Möglichkeiten der „grünen“ Chemie

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Our purpose:

We create chemistry for a sustainable future

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BASF Corporate Commitments

Our Corporate Commitments cover every part of our value chain and operations to deliver long-term business success.

Suppliers | BASF operations | Customers | And along the way…

We source responsibly

We produce safely for people and the environment

We produce efficiently

We drive sustainable solutions

We value people and treat them with respect

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Strategic Innovation and Research Agenda

SUSCHEM topics overview

CIRCULAR ECONOMY AND RESOURCE EFFICIENCY

Transforming Europe into a more Circular Economy

- Materials design for durability and/or recyclability
- Safe-by-design for chemicals & materials (accounting for circularity)
- Advanced processes for alternative carbon feedstock valorisation (waste, biomass, CO/CO_2)
- Resource efficiency optimisation of processes

LOW-CARBON ECONOMY

Mitigating climate change, with Europe becoming carbon neutral

- Advanced materials for sustainable production of renewable electricity
- Advanced materials and technologies for renewable energy storage
- Advanced materials for energy efficiency in transport and buildings
- Electrification of chemical processes and use of

ENVIRONMENTAL AND HUMAN HEALTH

Europe leading on environmental and human health protection

- Safe-by-design for materials and chemicals (functionality approach, methodologies, data & tools)
- Improve safety of operations through process design, control and optimisation
- Zero-liquid discharge processes
- Zero-waste discharge processes

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SUSCHEM Circular economy

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Table 1: Circular Economy and Resource Efficiency - SusChem Technology Priorities

FOCUS AREAS	SUSCHEM TECHNOLOGY PRIORITIES (KEY EXAMPLES)
MATERIALS DESIGN FOR DURABILITY	• Composites and cellular materials **(2.1)** • 3D-printable materials **(2.2)** • Bio-based materials **(2.3.1, 2.3.2, 2.3.3)** • Additives **(2.4)** • Biocompatible and smart materials **(2.5)** • Materials for electronics **(2.6)** • Membranes **(2.7)** • Materials for energy storage **(2.8)** • Coating materials and aerogels **(2.9)** • Laboratory 4.0 - Digital R&D **(4.1.1, 4.1.2, 4.1.3)**

Example 2: 90 % CO_2 emissions reduction is envisioned by producing lignin-based bio-oil from lignin in black liquor from the pulp industry.[38]

Example 3: Transforming lignin into a biodegradable biopolymer with enhanced properties (e.g. mechanical strength, ultraviolet (UV) light stability and fire-resistance), represents an alternative to plastics such as polystyrene (PS) with an improved environmental profile.[39]

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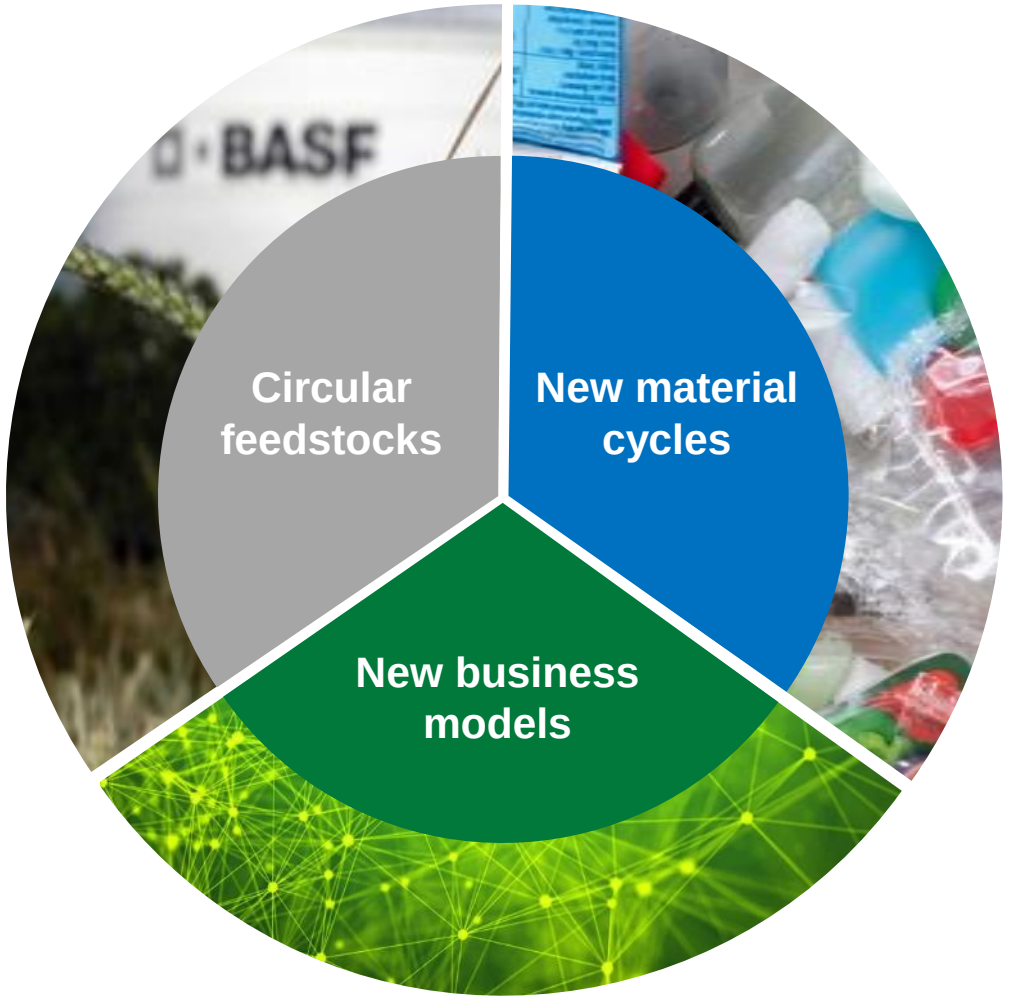
We have three areas of focus: circular feedstocks, new material cycles and new business models



Circular feedstocks

We will increase the volume of renewable and recycled feedstocks from sustainable sources, also via the certified mass balance approach.

New material cycles

We design materials for circularity, develop solutions which improve or enable recycling and establish product-specific recycling loops.

New business models

We enter new markets, create smart digital solutions and offer new services which allow a decoupling of growth from resource consumption.

By using alternative raw materials, we can manufacture the same products in a more sustainable way

Renewable feedstock

Biomass Balance portfolio

Derived from biomass, e.g. residues from agricultural production or food processing, crops

Dedicated bio-based portfolio

Sustainably sourced resources, e.g. RSPO certified

Recycled feedstock

e.g. ChemCycling™

Derived from post-consumer plastic waste or end-of-life tires

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Renewable raw materials for BMB need to be sourced sustainably

Use certified renewable raw materials

- Waste/residues are preferred, e.g. from paper and wood industry, agricultural residues
- Independent sustainability certification from recognized schemes, e.g., REDcert and ISCC

Apply standardized sustainability criteria

- Minimum sustainability criteria as in EU RED*
- Greenhouse gas emissions savings
- Responsible biomass production
- Protection of areas with high biodiversity and large carbon stocks

* Renewable Energy Directive of EU Commission

BASF’s Biomass Balance Approach

- Requires **no reformulation** – identical product performance
- **Available** easy and fast for nearly all our products
- **Saves fossil resources** and **reduces greenhouse gas** emissions
- Drives the use of sustainable **renewable feedstock**

Strategic Innovation and Research Agenda

SUSCHEM Low Carbon Economy

LOW-CARBON ECONOMY

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ELECTRIFICATION OF CHEMICAL PROCESSES, AND USE OF RENEWABLE ENERGY SOURCES

- New reactor & process design concepts and equipment **(3.1.2, 3.1.3)**
- New reactor and process design utilising non-conventional energy forms **(3.4)**
- Electrochemical, electrocatalytic and photo-electrocatalytic processes **(3.5)**
- Power-to-Chemicals **(3.8)**
- Hydrogen production with low-carbon footprint **(3.7.1, 3.7.2, 3.7.3)**
- Power-to-Heat **(3.6)**

IMPACT EXAMPLES:

Example 1: Development of renewable electricity-driven steam crackers (850 °C) to break down naphtha into olefins and aromatics for further processing, has the potential of cutting down CO_2 emissions by as much as 90 %. Metallic materials that can withstand the high electrical currents and high temperatures in the reactor will be necessary. [150]

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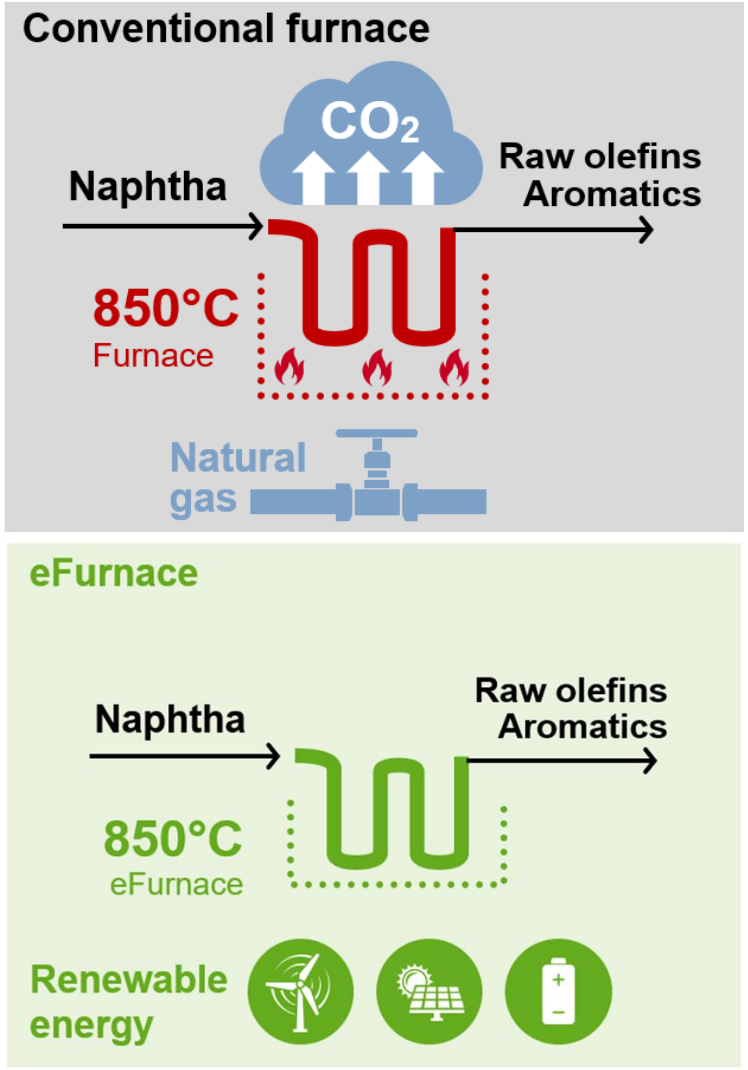
eFurnace – Electrification of steam cracker furnace



- Steam **crackers play a central role** in the production of basic chemicals.
- **High temperatures** needed for cracking process are normally achieved by burning fossil fuels – which emits high levels of CO_2.
- Fundamentally **new heating concepts** (eFurnace) and the use of **renewable energy** could **eliminate up to 90%** of process-related emissions in the future.
- To develop and pilot the concept, we signed a **cooperation agreement** with SABIC and Linde in 2021 and jointly applied for **funding to build a demonstration plant**.

Solutions for a sustainable future

Examples of Accelerator solutions

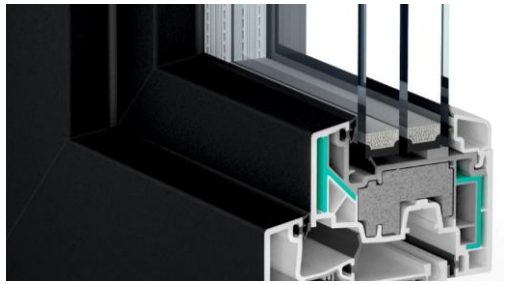
ecovio® M 2351
Biodegradable mulch film for agriculture

Lipofructyl® Argan LS 9779
Organic and fair trade certified argan oil for moisturizing skin and hair care

Merivon®
Fungicide for advanced disease control and plant health

Mattex® PRO
Additive in coatings with lower emissions

Tinuvin® NOR® 356
Highly effective light stabilizer increasing longevity of agricultural plastics



Ultradur®
Improves insulating properties of window profiles

Baxxodur® EC 301
Epoxy system for cost-competitive large wind blades manufacturing

Neopor® BMB
High insulation performance based on BASF's biomass balance approach

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The transformation of the chemical industry needs a suitable policy framework

Climate protection and industrial policy need to go hand in hand to make new technologies successful and applicable

- To make low-carbon technologies competitive, global CO_2 pricing would be the best solution. As long as this is not the case, measures to ensure competitiveness are needed.
- Key element is the abundant and large-scale deployment of renewable electricity at competitive prices.
- Developing infrastructure for hydrogen and electricity based on renewable energy will reduce costs and deploy the potential of different regions
- Innovation needs to be encouraged to incentivize large-scale investments in new, CO_2-neutral production technologies

Questions? Discussion!

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