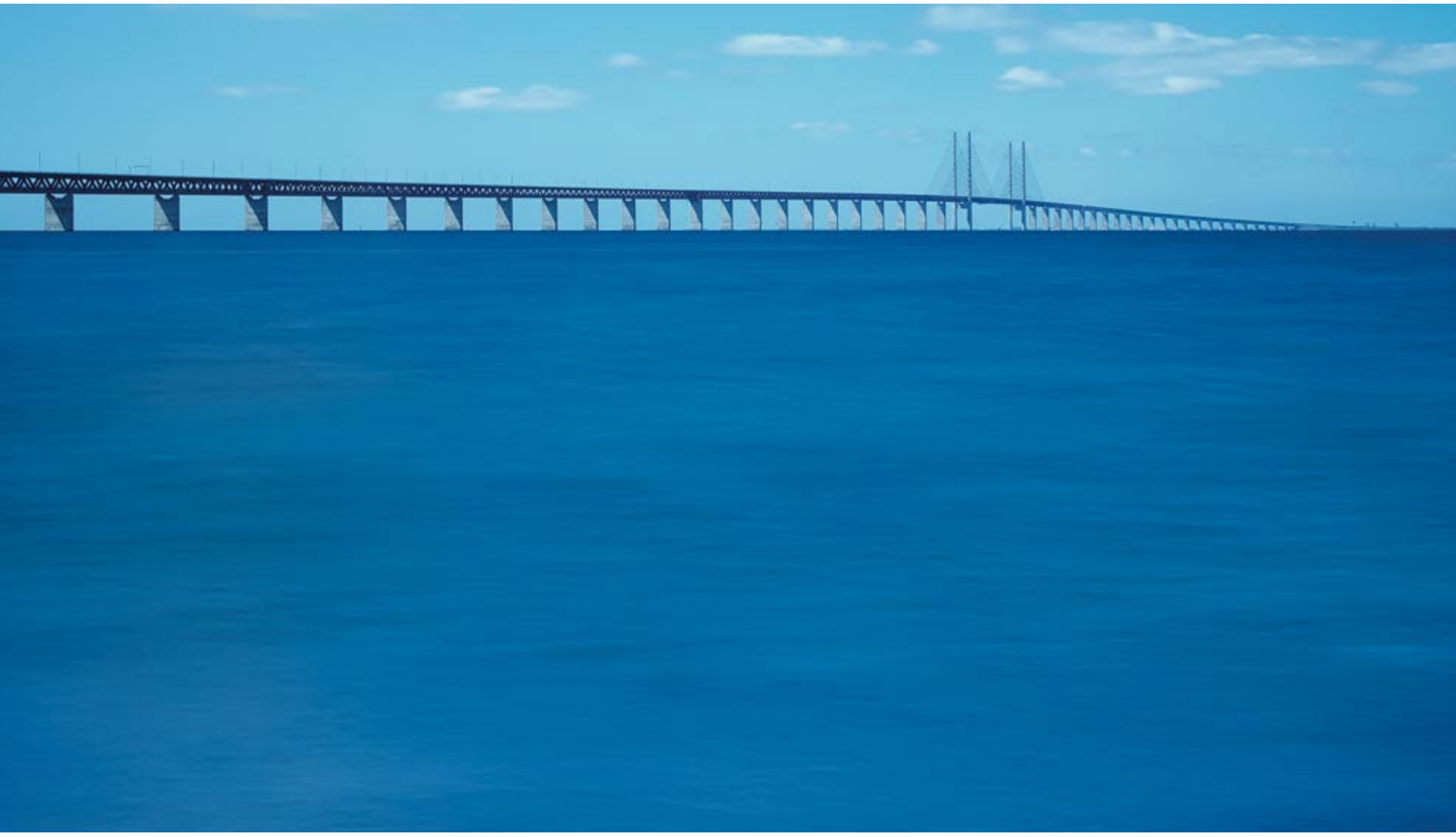
Rosti

Environmental Sustainability in Plastic Injection Moulding



Content

At Rosti, sustainability is more than a policy – it is the foundation of how we design, manufacture, and deliver solutions. As a global injection moulder with over 80 years of expertise, we help customers bring sustainable products from concept to reality. Our ambition is to be the preferred partner and trusted advisor for companies seeking to lower their environmental impact through design innovation, material choice, and responsible operations.

This guide explores the environmental challenges of plastics, the opportunities for circularity, and how Rosti's sustainability strategy delivers measurable results across our global network of Innovation and Sustainability Centres in Europe, Asia, and North America.

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What is the Environmental Impact of the Plastics Industry?

The plastics industry is essential to modern life but carries a significant environmental burden. In 2024, plastics production contributed millions of tons of CO_2e globally, with the majority tied to raw material sourcing and end-of-life management.

At Rosti, we've measured our own footprint and found that 73% of emissions come from materials, 14% from energy, and 12% from operations such as travel and packaging.

This knowledge empowers us to target reductions where they matter most. By addressing emissions through design optimization, material substitution, energy sourcing, and operational improvements, we're not just moulding components – we're helping shape a more sustainable plastics industry.

Global Sustainability Trends and the Plastics Industry

Across the globe, sustainability is transforming how plastics are produced, used, and recovered. Several key forces are shaping the future of the industry:

- ✓ **Circular Economy Adoption** – Governments, NGOs, and industry groups are pushing to move away from a "take-make-dispose" model. By 2040, circular approaches could reduce plastic leakage into oceans by 80%, according to the Pew Charitable Trusts.
- ✓ **Policy and Regulation** – New frameworks such as the EU Green Deal, the Single-Use Plastics Directive, and Extended Producer Responsibility (EPR) laws are requiring companies to design for recyclability, disclose carbon data, and take responsibility for products after use. In the U.S., disclosure rules from the SEC and state-level packaging mandates are emerging.
- ✓ **Material Innovation** – Advances in biopolymers, chemically recycled resins, and mass-balance approaches are providing alternatives to virgin fossil-based plastics. These solutions are still scaling but are expected to become mainstream in the next decade.
- ✓ **Consumer Demand and Brand Commitments** – Surveys consistently show that consumers prefer products with sustainable packaging and transparent supply chains. Major global brands have pledged ambitious targets – for example, making all packaging recyclable or compostable by 2025.

- ✓ **Transparency and Digitalization** – Technologies such as lifecycle assessments (LCAs), digital product passports, and supply chain traceability tools are helping companies measure and reduce environmental impact with greater accuracy.

These shifts mean that sustainability is no longer optional – it's becoming the baseline expectation in the plastics industry.

Companies like Rosti operate within this global movement, working alongside customers to adapt to these trends. By validating recycled and renewable materials, testing designs for recyclability, and providing CO_2 data to inform decision-making, we're aligning our practices with the same drivers affecting the entire industry.

Why is Sustainability Important in Plastic Injection Moulding?

Plastic injection moulding is one of the most widely used manufacturing processes in the world, producing everything from medical devices and food packaging to automotive and consumer goods. Because of its scale, it is also a critical lever for improving sustainability.

Why injection moulding matters:

- ✓ **Design determines impact**. Studies show that more than 80% of a product's CO_2 footprint is determined at the design stage. Choices around wall thickness, geometry, and assembly complexity lock in long-term material use, energy demand, and recyclability.
- ✓ **Material is destiny**. The type of resin used has a direct effect on carbon footprint. Shifting from virgin plastics to recycled or bio-based alternatives can cut emissions dramatically – for example, replacing virgin ABS with PCR ABS can reduce CO_2 by more than 50%.
- ✓ **Scale amplifies outcomes**. Even a small efficiency gain, such as lightweighting by 5%, can translate into significant carbon and cost savings when multiplied across millions of moulded parts.

Industry-wide implications:

This means injection moulders have a unique responsibility – and opportunity – to contribute to global sustainability goals. The ability to design for recyclability, validate new materials, and optimize production efficiency impacts not only direct customers but also entire downstream industries.

Rosti's role in the bigger picture:

As part of this global shift, Rosti:

- ✓ Validates and qualifies recycled and renewable materials through our Innovation Centres in Poland, China, and the U.S.
- ✓ Embeds design for recyclability in customer projects to ensure products fit into circular systems.
- ✓ Uses lifecycle assessments and CO_2e data to help customers make informed decisions, rather than relying on assumptions.

By combining these efforts, injection moulding moves beyond simply making parts – it becomes a driver of measurable, system-wide sustainability outcomes.

Rosti's Sustainability Strategy for Plastic Injection Moulding

Rosti's 2030 roadmap is anchored in six commitments:

1. **Clean Energy** – 100% clean energy across sites.
   - 2025: 86% clean energy (85% renewable, 1% nuclear)
   - Transitioned Sweden operations from nuclear to 100% renewable.
2. **Emission Reduction** – Cut Scope 1 & 2 by 50%.
   - 2024: Achieved 5% reduction from 2023 baseline
   - Biggest lever: material and design collaboration with customers.
3. **Green Materials** – Always offer renewable/recycled alternatives.
   - Database of 70+ green resins, 19 qualified, 8 in mass production
   - Applications: food packaging (bio-based PE), appliances (PCR ABS), EV charging (mass-balanced PC).
4. **Sustainable/Recyclable Design** – Recyclable option for every customer.
   - Life Cycle Analysis tools prove design impact.
   - Lightweighting and simplification reduce footprint by up to 20–30%.

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5. **Energy Efficiency** – 25% improvement by 2030.
    - 2024 delivered 4.9% improvement via waste removal, process optimization, and intelligent powering
    - Site Energy Leaders and Communities of Practice drive continuous progress.
6. **Zero Waste to Landfill** – All sites by 2030.
    - 2023 baseline: 14% waste to landfill.
    - Four sites already achieved Zero Waste.
    - Roadmap: 6 sites (2025), 8 sites (2027), 11 sites (2030).

These commitments ensure 100% of emissions sources are addressed, giving customers confidence that Rosti is a partner for the long haul.

Pathways to Reducing Customers' Carbon Footprint

Lowering the carbon footprint of plastics is one of the industry's biggest challenges. Studies consistently show that most emissions come from three sources: materials, energy, and design choices, with operational factors making up the rest. To meaningfully reduce impact, manufacturers need to act across all of these areas, not just one.

Key levers for emissions reduction across the industry:

- ✓ Product Design – Optimizing shape, wall thickness, and part complexity can deliver immediate savings. Even modest changes, like lightweighting packaging by 10%, can reduce both resin use and transport emissions by double digits.
- ✓ Material Selection and Validation – Shifting from virgin to recycled or bio-based polymers often has the single biggest impact on lifecycle emissions. Industry databases of qualified resins are growing, but consistent testing and performance validation remain critical for adoption.
- ✓ Energy Sourcing and Efficiency – The transition from fossil-based electricity to renewables is the most straightforward way to cut operational emissions. Coupled with smarter factory systems, this reduces the energy intensity of moulding.
- ✓ Operational Practices – From redesigning packaging and logistics to eliminating waste on the shop floor, operational tweaks can add up across global supply chains.

Rosti's contribution within this framework:

- ✓ **Design:** We collaborate with customers on lightweighting and modularity, using lifecycle assessments to demonstrate potential CO_2 savings.
- ✓ **Materials:** Our Innovation Centres in Poland, China, and the U.S. rigorously test and qualify PCR and biobased resins, with more than 70 materials in our database and 19 already validated for production.
- ✓ **Energy:** In 2024, Rosti consumed 77 GWh of energy, 56% of which came from clean sources. Several sites are already operating on 100% renewables, bringing us closer to our 2030 clean-energy goal.
- ✓ **Operations:** We are piloting initiatives such as including carbon footprint estimates alongside price in customer quotations, helping procurement teams make sustainability part of purchasing decisions.

By aligning these actions with the same levers recognized across the plastics industry, Rosti ensures our customers can see – and measure – real reductions in the footprint of their products.

Collaborative Partnership for Sustainability in Injection Moulding

Our biggest impact happens with customers, not for them. Collaboration means:

- ✓ Running design workshops to explore low-carbon options.
- ✓ Providing carbon footprint comparisons between material/design alternatives.
- ✓ Sharing insights from cross-industry projects, so customers benefit from proven solutions elsewhere.
- ✓ Acting as a supplier of choice for sustainable design, not just moulding.

Example: For a leading appliance brand, Rosti validated PCR PP (95%) that is now in mass production, proving recyclability while maintaining performance.

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What is Sustainable Injection Moulding Design?

Across the plastics industry, design is consistently identified as the single most powerful tool for reducing environmental impact. As mentioned above, research shows that over 80% of a product's carbon footprint is determined at the design stage, before a single part is moulded. Decisions made at this point – about weight, geometry, material, and assembly – can lock in decades of emissions or unlock opportunities for circularity.

Best practices emerging across the industry include:

- ✓ **Material Reduction** – Using advanced engineering methods such as finite element analysis to minimize wall thickness and weight without compromising strength. Lighter parts not only use less resin but also lower transportation emissions.
- ✓ **Simplification** – Designing components with fewer pieces or connection points to ease recycling and disassembly at end-of-life.
- ✓ **Recyclability by Design** – Selecting polymers and additives that are compatible with existing recycling streams and avoiding unnecessary multi-material mixes.
- ✓ **Circularity Strategies** – Creating products that can be reused, remanufactured, or incorporated into closed-loop systems, reducing demand for virgin plastic.
- ✓ **Lifecycle Analysis (LCA)** – Quantifying environmental impact from raw material extraction through production, use, and end-of-life, ensuring design choices are supported by data rather than assumptions.

Where Rosti contributes:

Rosti embeds these principles into customer projects by offering lifecycle analysis, validating new materials, and designing for recyclability. Our Sustainability and Innovation Centres in Europe, Asia, and North America provide the tools to simulate, test, and prove sustainability benefits before production begins.

By aligning with these globally recognized design strategies, injection moulding can shift from being a contributor to environmental challenges to being a driver of measurable, system-wide sustainability improvements.

Recycling of Plastic Scrap in Injection Moulding

The goal is to aim for zero waste to landfill, and scrap recycling is a key lever:

- ✓ **Recovery & Reuse:** Reintegrating in-process scrap into new parts without compromising quality.
- ✓ **Circular Partnerships:** Connecting customers with recyclers to close the loop.
- ✓ **Innovation in Waste Handling:** Segregating streams, tracking yields, and optimizing recovery.

Operation Clean Sweep strengthens this by preventing resin pellet loss; installing steel mesh grids on drains, educating employees, and monitoring compliance.

EU and U.S. Sustainability Standards Impacting Plastics Manufacturing and Injection Moulding

Across the plastics industry, regulatory frameworks are evolving rapidly, and manufacturers face increasing pressure to demonstrate sustainability in both product design and operations. These rules are reshaping how companies source materials, disclose emissions, and manage products at end-of-life.

Key regulatory drivers include:

- ✓ **EU Green Deal & Corporate Sustainability Reporting Directive (CSRD):** Companies operating in Europe must provide transparent carbon disclosures and integrate eco-design principles into their products.
- ✓ **Microplastics Regulations:** New requirements, such as mandatory washing machine filters in the EU, are aimed at reducing microplastic release into the environment.
- ✓ **Extended Producer Responsibility (EPR):** Packaging and product manufacturers are increasingly accountable for collection, recycling, and disposal once items leave the factory.
- ✓ **U.S. SEC Climate Disclosure Rules:** Public companies are preparing to report Scope 1–3 emissions, adding pressure throughout the supply chain to provide verifiable data.

For manufacturers, these frameworks highlight a critical shift: sustainability is no longer voluntary – it is a compliance requirement.

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Rosti integrates regulatory considerations into material validation and design processes, ensuring that parts are compatible with recycling systems, supported by CO_2e data, and compliant with evolving standards. By aligning with these rules at the design stage, we help customers not only meet current requirements but also prepare for future ones.

Education and Training for Responsible Handling of Plastic Resins

Technology alone isn't enough – it's people who make sustainability real. Rosti invests in:

- ✓ **Employee Training:** Covering resin handling, energy efficiency, and CO_2 reporting.
- ✓ **Contractor Education:** Ensuring suppliers and partners meet our standards.
- ✓ **Communities of Practice:** Cross-site groups focused on energy efficiency, design for recyclability, and emissions reduction

This culture of learning ensures sustainability is embedded in every role, from engineers to operators.

Positive Impact on Communities and the Environment

Across industries, sustainability is increasingly understood to extend beyond emissions and energy use. Companies are expected to contribute to the well-being of the communities where they operate, building trust and fostering shared responsibility for environmental and social outcomes.

Common approaches include:

- ✓ **Education and Awareness** – Partnering with schools, universities, and NGOs to promote environmental literacy and inspire future innovators.
- ✓ **Local Initiatives** – Supporting community programs focused on waste reduction, recycling, and circular economy practices at a grassroots level.
- ✓ Employee Engagement – Encouraging staff to participate in activities such as clean-up efforts, volunteer work, and sustainability awareness campaigns that strengthen local connections.

How Rosti contributes to this wider movement:

Rosti collaborates with regional schools and NGOs to promote awareness of sustainable practices, support recycling and waste-reduction programs in our communities and involve employees in initiatives that reinforce our culture of responsibility. These efforts complement our operational goals and reflect the broader expectation that manufacturers play a positive role not only in reducing their environmental footprint but also in supporting the communities where they work and live.

Environmental Initiatives Across Rosti's Global Sites

Rosti's global sites serve as test beds for sustainability innovation:

- ✓ Poland, China, USA Innovation Centres: Testing and validating >70 green resins.
- ✓ Sweden (GIS): Shifted from nuclear to 100% renewable energy in 2024.
- ✓ Germany (Dresden): Pioneering Zero Waste to Landfill with successful pilot projects.
- ✓ Malaysia & Turkey: Expanding local recycling partnerships to handle regional scrap streams.

Each site has Sustainability Champions and Energy Leaders who drive continuous progress and share best practices globally.

Conclusion

With clear commitments, measurable results, and deep expertise, Rosti is redefining what it means to be a global injection moulder.

- ✓ We measure.
- ✓ We act.
- ✓ We partner.

Rosti stands as a beacon of sustainability in the plastic injection moulding industry. Our dedication to environmental stewardship and our role as a trusted advisor in sustainable practices are at the core of our operations. We are committed to delivering high-quality, innovative solutions that meet and exceed industry sustainability standards. By integrating advanced technologies, sustainable materials, and responsible practices, Rosti ensures that we contribute positively to our environment and communities while leading the way in sustainable manufacturing.

Together, we're not just making parts. We're bringing sustainability from **concept to reality**, for our customers, our communities, and our planet.

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