FNa 6635

Material texts

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General description

The FNa 6635 features 100 % recycled steel in its doors and sidewalls, resulting in 80% less CO2 emissions during production compared to conventional steel. We've replaced traditional PVC with TPE for the door gasket, ensuring durability and better recyclability. The insulation foam and inner lining contain recycled or bio-based materials, which are incorporated through mass balancing and reduce environmental impact while maintaining the same performance. Also, we've reduced the ecological footprint of our packaging, without compromising on transportation safety.

TPE door gasket – short description

The thermoplastic elastomer (TPE) used for the door gasket combines optimal functionality with durability and good recyclability. TPE is compatible with other plastic materials in the recycling process, allowing for higher efficiency in its execution.

TPE door gasket – Deep Dive

Thermoplastic elastomers (TPE) have proven their worth since the 1970s in many applications previously dominated by conventional elastomers (rubber) or soft PVC. Unlike soft PVC, which obtains its elastic properties through plasticizers, TPE achieve their elasticity through the combination of hard and soft phases within a polymer ***(see Fig. 1)***. The hard phases enable thermoplastic behavior, while the soft phases provide elastic properties. This allows the creation of tailored materials with specific advantages in function, processing, and recycling.

TPE is particularly compatible with other polymers in mechanical recycling. A slight and unavoidable mutual contamination does not impair the quality of the recyclate. This opens up the possibility of efficient and high-quality recycling.

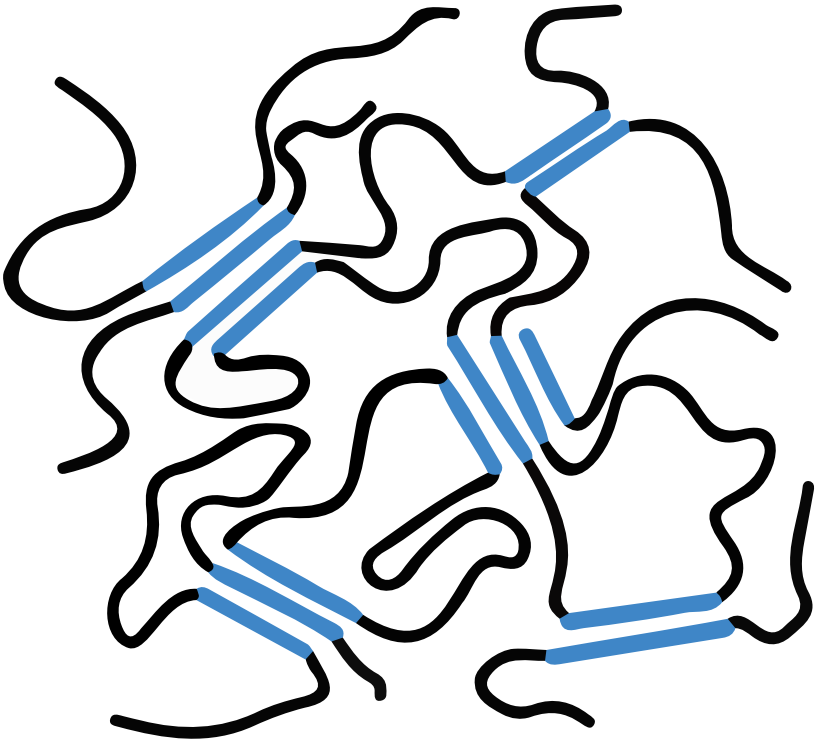

Fig. 1. Structure of thermoplastic polymers (Source: Wikipedia)

Steel – short description

The steel used for the sidewalls and door is made from 100 % recycled steel. It is produced in an electric furnace powered exclusively by renewable energy, resulting in 80 % less CO_2 emissions during production compared to conventional steel.

Steel – Deep Dive

In Germany, the industry was responsible for approximately 24 % of CO_2 emissions in 2023. About one-third of this comes from the iron and steel industry (Statista). The resulting 8 % of nationwide CO_2 emissions can be broken down into process-related emissions (1/3) and the generation of the required energy amounts (2/3).

There are various approaches to sustainably reduce CO_2 emissions:

- **Electric steel route:** Here, scrap metal and, in the future, increasingly CO_2-free produced sponge iron are processed into steel in an electric arc furnace. If the plant is operated with renewable energy, such as wind energy, CO_2 emissions can be reduced by up to 80 %.
- **Direct reduction with hydrogen:** As global steel consumption is higher than the available scrap steel quantities, a CO_2-reduced alternative for pig iron production is needed. Direct reduction of iron ore with „green“ hydrogen can reduce CO_2 emissions in crude steel production by about 95 % (Source: Salzgitter AG).
- **Carbon Capture and Use or Storage (CCU/S):** CO_2 is collected at the point of origin and either reused or stored.

The approach chosen for the FNa 6635, the electric steel route, is currently the only method available on an industrial scale for significantly reducing CO_2 emissions in steel products.

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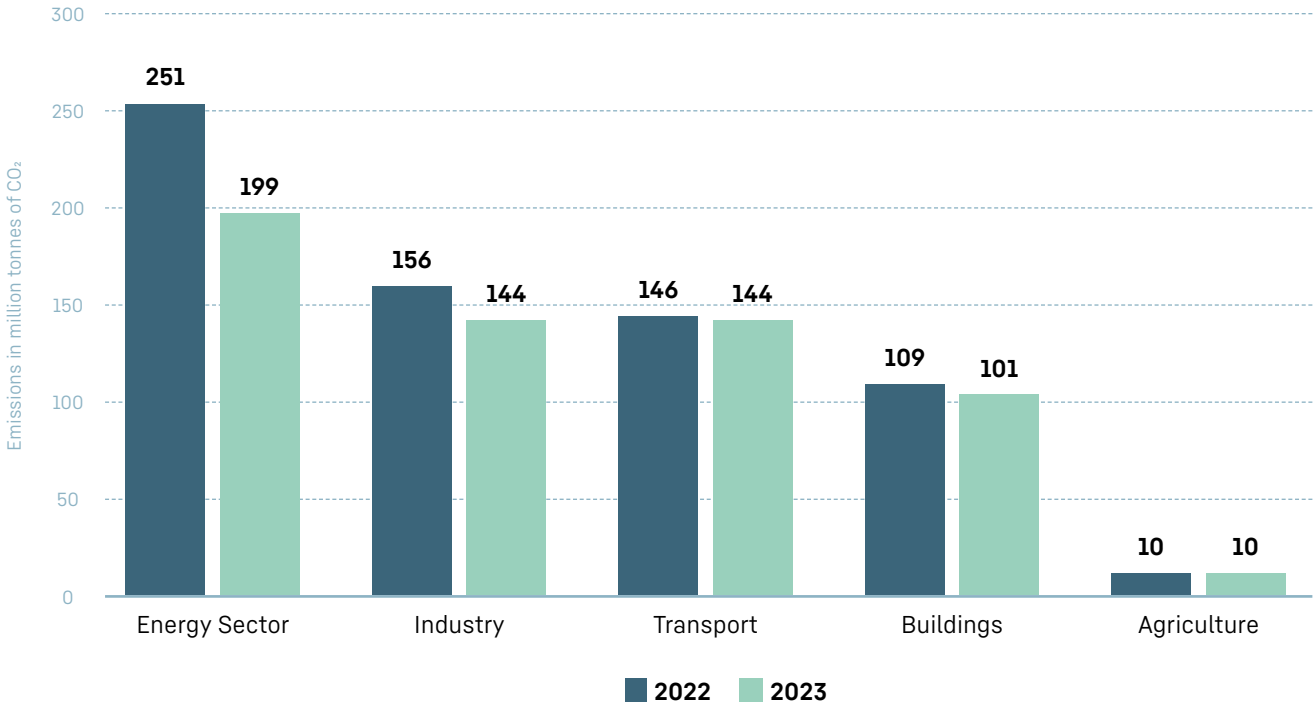
Carbon Dioxide Emissions in Germany by Sector in 2023 (in million tonnes of CO_2)



Sources
Federal Environment Agency
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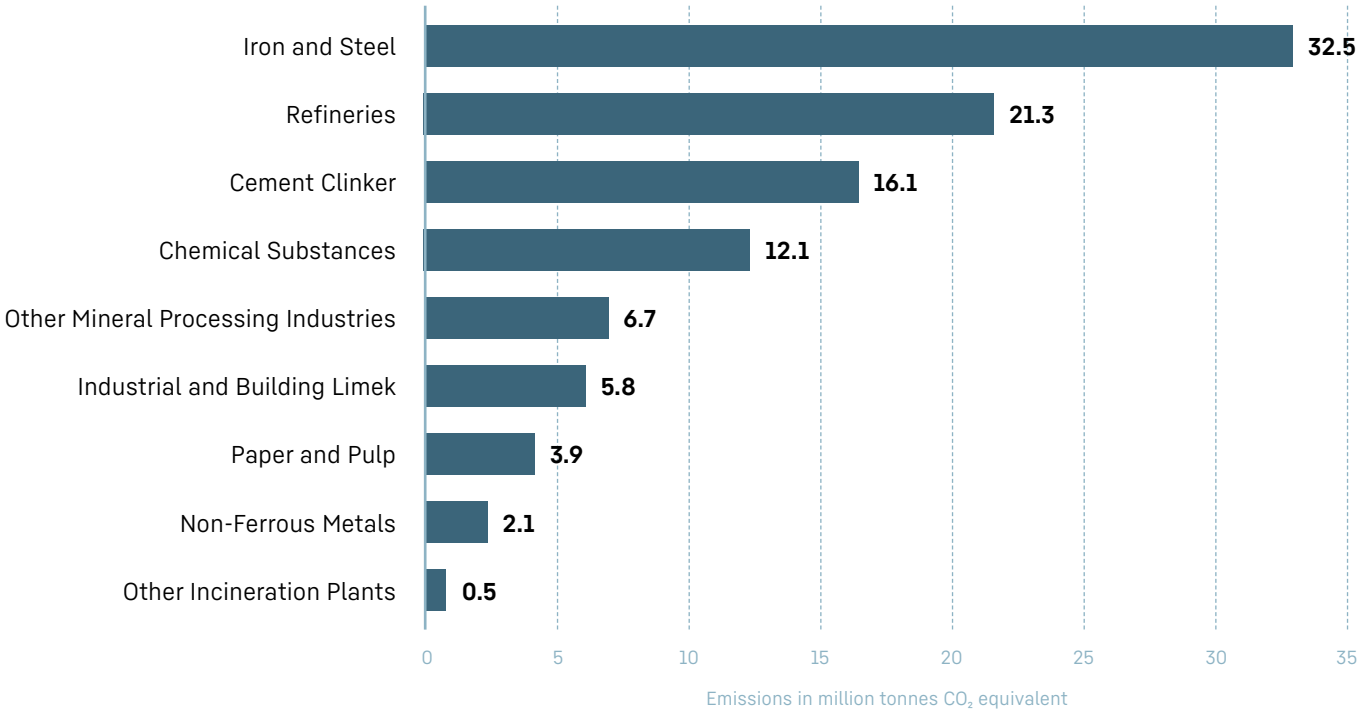
Further information
Germany; Status: March 2024

Greenhouse Gas Emissions of the Industrial Sector in Germany by Industry in 2023 (in million tonnes CO_2 equivalent)



Sources
Federal Environment Agency; German Emissions Trading Authority
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Further information
Germany

Foam – short description

For the foam insulation, materials are used in a mass-balance approach where the highest possible proportion of raw materials comes from recycled or bio-based sources. This ensures maximum insulation performance with reduced ecological impact.

Foam – Deep Dive

Polyurethane, originally patented by Otto Bayer in 1937, has developed over many years into a high-performance insulating material. Today, it enables the production of refrigerators and freezers with excellent insulating properties at marketable costs.

The properties of polyurethane result from the reaction of the base materials polyol and isocyanate. Injected under high pressure, they expand through blowing agents and fill the cavity between the appliance‘s cover layers with a mechanically stable sandwich element. This element has excellent insulating properties and low density.

Since the 1990s, however, environmentally friendly hydrocarbons such as cyclo- and isopentane have been used in Europe. In recent years, the chemical industry has increasingly relied on biogenic raw materials for the production of polyols and isocyanates. Castor oil and its derivatives, which contain reactive OH groups, as well as vegetable oils and lignin, serve as the basis for polyols.

As valuable plant oils are increasingly preferred for use in the food and feed industry, recyclates are increasingly coming into the focus of general interest. These come either from industrial waste or from consumer waste. Industrial waste is often homogeneous and easier to process, while consumer waste often varies and requires complex separation and cleaning steps.

Raw materials derived from industrial waste are incorporated together with petroleum-based materials into the complex manufacturing process of polyurethane. Precise information on the proportion of recyclates and biogenic substances is not provided by the manufacturer.

While production based solely on bio- or recycled materials is currently neither technically nor economically feasible, the mass-balance approach already enables a gradual increase in the proportion of alternative raw materials. We do not have detailed information about which sustainable raw material sources, in what proportions, and at which stages of the manufacturing process are used by the supplier for the foam. As environmentally conscious users, we benefit from the CO_2 reduction, even though this results in higher material costs. The entire process is conducted according to a certified procedure that is also externally audited, ensuring proper accounting.

This reduces the ecological impact of the insulating material while maintaining its important insulating property for the energy efficiency of the cooling appliance. At the same time, the use of such ecologically optimized materials at this early stage significantly supports the manufacturer on the path to a circular system.

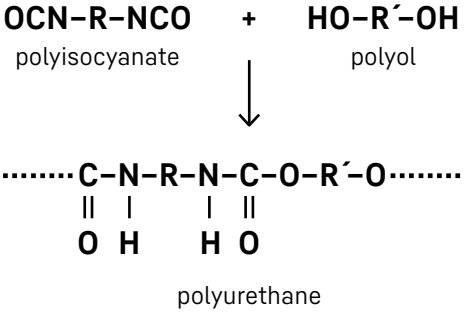


Abb 4. Isolation and Characterization of Castor Seed Oil and Its Utilization Potential in the Production of Polyurethane Foam | Semantic Scholar

Inner container – short description

For the plastic inner container, materials are used in a mass-balance approach that incorporates a proportion of 55 % recycled raw materials during production. This ensures optimal performance with a minimal ecological footprint.

Inner container – Deep Dive

The inner container of a cooling appliance is typically made of impact-resistant polystyrene or ABS and is produced through thermoforming. In this process, a plastic sheet is heated and formed over a mould using compressed air and vacuum. This efficient technology allows for the production of large, functional 3D bodies which, after attaching technical components such as heat exchangers and lighting, form the appliance's body along with the side and back walls.

Recycling the inner container integrated into the housing is a challenge. This involves separating plastic, foam, and metal, as well as meeting requirements such as colour, lightfastness, and mechanics. Another limiting factor is compliance with food safety standards. Materials used in refrigerators and freezers come into contact with food and must therefore meet specific criteria.

In our FNa 6635, we use impact-resistant polystyrene (HIPS) with recycled content from post-consumer waste added at a proportion of 55 %. These proportions are precisely mass-balanced and attributed to the inner container material through a certified, externally audited process.

Additionally, we collaborate with material producers and the recycling industry to further reduce CO_2 emissions by increasing the proportion of CO_2-reduced base materials. Our goal is to further reduce the production-related CO_2 footprint of Liebherr appliances in the future.

Packaging – short description

For our packaging, we have chosen materials that have a particularly high recycling content and are themselves easily recyclable, without compromising on transportation safety. In addition to the styrofoam parts we have also switched the materials for the strapping bands and foil bags.

Packaging – Deep Dive

We pay special attention to the protection of our appliances during transport. The packaging must pass stringent transport and stacking tests to ensure the safety and quality of the products.

All our packaging components are easily separable and recyclable – we do not use multilayer films or other composite materials that would cause problems in the recycling process.

The main component of Liebherr packaging is cardboard. This natural fibre-based material offers several advantages:

- Due to the well-developed infrastructure in most countries, cardboard has an excellent collection rate.
- The material is circular – collected material is mostly reused, reducing the need for fresh fibres.
- The material is bio-based and does not require fossil raw materials.
- If the material is not properly disposed of, it returns to the biological cycle and decomposes naturally.

Of course, Liebherr adheres to the applicable national and international laws regarding the origin of the raw fibres and the production of the cardboard.

For the bottom and top cushions, we use recycled expanded polystyrene (rEPS), known as Styrofoam. This is moisture-resistant, has good cushioning properties, is lightweight, and recyclable. The rEPS we use consists of nearly 95% recyclates, supporting a functioning circular economy. We opt for physical recycling, which has a better energy balance than chemical recycling.

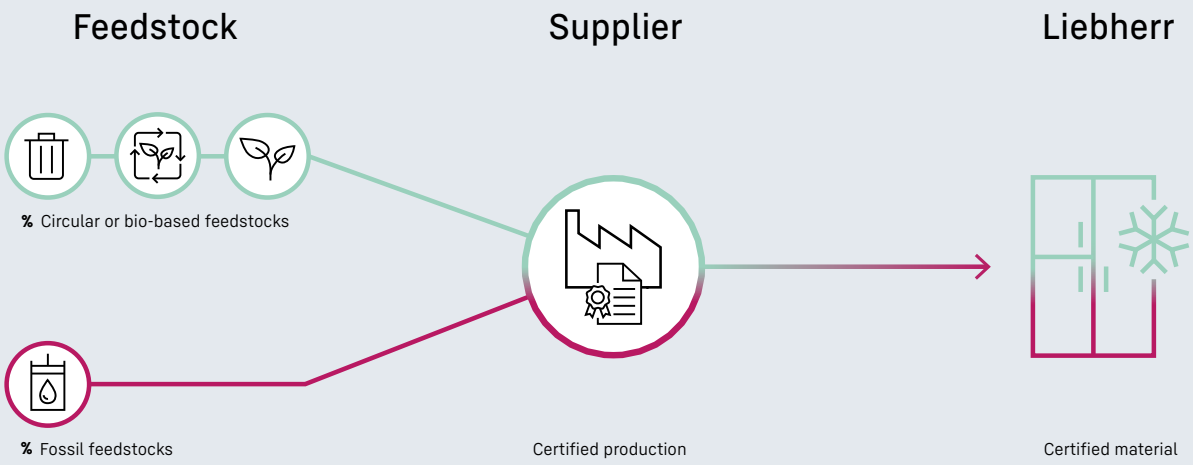
The PP (polypropylene) strapping bands consist of over 30 % recycled material and can support the weight of the appliance even when improperly used as a carrying aid.

We are constantly working on improvements. We optimise packaging volume and weight to avoid over-packaging and unnecessary material usage. At the same time, we increase the recycling content and reduce the plastic content, for example, by using paper bags instead of plastic films for accessories.

Explanation of the mass-balance approach we use in the FNa 6635 for the insulation foam and inner container

Since production based solely on bio-based or recycled raw materials is currently neither technically nor economically viable, the mass-balance approach represents a practical transitional solution to gradually increase the proportion of sustainable raw materials.

In this process, bio-based raw materials and/or recyclates are added to the petroleum-based material stream during manufacturing. Depending on the technology and raw material, this can occur at different points along the production chain and in varying proportions. Due to the mixing and joint processing of petroleum-based and sustainable raw materials, a clear physical allocation to an individual product or component is not possible. However, the benefits of these sustainability efforts, such as CO_2 reduction, can be quantified mathematically. To this end, the entire production is continuously eco-balanced through a certified procedure.



Kontakt

Adrian Wowra
Corporate Responsibility Communication,
Customer & Trade Relations

Telefon +49 170 441 55 91
E-Mail: Adrian.Wowra@Liebherr.com

Veröffentlicht von
Liebherr-Hausgeräte GmbH
Ochsenhausen / Deutschland
home.liebherr.com

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