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EPA Resource Conservation Challenge Web Academy

Climate and Waste:
The next frontier in waste management policies?

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

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Overview

- DEQ's evaluation of the greenhouse gas emissions of waste and materials
  - History/background
  - Examples
- Challenges
- Benefits of this evaluation

History/Background

- Strong statutory framework.
  - Solid waste policy
  - Recovery and generation (prevention) goals
- Strong interest in greenhouse gas impacts
  - From businesses (e.g. packaging)
    See www.deq.state.or.us/lq/sw/packaging/evaluationreport.htm
  - From governments
- Governor Kulongoski's Advisory Group on Global Warming
    See www.oregon.gov/ENERGY/GBLWRM/Strategy.shtml

Evaluation of policy/program options

<u>Frequency of collection (residential single-family)</u>

- Tradeoff between diesel-related emissions and recycling-related savings (production, forestry)
- 100 tons of "average" curbside recyclables in Oregon
  - Roughly 4 $MTCO_2E$ emissions from on-route collection vehicles (and diesel production)
  - Roughly 235 $MTCO_2E$ savings (net) when these recyclables displace virgin feedstock in production
  - Every-other-week collection (all other variables held constant) reduces fuel use <50% and reduces collection quantities by 9-20% relative to weekly collection
    - Emission reduction (tailpipe): <2 $MTCO_2E$
    - Emission increase (virgin material use): 21 – 47 $MTCO_2E$

Evaluation of policy/program options

Energy balance: long-haul of recyclables to market

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

Evaluation of policy/program options

The Choice of Markets Matters

Example: Glass bottles in rural Eastern Oregon

Bottles to aggregate (local market)

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

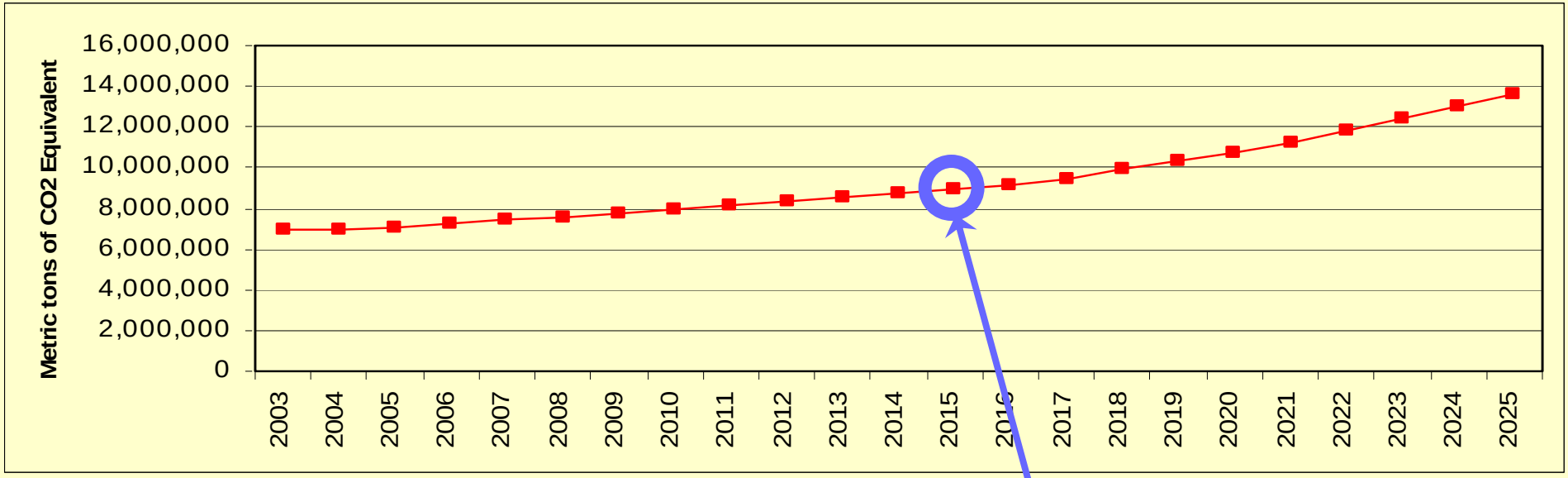
Bottles to Portland (bottles)

- Net savings per ton collected: ~2.1 MMBTU

Bottles to California via Portland (fiberglass)

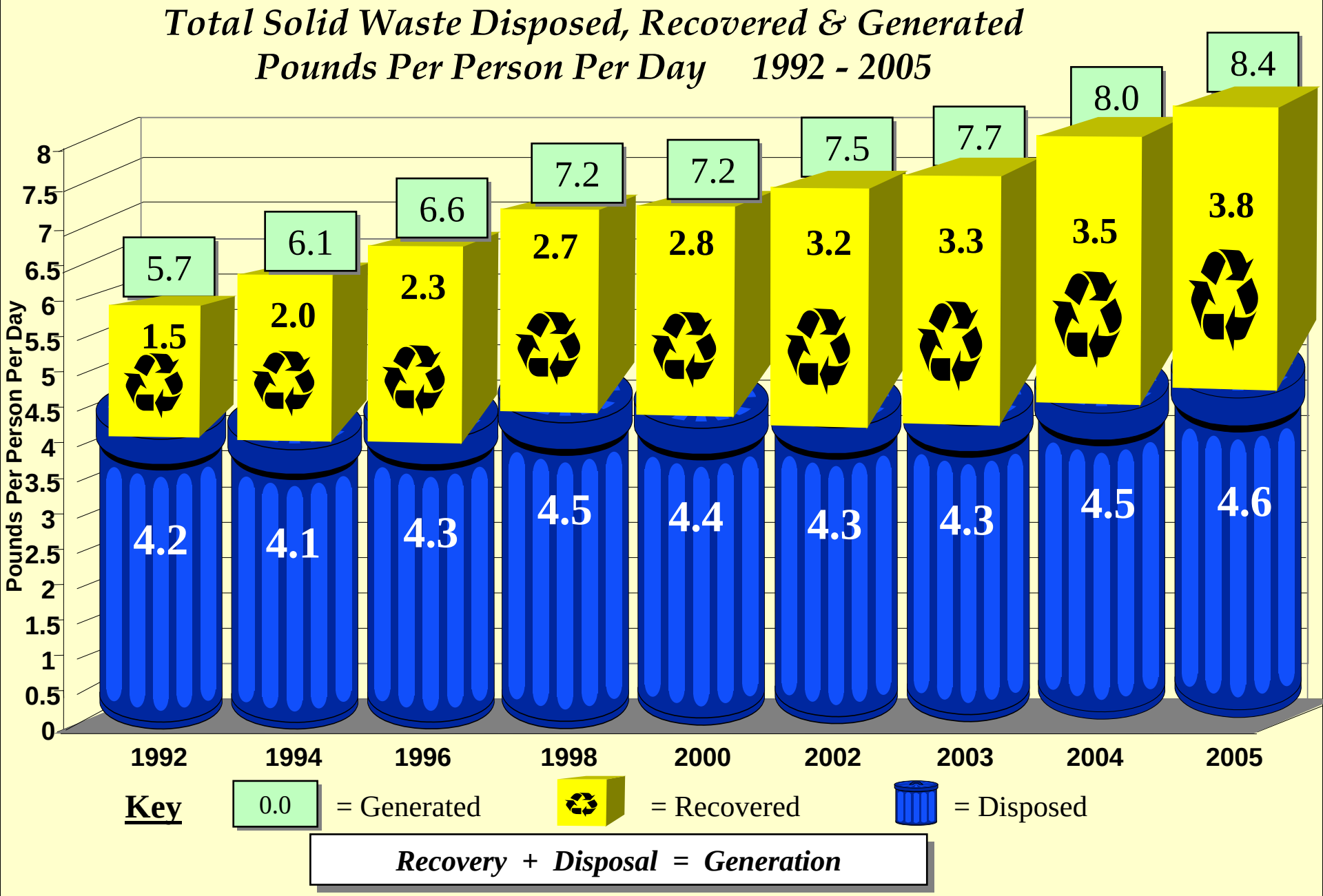
- Net savings per ton collected: ~3.2 MMBTU

Year 2004 "Business as Usual" Forecast of GHGs for Materials and Waste (Oregon)

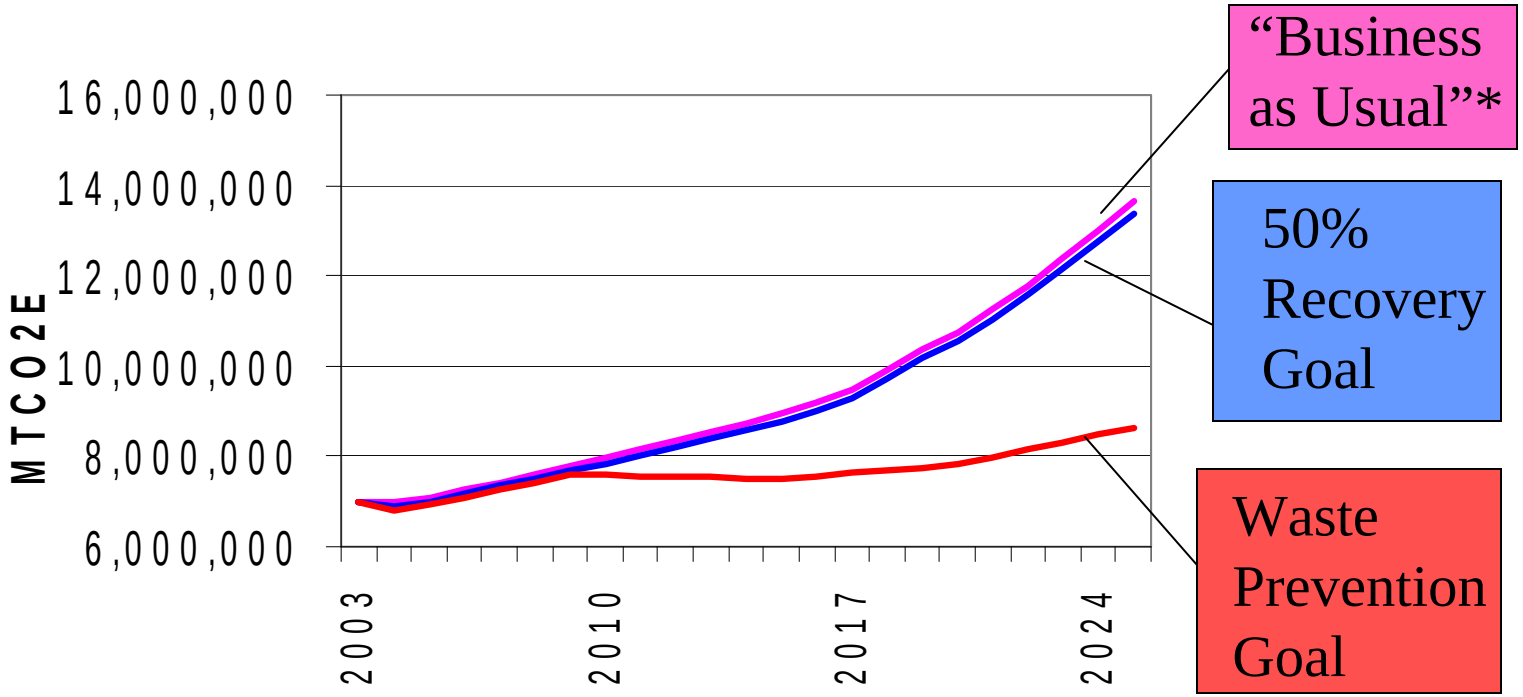


Material Production	10.9 $MMTCO_2E$
Recycling (manufacturing)	-1.0 $MMTCO_2E$
Recycling (forest related offsets)	-2.1 $MMTCO_2E$
Composting	-0.1 $MMTCO_2E$
Combustion (emissions)	0.3 $MMTCO_2E$
Combustion (energy recovery)	-0.6 $MMTCO_2E$
Landfilling (net)	1.4 $MMTCO_2E$
Total (2015)	**8.9 $MMTCO_2E$**

Recycling is Up in Oregon, But So is Waste Generation



Year 2004 Forecast of Materials-Related Greenhouse Gas Emissions



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

Evaluation of policy/program options

E-commerce order fulfillment packaging: box or bag?

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?

DEQ Life Cycle Inventory (LCI) 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 is consistent with ISO 14000 standards for LCI

See www.deq.state.or.us/lq/sw/packaging/resources.htm

DEQ Packaging LCI: Materials Evaluated

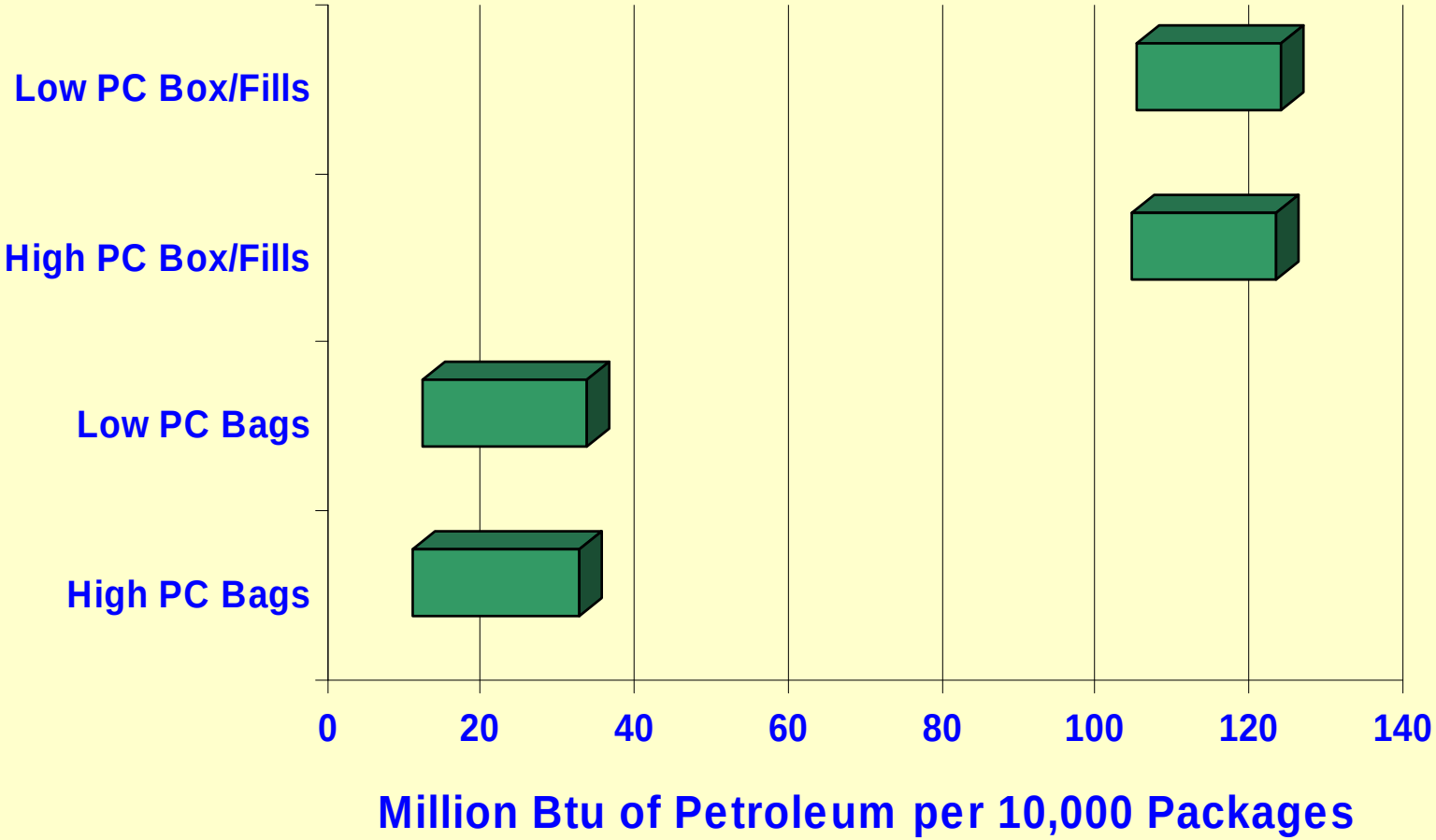
Corrugated box*

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

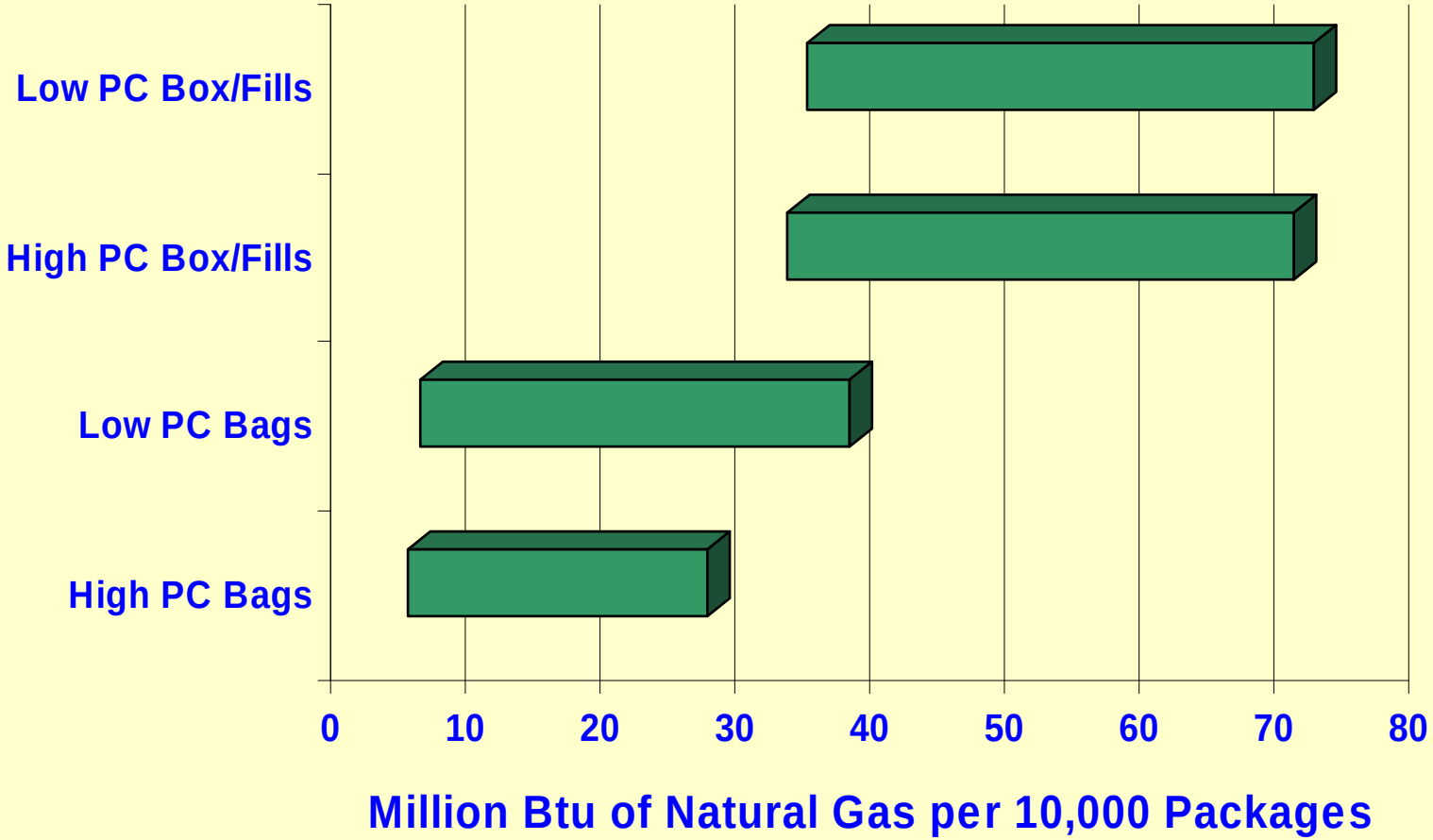
Shipping Bags
Unpadded all-kraft mailer*
Unpadded all-poly mailer*
Kraft mailer with ONP padding*
Kraft mailer with poly bubble padding*
Poly mailer with poly bubble padding*

*Different levels of post-consumer content also evaluated.

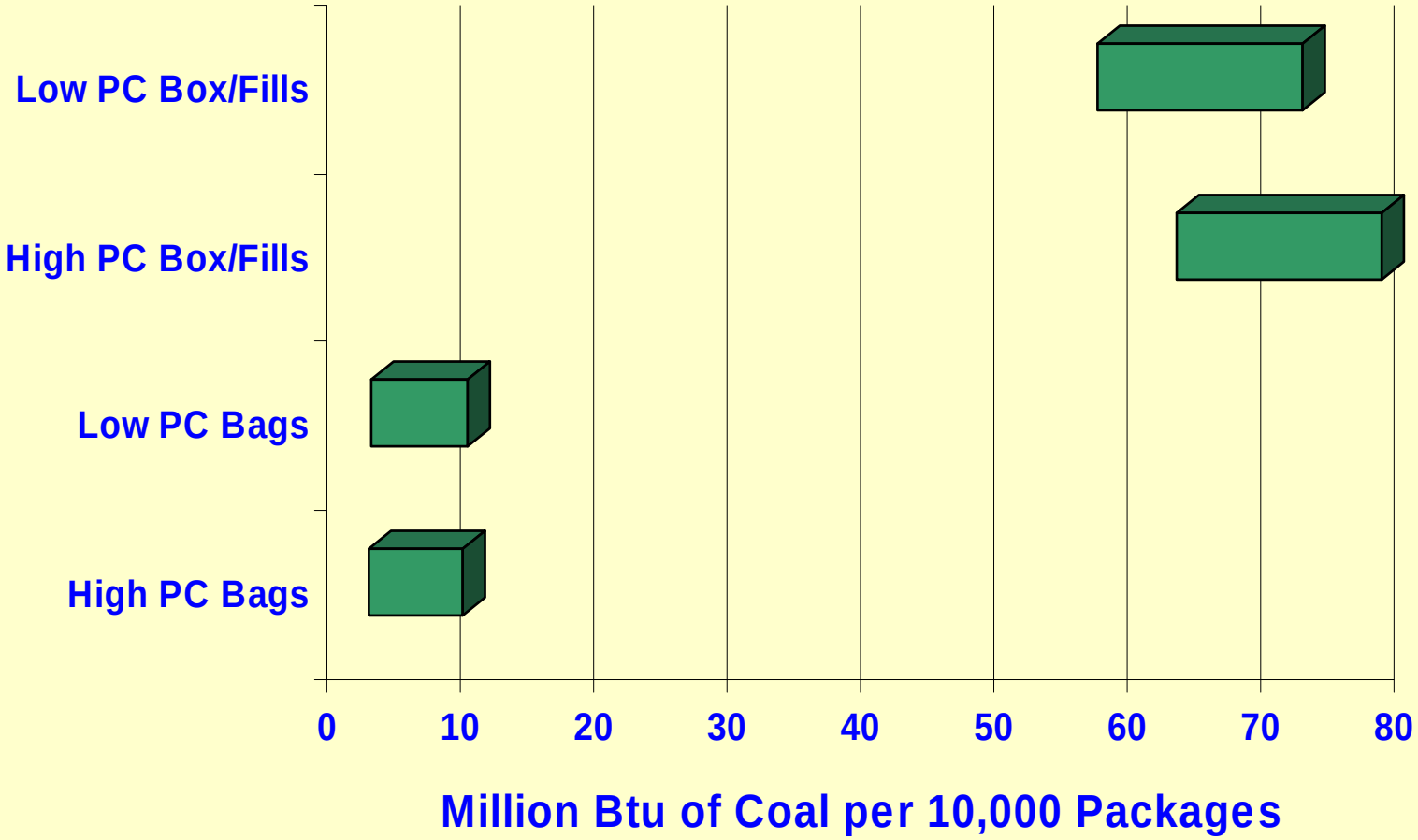
DEQ Packaging LCI Results: Petroleum



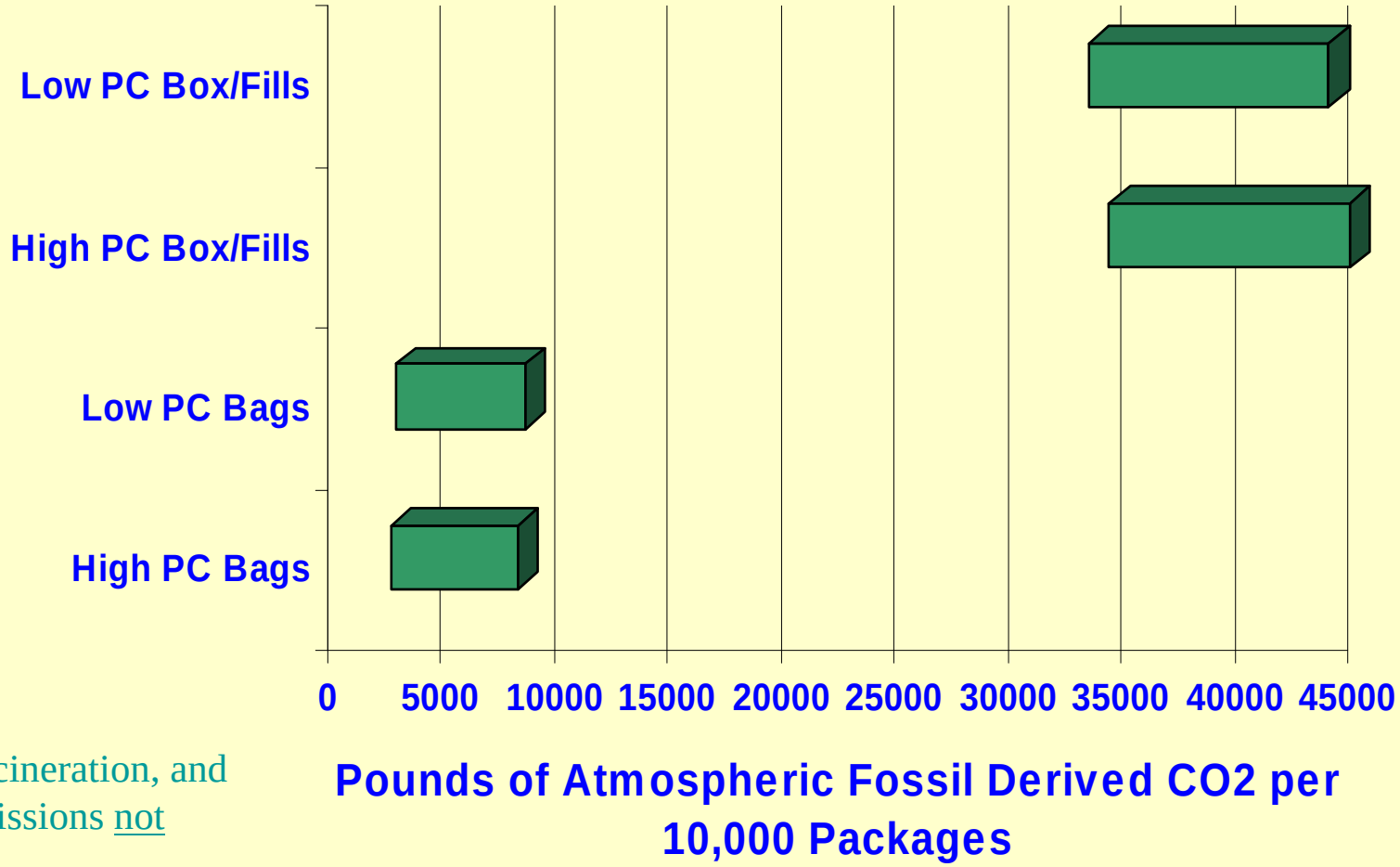
DEQ Packaging LCI Results: Natural Gas



DEQ Packaging LCI Results: Coal



DEQ Packaging LCI Results: Atmospheric Fossil Derived CO_2*



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

DEQ Packaging LCI Results

- Weight of materials used is a critical factor:
  - The heaviest box + void-fill option (corrugated box + molded pulp loose fill) weighs 26 times more than the lightest bag option (LLDPE bag).
  - 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 is not always the best predictor of life cycle energy use or emissions.

DEQ Packaging LCI Results (continued)

- Recycled content is also 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.
  - However, benefits are primarily "upstream" (production related) not disposal related.
- Please don't interpret the study as anti-paper, anti-box, or anti-recycling (it isn't).

Education and Public Information

- Estimation of the greenhouse gas (and energy) benefit of recovery in Oregon
  - "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

  See www.deq.state.or.us/pubs/reports.htm#Recovery
- Emphasis on "upstream" (vs. landfill-related) emissions

Challenges

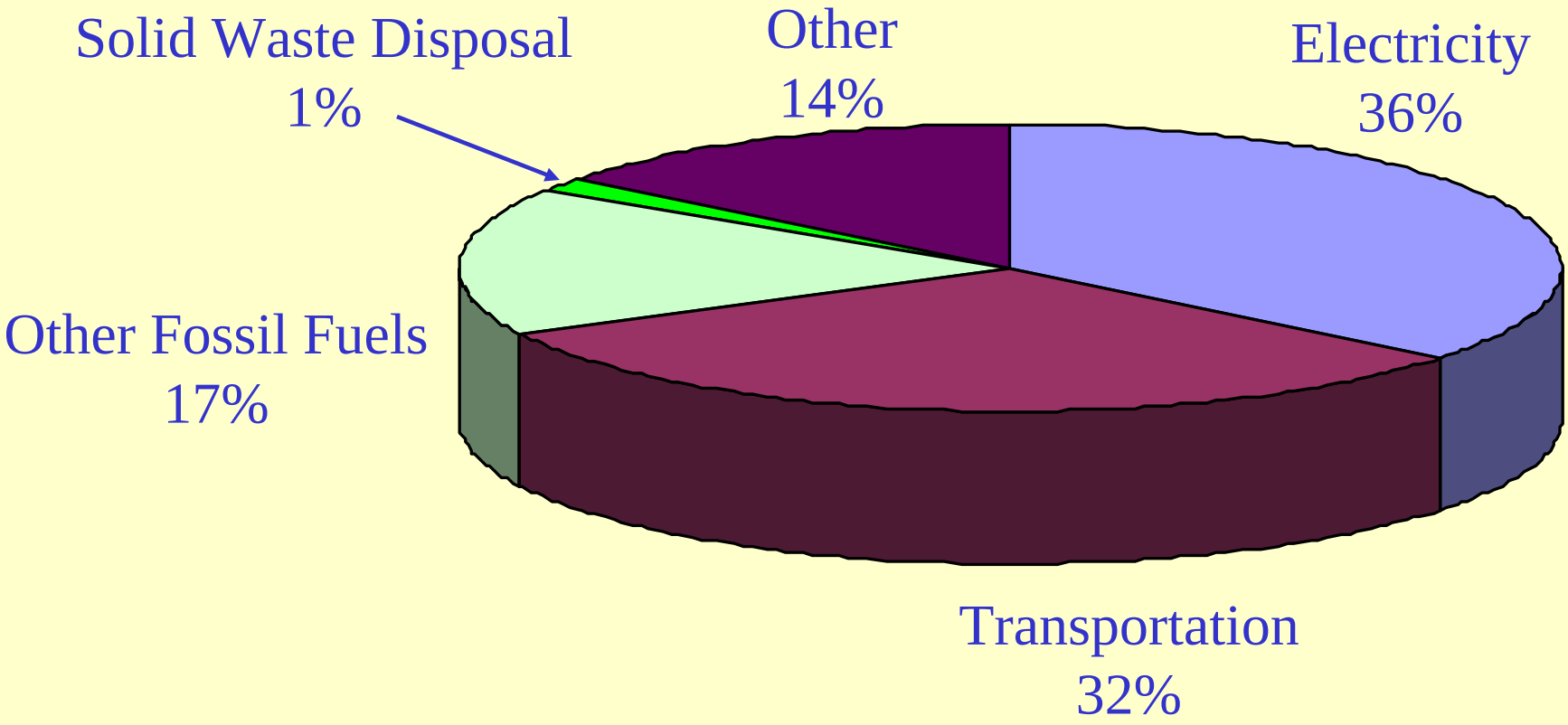
Data Issues

- Timing of methane releases
- Effectiveness of gas controls
- Forestry issues (estimate of benefits)
- Overseas production

More Challenges

- Potential for mis-use
  - Accidental or intentional
- Integration with other GHG programs
  - Inventories
  - Trading

Oregon Greenhouse Gas Emissions Inventory, 2000 (Conventional Accounting)



Accounting Issues

- 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).
- 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)

Production vs. Consumption Carbon Dioxide Emissions for the United States - 1997

Traditional Inventory
~5.6 Gt CO_2

Exports
~0.4 – 0.5 Gt CO2

Imported Goods
~0.5 – 0.8 Gt CO2

Net embodied emissions in trade: 2 – 7% above and beyond traditional inventory

Source: Weber and Matthews, 2007

Production vs. Consumption Carbon Dioxide Emissions for the United States - 2004

Traditional Inventory
~6.1 Gt CO_2

Exports
~0.5 – 0.6 Gt CO2

Imported Goods
~0.8 – 1.8 Gt CO2

Net embodied emissions in trade: 3 – 21% above and beyond traditional inventory

Benefits of accounting for greenhouse gases in solid waste/materials policy and programs

- 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 EPA!