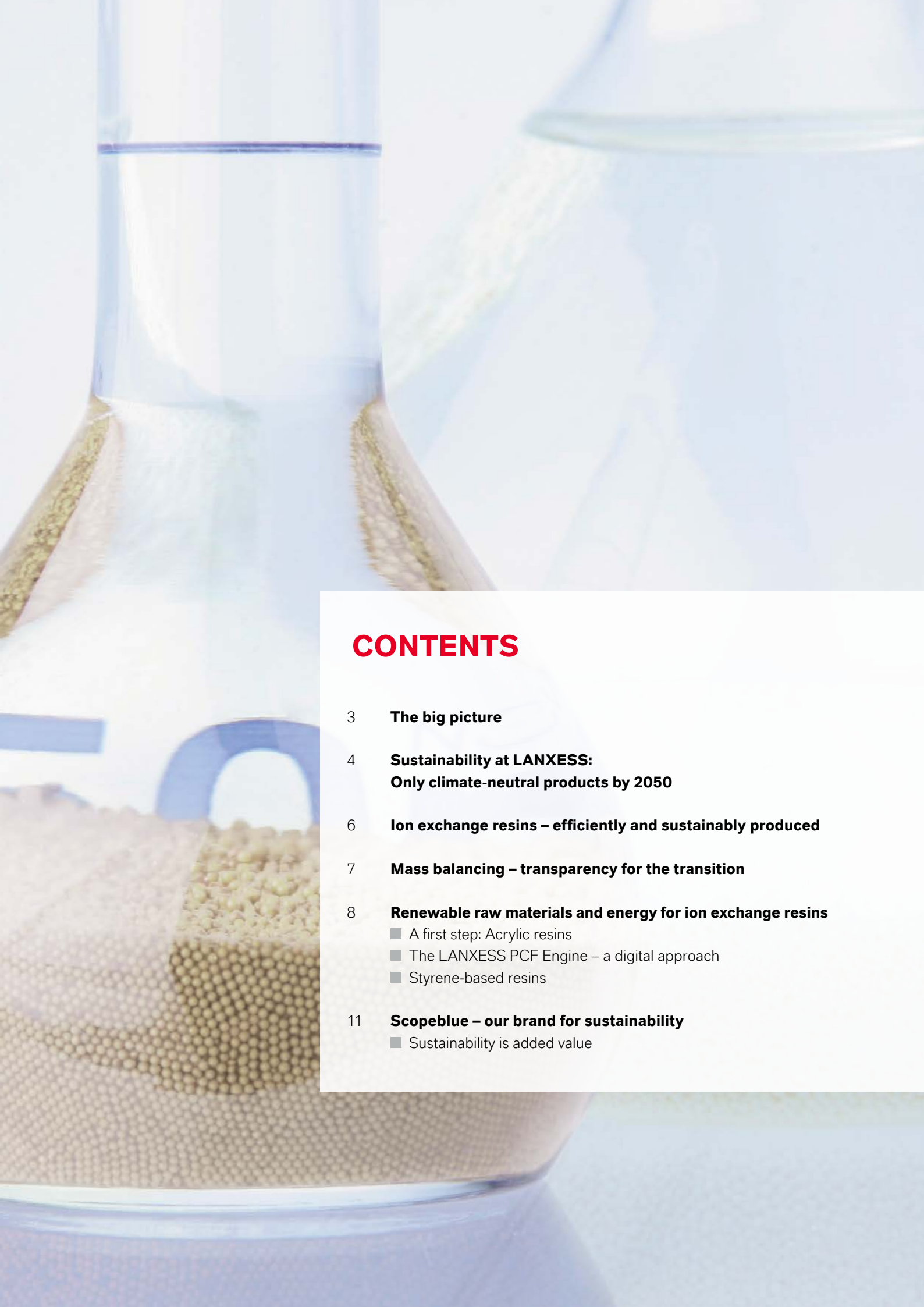
QUALITY SUSTAINS.

Sustainably produced ion exchangers –
small, climate-friendly resin beads

Lewatit® Scopeblue

QUALITY WORKS.

LANXESS Energizing Chemistry



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THE BIG PICTURE

Lewatit® Scopeblue

Sustainability is the greatest challenge of our times. The guiding principle behind the UN's 2030 Agenda for Sustainable Development, which was adopted in 2015, is to both ensure a decent existence for humans all over the world and to protect our planet's natural resources. The 17 individual goals encompass a range of economic, environmental, and social aspects. Responsibility for achieving these goals is shared among politicians, industry, science, society, and each of us as individuals.

The European Green Deal explicitly states that climate change and environmental destruction are existential threats to Europe and the rest of the world. The declared aim is to achieve a resource-efficient and competitive economy in which net emissions of greenhouse gases (GHG) are reduced to zero by 2050, growth is decoupled from the utilization of resources, and no person or region is left behind.

For industry, sustainability is becoming an increasingly important competitive factor and, in turn, a key driver of the transition towards a bio-based/circular economy.

Six environmental objectives

- Climate change mitigation[1]
- Climate change adaptation[2]
- Sustainable use and protection of water and marine resources
- Transition to a circular economy
- Pollution prevention and control
- Protection and restoration of biodiversity and ecosystems

[1] Net zero by 2050, 60% reduction by 2030 (currently under review by the EU).
[2] Build capacity and increase resilience.

Three basic guiding strategies for achieving greater sustainability have been defined:

- **Efficiency:** The more efficient utilization of materials and energy
- **Consistency:** Eco-friendly material cycles (circular economy), extensive recycling, and waste avoidance
- **Sufficiency:** Reduced production and consumption

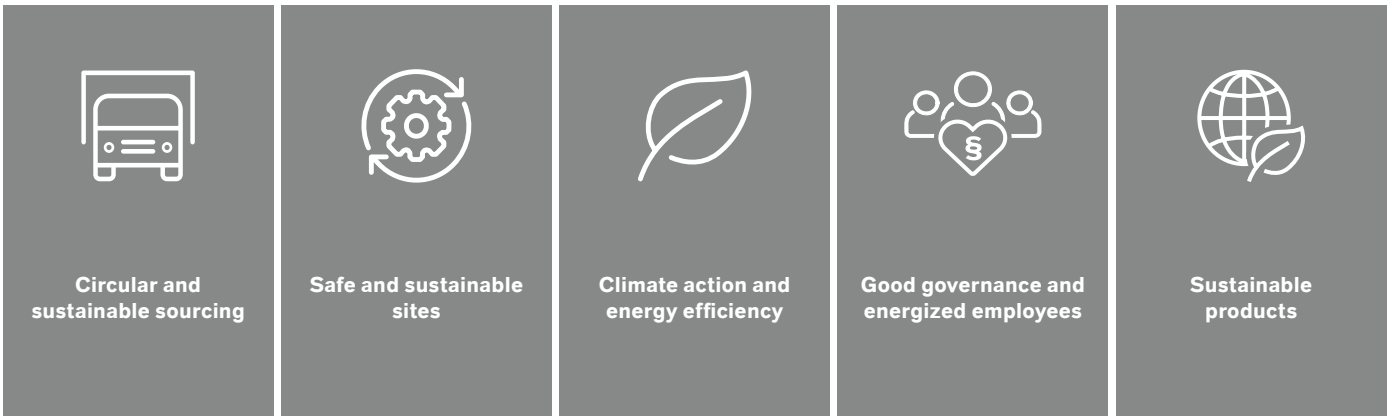
Goals of the UN's 2030 Agenda for Sustainable Development

SUSTAINABILITY AT LANXESS:
ONLY CLIMATE-NEUTRAL PRODUCTS BY 2050

All over the world, the concept of sustainable industrial production has never received more attention than it does today. Industrial production – including energy and heat consumption – currently accounts for around 40% of global GHG emissions. The production of raw materials such as steel, aluminum, plastics, and cement, which are also being used in ever greater quantities, has a significant share in this figure.

In light of its high resource and energy requirements and its global value chains, the industrial sector bears a special responsibility toward the environment – and also possesses important levers for making our future more sustainable and environmentally friendly. LANXESS is aware of this responsibility and has set itself some ambitious targets.

Sustainability targets at LANXESS



Climate protection is one of LANXESS' primary objectives. To ensure that global warming can be limited to 1.5°C in line with the targets set at the United Nations Climate Change Conference in Paris, emissions have to be reduced across the value chains – those include direct emissions from our own production facilities (scope 1), indirect emissions associated with the energy we use (scope 2), and emissions associated with raw materials and services such as logistics (scope 3).

Back in 2019, LANXESS formulated a clear strategy for scopes 1 and 2:

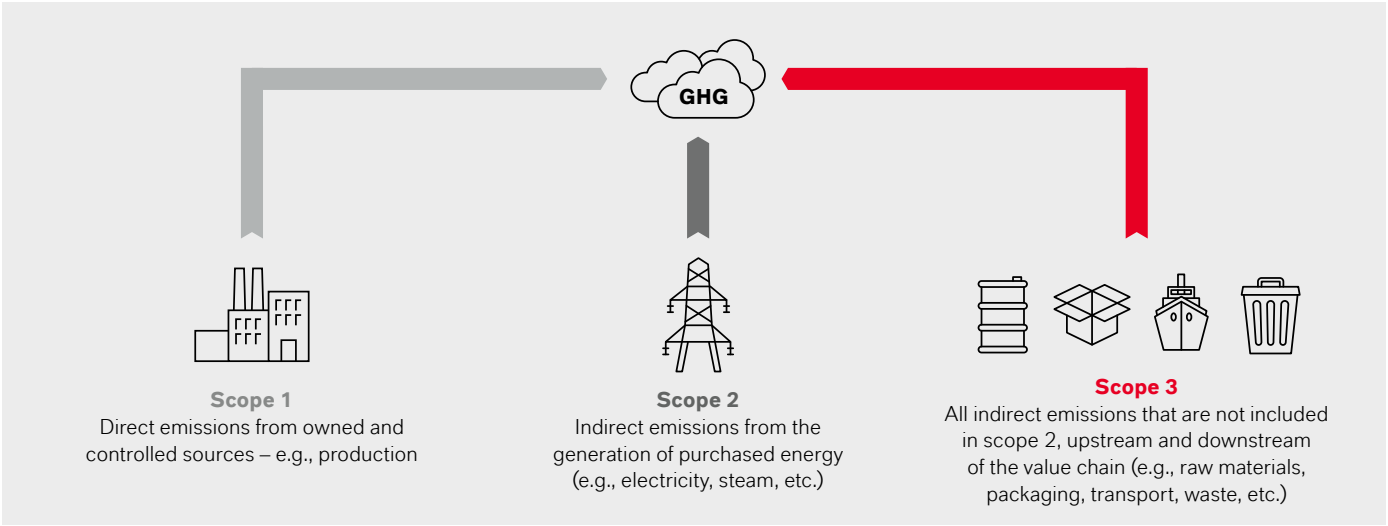
- Continuous reduction of GHG emissions by 50% by 2030 (compared with 2018)
- Continuous improvement of energy efficiency
- Decoupling of growth and emissions
- Climate neutrality by 2040

This year, LANXESS has also set itself a range of targets for the reduction of its scope 3 emissions that will be implemented in collaboration with its partners in upstream and downstream supply chains:

- Continuous and significant reduction of GHG emissions by 40% by 2030 (compared with 2015)
- Climate neutrality with respect to raw materials, logistics, and products by 2050 (net zero value chain)

In addition, the prudent and responsible use of water – especially in those areas suffering from water scarcity – is extremely important to LANXESS.

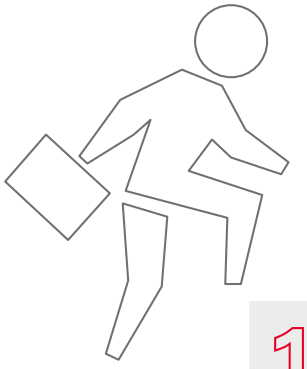
Emissions along the value chain of products manufactured by the specialty chemicals company LANXESS



Production processes (step 1, see figure below) that are as energy- and resource-efficient as possible are essential if we are to achieve our targets. Climate-neutral/circular products (step 2) also play a vital role. Bio-based – i.e., renewable – raw materials, renewable sources of energy, and/or circular materials are used in their manufacturing. The latter are obtained through the recycling or usage of wastes.

LANXESS' aim by 2050 is to carry only climate-neutral products in its portfolio. In addition, the products themselves can help to avoid emissions and close material cycles (step 3). Examples include high-performance materials for lightweight construction as well as battery components and chemicals for e-mobility.

Industrial products and their contribution to sustainability



3 **Products for climate protection and the circular economy**
Solutions that enable sustainable concepts

2 **Climate-neutral and circular products**
Carbon footprint, sustainable raw materials, recyclability

1 **Safe and sustainable products**
Portfolio optimization through the LANXESS Product Sustainability Monitor

ION EXCHANGE RESINS – EFFICIENTLY AND SUSTAINABLY PRODUCED

Ion exchange resins play a key role in water treatment and purification systems – whether for drinking water, service water, or wastewater. LANXESS has long been committed to the sustainable production of ion exchange resins. The prudent and efficient use of raw materials and energy is essential, not only from an economic point of view.

For example, freshly produced resin beads are separated into fractions based on their particle size by backwashing them with huge amounts of water. The water used for this classification process is filtered, collected, supplemented with fresh water, if necessary, and then reused in the same process.

LANXESS produces Lewatit® ion exchange resins at its site in Jhagadia, India, among other things. Industrial wastewater from the plant is treated using state-of-the-art technology and reused for cooling/irrigation, which reduces the water stress in the region. Jhagadia is one of four production sites where LANXESS plans to reduce total water withdrawals by 15% by 2023. Since mid-2020, the same site has been burning ground renewable raw materials such as nutshell and sawdust briquettes to generate steam and, as a result, has since reduced the consumption of fossil-based energy sources such as natural gas and coal by more than half. In the coming years, the site plans to switch completely to biomass and solar energy.

Since 2022, LANXESS has used renewable raw materials in its ion exchange resin production in Leverkusen. This represents a major technical, organizational, and regulatory challenge, but LANXESS has nonetheless succeeded in introducing its first bio-based products to the market.

In fact, sustainability already comes "as standard" with ion exchangers – whether for improved water quality through the removal of pollutants in the production of food and medicines or the extraction of metals for electric vehicle batteries. Ion exchange resins help to produce ultra-pure water, which is a prerequisite for the manufacturing of microelectronics components and solar panels – both indispensable in the generation of renewable energy and its storage. Some resins can even absorb carbon dioxide from the air by direct air capture to reduce the concentration of this GHG in the atmosphere. This small set of examples demonstrates the many and important ways in which ion exchangers contribute to sustainable development in our economies.

Ion exchange resins offer major potential for improving sustainability

Water quality	Customization in pharma and food	E-mobility	Microelectronics and semiconductors	Climate change mitigation

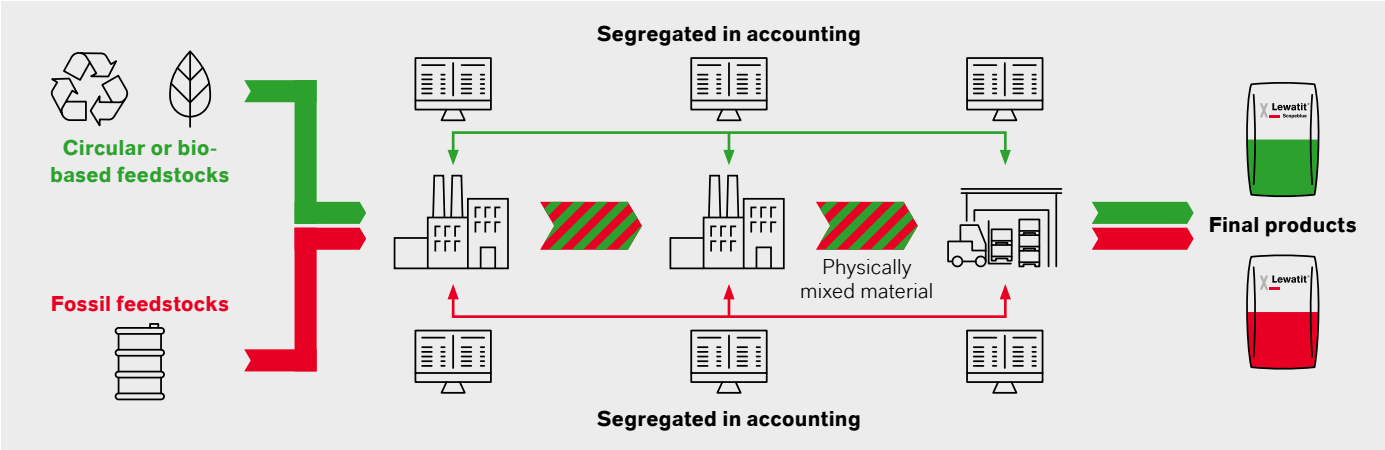
MASS BALANCING – TRANSPARENCY FOR THE TRANSITION

Lewatit® Scopeblue

Until all raw materials are available in sufficient quantities from bio-based/circular sources, mass balancing offers a pragmatic solution for disclosing the extent to which our production is sustainable. Mass-balanced products save fossil resources and generate measurably fewer GHG emissions, but are identical to conventional products in terms of the manufacturing process and quality. The most important criterion for their production is that only eco-friendly biomass and recycled materials are used at the beginning of the value chain.

Raw materials and precursors that are proven to be bio-based/circular in origin are deployed in the manufacture of mass-balanced products. These are calculated and allocated to specific products – according to their individual formulation and under consideration of all yields and losses. This method allows renewable raw materials to be integrated in existing production and supply chains.

Mass balancing creates transparency during the transition towards a sustainable economy.



Mass-balanced products are the result of four steps:

- Sustainable raw materials are procured.
- Production takes place in existing plants according to established procedures.
- The quantities of feedstock, intermediates, and end products are recorded.
- The sustainable raw materials used are allocated to selected products by means of a special accounting method. For a specific quantity of product defined as sustainable, evidence must be provided demonstrating that a corresponding quantity of sustainable raw materials has been processed.

The sustainability assessment of raw materials and products is based on product carbon footprints (PCFs) that are calculated by LANXESS.

Transparent + certified = credible

Independent organizations that review and certify not only the organizational situation at the production sites but also the correct quantity allocation to explicitly declared mass-balanced products ensure the accuracy, transparency, and, in turn, credibility of the mass balance. At LANXESS, certification takes place as part of the International Sustainability & Carbon Certification (ISCC) system in accordance with ISCC PLUS standards. This certification focuses on food and animal feed as well as technical and chemical applications in all non-regulated markets and across entire value chains.

Ion exchange resin production at the Leverkusen site in Germany has been ISCC PLUS-certified since January 2022. In January 2024, LANXESS also received ISCC PLUS certification for the Bitterfeld site, where ion exchange resins are also produced.

RENEWABLE RAW MATERIALS AND ENERGY FOR ION EXCHANGE RESINS

Synthetic ion exchange resins usually take the form of functionalized, cross-linked polyacrylates or polystyrenes. The monomers acrylonitrile and styrene, from which the polymers are primarily formed, constitute the majority of the mass and thus have a major impact on the carbon footprint of the resin. These monomers account for more than 50% of the dry mass of many resins. For these monomers, LANXESS has succeeded in finding supply sources based on renewable raw materials and concluded the appropriate agreements.

A first step: Acrylic resins

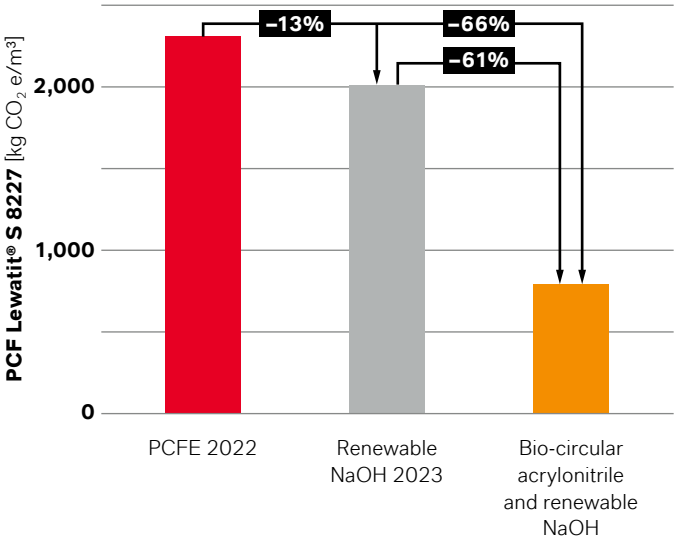
Acrylonitrile can be obtained in a mass-balanced manner from tall oil, a by-product of pulp production in the paper industry. Propene is initially formed, which, in conjunction with ammonia produced using "green" hydrogen, is converted to acrylonitrile. This monomer is available in large quantities and currently used for producing weak acidic cation (WAC) exchange resins.

In the mass balance method, it is currently allocated to the three ISCC PLUS-certified resin types Lewatit® S 8227, S 8229, and CNP P. For the carbon footprint of these WAC resins, which, according to the ISCC, are defined as "bio-circular," calculations show that GHG emissions are reduced by 60% compared with resins manufactured in 2023 with acrylonitrile from conventional fossil sources. Depending on the manufacturer and batch, the PCF of the raw materials can fluctuate – sometimes significantly – which means that such sustainability balances do not represent product constants.

In addition to raw materials, renewable sources of energy contribute to a product's carbon footprint and, in turn, its sustainability. In the case of ion exchange resins, this applies to, for example, caustic soda that is obtained from electrolysis and required in the production of many resins.

Thanks to a special partnership at the Verbund site in Leverkusen, we use caustic soda obtained by means of electricity from a hydroelectric power station on the river Rhine in Germany. This improves the sustainability of not only the aforementioned WAC resins, but also many other resins produced in Leverkusen.

Influence of biomass-balanced acrylonitrile and/or "green" (renewable) caustic soda on the product carbon footprint (PCF) of Lewatit® S 8227



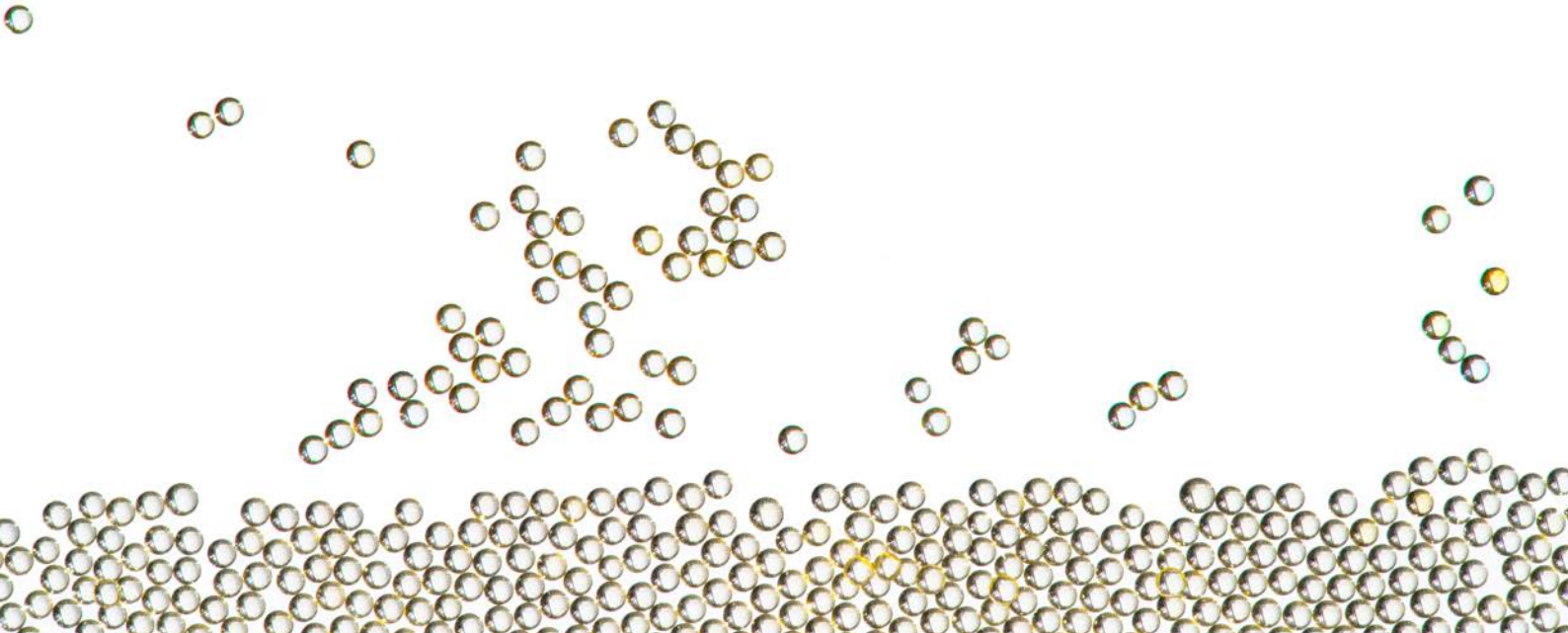
Source: LANXESS calculations based on the Product Carbon Footprint Engine (PCFE) including biogenic carbon restoration (2022; "cradle-to-gate")

The GHG emissions associated with Lewatit® S 8227 in 2023 have been reduced by 13% simply through the use of "green" caustic soda. Using bio-circular acrylonitrile further cuts the emissions by 61%, resulting in an overall reduction of 66% compared to the previous year 2022.

For WAC resins, the carbon footprint of the monomer and the saponification reagent caustic soda are the most important levers for cutting GHG emissions. One reason why this effect is so strong is because the synthesis sequence is relatively short, and only a few other – currently still fossil-based – raw and auxiliary materials need to be used.

The LANXESS PCF Engine – a digital approach

LANXESS has developed a tool that automatically calculates the carbon footprint for the Group's products. The Product Carbon Footprint Engine uses existing data from various business units and calculates the emissions generated using a cradle-to-gate approach. This includes greenhouse gas emissions during production, product-specific emissions related to raw materials, energy, operating materials, and transport, and emissions from waste disposal. The tool has been certified by TÜV Rheinland in accordance with ISO 14067 standards for quantifying the carbon footprint of products. With the Product Carbon Footprint Engine, we want to help our customers achieve their sustainability goals. The data pool used to calculate the carbon footprint is constantly being improved. Thus, in the future, emissions can also be calculated for products for which sufficiently qualified data is not yet available.



Styrene-based resins

Styrene – the other main monomer used in the production of ion exchange resins – can also be obtained from renewable raw materials such as tall oil in accordance with the mass balance method. LANXESS possesses industrial-scale quantities of bio-based styrene, which can be used to produce certain resins.

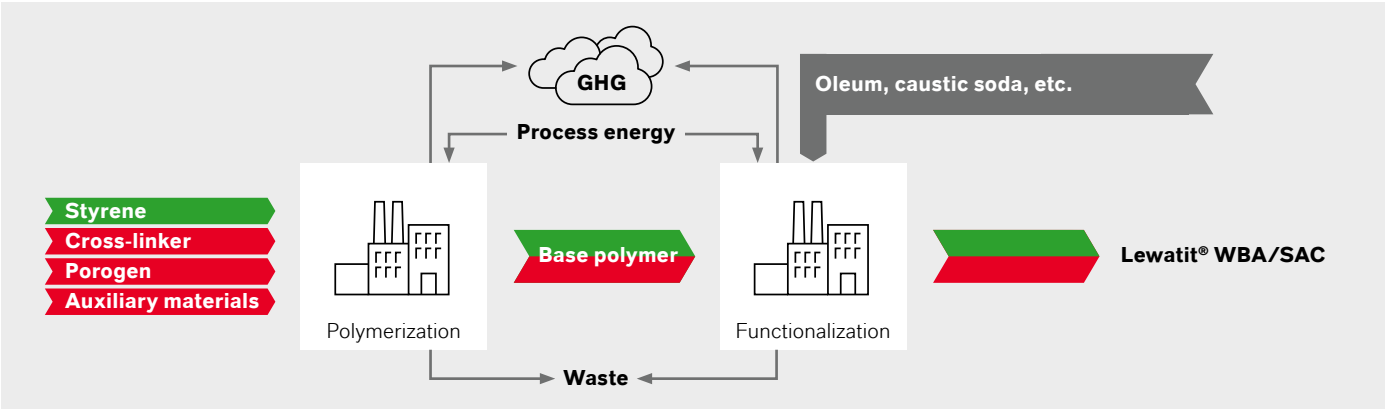
In January 2024, our ion exchange resin production plant in Bitterfeld, Germany, received ISCC PLUS certification. Now we can also produce our Lewatit® S 1567 as the first strongly acidic cation exchange resin (SAC) with biocircular styrene from tall oil using the mass balance approach. This replaces more than 90% of fossil raw materials with the bio-based styrene, resulting in a 76% reduction in greenhouse gas emissions compared to 2022 using conventional styrene.

In addition, with Lewatit® MP 62 WS and Lewatit® S 4528 we are offering two weak base anion (WBA) exchange resins. The latter is used as a free base for removing acids and also decolorizing, for example, sugar solutions, gelatin, glycerin, and whey. Lewatit® MP 62 WS is used for decontaminating ground and surface water, recovering precious metals, and neutralizing organic process flows.

With WBA exchange resins, the functionalization of the base polymer requires multiple steps involving a range of reagents and auxiliary materials, which is why the sustainability effect of this fully bio-circular monomer becomes "diluted" during synthesis with reaction partners and auxiliary materials from fossil-based sources. Even when fully bio-based styrene is used, the sustainability component of the WBA resins currently lies at just a little over 20%. This figure could be improved, however, if other solvents, reagents, and auxiliary materials such as ammonia and amines that are currently obtained from conventional, fossil-based sources can be produced from biogenic or recycled sources in the future.

Styrene can be derived from tall oil, a by-product of pulp production from conifers.

Production process for styrene-based ion exchange resins based on sustainable and conventional raw materials and additives



SCOPEBLUE – OUR BRAND FOR SUSTAINABILITY

Given the growing awareness of the need for and urgency of climate protection, there is an argument to be made for the production of ion exchange resins with a low carbon footprint and a high level of sustainability.

To render this benefit transparent for direct and end customers, LANXESS has launched its own umbrella brand for products demonstrating outstanding sustainability: Scopeblue.

With a share of renewable raw materials far in excess of 90% and a PCF reduction of more than 50%, the four ISCC PLUS-certified WAC and SAC resins actually fulfill both Scopeblue requirements.

Although our WBA resins do not yet meet the very high targets we have set for ourselves, every percentage gain in sustainability and every metric ton of GHG emissions avoided are steps in the right direction. This is why LANXESS adds the prefix "Eco" to these resins, to indicate that sustainable, bio-based, or recycled raw materials were used in their production.

Scopeblue defines two very strict requirements:

- More than 50% by mass of sustainable raw materials or
- More than 50% lower PCF relative to the standard product

Share of renewable raw materials in the resins of the Scopeblue and Eco range

Product name	Resin type	Sustainable raw material	Sustainability share (%)	GHG savings[4] (%)
Lewatit® S 8227 Scopeblue	WAC[1]	Acrylonitrile	>90	61
Lewatit® CNP P Scopeblue	WAC[1]	Acrylonitrile	>90	60
Lewatit® S 8229 Scopeblue	WAC[1]	Acrylonitrile	>90	61
Lewatit® S 1567 Scopeblue	SAC[2]	Styrene	>90	76
Lewatit® S 4528 Eco	WBA[3]	Styrene	>20	23
Lewatit® MP 62 WS Eco	WBA[3]	Styrene	>20	24

[1] WAC = weakly acidic cation exchange resin.
[2] SAC = strongly acidic cation exchange resin.
[3] WBA = weakly basic anion exchange resin.
[4] GHG savings compared to standard Lewatit® based on a fossil monomer (acrylonitrile/styrene).

Sustainability is added value

An important application for WAC resins is the production of cartridges for water filters, which are used mainly for creating decarbonized water in the preparation of hot drinks such as coffee and tea. These filters are used both at home and commercially. The ion exchange resin accounts for the biggest proportion of the mass of these cartridges.

Another key application for our Lewatit® S 1567 Scopeblue, an SAC resin in sodium form, is the softening of drinking water, both in industrial systems and in filter cartridges. Here too, the ion exchange resin accounts for the vast majority of the mass of such cartridges.

The high level of sustainability of the WAC resins from the Scopeblue product range therefore has a major impact on the sustainability balance of consumer-oriented end products such as the aforementioned cartridges. This product range makes the production processes and products of our customers more eco-friendly and can be leveraged as a competitive advantage or specially highlighted and advertised as offering added value.

The WBA resins Lewatit® MP 62 WS and Lewatit® S 4528 from the Eco series can also help our customers to achieve their sustainability targets – in wastewater treatment, for example, or in the chemical or food industries.

LANXESS is planning to have further resins certified to meet ISCC PLUS standards and included in the Scopeblue/Eco product range.

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