BASF Battery Materials: Driving electromobility

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Cautionary note regarding forward-looking statements

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BASF has the broadest offering to the automotive industry

Surface treatment, coatings, pigments
Headliner
Dashboard
Door side part
Window encapsulation
ABS cable
Air intake manifold, charge-air lines
Battery materials
Mounts for powertrain
Lubricants, engine coolants, engine cover
Air-filter housing
Oil pan
Spoiler, lower bumper stiffener
Brake fluids
Steering wheel
Headrests
Roof module
Hatrack
Catalysts
Fuel additives
Carpet, floor mats
Seats, handrests, armrests
Cross beam
Wheel rim
Suspension: jounce bumper, top mount, coil spring isolator
Electromobility is a net positive for chemicals demand per car

- **Emissions control and power generation**
  - Internal Combustion Engine (ICE): Higher demand
  - Battery Electric Vehicle (BEV): +

- **Engineering plastics**
  - Higher demand

- **Coolants**
  - Comparable demand

- **Coatings**
  - Comparable demand
BEVs and hybrids create opportunities in battery materials
But demand for catalysts will outgrow ICE** vehicle production for another decade

** ICE: Internal combustion engine

BEVs with strongest growth rate, ICEs expected to stagnate

Catalysts unit growth driven by regulations globally, further momentum from heavy duty, especially in Asia
Capturing the fast-growing battery materials market

Electromobility drives battery materials growth

Chemistry of cathode active materials is key to address electromobility challenges

Market projections for 2025*
- 10-15 million electric vehicles built per year
- 700-1,000 kt of CAM in electromobility
- €25-30 billion CAM market size

* Electric vehicles: BEV and PHEV; numbers capture various growth scenarios and BEV vs. PHEV ratios
BASF’s position in the battery value chain
Battery cell chemistry defines the success of electromobility

- **Mining**
  - Metal ore mining and upgrading

- **Metal refinery**
  - Metal salt solution and cast

- **BASF Battery Materials**
  - CAM and precursors

- **Systems and applications**
  - Cells batteries
  - OEMs

Shaping the future of electromobility with cathode active materials
BASF drives electromobility
With holistic offer to address key customer needs

- Global manufacturing presence, regional footprint
- Innovative and reliable processes with highest single-train capacities
- Strong pipeline to invest for growth
- Secure supply chain

- Broadest commercialized portfolio of nickel-rich CAM
- Customer proximity of development teams
- Toolbox for CAM customization
- Strong product and process development pipeline
- Extensive IP portfolio
BASF drives key cathode chemistries to improve energy density, lifetime and cost
BASF family of cathode active materials is matching all cell formats

Comprehensive toolbox developed to further customize performance requirements

- Morphology, chemical composition and powder processing are key levers to achieve optimal performance
- CAM materials under development will need to provide optimized balance of energy density, cost and stability

- BASF already supplies various CAM into all cell formats
- All future BASF CAM will be customized for optimized use in different cell formats
Fast-paced buildup of global CAM footprint and scale to win
Already supplying leading cell producers and OEM platforms, secure supply to growing customer base

2012
First CAM production facility in Elyria, Ohio

Europe planned greenfield production

2018
First production volumes at Harjavalta, Finland

2015
Foundation of BASF Toda Battery Materials (BTBM), Japan

2017
Tripled capacity at BTBM in Onoda, Japan

2018
Second CAM production facility in Battle Creek, Michigan; merged with Elyria, Ohio into BASF Toda Americas (BTA)
BASF and Nornickel join forces to supply the battery materials market

- BASF and Nornickel establish a strategic cooperation to meet the growing needs for battery materials in electric vehicles.

Ludwigshafen, Germany, and Moscow, Russia, October 22, 2018 – BASF has selected Hirajvalta, Finland, as the first location for battery materials production serving the European automotive market. The plant will be constructed adjacent to the nickel and cobalt refinery owned by Norilsk Nickel (Nornickel).
Latest news: China
Further strengthening our footprint in Asia

BASF and SINOPEC sign Memorandum of Understanding to expand cooperation in China

Ludwigshafen, Germany and Nanjing, China – October 29, 2018 – BASF and SINOPEC have signed a Memorandum of Understanding (MoU) in Beijing to further strengthen their partnership in upstream and downstream chemical production in China. The partners intend to build an additional steam cracker and to further expand their existing 50:50 joint venture, BASF-YPC Company, Limited (BASF-YPC). A joint pre-feasibility study will be concluded by the end of 2018. Additionally, the two companies will jointly explore new business opportunities in China’s fast-growing battery materials market.

The partners are also jointly exploring new business opportunities in battery materials. The rising importance of alternative energy in China, especially in the automotive industry, has led to a surge in demand for innovative battery materials for a range of applications.
BASF Battery Materials in pole position

- Broadest high energy density CAM portfolio
- Tailored solutions to strong customer base
- Established manufacturing know-how
- Strong innovation and growth pipeline
- Global presence and secure supply chain
- Long-standing strategic partnerships

BASF cathode active materials (CAM)
- Nickel-Cobalt-Manganese (NCM)
- Nickel-Cobalt-Aluminum (NCA)
We create chemistry