



Keeping our customers in the lead

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

## Comparing the Total Environmental Impact of CSD Packaging in North America

### 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 North America 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 314.9 lbs/1,000 units. Aluminum can had the highest GHG emissions at 570.9 lbs/1,000 units (81% more than the PET Bottle). The chemical process associated with producing aluminum from bauxite releases a significant amount of GHG, which contributes to the high level of GHG emissions for aluminum can. GHG emissions for the glass bottle fell in between at 500.4 lbs/1,000 units. PET had the lowest energy consumption at 3,225 MJ/1,000 units. Glass Bottle had the highest energy consumption at 4,227 MJ/1,000 units (31% more than the PET Bottle), while aluminum can fell in between at 3,917 MJ/1,000 units.

### Conclusion:

Compared to aluminum cans and glass bottles, PET packaging for CSD applications within North America remains the best alternative from an environmental perspective. Increased recycle rates, and the inclusion of PCR content into new bottles would help lower PET's current environmental footprint.

### Definitions:

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

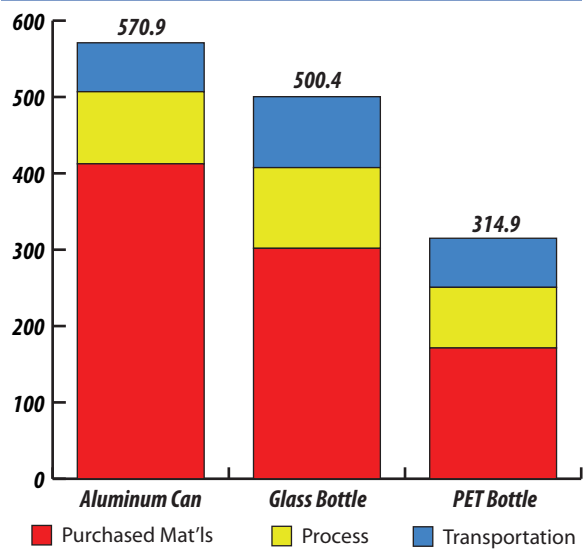
*Process* - Anything related to manufacture and filling of the primary package and its components.

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

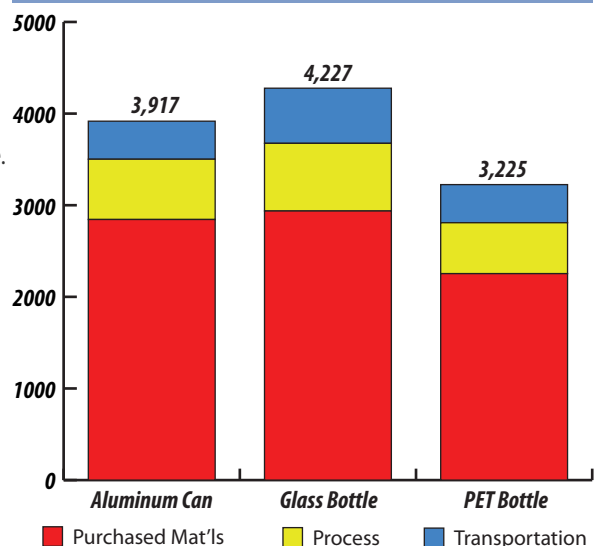
*Transportation* - Anything related to the movement of materials from one location to another.

*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)



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

Comparing the Total Environmental Impact of CSD Packaging in North America

## Assumptions:

- Package manufacturing and filling operations are co-located, keeping transport impacts low.
- PCR content rates used for package and closure manufacture are: Aluminum Can = 46%, Glass Bottle = 39%, PET Bottle = 0%.
- Costing - electricity rate of \$0.069/kWh and \$6.593/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 which is typical for North American market.
- Refillable glass was not considered.

## 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.
- Increased package robustness versus glass bottle and aluminum can.
- Shipping cost advantages vs glass.

Package Details			
Geography	North America		
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

## Global CSD by Package Type (Millions)

