



REIMAGINING THE MAGNET TECHNOLOGY THAT DRIVES THE WORLD

Disruptive Technology for Decommoditizing the Magnet Supply Chain

April 2024

History

1995 – Founded with a focus on superconducting magnets for particle accelerators and colliders

2009-2014 – Funded by U.S. Department of Energy and NASA for development of superconducting electrical machines for offshore wind turbine generators and turbo-electric aero propulsion

2015 to Present – Focus on the development of PM-Wire™ permanent magnets, magnet manufacturing and electrical machine development

Locations

Corporate Headquarters

Melbourne, Florida

- ✓ Corporate, Operations
- ✓ Engineering, R&D
- ✓ Machine Shop, Prototyping

Manufacturing

Located 3 miles from Headquarters

- ✓ MITUS PM-Wire™ Pilot Manufacturing Line
- ✓ Metal Alloys Development Lab



Corporate Headquarters
&
R&D



Manufacturing
&
Metal Alloy Development



Creating A New & Stable Magnet Supply Chain



Vision

Create a new and stable magnet supply chain

Mission

Magnet Innovation - “Building a Better Magnet in America”

Product

PM-Wire™

Innovative solution for the design, manufacture and application of magnets

Value Proposition

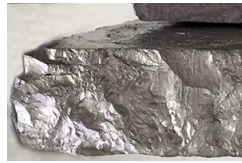
Increased performance and lower cost end-use product



Mining / Recycling



Oxide Extraction
NdPr



Metal Alloys



Conventional
Magnets



IMPACT INNOVATION PRODUCTS BUILDING A BETTER MAGNET CONTACT

U.S. COMPANY CREATING A NEW & STABLE RARE EARTH SUPPLY CHAIN
ADVANCED MAGNET LAB IS REINVENTING MAGNETS FOR TRANSFORMING ELECTRICAL MACHINES

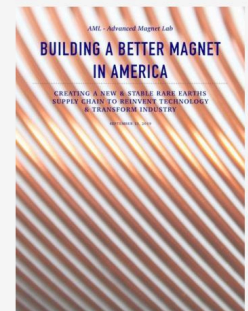
Unveiling a vision for the transformation of multiple industries that depend on rare earth materials, permanent magnets, and high performance electrical machines.

As the world evolves away from purely fossil fuel-powered engines, vehicles, and machines, toward electric and hybrid-powered machines, the need for better, more efficient, more powerful, lighter weight magnets and magnet-powered motors will take over in industries from transportation to wind energy to robotics and more.

This paper explores the future of magnets and their end-use impact and the solutions to the manufacturing challenges, supply of resources, and creation of a stable, thriving, vertically-integrated “mining to magnet to end-use” industry.

September 2019

OUR PERSPECTIVE
THE FUTURE OF MAGNETICS, E-MOBILITY AND MORE!



DOWNLOAD THE PAPER



AML
Metal Alloys



AML
Magnets



Creating A New & Stable Magnet Supply Chain



Problem Statement

Magnets are at the heart of manufacturing, consumer products, transportation and defense
China dominates the Rare Earth Magnet Industry (REMI) producing > 85% of the world's supply
China's vertical integration of cheap labor, raw materials and unsafe environmental standards have resulted in a "high-barrier to market-entry" for competitors Worldwide
Historically, U.S. companies entering the REMI could not compete and sustain their business

Solution – Innovative Technologies

Breaking China's stronghold requires downstream innovation for enabling a sustainable REMI supply chain to reinvent technology and transform the industry
AML has developed PM-Wire™. A novel solution for the design, manufacture of magnets which improve the performance and lower the cost of the end-use products

Supply Chain – Oxide and Alloys

AML has established relationships with U.S. and European oxide producers including magnet recyclers
AML has in house capabilities for developing alloy from metals at lab-scale
AML has established relationship with a U.S. company for alloy production

Strategic Partnerships

U.S. Department of Defense | U.S. Department of Energy | U.S. Navy | Oak Ridge National Laboratory |
U.S. Defense & Aerospace Companies | ReElement Technologies | more...

Magnets are the heart of Motors & Generators

Motors & Generators are what enable electricity, manufacturing, industrial processing, construction, transportation...

Wind Energy Medical Consumer

EV UAV Aircraft

Marine Defense



AML is **REINVENTING** the Magnet Supply Chain



Magnets & Manufacturing Innovation

Reinventing the design and manufacturing of magnets

Our manufacturing is unique and state-of-art. Production is high-rate, high-yield, high-quality with a fraction of the labor and capital required for conventional manufacturing methods



Manufacturing Innovation

Materials Innovation

Reducing the cost of magnet alloys

Our technology improves the application performance of all existing magnet materials and enables new, lower cost materials including non-rare earths

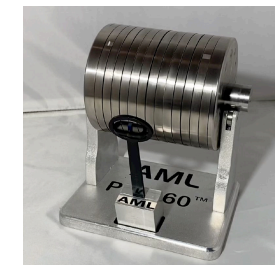


Lower Cost Metal Alloys

Magnet End-Use Product Innovation

Revolutionizing motors and generators

Our technology replaces conventional north-south topologies with optimized magnet shapes, magnetization and topologies which results in improved performance, reduced magnet count and ease of assembly



Magnet and Motor Innovation

We are Decommoditizing the Magnet Industry!

AML

Reimagining the Magnet Technology that Drives the World

Magnet Innovation

Reinventing the design and manufacturing of magnets

Today – Magnet manufacturing is archaic



AML

Laborious, low-yield, low-quality, limited in size, limited in performance optimization

Produced mostly in China



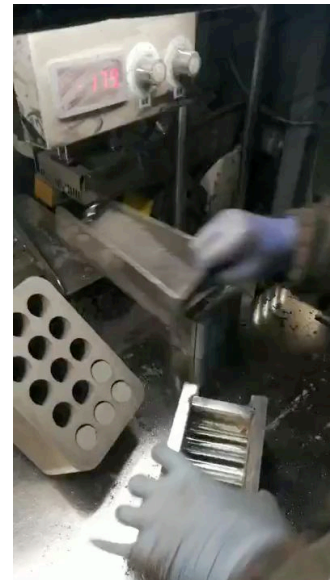
Mining



Processing



Rare Earth Materials



"Me-Too" Magnets



Technology

PM-Wire™ - A unique process for the design, manufacturing and application of permanent magnets

Enabling Configurations – long-length, rings, helixes and more

Enabling Magnetization / Topologies – magnetic flux distribution optimized for the application

High-Rate Manufacturing – mass produced / high yield - >98%

Value Proposition

Improves performance and lowers the cost of end-use products (e.g., motors)

Performance – higher efficiency, lighter, smaller, higher temperature operation

Lower Cost Material Options – performance equivalent to higher cost materials

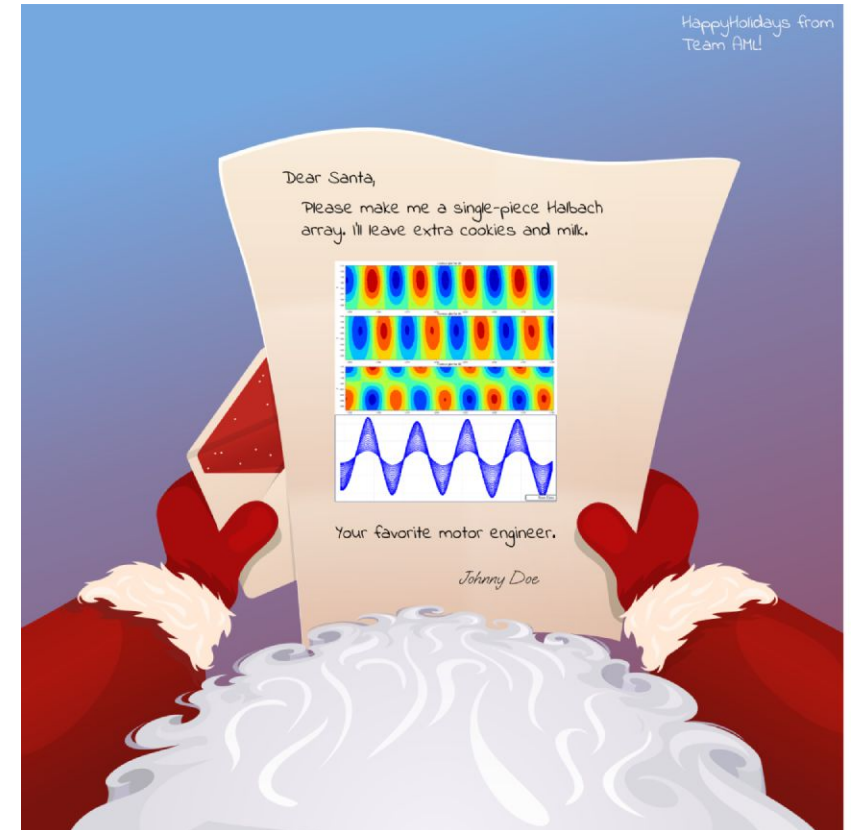
Manufacturing Ease and Safety – simplified assembly into end-use products

Sustainable Business – does not compete in existing commoditized market

PM-Wire Impact Example

Electric Vehicle Motor

- ✓ Collaboration with the Oak Ridge National Laboratory
- ✓ Replace ~**2,750** magnet Halbach array with **8** PM-360™ rings
- ✓ Eliminate need for active cooling of rotor
- ✓ Using a Non-sintered magnet alloy



- What motor engineers dream about -
"Single-piece Halbach array"

PM-UNIFORM™

Straight, curved, ring or helical magnets with Transverse or Radial magnetization

Single-Piece Magnets

Straight up to 1 m

Curved up 1 m arc

Rings up to 320 mm dia.

Helical (given by dia.)

Lower Cost Assemblies

Reduced part count



PM-UNIFORM™

PM-360™ - “Single-piece Halbach Array”

Straight, ring or helical magnets with “Continuously Changing Magnetization Direction”

Increased Performance

Halbach Array Performance

Reduced Weight

Iron Free

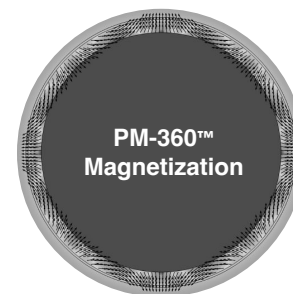
Lower Cost Assemblies

Reduced part count

Ease to assemble



PM-360™ - Helical



PM-360™ - Magnetization

PM-AXIAL™

Curved magnets with Axial magnetization allows rotor topologies having breakthrough benefits

Increased Performance

Halbach Array Performance

Higher Temperature

Reduced Overwrap

Reduced Weight

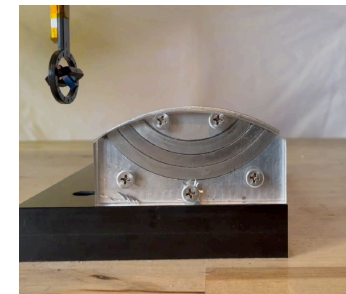
Iron Free

Lower Cost Assemblies

Reduced part count

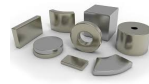
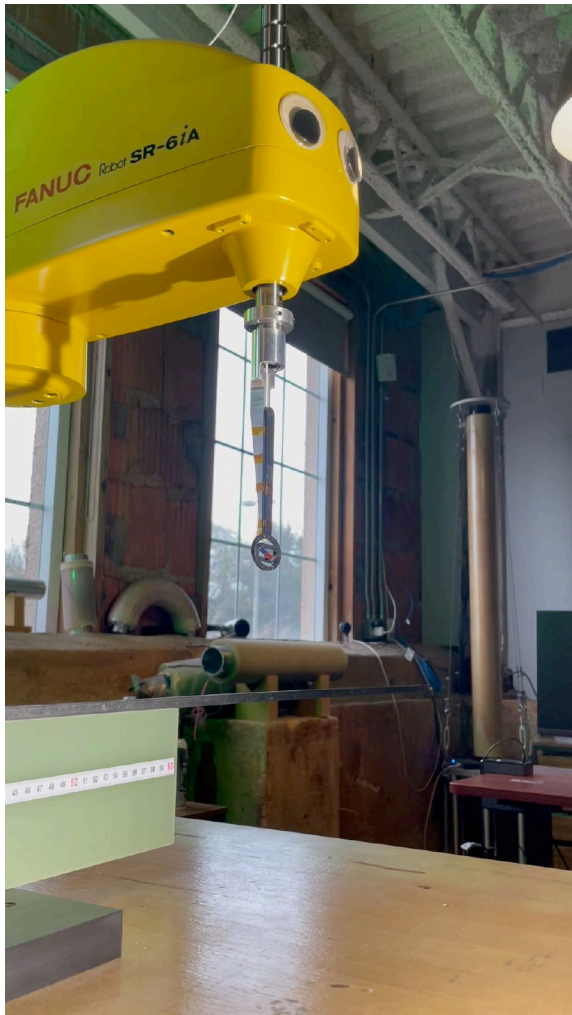
Ease to assemble

Lower grade metal alloys

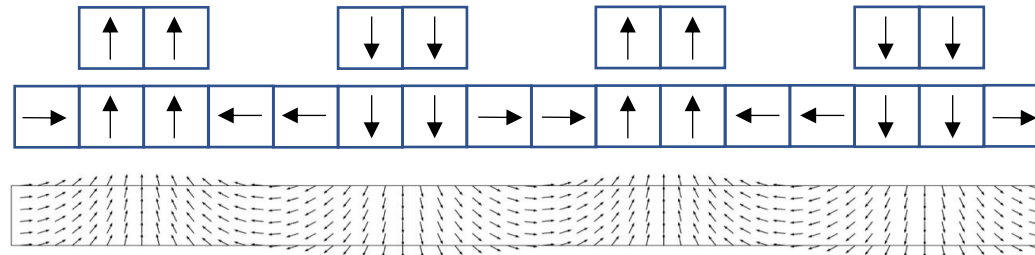


PM-AXIAL™

Ideal magnetic field distribution, Single-piece “Halbach Array”, Long-lengths



AML

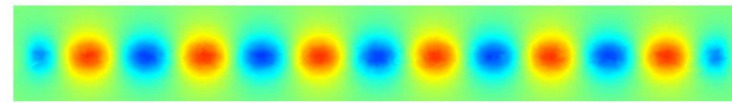


North – South Magnetization

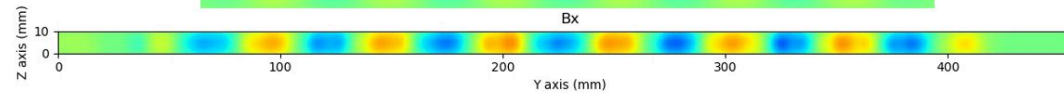
90 Degree Halbach Array

Continuously Changing Flux Direction

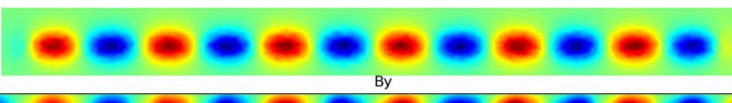
“Perfect Field” - FEA



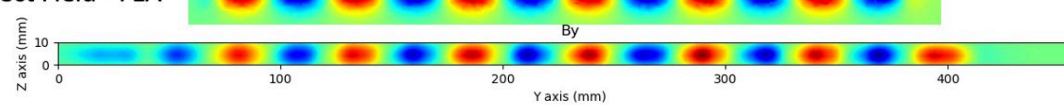
PM-Wire™



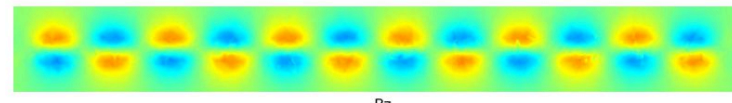
“Perfect Field” - FEA



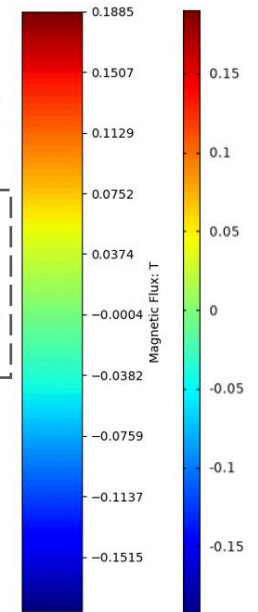
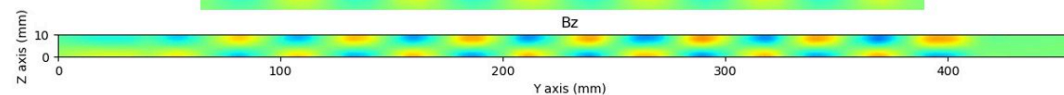
PM-Wire™



“Perfect Field”



PM-Wire™



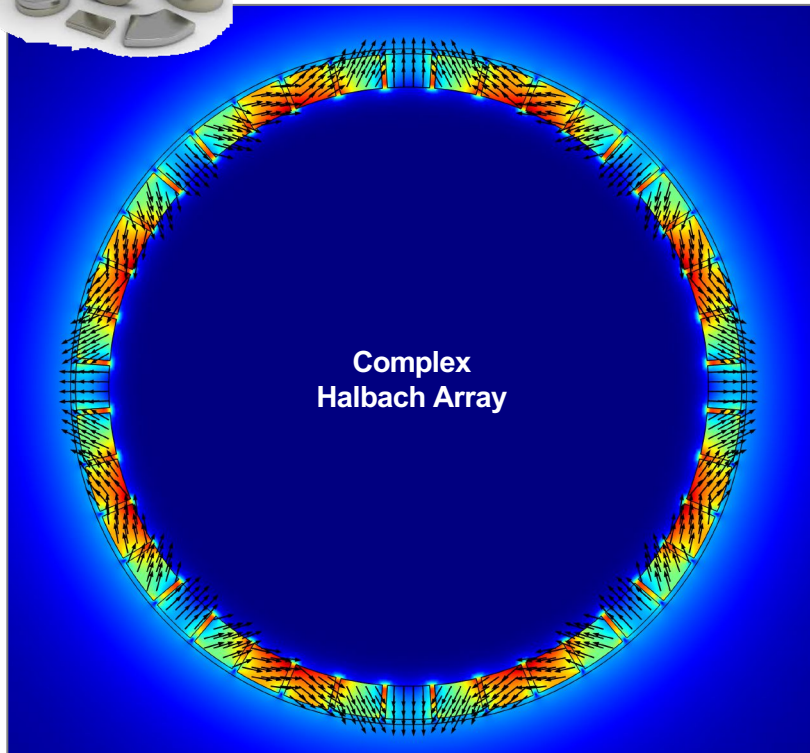
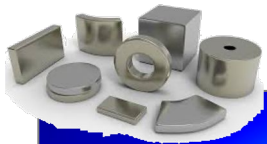
Video

Circular PM-Wire™ - PM-360™



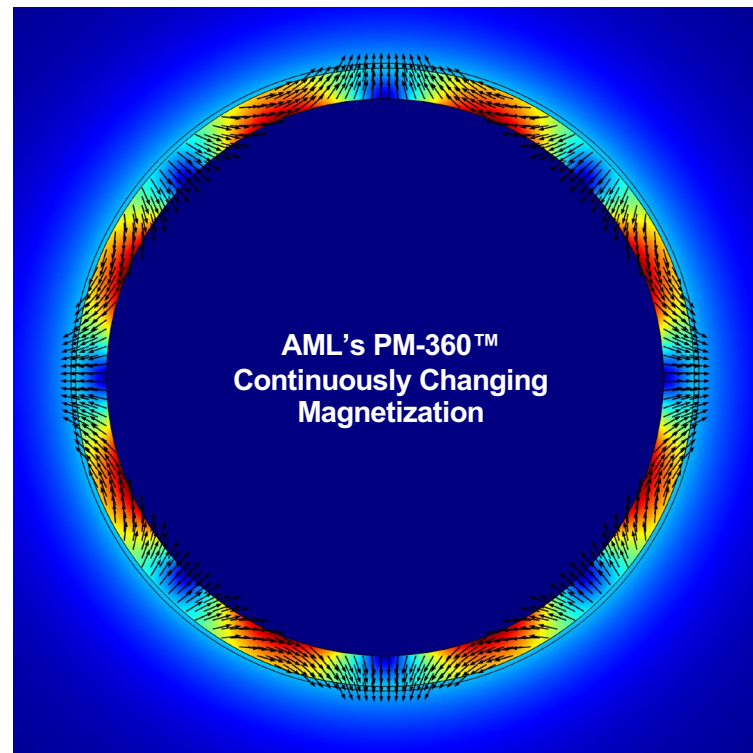
PM-360™

Single-piece, ring and helix “Halbach Array”



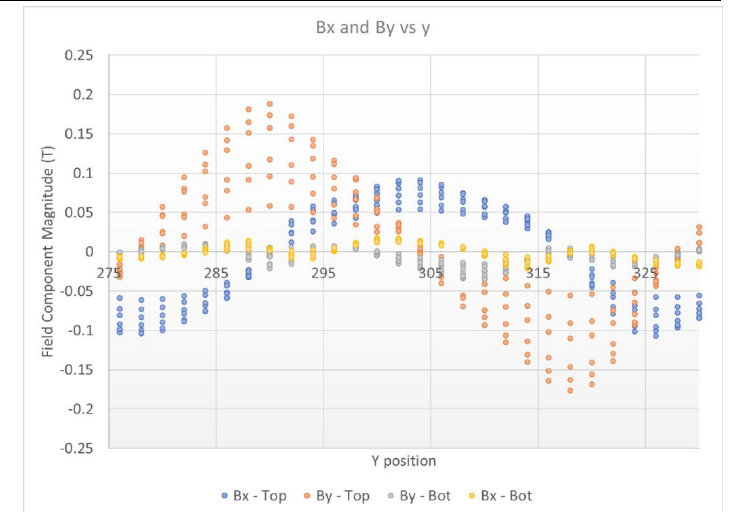
Complex Halbach Array

Conventional Magnets

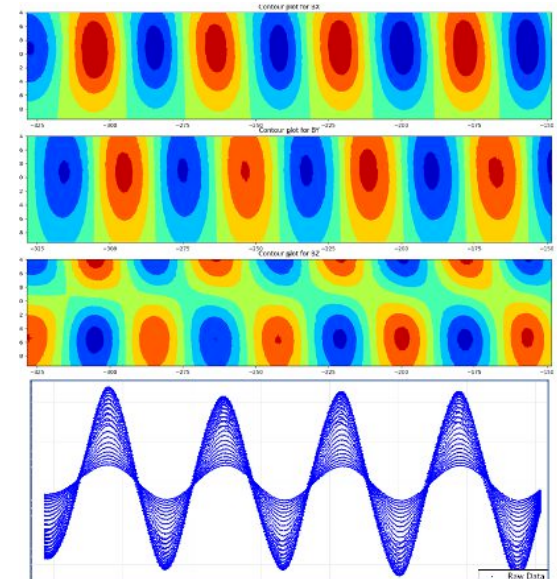


AML's PM-360™
Continuously Changing Magnetization

PM-Wire™



PM-360™ 3D Field Map Example



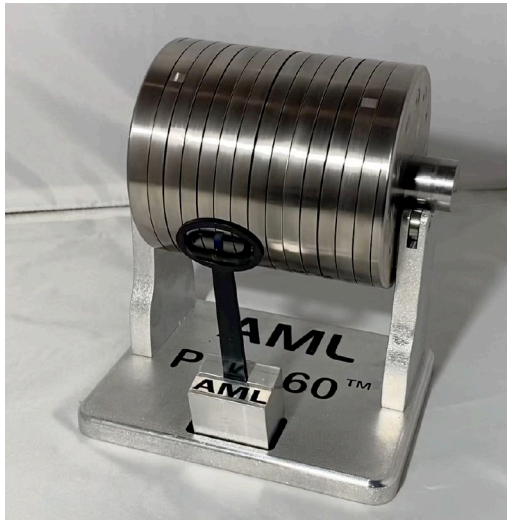
Circular PM-Wire™ - PM-360™



Single-piece, ring and helix “Halbach Array”
Outrunner and Inrunner Radial Flux and Axial Flux machines



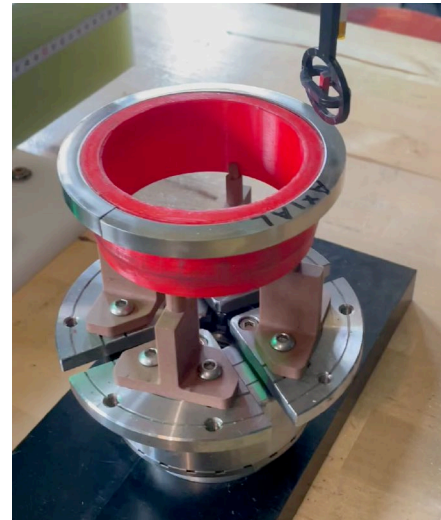
PM-360™



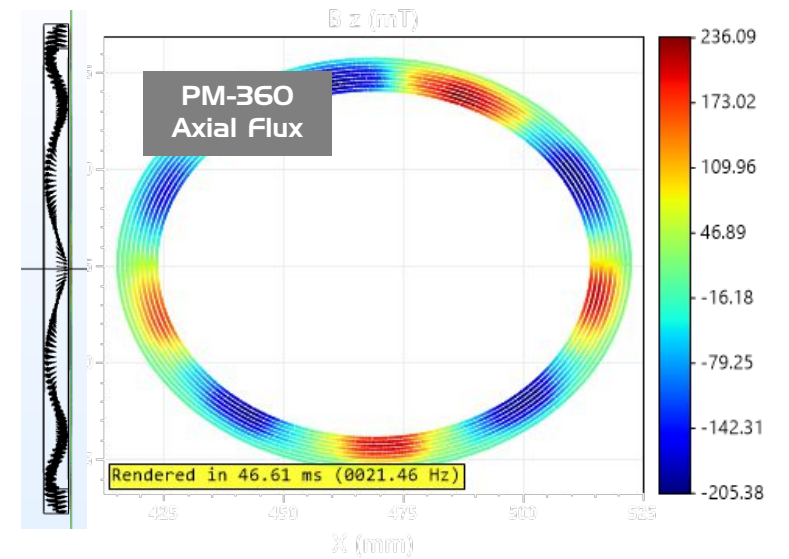
PM-360™ Radial Flux Rotor



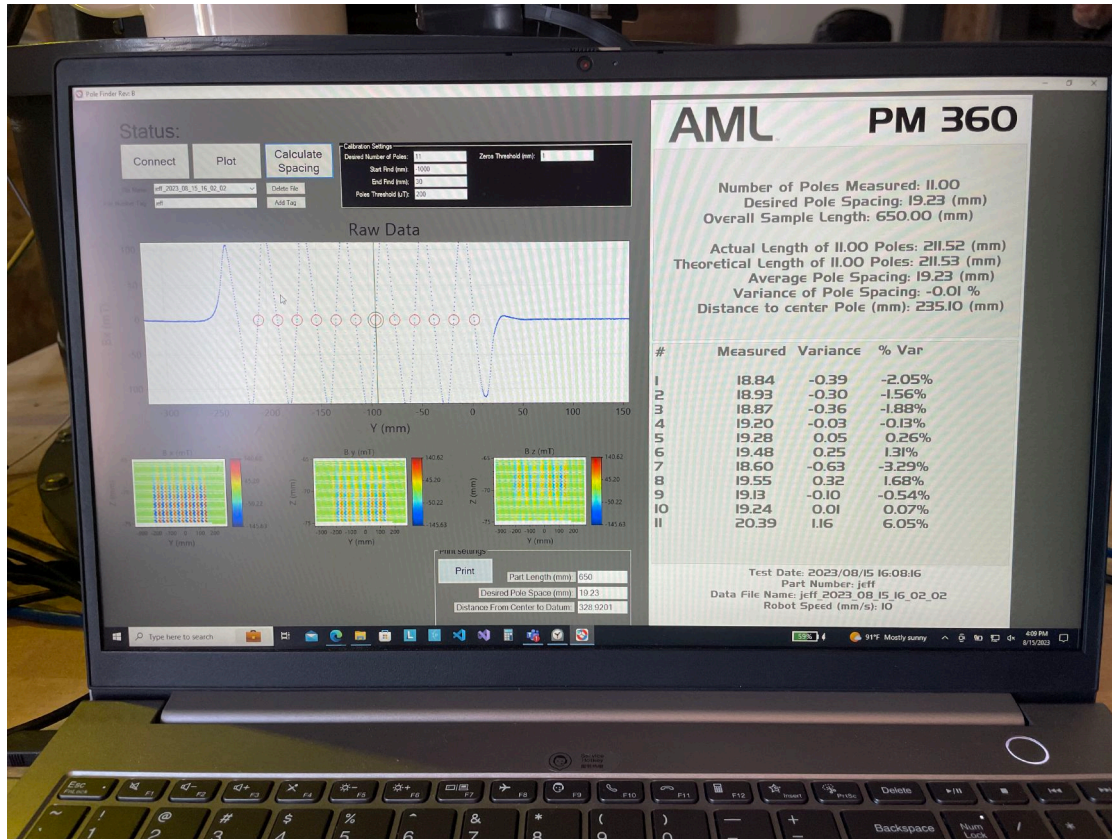
PM-360™ Outrunner Rotor



PM-360™ Axial Magnetization



PM-360™ Sintered Magnet Single-piece Halbach array



Curved Sintered PM-360™



Straight Sintered PM-360™

PM-AXIAL™ Magnets

Improves the performance of existing alloys

Enables a motor topology which is well suited for low coercivity alloys

- ✓ Provides very low demagnetization field enabling the use of low coercivity alloys including non-rare earths

Additional Features and Benefits

Optimized Performance

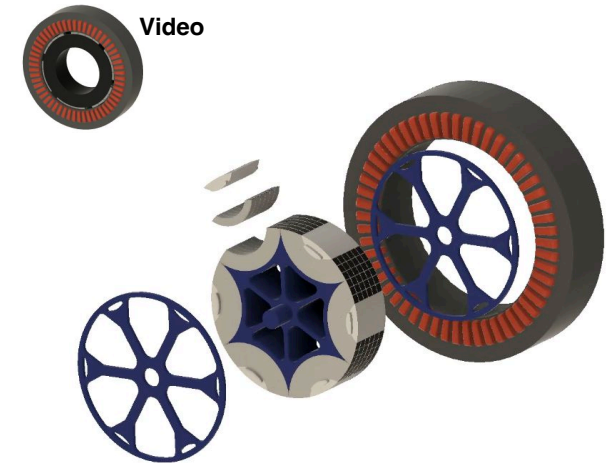
- ✓ Halbach Array like performance
- ✓ Higher Temperature Operation
- ✓ Enables lower grade / cost alloys with performance equal to higher grade alloys
- ✓ Significantly reduces or eliminates overwrap (magnet containment)

Reduced Weight

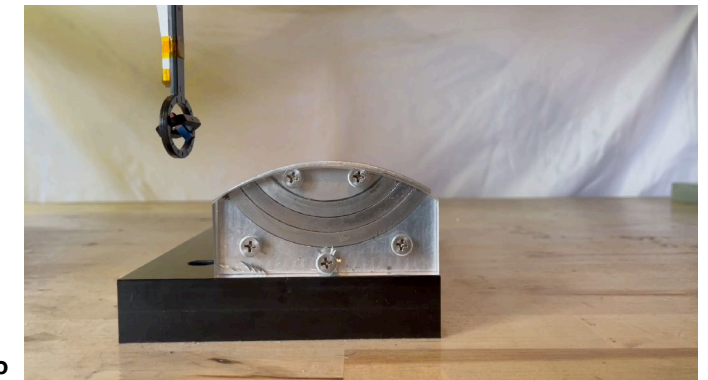
- ✓ No need for iron at the rotor

Ease of manufacturing and assembly

- ✓ All the segments can be mass-produced at low cost
- ✓ The magnetic flux is contained within the magnets making it easy and safe during assembly



Example of PM-AXIAL™ rotor design



Sample PM-AXIAL™ motor poles made with NdFeB alloy

AML

Reimagining the Magnet Technology that Drives the World

Manufacturing Innovation

High-rate, high-yield, high-quality and low capex

High Volume Manufacturing

3-6 meters / minute / production line

Capacity Potential Scenarios (magnet cross-section dependent)

Single Line Production Capacity - Straight PM-Wire™

High Volume (m/min)	Size by Cross Section	Daily Production (m)	Annual Production (m)	Daily Volume (mt)	Annual Volume (mt)	Capacity Per 6,000 mt of NdPr
4	2 cm x 2 cm	4,536	1,360,800	11	3,320	7 production lines
4	1.5 cm x 1.5 cm	4,536	1,360,800	6	1,868	11 production lines
4	1 cm x 1 cm	4,536	1,360,800	3	830	25 production lines

Production Parameters

Days Per Year	300
Hours Per Day	21
Line Utilization	90%

Production Capacity Comparison

NdPr Deposit	NdPr Supply	Potential Magnet Capacity (mtpa)	Planned Magnet Capacity (mt)
Mountan Pass Mine	6,000	20,000	1,000

AML capacity scenarios for producing 20,000 mt per year

Mount Pass Mine has an expected production capacity of 6,000 metric tons of NdPr rare earths which equates to ~20,000 metric tons of magnets

MP Material's 200,000 sq ft production facility will have the capacity to produce approximately 1,000 metric tons of magnets per year

MP Materials; Gabelli Funds 46th Annual Auto Symposium – October 31, 2022



Project MITUS - PM-Wire™ Pilot Line
Funded by the U.S. Department of Defense



Reimagining the Magnet Technology that Drives the World

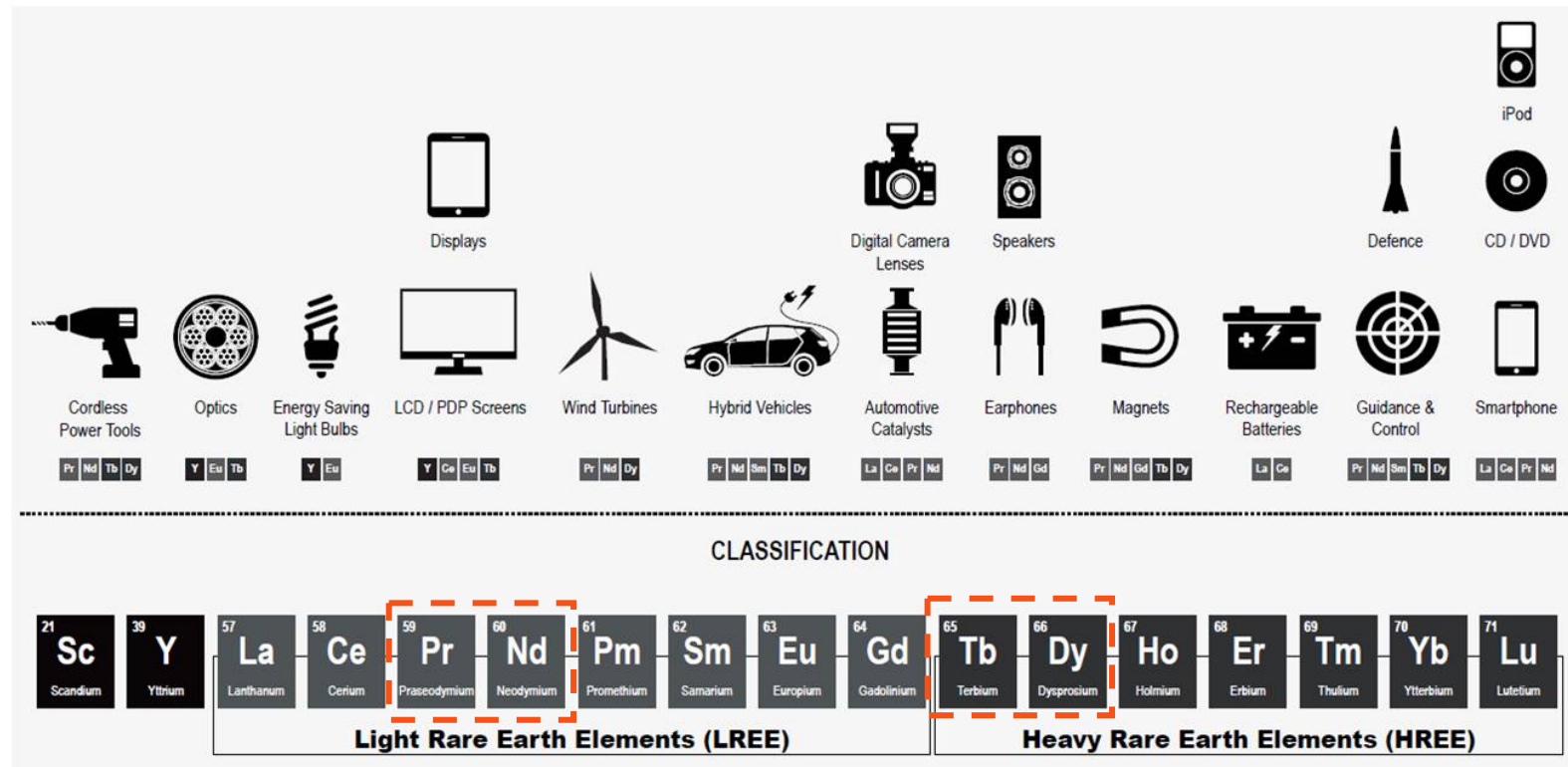
Materials Innovation

Improving performance of existing and enabling lower rare earth
and non-rare earth alloys for electrical machines

What are magnets made of?

Magnets are made of “Rare Earth” (RE) elements

RE’s are not rare, but they are difficult to separate out from ore



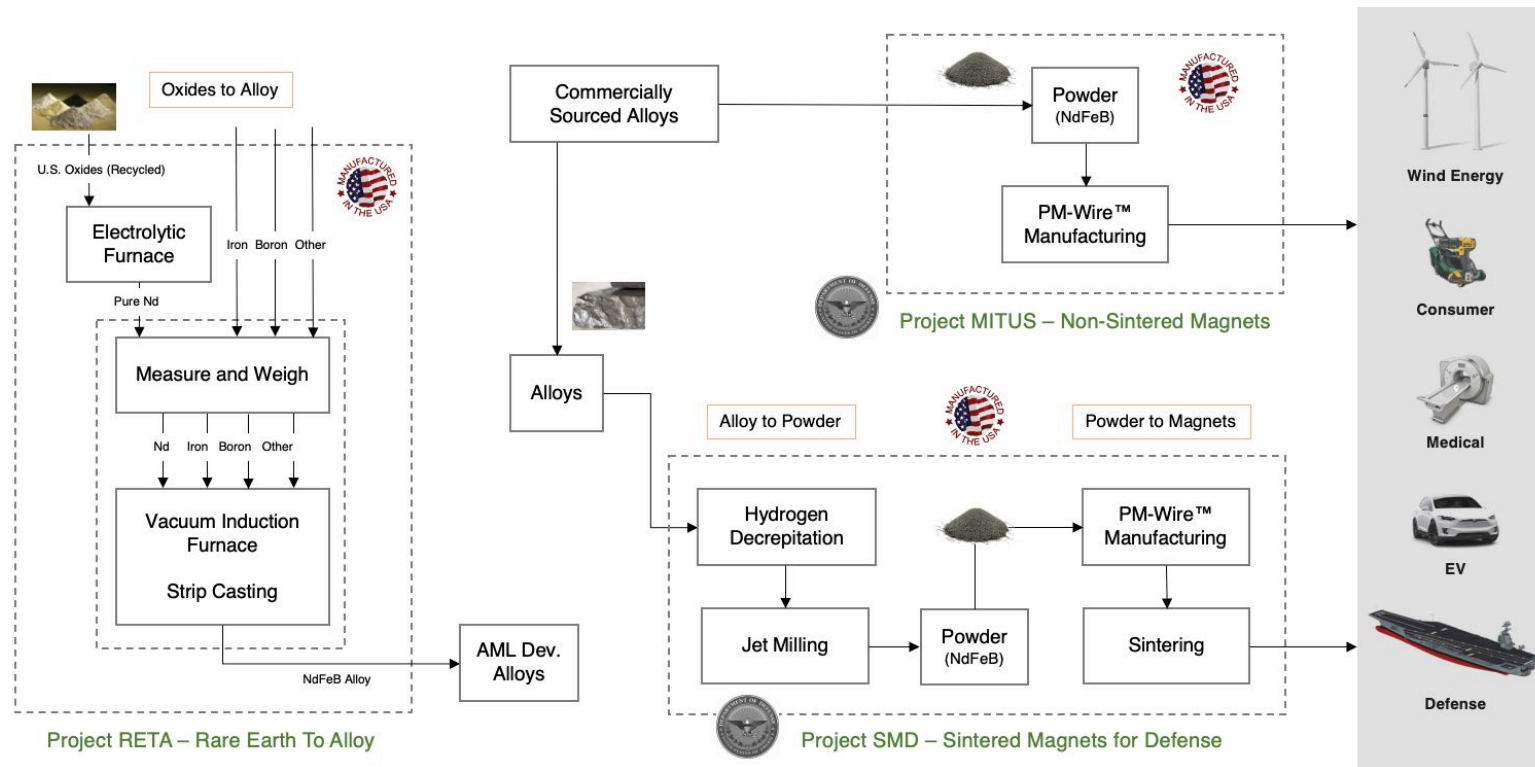
Source: China Water Risk report, “Rare Earths: Shades Of Grey – Can China continue to fuel our clean and smart future?” (June 2016)

Improved end-use product performance of existing sintered alloy compositions

Enable non-sintered alloys

Enable lower critical rare earth alloys

Enable non-rare earth alloys



Value Proposition

Improving the performance and lowering the cost of the end-use product like electrical machines

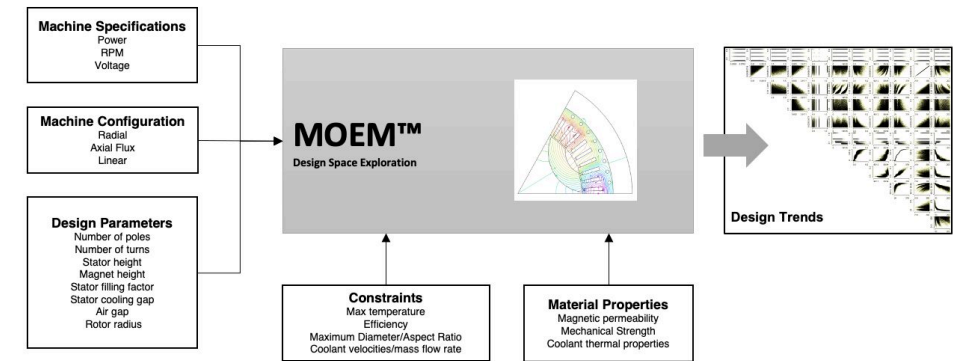
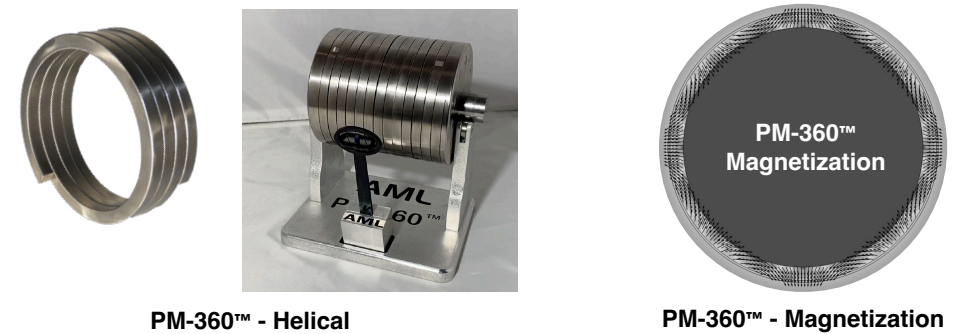
How this is possible?

PM-Wire magnets can replace conventional north-south rotor topologies

- ✓ Unique magnet shapes
- ✓ Unique magnetization
- ✓ Unique motor topologies
- ✓ Enable new materials

Impact Examples

- ✓ PM-AXIAL™ - Industrial Motor With Significant Improvement In Performance (NdFeB)
- ✓ PM-360™ - Industrial Motor Using Non-Sintered Alloy (NdFeB)
- ✓ PM-AXIAL™ - Industrial Motor Using Reduced Critical Rare Earth Alloy (Mischmetal NdFeB)
- ✓ PM-360™ - Electric Vehicle Motor Using Non-Sintered Alloy (NdFeB)
- ✓ PM-360™ - Electric Vehicle Motor Using No Critical Rare Earth Alloy (SmFeN)
- ✓ PM-AXIAL™ - Electric Vehicle Motor Using Non-Rare Earth Alloy (FeN)
- ✓ PM-360™ - Electric Vehicle Motor Using Non-Sintered and Non-Rare Earth Alloy (MnBi)



AML Application Development

Proprietary software and unique experience used for electrical machine optimization

Process flow: 1st Order Design Study (no charge) → Preliminary Design → Detailed Design →

Prototyping → Optimized Product

Baseline Design - Large, global electrical machine manufacturer

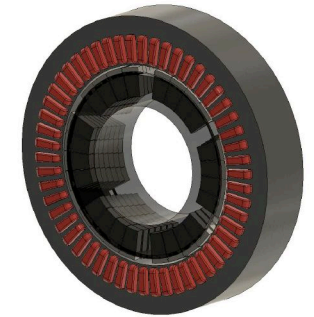
Torque - 311 Nm; Efficiency - 98.6%; Power - 375 kW; RPM - 11,500 RPM

Magnet Material: N48SH

Operating Temperature: 100 C

Critical Rare Earth Mass: 1.74 kg

- ✓ NdPr = 1.49 kg
- ✓ Dysprosium = 0.25 kg



Example 1

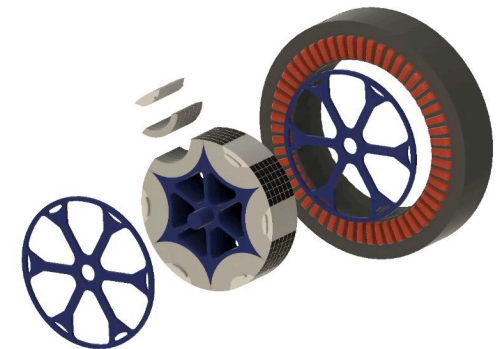
PM-AXIAL™ - Industrial Motor With Significant Improvement In Performance (NdFeB)

Solution

- ✓ Retrofit solution replaced north-south rotor pole topology with PM-AXIAL™
- ✓ No change to motor stator
- ✓ Same magnet N48SH NdFeB alloy

AML Performance Improvement

- ✓ Halbach array performance
- ✓ 150 C - 50% increase in operating temperature
- ✓ 50% reduction in rotor overwrap thickness
- ✓ Reduction in mass by removing the iron
- ✓ Modification of motor stator would result in additional increase in performance



Example 2

PM-360™ - Industrial Motor Using Non-Sintered Alloy (NdFeB)

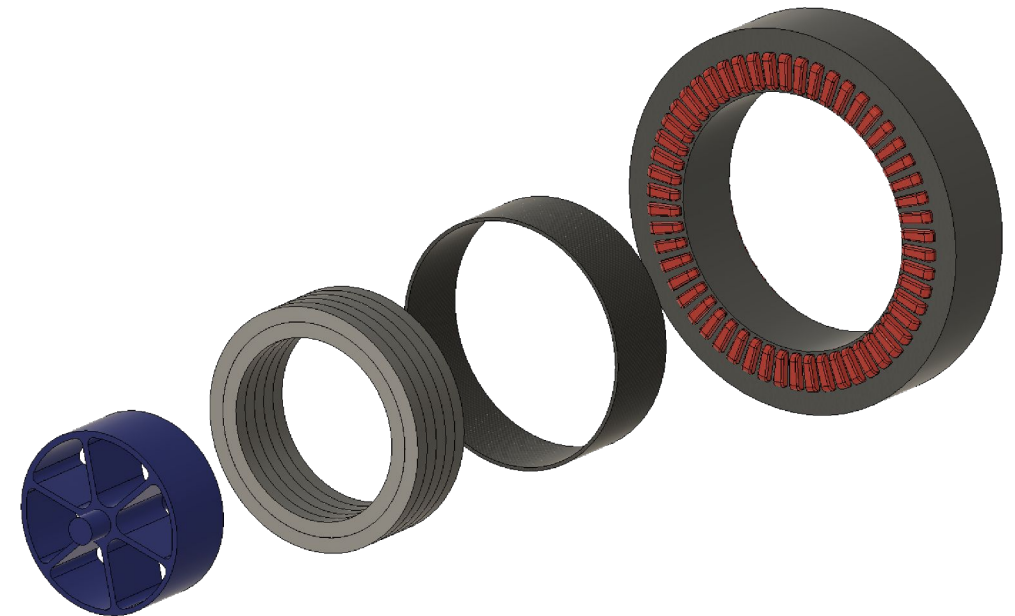
Specifications: 375 kW / 11,000 RPM

Solution

- ✓ Retrofit solution replaced north-south rotor pole topology with PM-360™
- ✓ No change to motor stator
- ✓ **Non-Sintered MF18P** alloy
 - Br and Hci (@ 120 C) = 0.89 T and 9.2 kGauss
- ✓ Replace 168 sintered N48SH magnets with **10 PM-360™ rings**

AML Performance

- ✓ Equivalent torque and efficiency
- ✓ 10% reduction in active mass and no **dysprosium**



Example 3

PM-AXIAL™ - Industrial Motor With Significant Improvement In Performance (NdFeB)

Specifications: 375 kW / 11,000 RPM

Solution

- ✓ Retrofit solution replaced north-south rotor pole topology with PM-AXIAL™
- ✓ No change to motor stator
- ✓ **Mischmetal (40%) / NdPr (60%)** FeB alloy
 - [Br and Hci (@ 120 C) = 1.01 T and 1.850 kGauss]

AML Performance

- ✓ Equivalent torque and efficiency
- ✓ 37% reduction in critical rare earths (**NdPr**) and no **dysprosium**
- ✓ 11% reduction in active mass

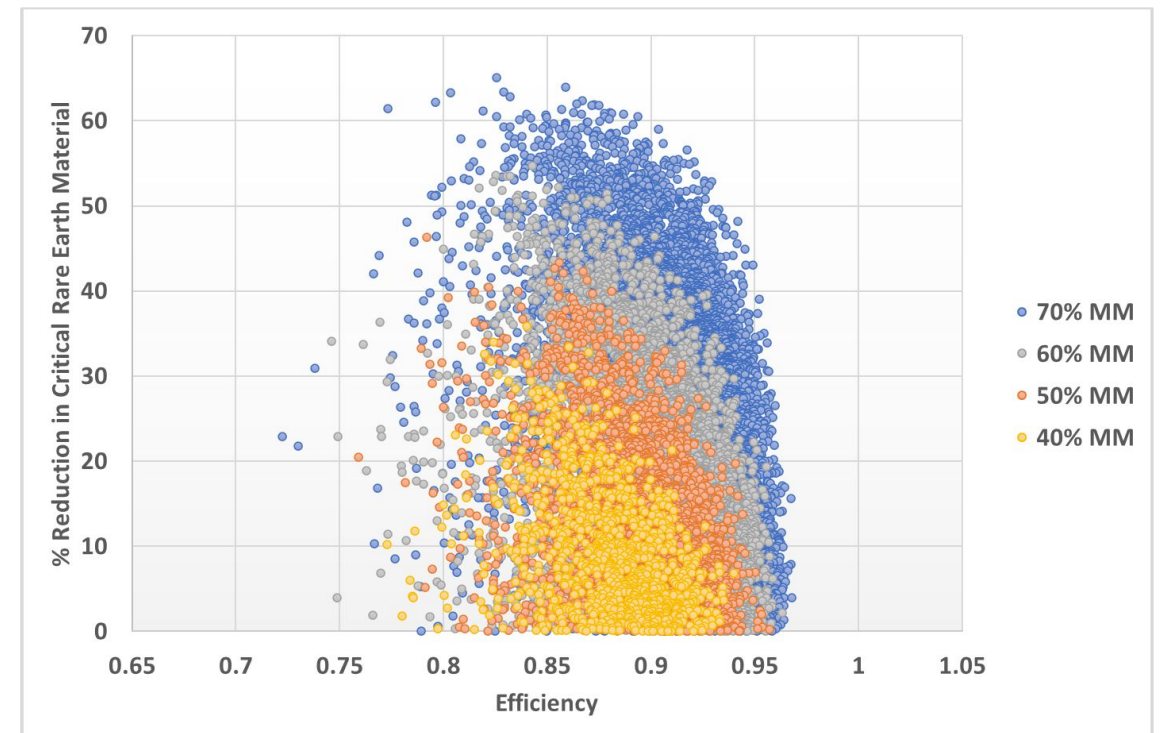


Cost Comparison

NdPr - ~ \$90 per kilogram

Mischmetal - \$1-\$5 per kilogram

(55% Cerium, 25% Lanthanum,
18% Neodymium, %2 Praseodymium)



Reduction in Critical Rare Earth Materials vs. Efficiency for an example AML Retrofit Design

Motor Specifications

Collaboration with the Oak Ridge National Laboratory

Outrunner Configuration

Power: 58 kW

RPM: 20,000

Example 4

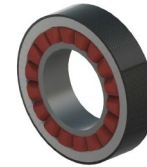
PM-360™ - Electric Vehicle Motor Using Using Non-Sintered Alloy (NdFeB)

Solution

- ✓ Retrofit solution replacing Halbach rotor topology with PM-360™
- ✓ Replacing ~2,750 NdFeB sintered magnets with **8 PM-360™ rings**
- ✓ Anisotropic Bonded (MQA-36-19) alloy
 - Br and Hci (@ 80 C) = 0.9 T and 19 kGauss

AML Performance

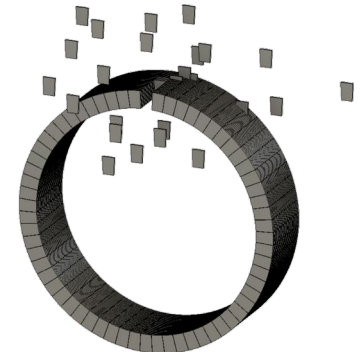
- ✓ Equivalent torque and efficiency
- ✓ Eliminate the need to actively cool the motor rotor
- ✓ Significantly reduce part count and complexity of assembly
- ✓ A fraction of the cost compared to sintered complex Halbach array design



Video

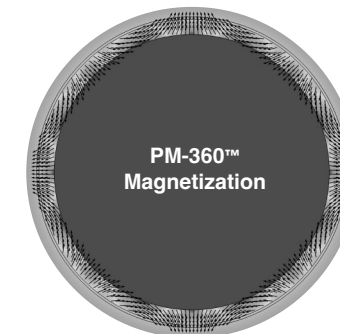


PM-360™

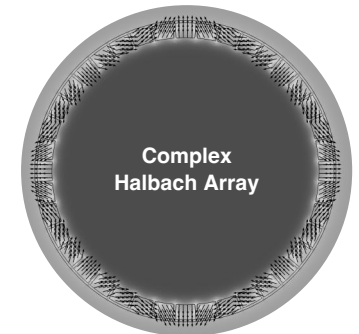


Halbach Array

Vs.



PM-360™ Magnetization



Complex Halbach Array

Motor Specifications

2022 U.S. Department of Energy Power Density Goal: > 50 kW/L

Power: 300 kW

RPM: 12,000

Example 5

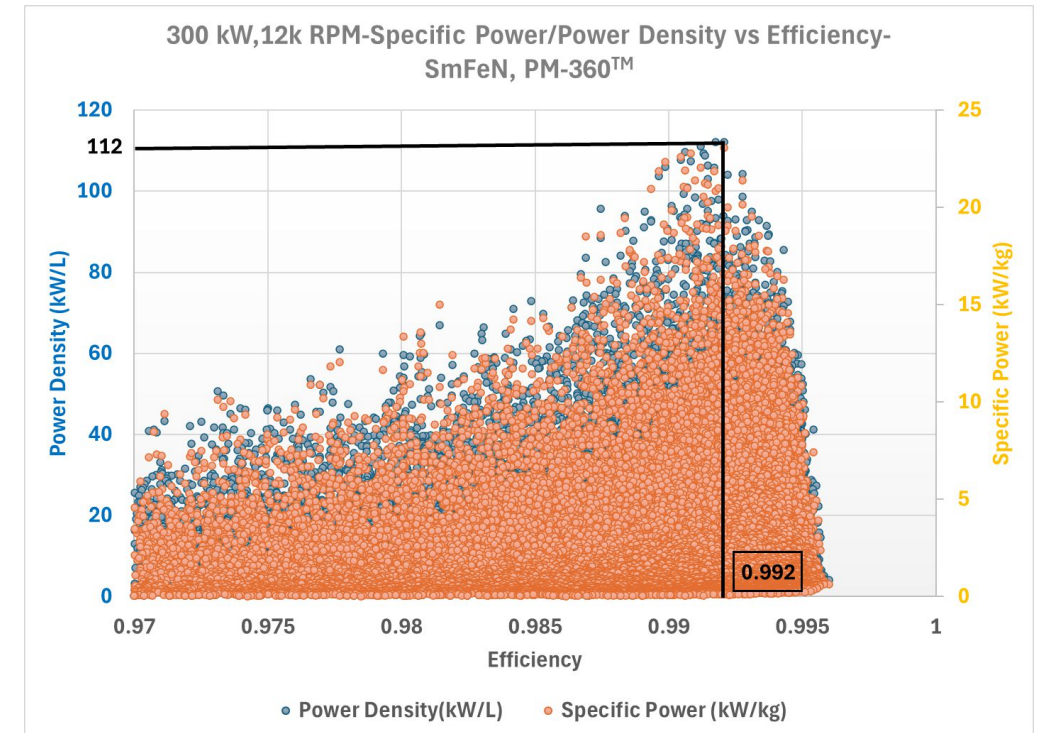
PM-360™ - Electric Vehicle Motor Using No Critical Rare Earth

Solution

- ✓ New Design (re-design of stator and rotor)
- ✓ **No Critical Rare Earth - Samarium Iron Nitride (SmFeN) alloy**
 - (SmFeN) with Br = 0.88T, Hci = 11.5 kGauss @120C

AML Performance

- ✓ Motor Efficiency ~ 99%
- ✓ Motor Power Density ~ **112 kW/L**



Motor Specifications

2022 U.S. Department of Energy Power Density Goal: > 50 kW/L

Power: 300 kW

RPM: 12,000

Example 6

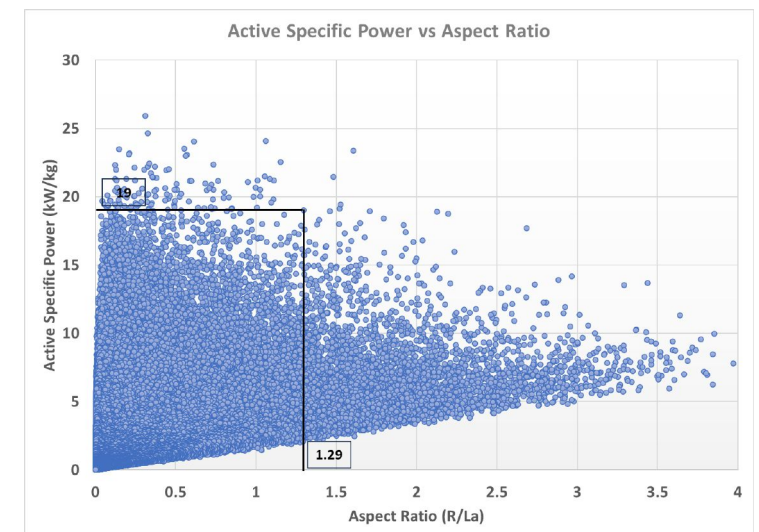
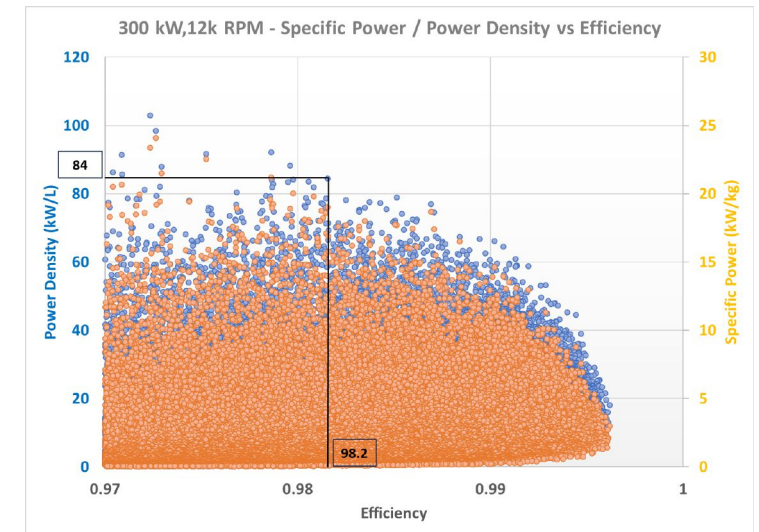
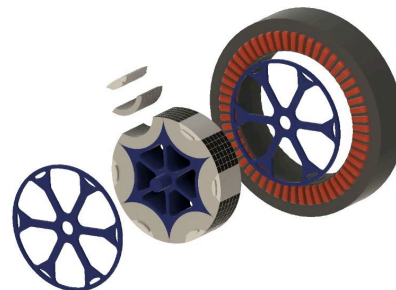
PM-AXIAL™ - Electric Vehicle Motor Using Non-Rare Earth Alloy (FeN)

Solution

- ✓ New Design (re-design of stator and rotor)
- ✓ **Non-Rare Earth - Iron Nitride (FeN)** alloy
 - NRE magnet material – Iron Nitride (FeN) with $B_r = 0.88T$, $H_{ci} = 3$ kGauss

AML Performance

- ✓ Motor Efficiency ~ 98%
- ✓ Motor Power Density ~ **70 kW/L**



Motor Specifications

Power Density: > 30 kW/L

Power: 300 kW

RPM: 12,000

Example 7

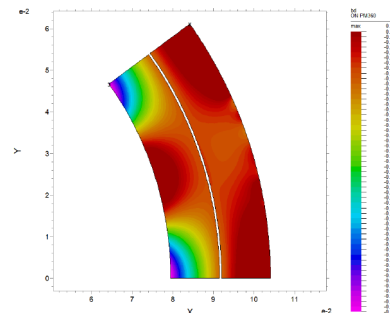
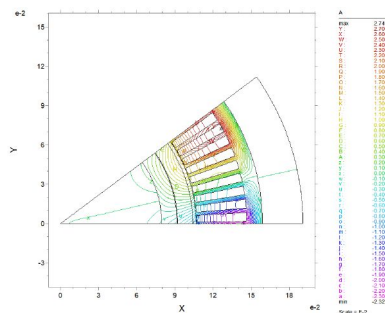
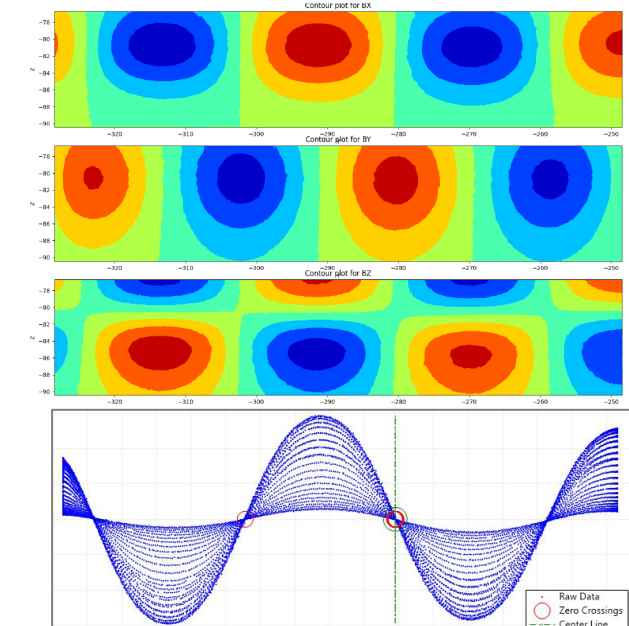
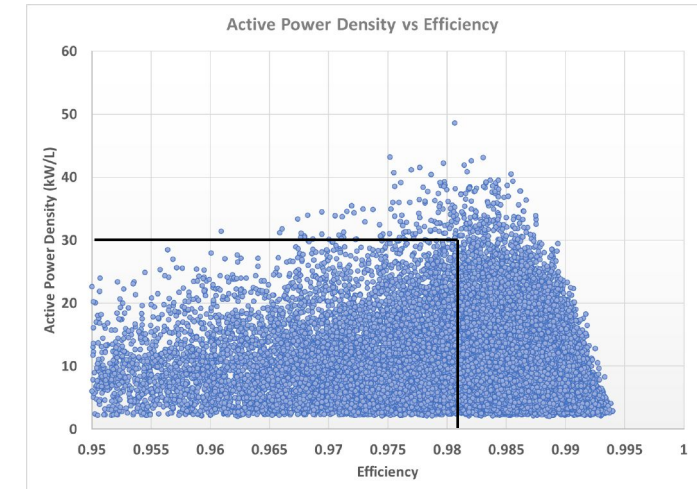
PM-360™ - Electric Vehicle Motor Using Non-Sintered and Non-Rare Earth Alloy

Solution

- ✓ New Design
- ✓ **Manganese Bismuth (MnBi)** alloy
 - MnBi @ 120 C, Br = 0.235 T and Hci = 15 kG

AML Performance

- ✓ Design Space Exploration shows the full design space opportunity for >30 kW/L power densities



AML

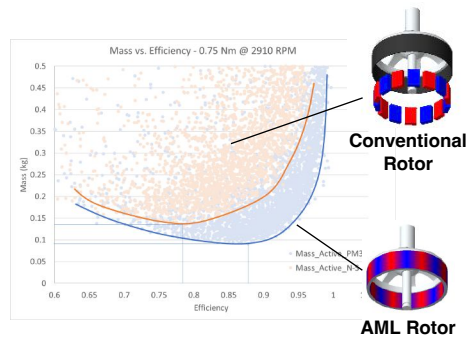
Reimagining the Magnet Technology that Drives the World

Technology and Business Execution

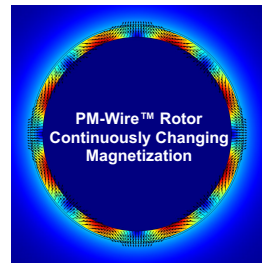
2017-18
Phase 1 - PM-Wire™ R&D
 The concept was validated using isotropic non-sintered NdFeB compositions. Magnets having uniform magnetization were produced. Achieved optimum performance
 Funding Source: AML



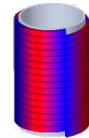
Isotropic Magnets



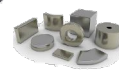
2020-21
Phase 2 - PM-Wire™ R&D
 Developed magnets having “continuously changing magnetization” (single-piece Halbach array) using anisotropic bonded NdFeB compositions. Achieved optimum performance
 Funding Source: U.S. Industry



Non-Sintered



PM-Wire™
 Single Part with ideal, continuously changing magnetization



Conventional - “Me-Too” Magnets
 Dozens / hundreds of piece parts with one-direction magnetization

2021-22
Phase 3 - Manufacturing
 Design, build and commissioning of an advanced PM-Wire™ Pilot Manufacturing. Line is ready for mass production of non-sintered magnets
 Funding Source: U.S. Dept. of Defense / DIU



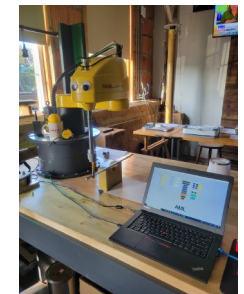
MITUS Advanced Manufacturing Line



2022-2023
Phase 4 - PM-Wire™ R&D
 Develop sintered PM-Wire™ magnet configurations using NdFeB compositions. Majority of funds used for facilities and processing equipment
 Funding Source: U.S. Dept. of Defense / DLA



Magnet Processing & Testing Equipment



Engaged With Industry
 Performed Dozen's of PM-Wire Application Design Studies

2023-24

Phase 5 – Manufacturing

Design, build and commissioning of a pilot automated manufacturing cell and post processing for sintered PM-Wire™

Production Capacity: **1 mt/annum**
 Funding Source: U.S. Dept. of Defense (Defense Logistics Agency (DLA))

NdFeB Production for Sintered PM-Wire™ Permanent Magnets

Capacity / Plan

- ✓ 1 mt/annum, Melbourne FL

Sintering Equipment

- ✓ Hydrogen Decepritation
- ✓ Jet milling
- ✓ Cold Isostatic Pressing
- ✓ PM-Wire Automation Pilot Cell
- ✓ Automated PM-Wire Ring Rolling
- ✓ Pulsers , Pre-alignment and Magnetization Fixtures
- ✓ High Vacuum Furnaces
- ✓ Electrical Discharge Machining
- ✓ Surface Grinding
- ✓ Particle Size Analysis, Simultaneous Thermal Analyzer
- ✓ BH-Looper



Manufacturing Automation Development

Planned 2024 -25

Phase 6 - Manufacturing

Manufacturing automation, processing equipment for production manufacturing of sintered PM-Wire™ conventional magnets

Production Capacity: **10 mt/annum**
 Potential Funding Sources: U.S. Dept. of Defense (DLA and DIU)

NdFeB Production for Sintered Permanent Magnets

PM-Wire™ & Conventional

Capacity / Plan

- ✓ 10 mt/annum, Melbourne FL

Sintering Equipment

- ✓ Hydrogen Decepritation
- ✓ Jet milling
- ✓ Cold Isostatic Pressing
- ✓ PM-Wire Automation Pilot Cell
- ✓ Automated PM-Wire Ring Rolling
- ✓ Pulsers , Pre-alignment and Magnetization Fixtures
- ✓ High Vacuum Furnaces
- ✓ Electrical Discharge Machining
- ✓ Surface Grinding
- ✓ Particle Size Analysis, Simultaneous Thermal Analyzer
- ✓ BH-Looper



Manufacturing Automation Development

2023-24

Metal Alloys

Development of lab-scale magnet alloy compositions which are optimized for performance and cost.

Funded by REE supply chain partner. U.S. magnet recycler



REE Pure Oxides



Magnet Metal



Magnet Alloy

2021-Present

PM-Wire™ Product Developments

Co-developing electrical machines for commercial use of PM-Wire™. To include US Dept. of Energy, US Navy, Oak Ridge National Laboratory and Heavy Industries Company

Funding Source: U.S. Dept. of Energy, Customer, AML IR&D Budget



Aircraft



Defense



EV



Industrial Motors

Market Pathways

Pathways are based on magnet material (alloy) type

Sintered Magnets

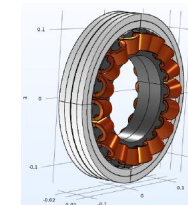
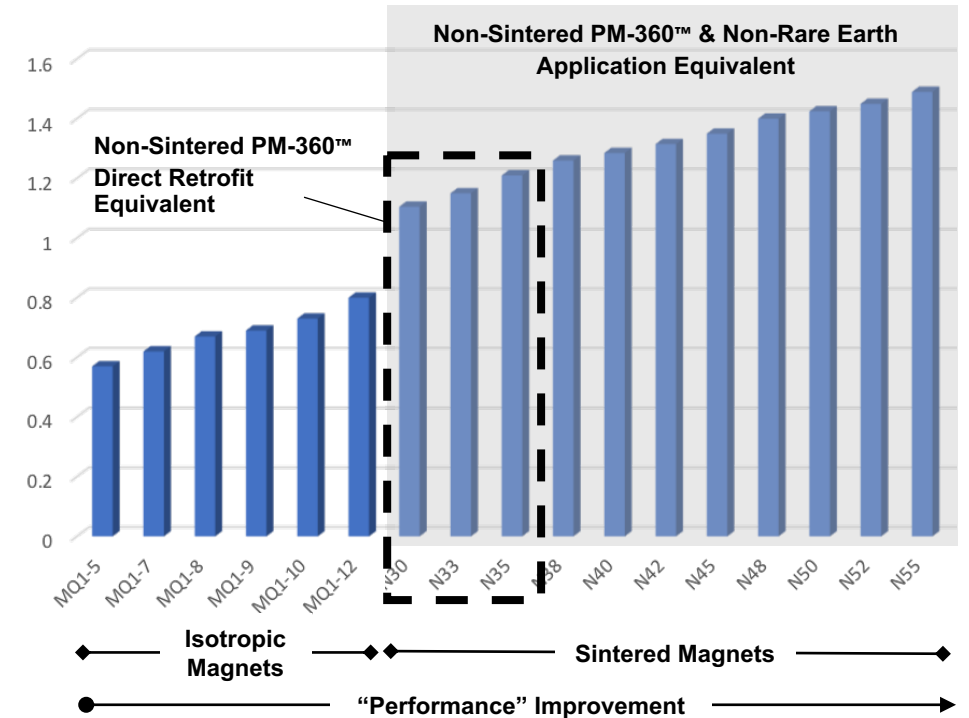
- ✓ PM-Wire™ manufacturing process validated for producing conventional magnets
- ✓ Requires engineering and commissioning Full-Rate Manufacturing automation
- ✓ **1 metric ton / annum manufacturing with a focus on defense applications in 2024**
- ✓ Planning 10 metric ton / annum manufacturing with a focus on defense applications in Q1/2026

Non-Sintered Magnets

- ✓ PM-Wire™ manufacturing process validated for producing non-sintered NdFeB magnets
- ✓ Ideal for densifying and containing material and eliminates need for a bonding agent
- ✓ Configured as a PM-360™ or PM-AXIAL™ magnets can replace sintered magnets
- ✓ **MITUS Manufacturing Line is ready for Full-Rate Manufacturing**

Non-Rare Earth Magnets

- ✓ PM-Wire™ manufacturing process validated for producing non-rare earth magnets
- ✓ Ideal for densifying and containing material and eliminates need for a bonding agent
- ✓ PM-AXIAL™ non-rare earth magnets can replace sintered magnets in motors and generators
- ✓ MITUS Manufacturing Line is ready for Full-Rate Manufacturing
- ✓ **Once materials are commercialization**

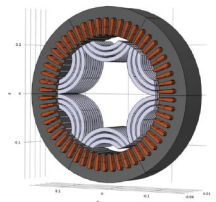


Non-Sintered Validation

OAK RIDGE
National Laboratory



EV



Non-Rare Earth Validation

Market Attraction

Gaining attraction for non-sintered magnets

1. Large heavy industries company qualified AML non-sintered magnets and will move forward to test in high RPM rotor in 2024
2. DoE-ARPA-E has approved change from sintered magnets to non-sintered for the ASCEND
3. U.S. defense and aerospace company who is the customer providing the specifications for the ASCEND motor/generator
4. U.S. defense and aerospace company is proposing two projects for motors which us non-sintered magnets
5. U.S. automotive company has an interest in AML's magnets using iron nitride from Niron Magnetics
6. Oak Ridge National Laboratory / DOE project will demonstrate non-sintered magnets can replace sintered magnets for electric vehicles
7. Large Japanese magnet manufacturer has interest in AML magnets which would open new markets for their non-sintered magnets

Market Attraction

Gaining attraction sintered magnets

1. U.S. Military Branch
2. U.S Defense & Aerospace Companies



Project MITUS - PM-Wire™ Pilot Line
High-Rate Manufacturing of Non-Sintered PM-Wire™
Funded by the U.S. Department of Defense



Scaling domestic production of sintered magnets for defense applications

1 mt / annum (funded by DoD / DLA)

10 mt / annum (DoD has asked for a proposal to scale to 10 mt)

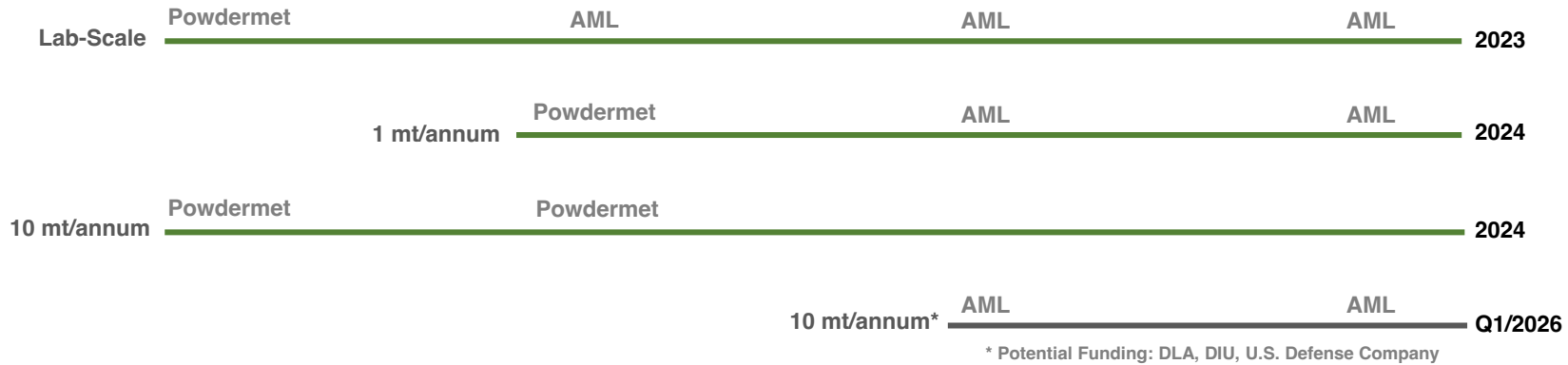
ReElement, Cyclic Materials,
Rare Earth Salts, more



Mining / Recycling



Extraction
REE Pure Oxides



Reduction
Magnet Metals



Strip Casting
Magnet Alloy



HD, Jet Milling
Magnet Powder



Magnet
Manufacturing



DoD Magnet Users



Sintered Magnets

Imagine a Magnet Industry Without Limitations

Materials

Enabling less critical rare earth and non rare earth alloys

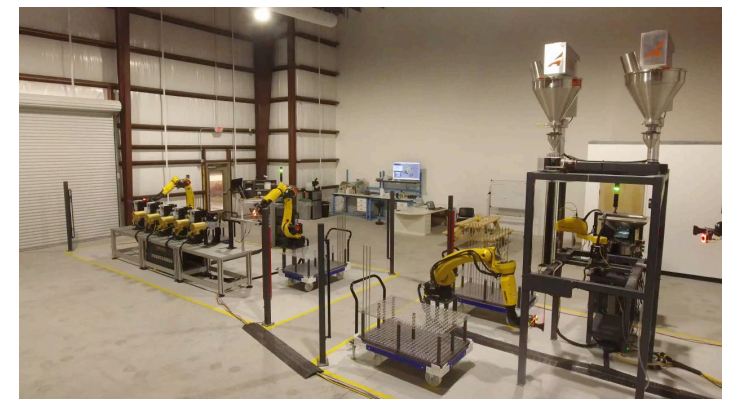
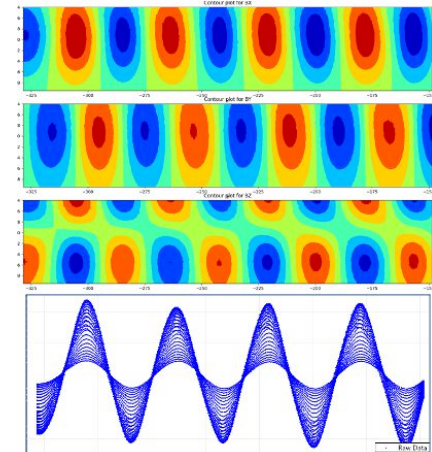
Magnets & Manufacturing

High-rate, high-yield, high-quality, low CapEx

Magnet End-Use Product

Improving the performance and lowering the cost of the end-use product

**Along with our supply chain, governmental and end-use partners,
We are Decommoditizing the Magnet Industry!**



AML Management



Mark Senti, CEO / Director / Founder

- 30+ years, visionary technology/business innovation leader
- IP, corporate structure, business development, joint ventures
- Cray Research, Founded & Exited – GSMA Systems / robotics



Wade Senti, COO / Director

- 10+ years, corporate accounting, investment banking
- Capital formation, strategic initiatives
- New business development



Dr. Philippe Masson, CTO

- 20+ years, Expert in electrical machines / superconductivity
- Lead electrical machine modeling, development
- AML, Florida State Univ., Univ. of Houston

Board of Directors



Mark Jensen

- Entrepreneur and businessperson who has founded several companies
- Chairman and CEO of American Resources Corporation (NASDAQ: AREC), a next generation producer of raw materials
- Mr. Jensen previously held positions in the financial services and investment sector



Marshall Heard

- The Boeing Company (ret.), Ran a \$4B Division
- Engineering, product development,
- Air Force Strategic Air and Systems Command



Raj Gutta

- Medical Doctor
- Entrepreneur
- Investor



Tom Turner

- 40+ years developing, operating and exiting high-tech businesses
- Companies included Wang Canada Limited, Datamax Corp. and Itronix.
- Currently active in a number of early-stage companies and a partner / developer of a new sustainable City in Costa Rica



Bill McCollum

- Dentons, Partner - Public Policy and Regulation
- Former Florida Attorney General
- Retired U.S. Congressman
- Retired commander in the U.S. Naval Reserves



Vernon Prince

- 25 + years, entrepreneur, executive
- Multiple advanced manufacturing operations
- Luminar Technologies, JDS Uniphase
- Founded/Exited - OPA



Reimagining the Magnet Technology that Drives the World

AML-Enabled.com

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Melbourne, FL 32901

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PM-Wire™