



United Nations Global Compact

Communication on Progress Covering Calendar Year 2014

8th April 2015

To our Stakeholders:

I am pleased to confirm that once again this year AMG Advanced Metallurgical Group N.V. ("AMG") reaffirms its support of the Ten Principles of the United Nations Global Compact (UNGC) in the areas of Human Rights, Labor, Environment and Anti-Corruption. Our Code of Business Conduct and Policy on Human Rights, both of which are available on our website, set out our commitments to act ethically and uphold the ten UNGC principles in all of our business activities.

In this annual Communication on Progress, we describe our actions to continually improve the integration of the Global Compact and its principles into our business strategy, culture and daily operations. We also commit to share this information with our stakeholders using our primary channels of communication, primarily the AMG website www.amg-nv.com.

Sincerely yours,

A handwritten signature in blue ink, appearing to read 'Heinz C. Schimmelbusch', is positioned above the printed name.

Dr. Heinz C. Schimmelbusch
Chairman of the Board and Chief Executive Officer

HUMAN RIGHTS

- Principle 1 - Businesses should support and respect the protection of internationally proclaimed human rights

AMG Advanced Metallurgical Group explicitly supports the United Nations' Universal Declaration of Human Rights. Although always an integral part of AMG, our formal commitment in this area started in 2009 with the publication of our Code of Business Conduct. This was augmented in 2011 by the publication of our Policy on Human Rights. Both of these documents can be found in the Corporate Governance section of the AMG website, and the Human Rights Policy is shown below:



Policy on Human Rights

AMG Advanced Metallurgical Group N.V. is a global company operating in a global market. We rely on our employees to implement our ethical values to ensure our business is conducted in a way that values human rights. We formally support the United Nations Global Compact including its labor, environmental, anti-corruption and human rights aspects. With respect to human rights:

AMG supports and respects the protection of internationally proclaimed human rights and will work to make sure it is not complicit in human rights abuses.

The key principles of the AMG Policy on Human Rights are driven by internationally accepted norms and national laws and are:

- **Children and Young Workers.** AMG does not employ children or support the use of child labor. We will support the creation of educational programs for young people including apprenticeships combined with formal education.
- **Equality of Opportunity.** AMG has zero tolerance for any kind of discrimination or harassment. We embrace cultural differences in our workforce. We will attract, develop, promote and retain the best employees based solely on merit and ability.
- **Freedom of Engagement.** All AMG employees have chosen to work for the company and AMG does not engage in forced labor or compulsory hiring practices.
- **Compensation.** AMG will compensate its employees through wages and benefits to ensure it meets or exceeds legal minimums and is in full compliance with all applicable laws and will be competitive to retain employees.
- **Freedom of Association.** AMG upholds the freedom of association and the right to collective bargaining.
- **Relationships with Communities.** AMG respects the customs, values and cultures of the local communities in which we operate including communities indigenous to those areas, taking into account their concerns and needs.

Within our company our human rights principles are enacted through the provision of safe and healthy working conditions in a non-discriminatory environment. We will continuously support our human rights standards by living our values in our interactions with local and national governments, and the communities in which we operate and wherever possible endeavor to extend our values and principles to our suppliers and contractors.

These human rights principle are universal to AMG, applied in everything we do, and are implemented irrespective of the developed or developing status of the countries in which we operate. This policy provides additional details to those commitments made in our Code of Business Conduct and applies to all AMG Advanced Metallurgical Group N.V wholly and majority owned facilities and shall be communicated annually to all employees.

A handwritten signature in blue ink, appearing to read 'Heinz C. Schimmelbusch'.

Dr. Heinz C. Schimmelbusch
Chairman of the Management Board and Chief Executive Officer

A review of this policy in 2014 determined it to still be adequate to articulate AMG's commitments.

The commitments made in these publications are monitored by a network of Compliance Officers under the oversight of a Chief Compliance Officer and a Compliance team. The Compliance team meets regularly to review Compliance and Ethical issues and is supported by an independent external consultant. This consultant has assisted in the development of policies, procedures and training programs. In 2014 there was a full Compliance meeting held in Amsterdam which included the Compliance team and all local Compliance Officers. The meeting included sharing best practices and Compliance Officer training. The Compliance team is also continually supported by senior management across the subsidiary companies. This team has developed Compliance training for AMG staff at all levels in the organization. This training has been tailored to the individual and includes face to face training for shop floor employees and on line training for office and executive staff. In 2014 there were no reported incidents of breaches of the AMG Code of Business Conduct related to human rights abuses.

- Principle 2 - Make sure businesses are not complicit in human rights abuses

The aim of the presence of an AMG business unit in a community is to strengthen and be part of the community, fostering sound relationships and avoiding conflicts. We respect the dignity and rights of our employees, their families and the communities in which we operate and others who might be affected by our operations and actively involving ourselves and supporting those communities. AMG also contributes through philanthropic donations to support local community needs including to schools, colleges and hospitals.

AMG sustains an expanding network of Code of Business Conduct Compliance Officers based in the countries and major sites where AMG companies are operating to locally identify any potential human rights abuses. In instances where this needs to be done independently and confidentially, a Whistle Blowing policy is in force allowing any employee to come forward and report issues. The Whistleblowing policy can be accessed through the Governance section of the AMG website. The Chief Compliance Officer and their team carefully review any and all Whistleblower complaints.

AMG also has a Supplier Conduct Charter, shown below, which is part of a process to ensure the standards relating to Human Rights which AMG holds itself to, are expanded to our suppliers as well. In particular, this policy states that: "AMG's suppliers should support and respect the protection of internationally proclaimed human rights and ensure they are not complicit in human rights abuses."



Supplier Conduct Charter

AMG Advanced Metallurgical Group N.V. is a global company operating in a global market. Our supplier–customer relationships are essential in building economic value, but are also important in promoting social and environmental best practices

Essential elements of our supplier-customer relationship will include specifications, price, quality, service level and technology. AMG will also take into account environmental and social impact in assessing supplier quality and will preferentially deal with partners who are able to demonstrate commitment in the following areas, based upon the relevant principles of AMG's Code of Business Conduct:

- Human Rights
 - AMG's suppliers should:
 - Support and respect the protection of internationally proclaimed human rights and ensure they are not complicit in human rights abuses.
- Labor
 - AMG's suppliers should:
 - Uphold the freedom of association and the effective recognition of the right to collective bargaining; support the elimination of all forms of forced and compulsory labor; support the effective abolition of child labor; and support the elimination of discrimination in respect of employment and occupation.
 - Have programs in place to protect the health and safety of your staff, subcontractors and local residents, preferably through a documented safety management system.
- Environment
 - AMG's suppliers should:
 - Support a precautionary approach to environmental challenges and act to promote greater environmental responsibility.
 - Comply with all local environmental laws and regulations in the locations in which you operate and hold all required permits.
 - Have procedures in place to prevent environmental incidents and response plans to mitigate the effects should such an incident occur, preferably through a documented environmental management system
- Anti-Corruption
 - AMG's suppliers should:
 - Not tolerate corruption in any of its forms, including extortion and bribery.
 - Comply with laws and regulations in the locations in which they operate.
 - Uphold high standards of personal and business ethics.

AMG will engage with its suppliers in a respectful and ethical way, encompassing fairness and honesty and will select suppliers on the basis of specifications, price, quality, service level and technology, but also Human Rights, Labor, Environment and Anti-Corruption approach, as outlined in this charter.

AMG Suppliers are expected to respond promptly to inquiries from AMG procurement professionals with respect to compliance with these principles and accept that they may be required to perform self-assessment questionnaires.

LABOR

- Principle 3 - Businesses should uphold freedom of association & effective recognition of the right to collective bargaining

AMG respects the freedom of its individual employees to join, or choose not to join, legally authorized association or organizations. AMG continues to use the Global Reporting Initiative

(GRI) indicator LA4 (Percentage of Employees Covered by Collective Bargaining Agreements) to monitor this principle. In our 2014 Annual Report we state:

“AMG respects the freedom of its individual employees and their rights to join, or to choose not to join, unions. Across the Company, 1,825 AMG employees (63%) were covered by collective bargaining agreements. 75% of AMG Processing and 63% of AMG Mining employees are covered by such arrangements. AMG Engineering, which includes a higher proportion of professional salaried staff, has 45% of its employees covered by collective bargaining agreements. There were no strikes or lockouts reported at any of AMG’s facilities in 2014.”

Additionally, we utilize indicator HR5 (Operations identified in which the right to exercise freedom of association or collective bargaining may be at significant risk, and actions taken to support these rights). In the 2014 Annual Report we state:

“Each AMG site is assessed during site visits and internal audits to identify if there is the possibility of freedom of association or collective bargaining being put at risk because of political or business factors. In 2014, it was found that no sites were at risk, with the exception of China, where the formation of unions remains restricted.”

Further, with the development and implementation of our Supplier Conduct Charter we begin to hold our suppliers to the same standard stating: *“AMG’s suppliers should uphold the freedom of association and the effective recognition of the right to collective bargaining; support the elimination of all forms of forced and compulsory labor”*

- Principle 4 - The elimination of all forms of forced and compulsory labor

All AMG employees work for the company as a result of need or want. Nobody is forced to work for AMG and we prohibit the use of any forced labor, including slavery, servitude, or prison labor. This is reflected in the widespread presence of unionized labor across AMG. Currently most of the locations and environments AMG facilities are present in are stable and advanced democracies, assisting in ensuring human rights abuses of this type are not occurring. Again, our Supplier Conduct Charter adopted in 2014 introduces our commitment to this principal to our suppliers stating: *“AMG’s suppliers should support the elimination of all forms of forced and compulsory labor.”*

- Principle 5 - The effective abolition of child labor

As stated in our Human Rights Policy, AMG does not employ children and strongly rejects the use of child labor, and expects our suppliers to do the same through the requirements of our Supplier Conduct Charter. AMG does actively support the creation of educational programs for young people including apprenticeships combined with formal education, particularly in the areas of science and engineering. In our annual report we utilize the Global Reporting Initiative indicator HR6 “Operations identified as having significant risk for incidents of child labor, and measure taken to contribute to the elimination of child labor”. In its most recent annual report AMG reported that it has reviewed 33 of its operating sites across the world to ensure that they are not at risk for employing child labor or exposing young workers to hazards. It was found that

no sites posed a risk at this time. AMG is at the root of the supply chain for several of its products and is proud to be able to supply metals such as Tantalum and Tin, commodities historically fraught with human rights abuses, from mining operations with strong ethical practices and not utilizing child labor. In particular our Tantalum supply chain in Brazil is certified as Conflict Free by the Electronics Industry Citizenship Coalition (EICC).

- Principle 6 - Eliminate discrimination in respect of employment and occupation

AMG's Code of Business Conduct states that the Company views as unacceptable any form of harassment or unfair or unlawful discrimination based on race, age, gender, color, sexual orientation, disability or national origin, whether by employees, temporary employees, managers, customers, vendors or AMG companies' visitors.

At year-end 2014, AMG Processing had a workforce of 1,183, AMG Engineering had 877 employees, and AMG Mining had 858 employees. Including corporate staff (39), the total AMG workforce was 2,918. Geographically, these were located in Asia (332), Europe (1,614), North America (546) and South America (426). A further 268 directly supervised contract workers were employed at AMG sites. AMG assesses the diversity of its workforce in terms of gender and age. The multinational, and therefore multicultural, nature of the business means that ethnic diversity is significant, but because of the difficulty in defining minority employees in such an environment, the Company does not collect data on this aspect. Of the total employees, 17% are female; 18% are under 30 years of age, 53% are between 30 and 50, and 28% are over 50. The Management Board is 66% male and 33% female. The Supervisory Board is 78% male and 22% female. One Supervisory Board member is aged 30-50 while eight are over 50.

The composition of the management board has been unchanged and remains at 33% female and the supervisory board moved from 13% to 22% female.

However, AMG is continuing to work to improve the diversity of its Boards. On page 27 of our 2014 Annual Report we note:

"Gender Diversity:

The Supervisory Board recognizes the importance of a diverse composition of the Supervisory Board and the Management Board in terms of gender. The Supervisory Board is pleased that in 2014, Mrs. Donatella Ceccarelli has joined the Supervisory Board as the second female member, next to Mrs. Ute Wolf who was appointed in 2013. New Dutch legislation, which became effective on January 1, 2013, requires the Company to pursue a policy of having at least 30% of the seats on the Supervisory Board and the Management Board be held by men and at least 30% of the seats be held by women. It is with particular regret that the Supervisory Board had to accept the resignation of Ms. Wolf when her term ends in May 2015. The company will, with increased focus, continue to take this allocation of seats into account in connection with the following actions: (1) the appointment or nomination for the appointment of the Supervisory Board and the Management Board and (2) drafting the criteria for the size and

composition of the Supervisory Board and the Management Board. At this moment, the Company does comply with article 2:166 Dutch Civil Code with regards to the composition of the Management Board, and does not fully comply with this article regarding the composition of the Supervisory Board, where currently only 22% of the Supervisory Board seats are held by women, which will fall to 11% after May 2015. The Supervisory Board will continue to look for suitable female candidates for the Supervisory Board.”

ENVIRONMENT

- Principle 7 - Businesses should support a precautionary approach to environmental challenges

All AMG facilities have a strong awareness and knowledge of their environmental impact and the company utilizes the Global Reporting Initiative (GRI) G3 guidelines to measure and report environmental impacts in a number of areas including raw material use, energy consumption, greenhouse gas generation, water use and discharge and waste generation and disposal. Collection of this data is vital to help sites focus on improving efficiencies – including reducing energy use and concurrent greenhouse gas emissions, but also reducing solid and liquid wastes and reducing water consumption. These environmental impacts are reported annually to our stakeholders in the Company annual report.

Many of AMG's activities focus on technologies to address fossil fuel efficiencies and reduce greenhouse gas generation, where we believe a precautionary approach is vital given the potential adverse effects. Many of the technologies that AMG produces, which we refer to as “enabling technologies” contribute to significant reductions in greenhouse gas emissions in the transportation and buildings sectors. The relevant section from the Annual Report to Shareholders showing how AMG measures its environmental impact is reproduced at the end of this Communication on Progress (COP).

- Principle 8 - Undertake initiatives to promote greater environmental responsibility

Twelve of the larger AMG manufacturing facilities now have ISO 14001 environmental management system certification in place. Formalized management systems are seen as a key tool to maintaining focus on environmental responsibility. Additionally AMG has invested in projects including hydroelectric generation, solar generation and heat recovery systems. It is also promoting energy management initiatives to improve efficiencies, with several larger energy users, including the largest, holding ISO 50001 energy management certification. The relevant section from the Annual Report to Shareholders showing how AMG measures its environmental impact is reproduced at the end of this Communication on Progress (COP).

- Principle 9 - Encourage the development and diffusion of environmentally friendly technologies

AMG has considered carefully what constitutes a “Green Company” and its CEO has coauthored a paper on this which is available on the AMG website and also reproduced at the end of this report, and a further published paper on the subject in the Stern Stewart Institute Periodical #10 (June 2014).

AMG’s businesses continue to focus on environmentally friendly technologies. In 2014 AMG expanded investment in the production of titanium aluminides used in the aerospace industry. Investments in the plant in Cambridge, Ohio that produces the steel strengthening alloy ferrovanadium from byproducts of the oil refining and power generation industries, eliminating landfill, has resulted in significant capacity increase. This technology reduces energy in the manufacturing process and by strengthening steel, significantly reduces the tonnages required in end user applications. AMG is also actively supporting the automotive industry as it moves to more fuel efficient turbo charged, low displacement engines, through heat treatment of fast moving, high temperature parts such as turbo chargers and piston heads. Similar applications have been seen in next generation aviation jet engines which contribute to the fuel efficiency of next generation aircraft and where AMG’s ceramic coating technologies further enable fuel efficiency savings. AMG continues to believe that nuclear power is required as part of the short and medium term solution to anthropogenic CO2 emissions and continue to supply products and engineering expertise to support this sector.

ANTI CORRUPTION

- Principle 10 - Businesses should work against corruption in all its forms, including extortion and bribery.

In 2009 AMG introduced (and published) its Code of Business Conduct to all of its staff which sets out guiding principles in its ethics and business conduct as adopted and approved by the Company’s Management Board and Supervisory Board. The Code of Business Conduct discusses in detail the ethical conduct and business practices which AMG expects from all employees, covering area’s like conflicts of interest, anti-bribery, insider dealing, policies on corporate entertainment and acceptance of gifts, and the integrity of our record keeping and reporting. AMG also has a stand-alone policy on Anti-bribery and Anti-corruption. This is available under the Corporate Governance section of the AMG-NV website. Specific training programs for staff, using web based training, and via face to face training, took place in 2014.

AMG further promotes these values throughout the Company with multi lingual posters prominently displayed at operational sites to raise awareness of the Code of Business Conduct and various ethically based programs.

we aim to create **value**
we **respect** people
we act with **integrity**

AMG's Code of Business Conduct and its supporting policies set out AMG's guiding principles in its ethics and business conduct and applies to all directors, officers and employees of AMG and its group companies worldwide regardless of their position, nationality, gender, race or religion.

At work you may face situations where interpretation or further guidance is needed. When this happens consult the Code of Business Conduct and its supporting policies or discuss the situation with your manager. You can also discuss with your local Compliance Officer or contact AMG's Legal Department.

www.amg-nr.com



We welcome comments on our Code of Business Conduct and supporting policies.

Michael Witzel, Chief Compliance Officer
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Notre but est de
créer de la **valeur**
Nous **respectons**
chaque personne
Nous agissons
avec **intégrité**

Le Code de conduite du travail d'AMG et ses politiques associées décrivent les lignes directrices relatives à l'éthique et à la conduite des affaires. Il s'applique à chaque dirigeant, administrateur et employé d'AMG et de ses filiales internationales, indépendamment sa position, sa nationalité, son sexe, sa race ou sa religion.

Au travail, vous pouvez être confronté à des situations dans lesquelles un accompagnement ou une aide à l'interprétation pourraient être nécessaires. Lorsque cela arrive, consultez le Code de conduite des affaires et ses politiques associées ou discutez de la situation avec votre responsable hiérarchique. Vous pouvez également discuter avec le Responsable local Ethique et Conformité ou contacter le service juridique d'AMG.

www.amg-nr.com



Nous nous félicitons de commentaires sur notre Code de conduite des affaires et des politiques de soutien.

Michael Witzel, Responsable Ethique et Conformité
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ATTACHMENT 1

SUSTAINABLE DEVELOPMENT SECTION FROM THE 2013 ANNUAL REPORT TO SHAREHOLDERS

Sustainable Development



SITE NAME ¹	LOCATION	COUNTRY	DIVISION
AMG HEADQUARTERS	AMSTERDAM	NETHERLANDS	AMG CORPORATE
AMG USA HEADQUARTERS	PENNSYLVANIA	USA	AMG CORPORATE
ALD IMP	BERLIN	GERMANY	AMG ENGINEERING
ALD USA ³	CONNECTICUT	USA	AMG ENGINEERING
ALD FRANCE	GRENOBLE	FRANCE	AMG ENGINEERING
ALD UK ³	GUILDFORD	UK	AMG ENGINEERING
ALD VACUUM TECHNOLOGIES ²	HANAU	GERMANY	AMG ENGINEERING
ALD VACUHEAT ²	LIMBACH	GERMANY	AMG ENGINEERING
ALD TT USA ²	MICHIGAN	USA	AMG ENGINEERING
ALD DYNATECH	MUMBAI	INDIA	AMG ENGINEERING
ALD TT MEXICO ²	RAMOS ARIZPE	MEXICO	AMG ENGINEERING
ALD JAPAN ³	SHINJUKU-KU	JAPAN	AMG ENGINEERING
ALD SINGAPORE ³	SINGAPORE	SINGAPORE	AMG ENGINEERING
ALD C&K	SUZHOU	CHINA	AMG ENGINEERING
AMG INTELLIFAST GMBH	SPEYER	GERMANY	AMG ENGINEERING
AMG ANTIMONY	CHAUNY	FRANCE	AMG MINING
BOGALA GRAPHITE LANKA	COLOMBO	SRI LANKA	AMG MINING
AMG MINING ²	KROPFMUHL	GERMANY	AMG MINING
AMG ANTIMONY	LUCETTE	FRANCE	AMG MINING
AMG MINERACAO ²	NAZARENO	BRAZIL	AMG MINING
AMG SILICON ²	POCKING	GERMANY	AMG MINING
AMG GRAPHITE	QINGDAO	CHINA	AMG MINING
AMG GRAPHITE TYN	TYN	CZECH REPUBLIC	AMG MINING
AMG ALPOCO	ANGLESEY	UK	AMG PROCESSING
AMG TITANIUM ALLOYS AND COATINGS ²	BRAND ERBISDORF	GERMANY	AMG PROCESSING
AMG ALUMINUM ³	JIAXING	CHINA	AMG PROCESSING
AMG ALUMINUM	KENTUCKY	USA	AMG PROCESSING
AMG ALPOCO	MINWORTH	UK	AMG PROCESSING
AMG TITANIUM ALLOYS AND COATINGS ²	NÜRNBERG	GERMANY	AMG PROCESSING
AMG VANADIUM ²	OHIO	USA	AMG PROCESSING
AMG SUPERALLOYS AND AMG ALUMINUM ²	ROTTERHAM	UK	AMG PROCESSING
AMG ALUMINUM	WASHINGTON	USA	AMG PROCESSING
AMG BRAZIL ²	SAO JOAO DEL REI	BRAZIL	AMG PROCESSING

¹ The chart indicates which facilities were included in the scope of the sustainable development data. Only data from these facilities is included in this section which may therefore show inconsistency with other sections of this annual report covering all facilities. ² Remote externally audited data 2014. ³ Minor or office facilities with estimated data.



This section provides our eighth annual sustainability report, which evaluates and compares AMG's social and environmental performance to previous years.

The reporting boundaries have not changed significantly since 2013; two operational sites have been combined and one office location has been closed. The 33 locations reporting in 2014 (in which AMG has a 51% or greater stake holding) are detailed in the table on page 38. They include mining and manufacturing operations and sales and administrative offices in 13 countries across 4 continents. The report considers the three segments: AMG Processing, AMG Engineering, and AMG Mining. AMG continues to assess the boundaries of this report based on the corporate ownership structure. All locations report their performance at the end of the fourth quarter, and no forecast data is used. However, sales and administrative office sites (typically with less than 10 employees) have been determined to be non-material to the report, and therefore estimated data has been used for these in 2014.

Scope of This Report

AMG utilizes the Global Reporting Initiative (GRI) G3, Mining and Metals Sector Supplement aspects. The GRI is a network-based organization that publishes the world's leading sustainability reporting framework. Additionally, AMG has applied GRI's principle of materiality to the report, which states: "Information in this report should cover issues and indicators that would

substantively influence the decisions of stakeholders using this report."

AMG utilizes a standard template, which sites use to report their data in order to ensure consistency in the interpretation of definitions of the key indicators. The report is independently verified by Conestoga-Rovers & Associates. The environmental key performance data for the three segments are summarized in the table on page 47.

AMG Advanced Metallurgical Group N.V.
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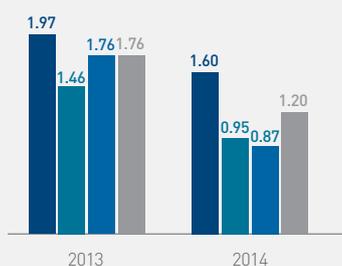
AMG People

GRI INDICATORS LA1, LA4, LA6, LA7, LA10, LA13 AND MM4

At year-end 2014, AMG Processing had a workforce of 1,183, AMG Engineering had 877 employees, and AMG Mining had 858 employees. For those facilities reporting here, including corporate staff (39), the total AMG workforce was 2,918 (facilities not yet covered in this section employ a further 73 people). Geographically, these were located in Asia (332), Europe (1,614), North America (546) and South America (426).

A further 268 directly supervised contract workers were employed at AMG sites. AMG assesses the diversity of its workforce in terms of gender and age. The multinational, and therefore multicultural, nature of the business means that ethnic diversity is significant, but because of the difficulty in defining minority employees in such an environment, the Company does not collect data on this

LOST TIME INCIDENT RATE

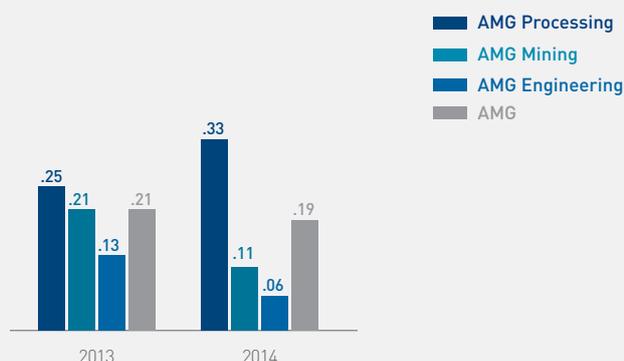


aspect. Of the total employees, 17% are female; 18% are under 30 years of age, 53% are between 30 and 50, and 28% are over 50. The Management Board is 66% male and 33% female. The Supervisory Board is 78% male and 22% female. One Supervisory Board member is aged 30-50 while 8 are over 50.

AMG respects the freedom of its individual employees and their rights to join, or to choose not to join, unions. Across the Company, 1,825 AMG employees (63%) were covered by collective bargaining agreements. 75% of AMG Processing and 63% of AMG Mining employees are covered by such arrangements. AMG Engineering, which includes a higher proportion of professional salaried staff, has 45% of its employees covered by collective bargaining agreements. There were no strikes or lockouts reported at any of AMG's facilities in 2014.

AMG is pleased to report that no fatal incidents occurred at any of our sites in 2014. Since the first Annual Report on safety in 2008, safety performance has improved significantly. AMG's medium-term goal is zero lost-time incidents – we cannot accept that any incident is inevitable. In 2014, we saw the best safety performance yet, extending the improving trend. For AMG as a whole, the Lost Time Incident Rate¹ dropped from 1.76 in 2013 to 1.20. The incident severity² was also lower at 0.19 compared 0.21 in 2013. Of the 33 locations included in this report, 18 achieved zero lost-time incidents in 2014. No specific

INCIDENT SEVERITY



occupational diseases were reported in 2014. The average absenteeism rate across AMG was 3.2%. The Company continues towards its ultimate goal of zero harm to any employee. Thirteen sites are OHSAS 18001 certified. Formal health and safety committees, with representatives from all levels of the organization, and which are intimately involved in decisions regarding safety, are in place at every major production facility and many of the smaller facilities. In 2014, 82% of the AMG workforce was represented in these committees.

AMG also collects data on the hours we invest in our people to develop their skills, categorized into management; professional, technical, sales and administration; and production and maintenance employees. The categories of training tracked included technical and professional development, quality, anti-corruption policies, human rights policies and health and safety.

This is important to our safety, environmental and ethics programs, and in maintaining our technical competitive advantage. Training data on corporate employees is not fully available. In 2014, the training provided was: management (156 employees trained, averaging 18.6 hours per person), professional, technical, sales and administration (797 employees trained, averaging 22.3 hours) and Production and Maintenance (1,716 employees trained, averaging 17 hours).

¹ Lost time incident frequency rate equals the number of lost time incidents multiplied by 200,000 divided by the total hours worked. Lost time injury was defined using local regulations.

² Incident severity is defined as the number of scheduled work days lost as a result of disabling injuries per thousand worker hours of exposure. In some locations calendar days are counted by local regulators and this data is used here if scheduled work days are unavailable.

Across all the reporting sites, AMG employees received an average of 17 hours of training time in 2014 (approximately 1% of total hours worked).

Human Rights and Ethics

GRI INDICATORS HR 3, HR 5, HR 6 AND SO 3

AMG remains fully committed to the protection of internationally proclaimed human rights and works to make sure it is not complicit in human rights abuses. Each AMG site is assessed during site visits and internal audits to identify if there is the possibility of freedom of association or collective bargaining being put at risk because of political or business factors. In 2014, it was found that no sites were at risk, with the exception of China, where the formation of unions remains restricted. Similarly, the Company has reviewed sites to ensure that they are not at risk for employing child labor or exposing young workers to hazards. It was found that no sites posed a risk at this time. Our policy on human rights is included in the Company Code of Business Conduct and Ethics, which was revised and updated in 2012, and detailed in the Company's human rights policy, both available on the AMG website.

Refresher human rights and ethics training was performed in 2014, and 1,234 employees were given refresher training in ethical businesses practices, including 511 in human rights and anti-bribery based materials. Compliance officers at the major sites monitor and implement the Code of Business Conduct and Ethics.

Resource Efficiency and Recycling

GRI INDICATORS EN 1 AND EN 2

The use of resources varies between AMG business units, ranging from those that locally mine or purchase primary raw materials to produce metals, alloys, and inorganic chemicals, through those which produce metals and alloys from secondary, recycled resources, to those which provide technology and engineering services. AMG resource usage data comprises raw materials, associated process materials, semi-manufactured goods and parts and packaging, by weight.

AMG Engineering provides predominantly furnace technology and engineering services, including furnace assembly operations and heat treatment services. The segment utilizes limited amounts of resources in these activities, mainly complex component parts for furnaces, which are routinely measured in units rather than by mass. Therefore, unlike the chemicals and alloys business units, only limited data is available on resource mass. In 2014, AMG Engineering reported using 2,930 mt of resources, all of which were classified as primary.

AMG Processing uses a much more diverse range of resources including power plant wastes and spent refinery catalysts for the production of vanadium alloys and metal salts for aluminum alloy production. The segment uses recycled iron, steel, aluminum and titanium in processes when possible. The segment utilized 154,000 mt of resources in 2014, of which 27,000 mt (17.5%) were secondary or recycled materials.

AMG Mining uses non-renewable resources such as graphite rich ores for the manufacture of natural graphite, and quartz in its silicon metal operations. In 2014, the primary utilization of resources was by AMG Mineração (780,000 mt) and AMG Silicon (183,000 mt) with the remaining AMG Mining sites using 53,000 mt.

Energy Consumption

GRI INDICATORS EN 3 AND EN 4

Energy remains a major area of focus for AMG for both environmental and economic reasons. In particular, high-temperature metallurgical processes and mining operations utilized in AMG Processing and AMG Mining are energy intensive. The two most significant energy carriers are electricity and natural gas, although other fuels and energy sources are captured in the data discussed here.³

The reported energy usage for AMG Processing is marginally lower in 2014 compared to 2013, decreasing from 962 terajoules (TJ) in 2013 to 940 TJ in 2014. Direct energy usage was 467 TJ and indirect 473 TJ.

The energy usage for AMG Mining was 2,173 TJ, split between direct (312 TJ) and indirect (1,861 TJ). The largest use, accounting for 78% of this usage, was the silicon metal production in Germany – an inherently energy-intensive process.

³ Indirect energy consumption does not include the energy consumed by electricity producers to generate the electricity or transmission losses.

ENERGY USAGE (%)

Direct/Indirect



Segmental



The energy used by low-energy heat treatment processes utilized by AMG Engineering remains low in comparison. The segment used 225 TJ, almost unchanged from 2013 (229 TJ). Indirect energy, in the form of electricity, accounted for 208 TJ, while direct energy use, primarily through natural gas, was 17 TJ.

Across AMG, the split between renewable and non-renewable indirect energy sources is difficult to determine since utilities do not generally publish this information (with some exceptions; e.g. CEMIG in Brazil now produces this data).

However, AMG does generate its own renewable energy. In 2014, AMG's hydroelectric generating facility near São João del Rei, Brazil operated at a lower capacity as a result of drought conditions and generated 21,790 GJ (6,053 MWh). This supplied AMG's local requirements at its São João del Rei, Brazil plant. Additionally, AMG Vanadium's solar power system generated 984 GJ (273 MWh) in 2014 and AMG Mineração's mine utilization of biodiesel in its truck fleet contributed 198 GJ of renewable energy.

Water Consumption

GRI INDICATOR EN 8

Water is essential to many manufacturing processes and is used by AMG primarily for non-contact, evaporative or single-pass cooling purposes, although a small number of AMG facilities do use wet chemical processes for

the production of metal oxides and other chemicals. In addition, mining operations can utilize water from mine dewatering or for ore processing. Water utilized for cooling, process and sanitary usage is reported by AMG facilities. Reported water use for AMG Processing decreased to 637,000 cubic meters in 2014, as a result of general reductions across a number of locations. AMG Engineering's water consumption was higher than during 2013 at 100,000 cubic meters.

AMG Mining has its largest water use at the mine sites in Germany and Sri Lanka, and the silicon metal production plant in Germany. Together these three sites used 1,179,000 cubic meters of water. Additionally, the mine in Nazareno, Brazil used 2.9 million cubic meters in 2014, a significant decrease from prior years, because of reimplementation of process water recycling and improved measurement. Full data is provided in the table on page 47.

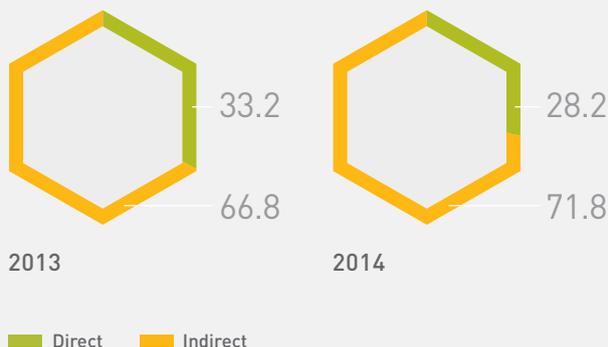
Biodiversity

GRI INDICATOR EN 11

Of the 33 locations reporting for 2014, four reported land areas on or adjacent to their property which had high biodiversity value, sensitive habitats or were protected. These areas are: river frontage in Hanau, Germany; native forest in São João del Rei, Brazil; river frontage and setback areas in Nazareno, Brazil; and wetlands in Ohio, United States. AMG remains very aware of the need to be responsible stewards of these important areas.

GHG EMISSIONS (%)

Direct/Indirect



Segmental



Climate Change

GRI INDICATOR EN 16

AMG facilities utilize processes that are associated with both direct and indirect greenhouse gas (GHG) emissions, and both types are reported here. Electricity used for the generation of heat for metallurgical processing has been, and remains, the most significant source of GHG emissions for AMG. This electricity use gives rise to indirect GHG emissions of CO₂ equivalent (CO₂e), which are dependent on the nature of its generation. Whenever possible, emissions have been calculated using up-to-date emission factors available from the electricity supplier, the local environmental agency, or the GHG protocol. Indirect emissions are defined as those emissions generated by sources outside of AMG's control, but where AMG ultimately uses the energy. Direct GHG emissions result primarily from the combustion of carbon-containing materials often as part of the metallurgical process, such as using coke as a reductant, but also for the generation of heat, such as burning natural gas in a boiler. Other GHGs occurring from processes other than combustion, such as hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride, are minimal for the AMG business units, but are included if relevant.

AMG Processing GHG emissions were almost unchanged from 2013 at 122,000mt of CO₂e, and 62% of these emissions are attributed to indirect sources while 38% are attributed to direct sources.

AMG Engineering GHG emissions in 2014 were 40,000mt, a decrease from 42,000mt. 95% of these emissions are indirect and associated with electricity usage.

AMG Mining emissions remain dominated by the silicon metal production activities. Of the 469,000 mt of CO₂e emissions in 2014, 430,000 mt are attributable to silicon metal manufacture (approximately 7.5kg CO₂e per kg silicon metal produced). This activity also dominates AMG's overall GHG emissions, accounting for 68% of total group emissions. Further, changes in supply mix, including reduction of nuclear and variations in renewable energy in Germany, resulted in higher emission factors for this electricity and accounted for this increase. These factors, outside of AMG's control, outweighed reductions achieved elsewhere.

AMG provides a complex mix of products and services, and it has become clear that year-on-year comparisons are difficult as product mix varies. GHG intensity is therefore defined on the basis of revenue rather than, for example, mt of product. Normalized to a revenue basis, AMG Processing emitted 122,000mt, with revenue of \$552.5 million, equivalent to 220mt CO₂e per million \$ revenue, a 4% increase from 2013. AMG Engineering generated 40,000mt CO₂e, \$220.5 million in revenue, or 181mt CO₂e per million \$ revenue, while AMG Mining is the most carbon-intensive segment with 469,000mt of CO₂e and \$320.9 million in revenue, equivalent to 1,462mt CO₂e per million \$ revenue. This wide range reflects

the diversity of AMG but also guides focus on reduction opportunities. For AMG as a whole in 2014, GHG intensity was 576mt per million \$ revenue, a 15% increase over 2013, and primarily related to higher electrical emission factors in Germany.

Emissions to Air

GRI INDICATORS EN 19 AND EN 20

The emissions of ozone-depleting substances remain de minimis for AMG. AMG Engineering also has de minimis air emissions for other pollutants, resulting from only small sources such as heating and hot water boilers. AMG Processing's production facilities do have some other air emissions, including SO_x (716 mt), NO_x (59 mt) and particulate materials (24 mt). Data is only available for regulated sources where measurements have been made. AMG Mining's largest emissions come mainly from the silicon metal production activities. In total, AMG Mining's facilities emitted 321 mt SO_x, 652 mt NO_x, and 11 mt of particulates.

Emissions to Water and Spills

GRI INDICATORS EN 21 AND EN 23

AMG facilities continue to maintain records of the volume of aqueous effluents, including process water and non-sanitary sewer discharges to local water courses. Clean water (typically freshwater used for cooling purposes that has not been affected in the process) is included in the figures given below. Chemical analysis of the effluent is utilized to determine the total mass of primary constituents of the water emissions.

In 2014, the total water disposed to water courses by AMG Processing equaled 402,000 cubic meters compared to 411,000 cubic meters in 2013. This slight decrease is attributed to variations in production volumes and increased focus on efficiencies.

Although most of AMG Processing's water is used for cooling purposes and therefore produces clean water discharges, some of the wet chemical processes generate aqueous waste streams. For the five production sites reporting industrial process water disposal, the major constituents were metals (777kg), fluoride (125 kg), sulfate (1,094 mt) and total suspended solids (5.3 mt).

AMG Engineering utilizes minimal water for non-contact, closed-cycle cooling purposes, and the discharges are

therefore clean water and not considered material to this report. The only significant water discharge of non-contact cooling water takes place at the site in Michigan, USA (31,000 cubic meters in 2014).

AMG Mining (excluding the mine in Brazil) discharged 878,000 cubic meters in 2014. This included cooling water used by the silicon metal furnaces and mine water from dewatering pumps. In several locations, mine water is utilized for process water before final discharge. Constituents from processing included metals (344 kg), fluoride (4,441 kg), sulfate (303 mt) and suspended solids (6,516 kg).

Additionally, the 2.3 million cubic meters of water discharged to surface water from the mine site in Brazil contain suspended solids, although accurate data is not yet available.

In 2014, there were no significant spills (defined by GRI as one which would affect the Company's financial statements as a result of the ensuing liability, or is recorded as a spill) of tailings or other process materials at any AMG site.

Waste Disposal

GRI INDICATOR EN 22

Detailed information was collected in 2014 for waste streams generated by AMG, along with documentation of their recycling or disposal method. AMG continues to minimize waste streams by avoiding generation, increasing reuse and recycling and minimizing landfill disposal. Landfill is a last resort. Wastes as defined here encompass materials not purposefully produced for sale and with no commercial value.

The total landfill or incineration disposal for AMG Processing was 10,470 mt, a decrease of 49% over 2013 (20,614 mt). This decrease is primarily related to conclusion of legacy remediation projects in Brazil, alongside ongoing and increasing recycling efforts. 69% of these materials (7,221 mt) were non-hazardous, with the remaining 3,249 mt disposed to licensed hazardous waste landfills.

The waste produced by AMG Engineering is much different in composition, and much smaller in volume. Just 116 mt were disposed to landfills in 2014 (138 mt in 2013), composed mainly of general waste, contaminated



oil and metals that could not readily be recycled, and almost no hazardous waste.

AMG Mining disposed of 7,320 mt of waste in 2014, of which just 229 mt were hazardous waste. The graphite mine in Sri Lanka together with the silicon metal manufacturing and graphite mine sites in Germany generated 91% of this waste.

Overall, the Company disposed of 17,907 mt of waste to landfills or incineration in 2014 compared to 29,400 mt in 2013. Hazardous waste accounted for 20% of the total.

Significant Fines for Non-Compliance with Environmental and Other Laws

GRI INDICATOR EN 28

No segment received any significant fine or equivalent penalty for non-compliance with environmental laws in 2014.

GRI INDICATOR SO8

In 2014, AMG Engineering and AMG Mining did not receive any fines. Within AMG Processing, the production facility in Brazil was fined \$229,000 relating to historic labor issues.

Product Responsibility

GRI INDICATOR MM 11

AMG continues its progress regarding its responsibilities under the REACH regulations in Europe, and is in the early stages of preparing for its 2018 registrations for products with volumes greater than 10 mt. European operations are working with Consortia in developing the health, safety and environmental data required for these registrations and have taken on the role as lead registrant in several cases. Industry groups continue to focus on developing health and safety knowledge of their products as the regulatory framework grows and expands across the world. AMG units are involved in, among others, the Vanadium International Technical Committee and the International Antimony Association.

GRI Contents

This section provides an overview of how AMG's Annual Report correlates with the GRI G3 guidelines for the voluntary reporting of sustainable development indices. The table below serves as a reference guide to the sections of the report where information about each item can be found. The GRI G3 guidelines facilitate

measurement of economic, environmental, and social dimensions of company performance. Third-party verification has been conducted relative to determining consistency with the GRI reporting principles. For brevity, only the most pertinent data is included in this report.

United Nations Global Compact

AMG commits its support to the principles of the United Nations Global Compact. The Global Compact, which is overseen by the United Nations, is a strategic policy initiative for businesses that, like AMG, are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labor, the environment and anti-corruption. In 2009, the AMG Management Board approved its commitment to the Global Compact and the intent of AMG to support the ten principles of the Global Compact. AMG will reaffirm its support and submit its third Communication on Progress in April 2015.

Extractive Industries Transparency Initiative

AMG continues its support of the Extractive Industries Transparency Initiative (EITI, eiti.org), a global initiative to improve governance in resource-rich countries through the verification and full publication of Company payments and government revenues from oil, gas and mining. EITI works to build multi-stakeholder partnerships in developing countries in order to increase the accountability of governments. Over 30 countries have now committed to the EITI principles and criteria. As of today, AMG does not have any extractive operations in an EITI-implementing country, although it does have exploration activities in Mozambique.

Global Reporting Initiative

AMG supports the GRI, and is an Organizational Stakeholder (OS). GRI is a network-based organization that has pioneered the development of the world's most widely used sustainability reporting framework and is committed to its continuous improvement and application worldwide. In order to ensure the highest degree of technical quality, credibility, and relevance, the reporting framework is developed through a consensus-seeking process with participants drawn globally from business, civil society, labor and professional institutions.

This framework sets out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. The cornerstone of the framework is the Sustainability Reporting Guidelines. AMG utilizes the third version of the Guidelines, known as the G3 Guidelines, which were published in 2006. Other components of the framework include Sector Supplements (unique indicators for industry sectors) and National Annexes (unique country level information). AMG has utilized the Metals and Mining Sector Supplement 2010 as a guide in preparing this report. GRI has recently published a fourth-generation of guidelines, G4. As an OS in the GRI Program, AMG is monitoring the implementation of this revision and will modify its data collection processes to match, although this will take several reporting cycles. OSs put their name to the GRI mission, products and processes, and promote broadening participation around sustainability and transparency. The OSs provide a key basis for legitimacy to GRI and reinforce its common commitment as a network to change.

Further information on AMG Sustainable Development and our commitments to these organizations, including our United Nations Global Compact Communication on Progress, can be found on the AMG website (amg-nv.com).

Environmental, Health, Safety and Social Reporting Statement of Assurance

SCOPE, OBJECTIVES & RESPONSIBILITIES

AMG's environmental, health, safety and social performance reporting has been prepared by the management of AMG who are responsible for the collection and presentation of the information. Conestoga-Rovers & Associates (CRA) was retained by AMG to conduct an independent review and assurance of the key information* and data reported in the Sustainable Development section of this Report. The objective of the assurance process is to check the materiality of the issues included in the Report and the completeness of reporting. Any claims relating to financial information contained within the Report are excluded from the scope of this assurance process. CRA's responsibility in performing our assurance

activities is to the management of AMG only and in accordance with the terms of reference agreed with them. CRA does not accept or assume any responsibility for any other purpose or to any other person or organization. Any reliance that any third party may place on the Report is entirely at its own risk.

APPROACH AND LIMITATIONS

CRA's assurance engagement has been planned and performed in accordance with AMG's internal guidance and definitions for the reported indices. The assurance approach was developed to be consistent with the GRI G3 Guidelines and international standards for assurance appointments. Remote audits utilizing telephone and web-based methods were carried out for 13 facilities (see table on page 38) identified by AMG, representing approximately 39% of the total number of AMG facilities. Stakeholder engagement was not within the scope of the assurance activities.

Conclusions/Recommendations

Based on the method and scope of work undertaken, and the information provided to CRA by AMG, the process undertaken by AMG provides a balanced representation of the issues concerning AMG's sustainability performance and is an appropriate presentation of AMG's environmental, safety, health and social performance in 2014. In our opinion, the processes for collecting and reporting sustainability-related data that AMG introduced in 2007 continue to be enhanced through better communication and awareness, and more consistent application of the environmental indices. Some challenges remain related to ensuring consistency in the approach related to various performance metrics and providing consistent and complete data in an efficient manner. It is recommended that AMG continue to focus on these challenges to improve reporting, but they do not materially affect the conclusions presented herein.

Julian Hayward, P. Eng.
Conestoga-Rovers & Associates
Ashley Valentine, P.E.
Conestoga-Rovers & Associates

* LA1, LA4, LA7, LA13, EN1, EN2, EN3, EN4, EN8, EN16, EN20, EN21, and EN22

Social and Environmental Key Performance Indicators and GRI Content Index

Selected Social and Environmental Key Performance Indicators*

GRI Indicator	DESCRIPTION	AMG Processing		AMG Engineering		AMG Mining		AMG	
		2013	2014	2013	2014	2013	2014	2013	2014
LA1	Total workforce	1,340	1,183	879	877	854	858	3,073	2,918
LA4	Employees covered by collective bargaining agreements (%)	72	75	45	45	86	63	68	63
LA7	Accident Rates (Total)	1.97	1.60	1.76	0.87	1.46	0.95	1.76	1.20
LA7	Accident Severity Rate (Total)	0.25	0.33	0.13	0.06	0.21	0.11	0.21	0.19
LA10	Average Hours of Training Per Year (per person)	25	24	14	18	15	17	17	17
EN2	Recycled Raw Materials [excluding mine](%)	14	17.5	0	0	0.1	0.1	2.1	2.4
EN3	Direct Energy Consumption (TJ)	547 [†]	467	25	17	252	312	823 [†]	796
EN4	Indirect Energy Consumption (TJ)	448	473	204	208	1,958	1,861	2,610	2,542
EN8	Water consumption (manufacturing) (cubic meters)	718,000	637,000	80,000	99,000	596,000	578,000	1,394,000	1,314,000
EN8	Water consumption (mining) (cubic meters)	NA	NA	NA	NA	6,676,000	3,544,000	6,676,000	3,544,000
EN16	CO ₂ equivalent emissions (mt)	121,000	122,000	42,000 [†]	40,000	389,000	469,000	551,000 [†]	631,000
EN20	SO _x emissions (mt)	606	716	0	0	356	321	1,017	1,037
EN20	NO _x emissions (mt)	56	59	0	0	723	652	779	712
EN20	Particulates discharged to air (mt)	18	24	0	0	11	11	28	35
EN21	Metals discharged (kg)	1,085	777	0	0	412	344	1,497	1,122
EN22	Hazardous waste (including recycled) (mt)	7,637	5,292	347	151	386	333	8,929	5,776
EN22	Non-hazardous waste (including recycled) (mt)	13,483	11,457	368	286	11,662	11,492	25,513	23,235
EN22	Percent of waste recycled (%)	26	35	62	71	28	38	26	36
EN22	Waste disposed to landfill (mt)	20,614	10,470	138	116	8,648	7,320	27,053	17,907
EN23	Spills (L)	0	0	0	0	0	0	0	0
EN28	Environmental Fines (\$)	0	0	0	0	0	0	0	0
SO8	Fines for non compliance with laws (\$)	195,000	229,000	0	0	0	0	0	0

* For a full list see pages 39-45. † Revised value.

GRI Content Index

PART	SECTION	REFERENCE	PAGES
Part I: Profile Disclosures	Strategy and Analysis	1.1, 1.2	1-47
	Organizational Profile	2.1 to 2.10	2-3
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Part III: Performance Indicators	Economic: Economic Performance	EC1	4-5
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	Social: Labor Practices and Decent Work	LA1, 4, 6, 7, 10, 13	39-41
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ATTACHMENT 2

WHAT IS A GREEN COMPANY?

WHAT IS A “GREEN” COMPANY?

This paper, co-authored by Dr. Heinz C. Schimmelbusch AMG Advanced Metallurgical Group N.V.’s Chief Executive Officer and Chairman of the Management Board, Dr. David J White, AMG Vice President Health, Safety and Environmental Affairs, and Mr. Jonathan A. Costello, AMG Vice President Corporate Development & Communications, explains how AMG approaches sustainability.

We speak of green technologies, green strategies, green companies, green IPO’s, green political policies, and lately “green bonds”. There are innumerable perceptions and meanings of “green” and no workable definition. We will offer a framework not only how to define “green” but also how to measure “greenness” of a company, a necessary step on the road to green ratings which then would assist investors with an interest or commitment to this movement. The proposed framework is the result of our involvement in “green” technologies at AMG Advanced Metallurgical Group, N.V., Amsterdam. A cautionary remark: The calculations in this brief are subject to further work and refining. By the very nature of their broad scope they will inevitably require approximations and estimations. However, we believe they are sufficiently accurate for the conclusions we have arrived at.

When AMG Advanced Metallurgical Group N.V. (“AMG”, EURONEXT AMSTERDAM: “AMG”) was created, the guiding principles were (1) that material science in general, and advanced metallurgy in particular, holds the key for technological solutions which respond to the trends towards a sustainable society; (2) that AMG would assemble a portfolio of productive assets in “critical” materials which are “critical” because of the demand shifts resulting from those trends; and (3) that AMG would focus on technological

innovations that combine financial with environmental attractiveness. We have consistently reiterated these principles.

The methodology of measuring financial attractiveness is well established. But how do we measure environmental attractiveness? In other words, how do we actually define the loosely and often carelessly used term “green”? Early on we decided to measure our environmental impact using CO2 emissions, and more particularly how does AMG contribute to the reduction of CO2 emissions. The reasons for this focus were that (1) there is a mounting body of evidence pointing toward anthropogenic CO2 emissions as the root cause of global warming; (2) even if this is not the case, fossil fuels must be finite and we must preserve them in order to have a sustainable society; and (3) if there is lack of final scientific proof of the impact of anthropogenic CO2 on temperatures and sea levels it is probably prudent to pay for a large insurance coverage.

In this exercise we end up with two different categories of CO2 reduction. One category includes process technology innovations that make possible a more efficient and less carbon intensive production of metals and alloys in comparison to traditional processes. In this case we are talking about energy savings and resulting CO2 reduction DURING manufacturing and we refer to those innovations as “mitigating” technologies as they “mitigate” emission risks (environmental viewpoint) and risks of being a high cost producer (financial viewpoint). The second category consists of the development of new offerings of products enabling our customers to reduce CO2 when USING these products in their operations compared to the use of traditional products. This second category we internally refer to as “enabling” technology innovations as they enable CO2 savings by our customers. Again, there is an environmental dimension (to arrest and reverse the global trend of increasing CO2 emissions) and a financial dimension (as the products in question tend to be highly competitive, and at least at the beginning of the lifecycle to command premium pricing).

A SHORT HISTORY OF ENVIRONMENTAL POLICIES

Governmental policies for the protection of the environment developed in several waves which sometimes overlapped. The first wave was the targeting of industrial emissions; waste gas and waste water, industrial residues and soil contamination. This can be summarized as “end-of-the-pipe” regulations. As regard to clean air, emissions of sulfur oxides, of nitrogen oxides and of dust particles were to be captured with sophisticated filter systems. Incidentally, by the time the Deutsche Bundestag, in 1971, for the first time debated clean air strategies, Lurgi, a German engineering firm, had already sold over 5000 filter systems around the world, starting before World War I. Air quality improvement was followed by wastewater purification processes and the avoidance of soil contamination.

The next wave was to complement “end-of-the-pipe” systems with better “pipes”; in other words better process technologies, recognizing that a more efficient process reduces what comes out at the end of the “pipe”. That is when CO₂ reduction entered the scene of environmental policy in the context of the rapidly emerging climate change debate and the Kyoto agreement. Energy saving in all its forms was taking center stage far beyond industrial processes and including residential and commercial buildings and transportation. In the beginning this wave of energy saving has been driven largely by economics quickly taken over by regulations and incentive programs.

A third industrial movement, with large scale environmental benefits as a by-product, has been “recycling”, driven both by regulations (in the case for restrictions making land-fills more expensive) and by economics (raw material prices). “Cradle-to-Grave” was replaced by “Cradle-to-Cradle”, industrial residues turning into raw materials replacing primary sources. The term “urban mining” was coined. Over time this grew into a recycling boom, becoming very visible in the 70’s and 80’s. One very good example for this partial industrial revolution is the rapid growth of the so-called “mini-mills” revolutionizing the steel industry by replacing iron ore as a feed stock by steel scrap.

This movement then had a derivative, the recycling of zinc contained in the filter-dust of those mills into a material competing with primary zinc

concentrates. Recycling processes now cover a wide array of industries and are associated with massive CO2 reductions compared with traditional processes based on primary resources only. Primary production continues, as inevitably it must to meet the demands of an increasing and more affluent population, but recycling is vital to a number of material supply chains including the large volume metals such as steel, aluminum and copper, and also niche metals including tantalum and tungsten, but also some non-metal commodities including paper, glass, and some plastics.

All these developments, partly environmentally motivated, but with concurrent financial benefits, cannot escape the fundamental law of diminishing returns. In addition, these measures have limited scale-ability. The same amount of money will buy fewer improvements than when it was spent last time. If you have installed a filter system, a water purification plant, an energy saving engine, a manufacturing scrap re-use circuit, you make a big step. From then on it is optimization, incremental improvements, “inch” by “inch”, so to speak. And the recycling movement ultimately is, in its growth potential, confined to the framework of general economic growth, it cannot – in the longer term – outgrow GDP.

Then, as the next wave, came the renewable energy movement, government subsidies for wind and solar, “bio” branded feedstock for energy production, motivated by CO2 reduction strategies and commitments in the aftermath of the Kyoto Protocol. As mentioned, CO2 reduction also stood behind the elaborate efforts to regulate the CO2 emissions of the global transportation sector through elaborate miles-per-gallons targets and penalties, from California to the EU. We will come back to that later. And presently we are in the “distributed energy” wave. Fuel Cell technology makes it possible to convert natural gas into electricity at the point of use through a low emission chemical process. Battery technology is behind the emergence of electric cars which do reduce CO2 emissions in densely populated areas, but only by shifting the emission point to the stack of the regional power plants that are necessary to generate the electricity required.

WHAT THEN IS GREEN?

All definitions put forward on this question so far have been fluid, highly qualitative, subject to interpretation, and partly ideological. UNEP have stated: “There is no internationally agreed definition of green economy and at least eight separate definitions were identified in recent publications. For example, UNEP has defined the green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient, and socially inclusive, and has pointed to another definition, that of the Green Economy Coalition (a group of NGO’s, trade union groups and others doing grass roots work on a green economy), defining green economy as ‘a resilient economy that provides a better quality of life for all within the ecological limits of the planet’. The International Chamber of Commerce says “The business community believes that the term “green economy” is embedded in the broader sustainable development concept. The “green” economy is described as an economy in which economic growth and environmental responsibility work together in mutually reinforceable fashion while supporting progress on social development. Business and industry has a crucial role in delivering the economically viable products, processes, technologies, services, and solutions required for the transition to a Green Economy”. Bank of America says about its recently issued “green bond”:

“The funds will be used specifically to finance renewable energy projects such as wind, solar and geothermal energy. Funds will also be used to finance energy efficiency projects that reduce energy consumption per unit of output and include projects such as lighting retrofits, district heating, co-generation, and building insulation in residential, commercial and public properties.”

The Bond was issued within an initiative “to help address climate change, reduce demands on natural resources and advance lower carbon economic solutions.”

ATMOSPHERIC CO2 CONCENTRATION

While all these environmental policy waves were going on the CO2 concentration in the atmosphere crept up year by year in a slightly accelerating mode and is presently crossing 400 ppm. The basic mechanics of that growth in CO2 levels can be expressed in terms of the KAYA equation, named after a Japanese scientist:

$$CO_2 = P * \frac{GWP}{P} * \frac{E}{GWP} * \frac{F}{E}$$

whereby P stands for Population, GWP for Gross World Product, E for Energy Consumption, F for CO2 emissions from Fuel combustion and industrial processes. Looking at this identity it is easy to see that if population and affluence, expressed by per capita output are rising, the CO2 level can only be kept constant if energy intensity (here as E/GWP) and Carbon intensity of energy production (here as F/E) are sufficiently falling. If, for example, the growth of renewable energy sources is not enough to compensate for falling nuclear energy production in the post Fukushima world, we are left with trying to lower energy intensity. Major advances in technology are necessary for that. In fact the World appears to becoming more, not less, dependent on carbon emitting energy generation. The resurgence of gas, particularly in the USA with the advent of hydraulic fracturing, has led a renaissance in gas powered energy generation. In terms of CO2 this is not a bad thing - every kilogram of methane gas burnt generates approximately 2.75 kilograms of CO2 and generates 14kWh. In contrast every kilogram of coal burnt generates 3.4 kilograms of CO2 and produces 11 kWh giving natural gas about 63% of the CO2 intensity of coal on a per kWh basis. Despite a fundamental change, World CO2 emissions continue to rise. The technological challenges in the energy generation space are self-evident – they require political will as well as available technologies. While there is a clear environmental motivation, the economic motivation is perhaps less clear. Oil and gas companies are in the business of selling oil and gas; power generators in the business of generating power and

more not less builds profits for these businesses, which are so vital to our economies.

If advances in energy generation are not available, not sufficient, without political will power, or without financial attractiveness, advances in energy utilization and efficiency can be made by organizations, independent of government regulations, have financial attractiveness in increasing efficiencies and may be sufficient to at least stem global CO2 emission trends. AMG, from its outset, was declaring it a priority to direct its technology resources based on material science to provide technology solutions in that space.

MITIGATING TECHNOLOGIES

As mentioned in the introductory remarks, at AMG we refer to technologies which are designed to reduce energy consumption and CO2 emissions DURING the industrial manufacturing phase (remember the “better pipe”) as mitigating technologies. These technologies are supposed to mitigate emission risks associated with high energy use in industrial production. They also tend to be highly competitive as conventional technologies over time are almost surely subject to creative destruction. An example which demonstrates technological leaps in the AMG portfolio is the ferro-vanadium production of AMG Vanadium in Cambridge, Ohio, USA. The conventional technology to produce ferro-vanadium in Cambridge was based on converting raw materials from primary mining in South Africa. We have changed that through a transformational technology innovation and today we are producing ferro-vanadium by extracting vanadium from spent catalysts which are a byproduct of oil refineries and from other residues. In doing so we have reduced the CO2 emissions from 28 kg per pound of ferro-vanadium produced to 14 kg per pound or 58,000 tons of CO2 per annum. We believe, by the way, that we are now the lowest cost producer of ferro-vanadium in the world, which can be researched from public materials. We suggest that the environmental attractiveness and financial attractiveness of this mitigating technology are not unrelated.

Mitigating technologies are, by their nature, limited and bounded. The ultimate aim of any company in considering CO2 emissions is to have “zero carbon emissions”, (and zero waste and so on). This aim is pursued by introducing mitigating technologies to make processes as energy efficient as possible, but the fundamental laws of physics remind us that to do work requires energy – there are few, if any, industrial processes that can be conceived that do not consume energy. Thus to approach zero carbon emissions, a company must either install its own low carbon generating capacity (typically solar, wind or hydro) or rely on factors outside its control to get low carbon energy. Within AMG, we see both situations – in Brazil AMG has its own installed hydro generation capacity, satisfying the needs of our local operations, and exporting some power to the grid. In the United States, we operate two similar alloy production facilities, one in the Pacific Northwest, supplied with hydropower, and one in the Midwest supplied with coal-generated power. By historical accident of location (prior to climate warming concerns) these similar plants have very different emissions profiles. The ease of mitigating technology savings are, by their bounded nature, means that they are relatively easy to measure. Mitigating technologies often have a simple, if arbitrary, baseline position and the ‘ownership’ of the savings is clear. This is perhaps why they have long been the focus of governments and green investment opportunities.

ENABLING TECHNOLOGIES

As the first case for an enabling technology innovation at AMG one could list AMG Engineering’s proprietary and highly innovative “Modultherm” heat treatment technology for the surface preparation of next generation engine parts. Comparing to conventional heat treatment processes our enhanced technology for heat treating 6 speed transmissions enables, by the way of higher torques and lower weight, CO2 savings of 14g/km per transmission adding up to about 400.000 tons per year when applied to our volume of 1.5 million transmissions per year (2011). Incidentally, the Modultherm technology also has a “mitigating” component as it uses gas for quenching instead of oil.

Even more dramatic is the case of AMG Engineering's application of this enhanced heat treatment process to the hardening of diesel fuel injector parts enabling them to operate under higher pressures (2250 bar vs. 150 bar) and they are utilized in new fuel efficient diesel engines. Applied to our volume (10 million units per year equivalent to 2.5 million four cylinder engines) this translates to CO2 savings of about 900.000 tons per year.

Another case for vehicle efficiency is the "light weighting" through the use of aluminum vehicle panels vs. steel panels. These military grade aluminum alloys utilize AMG Aluminum's enabling grain refining alloys. Applied to the new 2015 Ford-150, these weight reductions enable fuel efficiency to improve by an estimated 20% and correspondingly CO2 savings of about 685.000 tons per year across Ford's annual production volume for this model.

Let us switch to aerospace. AMG Processing's titanium alloys enables airframe weight reductions (compared to the conventional use of steel) leading to rather dramatic weight reductions: According to several public sources, the Airbus A320 aircraft generates CO2 per passenger per km of 97.5g against 75g from the more efficient Boeing 787-800. In 2011, 2.8 billion passengers travelled by air, with corresponding emissions of about 676 million tons of CO2. The use of titanium alloys in airframes (applying here a conservative estimate of our market share) is enabling a CO2 reduction of about 5.000.000 tons per year. AMG's titanium alloys typically contain high purity vanadium, a raw material that is sourced from vanadium containing residues.

In regard to aerospace, the final example is AMG Engineering's proprietary technology of thermal barrier coatings for turbine blades. This technology enables aerospace turbines to operate at higher temperatures and thus more efficiently. The thermal barrier coating facilitates operation of the turbine at temperatures above the melting point of the construction alloy. Applied to AMG's very high market share, this enables CO2 savings of about 800.000 tons per year.

These five examples all relate to transportation, which accounts for approximately 28% of all energy used by society. An even bigger area is in buildings where approximately 41% of energy is utilized for heating, cooling and lighting.

AMG also has a pivotal role in energy saving in buildings using state-of-the-art insulation materials. Graphite enhanced expanded polystyrene insulation increases the thermal coefficient of insulation materials resulting in estimated CO2 savings of about 6.000 kg per standard family home per year. In 2013, AMG Mining supplied enough graphite to produce insulation for approximately 160.000 homes, enabling about 930.000 metric tons of CO2 savings per year. This, by the way, is a perfect example of how materials, in this case natural graphite, turn into “critical materials” by the way of societal demand shifts.

Unlike mitigating technologies, enabling technologies are not bounded. The fact that they go into highly scalable (often consumer product) applications means that the CO2 savings they produce are quickly multiplied. In theory a company can not only become “zero carbon”, but go beyond into a carbon negative position. The challenge with enabling technologies comes in the measurement of the savings. Because the products are utilized by customers, producers cannot be sure of the savings. Further the model is different and more complex from that for mitigating technologies, under which it is clear who ‘owns’ the CO2 emission savings. In the case of enabling technologies there are often many organizations involved in providing consumers with a new lower carbon alternative, while it is the same consumer who will actually realize the saving (the airline passenger, the car driver or the home owner). We believe that, while both important, given the vast difference in scale of savings between mitigating and enabling technologies, that enabling technologies must now become the focus of green capital as the most effective return on investment in CO2 emission terms. Much greater strides may be made in global CO2 emission reductions from enabling thousands, millions or billions of others to make efficiencies in emissions, than even by making significant savings at one, two or a handful of locations.

MITIGATING VERSUS ENABLING

As an order of magnitude, AMG adding up those processes and products saves or enables to save about 8.5 million tons of annual CO2 emissions, of which only 58.000 tons or 6 % come from mitigating technologies (“end-of-the-pipe” in a wider sense {is this not “in pipe” as it is a technology change}). The biggest market for enabling technologies here seems to be aerospace, followed by automotive and then buildings. Some enabling technologies are being driven by regulation or targets. Most notably in the automotive sector, in the USA the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) have set ever tightening standards for vehicle emissions. In 2009 their ruling set the following targets:

mpg	2011	2012	2013	2014	2015
Passenger Cars	31.2	32.8	34	34.8	35.7
Light Trucks	25	26.4	27.8	28.2	28.6

Longer term proposed standards, set out in a 2010 ruling, take these to 40.3 - 41.0 mpg in 2021 and 48.7-49.7 mpg in 2025. In the European Union (“EU”) the targets are more stringent and nearer term - 42 mpg in 2021 and 51 mpg 2021. Financially viable enabling technologies are clearly needed and needed quickly, to achieve the ambitious goals.

The regulatory approach in aviation is different. The EU introduced its contentious EU Emissions trading System at the beginning of 2012. This system gives tradable CO2 emissions credits to operators for their flights. While still operable for flights inside the EU, the Union was forced to suspend it for international flights pending a global agreement which the International Civil Aviation Organization (ICAO) has agreed to implement by 2020. This will again be a market based mechanism.

Early goals in the USA, set by the Federal Aviation Administration’s (FAA) focused on a 12 % reduction in fuel burn by 2011 versus a 2000 baseline. By 2010 the industry had achieved 15.25 % reductions. The current Administration

goal is to achieve carbon neutral aviation industry growth by 2020. To reach this the Environmentally Responsible Aviation (ERA) project is targeting a 50% reduction in fuel burn for every subsonic flight mission (passenger and cargo) by 2020 (from a 2005 baseline) through a mix of technological and operational advances. Fuel taxes have gone to fund research initiatives include 'NextGen' engine technology, which feature AMG enabling technologies such as turbine blade coating technologies.

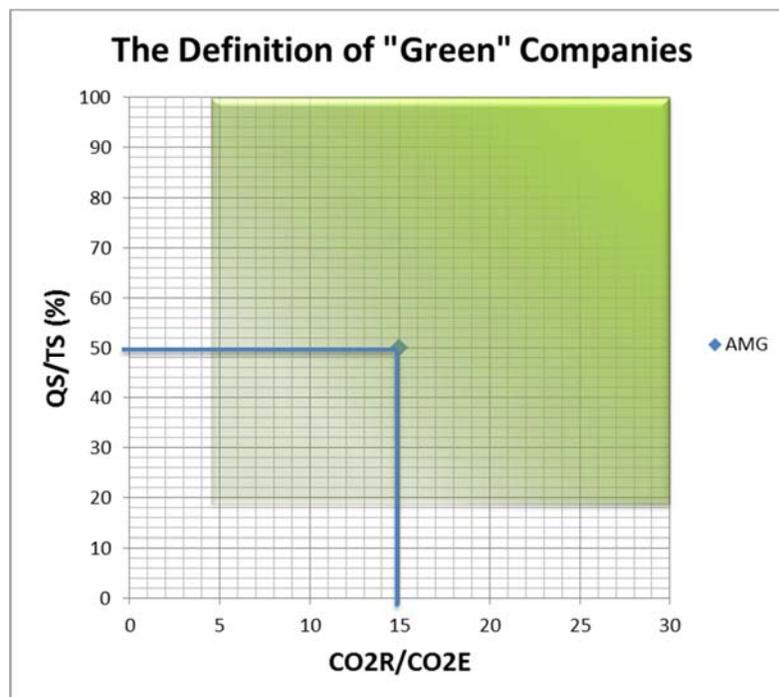
CUMULATIVE EFFECTS

Mitigating technologies are not scalable, we have said that, and more important, do not produce cumulative effects. The CO₂ savings as a result of our ferro-vanadium innovation are about 58.000 tons per year each year during the lifetime of the recycling plant. That is different with enabling technologies for more efficient cars, planes or buildings. The units installed in year one create the calculated savings in year one and repeat that in year two, three and so on. These savings then are cumulative with the savings of the units installed in year two and so on continuing over the lifetime of the vehicle models, aircraft or buildings. The growth stops only when the models are taken out of production or when the buildings stop to use the insulation material referred to earlier. This cumulative feature is very powerful.

Consider the Ford F150 case. We have calculated the CO₂ savings of 685.000 tons per year estimating an annual sale of 520.000 vehicles per year. Whether these are new additions to the overall global vehicle fleet, or they replace older less efficient models which are removed from the fleet, the net savings are the same. Those savings continue to be realized year on year over the life of the vehicle, and further savings come for each new more fuel efficient vehicle sold. Because of the cumulative effect that totals up in ten years to a cumulative CO₂ saving of about 37.6 million tons, not of 5.2 million tons which would happen in the case of mitigating technology applications.

HOW TO DEFINE A "GREEN" COMPANY

The AMG definition of “green” reduces activities to their net CO2 savings profile. The next step is to quantify the company’s green profile. AMG proposes this can be done by plotting qualifying sales (QS), sales which are associated with enabling technologies leading to global CO2 emissions reductions (i.e. sales associated with TCO2R below), as a percentage of total sales (TS) against the net CO2 reduction multiplier – defined as total CO2 reduction enabled (TCO2R)/ total CO2 emissions (TCO2E).

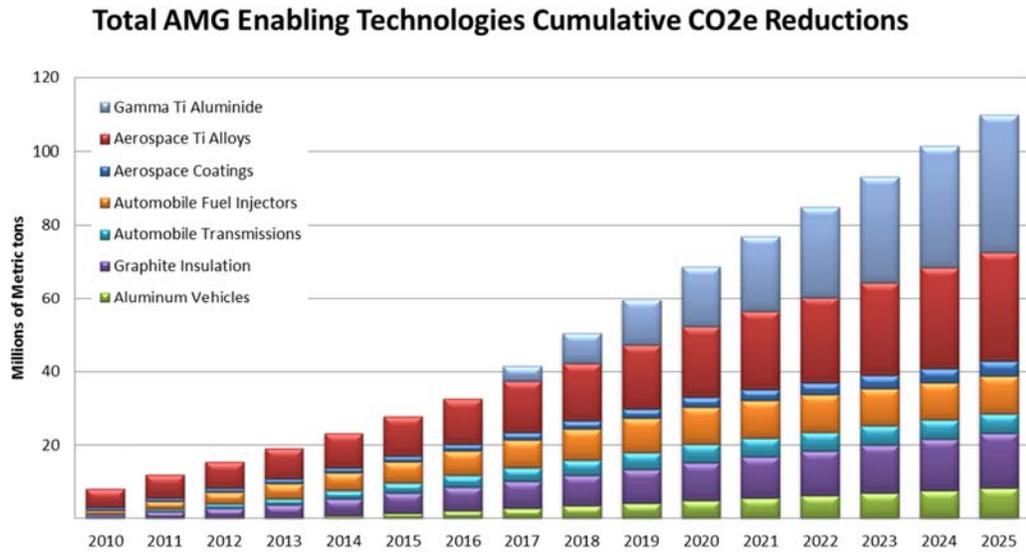


Where:

- QS – Qualifying Sales**
- TS – Total Sales**
- CO2R – CO2 Reduction Enabled**
- CO2E - CO2 Emissions**

The next challenge is how to set a minimum threshold on both scales where “green” companies come to reside. This has to be debated, an exercise which promises to be lively. Once defined, the green space would attract companies, especially if investors accept our framework for redefining “green” or a variation of it. In that case capital allocations would be incentivized to go “green” especially if the global investor community would declare a preference to finance “green” capital spending as defined.

For illustrative purposes we have attached AMG a selection of AMG’s enabling technology CO2 reduction profiles in both transportation and buildings, based on current estimated figures.



About AMG

AMG creates and applies innovative metallurgical solutions to the global trend of sustainable development of natural resources and CO2 reduction. AMG produces highly engineered specialty metal products and advanced vacuum furnace systems for the Energy, Aerospace, Infrastructure, and Specialty Metals and Chemicals end markets.

AMG Processing develops and produces specialty metals, alloys, and high performance materials. AMG is a significant producer of specialty metals, such as ferrovanadium, ferronickel-molybdenum, aluminum master alloys and additives, chromium metal and ferrotitanium, for Energy, Aerospace, Infrastructure and Specialty Metal and Chemicals applications. Other key products include specialty alloys for titanium and superalloys, coating materials and vanadium chemicals.

AMG Engineering designs, engineers and produces advanced vacuum furnace systems and operates vacuum heat treatment facilities, primarily for the Aerospace and Energy (including solar and nuclear) industries. Furnace systems produced by AMG include vacuum remelting, solar silicon melting and crystallization, vacuum induction melting, vacuum heat treatment and high pressure gas quenching, turbine blade coating and sintering. AMG also provides vacuum case-hardening heat treatment services on a tolling basis.

AMG Mining produces critical materials utilizing its secure raw material sources in Africa, Asia, Europe, and South America. AMG Mining produces critical materials such as high purity natural graphite, tantalum, antimony and silicon metal. These materials are of significant importance to the global economy and are available in limited supply. End markets for these materials include electronics, energy efficiency, green energy, and infrastructure.

With over 3,000 employees, AMG operates globally with production facilities in Germany, the United Kingdom, France, Czech Republic, United States, China, Mexico, Brazil, Turkey, Poland, India, and Sri Lanka and has sales and customer service offices in Belgium, Russia, and Japan (www.amg-nv.com).

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Disclaimer

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