



Keeping our customers in the lead

# Quantifying Environmental Impacts of Carbonated Soft Drink (CSD) Packaging

Comparing the Total Environmental Impact of CSD Packaging in Europe

## Objective:

The objective of this study was to quantify and compare the total environmental impacts of PET versus other single-use package types used in Europe for CSD. All package types were considered to be best in class. Three package types were considered: 23.9g PET bottle/355ml (2.3g HDPE closure), 200.0g glass bottle/355ml (2.1g metal closure), and 11.3g aluminum can/355ml (2.8g aluminum can end). The environmental impact was calculated by focusing on weight of materials, total energy consumption, and total greenhouse gas (GHG) release. A cradle-to-grave analysis was completed for each packaging scenario, including all materials, processing, and transportation.

## Results:

The PET bottle had the lowest GHG emissions to produce at 347.9 lbs/1,000 units. Glass bottle had the highest GHG emissions at 487.7 lbs/1,000 units (40% more than the PET bottle), followed by aluminum can at 429.4 lbs/1,000 units (23% higher than the PET bottle). Aluminum can had the lowest energy consumption at 3,163 MJ/1,000 units. Glass bottle had the highest energy consumption at 4,124 MJ/1,000 units, while the PET bottle fell in between the aluminum can and glass bottle at 3,413 MJ/1,000 units (8% more than the aluminum can). PCR rates for aluminum are higher in Europe vs USA (61% vs 46%). This 15% increase in PCR directly lowers the energy input required to manufacture the raw material used for aluminum can manufacture.

## Conclusion:

Compared to the glass bottle, PET packaging for CSD applications within Europe remains the better alternative from an environmental perspective. While PET has favourable GHG values versus aluminum can, the relatively high usage of PCR provides aluminum with a reduced energy consumption value over PET. Increased recycle rates and increasing the percentage of PCR content used in new bottles would improve PET's energy consumption considerably.

## Definitions:

**Cradle-to-Grave** - Cradle-to-grave is the full Life Cycle Assessment from manufacture ('cradle') to use phase and finally disposal phase ('grave').

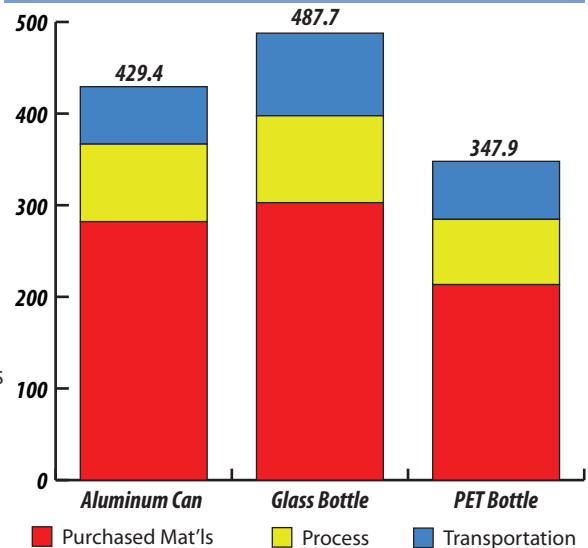
**Process** - Anything related to manufacture and filling of the primary package and its components.

**Purchased Materials** - Any material used for the manufacture of the primary package, including: raw materials/packaging, pallet packaging, etc...

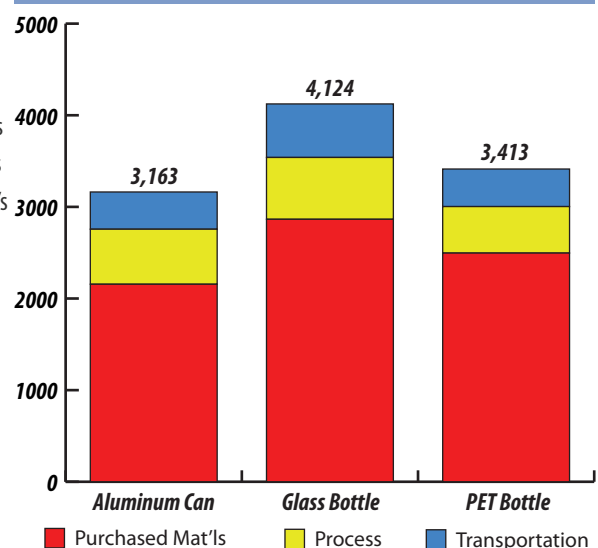
**Transportation** - Anything related to the movement of materials between locations.

**PCR** - Post-Consumer Recyclate. Material that was used by a consumer and then recycled for use in a new product (e.g. PET bottle).

GHG Emissions (lbs CO<sub>2</sub> & equivalents /1,000 units)



Energy Consumption (MJ /1,000 units)



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## Assumptions:

- Package manufacturing and filling operations are co-located, keeping transport impacts low.
- PCR content rates used for package and closure re-manufacture were: Aluminum Can = 61%, Glass Bottle 39%, PET Bottle 0%.
- Costing: electricity rate of \$2.69/kWh and \$1.20/Mcf of natural gas.
- Fill speeds (per min): Aluminum Can = 2,000, Glass Bottle = 1,250, PET Bottle = 1,350.
- Ship distance to retail for all three packaging types was 800km.
- One way glass was considered for European market.

## Exclusions:

- Energy and GHG emissions for transport from retail store to consumer's location were ignored.
- Consumption of the distribution network including electricity and GHG emissions for distribution centers and supermarkets.
- Infrastructure (buildings) are not considered. Buildings have a long service life. The environmental impacts of their construction and disposal, in terms of each packaging unit can be regarded as insignificant.
- Home consumer energy consumption (e.g. refrigerator usage).
- Labels were not considered for any package.

## PET Benefits:

- Significant weight savings over glass
- Shape Flexibility (can assume traditional bottle shapes)
- Rapid ramp up time to set up preform-blowing production cells
- Robustness of PET package vs Glass and Aluminum Can
- Shipping cost advantages vs glass

Package Details			
Geography	Europe		
Beverage Type	CSD		
Package	Can Aluminum	Bottle (Glass)	Bottle (PET)
Size (ml)	355	355	355
Weight per Unit (g)	11.29	199.76	23.9
Material	Aluminum	Glass	PET
Closure	Can End	Metal Cap	Plastic Closure
Weight per Unit (g)	2.77	2.09	2.31
Material	Aluminum	Metal	HDPE

