

ECO₂RP... ENABLING CO₂ REDUCTION PORTFOLIO AT THE HEART OF OUR ESG APPROACH

APRIL 2021



AMG ADVANCED
METALLURGICAL GROUP N.V.

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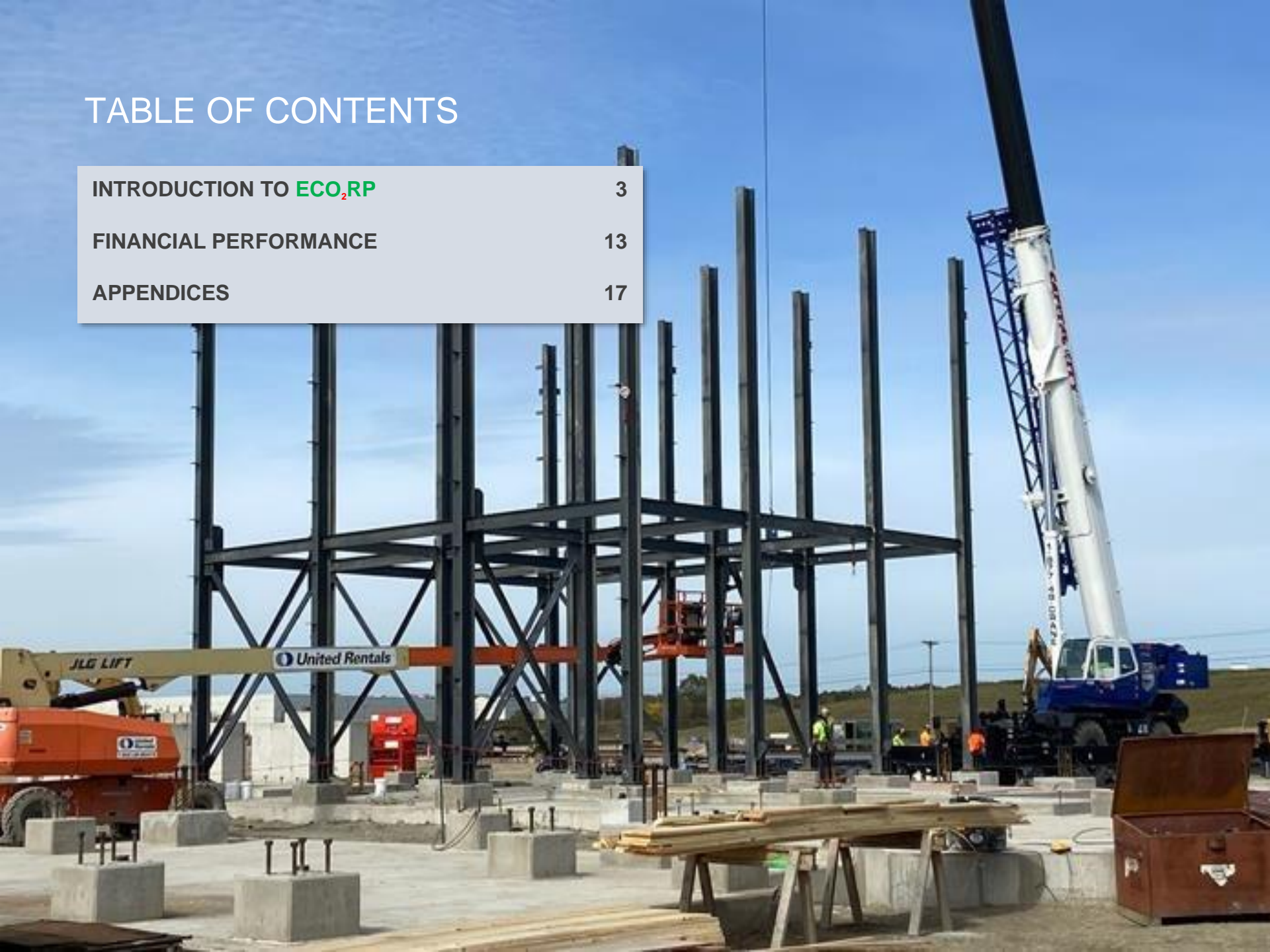
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AMG'S STRATEGIC ORIGIN

- AMG was founded on the basis of a key global trend:
 - Clean energy and energy savings demand materials science-based solutions
- This global trend toward CO₂ abatement created additional demand for materials in the periodic table that in turn became “critical” ¹⁾
- AMG was formed to be the technology leader in these “critical materials”
- As a result, by design, AMG has created and continues to grow a portfolio of product lines enabling its customers to reduce CO₂
(ECO₂RP)

1) Critical Materials are those defined as such by the EU and the U.S. in the following publications: The 2020 EU Critical Raw Materials List, published September 2020; and the U.S. list of Critical Materials per the May 2018 announcement by the U.S. Department of the Interior.

ECO₂RP CHRONOLOGY

We provide products that **enable** our customers to **reduce CO₂ emissions** through higher **energy efficiency**



The **EU regulation** is working in the direction of AMG's long-term objectives: **CO₂ reduction enabling activities** are at the core of the **EU TAXONOMY INITIATIVE**¹⁾



Since 2012 we have developed a methodology to measure the **enabled energy savings**²⁾

2012



In 2018 we further **refined the methodology** in **partnership with ERM**, starting to conduct Life Cycle Assessments (**LCA**) for each qualifying product

2018

ECO₂RP

We have created a **virtual portfolio** to measure the **energy saving enabled** by our products and evaluate the impact on AMG's **financial performance**

2020

ECO₂RP HAS BEEN CREATED TO REPRESENT AND QUANTIFY OUR EFFORTS TO SUSTAIN THE ENVIRONMENT. IT IS NOT INTENDED TO BE A REPORTING SEGMENT.

1) Regulation EU 2020/852 - art.16 & 69 – see appendix for further details

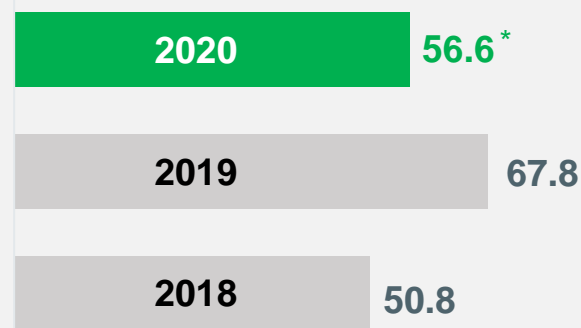
2) see “Enabling Metric, Please”. The Stern Stewart Institute No. 10 June 2014 pp. 58-63 by Prof. Dr. Steve H. Hanke and Dr. Heinz Schimmelbusch. For further detail, see [AMG's website](#).

ECO₂RP IS THE PORTFOLIO OF AMG'S **PRODUCTS ENABLING CO₂ REDUCTION**

Strict selection criteria

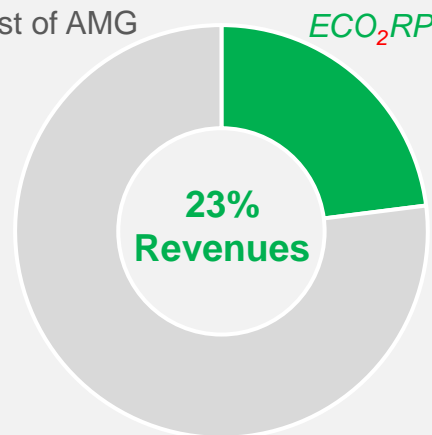
Products are accepted in **ECO₂RP** only when the **enabled CO₂ reduction** effect has been established by a LCA performed by a leading third-party expert

AMG'S enabled CO₂ emission reductions
(Million MT)



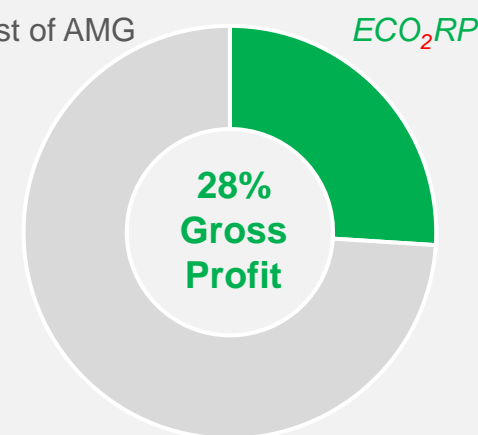
CO₂ reduction enabled
by AMG's products based
on the LCAs of 2018-2020

Rest of AMG



23% of revenue contribution
by **ECO₂RP** products in 2020
(up from 8% in 2010)

Rest of AMG



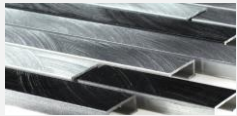
















28% of gross profit contribution
by **ECO₂RP** products in 2020
(up from 5% in 2010)

~ 81 MILLION \$ OF 2018-2020 AVERAGE GROSS PROFIT DERIVED FROM **ECO₂RP**

* 2020 decrease due to the global pandemic significantly impacting volumes in our aerospace exposed businesses.

ECO₂RP IS CURRENTLY COMPOSED OF 8 PRODUCTS THAT ENABLED 56.6 MILLION MT OF CO₂ REDUCTION IN 2020

	 34.2	1	Thermal barrier coatings, enabling fuel savings through higher operating temperatures in aircraft engines
	 6.5	2	Aluminum alloys, enabling reduced fuel consumption by light weighting
	 3.2	3	Master alloys for Ti alloys, enabling reduced fuel consumption by heat efficiency leading to fuel savings
	 2.9	4	Ferrovanadium , alloy for rebar steel, reducing quantity required for construction, and mitigation from recycling 
	 1.07	5	Graphite , as insulation in buildings, enabling lower domestic heating requirements
	 0.06	6	Turbocharger wheel casting , turbocharges in vehicle engines enable engine downsizing fuel efficiency
	 0.02	7	Glass coating, enabling lower cooling requirements
	 8.6	8	Automotive transmission heat treatment, enabling vehicle fuel savings



A **STRONG PIPELINE** OF LCA CANDIDATES TO BE ADDED TO THE **ECO₂RP** WILL ENABLE **FURTHER CO₂ EMISSION REDUCTION**...

LCA candidates enabling further CO₂ reduction

(Million MT)

ECO₂RP pipeline of LCA candidates

9



MOx Fuels, nuclear power to **replace fossil** power in China (est. 2022)

 12.0

10



Titanium aluminides, enabling **fuel savings** and use of hotter temperatures

 TBD

11



Nickel based super alloys, **recycling production scrap** instead of primary mining

 TBD

12



Vanadium Pentoxide (V₂O₅)

 TBD

13



Lithium Tailings

 TBD

14



Microsilica in cement

 TBD

15



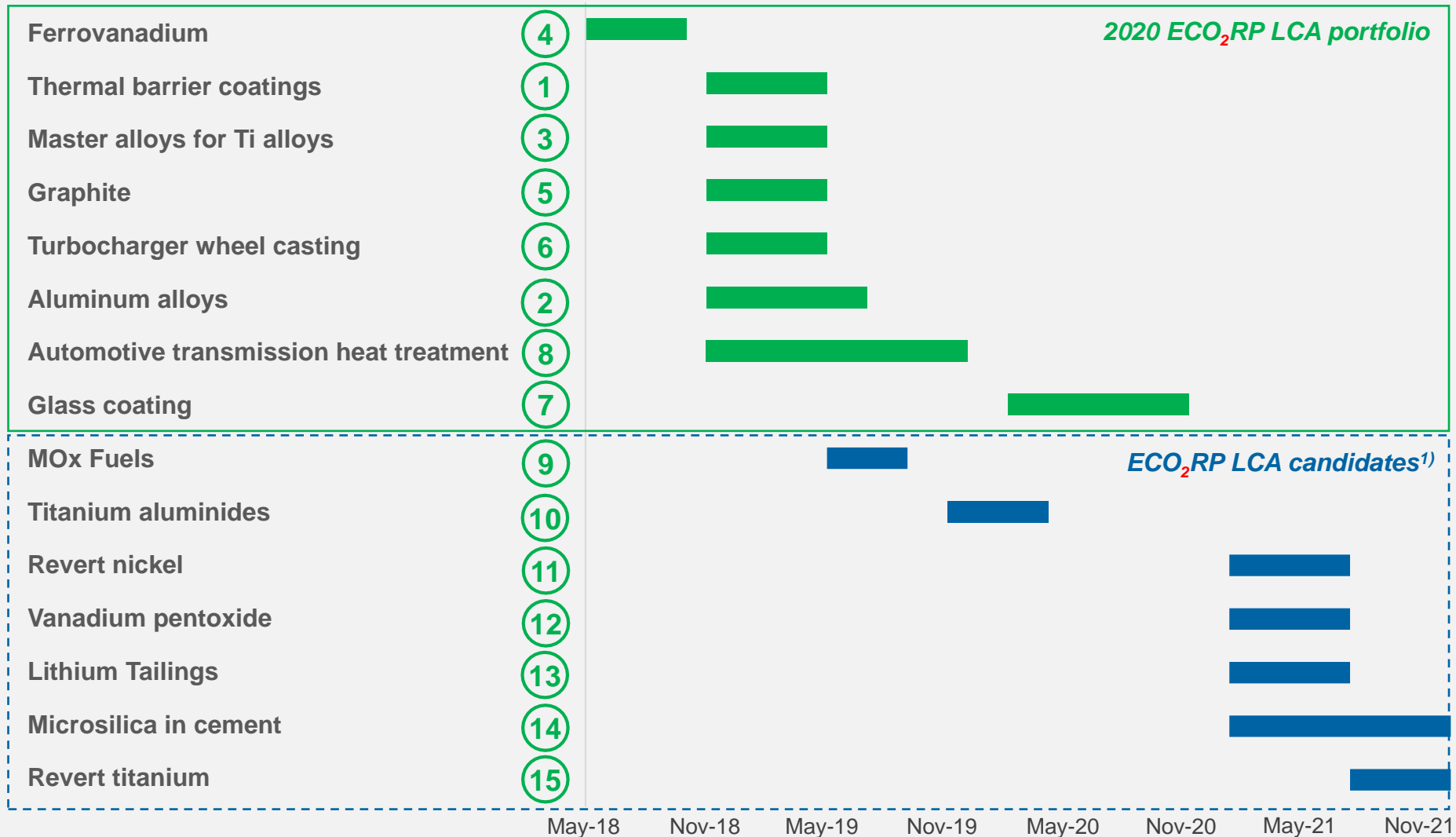
Revert Titanium

 TBD



...WITH TANGIBLE RESULTS EXPECTED IN THE **NEAR FUTURE**

List of LCA projects enabling further CO₂ reduction



1) Excluding CO₂ savings from energy storage contributions

VERIFIED CARBON STANDARD METHODOLOGY DEVELOPMENT

Methodology for Reduction in GHG Emissions From Metal Production Using Metal Bearing Wastes

- AMG in final stages of publishing a VERRA - Verified Carbon Standard Methodology
- Methodology allows certified projects to turn their greenhouse gas (GHG) emission reductions and removals into tradable verified carbon units (VCU)

TENTATIVE TIMELINE



AMG STRATEGIC PRIORITIES BEYOND 2020: THE **ENERGY TRANSITION** PASSES THROUGH THE **ELECTRICITY STORAGE**

Grid Storage Batteries play a critical role in **reducing CO₂**. Battery-based electricity storage capacity enables additional renewable energy for the utility industry, **removing a bottleneck in renewable expansion**



provides raw materials for lithium, vanadium & tantalum for **battery and capacitor use**

Batteries

Lithium

- Preliminary engineering for the first battery grade lithium hydroxide refinery in Europe, to be located in Germany
- AMG is preparing a pilot plant operation for lithium solid state batteries in Germany



Vanadium

- Planning to expand production of vanadium oxide electrolytes for stationary batteries sourced from waste streams in gasification (Germany) and refinery waste (US)
- Overseas expansion through the JV Shell – AMG Recycling BV



Capacitors

Tantalum

- AMG is the world's largest producer of conflict free tantalum at the Mibra mine in Brazil. It is the preferred metal for capacitor manufacturing
- Energy is stored on the capacitor's conductors; the larger the surface of the conductor, the more charge it can store



AMG IS CURRENTLY WORKING ON HOW TO LINK INCREMENTAL ELECTRICITY STORAGE CAPACITY WITH RENEWABLE ENERGY PRODUCTION

OUR COMMITMENT TOWARD SUSTAINABILITY CREATES SHARED VALUES ACROSS OUR STAKEHOLDER GROUP...

Suppliers



*"In 2019 MPC delivered 5,300 metric tons of spent catalyst to AMG. AMG extracted the vanadium and other valuable metals. This reclamation process produces **41,500 less metric tons of CO₂e emissions** than traditional steel manufacturing"¹⁾*

Employees



Jane Neal
VP AMG Vanadium

*"Our president brings a personal philosophy that instills a spirit of **inclusion** in our organization by valuing people of diverse backgrounds, gender and experience. He, I and the entire AMG organization have a mission to develop our team members, providing **opportunities** for individuals to grow and realize their **full potential**."*

Customers



Supplying conflict-free critical materials

Providing critical materials from conflict-free areas** is important to AMG and our clients in the electronics industry. We proudly work with them to meet this goal: **AMG is the world's largest supplier of conflict-free tantalum

Investors



Berenberg
Equity research

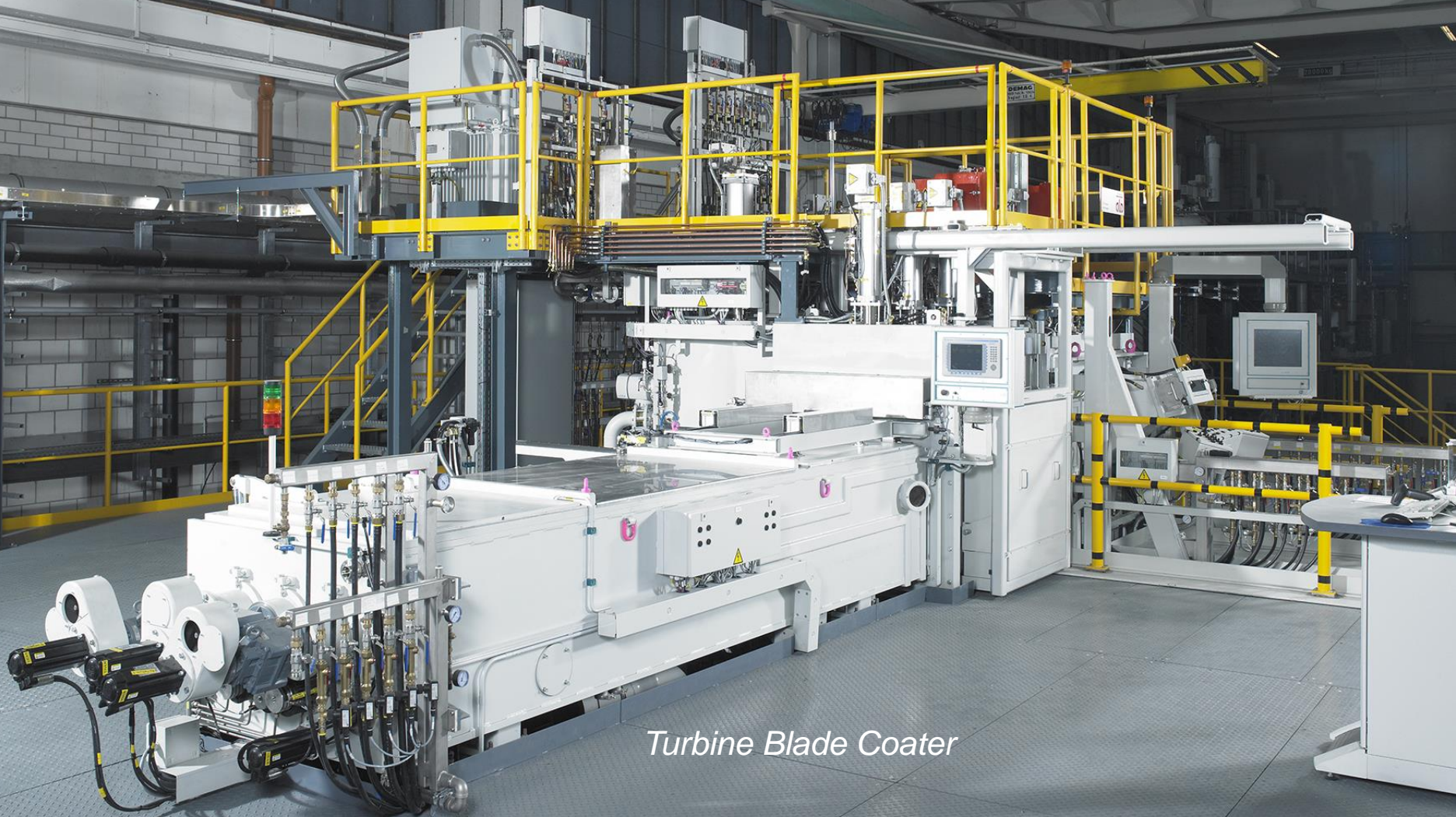
*"We like **AMG** for its **value creation** from innovation, exposure to **rising recycling fees** for its vanadium raw material, **leadership in circular economy**, ability to produce lithium at a lower cost than peers, **attractive valuation and ESG angle**."*

Communities



***Environmental education program** developed by AMG Mineração in 2018, reaching >700 people from **local communities and stakeholders** during 2019*

ECO₂RP *FINANCIAL PERFORMANCE*



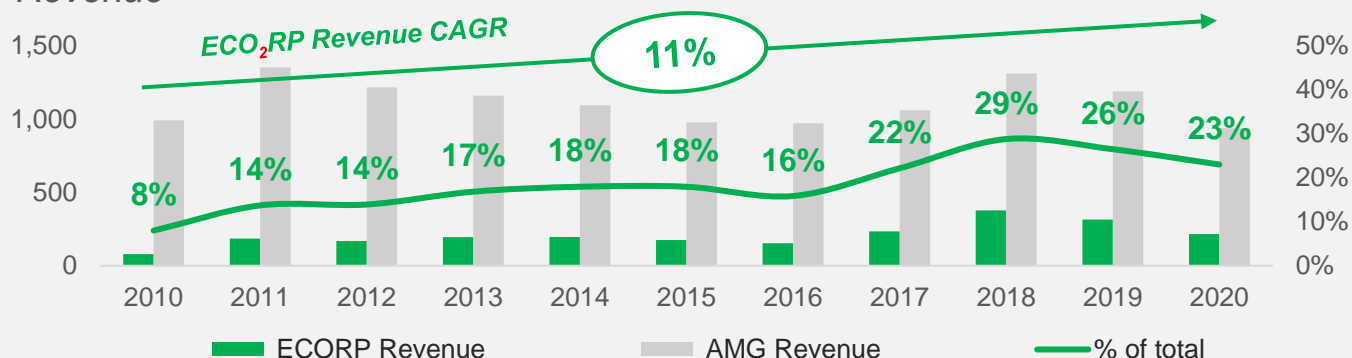
Turbine Blade Coater

ECO₂RP HAS BECOME THE GROWTH ENGINE FOR AMG OVER THE PAST 10 YEARS, EXPANDING IN SCALE & PROFITABILITY

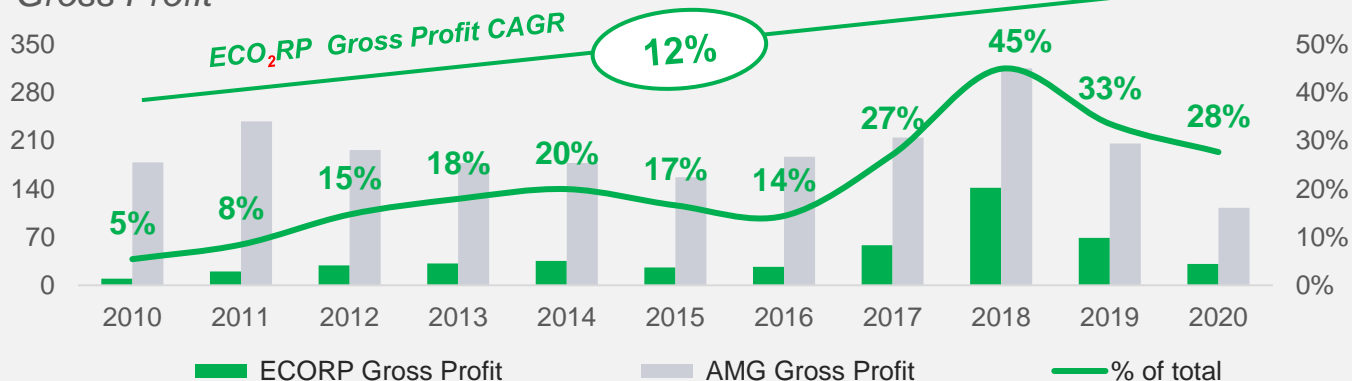
Relevance of the ECO₂RP within AMG (Key economics '10 – '20)

ECO₂RP - Key highlights

Revenue



Gross Profit



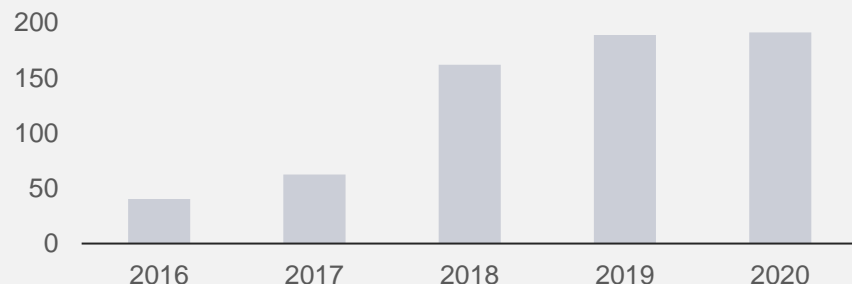
- Higher growth in Revenue and Gross Profit than AMG as a whole
- The gross profit of ECO₂RP is growing faster than the related revenues
- Gross margin of ECO₂RP is higher than the group as a whole

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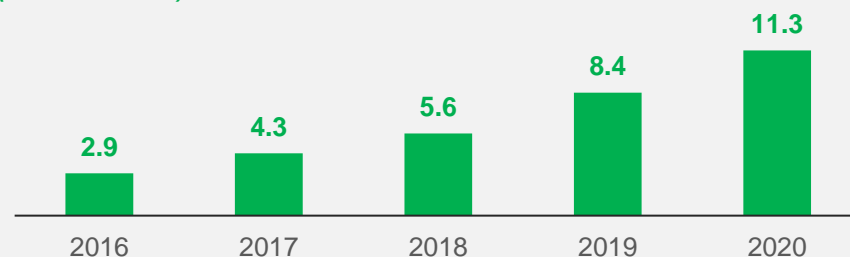
ECO₂RP CASE STUDIES – FERROVANADIUM & GRAPHITE

Ferrovanadium

Cumulative Gross Profit (Million \$)

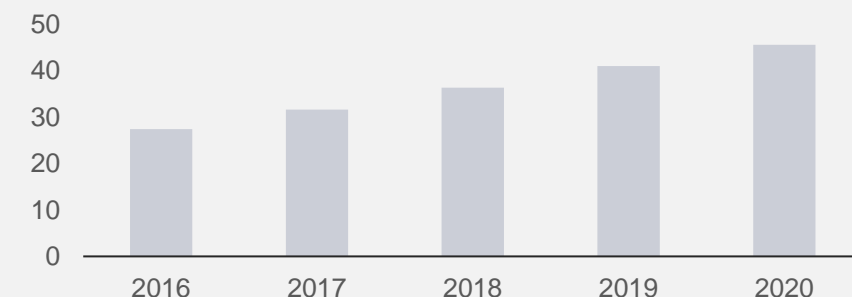


Cumulative Enabled & Mitigated CO₂ Reduction (Million MT)

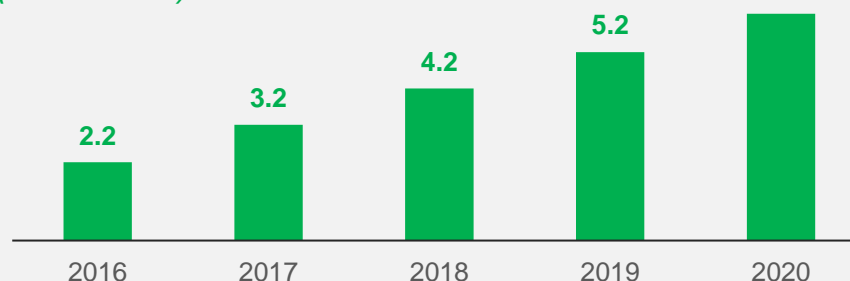


Graphite

Cumulative Gross Profit (Million \$)



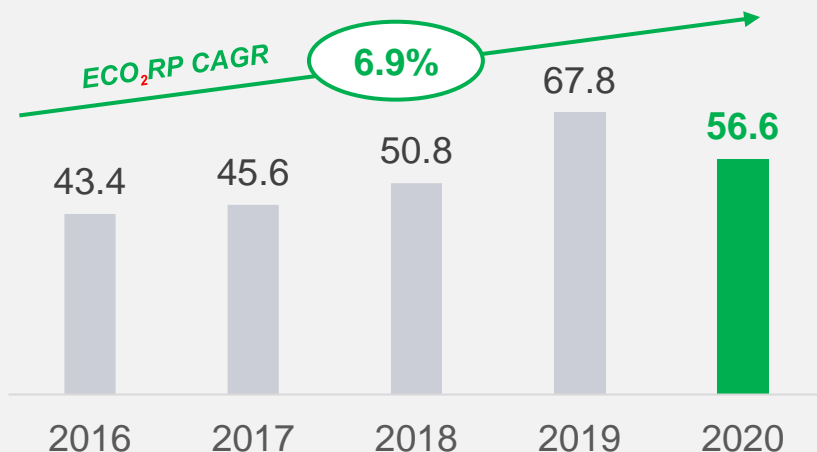
Cumulative Enabled CO₂ Reduction (Million MT)



AMG'S INFRASTRUCTURE-RELATED CO₂ REDUCTION PRODUCTS ARE NOT ONLY PROFITABLE BUT VERY EFFECTIVE IN ENABLING OUR CUSTOMERS TO REDUCE CO₂ EMISSIONS

ECO₂RP VALUE INDICATIONS

AMG's CO₂ offset credit valuation based on the enabled CO₂ emission reductions (Million MT)



- If the ECO₂RP enabled CO₂ reduction products were tradeable as European CO₂ Allowances, the total value of 56.6 million MT of enabled CO₂ reduction at € 25 / ton would be € 1.4 billion.
- The EU Taxonomy legislative efforts – embracing the “enabling CO₂ reduction concept” – confirms AMG’s ECO₂RP strategy

ECO₂RP financial highlights

11%

2010-2020
Revenue CAGR

\$81m

2018-2020
average gross profit

12%

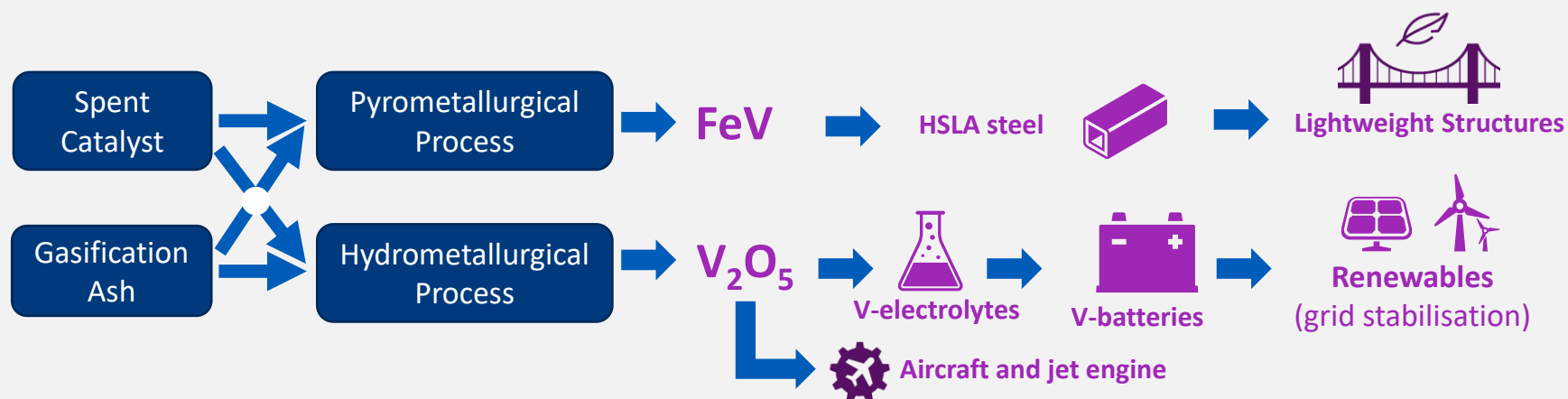
2010-2020
Gross Profit CAGR



APPENDICES

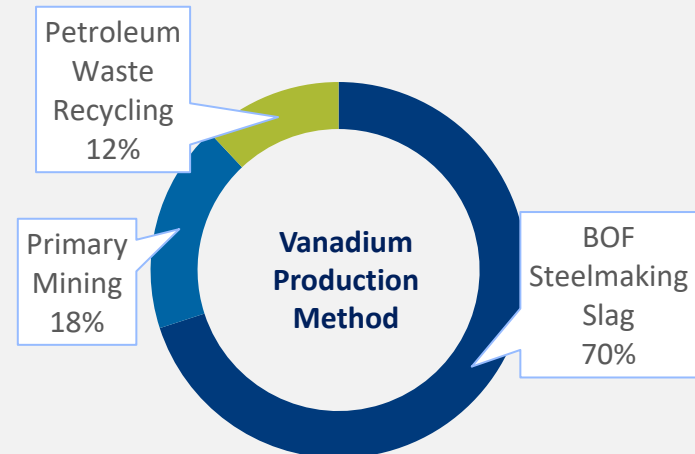
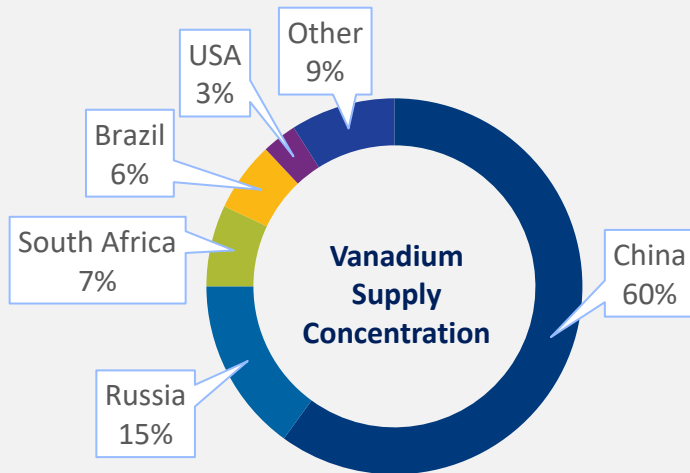
*Lithium Processing,
AMG Brazil*

PROCESS OVERVIEW



- Production of high-purity vanadium-pentoxide (V_2O_5) enables energy storage capabilities and renewable target to achieve GHG goals
- **Diversification** of input feeds, process routes and end market
- Significant **CO₂ emission savings** via recycling, approx. 80% lower than primary extraction
- HSLA steel enables a **20-40% reduction in steel use**, significantly reducing resource use and transport-related CO₂ emissions
- High purity V_2O_5 for VRFB energy storage applications, enabling **renewable power growth**

GLOBAL VANADIUM AT A GLANCE

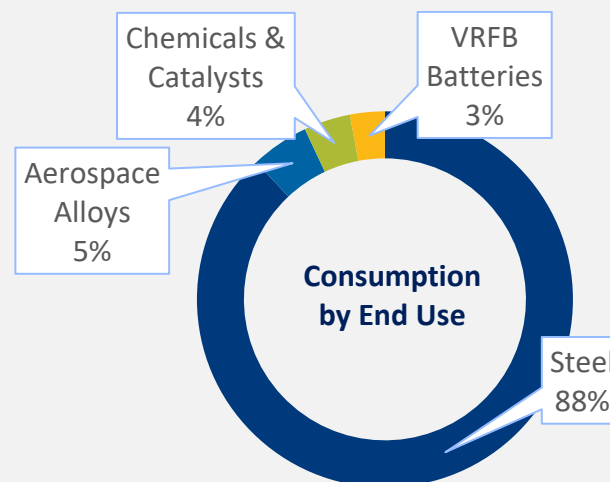
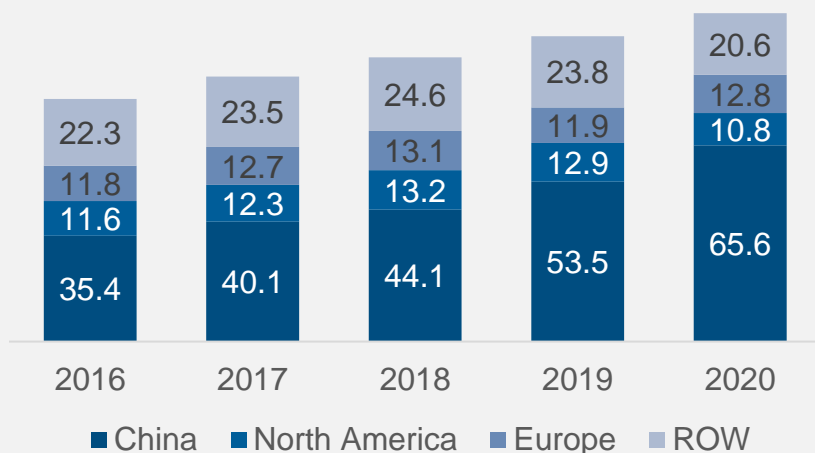


- Over time new vanadium production will come from increased recycling of petroleum wastes and from primary mining as the demand for vanadium continues to grow. Production from steelmaking slags will gradually decline over time as BOF steelmaking is gradually replaced by mini-mills in China
- Only a very small percentage of the global vanadium supply base can produce “high-purity” vanadium compounds necessary for future VRFB system applications

Sources: AMG Vanadium, Vanitec, Roskill, Metal Bulletin

GLOBAL VANADIUM AT A GLANCE

Vanadium Consumption



- Vanadium consumption is largely driven by China and rebar production, data indicates China will become a net importer of vanadium as consumption grows. Net exports in June 2020 were negative for example. In May 2020, the Chinese government announced fiscal stimulus of about US\$500 billion which is expected to drive further steel sector and vanadium demand growth.
- Despite the period of low demand outside of China we expect a demand to return to normalized levels in the short term
- Potential new demand from the emerging VRFB could result in an increased demand for high-purity vanadium compounds

Sources: AMG Vanadium, Vanitec, Roskill, Metal Bulletin

CO2 REDUCTION ENABLING ACTIVITIES ARE AT THE CORE OF THE NEWEST EU TAXONOMY INITIATIVE

Regulation (EU) 2020/852 of the European Parliament and of the Council on the establishment of **a framework to facilitate sustainable investment** and amending Regulation (EU) 2019/2088.

For each environmental objective, the Taxonomy Regulation (TR) recognizes two distinct types of substantial contribution that can be considered Taxonomy-aligned:

“Economic activities that make a substantial contribution based on their own performance”



<AND>

Article 16 - **Enabling** Activities

“An economic activity shall qualify as contributing substantially to one or more of the environmental objectives set out in Article 9 by directly **enabling** other activities to make a substantial contribution to one or more of those objectives, provided that such activity:

- a) does not lead to a lock-in of assets that undermine long-term environmental goals, considering the economic lifetime of those assets; and
- b) has a substantial positive environmental impact, on the basis of life-cycle considerations.”

ABBREVIATION KEY



Circular Economy Focus

ECO₂RP:

Enabling CO₂ Reduction Portfolio

ERM:

Environmental Resources Management

GHG:

Greenhouse Gas

GRI:

Global Reporting Initiative

LCA:

Life Cycle Assessment

TBC:

Thermal Barrier Coating

VRFB:

Vanadium Redox Flow Battery