



We create chemistry

**Investor Update 2021  
BASF Battery Materials  
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Member of the Board of Executive Directors

The spoken word applies.

Welcome back everybody to the second part of our Investor Update.

**[Slide 1: Title slide]**

The focus of this afternoon session, at least here in Germany, will be our strategy and our path forward for the Battery Materials business.

**[Slide 2: Agenda: The automotive industry transformation is accelerating]**

I will guide you through this presentation. I will start, of course, with a bit of an outlook on the relevant industry, and then home in on the actual product and product characteristics that we talk about for the cathode active material. I will spend most of the time going through our strategy and our steps towards becoming one of the key players of the battery materials value chain and how we will drive profitable growth for BASF throughout the next decade with battery materials.

**[Slide 3: The automotive industry is in the middle of a major transformation towards electromobility]**

I hope I don't have to explain the dynamics of the automotive industry, because there have been very visible developments in this space over the last years. The automotive industry is in the middle of a major transformation. It all circles around the transformation of the drivetrain technology and the move from internal combustion engines to electrified mobility.

We assume in our models that, by 2030, roughly 30 percent of all cars produced worldwide will be either fully electric or a plug-in hybrid version. As you can see, this share will increase significantly, even beyond 2030. The electrification of the powertrain will be the dominant trend in this industry.

What you can also see on the right-hand side is that, by 2030, around 70 percent of all battery electric vehicles will be produced either in Europe

or in China. You will see later, connecting well with our strategy, why China and, in particular Europe, are centerpieces of our strategic approach in this market.

**[Slide 4: Major countries and OEMs have determined that battery powered vehicles are the key technology for the next decades]**

I think what's also quite remarkable is the trend and the acceleration of the trend towards electromobility over the last couple of years. Hardly a week goes by where you do not see an announcement by either a country, an economic region or an OEM committing towards this transformation. I think it's fair to say that we are seeing an irreversible shift that is gaining momentum and it's gaining momentum globally. This is why this acceleration is supporting our strong focus on battery materials and cathode active materials as a key growth driver for BASF Group going forward.

**[Slide 5: Agenda: Electromobility is the biggest growth opportunity in chemicals]**

Let's talk a bit about cathode active materials and the role they play in electromobility. I can tell you: This is a unique opportunity, not only for BASF but for the entire chemical industry, because electromobility is one of the biggest growth opportunities that I have seen in at least the last 20 years in the chemical industry.

**[Slide 6: BASF is the largest chemicals supplier to the automotive industry with a proven track record to outgrow the market]**

It's particularly relevant to BASF because automotive is one of our key customer industries. 20 percent of the Group sales today are connected to the automotive industry through our direct business with OEMs, but also through a lot of tier suppliers and our aftermarket businesses. So, this is a very significant industry for us; our most important customer industry. Of course, if this industry is in the middle of such a big transformation, we are

in a particularly advantageous position to benefit from our strengths in this industry during this transformation.

Over the past decades, we have proven to be a strong solution provider for the automotive industry and we've also proven that we can outgrow the automotive market through our broad and very targeted solutions approach towards this very demanding industry.

**[Slide 7: The chemical content per car is higher in a BEV compared to ICE, with CAM as the single largest growth opportunity]**

The transformation of the powertrain from internal combustion engine to battery-driven provides a significant upside for a chemical supplier like BASF, because the chemical content per car is going to increase significantly. As you can see here, we assume that the chemical content, as we define it, per car is going up by a factor of 2.5 when you switch from a model internal combustion engine car to a fully electrified vehicle.

Of course, the majority of this additional value comes from the powertrain technology, or through the battery. Hence, it has been, for quite some years, a strategic focus for us to capture growth opportunities in this transformation.

**[Slide 8: The market for CAM will grow by ~21% per year and reach a total size of 4,200 kt by 2030]**

This, of course, relates to a very, very strong growth in the market for cathode active materials. We predict that over the next years, until 2030, we will see annual growth rates of north of 20 percent per year. The market size for cathode active materials will reach 4.2 million tons by 2030. This corresponds roughly to a market value at predictable metal prices of roughly 100 billion euros. Just to put this into perspective for you: That is the entire market size of today's polypropylene market. Hence within a decade, we are really looking at the emergence of a major market opportunity that is fully within reach for a company like BASF. This is why

it is extremely attractive to us to participate in this strong market growth.

You also see: The majority of the cathode active materials market will be located in Asia, with Europe a close second and then Americas at a distant third. But this is, of course, a point in time; we assume that, beyond 2030, also especially in North America the market for CAM will significantly increase.

This strong demand growth of global electromobility will drive two things: It will drive the demand for global capacity investments in cathode active materials. We will take a closer look at this. But it will also drive the demand for base metals that today are part of this battery technology. We are talking especially about nickel, cobalt and lithium. We are also going to go a little bit into this.

**[Slide 9: Agenda: CAM is key to electromobility]**

Before we start talking about BASF's approach towards the battery industry and our strategy, I want to highlight a few key characteristics of the cathode active material and the products that are important as a backdrop to understand why we are approaching this business in the way we do.

**[Slide 10: Within the electrified powertrain, CAM allows for the greatest level of differentiation and holds the largest material value]**

First of all, the cathode active material is the key material for driving the desired properties of a battery in the world of future electromobility. Everything circles around performance, safety and cost. In a lot of these categories that you see here on the slide, the cathode active material is the key material that will drive these criteria.

On the right-hand side, you also see a very important point. This is the cost contribution of various parts within an electrified vehicle. As a rule of thumb, you can say that out of a cost of a battery-powered vehicle, about

one third is the battery. From the battery cost, about one third is the cathode active material. So, the cost impact of these materials towards a car and, with this, also towards the profitability of an OEM, is significant. I think the automotive industry has never been exposed to a single component like the battery that has had such a big impact on the cost composition of a car and also its profitability.

**[Slide 11: Among the CAM options, high-Ni NCM is the superior chemistry and will lead the market going forward]**

When we talk about cathode active materials, there is, of course, different chemistries that are already established and deployed in the market. If we choose a very rough segmentation, you can talk about nickel-based technologies – this is typically NCM or NCA-type materials, so nickel, cobalt, manganese or nickel, cobalt, aluminium – and then there are also the so-called LFP materials – this is lithium iron phosphate materials – that are already deployed today, typically in lower cost cars, where performance and range are not such a big driver.

We believe that both of these technologies, nickel-containing as well as LFP-based batteries, will have a future. They will both grow significantly. But we are also convinced that, in the long run, nickel-based materials like NCM and NCA will be the prevailing technology that we will see in the market.

However, there is a certain complementarity when you talk about properties, as you can see indicated on the right-hand side. But we believe that the playing field for NCM materials, also relating to cost development, is still allowing a strong competition also with LFP materials. I would even argue that, if you look holistically at the Battery Materials business and you incorporate a closed-loop philosophy and you take recycling into account, that NCM will play out its strengths even further.

So, the message is: Yes, LFP has a certain place and position; it will be in the market; and it will strongly grow. But we still believe that NCM is going to be the dominant technology.

**[Slide 12: Base metals make up ~60% of the CAM cost, therefore low cost and reliable sourcing is imperative to achieve competitiveness]**

The third topic that I want to quickly touch on is the importance of metal supply and of metals to the cost structure of a cathode active material. You can see here that about 60 percent of the cost for a cathode active material are made up of the cost of the key metals that are introduced into this material and this is nickel, lithium and cobalt. In particular for nickel and lithium, we project that these materials will be tight when the electromobility trend develops as projected, especially towards the middle of the decade. Security of supply and competitive sourcing of these materials will be key to success for everybody in the battery materials value chain.

**[Slide 13: Agenda: BASF has a clear strategy to become a leading CAM player]**

With these key characteristics, let's jump into what we are doing and how we are approaching the field of cathode active materials and want to become a leading player in this battery industry.

**[Slide 14: Already today, BASF is at the forefront of CAM innovation, meeting market and specific customers' needs across the globe]**

Let's start with a picture of who we are today in this industry. As you can see, we started already more than 15 years ago. We have a lot of experience in this field of chemistry, in this product area. We might have been a little too early with some of the developments that we started 15 years ago, but the result of that is that we have a very strong and very powerful IP portfolio that will be a critical success factor also for us going forward.

You can also see that we are an established CAM producer already. In 2021, with capacities of more than 40,000 tons of CAM being completely sold out, we are a significant player already today in this industry. We strengthen this position by our recent joint venture formation with Shanshan in China and we will have 160,000 tons of capacity in 2022, including the Shanshan capacities and the start-up of our European plant in Schwarzheide.

You can also see that this is a quite innovative area. We have just short of 2,000 people working in battery materials and about 300 of them are scientists and engineers. So, you can see: This is a very technical and innovation-driven area. I am going to get back to this as well.

**[Slide 15: For BASF, four interdependent areas form the key elements of success in the global battery materials business]**

Strategically, we are looking at the Battery Materials business as a business with four distinct pillars. We believe that the integration of these four pillars really creates a powerful proposition for customers in this industry, i.e., the cell producers but also the OEMs. We are also convinced that we have to deploy these strengths in these four distinct areas on a global scale.

There are two reasons for this: First of all, the automotive industry is not interested in creating another supply chain that is so critical to their future success that is dependent on one region alone. Hence, the localization of the important capacities in all major markets is a key driving factor for their strategies. On the other hand, the market for battery cells will be dominated by a few very large players. They do not have the capacities or the strategies to work with a large number of suppliers, but rather with a few key suppliers that can also work with them and develop new platforms with them on a global scale. This leads us very strongly to a strategy to globalize our Battery Materials business.



You can see: The four pillars are clear; they are CAM, the actual material, it's precursor PCAM. Also, the metals and battery recycling will be key components of this integrated model that we bring to this market.

This will all be embedded into a trend that is unstoppable in the battery materials market and is increasingly becoming a key priority for every customer discussion. This is sustainability. This relates to CO<sub>2</sub> reduction, of course, in the battery material itself, but it also relates to the recycling activities, so closing the loop and making sure resource efficiency is driven to the highest level.

Now let's look at the right-hand side and let's talk about metals and recycling in a first step.

**[Slide 16: We combine metal sourcing by trading and recycling globally, copying the business model established successfully for PGMs]**

We have the strategy to build our metals position around the successful business model that we have established over many decades in the precious metal recycling area. It goes way beyond just a normal backward integration of sourcing materials. It will contain primary sourcing of critical materials from strategic suppliers, but it will also include secondary sourcing and the connection to a recycling business. But it will also contain an asset-backed trading arm, so that we can, at the end of the day, offer our customers holistic management of price and liquidity risk and also improve our cost position and take risk out of our supply chain. So, overall, this model is what we have in mind.

**[Slide 17: We establish a secure supply network in close proximity to our production sites across regions]**

We started with some already published cooperation projects. Many of you will know about our long-term supply agreement with Nornickel to supply nickel and cobalt for our precursor plant in Finland; I will get back to that

in a second. But we also have engaged in a pre-feasibility study with the French company Eramet to look into opportunities to source and refine cobalt and nickel intermediates in Indonesia.

I would expect that, in the next years, you will see quite a number of different arrangements that BASF will enter. We will utilize and deploy the full range of models, from supply agreements to partnerships, also to backward integration and potential equity investments where necessary.

**[Slide 18: Competitive recycling capabilities will be a key success factor]**

The next topic is recycling. It is a topic that will become very relevant in this industry. However, it will become relevant a bit later because the availability of end-of-life batteries will only emerge when this industry is at a certain maturity range. We have already announced that we will enter this business by investing into a prototype plant here in Germany. You can see a picture of this plant already on this slide. We will, of course, then back this up with a full-scale investment at a later point in time, probably towards the middle of the decade. This would also be an investment in Europe.

This recycling business will cater to three strong demands in this industry. The one is complying with the battery recycling philosophy that many industry participants, but also regulators have. Second, it's reducing the need for virgin material. Since, as I mentioned, nickel and lithium in particular will be in tight supply for quite some time. This means that recycling material is, of course, of a significant value as a complement to the physical supply of metals.

Thirdly, this is all a strong contribution to lowering the CO<sub>2</sub> footprint of the cathode active material because recycled metal comes with a significantly lower CO<sub>2</sub> footprint than virgin material that comes out of a mine.

We will deploy a BASF proprietary process to this which we are finalizing as we speak. This will focus on reducing the CO<sub>2</sub> footprint to best-in-class levels, but also achieve industry-leading recovery rates of the key metals and especially of lithium where we will be able to extract lithium in the exact right form that it can be redeployed into the manufacturing of CAM directly out of our recycling plant. This gives us a key competitive advantage in the recycling business.

**[Slide 19: For BASF, four interdependent areas form the key elements of success in the global battery materials business]**

Now, let's look at the other side of these four pillars. Here it's all about the finished products or CAM and its precursor, the so-called PCAM.

**[Slide 20: PCAM and CAM are high-performance materials customized for the specific requirements of each individual customer's battery system]**

One thing is very important to understand: There is no one-size-fits-all CAM in this market. These CAM materials are highly customized materials towards the specific requirements of individual cell producers or OEMs. You can see here: The complexities come from the various sub-segments and cell designs.

First of all, there are different types of CAM materials for different needs in the overall electromobility market. On the other hand, there is a huge variety of different cell designs e.g., but also very customer-specific philosophies around chemistries that are being deployed or certain particle distributions or designs of the cells themselves.

This all calls for highly-customized development of these CAM materials in very close cooperation with customers. I am sometimes surprised when I hear market reports about CAM and everybody talks about a generic overcapacity in the market. From my perspective, this is not so relevant because you have to look specifically at whether the material is actually

something that could be deployed by a cell manufacturer because it's commercially viable and technically qualified. I think this is a very important consideration.

If you want to be successful in this market, you need close connections and close collaborations with cell manufacturers and OEMs. This also requires strong R&D capabilities in the regions where these cell manufacturers and OEMs sit. It also requires a strong IP portfolio because you have to adapt this product according to quite a number of variables according to the customers' recommendations.

This is an innovative market. I will talk to you a little bit about the product innovation space, but in particular about process innovation. From our perspective, both of these dimensions will play a key role in the battery field going forward.

**[Slide 21: Product innovation enables the broadest CAM portfolio in the industry, and we continue to add new solutions]**

This shows you a bit the playing field of an NCM material. As you can see, there are quite a number of variables, especially with the metals composition that you can see today in the market. This shows how variable and how broad our technology portfolio is already today. We see a couple of trends in the industry, e.g., going to very high-nickel materials to drive the performance of battery materials and of battery cells very high. But we also see, especially recently, trends towards high-manganese materials that, on the other hand, will be attractive for the lower cost sub-segment for example high-volume models to compete with LFP-based batteries.

This whole playing field is very dynamic, and we will see a lot of different technologies being deployed and further developed. So broad capabilities in manufacturing and developing these types of products, plus the appropriate IP portfolio are going to be critical.

With our recent joint venture formation with Shanshan, we have a combined materials portfolio that technology-wise fits very well together. Shanshan traditionally comes from a more consumer electronics background, so some of the technologies that they bring in complement our strengths and IP positions very well.

**[Slide 22: BASF strategies for modularization and process innovation will further drive down the cost of PCAM and CAM production]**

I already told you that also process innovation is a key driver in this industry. It's fair to say that here BASF can play to our traditional strengths of putting great chemical engineers and process-development chemists to the task of improving a technology that is fundamentally still the same technology that was deployed when lithium-ion batteries were invented in the 1970s in Japan.

When we talk about CAM 1.0, we basically talk about a plant design and a process that we deploy today in Schwarzheide. We have a lot of activities underway and partly finished where we are focusing on the plant design itself, so lowering specific capex to build those plants and to nurture their future growth, but on the other hand, also to change the chemical process of making these PCAM and CAM materials and lowering our cash cost significantly below today's benchmark. We are already at this stage with our first-generation process that we will invest in Schwarzheide, but we will see further opportunities also going down the road. If we end up at CAM 2.0, which is our vision and which is basically the technology we will deploy in the next investment phase in Europe, we will be in an even better position than we are today. We believe that there are a lot of learning curves still to be made.

**[Slide 23: BASF has production assets and R&D hubs in close proximity to the most important BEV markets in every region]**

When you look at the strategy of our growth in CAM materials, it can be nicely explained with this world map. As you can see at the upper left-hand side, already in 2012, we invested into the first cathode active material plant in North America. We were maybe a little bit ahead of our time, but the real breakthrough, I would say, came with our joint venture formation 2015 and the expansion in 2017 of our Japan operation, the BASF Toda joint venture that was formed in 2015.

We then entered the BASF Shanshan joint venture in China. We will talk about this. Our key investment project right now is the establishment of a European footprint in cathode active material and in PCAM.

**[Slide 24: Our unique European production set-up progresses well with available capacities already fully contracted to strategic customers]**

This footprint you can see here. We have established a unique European footprint with our set-up: That starts with a precursor plant in Finland which is integrated with the base metal refinery of Nornickel. They are basically next to each other and the intermediates are being transported without isolation from one plant to the other. That gives us some integration advantages there. The base metal refinery is directly supplied from Nornickel's sources and mines in Russia.

This precursor material is then transported to Schwarzheide and will be converted to CAM material that we will supply to customers predominantly in Europe. This capacity of 24,000 tons, will be started up in 2022. As of today, we are still roughly a year before full operation. The plant is already fully contracted to strategic customers.

Of course, we will also, in particular in Europe, deploy all technologies to reduce the CO<sub>2</sub> footprint of our PCAM and CAM materials. I will show you

some data in a second. This is particularly important because the European market will be undersupplied with cathode active materials for quite some time. If you look in the announcement of cell capacities that are going to be built and projected in Europe, and you can compare this to the announcement of cathode active material supplies, you can see that there is a heavy under-supply. This gives us tailwind for European investments because the interest from the OEMs is not to have a full dependency on imported material. So, there is a lot of pressure to expand cathode active materials capacity in Europe and to reduce the sustainability impact that this material will have in the final battery. This is, of course, done much more easily with a local manufacturing footprint.

**[Slide 25: With Shanshan, we reduce our time to market, gain immediate access to further capacity and bolster our R&D capabilities]**

In China, I already mentioned our new joint venture. We just formed the joint venture four weeks ago. Right now, we are in the phase of really getting into the business and getting our hands onto it.

But the reasons to get into this joint venture for me are very striking if you understand the background of this industry. First of all, it gives us much better customer proximity and time to market. If you look at the dominance of the Asian cell manufacturers today, we believe that this will also be very much an Asian play in the future. Very important cell manufacturers will make the key decision for their future platforms, for their technology developments in Asia and particularly in China. We are therefore convinced that you need a strong position in China to be part of this development cycle and be able to supply them with competitive materials in their home country and then being able to globalize together with them.

On the other hand, we gain access to immediate further capacity. As I said, 90,000 tons of additional capacity already by 2022 will be available for

business in China, but also to support our business growth in Europe and in North America, for example with export material from these very competitive capacities that Shanshan has built over the last years.

Thirdly, it will complement our R&D activities. The Shanshan team has 200 people in R&D and has over time become a very capable developer of cathode active material. There is a nice fit and a nice complementarity between BASF and Shanshan. We assume this will be an important steppingstone towards becoming a strong global player in this market as well. I also have to say: This is a quite profitable company. This shows that the competitiveness of Shanshan and their acceptance in the market is on a very high level.

**[Slide 26: We establish close customer collaborations and strategic partnerships across the entire battery value chain]**

On this slide you can see recent announcements that we have made on collaborations, and customer engagement in this market. We have seen an accelerating interest in BASF as a global partner for long-term development projects. Of course, we can't talk about all the collaborations we have with cell producers and OEMs due to confidentiality, but here are just some examples where we have clearly communicated intentions to develop a strong business going forward with industry champions like CATL or SVOLT from the cell manufacturer side, Porsche from the OEM side, and also a couple of big customers on the consumer electronics side. This is the business that Shanshan brought into the joint venture.

**[Slide 27: As a result of our holistic approach, we can offer CAM products with best-in-class CO<sub>2</sub> footprint with further reductions planned]**

I want to switch gears a bit and go back to the topic that I said will, at the end of the day, enclose our entire strategy and drive everything that's going on in this battery market.



Sustainability is the reason why we are in batteries in the first place. Lowering CO<sub>2</sub> footprint is going to be a key requirement also by OEMs and cell producers. With our holistic approach towards setting up our capacities as we have here in Europe, we can already demonstrate that we are advancing very quickly towards having the best-in-class CO<sub>2</sub> footprint. You can see that we have clearly identified steps to get our CO<sub>2</sub> footprint down even further to be significantly ahead of competition when you compare this to imported materials.

**[Slide 28: We have established several projects to ensure that the value chain we are building is best-in-class regarding ESG criteria]**

This is just one element of a very holistic strategy that we have around sustainability as an overall guiding principle. This relates to the sourcing of metals, it relates to the recycling part, and it relates to lowering the CO<sub>2</sub> footprint of our materials in our operations. It goes way beyond just an individual sustainability measure, but there is a holistic strategy behind it.

This is why we also engaged very early on in industry initiatives like Cobalt for Development or the Responsible Minerals Initiative, already preparing for the upcoming sustainability requirements, especially when it comes to the metal value chain, which will also be key to have a license to operate in this industry.

**[Slide 29: Agenda: Financials and key takeaways]**

Let me show you our financial aspirations and projections for the Battery Materials business, also looking out to 2030.

**[Slide 30: The Battery Materials business will become a significant earnings contributor to the BASF Group]**

We target to build a business in cathode active materials with roughly a 10 percent market share which corresponds roughly to sales of 7 billion euros by 2030, 1.5 billion euros already will be achieved by the year 2023. We also assume EBITDA margins will be north of 30 percent if you exclude

the metals value out of this business. We currently assume that capital expenditures by the end of the decade will be around 4 billion euros. Of course, here it's a lot harder to predict the exact capex spend because it will come in various projects.

The industry development in batteries is quite dynamic. So, clarity around capex is not really possible to the extent that we saw earlier for our Zhanjiang Verbund site. But the order of magnitude is useful and if you look at investments between CAM, PCAM, recycling, this is the range we are currently projecting.

**[Slide 31: BASF Battery Materials: Key takeaways]**

Let me close by saying that we are committed to going through the transformation of the automotive industry together with our customers. We want to play a key role as a solution provider for the automotive industry now and in the future. We believe that electromobility and particularly cathode active materials will play a key role in this industry.

We have a sound strategy of an integrated business model, bringing our strengths and chemistry on the PCAM and CAM side together with holistic business models and sustainability-driven strategies around metal sourcing, trading and recycling. This is going to be a great platform for BASF to capture this biggest growth opportunity in the chemical industry and will provide, at the end of the day, a great platform for profitable growth for BASF until 2030 and beyond.

Thank you very much for your attention.