

# AETHIC Reef-safe sunscreen (SPF 50)

Comparative LCA against two SPF 50 sunscreen formulations that use other organic UV filters

## 1 INTRODUCTION

AETHIC's sunscreen follows a patented eco-compatible formulation (EP 2 736 482 B1). It uses three UV filters (MBBT, DHHB, EHT) and leaves out filters such as BEMT, cinnamates, benzophenones and octocrylene. It is made at Centisia (Italy) and packed in bio-based HDPE.

Goal: verify it for Water Revolution Foundation's Hub of Verified Solution. No exact commercial formulas were available, so the BAU is two formulations: Alternative 1, Gatefossé's Dry Touch City Shield SPF 50+ (10 UV filters, incl. octocrylene), and Alternative 2, the ISO 24444:2019 SPF > 50 reference.

## 2 METHODOLOGY

Functional unit. 150 mL of SPF 50 sunscreen: four whole-body applications of 35 mL, every 2 hours for 8 hours, plus about 10 mL left in the bottle.

Impact methods. EF 3.1 (16 midpoint categories). ReCiPe 2016 added for marine and terrestrial ecotoxicity and as a sensitivity check.

System boundaries. Cradle to grave, same for all three: ingredients and their transport, manufacturing (energy at the filling site), distribution, end of life of the bottle and leftover product. No cut-off criteria.

Data sources. Primary data from AETHIC and Centisia. Ecoinvent 3.11; SimaPro 10.3. BASF and Braskem did not share data. LCI for 4 of 12 UV filters from literature; proxies for the rest (e.g. DHHB for MBBT, DHBT for EHT).

Standards. ISO 14040, ISO 14044; review per ISO/TS 14071:2024 (reviewer Çisem Berkem); consistent with the PEF method. No PEFCR exists for sunscreens.

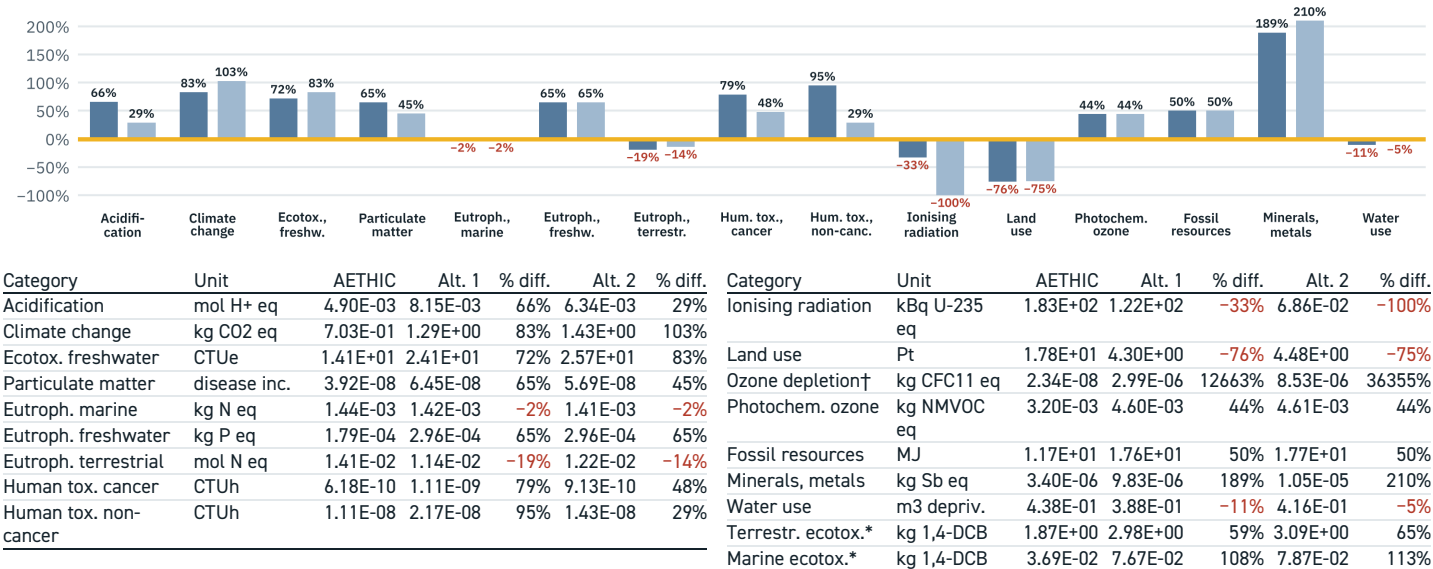
Data quality (DQR, Table 31). AETHIC: 26.7% excellent, 13.3% poor. MBBT data rated poor (5.0).

Significance. Differences of ±25% or more are treated as significant.

Not reported: exact formulas of commercial sunscreens; LCI data for MBBT and several other UV filters (proxies used); a score for UV filters released into the sea during use (LCIA methods cannot model it).

## 3 RESULTS per functional unit (150 mL)

% difference of each alternative vs AETHIC, as printed in Table 40 (positive = alternative higher)



Values from Table 40. Report Figure 11 shows the alternatives as % of AETHIC, so the printed % differences are plotted. † Left out of Figure 11 and the discussion: one chemical (polydimethylsiloxane) dominates. \* ReCiPe; excludes bio-based HDPE and hydroxyethyl cellulose, so AETHIC is underestimated.

### Monte Carlo, 1,000 runs (§5.3)

AETHIC lower than Alt. 1 / Alt. 2: climate change, acidification, photochemical ozone, PM in 100% / 100% of runs; fossils 100% / 99.9%; marine eutrophication 91.8% / 88.9%.

Unclear (near even splits): water use, human toxicity, freshwater ecotoxicity. Terrestrial eutrophication leans to Alt. 1 (AETHIC lower in 35.5% of runs).

Alternatives better: ionising radiation and land use.

### Sensitivity (§5.4)

No proxies (Table 49): results drop a lot for all three; the report says this choice matters more than the differences between products.

MBBT as octocrylene (Table 50): same trade-offs. As BEMT (Table 51): AETHIC's climate change rises 125%; the conclusions say it stays lower in six categories.

Transport ±50%: most categories stay within 90–110% for AETHIC and 85–115% for the alternatives.

### Where the impacts come from (§5.2)

All three: raw material acquisition dominates, mainly ingredient production.

AETHIC: UV filters give over 70% of climate change. Olive oil and bio-based HDPE are hotspots for acidification, water, land use and PM.

Alternatives: UV filters (notably BEMT), plus dimethicone, propylene glycol and acrylic acid.

## 4 KEY FINDINGS

Lower in 11 of 16 EF 3.1 categories against both alternatives (Table 40). Climate change: 7.03E-01 kg CO<sub>2</sub> eq per 150 mL against 1.29E+00 and 1.43E+00. Fossil resources: 11.7 MJ against 17.6 and 17.7 MJ.

Trade-offs: AETHIC is higher in land use, ionising radiation, terrestrial eutrophication and water use; marine eutrophication is about equal (–2%). Ionising radiation comes from the EHT proxy and is likely overestimated.

Robust where data are stable: the Monte Carlo runs confirm AETHIC is lower in climate change, acidification, photochemical ozone, PM and fossil use.

Not scored: the reef-safe benefit itself. The marine toxicity of UV filters washed off in use is discussed (§5.5) but not part of the LCA results.

Keep in mind: no commercial product was compared, and proxies drive much of the result. The conclusions (p. 132) give climate-change savings of 66% and about 30%.