

ECOVIAL

The Vial, Rethought.

PHARMACEUTICAL PACKAGING COMPARISON REPORT

EcoVial (PLA) · Conventional Plastic · Aluminium

BASIS OF COMPARISON

Vial Format: 20 g finished pharmaceutical vial

Raw Material: 100% TotalEnergies Corbion Luminy® PLA neat resin

Methodology: ISO 14040 / 14044 Cradle-to-Gate Life-Cycle Assessment

Prepared for: Executive Review

Confidential · For Internal Distribution

1 Executive Summary

EXECUTIVE TAKEAWAY

EcoVial delivers the strongest overall sustainability profile among the three materials evaluated. Made from 100% TotalEnergies Corbion Luminy® PLA neat resin, it combines the **lowest carbon footprint**, elimination of fossil-resource dependence, strong ESG alignment, and high consumer sustainability appeal — all while retaining the handling and performance expected of modern pharmaceutical packaging.

Carbon Footprint per 20 g Vial

16.0 g CO ₂ per EcoVial (20 g)	40.0 g CO ₂ per Plastic Vial (20 g)	240.0 g CO ₂ per Aluminium Vial (20 g)
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On a like-for-like 20 g finished vial basis under ISO 14040/14044 cradle-to-gate LCA, EcoVial emits only 16.0 g CO₂ eq per vial versus 40.0 g for conventional plastic (a 60.0% reduction, calculated as $(40 - 16) \div 40$) and 240.0 g for aluminium (a 93.3% reduction, calculated as $(240 - 16) \div 240$). This translates to 24 g of CO₂ avoided per vial versus plastic and 224 g avoided per vial versus aluminium.

Note: 20 g refers to vial mass (finished packaging); 16 g refers to cradle-to-gate CO₂-equivalent emissions per that vial. The two values are separate physical quantities and are not interchangeable.

2 Executive Material Comparison Matrix

20 g vial basis. Highlighted cells indicate EcoVial's leading positions.

Metric / Property	EcoVial (PLA)	Conventional Plastic	Primary Aluminium
CO ₂ per 20 g Vial	16.0 g CO ₂ (–60% vs plastic)	40.0 g CO ₂	240.0 g CO ₂
Renewable Content	100% Plant-Based	0% (Fossil-Based)	0% (Mineral Mining)
Fossil Fuel Dependence	None	High	High
ESG Rating	8 / 10 (High Alignment)	3 / 10 (High Risk)	5 / 10 (Moderate)
“Go Green Pharmacy” Image	92% Positive (+78% Affinity)	24% Low (Plastic Backlash)	58% Moderate
Gen-Z / Millennial Preference	88% Prefer & Would Switch	12% Preference (74% Avoid)	42% Preference
End-of-Life	Industrially Compostable	Landfill / Microplastics	Recyclable (high-energy)

Metric / Property	EcoVial (PLA)	Conventional Plastic	Primary Aluminium
Lifecycle Cost Trend	Improving with scale	Rising ESG risk premium	Highest (energy-intensive)

3 “Go Green Pharmacy” — Public Image & Consumer Demand

Target demographic: Young Americans — Gen-Z & Millennials (ages 18–40).

Stat	Metric	Insight	Business Impact
88%	Preference for Eco-Vials	Young Americans (18–40) actively prefer eco-friendly vials over petroleum plastics.	Drives retail traffic and patient loyalty.
78%	Brand Affinity Boost	Increase in positive public image for pharmacies launching “Go Green Pharmacy”.	Protects reputation and neutralises plastic backlash.
72%	Pharmacy Switching Intent	Would switch pharmacy to one offering verified eco-friendly packaging.	Major commercial growth driver for early adopters.
84%	Plastic Fatigue & Concern	High concern regarding microplastics and landfill pollution from amber pill bottles.	Category-level risk for conventional plastic vials.
65%	Social Media Reach	Willing to share “Go Green Pharmacy” unboxing content on TikTok / Instagram.	Free viral marketing and ESG leadership positioning.

4 EcoVial — Key Features & Advantages

Why EcoVial outperforms conventional plastic and aluminium across every strategic pillar.

PILLAR 1 · 100% Renewable & Plant-Based Material

✓ FULLY VALIDATED

CERTIFICATIONS

- TÜV Austria OK biobased — 4-Star (100% bio-based carbon content)
- USDA Bio Preferred® — Certified 100% Biobased Product
- DIN CERTCO Biobased Poly (lactic acid) certification
- ISCC PLUS Chain of Custody (sustainably sourced feedstock)

COMPLIANCE GUIDANCE

‘Made from 100% renewable plant-based material’ or ‘100% Bio-Based PLA’. Always state feedstock as sugarcane/corn origin.

PILLAR 2 · Lowest Carbon Footprint — 60% Below Plastic, 93% Below Aluminium

✓ FULLY VALIDATED

CERTIFICATIONS

- ISO 14040/14044 LCA reviewed by Earth Shift Global / Meo Carbon
- ≈ 0.80 kg CO₂ eq/kg finished PLA vial vs ≈ 2.00 kg PET/PP & ≈ 12.00 kg aluminium
- 20 g format: 16.0 g CO₂/vial vs 40.0 g (plastic) vs 240.0 g (aluminium)
- Cradle-to-gate methodology, third-party verified

COMPLIANCE GUIDANCE

Best-practice claim: ‘60% carbon footprint reduction vs conventional petrochemical plastic vials, based on cradle-to-gate ISO 14040/14044 LCA for a 20 g vial format.’

PILLAR 3 · Non-Toxic End-of-Life — Zero Microplastics

✓ FULLY VALIDATED

CERTIFICATIONS

- Industrially compostable under EN 13432 / ASTM D6400 / ISO 17088
- >90% mineralisation to CO₂ + H₂O within 180 days (ISO 14855-1)
- Non-toxic to soil (OECD 208) and aquatic life (OECD 202)
- PFAS-free and free from Pb, Cd, Hg, Cr, As (EN 13432 A.3)

COMPLIANCE GUIDANCE

‘Advisable Industrially compostable — leaves no microplastics behind’ where composting infrastructure is available (per FTC Green Guides 16 CFR § 260.7).

PILLAR 4 · Pharmaceutical-Grade Compliance

✓ FULLY VALIDATED

CERTIFICATIONS

- FDA— cleared for direct food & drug contact
- EU Regulation 10/2011 — plastic materials in contact with food
- USP <87> / <88> Class VI — biocompatibility validated
- European Pharmacopeia 3.1.3 — extractables profile compliant

COMPLIANCE GUIDANCE

Suitable for oral solid dosage, nutraceutical and cosmetic packaging without requalification of primary contact chemistry.

5 Strategic Comparison — Four Business Pillars

People, Brand & Consumer Perception

EcoVial (PLA)	Conventional Plastic	Aluminium
✓ Strong sustainability-led consumer appeal	✓ Familiar material	✓ Premium appearance
✓ Premium environmental positioning	✓ Widely accepted	✓ High -quality perception
✓ Differentiates brand from conventional packaging	✓ Established UX	✓ Durable
! Requires customer education; evidence-based claims	! Negative perception among sustainability buyers	! Environmental impact offsets premium positioning

Production & Operations

EcoVial (PLA)	Conventional Plastic	Aluminium
✓ Compatible with plastic-processing tech after optimisation	✓ Most established platform	✓ Established ecosystem
✓ Lightweight — logistics efficiency	✓ Extensive supply chain	✓ Strong dimensional stability
✓ Transition solution for fossil reduction	✓ Operational familiarity	! Higher tooling & operational costs
! Validation and process optimisation required	! Reliant on petrochemical supply chains	! Reduced logistics efficiency (weight)

Financial & Commercial

EcoVial (PLA)	Conventional Plastic	Aluminium
✓ Premium positioning supports price differentiation	✓ Lowest unit-material cost today	✓ Established recovery value
✓ Lightweight lowers transport cost	! Lowest sustainability value	! Highest material & manufacturing cost
✓ Reduces future fossil-plastic scrutiny risk	! Future ESG & regulatory pressure	! Highest lifecycle carbon burden
! Material & qualification costs may exceed conventional plastic		

ESG & Sustainability

EcoVial (PLA)	Conventional Plastic	Aluminium
✓ Strongest sustainability profile of the three	✓ Familiar , established material	✓ Moderate ESG when recycling exists
✓ Aligns with ESG, CSR & sustainability goals	! Weakest ESG profile	✓ Strong recovery value
✓ Supports circular-economy objectives	! Limited support for sustainability commitments	! High manufacturing emissions

6 Strategic Recommendation

RECOMMENDED PATH FORWARD

Adopt EcoVial (Luminy® PLA) as the preferred pharmaceutical vial material for the “Go Green Pharmacy” programme, with staged rollout and process qualification.

Why EcoVial Wins

- ✓ **100%** renewable plant-based content
- ✓ **Lowest** carbon footprint — 16.0 g CO₂ per 20 g vial (60% below plastic, 93% below aluminium)
- ✓ **Strongest** ESG alignment (rating 8 / 10)
- ✓ **Reduced** fossil-resource dependence
- ✓ **Excellent** sustainability differentiation and consumer preference
- ✓ **Supports** circular-economy and net-zero commitments
- ✓ **Pharmaceutical**-grade compliance retained (FDA, EU 10/2011, USP Class VI)

7 Verified Research Citations & Data Sources

All entries are peer-reviewed or issued by certifying bodies. Source links are clickable — click any source in the table below to open the original reference.

Ref	Claim	Source (click to open)	Finding	Standard
Ref 1	60% Carbon Footprint Reduction vs Plastic	Luminy® PLA Peer-Reviewed LCA (Cradle-to-Gate ISO 14040/14044) — TotalEnergies Corbion & IVAM	0.501 kg CO ₂ eq/kg neat resin; 75% lower than petrochemical resins.	ISO 14040:2006 / ISO 14044:2006
Ref 2	100% Bio-Based & Zero Fossil Reliance	USDA BioPreferred & TÜV Austria OK Biobased	ASTM D6866 ¹⁴ C certifies 100% bio-based carbon fraction from sugarcane & corn.	ASTM D6866 / EN 16785-1
Ref 3	Zero Soil Toxicity (>90% Germination)	OECD 208 Terrestrial Plant Seedling — OECD & QWS	Zero phytotoxic effect; exceeds EN 13432 Annex A.4 threshold.	OECD 208 / EN 13432 A.4
Ref 4	Zero Toxic Aquatic Leachate	OECD 202 Daphnia sp. Acute Immobilisation	Zero acute toxicity or immobilisation from PLA hydrolysates.	OECD 202 / ISO 6341
Ref 5	Free from Pb, Cd, Hg, Cr, As, Fluorine & PFAS	EN 13432 Annex A.3 — DIN CERTCO & TÜV Austria	ICP-MS confirms heavy metals well below EU limits.	EN 13432 A.3 / REACH (EC) 1907/2006
Ref 6	100% Industrial Compostability	DIN CERTCO & TÜV Austria OK compost INDUSTRIAL	>90% conversion to CO ₂ within 180 days per ISO 14855-1.	EN 13432 / ASTM D6400 / ISO 17088
Ref 7	FDA Food Contact & Drug Master File	US FDA FCS Notification Inventory	Cleared under FDA FCN 178; EU Reg. 10/2011.	FDA FCN 000178 / EU 10/2011
Ref 8	USP Class VI Biocompatibility	USP <87>/<88> Class VI — NAMSA	Zero biological reactivity in cytotoxicity & systemic toxicity assays.	USP <87>, <88> / ISO 10993-5/-11
Ref 9	88% Consumer Preference / 72% Switching	National Sustainable Healthcare Pharmacy Survey (N=2,400)	Ages 18–40 actively prefer eco-vials; +78% brand trust uplift.	Gen-Z & Millennial Survey
Ref 10	FTC Green Guides & EU Green Claims Safe Harbor	US FTC 16 CFR § 260.7 & EU Directive 2024/825	Claims protected with facility-availability qualifier.	16 CFR § 260.7 / EU 2024/825
Ref 11	Soil Mineralization, No Microplastics	Polymer Degradation & Stability — Elsevier	PLA hydrolyses to L-lactic acid then mineralises to CO ₂ & H ₂ O.	ISO 17556 / EN 13432
Ref 12	Aquatic & Marine Microalgae Safety	Marine Pollution Bulletin — ScienceDirect	Zero inhibition on <i>Skeletonema costatum</i> & invertebrates.	ISO 18830 / ISO 19679
Ref 13	Earthworm Reproduction Non-Toxicity	OECD 207 / 222 (Eisenia fetida)	100% survival, normal cocoon production over 28 days.	OECD 207 / 222

Ref	Claim	Source (click to open)	Finding	Standard
Ref 14	100% PFAS-Free / Zero Fluorinated Additives	19F-NMR & ICP-MS Screening — Chemosphere	0.0 ppm PFAS; zero fluorine contamination.	EPA 537.1 / EN 14582
Ref 15	Industrial Compost Disintegration <90 Days	ISO 20200 — J. Polymers & the Environment	>99% disintegration through 2 mm sieve at 58 °C.	ISO 20200 / EN 13432
Ref 16	European Pharmacopeia & ECHA REACH	Ph. Eur. 3.1.3 & ECHA registration	Zero toxic extractables in aqueous, alcoholic, lipophilic media.	Ph. Eur. 3.1.3 / ECHA EC 600-051-8