



CRITICAL MATERIALS FOR

THE NEW MILLENNIUM



AMG Titanium Alloys & Coatings
Capital Markets Day June 2017



TABLE OF CONTENTS

AMG Business Segments	1
AMG Titanium Alloys & Coatings:	
Safety	2
Overview	3
Titanium Aluminides	4
Long Term Contracts	9
Titanium Master Alloys	13
Chemicals	14
Coating Materials	15
Strategy	16
Plant Tour	17

CAUTIONARY NOTE

THIS DOCUMENT IS STRICTLY CONFIDENTIAL AND IS BEING PROVIDED TO YOU SOLELY FOR YOUR INFORMATION BY AMG ADVANCED METALLURGICAL GROUP N.V. (THE "COMPANY") AND MAY NOT BE REPRODUCED IN ANY FORM OR FURTHER DISTRIBUTED TO ANY OTHER PERSON OR PUBLISHED, IN WHOLE OR IN PART, FOR ANY PURPOSE. FAILURE TO COMPLY WITH THIS RESTRICTION MAY CONSTITUTE A VIOLATION OF APPLICABLE SECURITIES LAWS.

This presentation does not constitute or form part of, and should not be construed as, an offer to sell or issue or the solicitation of an offer to buy or acquire securities of the Company or any of its subsidiaries nor should it or any part of it, nor the fact of its distribution, form the basis of, or be relied on in connection with, any contract or commitment whatsoever.

This presentation has been prepared by, and is the sole responsibility of, the Company. This document, any presentation made in conjunction herewith and any accompanying materials are for information only and are not a prospectus, offering circular or admission document. This presentation does not form a part of, and should not be construed as, an offer, invitation or solicitation to subscribe for or purchase, or dispose of any of the securities of the companies mentioned in this presentation. These materials do not constitute an offer of securities for sale in the United States or an invitation or an offer to the public or form of application to subscribe for securities. Neither this presentation nor anything contained herein shall form the basis of, or be relied on in connection with, any offer or commitment whatsoever. The information contained in this presentation has not been independently verified. No representation or warranty, express or implied, is made as to, and no reliance should be placed on, the fairness, accuracy or completeness of the information or the opinions contained herein. The Company and its advisors are under no obligation to update or keep current the information contained in this presentation. To the extent allowed by law, none of the Company or its affiliates, advisors or representatives accept any liability whatsoever (in negligence or otherwise) for any loss howsoever arising from any use of this presentation or its contents or otherwise arising in connection with the presentation.

Certain statements in this presentation constitute forward-looking statements, including statements regarding the Company's financial position, business strategy, plans and objectives of management for future operations. These statements, which contain the words "believe," "expect," "anticipate," "intends," "estimate," "forecast," "project," "will," "may," "should" and similar expressions, reflect the beliefs and expectations of the management board of directors of the Company and are subject to risks and uncertainties that may cause actual results to differ materially. These risks and uncertainties include, among other factors, the achievement of the anticipated levels of profitability, growth, cost and synergy of the Company's recent acquisitions, the timely development and acceptance of new products, the impact of competitive pricing, the ability to obtain necessary regulatory approvals, and the impact of general business and global economic conditions. These and other factors could adversely affect the outcome and financial effects of the plans and events described herein.

Neither the Company, nor any of its respective agents, employees or advisors intend or have any duty or obligation to supplement, amend, update or revise any of the forward-looking statements contained in this presentation.

The information and opinions contained in this document are provided as at the date of this presentation and are subject to change without notice.

This document has not been approved by any competent regulatory or supervisory authority.

SLIDE I: AMG BUSINESS SEGMENTS

AMG CRITICAL MATERIALS

- Vanadium
- Superalloys
- **Titanium Alloys & Coatings**
- Aluminum Alloys
- Tantalum & Niobium & Lithium
- Antimony
- Graphite
- Silicon Metal

AMG ENGINEERING




Vacuum Technology

- Metallurgy
- Heat Treatment Services

SLIDE II: HEALTH AND SAFETY FOCUS

LEADING SAFETY INDICATORS

- The number of safety improvement items (based on near miss or unsafe conditions) reported in 2016 was 31% higher compared to 2015. These are essential in order to avoid potential injuries.
- Safety training hours increased 11% in 2016.
- At the end of Q1 2017, lost time incident rate was 77% lower and total incident rate and incident severity rate were down 89% and 99%, respectively, from Q1 2016.

YEAR	LOST TIME INCIDENTS IN THE LAST 12 MONTHS	12 MONTH AVERAGE LOST TIME INCIDENT RATE	12 MONTH AVERAGE INCIDENT SEVERITY RATE	12 MONTH AVERAGE TOTAL INCIDENT RATE
2016	4	1.31	0.34	2.62
2017	1 	0.30 	0.01 	0.30 



Rigorous commitment to safety reflected in continually improving safety records

SLIDE III: OVERVIEW

AMG Titanium Alloys and Coatings



A leading manufacturer of high performance metals and materials

End Market

TRANSPORTATION



Key Products

- Titanium Aluminides (γ -TiAl)

Value Proposition

- The new high growth area in light-weighting aerospace engines
- Strong thermo-mechanical properties at lower densities
- Reduction of engine weight, improving fuel efficiency (CO₂ emissions)

Applications

- Presently, the main application in blades of the low pressure turbine (Boeing 737 max and the Airbus A320 neo)



SLIDE V: MARKET – TITANIUM MASTER ALLOYS & TI ALUMINIDES

Material

Ti-64

Ti-6246

Ti-834

Ni-based
Superalloys

Ti
Aluminides

Op temperature
[°C]

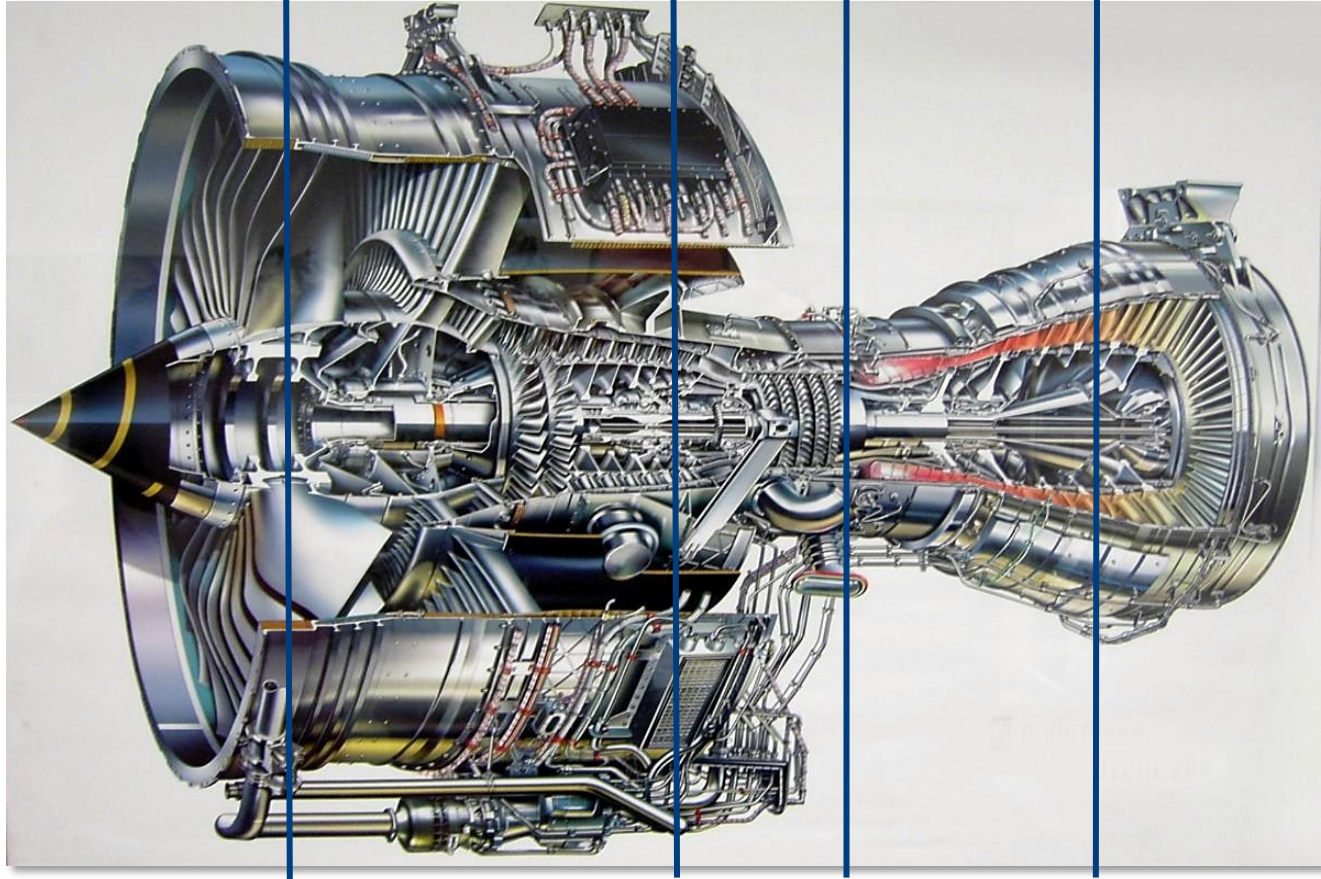
up to 300

up to 450

up to 600

1,230 - 750

up to 750



AMG TAC produces a complete range of materials along the exhaust path

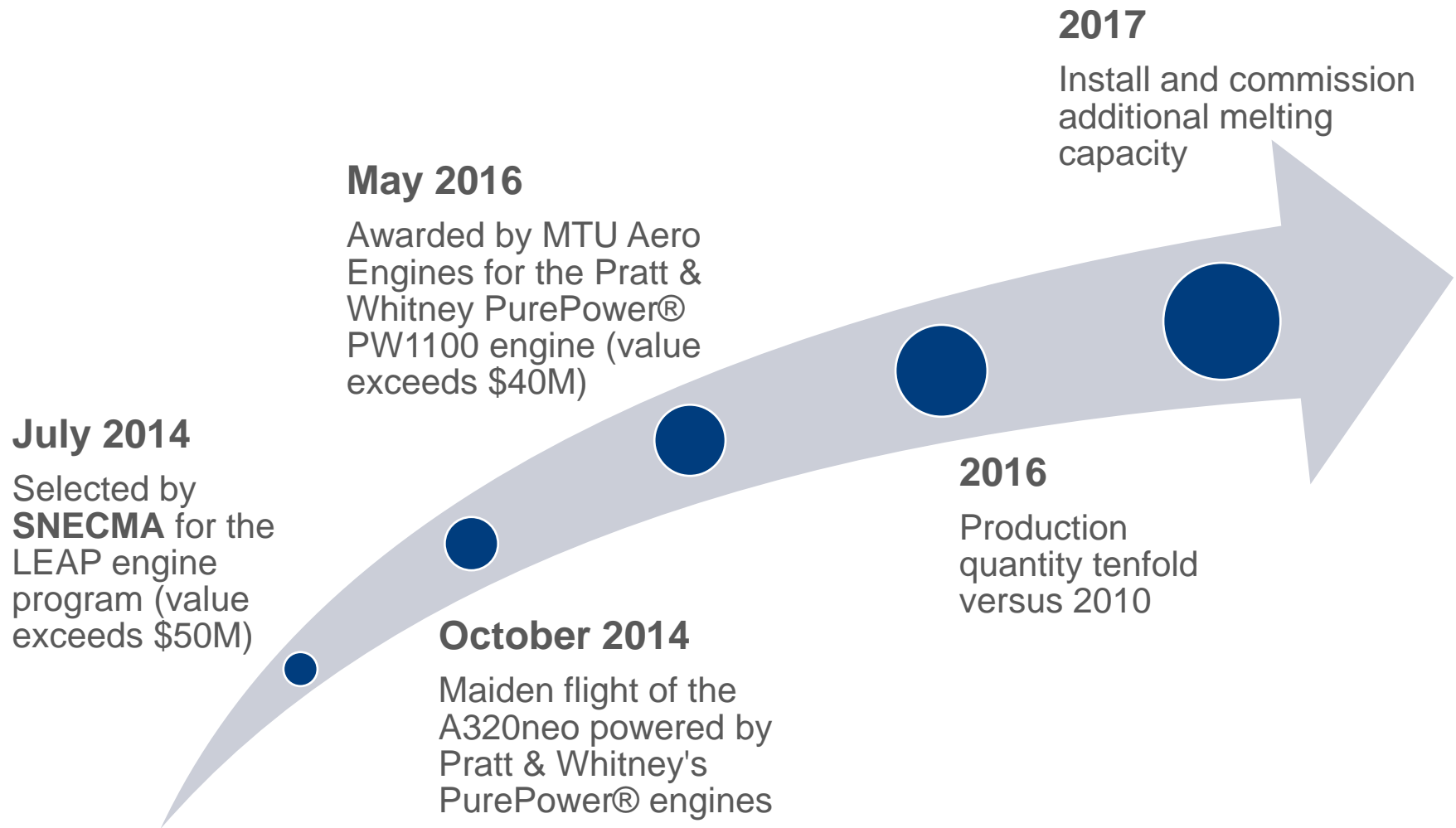
SLIDE VI: TITANIUM ALUMINIDES – PRODUCTS, END MARKETS, AND APPLICATIONS



SLIDE VII: TITANIUM ALUMINIDES – PRODUCTS, END MARKETS, AND APPLICATIONS



SLIDE VIII: TITATNIUM ALUMINIDES EXPANSION TIMELINE



Titanium Aluminides Sales Visibility

- Close to 100% of sales contracted
- Average contract length: 5 years or longer

SLIDE X: MARKET – TITANIUM ALUMINIDES MID-/LONGTERM



P&W PurePower engine



Airbus A 320neo



Mitsubishi Regional Jet



CFM LEAP engine



Airbus A 320 neo: LEAP-1A



Boeing B737MAX: LEAP-1B

SLIDE XI: MARKET – TITANIUM ALUMINIDES MID-/LONGTERM

We are the world leader in Titanium Aluminides

Aircraft

Boeing 747-8
Intercontinental +
Freighter

Boeing 787
“Dreamliner”

COMAC 919
Boeing 737 max
Airbus A320 neo

Bombardier
CSeries
MRJ Mitsubishi
Regional Jet
Irkut MS-21
Airbus A320 neo



Engine

GE Aviation
GEnx-1B

GE Aviation
GEnx-2B

Snecma / GE
LEAP-X

P&W / MTU
**Geared Turbo
Fan (GTF)**
PW1524G /
PW1217G /
PW1400G/
PW1100G

SLIDE XII: MARKET – TITANIUM ALUMINIDES SHORT-/MIDTERM



Source: Ascend, Avascent Analysis

SLIDE XIII: TITANIUM MASTER ALLOYS – PRODUCTS, END MARKETS, AND APPLICATIONS

End Market

TRANSPORTATION



Key Products

- Titanium master alloys for aircraft engine components
 - Vanadium Aluminum (VAI)
 - Molybdenum Aluminum (MoAl)

Value Proposition

- Reduce aircraft weight, improving fuel efficiency and reducing CO₂ emissions

Applications



Fastener

Source: PCC website



Undercarriage

Source: Kobe website



A Boeing 787 Dreamliner contains ~ 250k lb titanium, a 17% increase in fuel efficiency compared to an older Boeing 737

SLIDE XIV: CHEMICALS – PRODUCTS, END MARKETS, AND APPLICATIONS

End Markets

SPECIALTY METALS & CHEMICALS



TRANSPORTATION



Key Products

- Vanadium oxides and compounds for various industries
 - V_2O_5 , AMV, KMV, SAV

- Vanadium oxides for Titanium master alloys (for aircraft engines and components)
 - V_2O_5 , VO_2

Value Proposition

- Act as catalyst for chemical reactions
- Protect from corrosion
- Absorb UV and IR-light

- Reduce aircraft weight, improving fuel efficiency and reducing CO_2 emissions

Applications



Catalyst's are used to clean exhaust gases or to produce chemical products



Titanium master alloys to produce Titanium Alloys like Ti-6-4

SLIDE XV: COATINGS – PRODUCTS, END MARKETS, AND APPLICATIONS

End Markets

SPECIALTY METALS & CHEMICALS



ENERGY



Key Products

- Sputtering targets for various industries such as tooling, automotive and aerospace
 - AlTi, AlCr
- Sputtering targets and rotatable targets for the flat glass industry
 - AZOY® (ZnO/Al₂O₃), CROMA®
- Sputtering targets for TCF's for PV thin film cells
 - AZOY® (ZnO/Al₂O₃)
 - Aluminium
 - Chromium

Value Proposition

- Improve wear resistance
- Provide protective hard coatings
- Thermal insulation
- Reflecting or transparent
- Electrically conductive
- Solar absorbing
- Metallization
- Anti-reflective
- Use of TCO's

Applications

- Surface coatings applied to tooling to improve wear resistance and to avoid abrasion
- Coating layer applied on building glass to improve thermal insulation and reduce reflection
- All thin film producers apply TCO's with the sputtering process and ~90% of thin film TCO layers are made with ZnO:Al₂O₃

Summary

- Traditional emphasis: light-weighting the engine
- Additional future emphasis: metallurgical powder products for additive manufacturing

SLIDE XVII: PLANT TOUR

