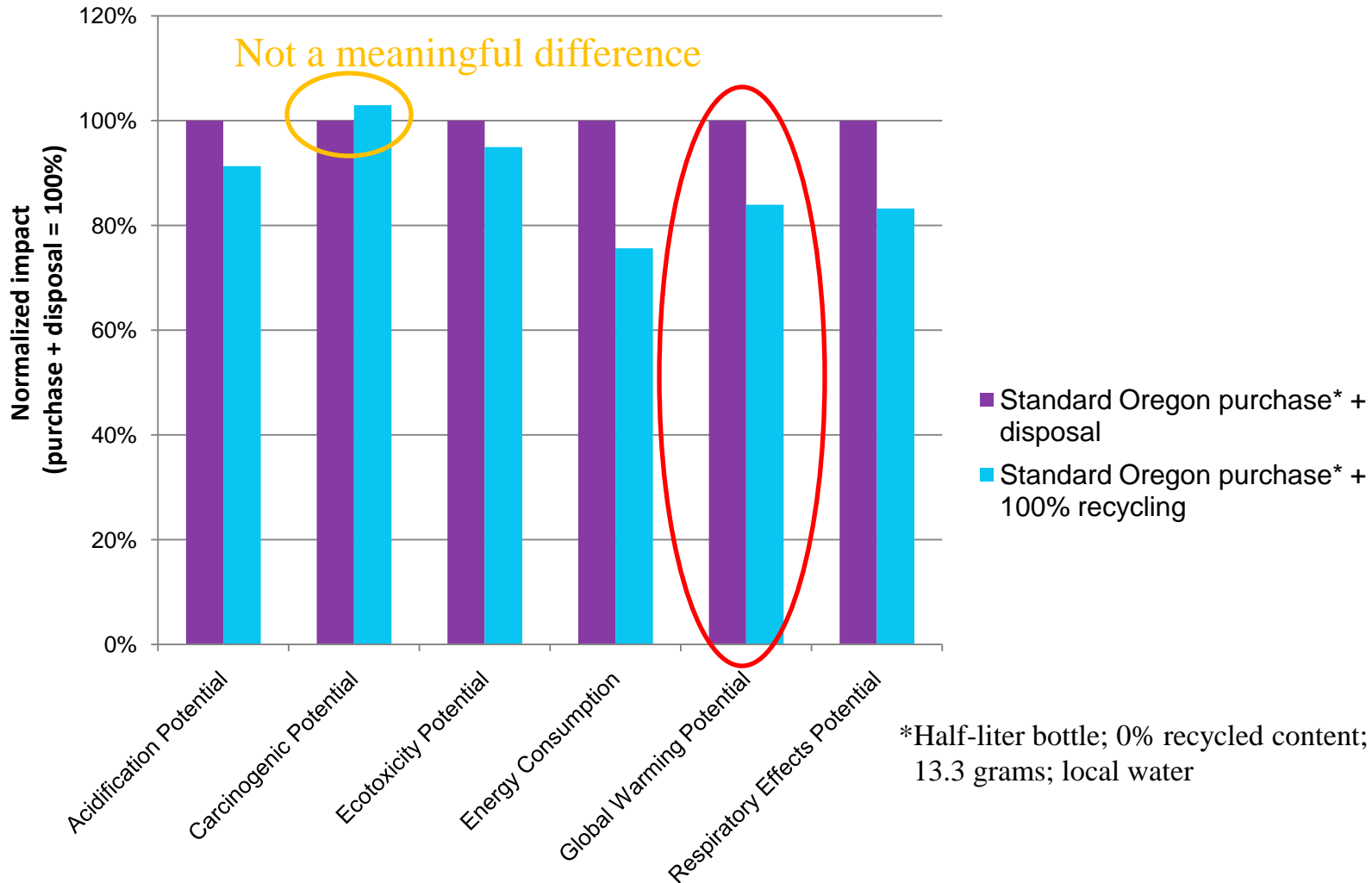
## DEQ's Life Cycle Analysis of Water Delivery

- 3 basic systems:



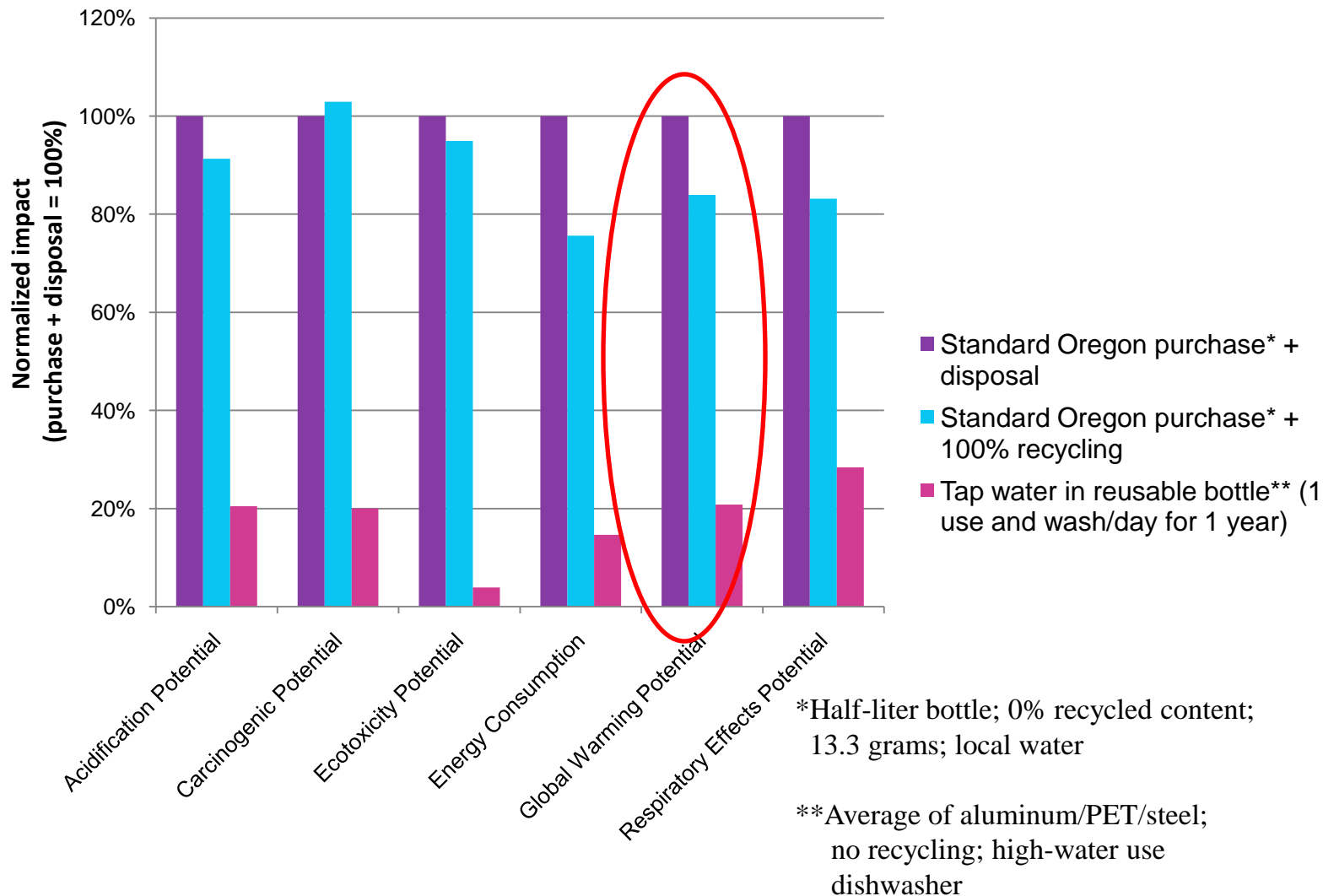


## Disposal vs. Recycling



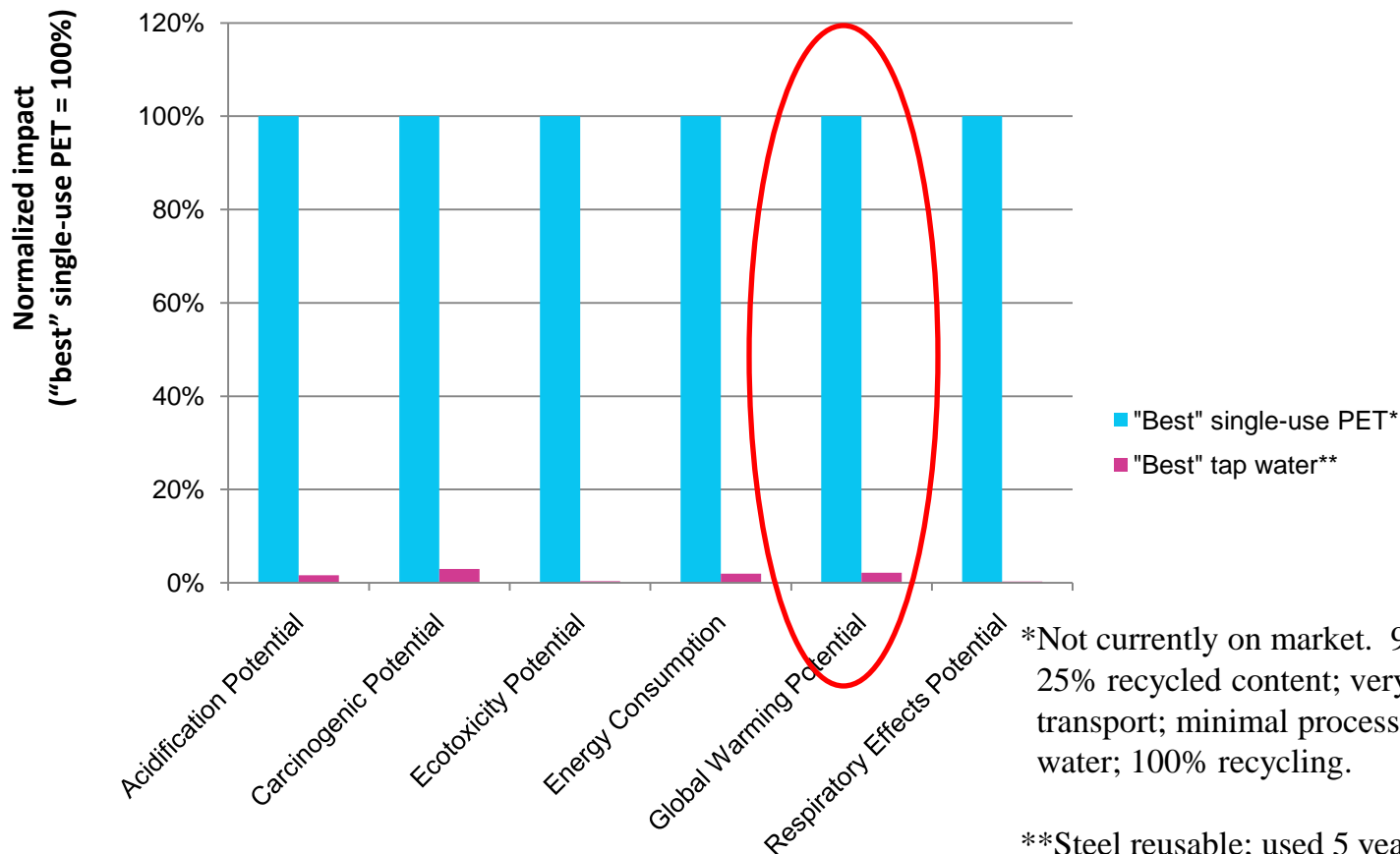


## Disposal vs. Recycling vs. Prevention





## 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



## DEQ E-Commerce Study: Options 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

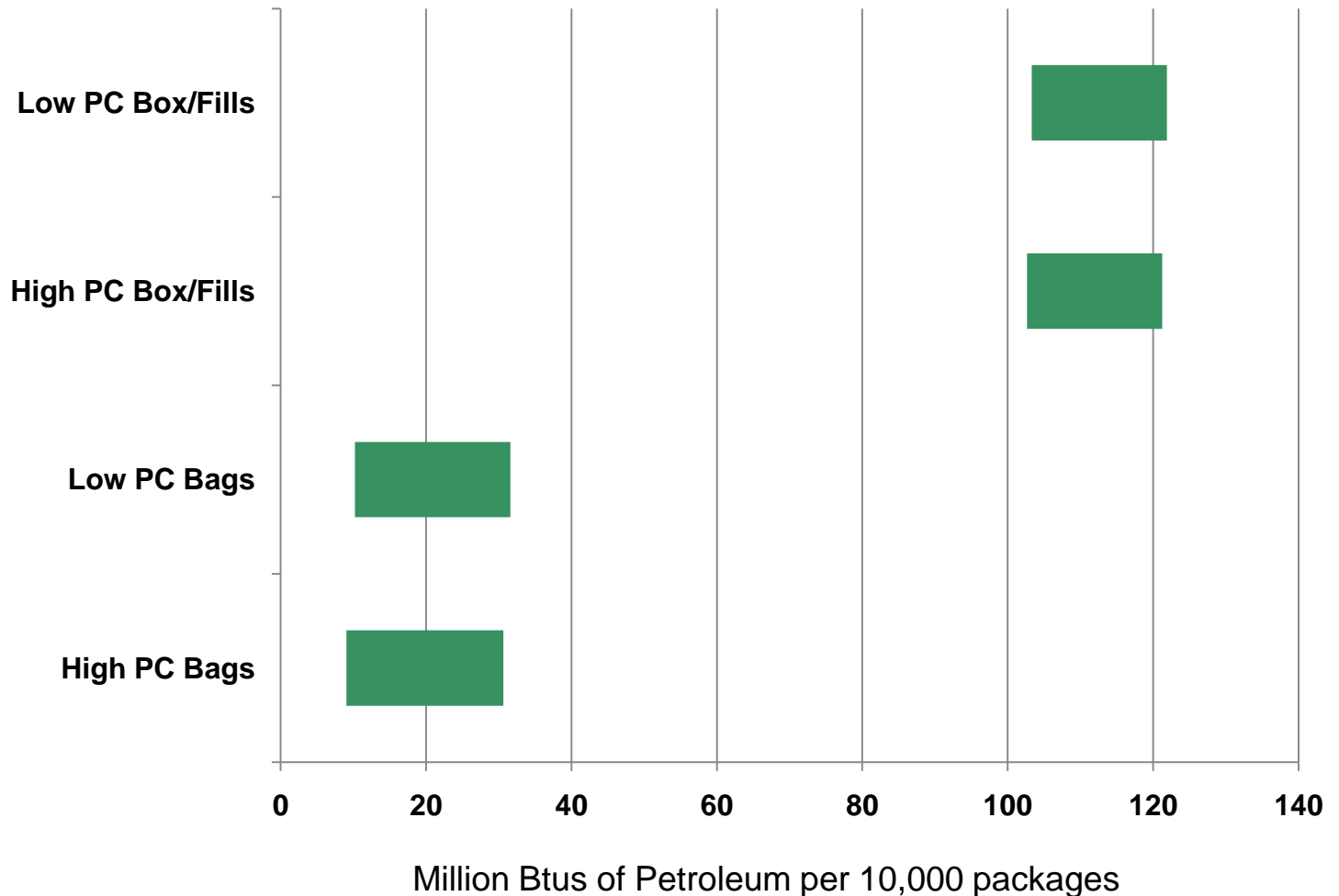
### Shipping Bags

- 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.

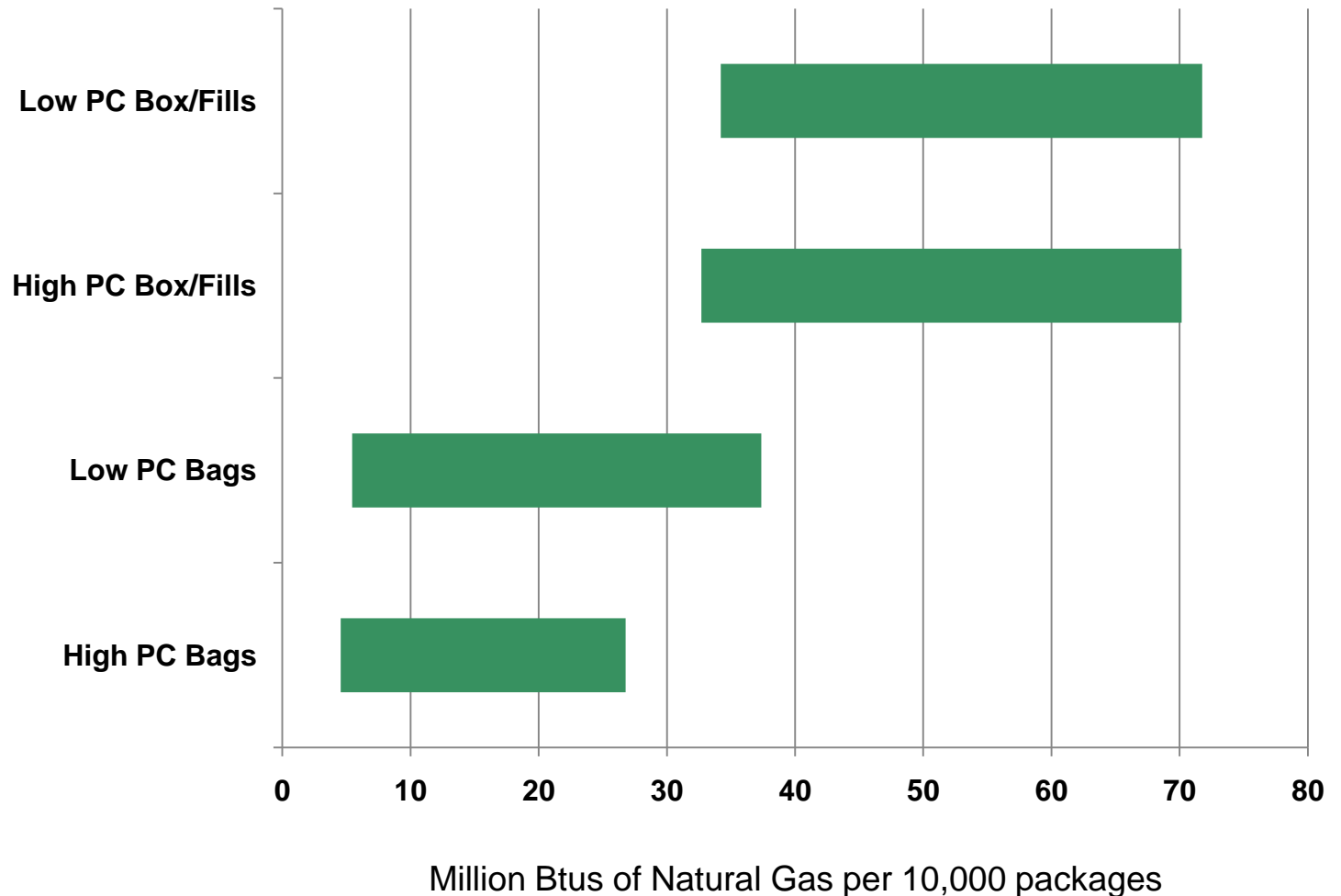


## DEQ E-Commerce Study: Life Cycle Petroleum Consumption



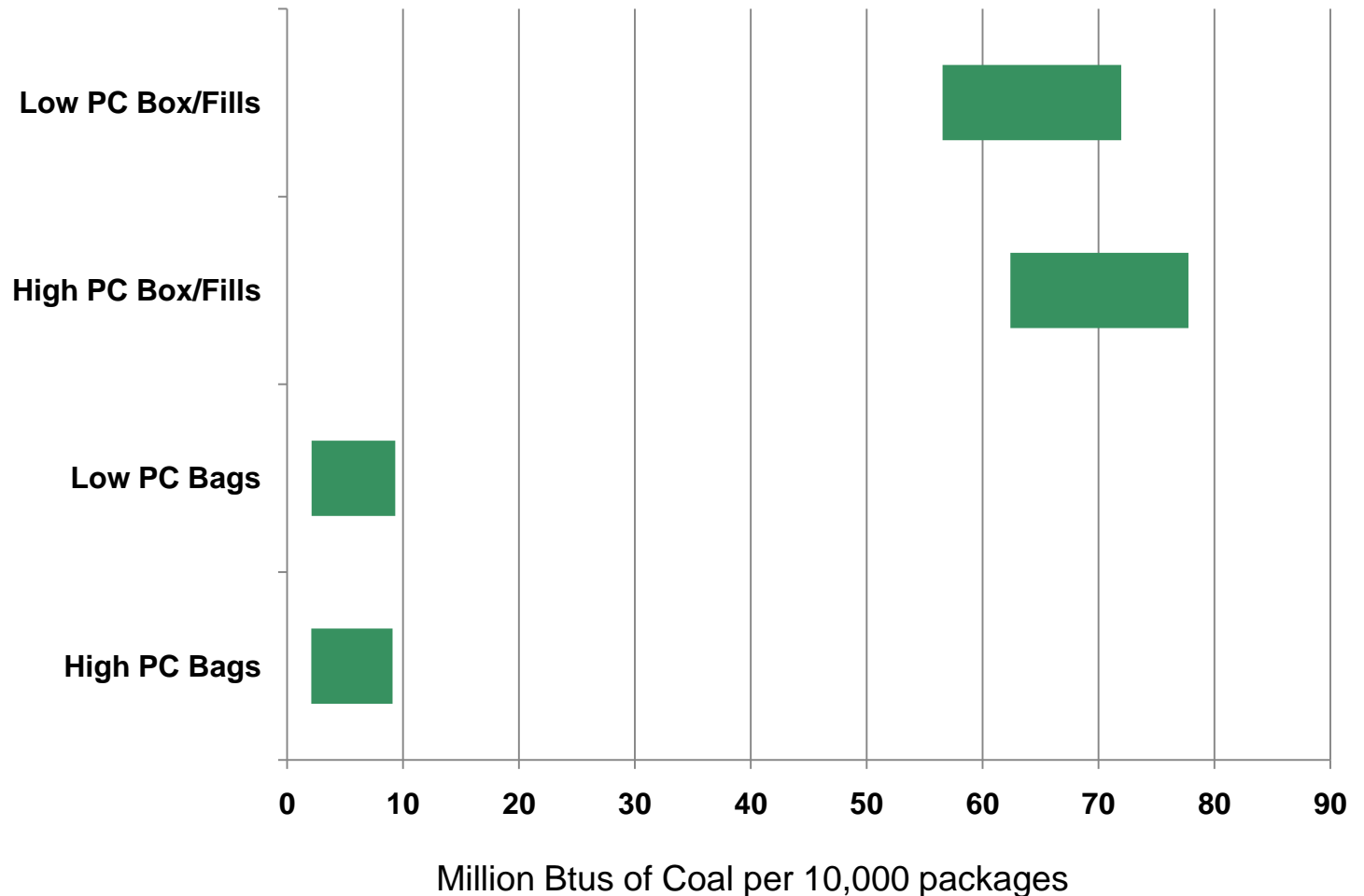


## DEQ E-Commerce Study: Life Cycle Natural Gas Consumption



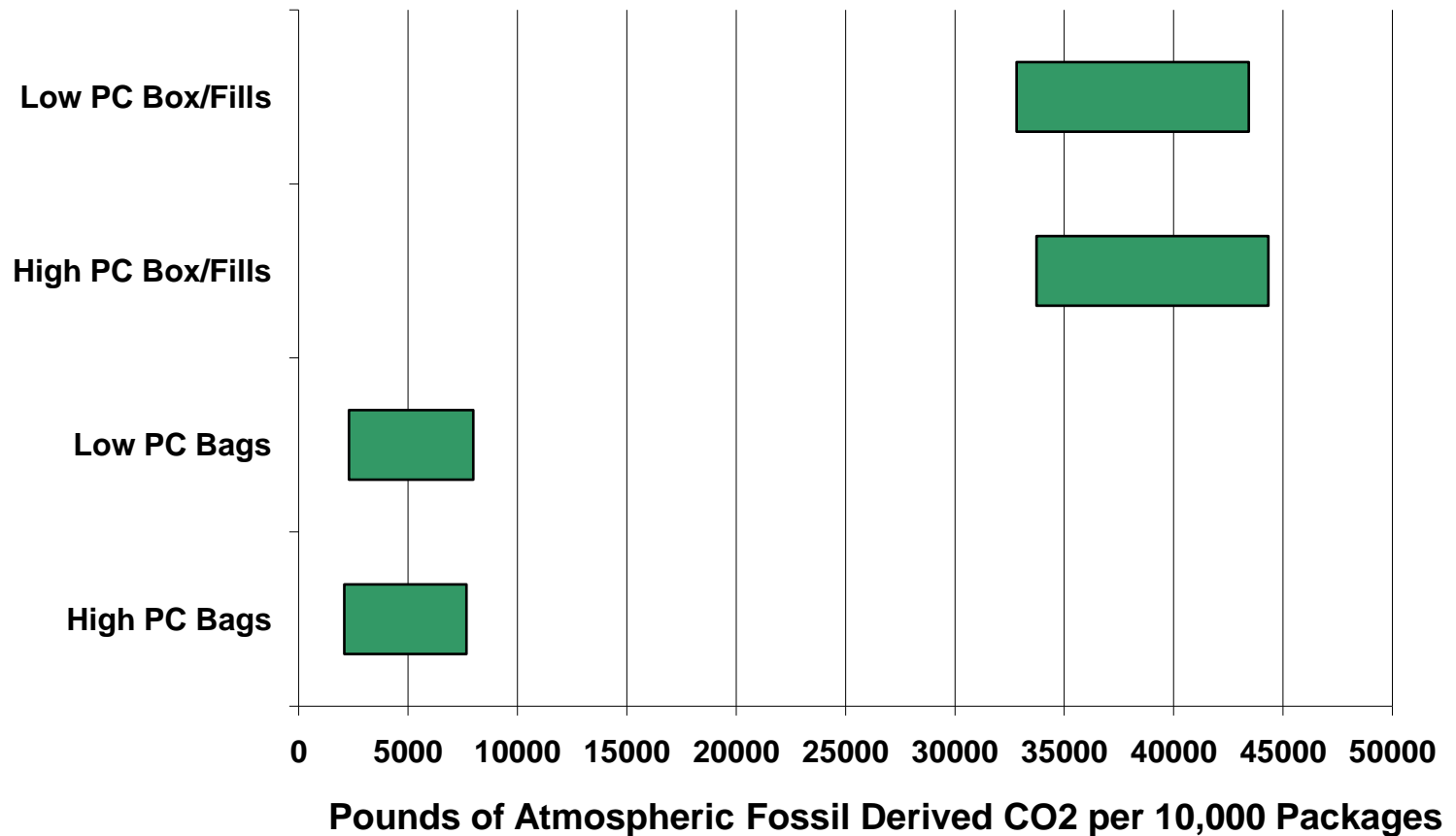


## DEQ E-Commerce Study: Life Cycle Coal Consumption





## DEQ E-Commerce Study: Fossil-Derived CO2 Emissions



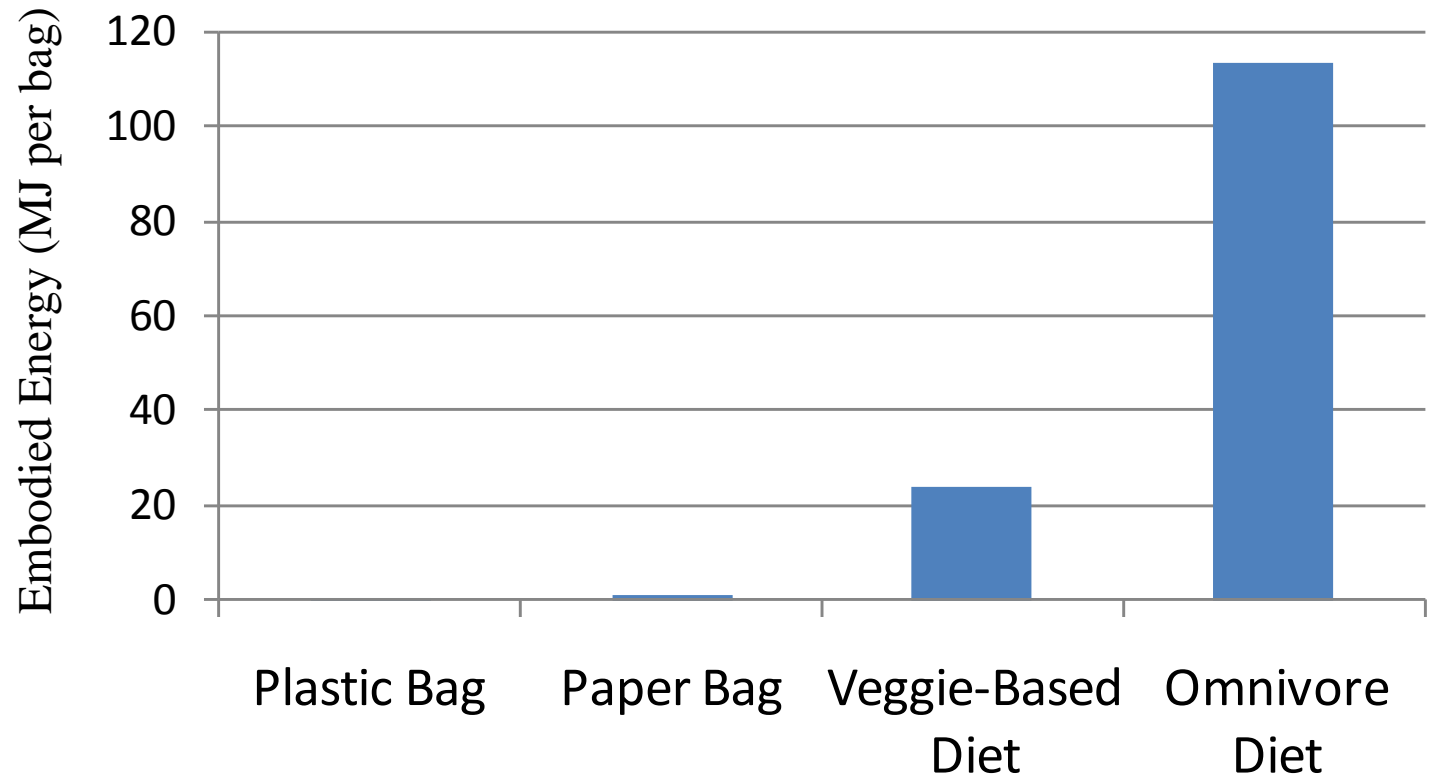


## DEQ E-Commerce LCA: Conclusions

- Mass matters!
- When making *purchasing* decisions between *dissimilar* materials:
  - Waste prevention correlates well with reduced environmental burdens
  - Recyclability and recycled content do not



## Products are more impactful than packaging





## Rebound Effects

- Response to financial savings resulting from resource conservation . . . money is still spent, albeit it someplace else.
- Emissions intensity = life-cycle emissions per dollar spent
- Waste prevention should focus on products with high emissions intensity



## Greenhouse Gas Inventories

- Typically the first step in climate action planning
- Used to:
  - Identify sources of emissions.
  - Communicate how the community (or organization) contributes to global warming.
  - Identify opportunities for emissions reductions.
  - Track/measure change (reductions, hopefully) over time.



## Community-Scale Inventories

Two common approaches:

- “The bubble” (pure geographic emissions)
- “The bubble” adjusted for electricity and/or waste disposal (imports and exports)

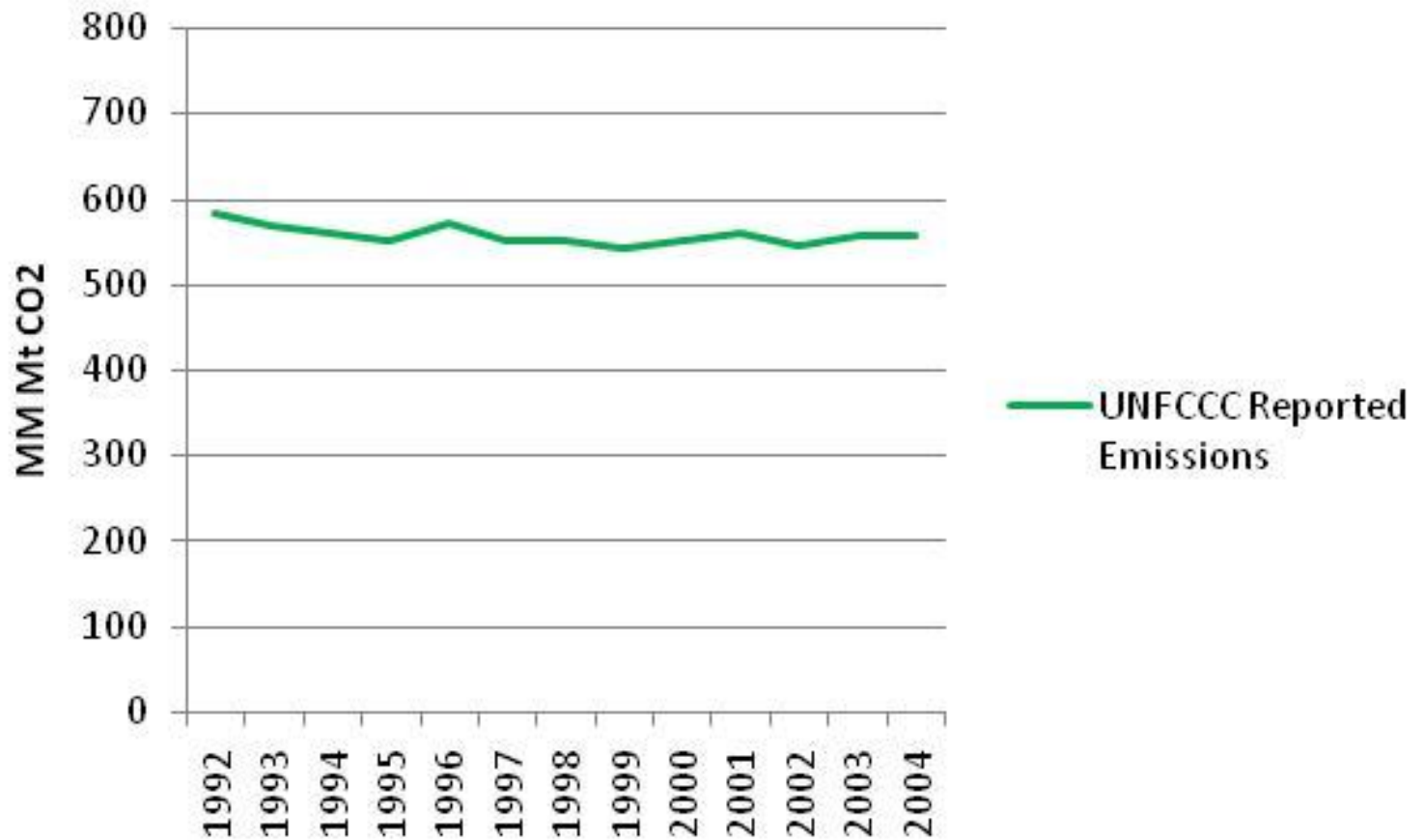


## Some Limitations of Traditional Inventories

- Provides an incomplete picture of how the community (or organization) *contributes* to emissions
- May fail to incent materials conservation practices
- Opportunities to reduce emissions may go overlooked
- May create misleading feedback over time

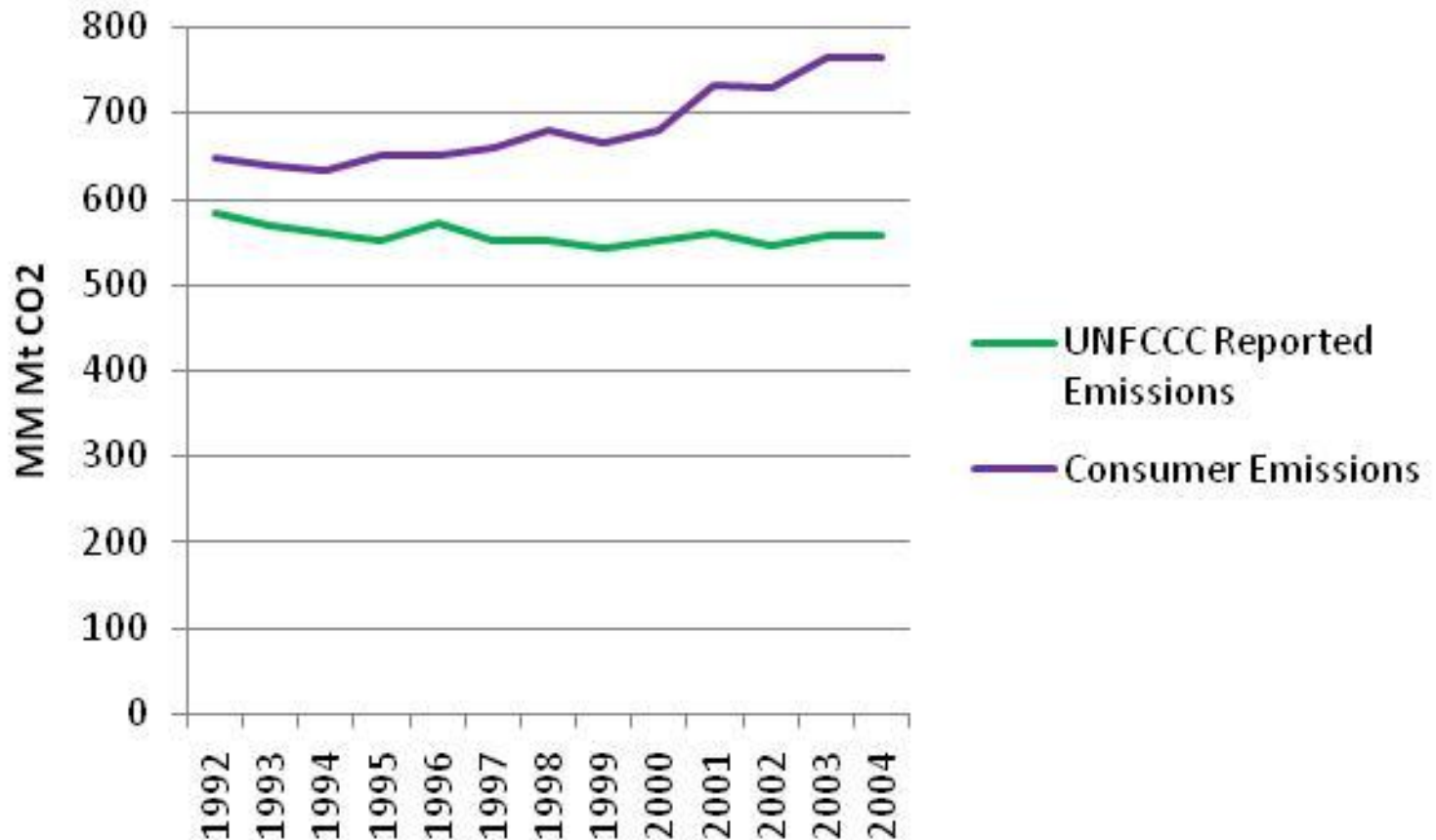


## Misleading Feedback? United Kingdom Greenhouse Gas Emissions





## United Kingdom Greenhouse Gas Emissions – A More Complete Picture





## Accounting for Materials in Community-Scale Inventories

- West Coast Forum on Climate and Materials – Inventory Workgroup
  - Protocol development
  - Toolkit for state and local governments
- Two schools of thought:
  - “Purist”: reductions count only if the emissions being reduced are included in the inventory
  - “Pragmatist”: reductions count if we influence them, even if the emissions being reduced aren’t in the inventory



## Three Basic Approaches

- **Materials/Waste Flows**
  - Use tonnage estimates (generation, disposal)
  - Multiply by per-ton emissions factors
  - Might supplement traditional inventories (if no double counting)
  - Examples: Oregon (2004), Ft. Collins (2009)
- **Consumption Inventories**
  - “Consumption” is denominated in dollars
  - Multiply by per-dollar emissions factors
  - Exist in parallel with traditional inventories
  - Examples: Oregon (2010), King County/Seattle (2010)
- **Pro-rate the National “Systems-Based” View**
  - Adjust for local conditions
  - Example: Portland Metro (2010)



## Concluding Thoughts

- GHG impacts of materials is huge
- “Demand-side” reduction strategies include recycling, waste prevention, and low-carbon purchasing. All are important.
- Traditional inventories, coupled with a “purist” view, may limit public action to reduce the GHG impacts of materials. Solutions include:
  - Adopting a “pragmatic” view of inventories and climate action plans.
  - Changing how inventories are done, and/or communicated.
- Changing inventory methods is challenging, and very much a work in progress.