The State of the Industry: Challenges in Resin Supply, Blow Mold Equipment (*New Trends), Developments for Sustainability, Light-Weighting and Recycling*

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spe BLOW MOLDING

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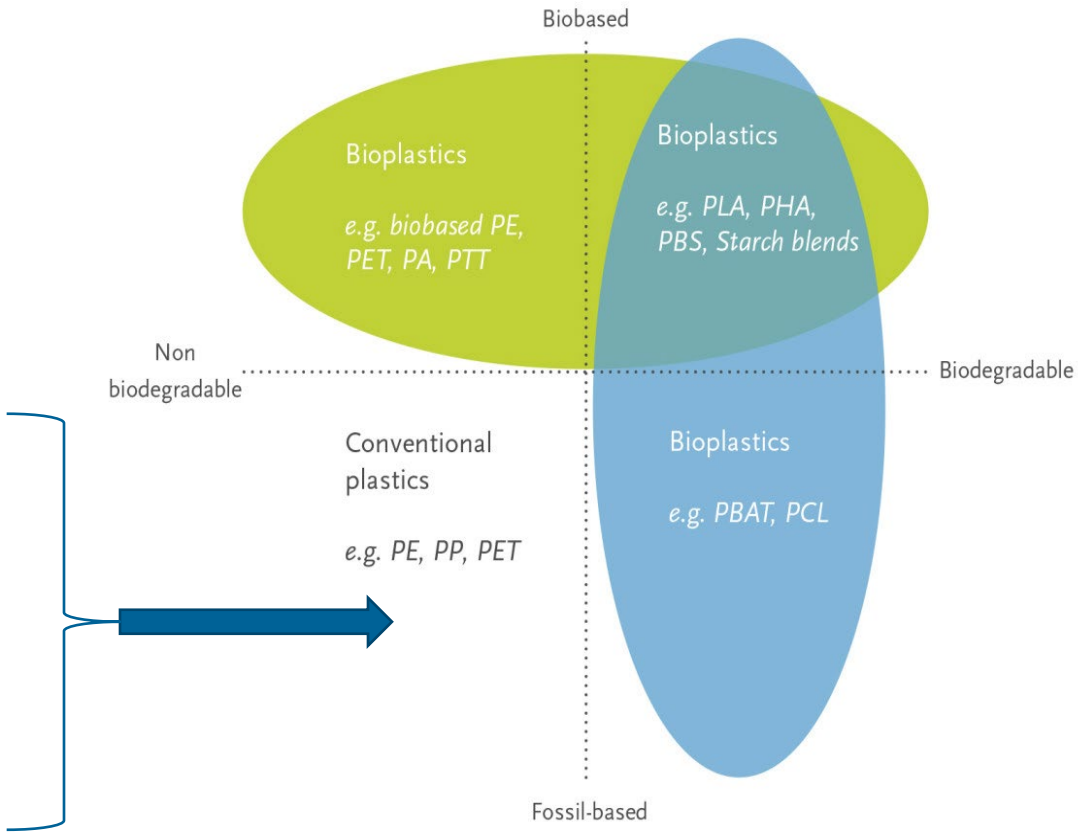
Agenda

- Bioplastics
- PET supply chain status
- Change in consumer behavior post pandemic
- Trends in beverage filling in PET
- Light weighting opportunities
- Barrier properties in PET
- State of recycling in US

Bioplastics

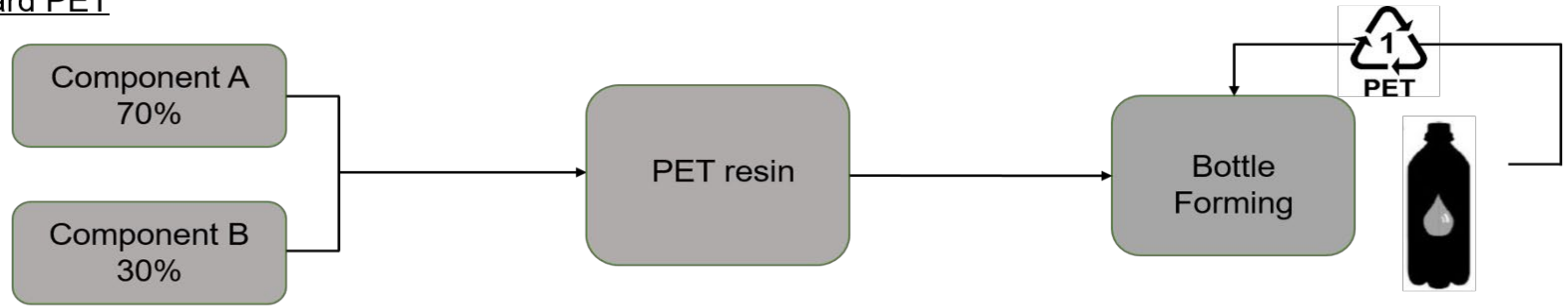
- Bioplastics – bio-based, biodegradable, or both
  - Similar properties as conventional plastics
  - Reduced carbon footprint,
  - Better functionalities, or
  - Waste management options (composting)
- Three main group
  - Bio-based or partially bio-based non-biodegradable
    - Bio-based PE, PP, or PET
  - Bio-based and biodegradable plastics
    - PLA, PHA, PBS
  - Fossil-based and biodegradable plastics
    - PBAT



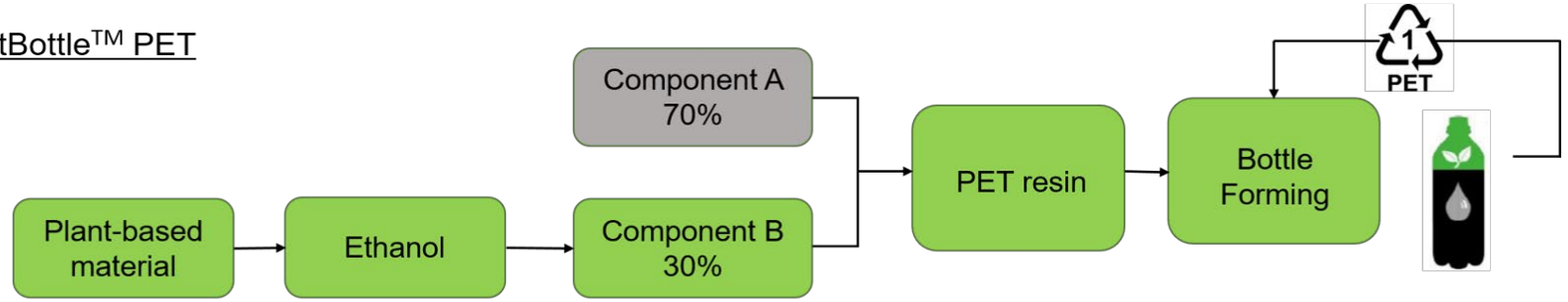
Source: European Bioplastics, Nova-Institute (2019)

Bio-based PET Bottles

Standard PET



PlantBottle™ PET



100% Bio-PET

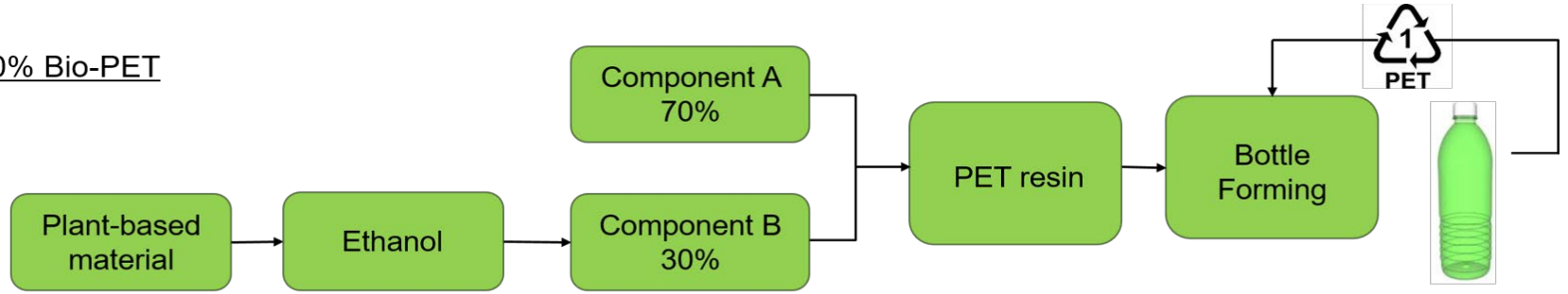


Image modified from http://www.sloop-consulting.com/en/arcmrc11.htm

Key Player In Current Bio-PET Production

Anellotech

BioBTX

gevo

NATURALL BOTTLE ALLIANCE

INDORAMA VENTURES

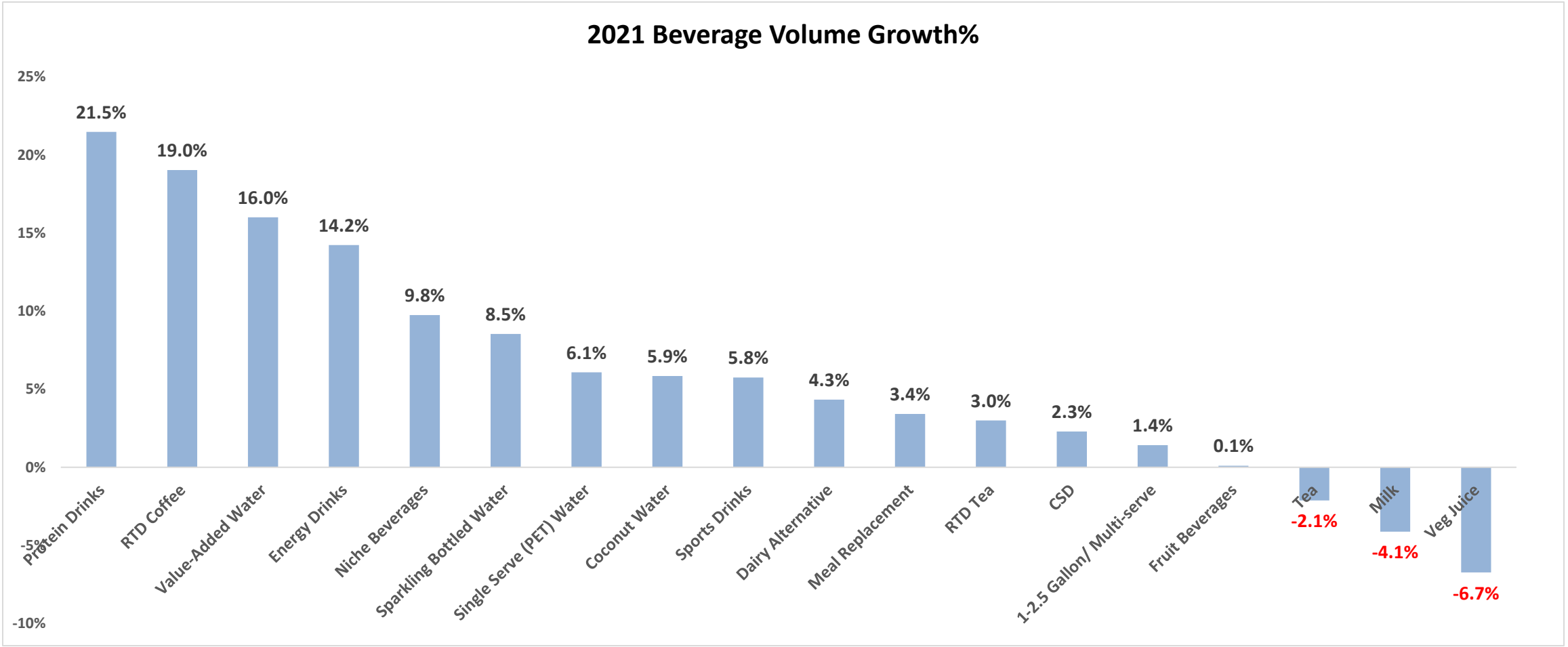
ORIGIN

VIRENT

PET Supply Chain- Market Snapshot

- Tight PET supply market
- Supplier forcemajures
- Strong demand for consumer goods
- Oil prices elevated due to Russia/Ukraine War
- Port congestion and equipment challenges
- Labor shortage (truck drivers)
- Raw material supply disruptions
- Weather related incidents (winter freeze and water shortages)
- China Covid shutdowns

Beverage Trend Post Pandemic

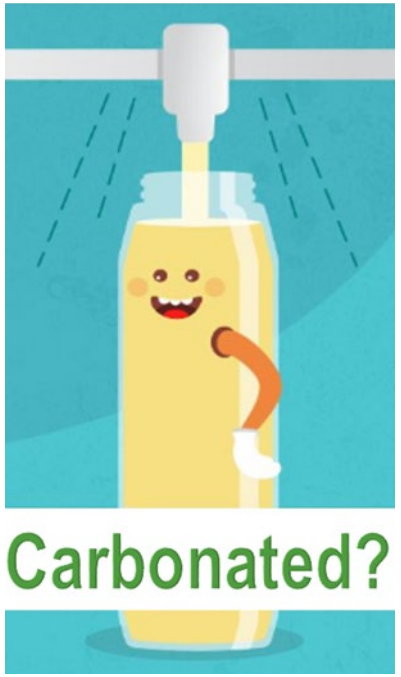


Source: Beverage Marketing 2/15/22

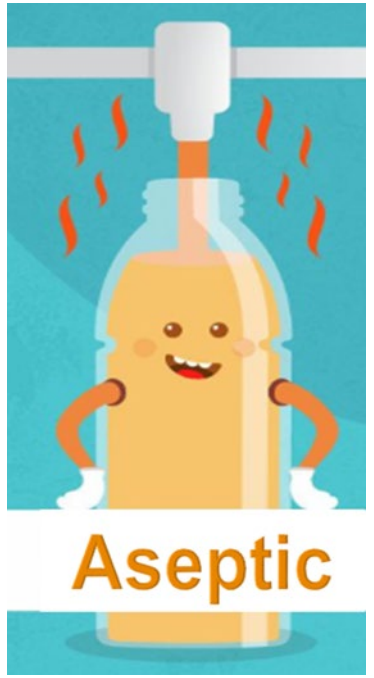
Trends- Beverage Filling in PET

The product is heated to certain temperature and held at specified time before filling into the bottle at specified temperature.

The product may/not be heated but it is cooled before filling into bottles. Products will contain preservatives.



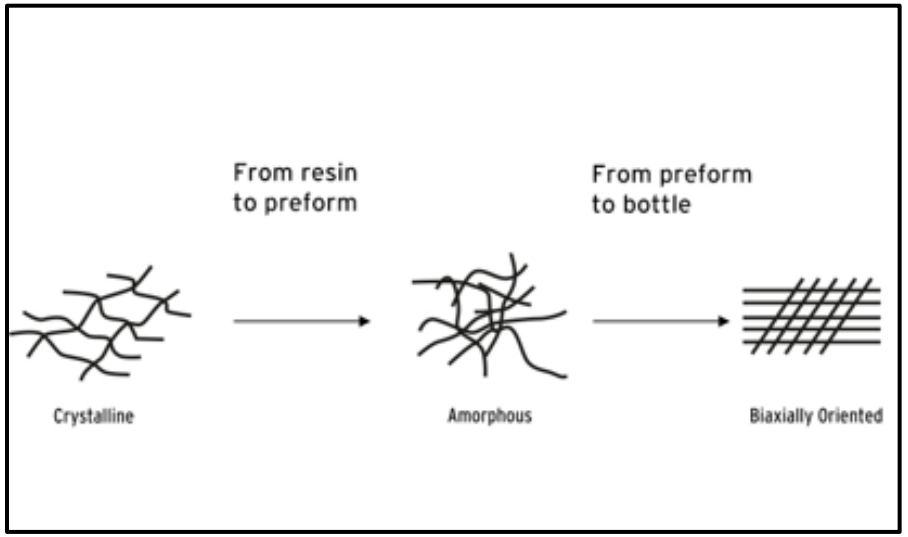
CO_2 is the main kill step although some formulas contain preservatives depending on ingredients used.



Product is heated to specified temperature, held for specific amount of time, cooled to room temperature, and aseptically filled into presterilized container.

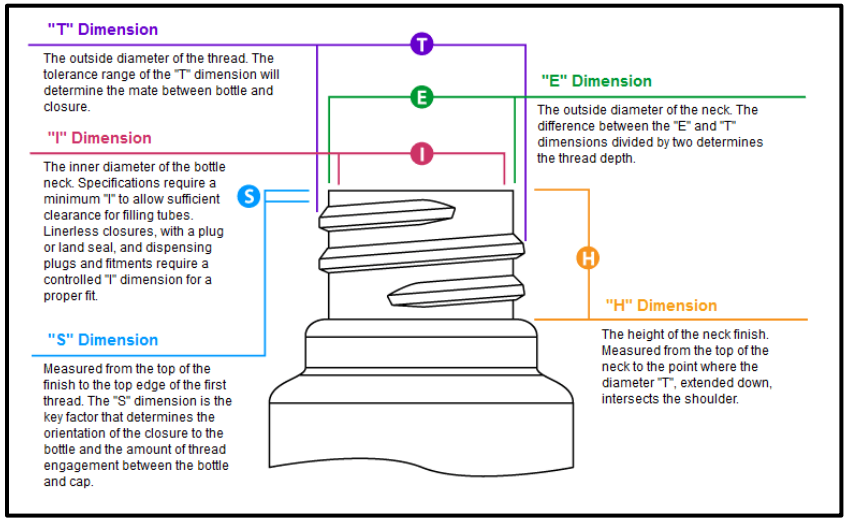
Light Weighting in PET

- Advantage of PET
  - Bi-axial orientation
  - Better mechanical properties
  - Reduction of secondary packaging



- Bottle design opportunities
  - Utility Vs design features
  - Base design

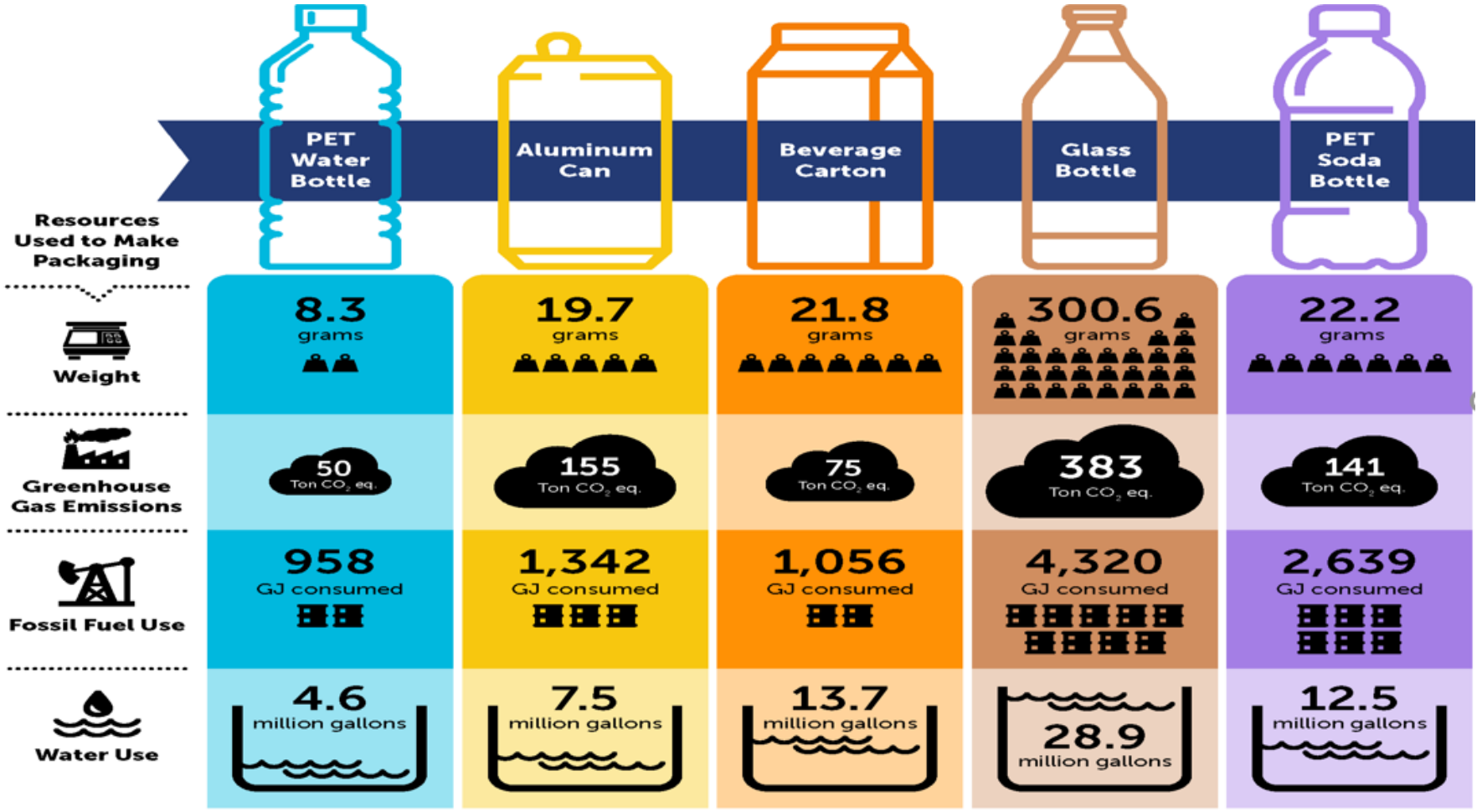
- Neck design opportunities
  - Light weighting options
  - Thread design



Barrier Properties -Trends And Challenges

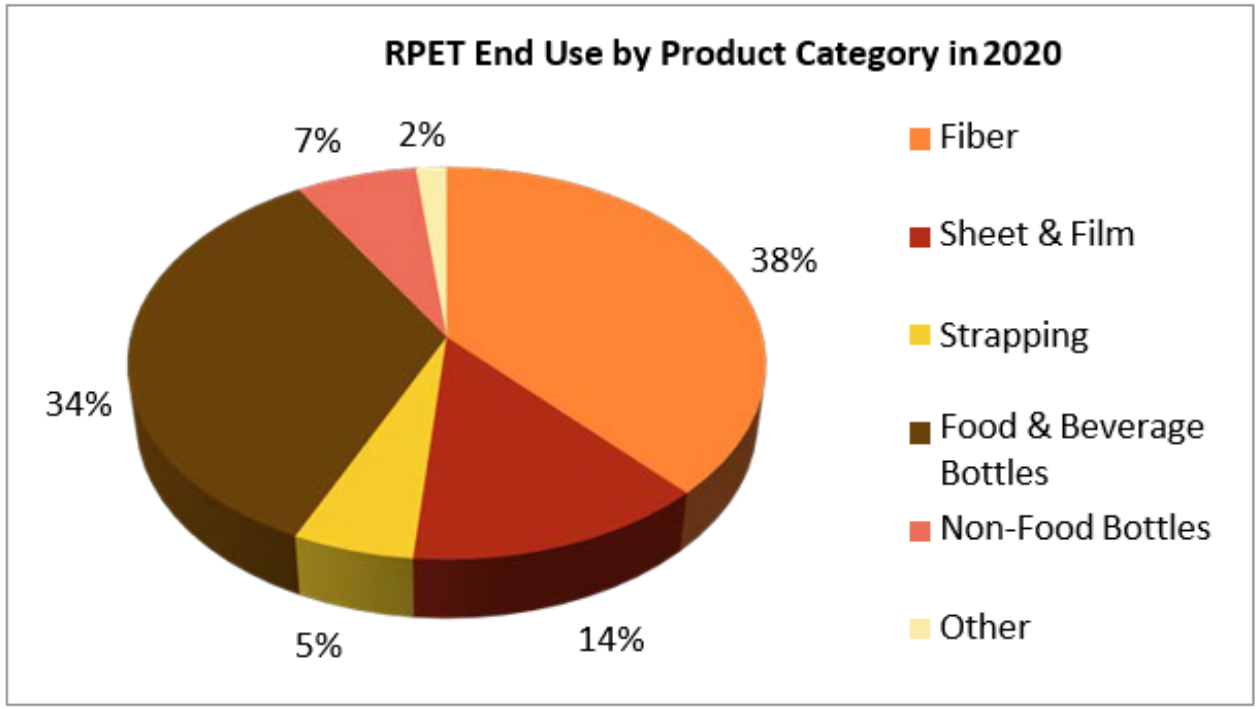
	Pros	Cons
Active O_2 Scavengers	• Extended shelf life achievable • Eliminates oxygen from headspace too • No impact on PET recycling if scavenger in the closure	• Detrimental for recycling if blended with PET • Impact on clarity/color of PET bottle
Passive Barriers	• Recycling-friendly if barrier material separated during recycling of PET • Usually minimal impact on clarity/color of PET bottle	• Doesn't remove oxygen permeating through the thread/closure • Limited shelf life achievable

Environment Impact Of Packaging



Source: Life Cycle Assessment for IBWA by Trayak (2021), which used COMPASS to compare packaging sustainability using the average recycled content for each package as reported by industry/industry associations. Weights are for individual 16.9 oz containers. The other values represent 1 million 16.9 oz bottles or cans each. GJ consumed is the total quantity of fossil fuel consumed throughout the life cycle.

NAPCOR 2020 Recycling Report



- US Recycling rate for PET bottles
  - 1999-24%
  - 2020-27%

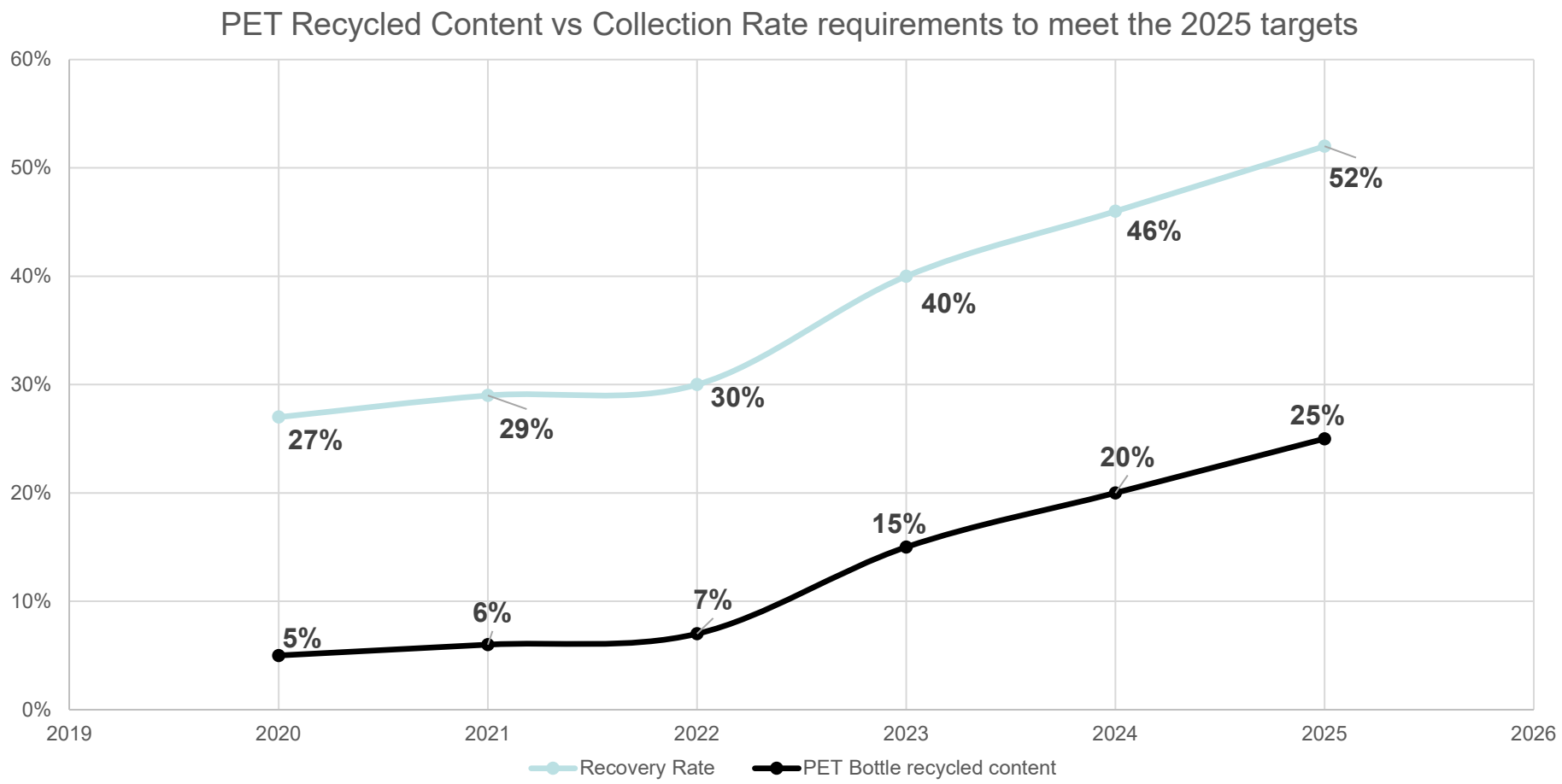
Actual PCR PET Use Rate

RPET GENERATION RATE CALCULATION

24 rPET Plants in the US with nameplate capacity of 1,295,000 MT
2020 PET collected in US 787,436 MT

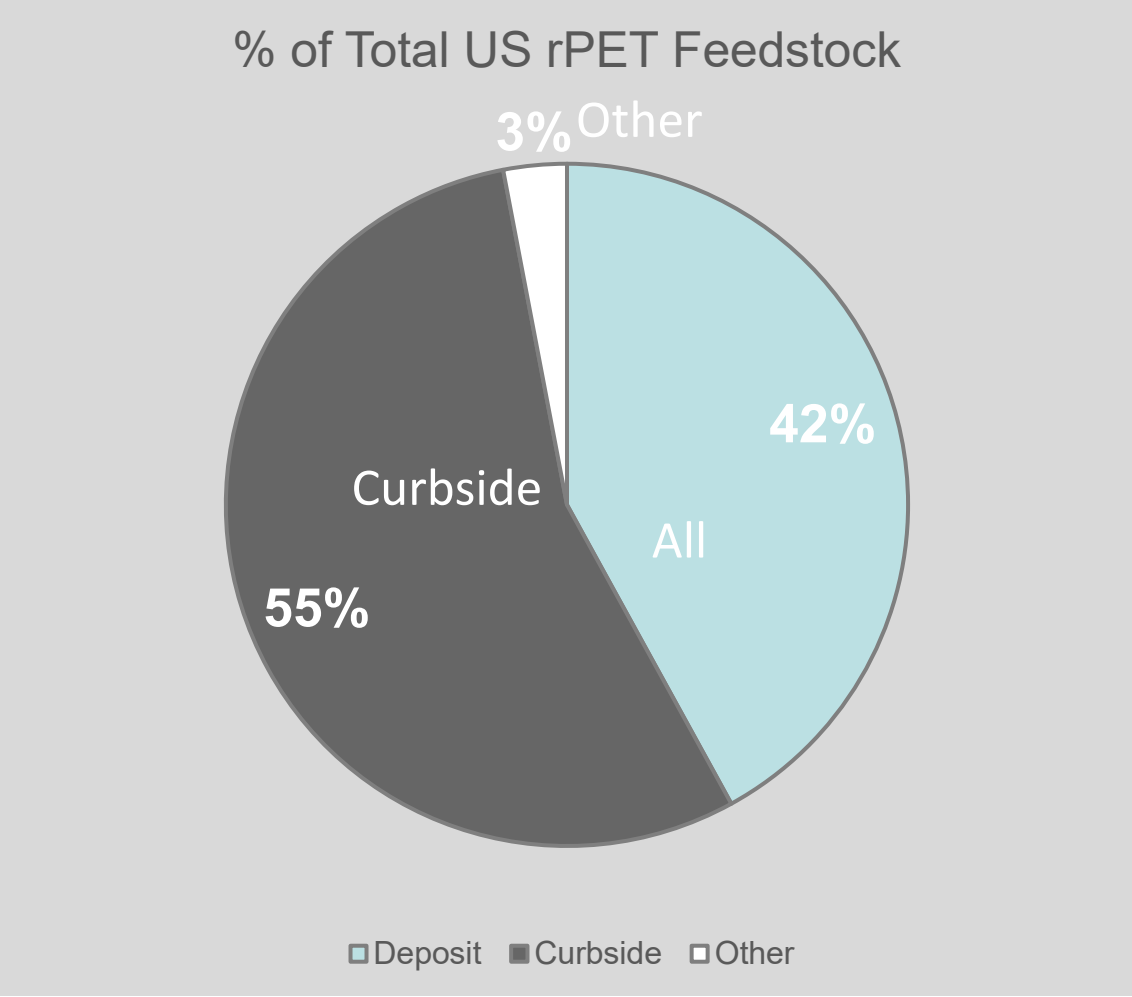
6% effective rPET content in bottles in 2020

Recovery Rate Vs rPET Content Need



To achieve a 25% rPET content across the Beverage Industry we will need to increase our collection rate from 27% to 50%

Percentage of collection by method of PET in US



New Legislation impacting PET recycling

PCR Mandates

CA 15%, 25%, 50%

WA 15%, 25%, 50%

NJ

ME

Extended Producer Responsibility Laws

ME

OR

CO

CA

Bottles in Deposit System Exempt

Secondary Packaging Included

Tertiary Packaging Included

Questions?