

FROM THE CEO

LETTER TO SHAREHOLDERS

On behalf of the Management Board, I hereby present AMG's 2019 Annual Report. 2019 was a year of advancement on several key strategic themes which are cornerstones of our strategy for long-term value creation.

Dear Shareholders,

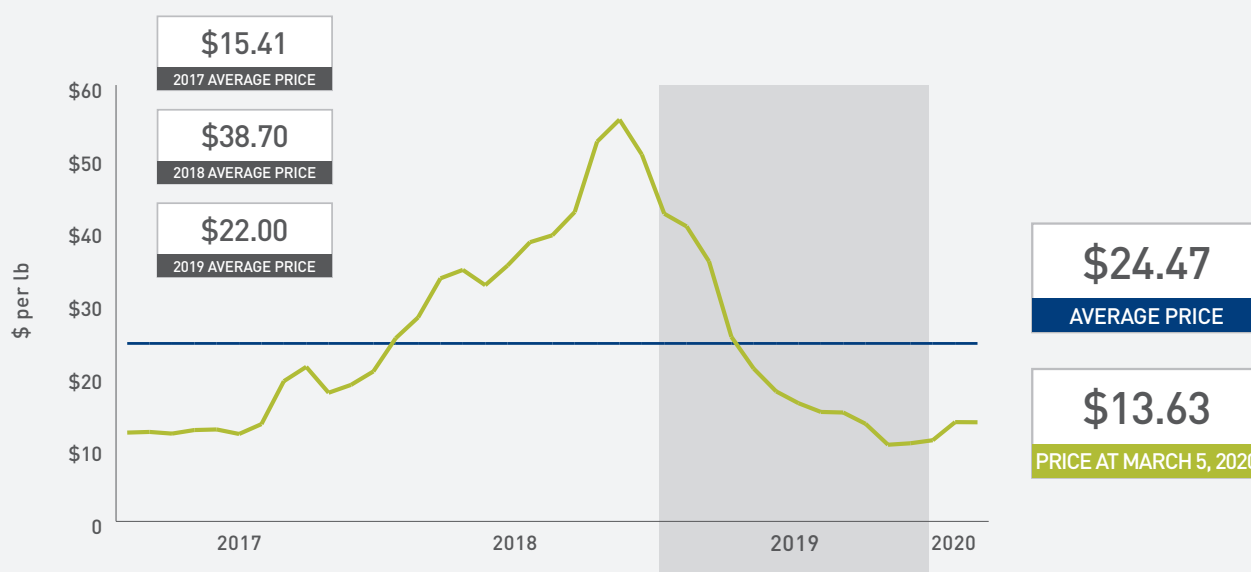
For AMG, 2019 was a year with strong operational headwinds in the form of unprecedented low prices for our key products which further declined even after we thought the bottom had been reached. Despite these price headwinds facing our operating units—with prices across the board substantially below even 2008 crisis levels—AMG achieved an EBITDA of \$121 million, an operating cash flow of \$47 million, and a return on capital employed of 13.7%. It is important to note that even at these low prices, all nine AMG business units were EBITDA positive, indicating that our focus on being the low-cost producer in each of our niche markets was successful. As usual in the AMG portfolio, AMG Technologies operated under different cycle times, and acted as an EBITDA stabilizer. The vanadium market posed a special challenge with the upward price spike in 2018 followed by a sharp downward price trough in 2019, negatively impacting EBITDA by more than \$70 million compared to the prior year. This effect is described in more detail in the Critical Materials section of this Annual Report. Most importantly for the future, we executed a contract that helps to eliminate the inventory spike risk by selling our ferrovandium production to Glencore under a 6-year agreement at indexed prices.

2019 was a year of advancement on several key strategic themes which are cornerstones of our strategy for long-term value creation. The **dominating theme** in 2019 has been AMG's success in **enabling the circular economy** and is featured on the cover page of this Annual Report. This

success is highlighted by our project in Ohio to double the capacity of the world's largest vanadium recycling facility which extracts vanadium from refinery waste. Other important themes advanced in 2019 were the pursuit of an innovative value chain by AMG Mineração, Brazil, and AMG Lithium, Germany; the integration of AMG Engineering and AMG Titanium Alloys & Coatings into a new division called AMG Technologies as a first step, prior to seeking a separate listing; and the successes in AMG's comprehensive approach to enable CO₂ savings by our customers, an approach which has now taken on the status of a mission throughout all of AMG and was the theme of last year's Annual Report. All of these strategic themes work well with AMG's approach toward its stakeholders and within AMG's strategic framework and its overriding objective to create long-term value. AMG's strategic objectives, as first formulated and adopted in 2017, are unchanged and are continuously monitored, taking into account the changing economic environment and AMG's priorities and opportunities.

As a reminder, AMG's comprehensive approach to CO₂ savings started several years ago when we developed a methodology to measure tons per annum CO₂ savings associated with the use of certain AMG products by our customers. In the interim, we have made significant advancements across our entire product portfolio. Cooperating with a third party, ERM Group Inc, we have upgraded our in-house analytics and developed and

FERROVANADIUM PRICE TREND SINCE 2017



Pricing source: Metal Bulletin's Ferro-vanadium 70-80% V, in-whs Pittsburgh, \$/lb
 Note: average price defined as the average of the monthly prices from January 1, 2017 through March 5, 2020

are implementing what we believe to be a best-in-class proprietary measurement methodology. In addition, we are continuously improving our methodologies by working with carbon exchanges to qualify certain CO₂ savings associated with AMG's technologies as tradable "products." As a result of these efforts, we are proud to announce that we have enabled 67 million tons of net CO₂ savings on an annualized basis. CO₂ saving activities have become a defining element of AMG's corporate strategy, developed step-by-step over many years across our portfolio.

THE VANADIUM RECYCLING EXPANSION

During 2019, we commenced construction of our second recycling plant for the production of ferrovanadium and other alloys from refinery waste (vanadium-containing spent catalysts and similar residues), solidifying our position as the world's largest recycler of such secondary materials by using our proprietary best-in-class process technology. The new plant is located in Zanesville, Ohio, and will double the capacity of the first plant in neighboring Cambridge, Ohio.

In order to finance the Zanesville project, we were able to secure \$325 million of funding from a tax-exempt bond issue with attractive conditions (30-year maturity, 4.28% fixed interest).

Subject to regulatory approvals, we also formed Shell AMG Recycling B.V. ("Shell-AMG"), a joint venture equally owned by Shell Catalysts & Technologies and AMG for the

construction of refinery waste recycling plants outside of North America. The IMO 2020 legislation, reducing the sulfur levels in maritime fuels from 3.5% to a maximum of 0.5%, has led to a growth trend in refinery catalyst consumption, which in turn implies a growth trend in spent catalysts. Additional recycling capacity will be needed. That is one of the main drivers of this joint venture.

As a first major step for the new joint venture, subject to regulatory approvals, both Shell and AMG signed a memorandum of understanding with the Saudi Arabia Government Investment Authority (SAGIA) for a feasibility study for the construction of an Ohio-type refinery waste recycling facility in the Kingdom of Saudi Arabia.

EXPANDING VANADIUM MARKETS

We achieved significant progress in the process technology to convert roasted spent catalyst (the first step in our process to reclaim metals from spent catalysts by removing sulfur) to vanadium pentoxide ("V₂O₅"). Our plan is to use this V₂O₅ in the production of electrolytes for vanadium redox flow batteries ("VRFB"). VRFBs are a highly competitive solution for stationary electricity storage. This application represents an exciting new vanadium demand category, primarily to facilitate grid-stabilization. To better understand this potentially very large market, AMG has filed an investment application with the German regulatory authorities for the construction and operation of a VRFB with a planned operating capacity of 55 MW/220MWh.

CAMBRIDGE, OHIO PLANT



ZANESVILLE, OHIO PLANT (UNDER CONSTRUCTION)



There are high growth expectations for stationary battery-based electricity storage systems in general, and for VRFBs specifically, which are usually expressed in multiples of today's storage capacity. Advantages for VRFBs when compared to lithium-ion batteries include, first and foremost, safety (due to no fire risk from thermal runaway), long lifetime cycles, low operating cost, ease of recycling (100% of the vanadium is reusable), and very fast response time. There are people who agree with these advantages but have concerns about the volatility of vanadium prices. The world's largest VRFB, the Dalian Province-based project built and operated by Rongke Power, incurred a major commissioning delay when it entered the market for a substantial vanadium purchase only to face the very same 2018 upward price spike referred to earlier.

AMG is positioning itself to act as a partner for aspiring battery operators, mitigating the V_2O_5 price risk. Since expanding wind and solar energy production, with their inherent intraday cycles (sun) and the inherent volatility (wind), requires expanding electricity storage capacity, and because the conventional pumped hydro storage is of limited use in these situations, the use of vanadium oxide for VRFB electrolytes adds another dimension to AMG's relevance in the reduction of CO_2 emissions, namely by making renewable energy more efficient.

LITHIUM: NEW CHEMICALS VALUE CHAIN

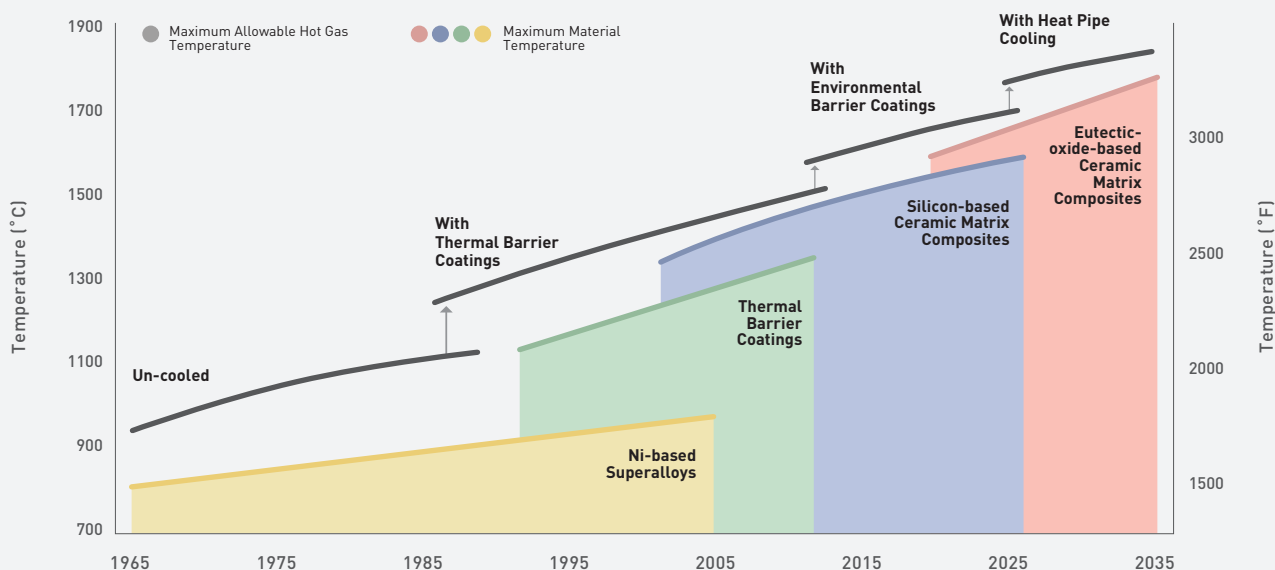
In 2019 we substantially completed the build-up of a highly experienced team in the lithium chemicals space, thereby providing the necessary human resources to develop and implement a revised downstream strategy

within the fast-moving landscape of emerging European lithium battery initiatives.

The lithium world has changed considerably within the last 24 months. The supply chain for the electric vehicle sector in Europe is in rapid formation. In this context, we have revised our lithium strategy to match the requirements of that emerging supply chain. As announced, we are completing the preparatory stages to invest in a lithium hydroxide refinery to be built in Zeitz, Sachsen-Anhalt. This facility will upgrade a variety of lower-grade lithium chemical products into high-quality material suitable for usage in lithium-ion battery cells. We talk about the whole spectrum of quality here, not only chemical specifications but also a quality assurance system to comply with automotive quality standards. This battery-grade hydroxide plant will also have the advantage of being in close proximity to our European customers. The first module will be designed to deliver 20,000 tons per annum of battery-grade hydroxide to the market by the end of 2022/beginning of 2023. The production site will have the potential to support 4 more such modules.

We have commissioned a state-of-the-art laboratory and pilot plant operation for lithium chemical product development and testing in Frankfurt-Hoechst. This facility enables us to analyze the performance of certain lithium-based materials. We will also utilize our in-house expertise for the development of new lithium materials which target the next generation of lithium-ion batteries. We are actively supporting our customers in developing these new materials. As an example, we are now investing in a

THERMAL BARRIER COATING REVOLUTION



Source: Wadley Research Group, University of Virginia, 2013

new pilot reactor which will produce substantial amounts of sulfur-containing lithium battery materials designed for solid-state lithium batteries.

AMG CRITICAL MATERIALS

The strategic fundamentals of AMG which we have pursued for over a decade are leading the Company to an important crossroads. The common theme of **AMG Critical Materials** has been to manage global value chains from unconventional origins and transform them into highly refined products for sophisticated end-market applications. Regarding vanadium and lithium, this has led to plant construction projects in the US, Germany, Brazil and now—together with Shell—in Saudi Arabia. As a result, we are about to change the portfolio substantially. The \$300 million investment in Zanesville, Ohio, is equal to the total capex of AMG over the last 5 years. The size of this project illustrates the significance of the change happening within AMG, which has in turn caused an adjustment of our management structure.

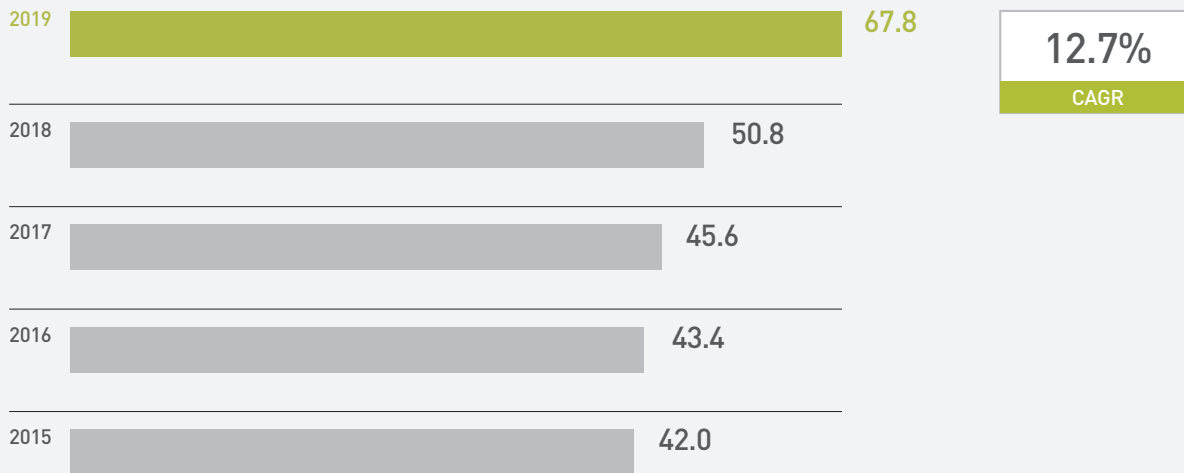
AMG TECHNOLOGIES: IPO READINESS

AMG Technologies is at the forefront of many recent advancements in aircraft engine technology, both in terms of technologies and materials. AMG Engineering's turbine blade coating equipment enables aircraft engine manufacturers to increase operating temperatures way beyond the physical limitations of the base materials by coating nickel-based superalloy blades in the high-pressure combustion section of the engine.

In 2019 it became obvious that AMG Titanium Alloys & Coatings and AMG Engineering should be a business unit under one operative and strategic management team. Combining engineering and operational knowhow worked well when we created a vacuum technology-based heat treatment services unit, which did not sell machines but owned and operated them. This route usually leads to accelerated learning; so we asked ourselves why don't we apply this experience to our core metallurgical furnace field? The answer to that obvious question became AMG Titanium Alloys & Coatings' "own-operate" activity, in which it owns and operates furnaces produced by AMG Engineering to manufacture titanium aluminides. This change in strategy has led, over many years, to market leadership in titanium aluminides, where AMG is presently the key supplier to the new generation LEAP engine platform for this material. This platform is expected to deliver more than 100,000 engines over its 20-year lifespan. Using proprietary Plasma Melting systems, we produce titanium aluminide feedstock for blades in the low-pressure turbine section of the Leap engine. Furthermore, AMG Engineering is the lead supplier of Thermal Barrier Coating equipment for that same engine, used to coat nickel-based superalloy turbine blades utilized in the high-pressure combustion section.

The management focus of **AMG Technologies** is the development of new technological solutions which enable aerospace engines to be more fuel-efficient and to offer our customers—the major US and European aerospace engine producers and their supply chain partners—a host of services related to these product lines. One such area

AMG'S ENABLED CO₂ EMISSION REDUCTIONS
(Million MT)



of development for AMG Technologies has been in the realm of additive manufacturing. In 2018, AMG Titanium Alloys & Coatings commissioned a new powder metallurgy furnace, designed and built in-house by AMG Engineering, and is currently in the process of developing new high performance metal powders for additive manufacturing in the aerospace market. Furthermore, AMG Engineering is developing new technological solutions in the additive manufacturing field which we believe will deliver substantial cost and productivity improvements when compared to the existing product offerings available today from our competitors. It is worth noting that additive manufacturing adds another dimension in advancing the circular economy by eliminating the waste associated with traditional manufacturing techniques.

These key market positions developed over many years resulted in substantial earnings growth and, combined with new technologies and products currently under development, will position the business for continued growth moving forward.

The ideal skill set for AMG Technologies' future development has only a small overlap with the skills needed to develop AMG Critical Materials. Furthermore, AMG Technologies has opportunities for growth through industry consolidation and through the nurturing of technology startups to develop new materials and coating technologies. Therefore, since the beginning of 2019, we have been developing a route to a separate public listing of AMG Technologies. To this end, we have appointed ABN AMRO and Citi as Joint Global Coordinators of an Amsterdam IPO. Presently, the priority is to establish

AMG Technologies' IPO "readiness," including corporate reporting structures and respective audits, and then await appropriate market windows. Upon its public listing, AMG Technologies will be a truly standalone public company where AMG's Board representatives will be joined by a majority of independent board members.

CO₂ SAVINGS

Let me mention a few of the CO₂ saving successes that led to the net CO₂ savings of 67 million tons on an annualized basis in 2019. First, the use of ferrovanadium in steel alloys provides a lightweighting effect, reducing the quantity of steel required. If 100% of AMG's ferrovanadium production in 2019 had been used for (Chinese) rebar, the annual savings would be approximately 1.2 million metric tons of CO₂. Second, natural graphite-based graphite polystyrene insulation materials, compared to conventional expandable polystyrene materials, leads to lower domestic heating and cooling requirements. Given our deliveries to graphite polystyrene customers, AMG's product saves approximately 1.0 million tons of CO₂ per year. Third—and much more dramatic—CO₂ savings in aerospace engines are achieved by AMG's turbine blade coating which allows the operation of the engine at higher temperatures, thus enabling significant fuel reduction. Given our global turbine blade coating furnace footprint, these fuel savings add up to an annual reduction of 46.3 million tons of CO₂ emitted per year. This is the biggest CO₂ savings success for AMG over the years.

In 2019 we signed a long-term contract for the delivery of sintering furnace systems to the government of China to

convert plutonium into **MOX (Mixed Oxide)** fuel for use in nuclear power plants. The calculated CO₂ savings—given the amounts of plutonium converted versus the average CO₂ production of Chinese grid electricity—is more than 12 million tons annually. That will show up if and when the conversion operations start. AMG is the sole supplier of that conversion technology through our subsidiary ALD France in Grenoble, France. You can appreciate the benefits of this arrangement in various ways: (i) it is profitable; (ii) it reduces the atomic weapons potential (with, obviously, everyone as a stakeholder); and (iii) it saves CO₂ by providing clean energy.

MOX Sintering Furnace



BALANCE SHEET SOLIDITY

Reflecting on our long-term strategy, the strength of our balance sheet and ample liquidity bear mentioning. Although we are planning on spending significant capital on our Zanesville ferrovandium facility over the next two years, all of that money has been raised and is sitting on our balance sheet in the form of restricted cash—i.e., the use of that cash is restricted to expenses related to building that plant. To put it another way: the entire Zanesville plant has been paid for with a 4.28% 30-year bond, and it will not require any cash or cash flow from AMG NV. At AMG, as of December 31, 2019, we have \$226 million in cash plus \$170 million available from our revolving credit facility for a total liquidity of \$396 million. If you include our yearly operating cash flow together with these figures, you will see that AMG can easily meet its dividend obligations as well as its maintenance and growth capital expenditures. The strength of AMG's balance sheet is a key competitive advantage, and we intend to protect it zealously.

COMPLIANCE

Finally, I wish to say a word about AMG's culture, its values, and the importance of compliance. AMG's Values—safety, value creation, respect for people and integrity—form the basis of how we conduct our operations and deal with our employees, business partners and stakeholders. Based on our Code of Business

Conduct and Speak Up & Reporting Policy, as well as other essential policies such as those concerning anti-bribery and anti-corruption, antitrust and competition law, we have built a dedicated legal & compliance organization with a Chief Compliance Officer that reports directly to the Chairman of the Management Board and who is heading a core compliance team, assisted by a global network of local compliance officers mirroring all AMG locations worldwide. This seamless and dedicated network keeps compliance's ear to the ground and safeguards permanent monitoring and improvement of policy promotion and implementation. It also coordinates comprehensive ethics training programs for all AMG staff, as AMG highly values continued learning and improvement of knowledge in this area.

As I have told my fellow employees at AMG on many occasions, success without integrity is no success at all. The AMG leadership team strives to live up to the AMG Values on a daily basis and aims to set a clear example of the behavior and attitude required from all our employees.



DR. HEINZ C. SCHIMMELBUSCH
CHIEF EXECUTIVE OFFICER