International Life Cycle Assessment and Management Conference 2007

Life cycle assessment: Applications to solid waste policy and program development in Oregon

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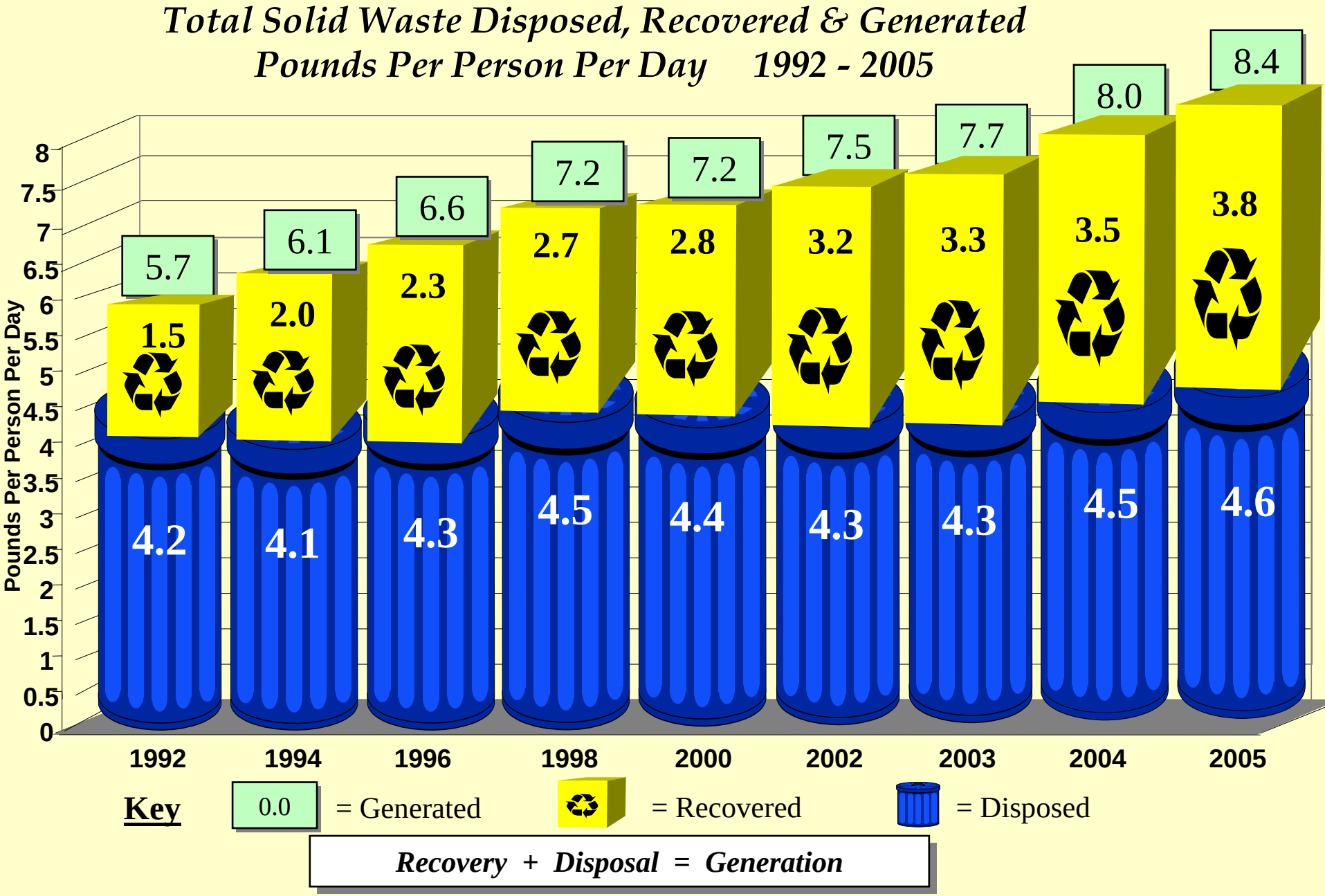
Overview

- Background: Solid waste management in Oregon
- Use of LCA
  - Advisory Group on Global Warming
  - Energy impacts of recycling
  - E-commerce packaging study
  - Waste Prevention Strategy

Solid Waste Management in Oregon

- Solid waste management hierarchy (in State law):
  - First prevent,
  - Then reuse,
  - Then recycle,
  - Then compost,
  - Then recovery for energy,
  - Then dispose in landfills.
- But historically, the focus has been on disposal, with recycling & composting prominent since 1991.
- Recovery rate is currently ~45%.
- Most disposal is via landfill.
  - Oregon has 2 waste incinerators.

Recycling is Up in Oregon, But So is Waste Generation



Oregon's Statutory Recovery and Generation Goals

Recovery Goals

Recovery = recycling, composting, some energy recovery

- 45% recovery rate in 2005.
- 50% recovery rate in 2009.

Generation Goals

Generation = all discards

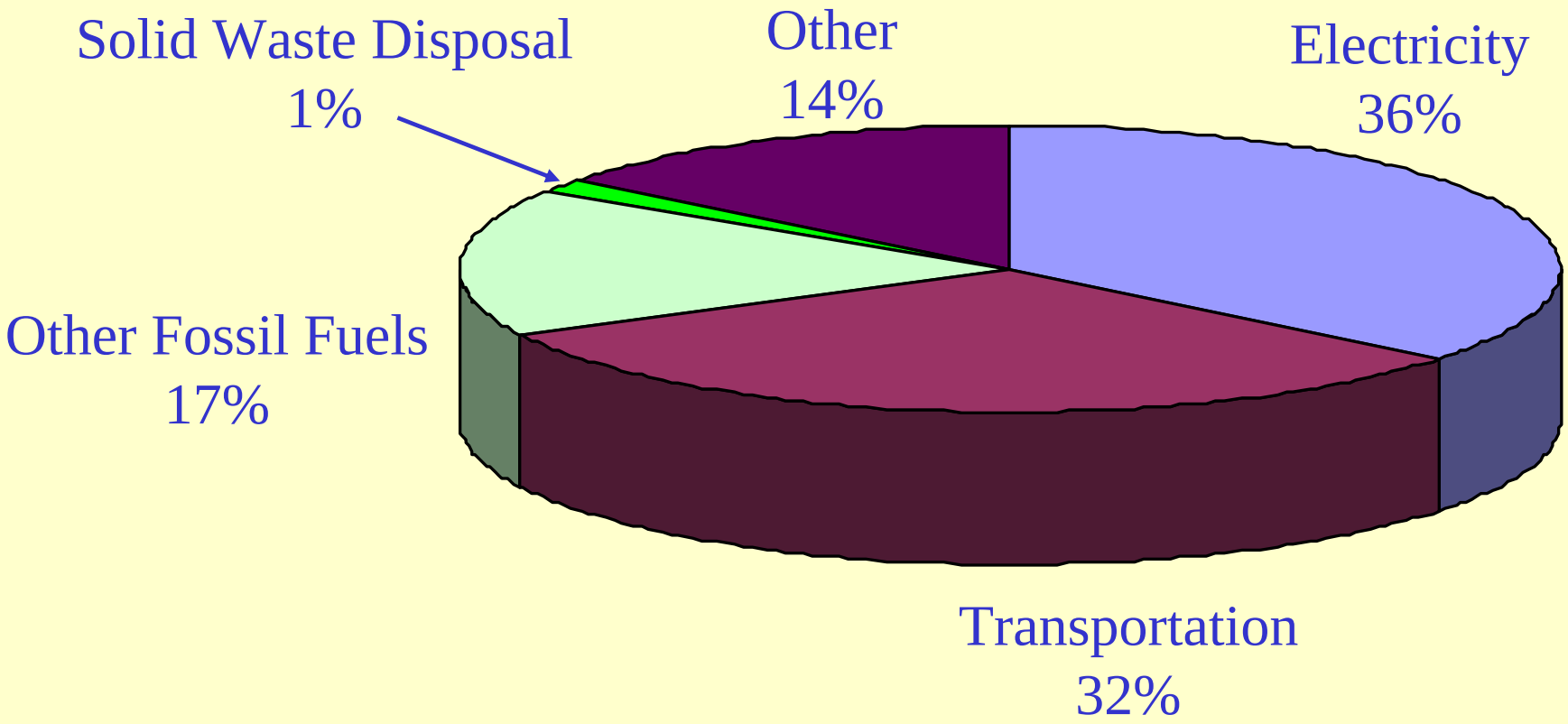
- No increase in per-capita waste generation in 2005 and subsequent years.
- No increase in total waste generation in 2009 and subsequent years.

DEQ's Solid Waste Program

- Facility permitting/inspections
- Enforce "Opportunity to Recycle" requirements
- Statewide planning and evaluation
- Waste reduction and planning grants
- Technical assistance and information
- Voluntary partnerships with industry
- Bottle bill; e-waste product stewardship program

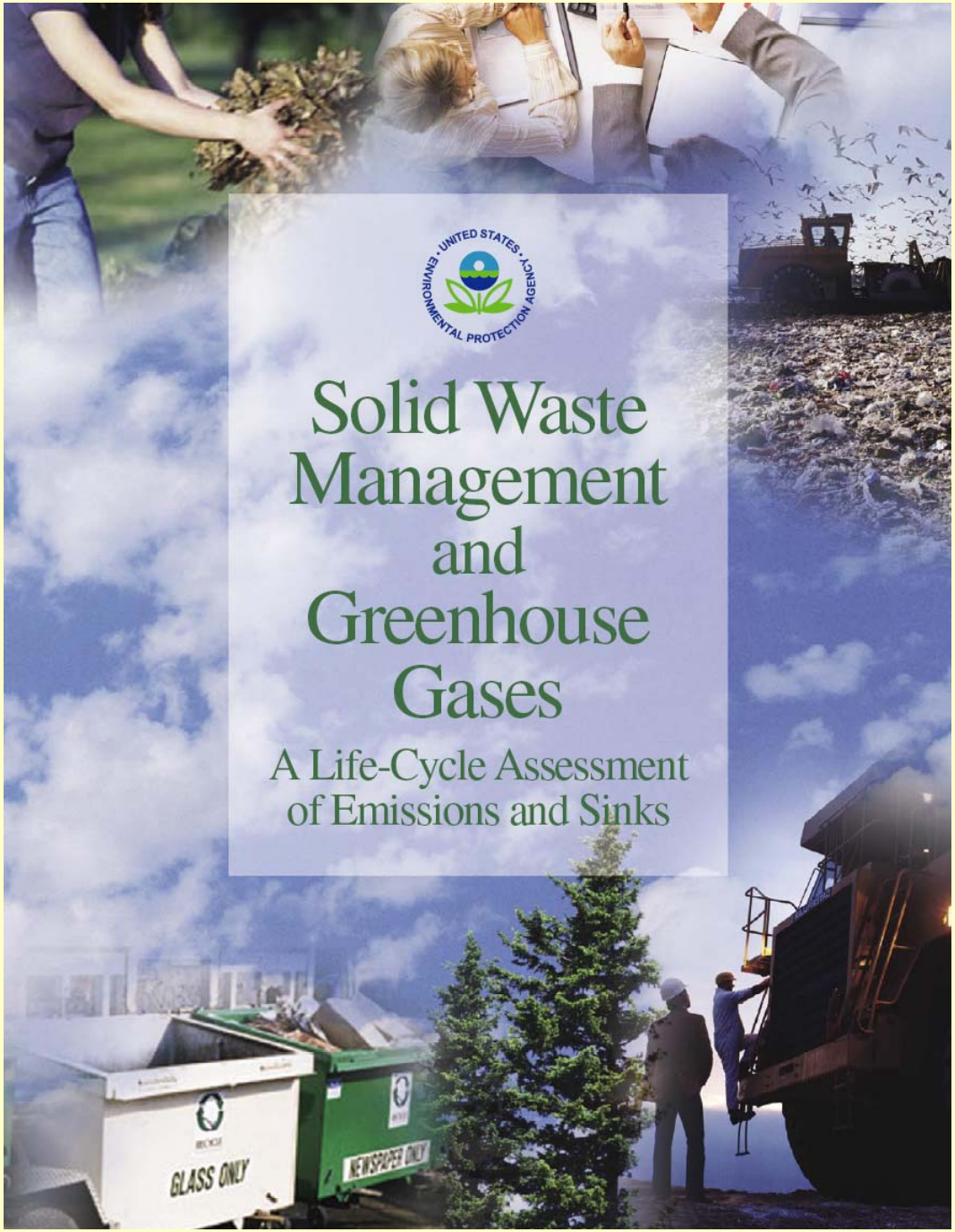
Global Warming

Oregon Greenhouse Gas Emissions Inventory, 2000 (Conventional Accounting)



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"



EPA Greenhouse Gas, Energy, and Waste Resources:

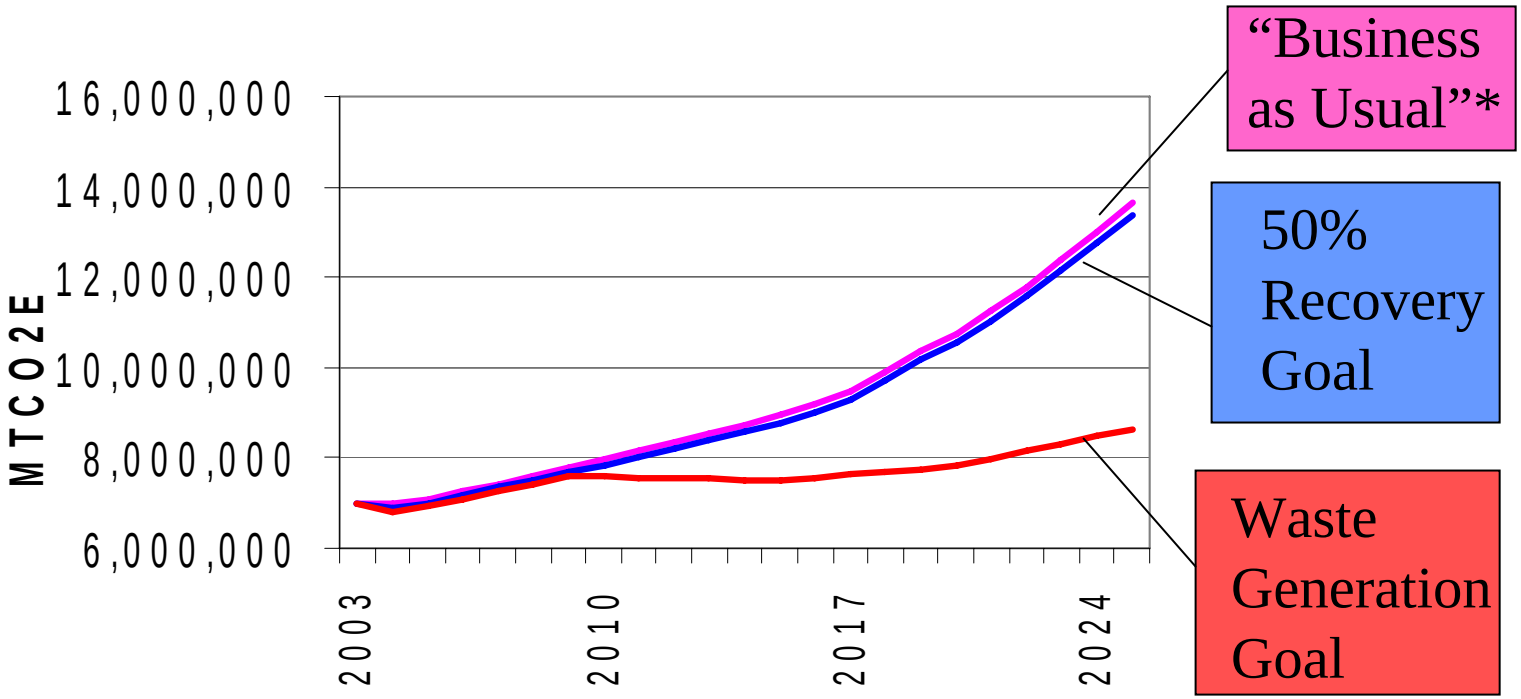
Report:
http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html

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

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)
  - More frequent collection is better than less frequent collection
- 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%

Energy

Key Findings: Energy

- 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

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

E-Commerce Packaging

A Common Question:
To Box, or To Bag?

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.
- Inventory analysis (not 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

DEQ Packaging Study: Materials Evaluated

Corrugated box*

Void Fill (for boxes)

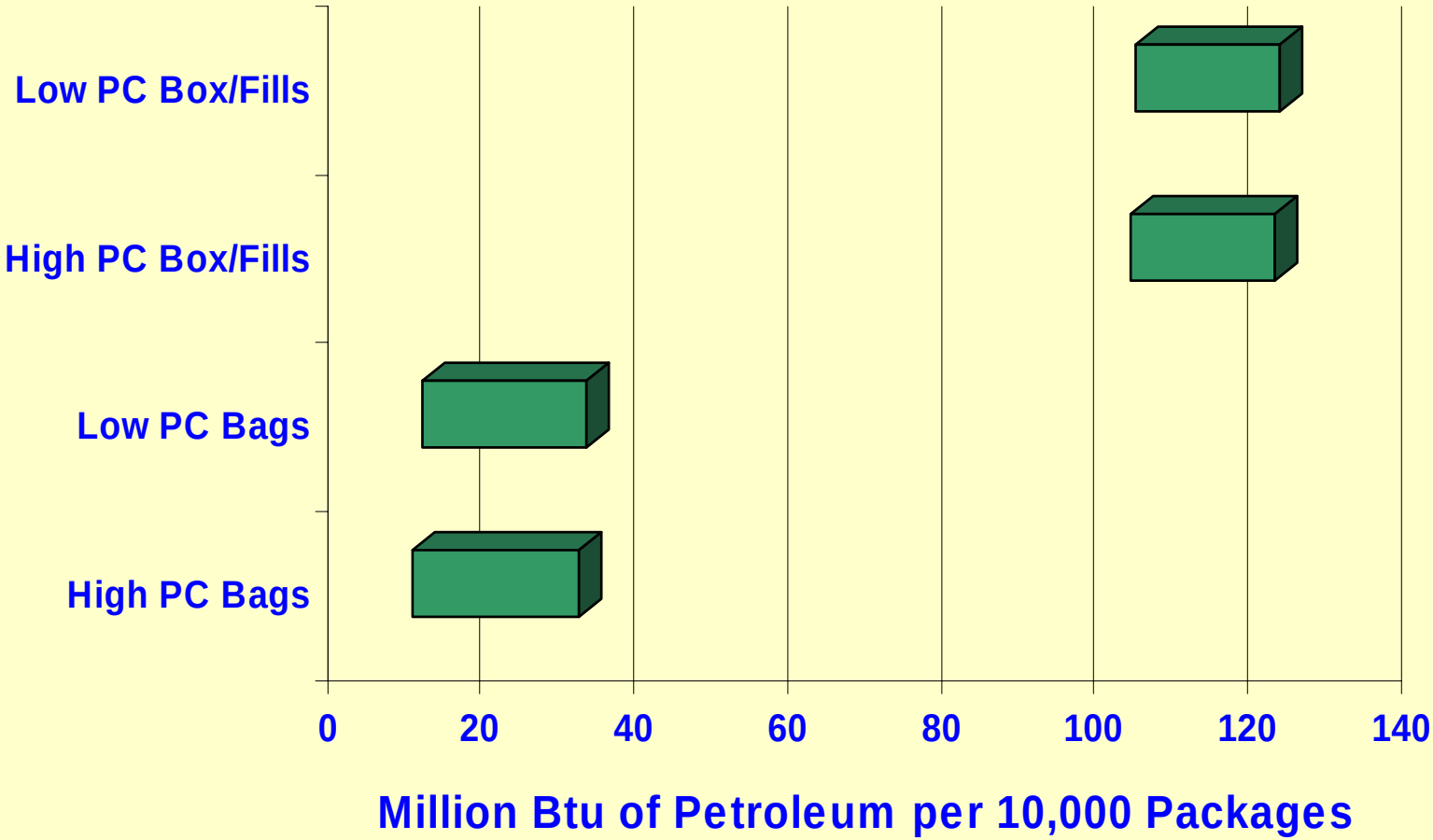
Polystyrene loose fill*
Corn starch loose fill
Molded paper loose fill
Inflated “air pillows”*
Newsprint dunnage*
Kraft dunnage*
Shredded office paper
Shredded boxes

Shipping Bags

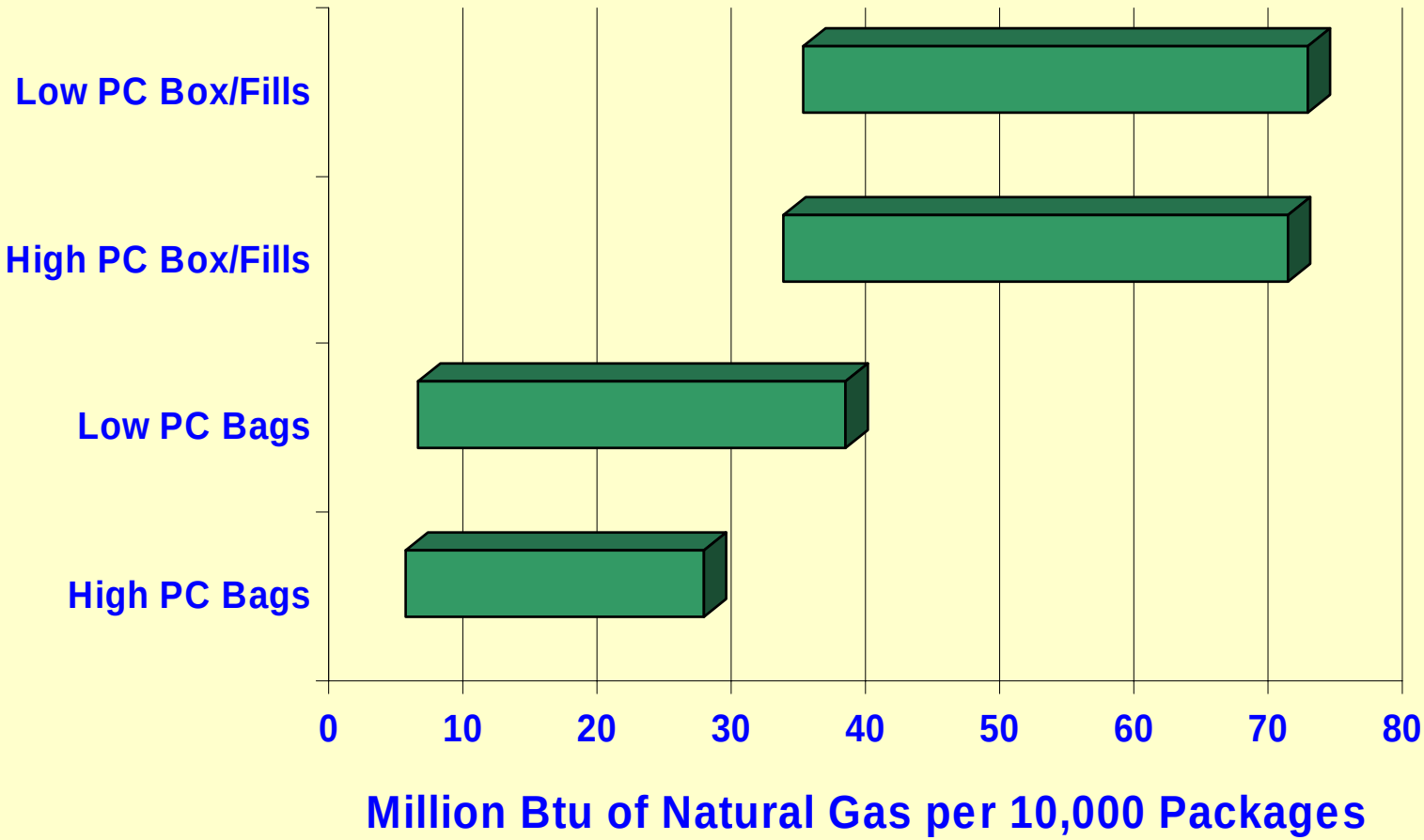
Unpadded all-kraft mailer*
Unpadded all-poly mailer*
Kraft mailer with ONP padding*
Kraft mailer with poly bubble padding*
Poly mailer with poly bubble padding*

*Different levels of post-consumer content also evaluated.

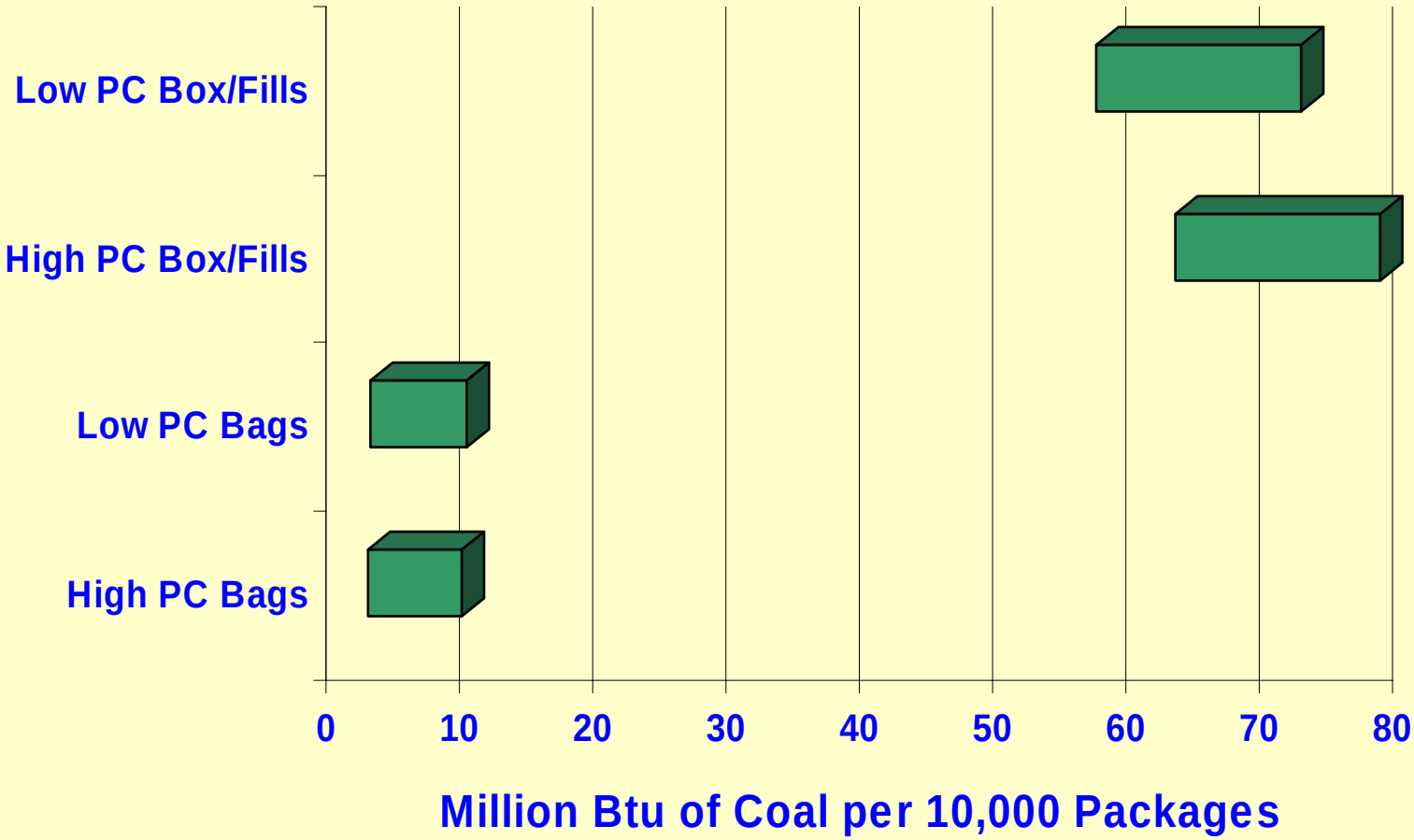
Results: Petroleum



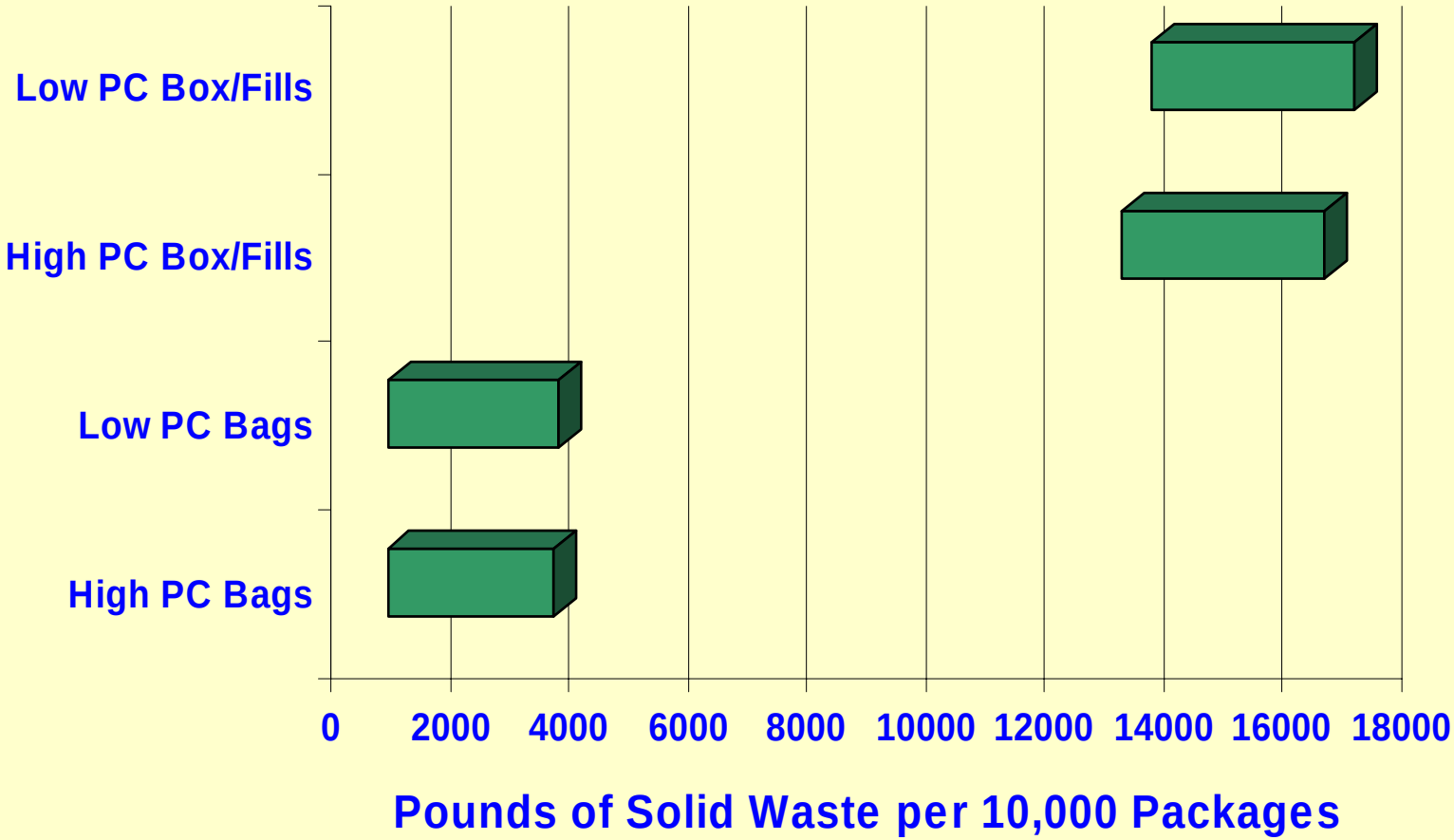
Results: Natural Gas



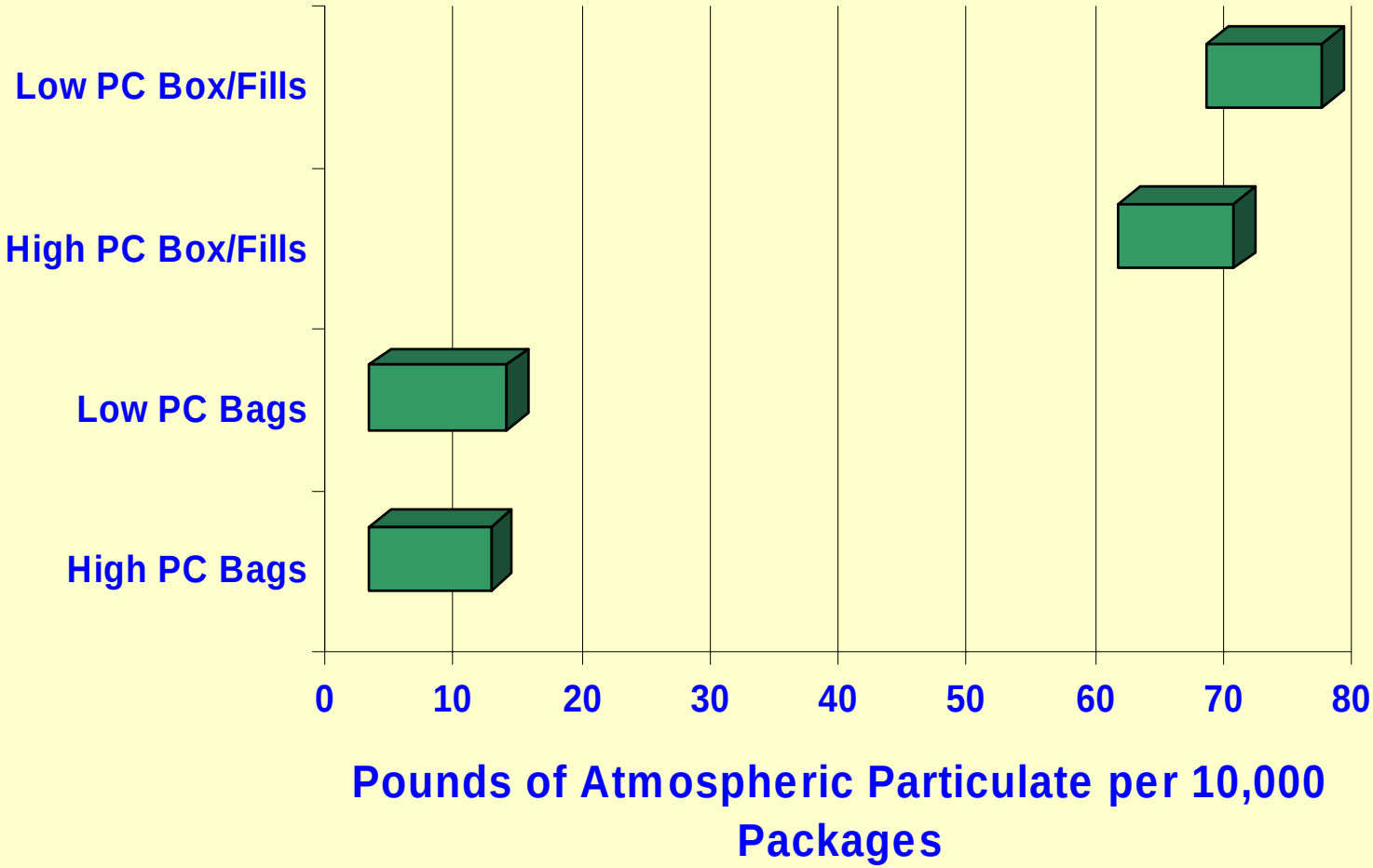
Results: Coal



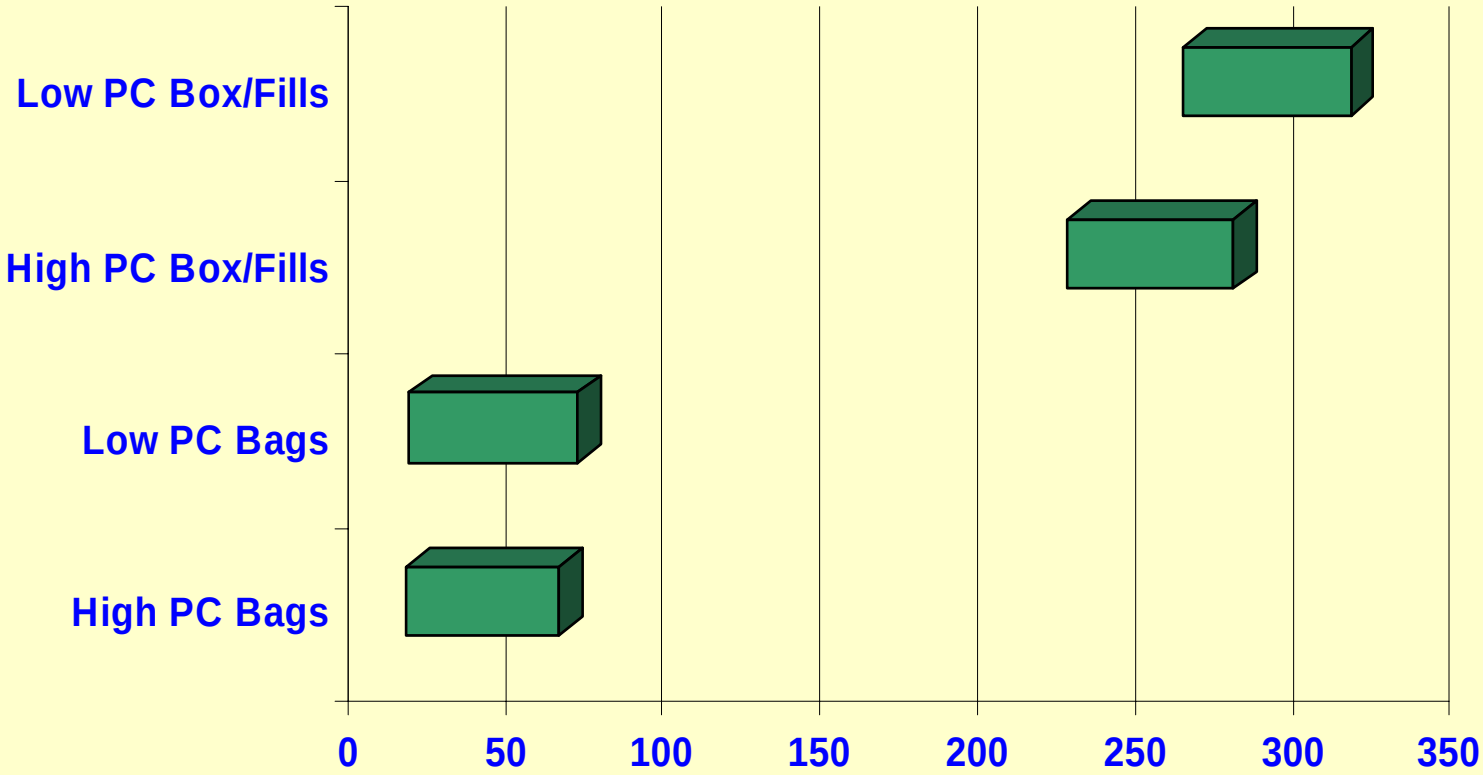
Results: Solid Waste



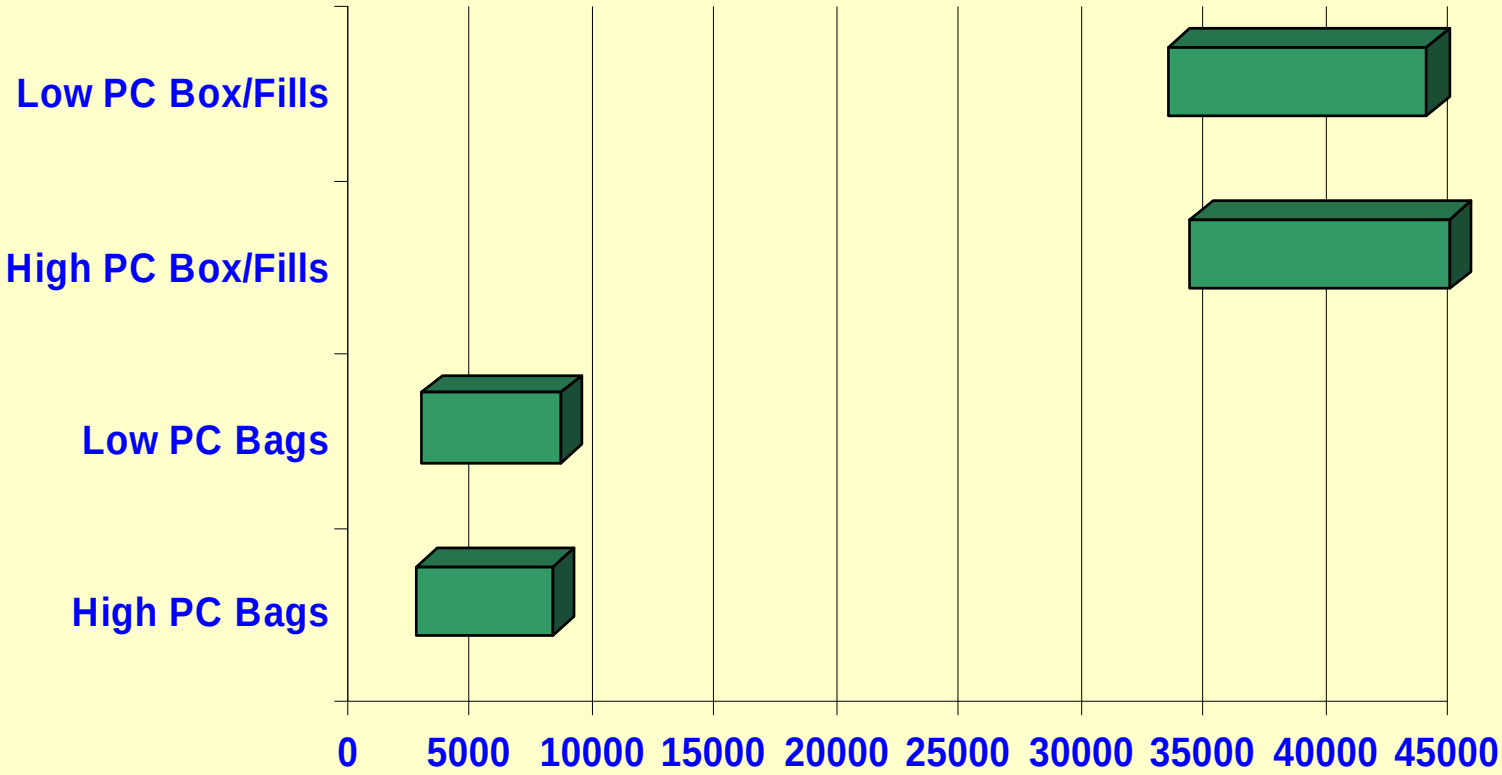
Results: Atmospheric Particulate



Results: Atmospheric NOx

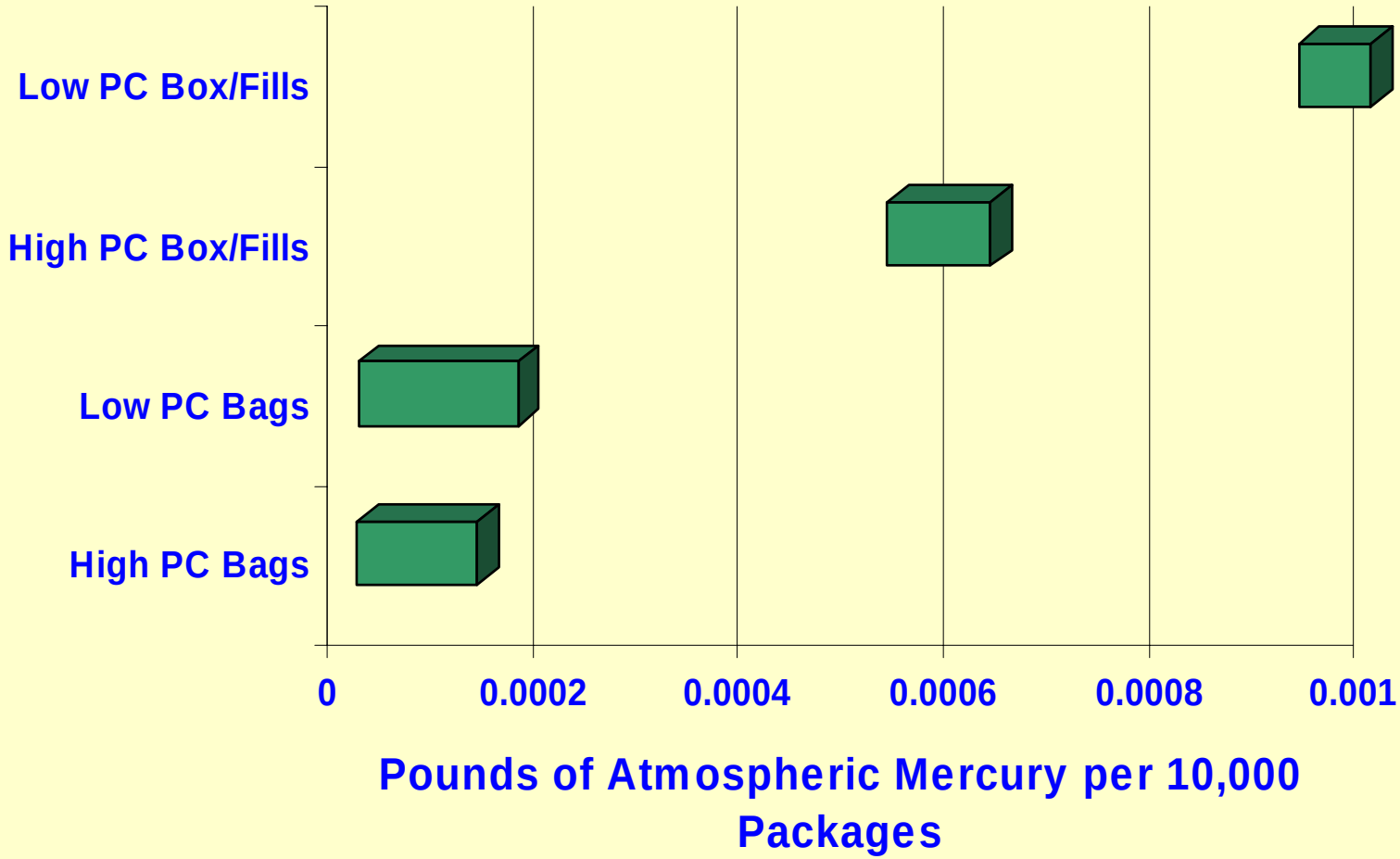


Results: Atmospheric Fossil Derived Carbon Dioxide*

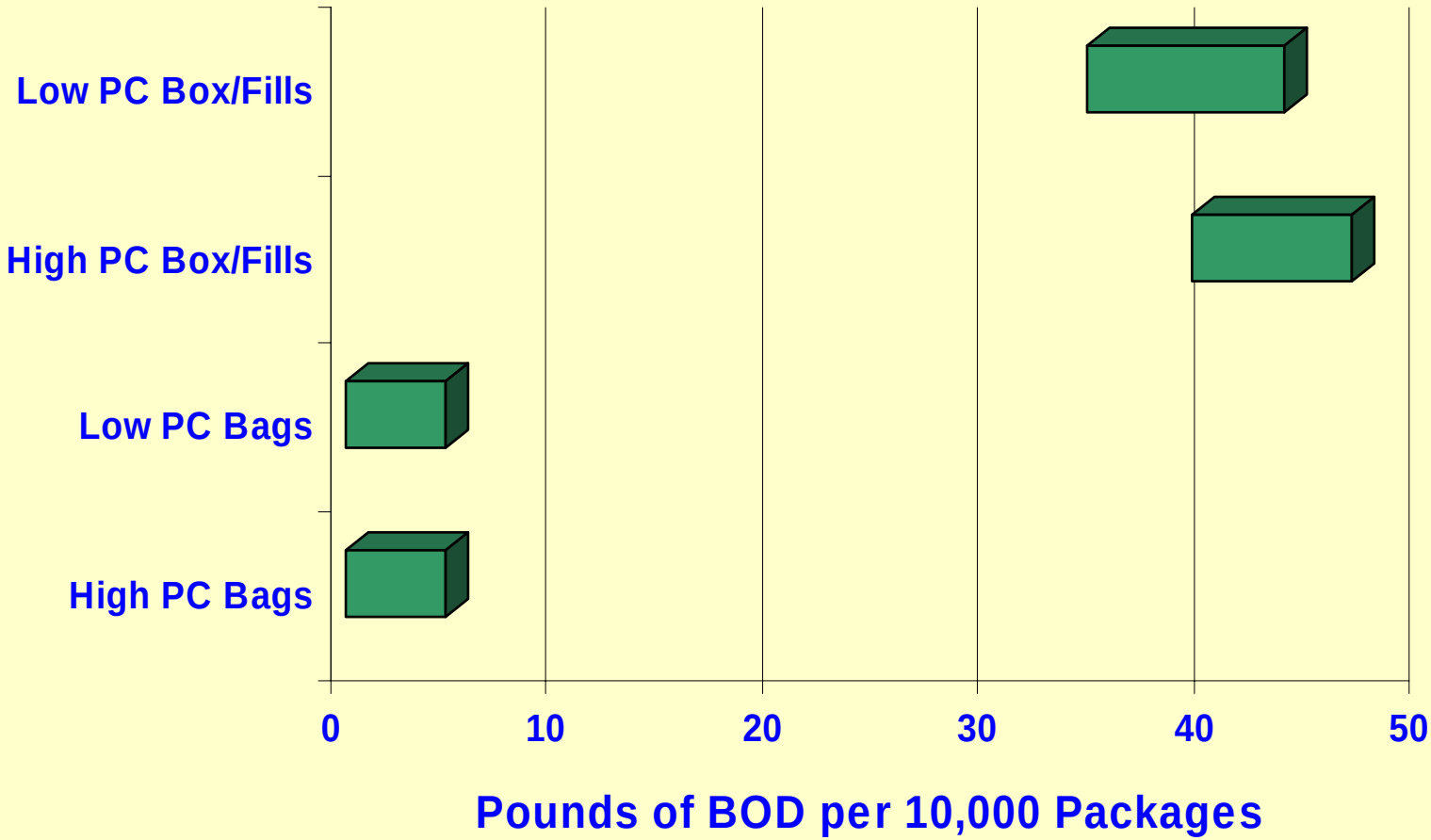


*Landfill, waste incineration, and forestry-related emissions not included.

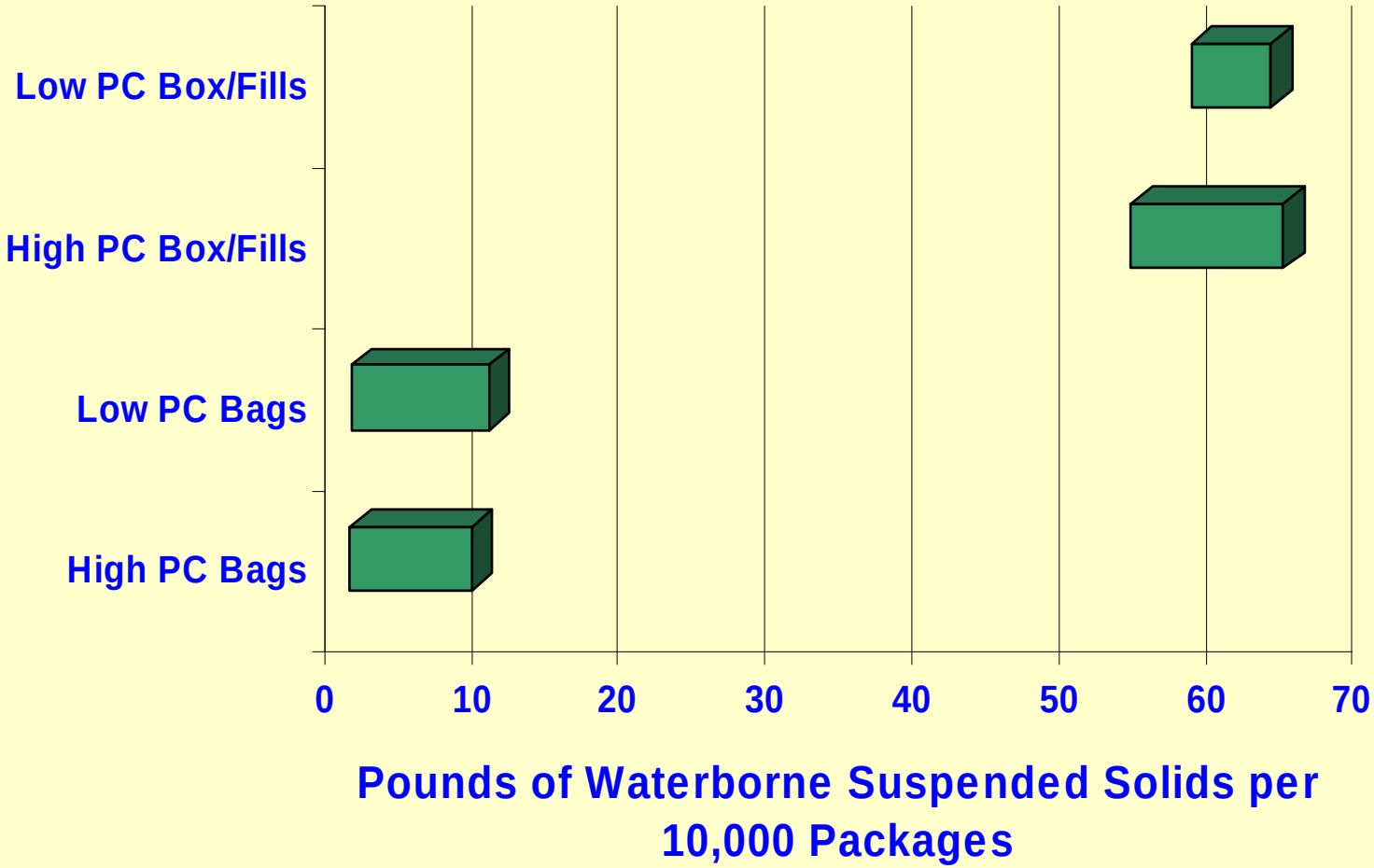
Results: Atmospheric Mercury



Results: Biological Oxygen Demand



Results: Waterborne Suspended Solids



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.

Waste Prevention Strategy

Draft Waste Prevention Strategy

Proposes priority focus areas for DEQ's work in waste prevention for the next 10 years:

1. Design, construction, remodeling and demolition of buildings
   - Whole building LCA to evaluate possible BMPs
2. Business waste (short-term focus on packaging)
   - Evaluation of bioplastics
3. Consumer education
   - Identify "high priority" actions; relate to greenhouse gases
4. "Foundation" research and analysis
   - LCA capacity building
   - Economic input/output analysis
   - Special studies (e.g. water packaging?)

Closing Thoughts

Benefits of LCA

- Prioritizing efforts
- Conducting critical analysis of options to achieve real environmental benefits
- Communicating with public and policy makers