

News Release

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Innovations for a climate-friendly chemical production

- **BASF pursuing ambitious Carbon Management program, with R&D activities opening up new possibilities**
- **Research Press Conference presents four groundbreaking projects for CO₂-reduced future production processes**

Ludwigshafen – January 10, 2019 – Climate protection is firmly embedded in BASF's new corporate strategy. A central goal of this strategy is to achieve CO₂-neutral growth until 2030. To accomplish this, BASF is continuously optimizing existing processes, gradually replacing fossil fuels with renewable energy sources and developing radically new low-emission production processes. The company is bundling all of this work in an ambitious Carbon Management program. Today, BASF presents the latest research findings on these new processes as well as innovative, climate-friendly products at its Research Press Conference in Ludwigshafen.

“To reach the climate protection targets, a large-scale reduction in CO₂ emissions will be necessary. As a raw material, CO₂ is only suitable in selected applications and such uses will therefore not make a decisive contribution to slowing climate change,” stressed Dr. Martin Bruder Müller, Chairman of the Board of Executive Directors and Chief Technology Officer of BASF SE. In the past decades, the company has already avoided considerable CO₂ emissions by optimizing its production processes and increasing efficiency. Since 1990, BASF has reduced its greenhouse gas emissions by 50% while doubling its production volumes in the same period. “Achieving another significant reduction in CO₂ emissions will require

entirely new technologies, which is why BASF has launched an ambitious R&D program,” said Brudermüller.

Because energy is needed to perform chemical reactions, fossil fuels are the largest source of CO₂ in the chemical industry. BASF’s steam crackers, for example, must reach a temperature of 850°C in order to break down naphtha into olefins and aromatics for further processing. If this energy could come from renewable electricity instead of the natural gas typically used now, CO₂ emissions could be dramatically reduced by as much as 90%. BASF therefore aims to develop the world’s first electrical heating concept for steam crackers within the next five years. At the same time, material testing will be necessary to determine which metallic materials can withstand the high electrical currents and are suitable for use in this type of high-temperature reactor.

The production of hydrogen also releases significant volumes of CO₂. The chemical industry uses large quantities of hydrogen as a reactant. At BASF, for instance, it is used in ammonia synthesis. Hydrogen will also be essential for many sustainable energy carrier and energy storage applications in the future. Together with cooperation partners, BASF is therefore developing a new process technology to produce hydrogen from natural gas. This technology splits natural gas directly into its components hydrogen and carbon. The resulting solid carbon can potentially be used in steel or aluminum production, for example. This methane pyrolysis process requires comparatively little energy. If this energy comes from renewable sources, hydrogen can be produced on an industrial scale without CO₂ emissions.

Development of new catalysts is vital to success

As a central, high-volume intermediate, olefins represent an especially important area where BASF is looking to develop new low-emission processes. The considerable CO₂ emissions resulting from current production methods in the steam cracker could also be significantly reduced through “dry reforming” of methane. This process creates a syngas which is then transformed into olefins via an intermediate step of dimethyl ether. BASF researchers have now been able to find a way to do this for the first time thanks to new, high-performance catalyst systems. These new-generation catalysts are being marketed in cooperation with Linde. Depending on the availability of raw materials and renewable electricity, this innovative process could then be a complement or alternative to the potential electrical heating of steam crackers.

BASF is also presenting a new approach for using CO₂ as a chemical feedstock: the production of sodium acrylate from ethylene and CO₂. Sodium acrylate is an important starting material for superabsorbents, which are widely used in diapers and other hygiene products. A few years ago, researchers at the BASF-supported Catalysis Research Laboratory (CaRLa) at the University of Heidelberg were able for the first time to successfully close the catalyst cycle for this reaction. In the meantime, BASF experts have made important progress in scaling up this process to industrial scale and have demonstrated that it can be successfully implemented at laboratory scale in a mini plant. Compared to the current propylene-based production method for superabsorbents, in the new process CO₂ would replace around 30% of the fossil fuels, provided that a larger-scale process also proves to be stable and energetically favorable.

Commitment to cutting-edge research in the global Know-How Verbund

The four projects presented are representative of the unique portfolio of topics addressed by BASF's research activities, which also include work on groundbreaking innovative leaps. BASF aims to maintain its research and development expenditures at the high level of previous years. These expenditures amounted to €1,888 million in 2017, and the figure for 2018 will be published at the Annual Press Conference at the end of February. BASF's research pipeline includes around 3,000 projects, which are being worked on by more than 11,000 employees in research and development worldwide. An important component of the Know-How Verbund is the network of R&D collaborations with excellent universities, research institutes and companies.

About BASF

At BASF, we create chemistry for a sustainable future. We combine economic success with environmental protection and social responsibility. The more than 115,000 employees in the BASF Group work on contributing to the success of our customers in nearly all sectors and almost every country in the world. Our portfolio is organized into six segments: Chemicals, Materials, Industrial Solutions, Surface Technologies, Nutrition & Care and Agricultural Solutions. BASF generated sales of more than €60 billion in 2017. BASF shares are traded on the stock exchanges in Frankfurt (BAS), London (BFA) and Zurich (BAS). Further information at www.basf.com.

Forward-looking statements and forecasts

This release contains forward-looking statements. These statements are based on current estimates and projections of the Board of Executive Directors and currently available information. Forward-looking statements are not guarantees of the future developments and results outlined therein. These are dependent on a number of factors; they involve various risks and uncertainties; and they are based on assumptions that may not prove to be accurate. BASF does not assume any obligation to update the forward-looking statements contained in this release above and beyond the legal requirements.