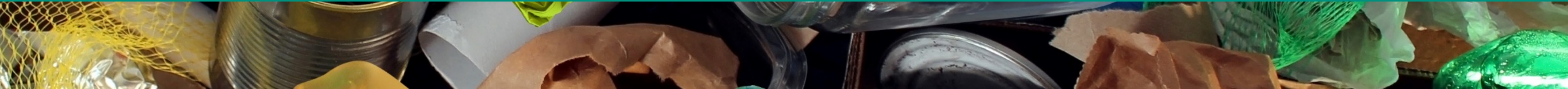
Plastics Recycling Challenges and Improvements

David Allaway, Oregon Department of Environmental Quality

U.S. Department of Energy Sustainable and Circular Economy for Plastics Workshop

June 8, 2023 – Seattle



Plastics Recycling Pathways in Oregon

1. Private-sector reclaimers

2. Deposit-Return System (bottle bill)

3. Local government services

Changes in Collection

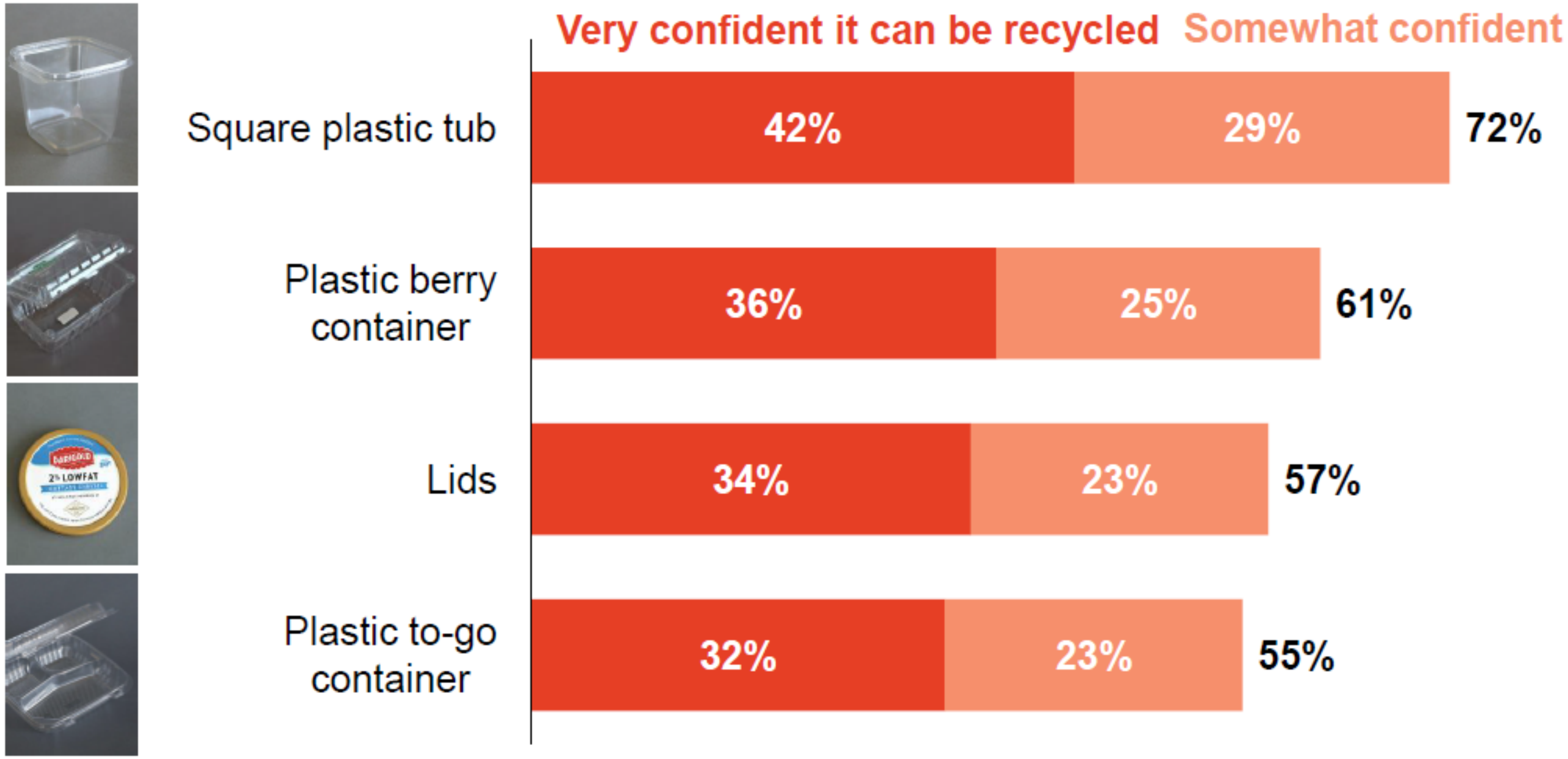
Exports

塑料王國
a film by JIU-LIANG WANG
PLASTIC CHINA
OFFICIAL SELECTION 2017
sundance
film festival

Oregon Recycling Steering Committee

- David Allaway and Abby Boudouris, Oregon DEQ (co-chairs)
- Dylan de Thomas, The Recycling Partnership
- Sarah Grimm, Lane County
- Jason Hudson, Waste Connections
- Nicole Janssen, Denton Plastics
- Scott Keller, League of Oregon Cities (City of Beaverton)
- Laura Leebrick, Rogue Disposal & Recycling
- Kristan Mitchell, Oregon Refuse and Recycling Association
- Jeff Murray, Environmental Fibers Inc.
- Pam Peck, Metro
- Amy Roth, Association of Oregon Recyclers
- Timm Schimke, Association of Oregon Counties (Deschutes Co.)
- Jay Simmons, NORPAC
- Vinod Singh, Far West Recycling
- Matt Stern, Waste Management
- Bruce Walker, City of Portland

Challenges: Public Confusion



DHM RESEARCH | METRO RECYCLING RESIDENT SURVEY | SEPTEMBER 2018

Confusion + Wishful Recycling = Contamination

Challenges: Unfavorable Economics

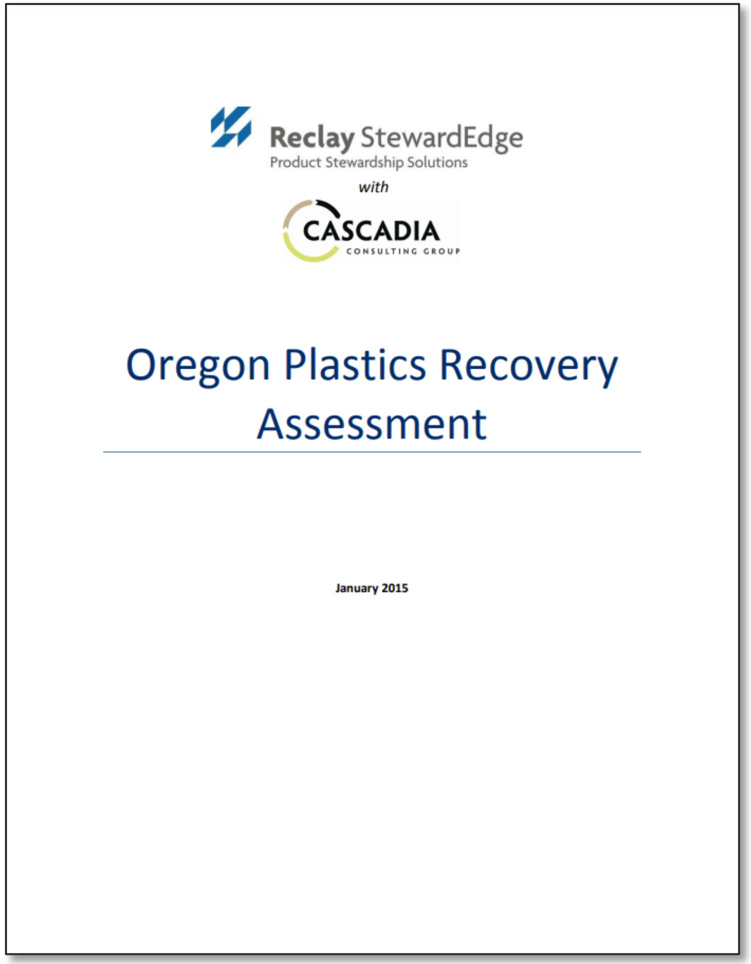
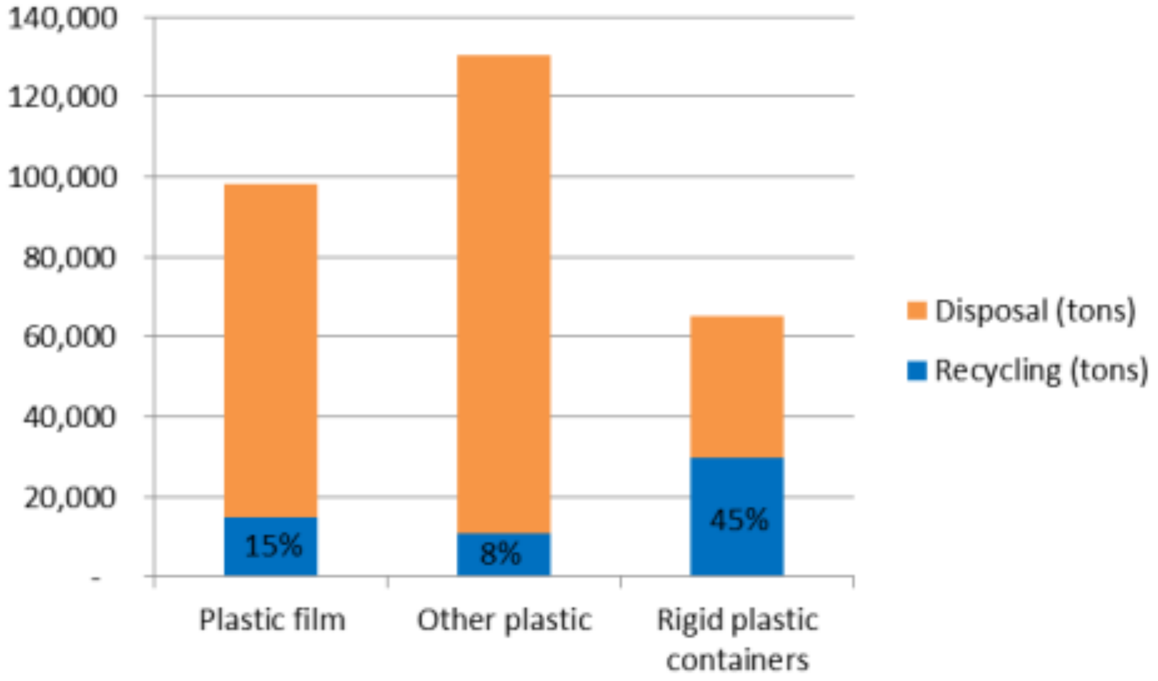
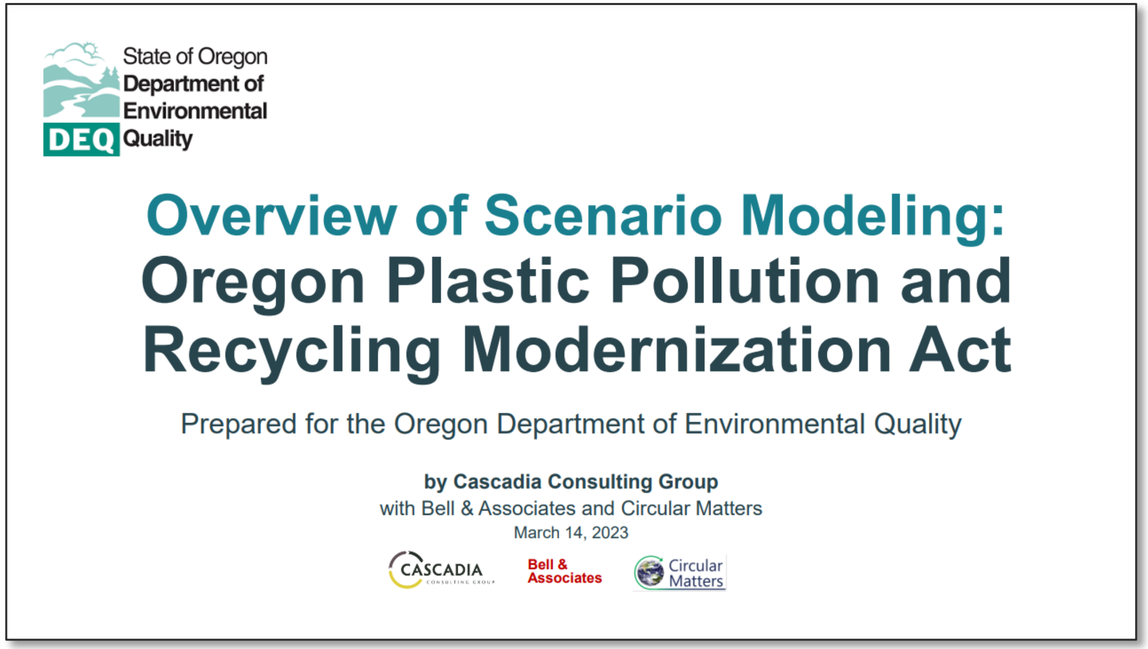


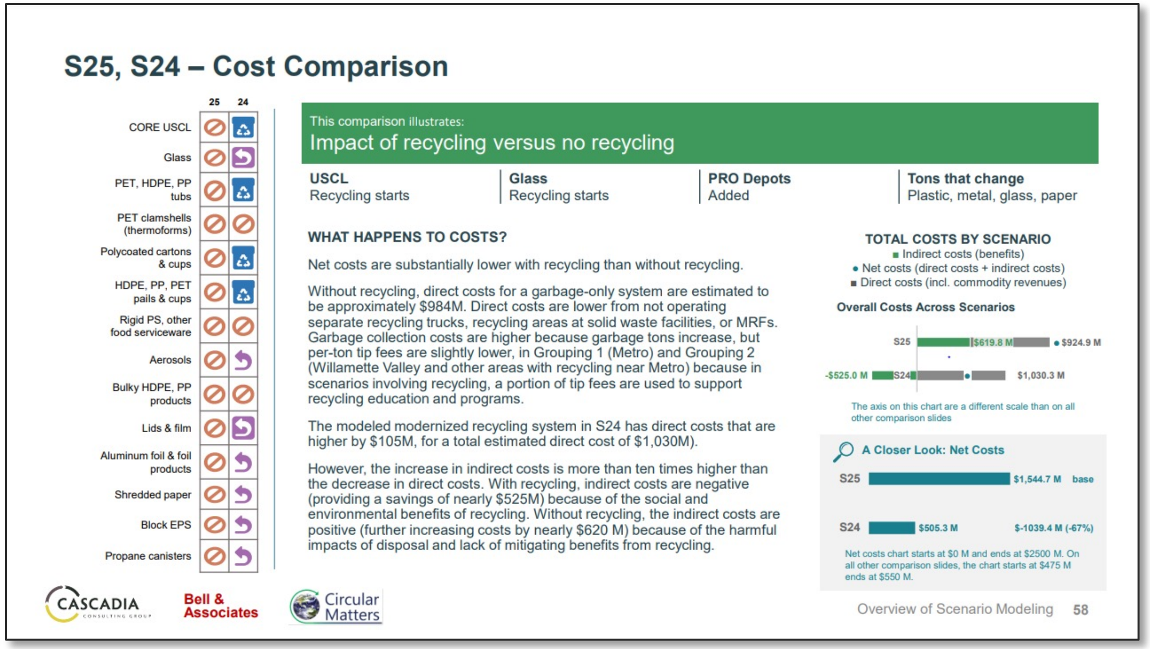
Figure 1. Plastics Recycling and Disposal Tonnages, with Material Recycling Rates (2012)



https://www.oregon.gov/deq/recycling/Pages/Plastics-Recovery.aspx

2023 Economic Assessment

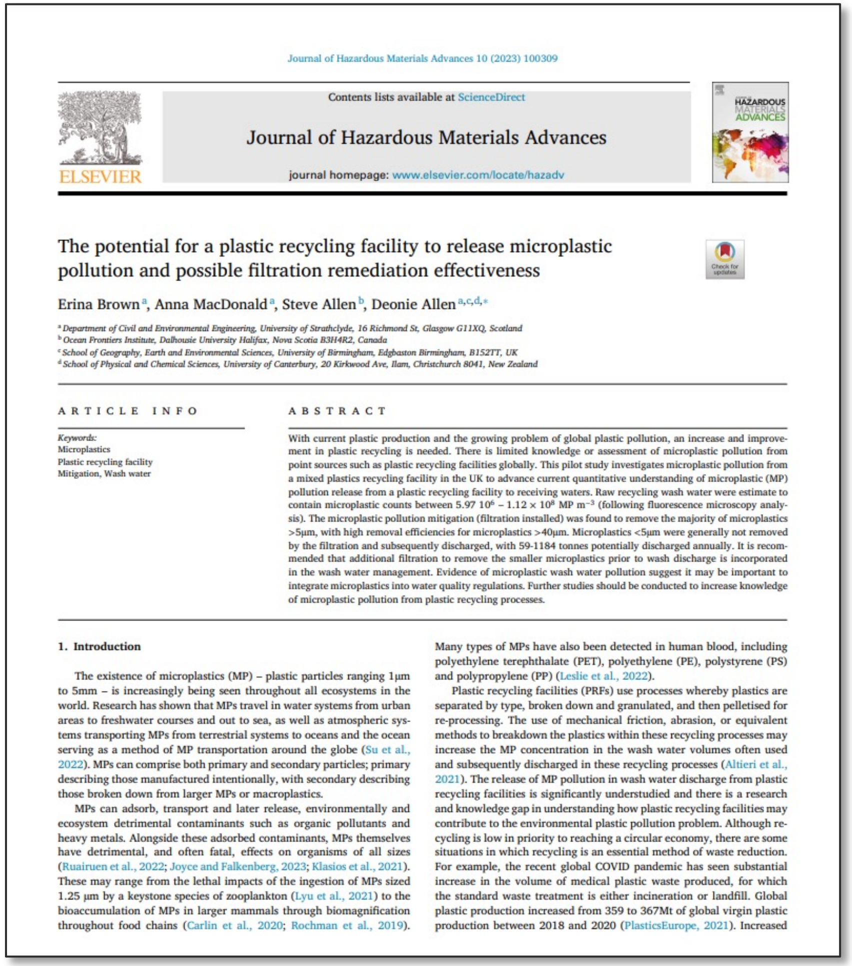




https://www.oregon.gov/deq/recycling/Pages/Material-Lists.aspx

DEQ

Challenges: Negative Impacts



Journal of Hazardous Materials Advances 10 (2023) 100309

Contents lists available at ScienceDirect

Journal of Hazardous Materials Advances

journal homepage: www.elsevier.com/locate/hazadv

The potential for a plastic recycling facility to release microplastic pollution and possible filtration remediation effectiveness

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ARTICLE INFO

Keywords:
Microplastics
Plastic recycling facility
Mitigation, Wash water

ABSTRACT

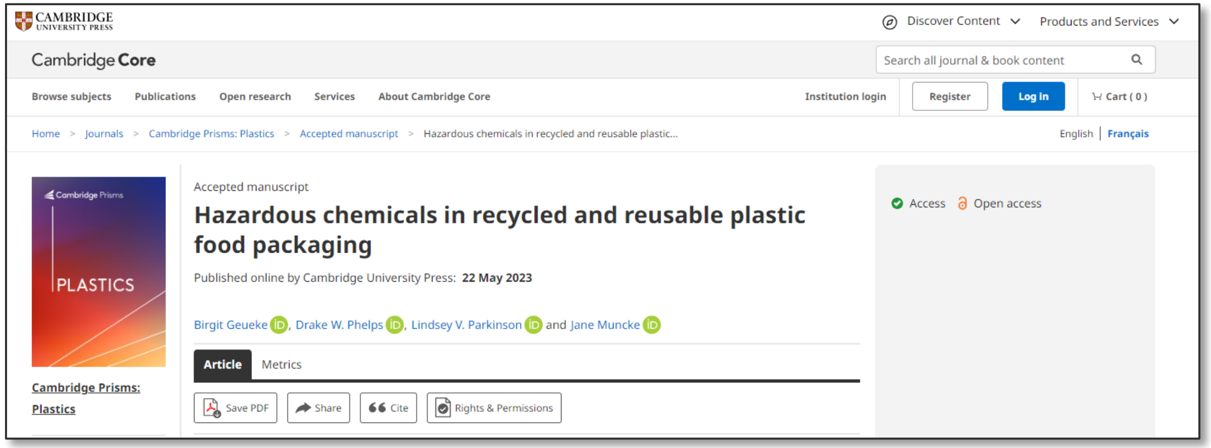
With current plastic production and the growing problem of global plastic pollution, an increase and improvement in plastic recycling is needed. There is limited knowledge or assessment of microplastic pollution from point sources such as plastic recycling facilities globally. This pilot study investigates microplastic pollution from a mixed plastics recycling facility in the UK to advance current quantitative understanding of microplastic (MP) pollution release from a plastic recycling facility to receiving waters. Raw recycling wash water were estimate to contain microplastic counts between $5.97\ 10^{6} - 1.12 \times 10^{8}$ MP m^{-3} (following fluorescence microscopy analysis). The microplastic pollution mitigation (filtration installed) was found to remove the majority of microplastics >5μm, with high removal efficiencies for microplastics >40μm. Microplastics <5μm were generally not removed by the filtration and subsequently discharged, with 59-1184 tonnes potentially discharged annually. It is recommended that additional filtration to remove the smaller microplastics prior to wash discharge is incorporated in the wash water management. Evidence of microplastic wash water pollution suggest it may be important to integrate microplastics into water quality regulations. Further studies should be conducted to increase knowledge of microplastic pollution from plastic recycling processes.

1. Introduction

The existence of microplastics (MP) – plastic particles ranging 1μm to 5mm – is increasingly being seen throughout all ecosystems in the world. Research has shown that MPs travel in water systems from urban areas to freshwater courses and out to sea, as well as atmospheric systems transporting MPs from terrestrial systems to oceans and the ocean serving as a method of MP transportation around the globe (Su et al., 2022). MPs can comprise both primary and secondary particles; primary describing those manufactured intentionally, with secondary describing those broken down from larger MPs or macroplastics.

MPs can adsorb, transport and later release, environmentally and ecosystem detrimental contaminants such as organic pollutants and heavy metals. Alongside these adsorbed contaminants, MPs themselves have detrimental, and often fatal, effects on organisms of all sizes (Ruairuen et al., 2022; Joyce and Falkenberg, 2023; Klasios et al., 2021). These may range from the lethal impacts of the ingestion of MPs sized 1.25 μm by a keystone species of zooplankton (Lyu et al., 2021) to the bioaccumulation of MPs in larger mammals through biomagnification throughout food chains (Carlin et al., 2020; Rochman et al., 2019). Many types of MPs have also been detected in human blood, including polyethylene terephthalate (PET), polyethylene (PE), polystyrene (PS) and polypropylene (PP) (Leslie et al., 2022).

Plastic recycling facilities (PRFs) use processes whereby plastics are separated by type, broken down and granulated, and then pelletised for re-processing. The use of mechanical friction, abrasion, or equivalent methods to breakdown the plastics within these recycling processes may increase the MP concentration in the wash water volumes often used and subsequently discharged in these recycling processes (Altieri et al., 2021). The release of MP pollution in wash water discharge from plastic recycling facilities is significantly understudied and there is a research and knowledge gap in understanding how plastic recycling facilities may contribute to the environmental plastic pollution problem. Although recycling is low in priority to reaching a circular economy, there are some situations in which recycling is an essential method of waste reduction. For example, the recent global COVID pandemic has seen substantial increase in the volume of medical plastic waste produced, for which the standard waste treatment is either incineration or landfill. Global plastic production increased from 359 to 367Mt of global virgin plastic production between 2018 and 2020 (PlasticsEurope, 2021). Increased



Plastics in "Clean" Paper Bales Exported to East Java, Indonesia for "Recycling"

Photos: Megan Ponder

Challenges: “Circularity” does mean what most people think it does

DESIGN OUT WASTE AND POLLUTION

A circular economy reveals and designs out the negative impacts of economic activity that cause damage to human health and natural systems. These costs include: the release of greenhouse gases and hazardous substances; the pollution of air, land, and water; and structural waste, such as underutilised buildings and cars.

KEEP PRODUCTS AND MATERIALS IN USE

A circular economy favours activities that preserve value in the form of energy, labour, and materials. This means designing for durability, reuse, remanufacturing, and recycling to keep products, components, and materials circulating in the economy. Circular systems make effective use of biologically based materials by encouraging many different economic uses before nutrients are returned to natural systems.

REGENERATE NATURAL SYSTEMS

A circular economy avoids the use of non-renewable resources where possible and preserves or enhances renewable ones, for example by returning valuable nutrients to the soil to support natural regeneration.

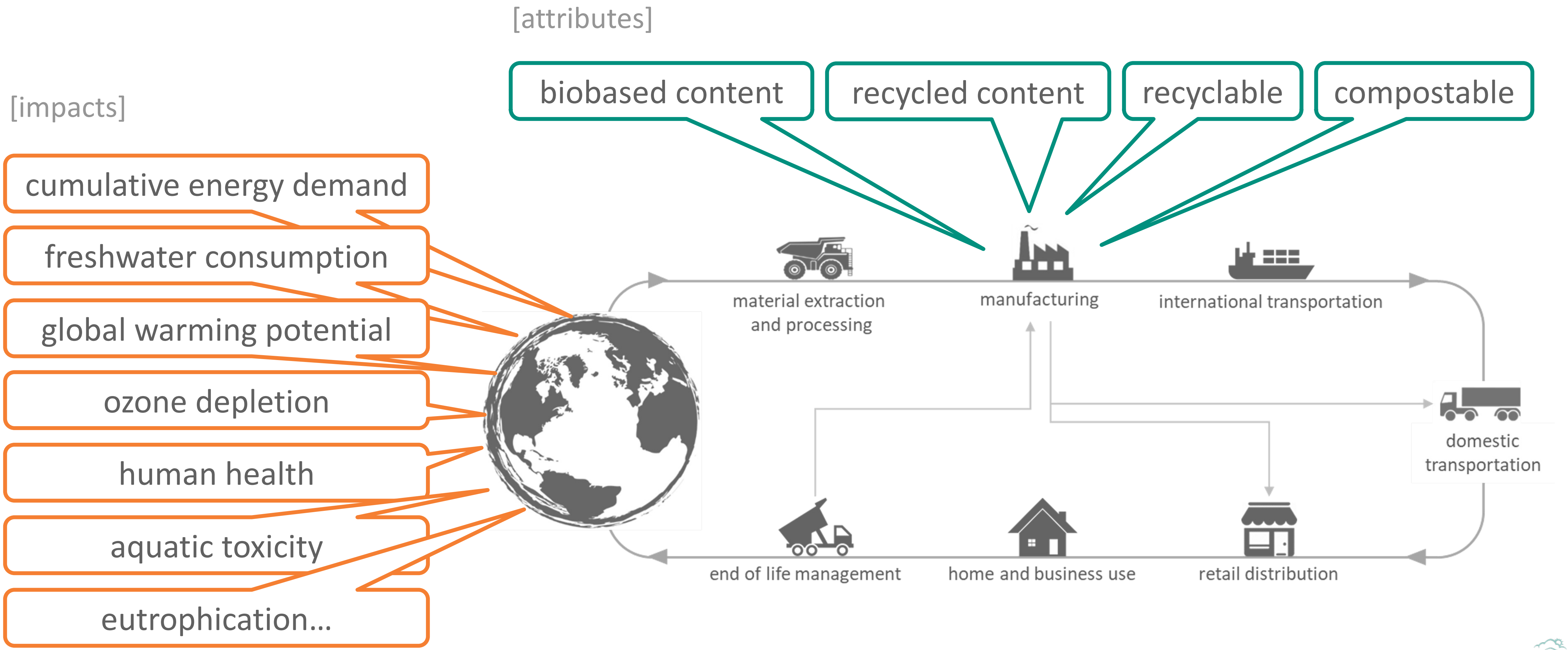
Missing Conditions

1. Recycling should be a means to achieve higher-order goals (conserving resources, reducing pollution)
2. “Circular” solutions should focus on the quality of outcomes, not just tons recycled
3. “Circularity” initiatives should enable, not disable, additional solutions (such as prevention and decarbonization)

EPA Coffee Analysis

Coffee Packaging (11.5 oz product)	Recyclable postconsumer?	Energy Consumption (MJ/11.5 oz.)	CO2 eq Emissions (lbs/11.5 oz)	MSW Waste Generated (lbs./ 100,000 oz. of product)
	Steel can – yes Plastic lid – no	4.21	0.33	1,305
	Plastic container – yes Plastic lid - no	5.18	0.17	847
	Flexible pouch - no	1.14	0.04	176

Material Attributes and Life Cycle Impacts

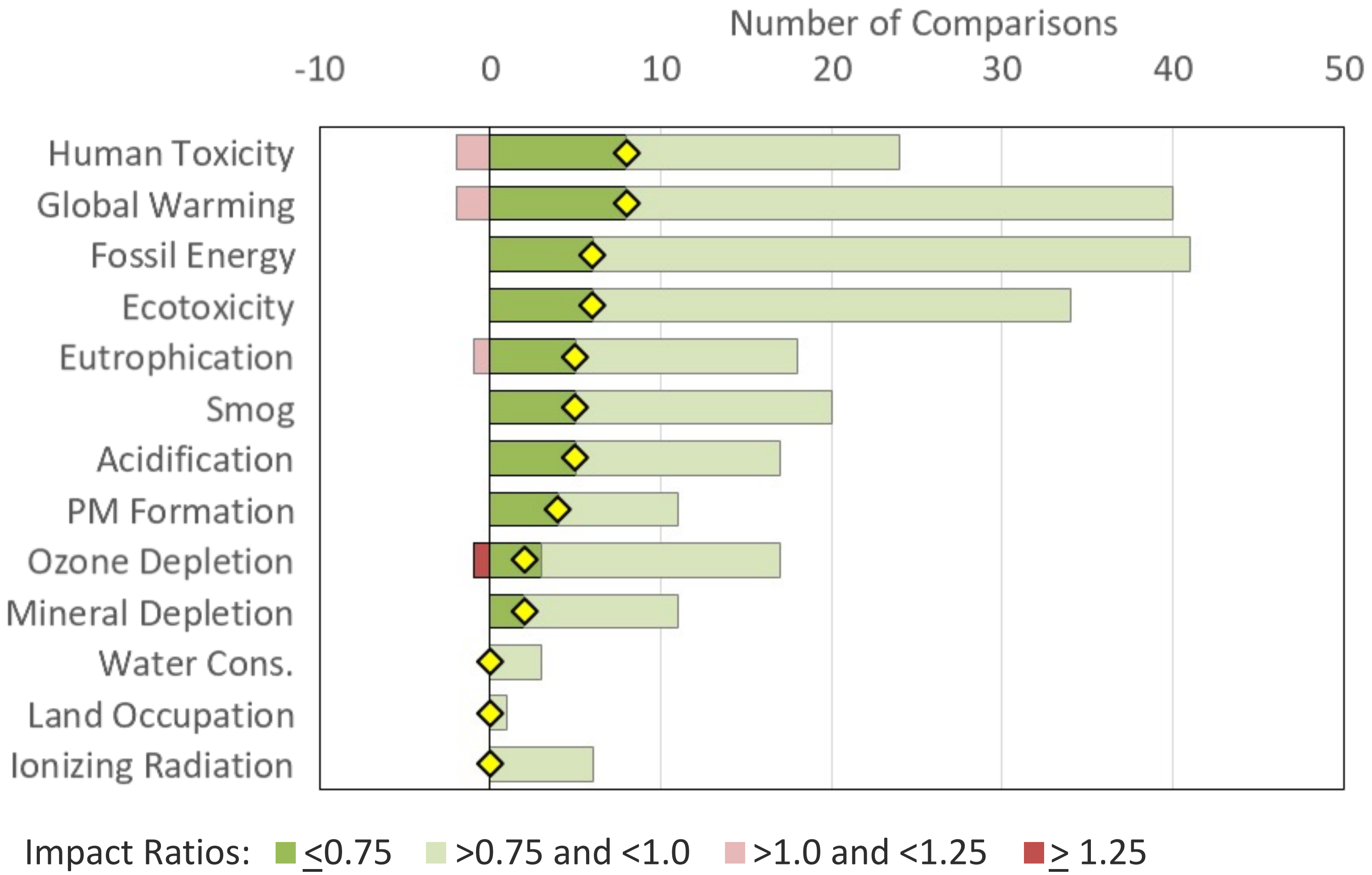


Research Question

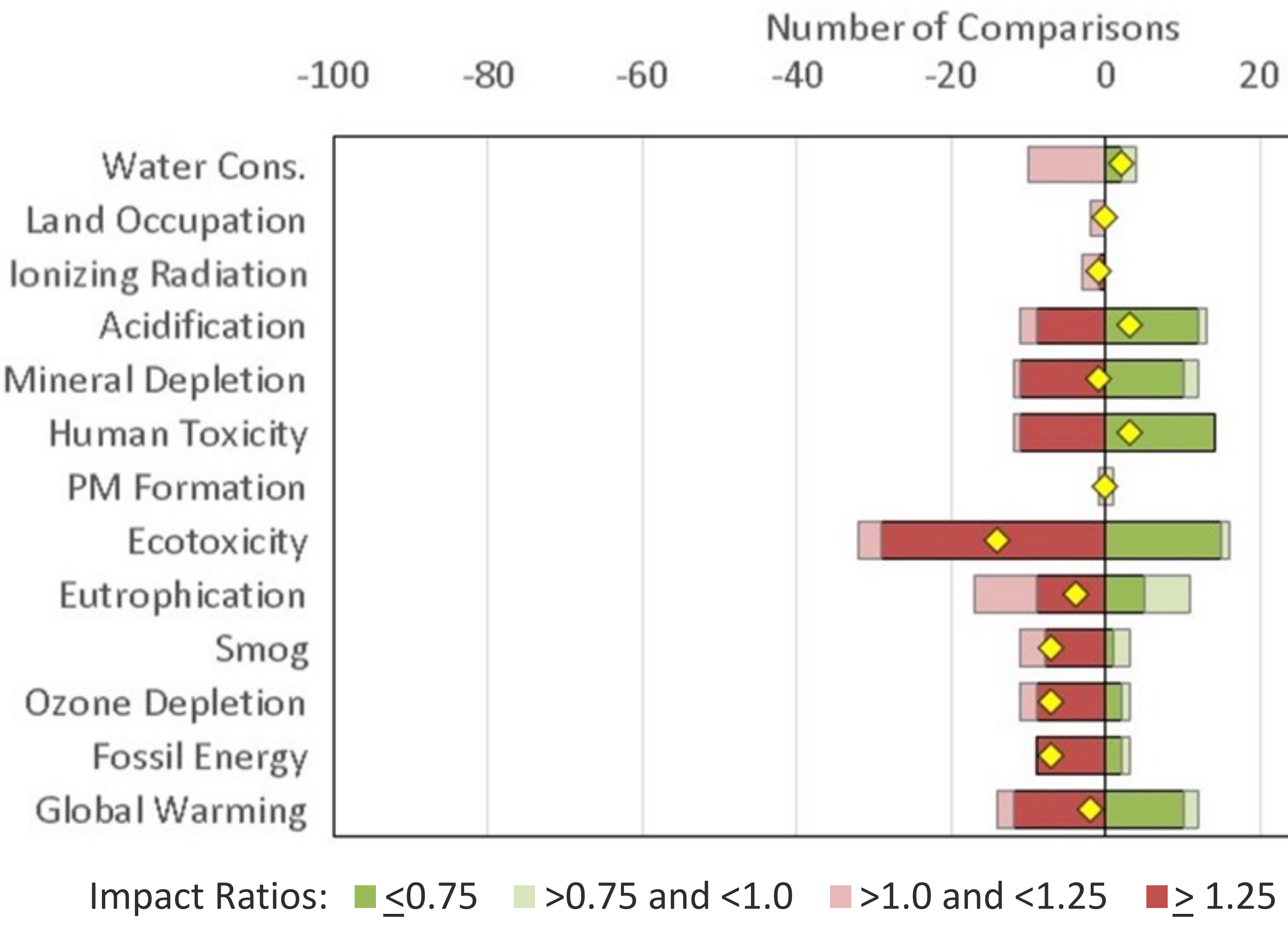
How well (and when) do popular material attributes correlate with reduced environmental impacts?

https://www.oregon.gov/deq/mm/production/Pages/Materials-Attributes.aspx

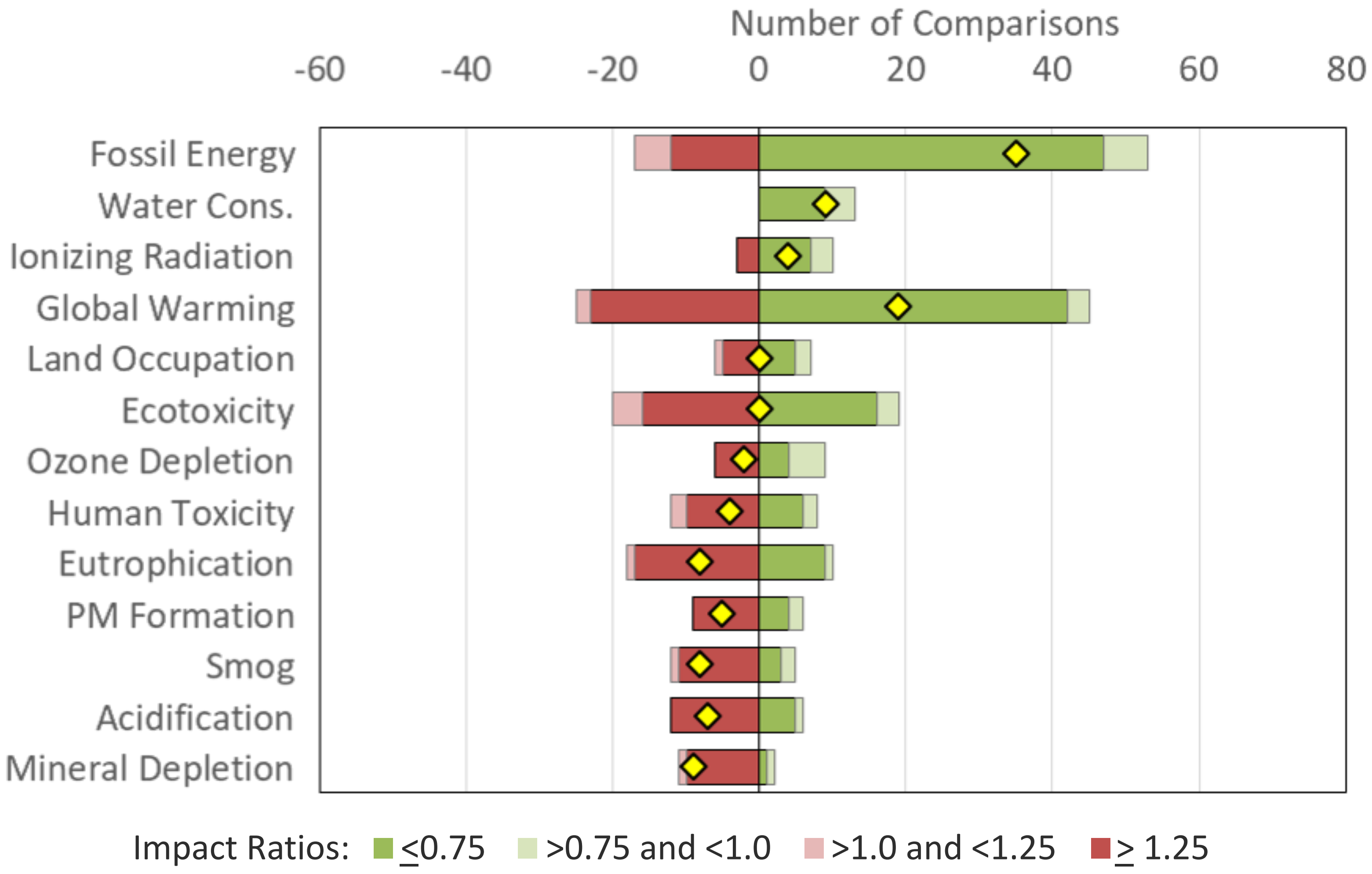
Comparing *Same-Material* Packages with Higher vs. Lower Recycled Content



Comparing *Different-Material* Packages with Higher vs. Lower Recycled Content

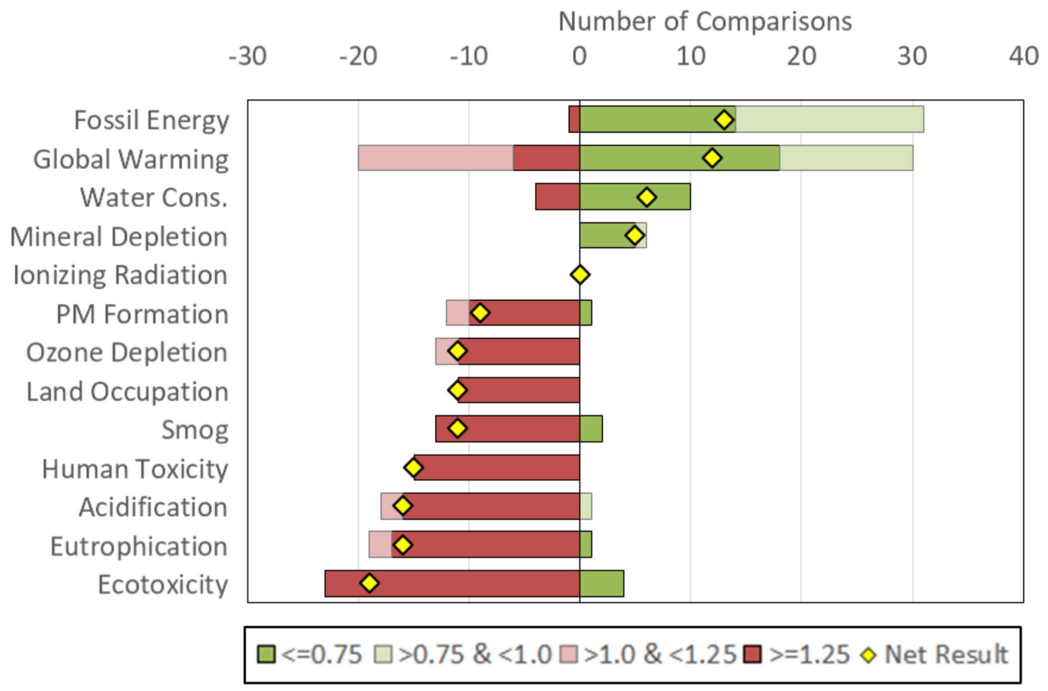


Comparing Different Packages Based on Attribute of Recyclability

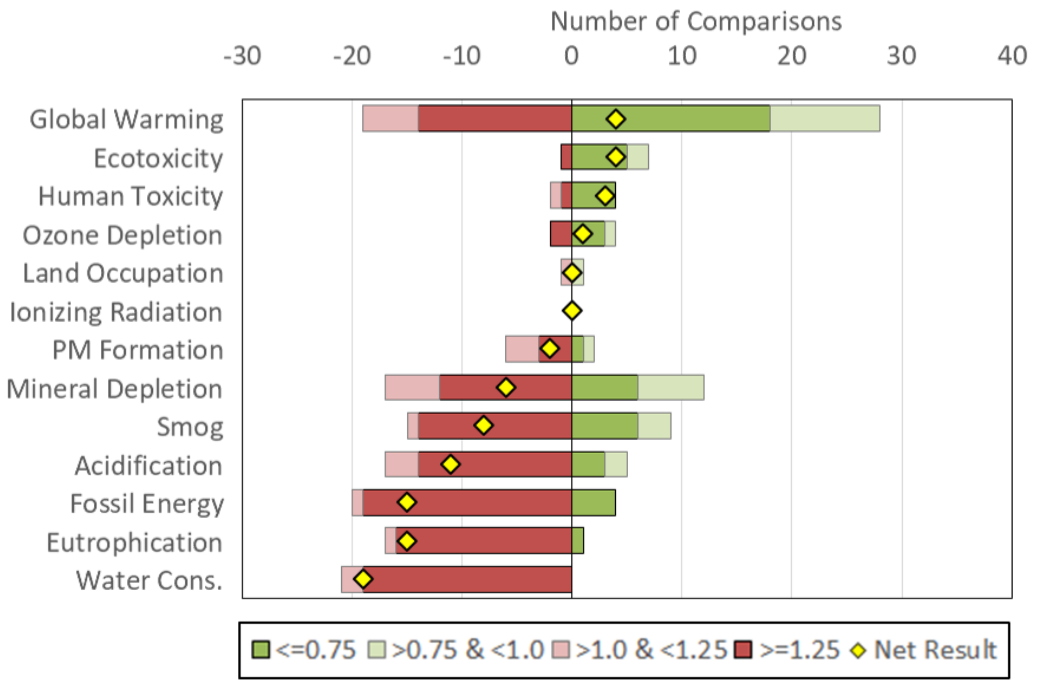


Comparing Different Packages Based on Attribute of Bio-Based Content

Same packaging materials (e.g., bio-PET vs. fossil PET)



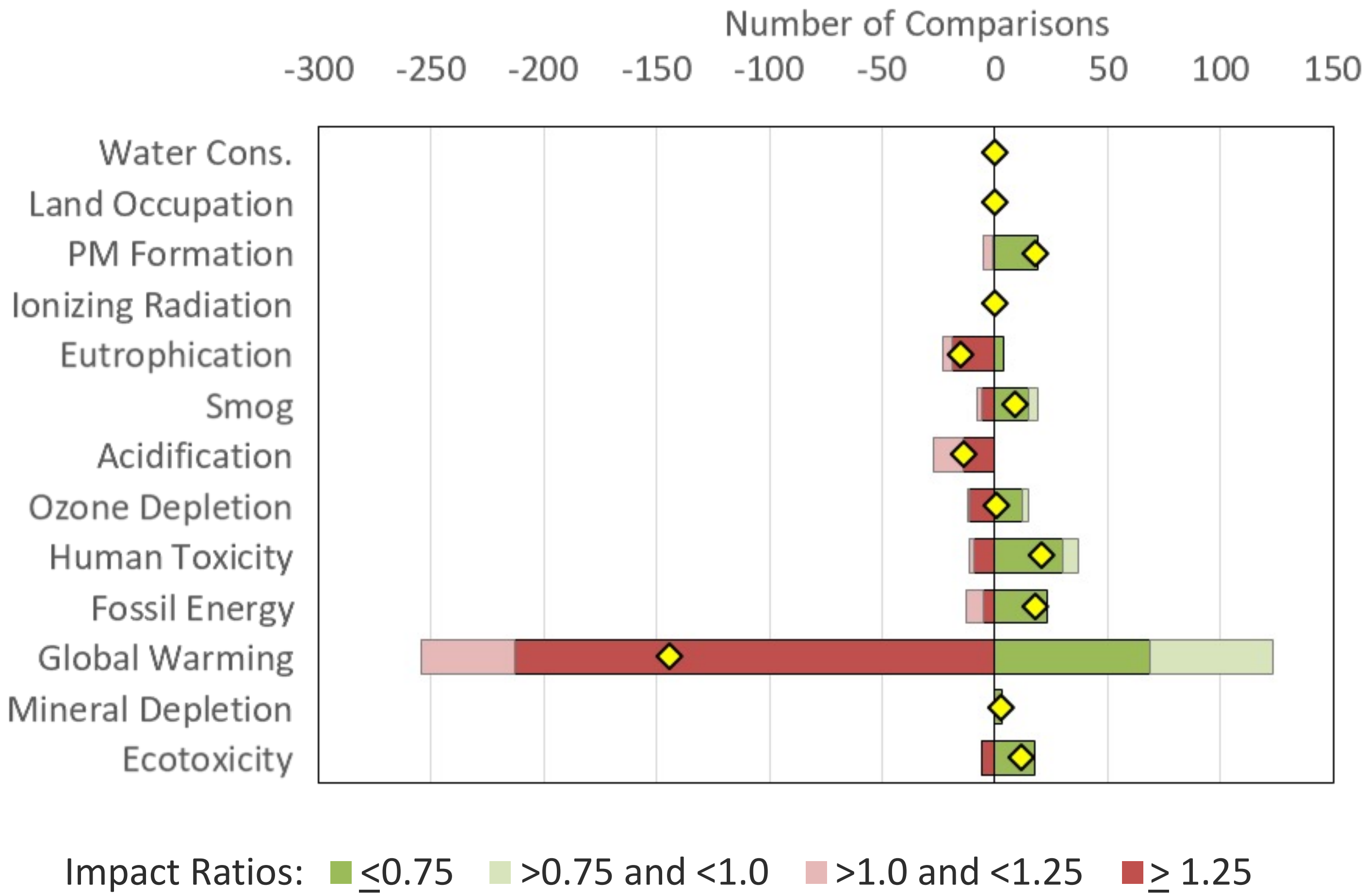
Different packaging materials (e.g., paper mailer vs. conventional plastic mailer)



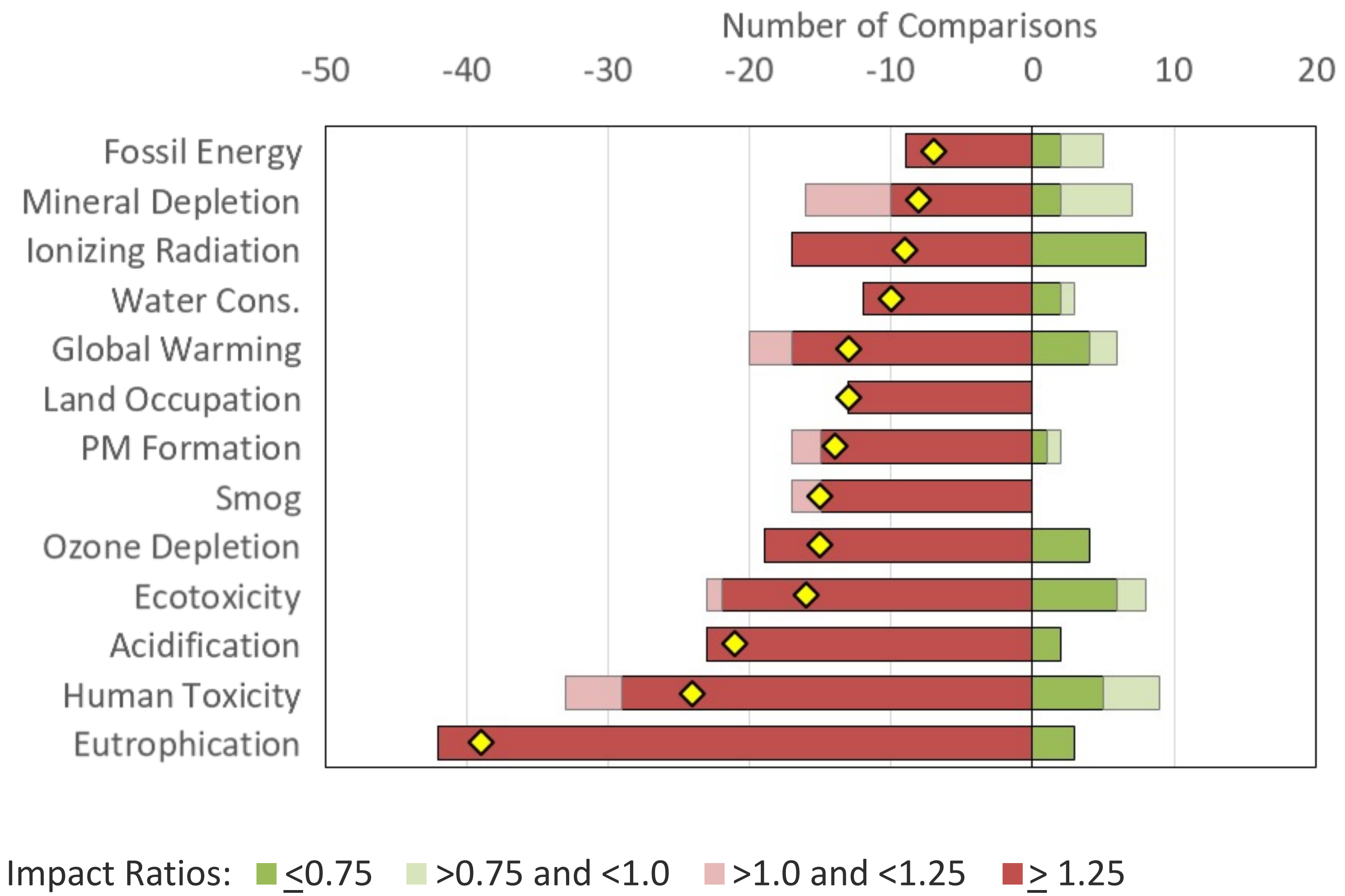
Impact Ratios: ≤0.75 >0.75 and <1.0 >1.0 and <1.25 ≥ 1.25

DEQ

Comparing Different Packages Based on Attribute of Compostability



Comparing Food Serviceware Based on Attribute of Compostability



Statement from Oregon Composters

Why We Don't Want Compostable Packaging and Serviceware

Every year, the Pacific Northwest's compost industry turns hundreds of thousands of tons of yard and food wastes into nutrient-rich compost for agriculture, nurseries, landscaping businesses and home gardens.The quality compost products that we create develop healthier and more resilient soil, reduce greenhouse gas emissions, recycle nutrients, conserve water, and may reduce the use of synthetic fertilizers, pesticides and herbicides.

"Compostable" packaging and serviceware items have been on the rise for the past decade and they are increasingly ending up in our facilities. These materials compromise our composting programs and limit many of the environmental benefits of successful composting.

Here are nine reasons why we don't want "compostable" packaging or serviceware delivered to our facilities:

1 **They don't always compost:** Not all 'certified' compostable items will actually compost (break down) as fully or quickly as we need them to. This is because certification standards test compostability based on laboratory conditions. Those conditions are not always replicated in the real world (our facilities) which means that some "compostable" items don't fully compost. The result is a finished compost that is contaminated with bits of partially degraded "compostable" material.

2 **Contamination happens:** As a consumer, you may sort properly – but your neighbor might not. When collection programs accept compostable products, non-compostable look-alike items inevitably end up in the mix. These materials then must be removed, either at the start (when we receive them) or at the end (as pieces of garbage mixed in with finished compost). Either way, this contamination increases our operating costs and degrades the quality of our product, which makes the compost industry less economically viable.

3 **They hurt resale quality:** We don't want to produce finished compost that is contaminated with fragments of packaging and serviceware, and our consumers won't purchase contaminated material. Contamination lowers the value of our product, making it difficult and sometimes impossible to sell. When fewer people use compost, its environmental benefits aren't realized.

4 **We can't sell to organic farmers:** Farmers often use compost in the production of certified organic foods. National standards prohibit the use of many different packaging materials when making compost used to grow crops certified as "USDA Organic". Accepting packaging and serviceware at our facilities hinders our ability to provide finished compost to organic farmers.

5 **They may threaten human and environmental health:** Packaging designed for water and grease resistance as well as other consumer packaging may contain chemicals that can transfer into finished compost. From the compost, these chemicals may then transfer to ground and surface waters, be taken up by plants, and lead to negative health impacts. While some chemicals of concern are being voluntarily phased out by some packaging producers, not all have been outlawed, and alternatives are not always guaranteed to be safe. Separately, non-degraded fragments of plastic packaging can contaminate finished compost, intensifying environmental health concerns when it is used by buyers. We want to keep our compost clean and safe for all.

6 **It increases our costs and makes our job harder:** Some of us have accepted compostable packaging in the past, and found that loads of compostable packaging require us to change our processes, adding water, using more energy and spending additional resources to produce finished compost. Some types of compostable packaging mostly degrade into carbon dioxide and water and leave behind little of value for all of the extra effort required.

7 **Just because something is compostable doesn't mean it's better for the environment.** Oregon DEQ has found that compostable serviceware often has a larger (life time) environmental footprint than non-compostable items*. For example, compostable materials may require more fossil energy use, release more greenhouse gases, or result in more ecological toxins than their non-compostable counterparts, mostly due to how they're made. The research confirms what scientists already know: that *what materials are made of, and how they're made, may be more significant than whether they're composted vs. landfilled*. "Composting" and "compostable" are not the same idea. Composting is a beneficial treatment option for organic wastes, but "compostable" is not a guarantee of low impact.

8 **In some cases, the benefits of recycling surpass those of composting.** Some items, like paper bags, can be either composted or recycled. Generally speaking, the recycling of manufactured materials (such as packaging) back into new products or packaging can provide greater overall environmental benefits than composting does.

9 **Good intentions aren't being realized.** Compostable items often cost more – sometimes up to five times as much as non-compostable alternatives. That's a lot of money spent on products that might not actually help the environment – money that could be spent in more productive and beneficial ways.

Not only do compostable products often cost more to purchase, they also drive up the costs to operate our facilities and impede our ability to sell finished compost. Compostable packaging is promoted as a means of achieving "zero waste" goals but it burdens composters (and recyclers) with materials that harm our ability to efficiently process recovered materials. Reusable dishware is almost always a better choice for the environment. If you must use single-use items, please don't put them in your compost bin.

We need to focus on recycling organic wastes, such as food and yard trimmings, into high-quality compost products that can be used with confidence to restore soils and conserve resources. Compostable packaging doesn't help us to achieve these goals. We need clean feedstocks in order to produce quality compost.

Please help us protect the environment and create high quality compost products by keeping "compostable" packaging and serviceware out of the compost bin.

Thanks for your cooperation!

REXIUS COMPOST & ORGANICS
Dirt Hugger
Recology ORGANICS OREGON
REPUBLIC SERVICES Pacific Region Compost
LANE FOREST PRODUCTS The company to grow with
DESCHUTES RECYCLING Compost Facility
Pendleton Sanitary Service, Inc.
ROGUE COMPOST EST. 2002
WASTE PRO

*See https://www.oregon.gov/deq/FilterDocs/compostable.pdf

DEQ

Summary of Challenges

1. Public confusion, which leads to . . .
2. Increasing contamination, which contributes to . . .
3. Unfavorable economics
4. Negative impacts
5. Confusion about what “Circularity” means
6. Lack of supportive policy

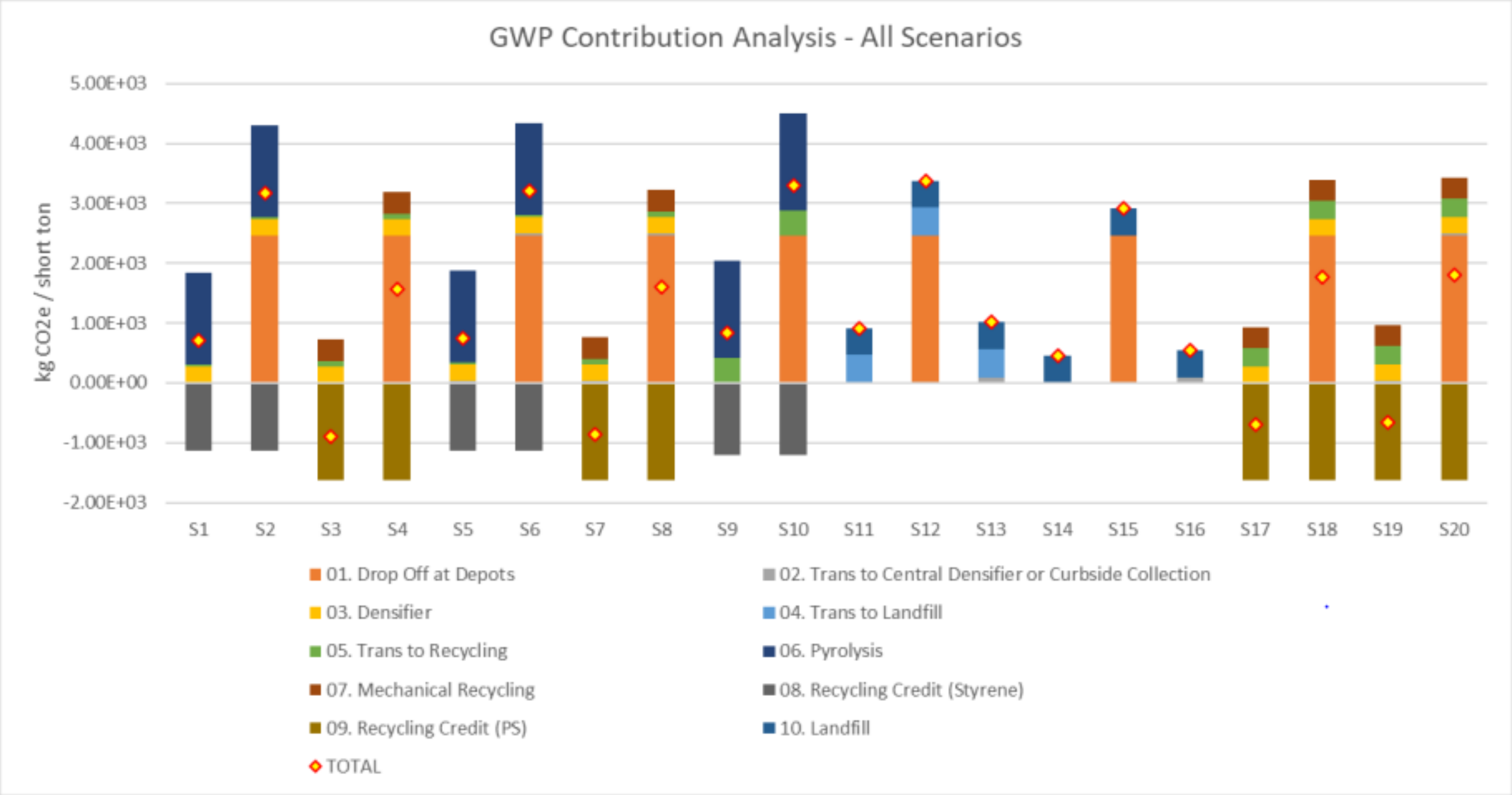
Oregon's Plastic Pollution and Recycling Modernization Act (SB 582, 2021)

- New regulatory obligations on local governments, commingled processors, and "producers"
- "Shared responsibility" model
- Most changes go into effect July 1, 2025

Expected outcomes

- Standardized acceptance lists
- Greater and more consistent supply for reclaimers
- Improved material quality
  - Reductions in in-bound contamination
  - Improved bale quality (post-sorting)
- Responsible end markets
  - Compliant
  - Transparent (with regard to impacts)
  - Environmentally sound
  - Achieve adequate yields

Case Study: Block Expanded Polystyrene



https://www.oregon.gov/deq/recycling/Documents/PyrolysisResults071122.pdf

Block Expanded Polystyrene (continued)

Key Findings

1. Recycling can yield modest benefits
2. Mechanical recycling is preferable to pyrolysis
3. Important to reduce collection impacts (transport)

Policy Outcomes (draft rules)

1. Include on PRO Recycling Acceptance List
2. Require extensive network of drop-off sites (convenience)
3. Require mechanical recycling until chemical recycling is proven to be more beneficial
4. Include performance standards to optimize climate benefits

Expected outcomes (continued)

- Cost internalization and reduced free-ridership
- Ecomodulation to drive design changes
  - Improved evaluation and disclosure of impacts
- Restored public confidence
- Additional (non-recycling) environmental benefits

Thank you!

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More information at: RecyclingAct.Oregon.gov