



TemperPack

ClimaCell®



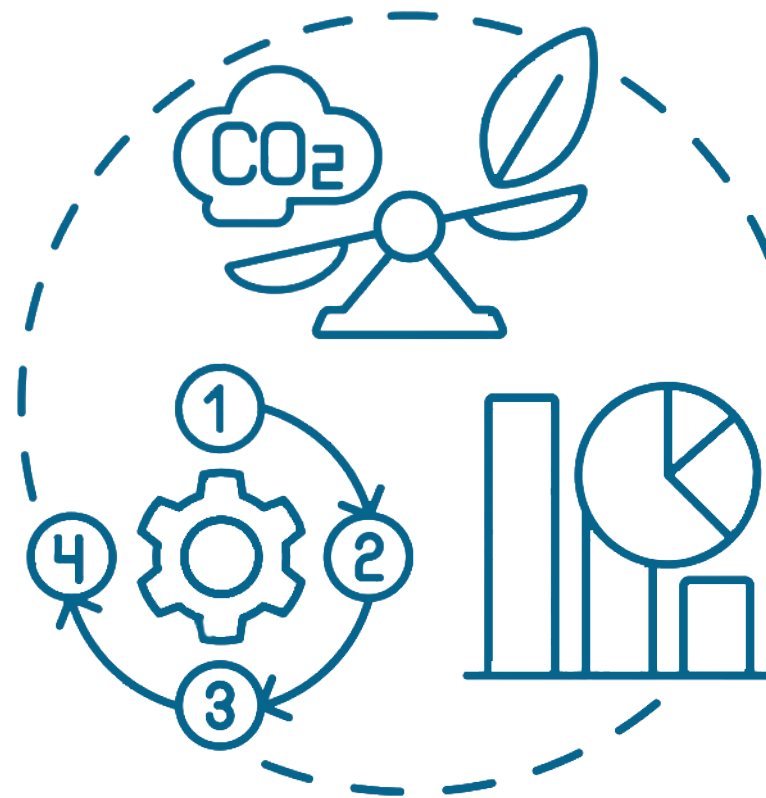
COMPARATIVE LIFE CYCLE ASSESSMENT

ClimaCell vs. EPS LCA Summary



Solving the toughest packaging problems with science and sustainability

Ever wondered how a product's journey impacts our planet from start to finish? Life Cycle Assessments (LCAs) provide a rigorous, data-backed process for measuring the full environmental impact, from raw material extraction through final disposal. LCAs help businesses understand the nature of their impact and provide insight for improving operations by breaking down energy use, emissions, and resource consumption. For companies serious about sustainability, LCAs are an essential tool for building trust with transparent, credible data and creating a roadmap for smarter, cleaner operations.



Carbon Emissions are just one type of impact. Resource Depletion is another. ClimaCell is 67% less impactful than EPS. Want to learn more? Read on.





Introduction

The rising demand for e-commerce and cold-chain logistics has significantly increased the need for reliable and sustainable packaging materials. Expanded Polystyrene Foam (EPS) has long been the industry standard for insulation in shipping perishable goods due to its thermal efficiency and cost-effectiveness. However, EPS is derived from fossil fuels, is challenging to recycle, and contributes to environmental degradation. To address this, TemperPack developed ClimaCell®, a sustainable alternative that matches EPS's performance while significantly reducing its environmental footprint.

TemperPack conducted the assessment internally and hired Long Trail Sustainability for consulting and organizing an independent review panel. They also prepared a report, following ISO 14040 and 14044 standards, to compare the environmental impacts of ClimaCell and EPS.

Based on data from our operations and 3rd party sources, this cradle-to-grave analysis examined the full lifecycle of both products, from raw material extraction to end-of-life disposal, assessing key

environmental indicators. The study measures several types of environmental impact, including Global Warming Potential, Carcinogenics, and Fossil Fuel Depletion.





Key Findings

The LCA compared one 11" x 9" x 10" box with 1.5" ClimaCell insulation to another identical box with EPS. The boxes were then compared across three main environmental endpoints and specific midpoints to gain deeper insights into individual impact categories. Endpoints are the final effects of environmental impacts on three main areas of concern: human health, ecosystem quality, and resource availability. Midpoints are specific points along the cause-effect chain of environmental impacts. They represent measurable impacts but do not yet show the consequences for humans, ecosystems, or resources.

Endpoint results

- **Human health:** ClimaCell demonstrates 47% lower damage compared to EPS. This endpoint includes impacts from greenhouse gas emissions, particulate matter, and toxic substances that harm human well-being.
- **Ecosystems:** ClimaCell has a 4% lower impact on ecosystems, encompassing biodiversity loss, habitat degradation, and waterway contamination.
- **Resource scarcity:** ClimaCell outperforms EPS with a 67% reduction in resource depletion, largely due to its reliance on renewable materials like corn starch and kraft paper.

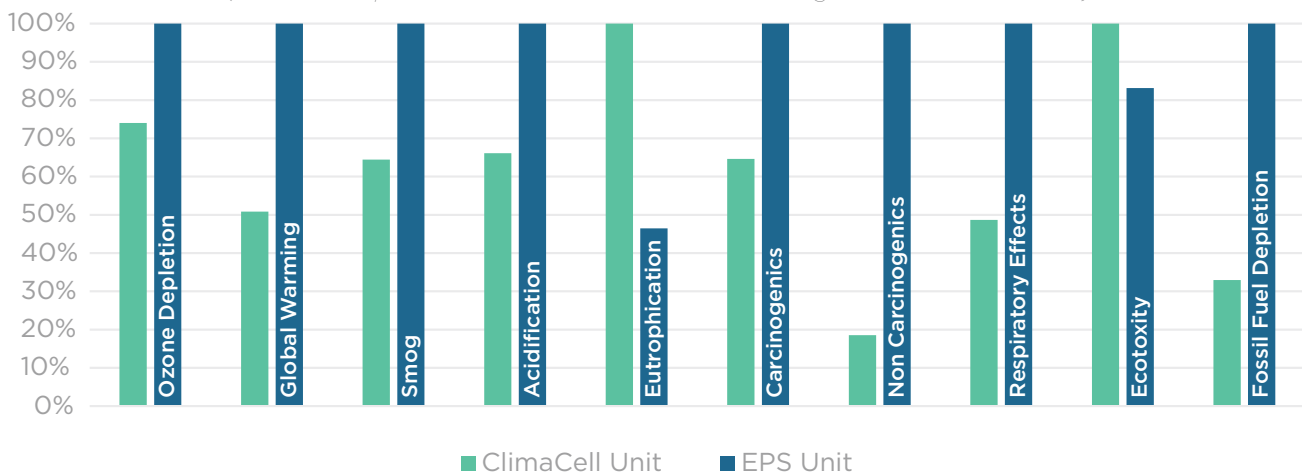
Midpoint results

- **Cumulative energy demand:** ClimaCell uses 40% less energy, reflecting its more efficient manufacturing and material sourcing.
- **Water use:** ClimaCell achieves a 15% reduction in water consumption, which is critical in regions facing water scarcity.
- **Climate change:** ClimaCell emits 42% less CO₂ equivalent compared to EPS, significantly reducing its contribution to global warming.

These findings demonstrate ClimaCell's potential to reduce environmental damage across critical sustainability metrics.

Comparing EPS and ClimaCell, TRACI Method

(Relative midpoint results of ClimaCell and EPS using the TRACI 2.1 method)





Lifecycle Overview

System boundaries

The LCA employed a cradle-to-grave framework, covering:

- **Raw material acquisition:** Includes extraction and processing of materials like corn starch for ClimaCell and polystyrene for EPS.
- **Manufacturing processes:** Assesses energy and resource inputs for production.
- **Distribution:** Examines transportation impacts from manufacturing sites to customers.
- **End-of-life disposal:** Evaluates recyclability, landfill contribution, and emissions.

Materials and manufacturing

ClimaCell is constructed primarily from renewable resources:

- **Corn starch:** Forms the insulation material, which is biodegradable and derived from plants.
- **Kraft paper:** Provides structural support and is widely recyclable.
- **Non-toxic additives:** Enhance performance while maintaining sustainability.



ClimaCell is manufactured at TemperPack's facilities in Richmond, VA, and Las Vegas, NV, using electricity and water in its extrusion and assembly processes. These facilities produce ClimaCell, ensuring process specificity and data accuracy.

EPS is made from expanded polystyrene, a plastic polymer derived from petroleum. The manufacturing process involves:

- **Foaming:** Expanding resin beads with heat and steam to form lightweight foam.
- **Molding:** Shaping foam into coolers or insulation liners using additional heat and pressure.

These processes are energy-intensive, contributing significantly to EPS's environmental footprint.





Distribution and End-of-life

Distribution

Both ClimaCell and EPS are distributed to customers in corrugated shipping boxes. The transportation impacts for both materials were modeled using weighted averages based on distance and shipping data, with a consistent methodology to ensure comparability.

End-of-life scenarios

- **ClimaCell:** Designed to integrate with standard corrugated recycling streams, achieving an estimated 92% recycling rate in the U.S. and is certified by How2Recycle® as widely recyclable.
- **EPS:** Recycling options for EPS are limited, and it is rarely accepted in curbside recycling programs. Most EPS ends up in landfills or is incinerated, contributing to greenhouse gas emissions and resource depletion.





Process Contributions to Environmental Impact

The primary contributors to ClimaCell's environmental footprint are:

- **Corrugated shipping box:** Significant for both water use and ecosystem impact.
- **Corn starch insulation:** Drives energy use and emissions, primarily due to agricultural processes.
- **Manufacturing energy:** Electricity and water usage, although less impactful than raw materials.

EPS's major impact drivers include:

- **Polystyrene production:** Accounts for over half of the total energy demand and emissions due to its reliance on petroleum.
- **Foaming and molding:** These energy-intensive processes contribute significantly to its overall footprint.
- **End-of-life disposal:** Evaluates impact and emissions from recycling, landfilling, or incineration of packaging waste.





Comparative Analysis: ClimaCell vs. EPS

When directly compared, ClimaCell outperforms EPS across most environmental metrics.

- **Energy efficiency:** ClimaCell's production requires 40% less energy than EPS, largely due to its use of renewable materials.
- **Water conservation:** ClimaCell's water use is 15% lower, with reductions stemming from both manufacturing and material sourcing.
- **Carbon footprint:** ClimaCell reduces CO2 emissions by 42%.
- **Human health:** There is a 47% lower associated damage to human health when using ClimaCell.

We recognize that in the areas of Eutrophication and Ecotoxicity, based on our existing operations and supply chains, ClimaCell has greater impact than EPS. The biggest drivers of both metrics are the agricultural processes associated with corn production. We're always looking for ways to improve, including exploring raw materials supply sources and processes.

Sensitivity and uncertainty analysis

To validate the findings, the study included sensitivity and uncertainty analyses:

- **Recycling rates:** Varying ClimaCell's recycling rates from 0% to 92% confirmed its environmental superiority over EPS under all scenarios.
- **Methodology variations:** Using alternative impact assessment methods, such as TRACI, consistently showed ClimaCell's lower impact, reinforcing the robustness of the results.



Switching from EPS to ClimaCell is a meaningful step toward meeting your goals and meeting the needs of your customers, employees, and the planet.

Conclusion

Compared to EPS, ClimaCell significantly reduces impact to environment.

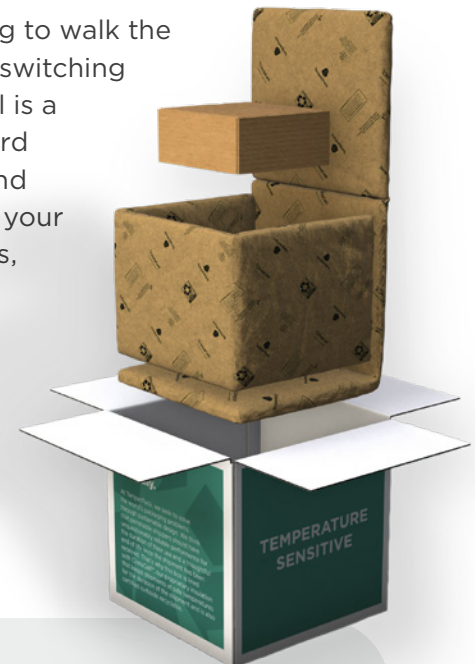
By choosing ClimaCell over traditional packaging, companies can dramatically reduce their harm to human health and ecosystems, all while meeting the growing customer demand for truly sustainable solutions.

Benefits for our customers

By transitioning to ClimaCell, customers gain several benefits:

- **Lower environmental footprint:** Customers contribute to a significant reduction in greenhouse gas emissions, resource use, and water consumption.
- **Support for sustainability goals:** ClimaCell aligns with corporate Environmental, Social, and Governance (ESG) priorities, including reducing climate risk.
- **Brand enhancement:** Using ClimaCell demonstrates a commitment to sustainability, which resonates with eco-conscious consumers and stakeholders.

For businesses looking to walk the talk on sustainability, switching from EPS to ClimaCell is a meaningful step toward meeting your goals and meeting the needs of your customers, employees, and the planet.



Request More Information

If you would like a copy of the full 86-page LCA with references and appendices, please get in touch with your account representative.

