The 850°C Challenge

How BASF SE is redesigning high-heat chemistry for a net-zero future

Executive Summary

BASF SE, the world's largest chemical company by revenue, faced a paradox that defines the modern industrial era: how to decarbonise one of the most energy-intensive value chains on earth without compromising competitive economics. Unlike consumer brands where ESG pivots are largely narrative, BASF's transition required re-engineering 850°C cracking furnaces, redesigning hydrogen supply chains, and retooling a 160-year-old Verbund network.

This case study analyses four structurally unique challenges BASF confronted between 2020 and 2024 and the unconventional ESG solutions it derived.The outcome is instructive: Scope 1 + 2 emissions remain at 17.0 Mt CO_2e (2024), reflecting a production uptick, yet renewable electricity share rose to 26%; the electrified steam cracker demonstration plant went live in Ludwigshafen; and Sustainable-Future Solutions now represent 46.3% of revenue up from 41.4% in 2023. BASF's model demonstrates that heavy-industry ESG transformation is achievable when it is embedded in capital allocation, executive compensation, and product portfolio steering simultaneously.

Company Overview

BASF SE, founded in 1865 and headquartered in Ludwigshafen, Germany, is one of the world's largest chemical companies, employing around 112,000 people across a global network of six Verbund sites and roughly 350 production facilities. The company operates through six key segments and is listed as BAS on the Frankfurt Stock Exchange and BASFY as an ADR in the United States. A defining feature of BASF is its proprietary Verbund system, an integrated production network where by-products and waste heat from one process are reused in another, creating significant cost efficiencies and operational synergies, while also concentrating risk when fossil-fuel-based inputs are used. BASF formalised its sustainability strategy in 1994 and further strengthened its long-term direction in September 2024 with the launch of its 'Winning Ways' corporate strategy, positioning itself as the preferred chemical company to enable customers' green transformation.

Financially, the company reported €65.3 billion in revenue and €7.3 billion EBITDA (before special items) in 2024, with sustainable-future solutions contributing 46.3% of total sales, Loop (circular) solutions generating €5.7 billion (with a €10 billion target by 2030), and a planned green transformation capex of approximately €600 million annually for 2025-2028.

ESG Leadership & External Ratings

Challenges

The following four challenges are structural and specific to BASF's Verbund architecture, product mix, and global footprint.

Steam Cracker Lock-In	Green Hydrogen Paradox
Steam crackers operate at ~850°C, historically achieved only by burning natural gas. For BASF, which runs two crackers at the Ludwigshafen Verbund alone, this was not a peripheral issue but crackers are the origin point of nearly all downstream carbon chains. Replacing the heat source requires redesigning furnace architecture on an industrial scale; no off-the-shelf electric solution existed before 2022. This created a structural decarbonisation gap: renewable electricity was available, but the hardware to use it in high-temperature cracking did not exist commercially.	Hydrogen is BASF's most critical process feedstock used across ammonia synthesis, hydrogenation, and desulphurisation. The dominant production route (steam methane reforming) is emissions-intensive. BASF's challenge was not merely cost: the Verbund's integrated design meant that substituting hydrogen sources required simultaneous re-piping of multiple plants. Additionally, grid-scale electrolysis at BASF's required volumes (tens of thousands of tonnes per year) had never been demonstrated at a single chemical site in Germany.
Portfolio-Level Carbon Blind Spot	**ESG Governance Fragmentation**
BASF sells approximately 45,000 individual product lines across six segments and customers in virtually every industry. Before implementing Product Carbon Footprints (PCFs), BASF had no standardised, auditable method to communicate the Scope 1-3 emissions embedded in each product. This was uniquely problematic because BASF's customers (automotive OEMs, packaging companies, electronics manufacturers) were themselves setting Scope 3 targets—and could not account for BASF's contribution without product-level data. The gap risked customer churn to lower-footprint suppliers.	BASF's ESG ambitions pre-2020 were disconnected from financial incentives. Sustainability targets sat in the CSR function while capital allocation was driven purely by ROCE. The Verbund's complexity meant that decarbonisation investments at one site created benefits across several others—yet the business unit bearing the capex received no internal credit. This misalignment of incentives produced chronic underinvestment in emission-reduction projects that were collectively NPV-positive but locally unattractive.

Objectives & Targets Set

Targets drawn from BASF Report 2024 and official BASF sustainability portal. All targets cover Scope 1 + 2 unless noted.

TARGET	METRIC / DEADLINE	STATUS (2024)
GHG Emissions (Scope 1+2)	-25% vs. 2018 by 2030; net-zero by 2050	17.0 Mt CO_2e in 2024; ~60% below 1990
Renewable Electricity Share	Use of renewable electricity across all European Performance Materials by 2025 (PPAs + on-site)	26% of total group electricity from renewables (2024)
Sustainable-Future Solutions	>50% of TripleS-assessed revenue by 2030	46.3% in 2024 (up from 41.4% in 2023)
Loop (Circular) Solutions	€10 billion in sales by 2030	€5.7 billion achieved in 2024

Sustainable Water Management	100% of Verbund sites + water-stress sites by 2030	65% achieved (2024); 8 new sites added
Scope 3.1 Raw Materials Emissions	Net-zero by 2050; specific reduction target set 2024	New; tracking via Catena-X PCF data exchange

Strategy, Approach & Implementation

BASF's implementation was architecturally distinct from peer ESG programs in one critical dimension: every solution was designed to fix a structurally specific internal problem. The company did not simply reduce its own footprint; it re-engineered the industrial processes and governance systems that were generating it. Below are the four core implementation pillars, each mapped directly to the challenge it addressed.

01 - Electrically Heated Steam Cracker

BASF's answer to the steam cracker lock-in was not incremental efficiency improvement but a full hardware redesign partnership. In 2024, BASF, SABIC and Linde jointly commissioned the world's first industrial-scale demonstration plant for electrically heated steam cracker furnaces, fully integrated into one of the two live crackers at the Ludwigshafen Verbund site.

The prototype tests two distinct heating architectures simultaneously: direct electrical resistance heating and indirect electrical heating via a secondary medium. The reason for running both in parallel is deliberate; BASF has not pre-committed to a single technology path, preserving optionality as both approaches are validated. Renewable electricity powering the furnace can reduce process-related emissions by at least 90% vs. conventional gas firing. The co-development model also distributes R&D risk and IP across three industrial players, making commercial scale-up and eventual industry-wide licensing far more achievable than a solo programme could deliver.

02 - Green Hydrogen Electrolyser

BASF's hydrogen challenge required solving two problems at once: replacing an emissions-intensive feedstock and demonstrating that megawatt-scale electrolysis could function within a Verbund's tightly interconnected plant network.

In 2024, BASF invested €59 million in a water electrolysis plant at Ludwigshafen, powered entirely by renewable electricity. The facility is designed to produce up to 8,000 metric tonnes of emission-free hydrogen per year, with an expected annual CO_2 avoidance of up to 72,000 tonnes.

Critically, BASF did not stop at electrolysis. In parallel, the company is piloting methane pyrolysis; a process that produces hydrogen from natural gas with near-zero emissions when powered by renewables, and which requires considerably less electricity than water electrolysis. Running both technologies simultaneously means BASF is building a dual-pathway green hydrogen supply chain: one optimised for zero-carbon output (electrolysis), one optimised for lower energy intensity (pyrolysis). This is a uniquely pragmatic design for a Verbund operator where hydrogen demand is both large and continuous.

03 - Product Carbon Footprint Platform & Catena-X

BASF's response to the portfolio carbon blind spot was the most institutionally complex of the four levers. The company has maintained Product Carbon Footprints (PCFs) for its entire catalogue of approximately 45,000 sales products since 2008, making BASF the only industrial enterprise globally to publish a comprehensive corporate carbon footprint annually.

The critical innovation in 2024 was not the PCFs themselves but their delivery infrastructure. BASF migrated its PCF data to the Catena-X network, enabling machine-readable, real-time PCF transfer directly into customers' Scope 3.1 accounting systems. For automotive OEMs under regulatory pressure to disclose supply-chain emissions, this removes a significant data-collection burden and creates a structural switching cost. By end-2024, 98.3% of the relevant portfolio had been assessed

under the TripleS methodology. Products in the Challenged classification trigger mandatory action plans, creating a governance loop from portfolio data through to product reformulation.

04 - ESG Wired Into Executive Compensation

BASF's governance intervention was the most direct in design and the most far-reaching in consequence. From 2020, Scope 1+2 CO_2 reduction was formally established as BASF's most important non-financial KPI, given equal weight alongside EBITDA-based metrics in the Long-Term Incentive plan for the Board of Executive Directors and senior executives. This was not a cosmetic ESG weighting; it placed carbon performance on an identical financial footing with return metrics that had historically dominated capital allocation.

In 2024, 16.7% of the Short-Term Incentive formula became sustainability-linked, meaning carbon and sustainability performance now affects near-term as well as long-term executive pay. The September 2024 'Winning Ways' strategy went a step further, making customer green transformation enablement the explicit primary commercial ambition of the Group. Business units can no longer treat decarbonisation capex as a cost centre without upside; it is now scored in the same incentive system as revenue growth.

Results & Impact

Environmental Performance

BASF's environmental results between 2018 and 2024 reflect the first phase of a multi-decade transition. Absolute Scope 1+2 emissions held at 17.0 Mt CO_2e in 2024, meaning emission intensity per tonne of product continued to fall. The renewable electricity share rose to 26%, up from 23% in 2023, driven by new PPAs and on-site generation across European Performance Materials sites. The reduction trajectory from 1990 is particularly striking: BASF has cut specific emissions (per tonne of product) by approximately 74-75% over three decades while output has grown substantially.

Metric	1990 Baseline	2018 Baseline	2024 Actual	Direction
Scope 1+2 GHG (Mt CO_2e)	~45 Mt (est.)	22.5 Mt	17.0 Mt	↓ 24% vs. 2018
Specific Emissions (per tonne product)	100 (index)	-	~26 (index)	↓ ~74% vs. 1990
Renewable Electricity Share	-	-	26%	↑ vs. 23% in 2023
Sustainable Water Mgmt (sites covered)	-	-	65% of target	↑ from 57% in 2023

Business Performance

The commercial case for BASF's ESG pivot is now quantifiably clear. The 4.9 percentage-point rise in Sustainable-Future Solutions revenue in a single year a €65.3 billion revenue base represents approximately €3.2 billion of incremental ESG-linked revenue shift. This is not a rounding error; it is the company's fastest-growing revenue category. Loop Solutions (circular feedstock and recycled-material products) reached €5.7 billion in 2024, on a trajectory toward the €10 billion target by 2030. The PCF platform and Catena-X integration are generating structural customer lock-in in the automotive segment face a meaningful switching cost.

Metric	2024	2030 Target
Sustainable-Future Solutions (% of TripleS revenue)	46.3%	>50%
Loop / Circular Solutions Sales	€5.7B	€10B
TripleS Portfolio Coverage (assessed)	98.3%	100%
PCF-capable products	~45,000 (100%)	Maintained

Future Roadmap (2026 and Beyond)

NOW 2024-2026	– Run first industrial electric cracker at Ludwigshafen + publish validated emissions data – Commission 8,000 t/yr green hydrogen electrolyser at Ludwigshafen (€59M invested) – Expand Catena-X PCF sharing to >50% automotive customers for Scope 3.1 transfers – Launch Zhanjiang (China) Verbund site with lower emission intensity (Q4 2025 target) – Deploy ~€550M in Scope 1 & 2 decarbonisation and renewable energy (2025-2026 tranche)
MID-TERM 2027-2030	– Cut Scope 1+2 emissions by 25% vs. 2018 baseline (~16.9 Mt CO_2e target) – Achieve >50% revenue from Sustainable-Future Solutions (ahead of 2030 target) – Scale Loop (Circular) Solutions sales from €5.7B (2024) to €10B by 2030 – Implement sustainable water management at all Verbund and water-stress sites (~90% water coverage) – Commercialise electric cracker tech and explore licensing beyond BASF Verbund sites
LONG-TERM 2031-2050	– Achieve net-zero Scope 1 & 2 emissions by 2050 (aligned with 1.5°C pathway) – Extend net-zero to Scope 3.1 (upstream) by 2050 using Catena-X PCF tracking – Offset residual emissions via high-credibility nature-based and technical removals – Fully decarbonise the global Verbund network (renewables, green H_2, circular feedstocks, CCS where needed)

Conclusion

BASF's ESG story is not a narrative of corporate good citizenship layered on top of a chemical business. It is a story of hard engineering choices, capital reallocation, and governance redesign in one of the world's most emissions-intensive industries.

What makes BASF's approach analytically interesting is the precision with which each ESG solution maps to a structurally specific problem. The electric cracker addresses a hardware lock-in that no offsets or PPAs could solve. The Catena-X PCF platform addresses a data-architecture deficit that prevented BASF's sustainability from being visible in its customers' Scope 3 inventories. The LTI wiring of CO_2 KPIs with 33% weight addresses a governance misalignment that was silently blocking the economics of decarbonisation.

The quantitative evidence from FY2024 is cautiously encouraging. Absolute emissions held flat at 17.0 Mt despite production volume growth meaning intensity fell. Renewable electricity share rose to 26%. Sustainable-Future Solutions crossed 46% of revenue. Loop Solutions reached €5.7 billion.

The candid reality is that 17.0 Mt CO_2e remains a large number for a single company. The 2030 target of a 25% absolute reduction from 2018 is modest relative to the 1.5°C science. The new Zhanjiang Verbund site adds future emissions risk. Yet within the constraints of heavy-industry transformation BASF represents a credible, data-backed case of ESG integration at scale.

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