How Biomaterials Innovation Can Help Reduce Plastic Pollution

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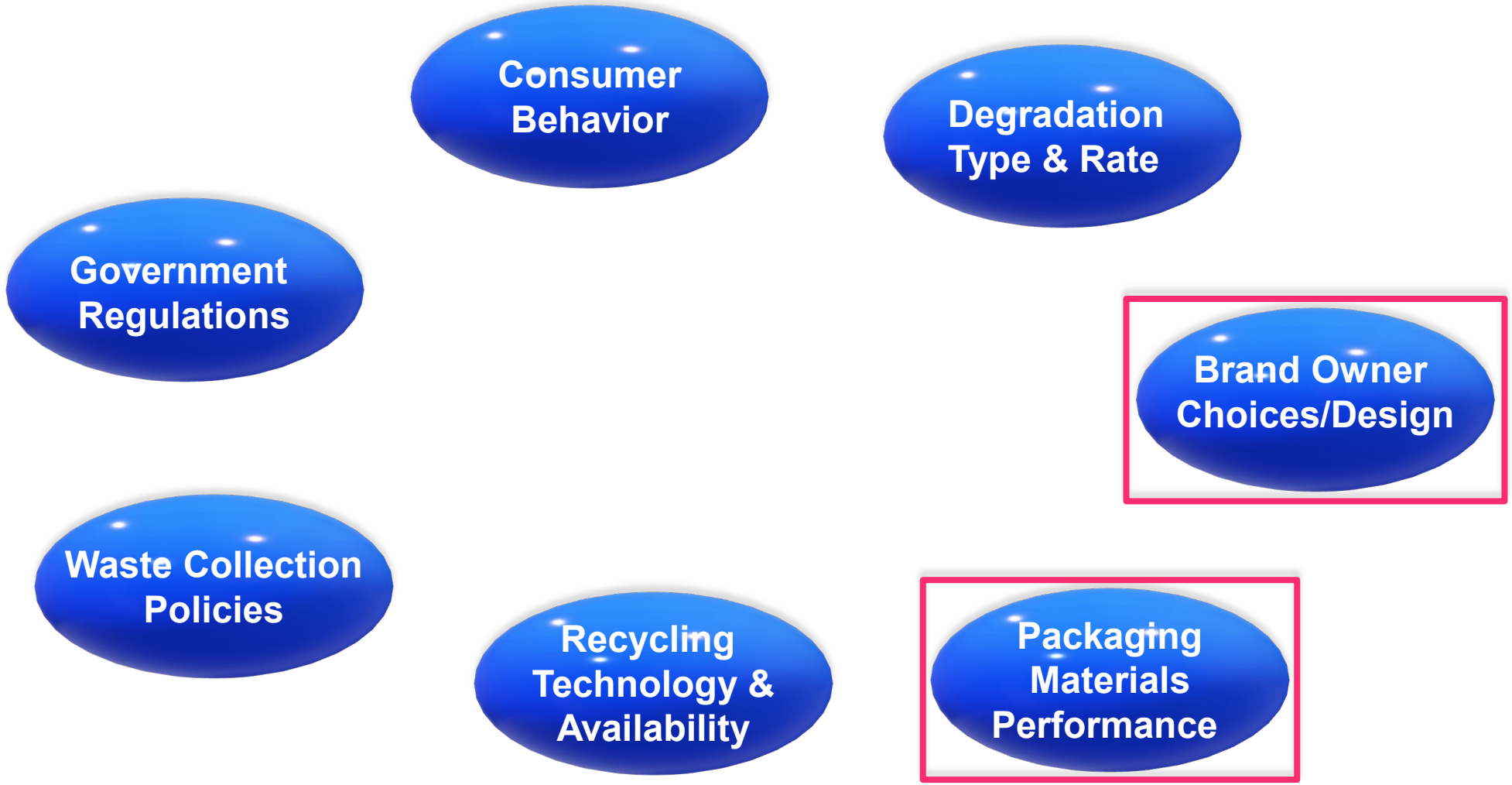
PROSPERITY FOR ALL

Ocean Plastics Pollution is an Incredibly Complex Issue



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- Safety/Freshness
- Convenience
- Affordability

Plastics Bring a Lot of Value

But that Value Comes with Massive Costs

- Fossil-based impacts on climate
- Persistence in the environment
- Impact on wildlife

Can we innovate using new materials that maintain the value and mitigate the costs?

Example # 1: Using Less Plastic to do the Same Job

10-30% thicker walls

- PET bottles are recyclable, unbreakable, and conveniently re-closable
- However, carbonated beverage bottles use ~10-30% more plastic than water bottles
- Driven by need to preserve freshness—PET cannot keep the carbonation inside
- *Can we reduce the amount of plastic needed to preserve shelf life?*

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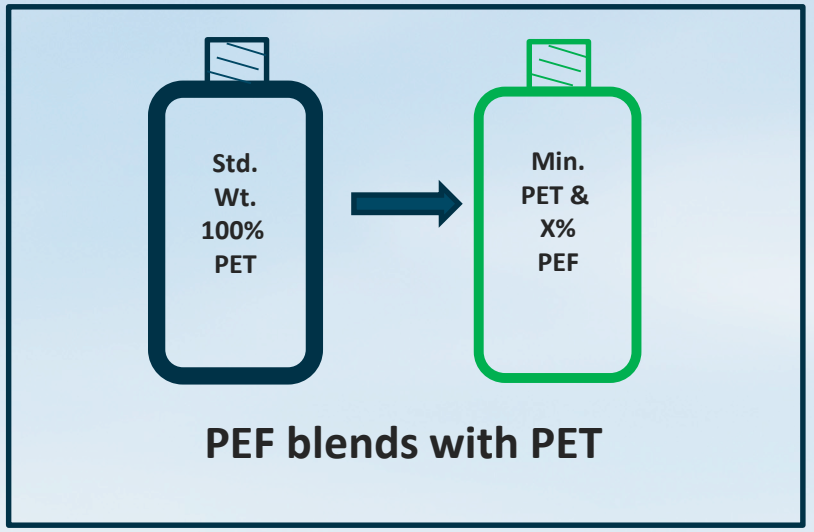
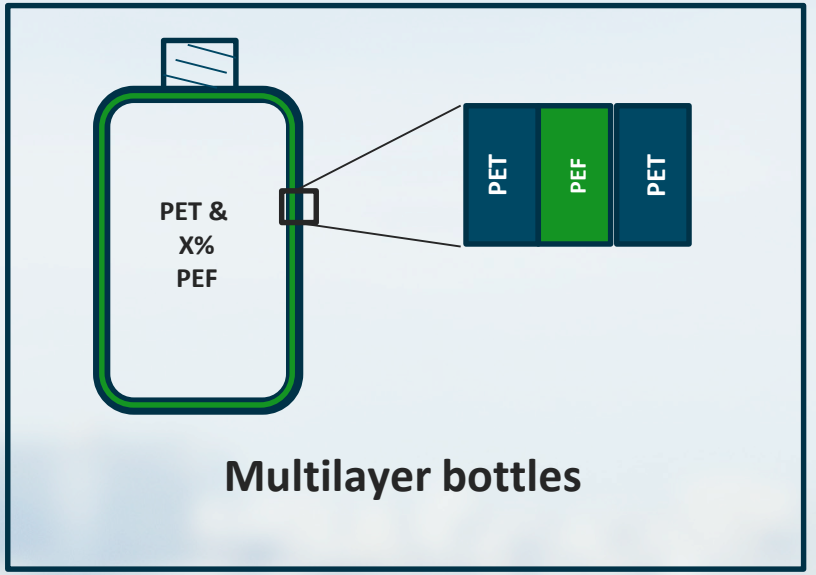
PEF: A New Polymer with ~10x Better Barrier than PET

- PEF is made from abundant renewable resources (corn starch)
- PEF allows ~10-20% light-weighting <u>at same cost</u>
- PEF blend/multi-layer bottles are recyclable in the existing PET stream





- Paper and cotton are made from cellulose—a natural material composed of sugars
- These “polysaccharides” are truly biodegradable since microbes recognize them as food
- Most synthetic polymers are completely inert; a few are somewhat biodegradable

Natural Products are Biodegradable

Cellulose/Paper is Often Mixed with Plastic

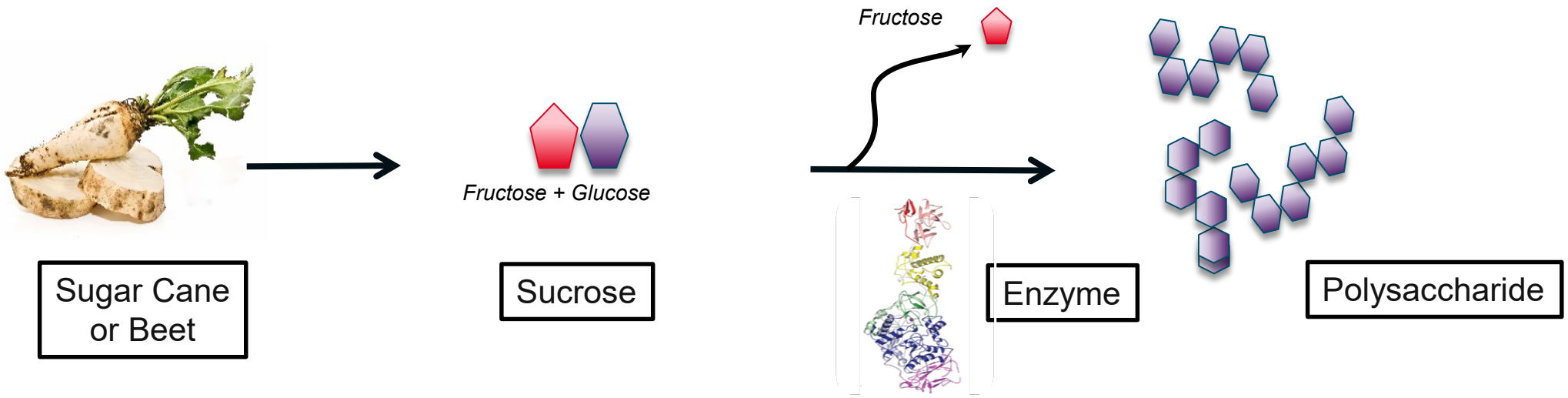
- Paper cups and many cardboard boxes are coated with plastic to make them water- and grease-proof

- Cellulose-based wipes often have plastic binders to give them the required strength

- Paper-based packages cannot be used in many applications due to other performance deficiencies

What if we could replace that plastic with a biodegradable polysaccharide material?

Example # 2: Learning from Nature to Make New Materials



- Nature makes polysaccharides inside plants using protein-based catalysts called enzymes
- We can mimic this process to turn cane or beet sugar into polysaccharides with a variety of properties
- These materials provide performance like synthetic polymers but are marine biodegradable
- The process is low-energy and produces almost no waste

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Some Applications of Engineered Polysaccharides

Plastic-free grease barrier for paper-based dry food packaging

Enabling higher recycled content in cardboard

Replacing latex for plastic-free wipes

Improving performance and biodegradability of biopolymers

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Biomaterials Innovation is Part of the Solution to Ocean Pollution

- Moving from fossil-based materials to plant-based materials to reduce climate impact
- Light-weighting plastic packages while maintaining performance and recyclability
- Enabling truly biodegradable solutions by enhancing the performance of paper-based and biopolymer materials

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