



Life Cycle Assessment

MonoSol
A Kuraray Company



a future without waste

At MonoSol,
we envision a future without
waste. This goes beyond
material waste; it includes
saving time, energy, natural
resources and human
potential. Every action we
take is geared towards our
mission of creating innovative
products that simplify life,
enhance safety and promote
sustainability.



Life Cycle Assessment (LCA)

1

What is a LCA?

LCA or Life cycle assessment is a process of evaluating a product's environmental impact throughout its life cycle.

2

What is a CO₂ footprint?

A carbon footprint is the amount of greenhouse gases – primarily carbon dioxide – released into the atmosphere by process activities involved in the life cycle of the product. It is measured as tons of CO₂ emitted per year / per ton of product. It is a number that can be supplemented by tons of CO₂ - equivalent gases, including methane, nitrous oxide and other greenhouse gases.

3

Cradle to gate

LCA evaluation is defined by boundaries and in this case it is from raw material extraction (cradle) to the downstream production site for specific applications i.e. detergent packet production (gate).

This includes all production steps, from the production of raw materials and chemical precursors to energy production and consumption, transportation, and processing.

4

Why do we have a life cycle assessment?

In the typical carbon footprint of a detergent packet, the water-soluble film is responsible for a very small percentage of the greenhouse gas emissions. Yet it is important to generate primary data for this portion so as to enable our customers to accurately determine the actual impact from this contribution and thereby to develop plans to improve on this looking forward.

Without primary data, the data quality index of this contribution would be much lower as the typical values in LCA databases will not have the granularity and specificity that we have achieved through this assessment. With the calculation of our LCA, we want to make a further contribution to making our product more sustainable in the multitude of its applications.

5

Blown film vs Cast film

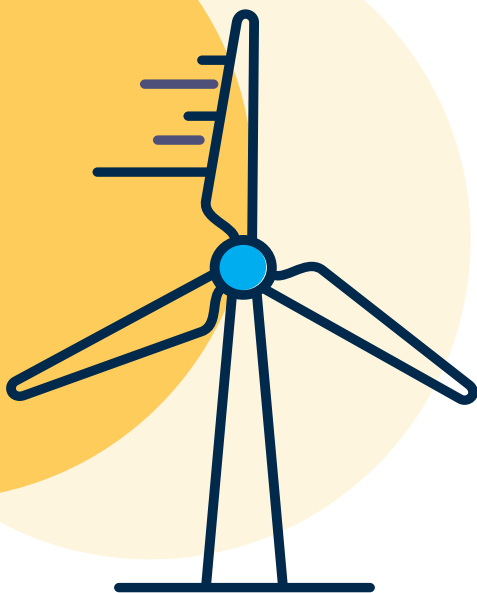
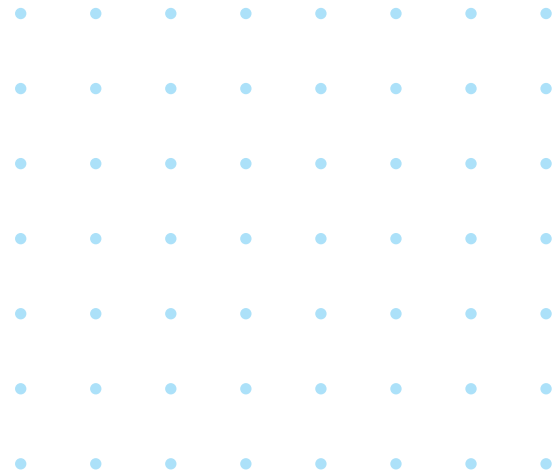
MonoSol uses two different processes for production of water-soluble film: a solution casting process and a blown-extrusion process. Each of these processes have numerous unique aspects to consider during a LCA study including raw materials inputs, energy inputs, and production location. MonoSol has completed two separate studies based on the processes and consequently generated the primary data on the films produced using each of these processes.

Our Sustainability Activities

Sourcing

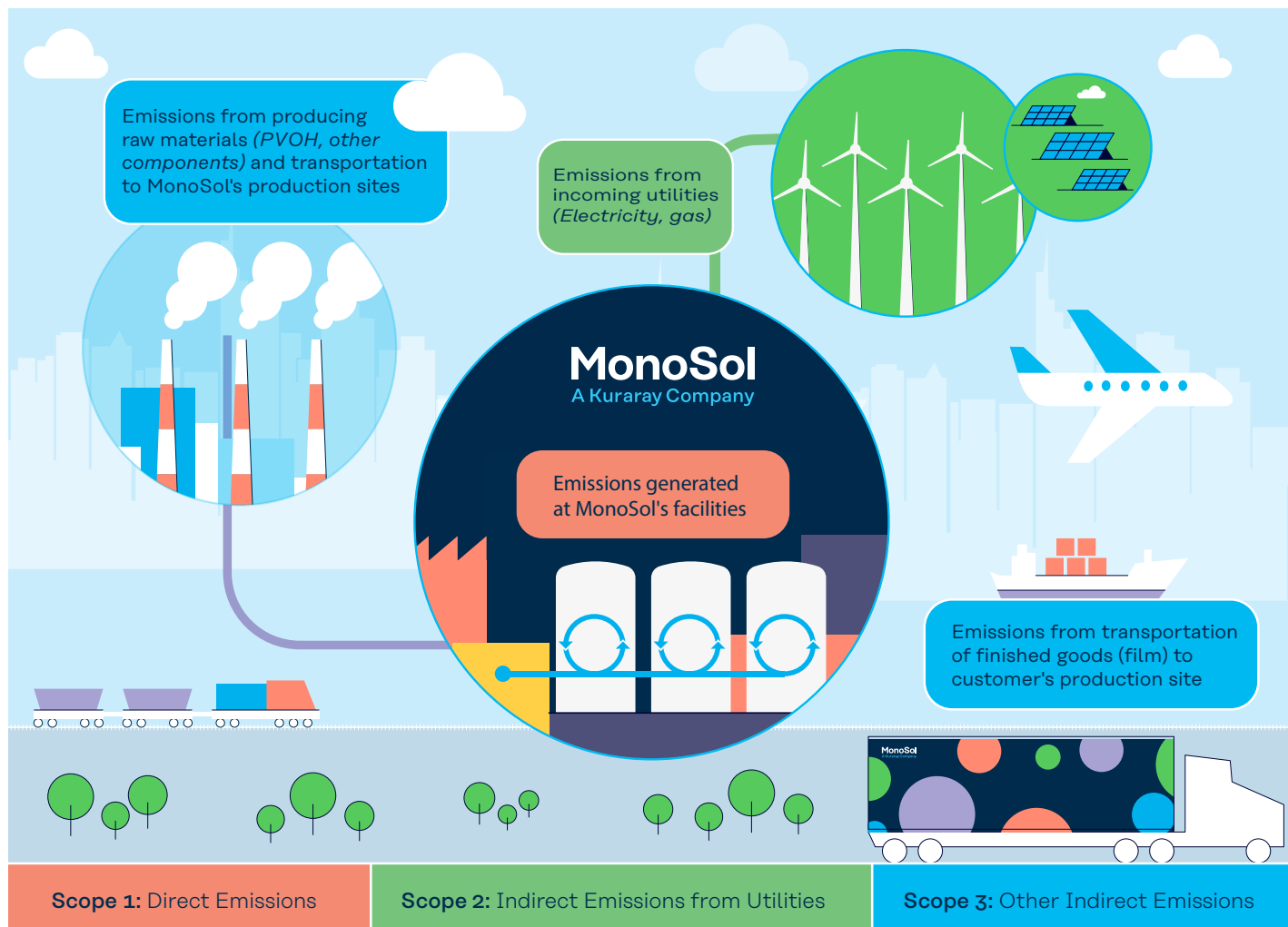
MonoSol follows Kuraray's global sustainability procurement guidelines in sourcing for all our raw materials which encourage supplier-led greenhouse gas emission reduction initiatives and goals.

Additionally, because of our direct relationship with Kuraray POVAL PVOH division, we have close engagement on upstream sustainability projects on resin emissions reduction efforts.

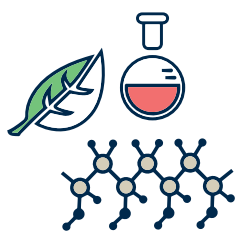


Energy

In 2022, MonoSol switched all of the electricity used in our facilities to 100% renewable sourced leading to an 11% reduction in our carbon footprint for the cast film. (Blown film has used renewable electricity since 2013). We are gradually shifting to renewable natural gas that will positively impact our scope 2 emissions. MonoSol is driving energy-saving projects in our production operations that are targeting our Scope 1 emissions.



Sustainability is *built into* our technology



Beginning of life

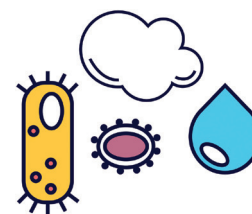
We are maximizing the percentage of bio-based materials in our products and assessing and optimizing across the value chain for sustainable opportunities.



In use

Our materials facilitate sustainability with the consumers:

- **Reduced waste** (avoiding overdosing)
- **Safe handling of chemistry** that enables cold-wash cycles
- **Compaction reduces** transportation costs and CO₂ emissions

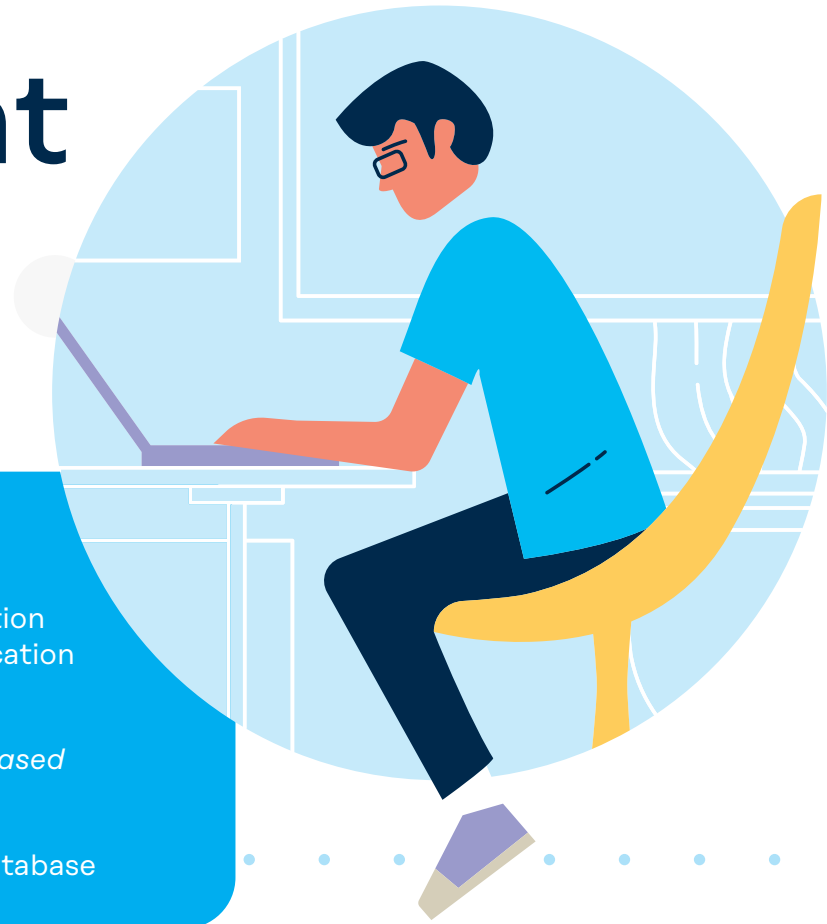


End of life

Our products have an excellent and proven end-of-life story as they biodegrade rapidly, leaving behind nothing but CO₂ and water.

Life Cycle Assessment

Data and Scope



Cast Film

- i. Calculated in 2022 based on production data from 2020 in our production location in Indiana, USA
- ii. Cradle-to-gate (*distribution center based in mainland EU*)
- iii. Secondary data is from Ecoinvent database

Blown Film

- i. Calculated in 2023 based on production data from 2022 in our production location in Hartlebury, UK
- ii. Cradle-to-gate (*distribution center based in mainland EU*)
- iii. Secondary data is from Ecoinvent database



CO₂ Footprint

Cast
Film

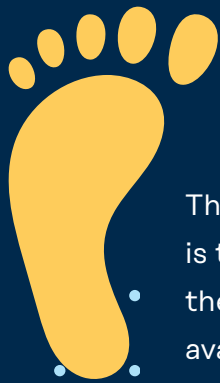
4.47

kg eq. Per kg of film
(Global warming potential
GWP100a)

Blown
Film

2.97

kg eq. Per kg of film
(Global warming potential
GWP100a)



The carbon footprint of our PVOH film is the most accurate primary value for these types of films; the typical values available in LCA databases unfortunately use the value for the PVOH resin as a proxy for the film, drastically reducing the data quality index.



MonoSol's direct relationship with Kuraray's PVOH resin business enables access to high quality primary data on the resin component of the film, thus enhancing the data quality index of the generated LCA. This enables direct engagement on emission reduction activities on the PVOH resin that consequently have a positive impact on scope 3 emissions.

**The smaller
our footprint,
the better
yours!**





MonoSol

A Kuraray Company

Adding value
to your products
– worldwide

Please contact us to discuss
how our sustainability efforts
and yours can work together.

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MonoSol is a global materials science company specializing in water-soluble biodegradable film technology. We are part of Kuraray Group, a leading specialty chemical company. Our sustainable PVOH technology has significantly impacted product categories such as detergents, healthcare, home care and agriculture.

MonoSol is committed to creating **simpler, safer** and **more sustainable** industry solutions by harnessing the power of biodegradable water-soluble film technology. This innovative approach allows our products to disappear after use, promoting sustainability and harmony with nature.

With a manufacturing and technical footprint spanning the globe, MonoSol possesses the reach and expertise required to partner with customers through every step of the product transformation process, from concept and scale-up to commercial launch.

Through continuous exploration and pushing boundaries, MonoSol aims to challenge its employees and customers to redefine what is achievable.