A State Government's Application of Life Cycle Inventory Analysis

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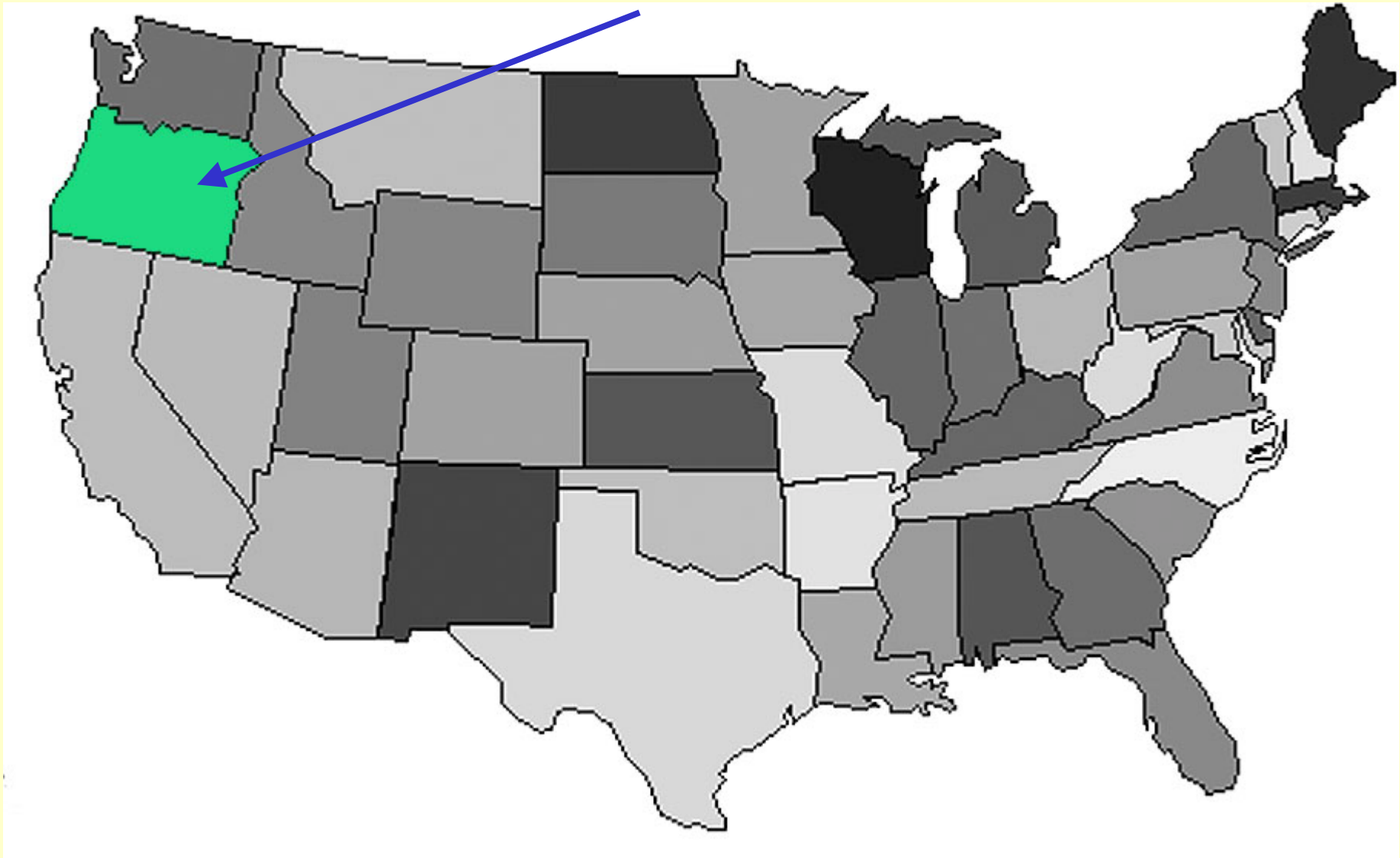
Overview

- Background and Policy Framework: Why Waste Prevention and Recycling? Why Packaging? Why Life Cycle Analysis?
- The Life Cycle Analysis: Partners, Methods, and Preliminary Results.
- How the Results May Be Used.

Location of Oregon



Background: State of Oregon

- Population (2000): 3,421,000
  - 79% urban/suburban; 21% rural*
  - Portland-Salem metropolitan area: 1,920,000
- 36 counties, 240 cities.
- Major industries: high technology (manufacturing & services), forest products (lumber, paper), agriculture (cattle, wheat, fruit, grass seed), tourism, services.
- 52% of land in federal ownership.

*As defined by U.S. Census.

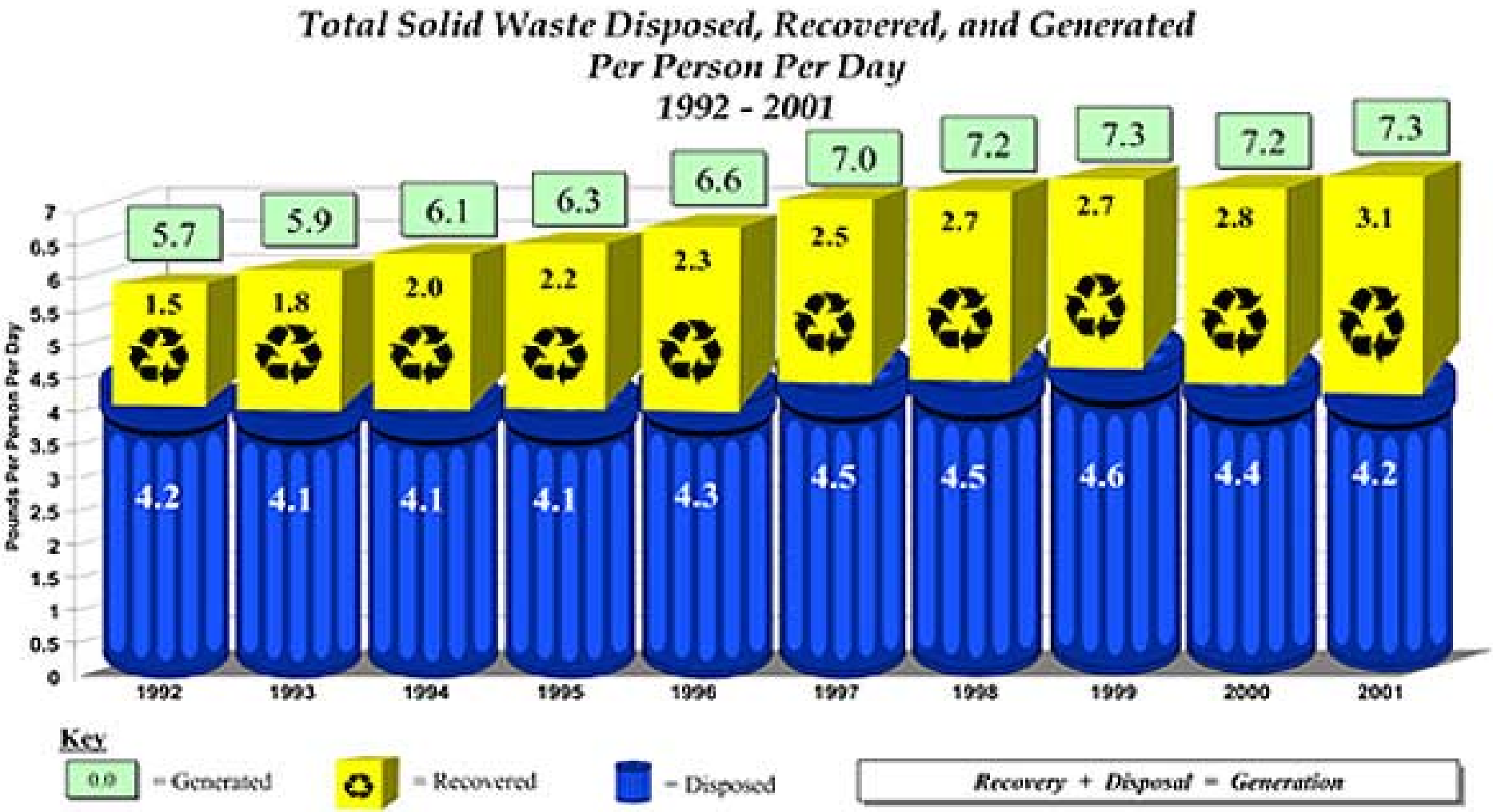
Solid Waste Management in Oregon

- Most waste collection and disposal services are provided by the private sector.
- Solid waste collection is regulated by local governments (cities and counties).
- State government (DEQ):
  - Permits/regulates disposal facilities
  - Enforces “opportunity to recycle” laws
  - Measures recovery rate and waste composition
  - Provides education and technical assistance to cities, businesses, public
  - Provides grants to local governments
  - Enforces other provision of law

Solid Waste Management in Oregon (continued)

- Oregon was the first “bottle bill” (deposit) state in the United States (1970).
- 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.
- All counties have waste recovery goals; DEQ reports attainment of goals annually.
- Recovery rate is currently 43%.

Recycling is Up, But So is Waste Generation



Waste Generation

- Per-capita waste generation in Oregon increased 28% from 1992 to 2001 (average 2.8% per year).
- Oregon's per-capita waste disposal was the same in 2001 as it was in 1992, despite the fact that materials recovery more than doubled over the same time period.

Waste Policy Leadership Group

- Statewide advisory group (1999 - 2000) chartered to recommend future policy and program directions for DEQ.
- Waste prevention recommendations:
  - Focus on commercial/industrial sectors.
  - Focus on “high impact” waste types.
  - DEQ should take on roles where a statewide perspective is needed, state leadership is required, and there is a need not addressed by another entity.
  - DEQ roles may include: information provider, information hub, technology transfer, capacity building, evaluation, statewide coordination.

Statutory Background: Policy (ORS 459.015)

Pre-2001 Waste Reduction Policy:

- Recycling a matter of statewide concern; opportunity to recycle should be provided.
- Shortage of appropriate landfill sites exists in Oregon.
- Waste prevention, reuse, and recycling will extend landfill life and reduce environmental impacts of landfills.

2001 Legislative Findings (ORS 459.015)

- There are limits to Oregon's natural resources and the environment's ability to absorb the impacts of increased consumption and waste generation.
- It is in the best interest of the people of Oregon to conserve resources and energy.

What does this mean?

- The policy framework of solid waste reduction has shifted from "conserving landfill space" to a broader set of natural resource and environmental issues. This is where LCA may be relevant.

New (2001) Waste Generation Goals (ORS 459A.010)

Generation = Disposal + Recovery

- For the calendar year 2005 and subsequent years, no annual increase in per capita municipal solid waste generation; and
- For the calendar year 2009 and subsequent years, no annual increase in total municipal solid waste generation.

Short-Term Waste Prevention Strategy

- Grants
- Promotion of materials exchanges/reuse
- Business demonstration partnerships and outreach:
  - Packaging efficiency & waste prevention
  - “Green Photocopier” project (led by Metro)
- Edible food salvage
- New yard debris chipper tax credit
- Technical assistance, information sharing, publications, videos
- Planning and evaluation

Business Packaging Project

- Packaging comprises ~20% of waste generation in Oregon.
- May be easier for businesses to change packaging than product.
- Pilot project objectives:
  - Through technical assistance, accomplish measurable waste prevention at a small number of Oregon businesses (voluntary participation).
  - Develop and promote best management practices.
  - Evaluate effectiveness of pilot project and need for longer-term activities in these areas (non-regulatory only!).

A Common Question:
To Box, or To Bag?

Bags and Boxes

- Boxes have recyclability and recycled-content advantages over most types of bags.
- But bags have clear 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?
- Significant interest in this area, and potential to advance waste prevention.

Common Void Fill Options

- No void fill
- Inflated polyethylene air packets
- Expanded polystyrene loose fill (“peanuts”)
- Corn starch loose fill (“peanuts”)
- Molded pulp loose fill
- Crinkled kraft paper
- Crinkled newsprint
- Shredded 100% postconsumer corrugated containers or office paper

Common Business Perceptions

- The choice of void fill is the most important environmental choice (more so than choices about boxes).
- Plastic is made from oil and is therefore “bad”.
- By extension, products not made from oil aren’t “bad” (or as bad).
- Downstream (disposal) impacts are as important, or more important, than upstream (manufacturing) impacts.
  - Wastes that biodegrade are inherently “good”.
  - Recyclability is important.
- Significant environmental improvement is likely to be realized by increasing post-consumer content.

Questions

- Do the waste prevention options (bags, shredded void fill, lighter-weight void fill) make environmental sense?
- How do various options compare against each other? How much environmental gain can be achieved?
- Does it make sense to purchase a high-recycled content packaging material even if it has to be transported a greater distance?

More Questions

- What are the upstream impacts of biodegradable loose fill? How does it compare against other types of loose fill?
- How much energy is required to shred office paper or corrugated for loose fill? Does shredding make sense?
- If a retailer is interested in energy conservation, should they first focus on “traditional” areas (HVAC, lighting, etc.) or on the embodied energy of materials?

Life Cycle Inventory Analysis: Background

- Commissioned by Oregon DEQ.
- Co-funded by DEQ, Metro (regional government of the Portland area) and U.S. EPA.
- Consultant team: Franklin Associates (life cycle analysis) and Pack Edge Development (packaging engineering).
- Study is limited to packaging for mail-order non-breakable items.
- Inventory analysis, not impact analysis.
- Study reports life-cycle:
  - energy inputs by source (fuel) and also by type (process, transport, energy of material resource),
  - solid wastes (process, fuel-related, and postconsumer),
  - about 40 different atmospheric emissions (including 3 greenhouse gases) and about 40 different waterborne emissions.

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

Mailers
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.

Study Activities: Appendices

Appendices/Background Documentation:

- Representative product and transportation distances, modes.
- Definition of packaging systems; composition and weights of representative packages.
- Energy requirements and environmental emissions for fuel production and consumption.
- Material production (polyethylene resin, bleached kraft paper, etc.) and product fabrication.
- Waste management.

Two sets of appendices:

- “full appendices” containing proprietary data sets.
- “public appendices” suitable for public release, aggregated to protect proprietary data.

Study Activities: Report

Report:

- 1,000-pound modules (component materials).
- 10,000-package modules (as shipped).

Spreadsheet model to explore “what if” scenarios.

Variables include:

- Packaging weight
- Packaging composition
- Level of post-consumer content
- Transportation distances (packaging to distribution center, packaged product to customer)
- Diversion rate (reuse or recycling of postconsumer packaging that diverts it from disposal).

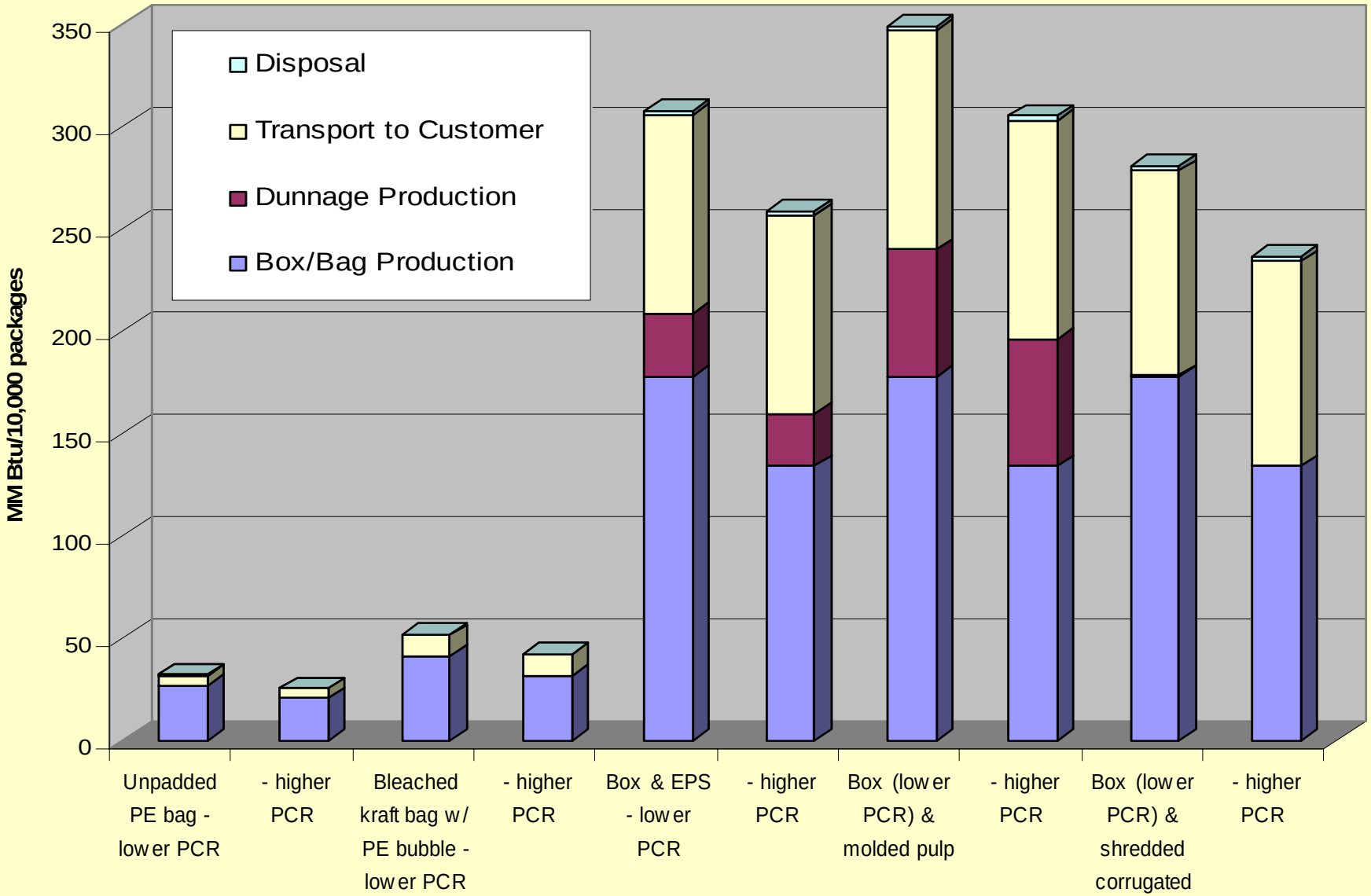
Study Activities: Critical Review

- ISO 14040 compliant critical review of full appendices and project report by panel of independent life cycle experts.
- Funded by U.S. EPA, Environmentally Preferable Purchasing Program.
- Scheduled for 4th Quarter of 2003.

Some Unusual Characteristics of This Project

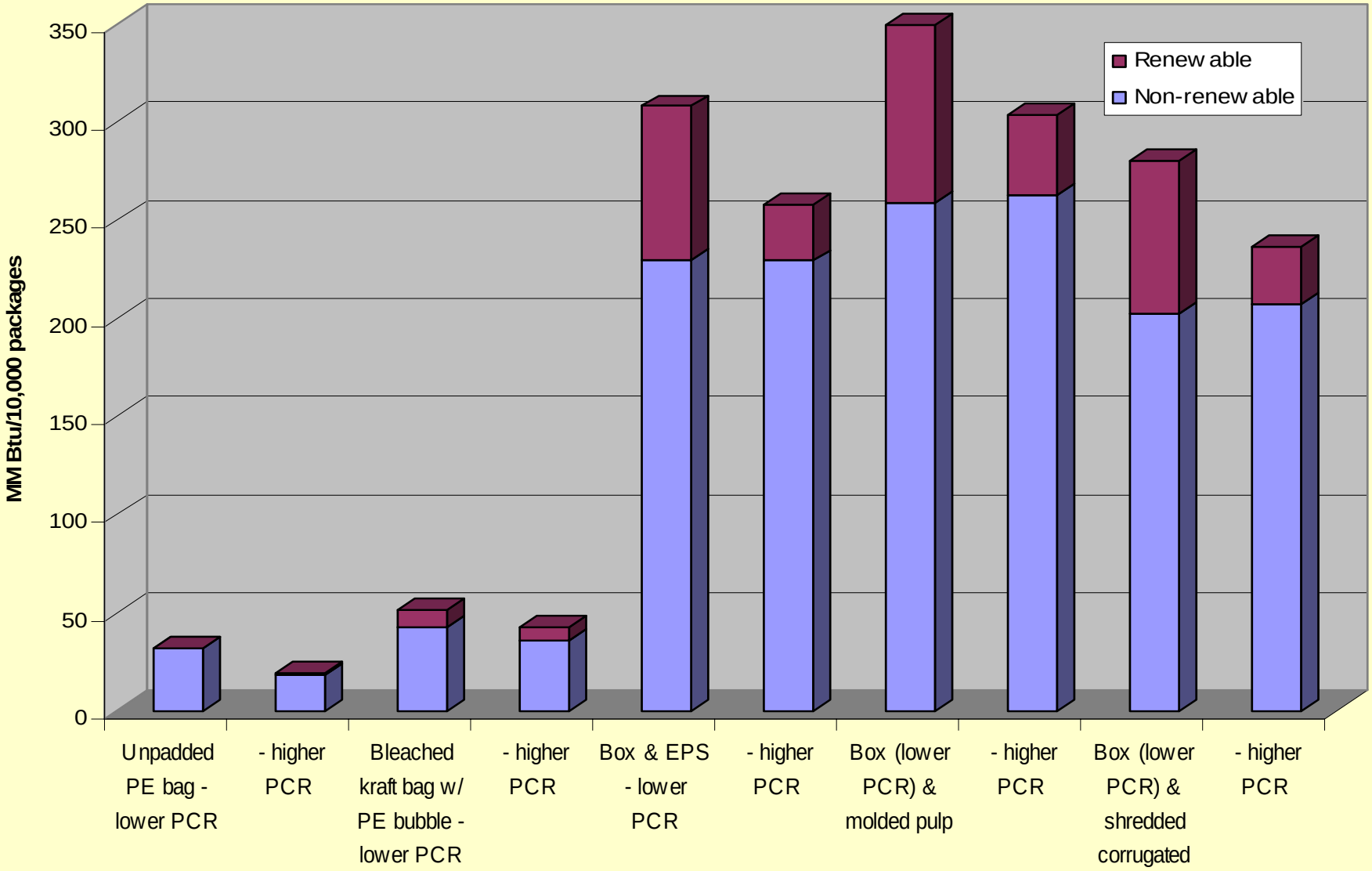
- Move beyond single-criteria environmental issues (such as solid waste, use of renewable resources, etc.).
- Publicly-funded, not privately-funded. This may enhance perceived credibility of results.
- Reporting of results by multiple stages: manufacture of product, transportation to order fulfillment center, transportation to customer, end-of-life disposal.
- Critical review by external review panel.
- Spreadsheet model for “what if” scenarios.

Preliminary Draft Results – Energy (by process)



PE = polyethylene PCR = post-consumer recycled (content) EPS = expanded polystyrene

Preliminary Draft Results – Energy (by source)



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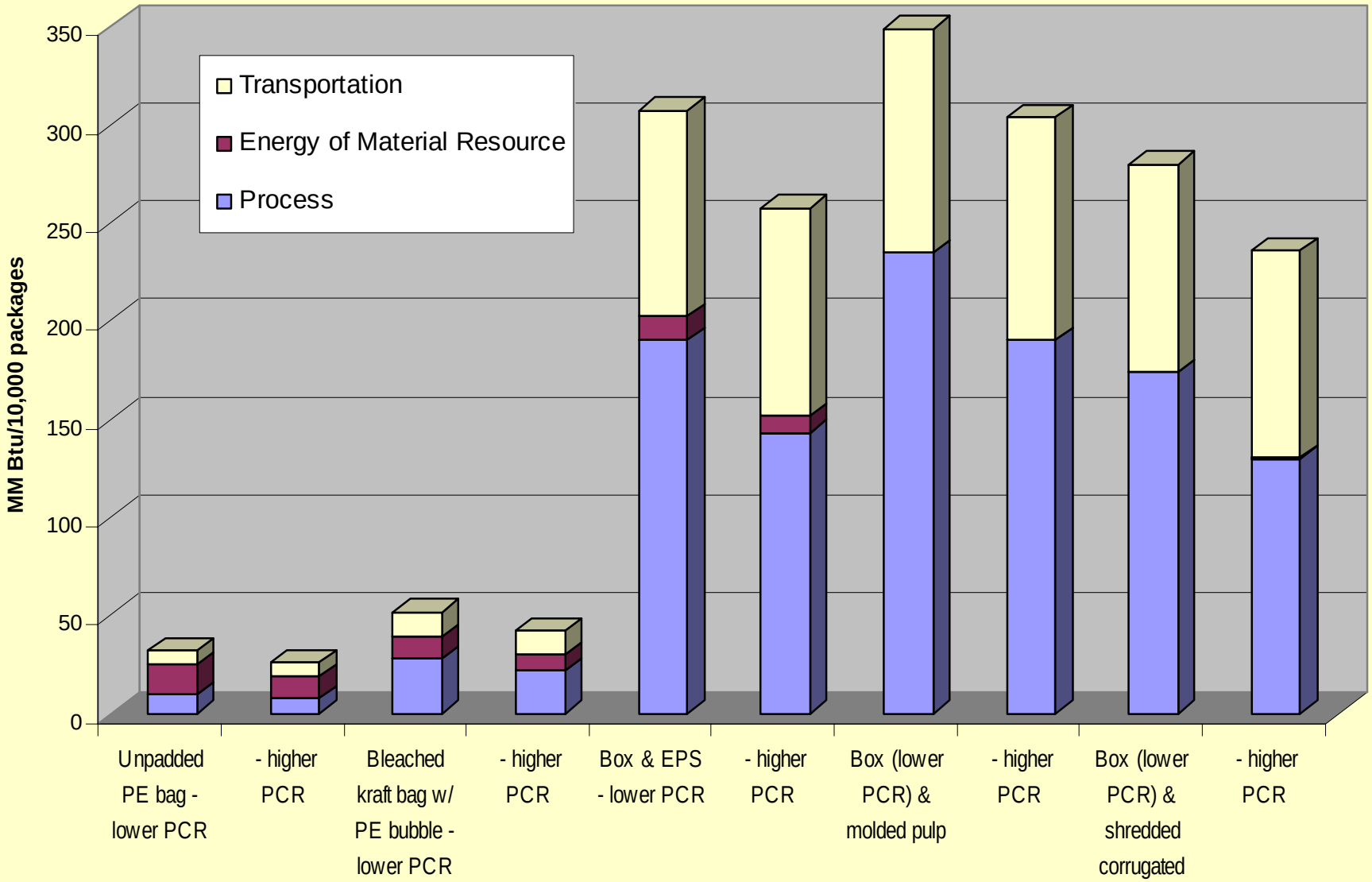
Preliminary Draft Results – Energy (by type)



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Preliminary Results

- Weight of materials used is a critical factor:
  - Heavy packages with low profile-per-pound have higher overall burdens than light packages with high profile-per-pound.
  - Bags have much lower burdens than boxes because of their much lower weight.
  - The heaviest box + void-fill option (corrugated box + molded pulp loose fill) weighs 26 times more than the lightest bag option (LLDPE bag).
- Plastics have higher energy of material resource, but lower fossil fuel use in process & transportation (and overall) when used in packaging applications because of their low weight.
- Within individual types of paper packaging, increasing recycled content reduces total life-cycle energy use considerably, but reduction in *non-renewable* energy use varies.
- The option with the highest post consumer content loose fill (molded pulp) also has the highest use of non-renewable fuels!

Full Report

- Available in early 2004
- Send me an e-mail for notification: allaway.david@deq.state.or.us

How Might the Results Be Used?

- Not to regulate users or manufacturers of packaging materials.
- Help users of packaging identify opportunities for environmental improvements.
- Demonstrate the environmental benefits of waste prevention (as it compares against recyclability and recycled content) – help people think holistically (not just about recycling).
- Demonstrate that the environmental benefit of recycling isn't so much in keeping material out of the landfill but rather in providing materials to industry that can be used to displace virgin feedstock.
- Respond to criticisms of businesses that choose to use a non-recyclable or visibly non-renewable (but low weight) packaging material.
- Pieces of the study might be used in other contexts as well, both by DEQ and by other parties.

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