

# Environmental Product Declaration (EPD)

Based on ISO 14040, ISO 14044, and ISO 14025 frameworks

## Product Identification

Product name: Ceramic Mug vs. Paper Cup  
Functional unit: One beverage consumed (per drink)  
System boundary: Cradle-to-gate + use phase (washing for mug)  
Geographical scope: Europe (generic energy mix)  
Software & method: openLCA 2.x, IPCC 2013 GWP 100a  
Database: Custom (ELCD 3.2-based flows)

## Goal and Scope

This study compares the global warming potential (GWP) of a reusable ceramic mug and a single-use paper cup. The objective is to demonstrate LCA modeling, parameterization, and interpretation skills using openLCA. End-of-life impacts are excluded; results represent cradle-to-gate + use phase.

## System Boundaries

Life-Cycle Stage	Included	Description
Raw material extraction	Yes	Clay and paperboard production
Manufacturing	Yes	Cup forming and ceramic firing
Distribution	No	Excluded (assumed negligible)
Use phase	Yes	Washing (ceramic mug only)
End-of-life	No	Excluded from baseline scenario

## Key Assumptions and Parameters

Parameter	Value	Unit	Description
Mug mass	0.35	kg	Typical ceramic mug
Mug lifetime	500	uses	Reuse cycles assumed
Washing electricity	0.02	kWh/use	Dishwashing energy
Washing water	0.5	L/use	Tap water consumption
Paper cup mass	0.01	kg	Average 250 mL paper cup
EF ceramic production	1.0	kg CO <sub>2</sub> /kg	Emission factor
EF paper cup	1.05	kg CO <sub>2</sub> /kg	Average primary data
EF electricity	0.421	kg CO <sub>2</sub> /kWh	EU grid average
EF water	0.0003	kg CO <sub>2</sub> /L	Water supply & treatment

## Life Cycle Impact Assessment (LCIA) Results

Impact category: Global Warming Potential (GWP 100a, kg CO<sub>2</sub>-eq)

Scenario	Production	Use phase	Total (per drink)
Paper cup	0.0105	—	0.0105
Ceramic mug	$0.35 / 500 = 0.0007$	0.0202	0.0209

Result: The mug emits ~ 0.0209 kg CO<sub>2</sub> per drink, versus 0.0105 kg CO<sub>2</sub> for a paper cup.

Under baseline assumptions, washing dominates the mug's footprint; no carbon break-even occurs within 500 uses.

## Interpretation

The ceramic mug's impact is driven by washing energy. Increasing lifetime or reducing washing electricity could achieve a positive break-even.

The paper cup has a lower per-drink footprint but accumulates over frequent use.

## Limitations

Transportation and end-of-life impacts were excluded. Data are generic; results are indicative only.

This EPD follows ISO 14040 principles for educational demonstration and is not valid for commercial verification.