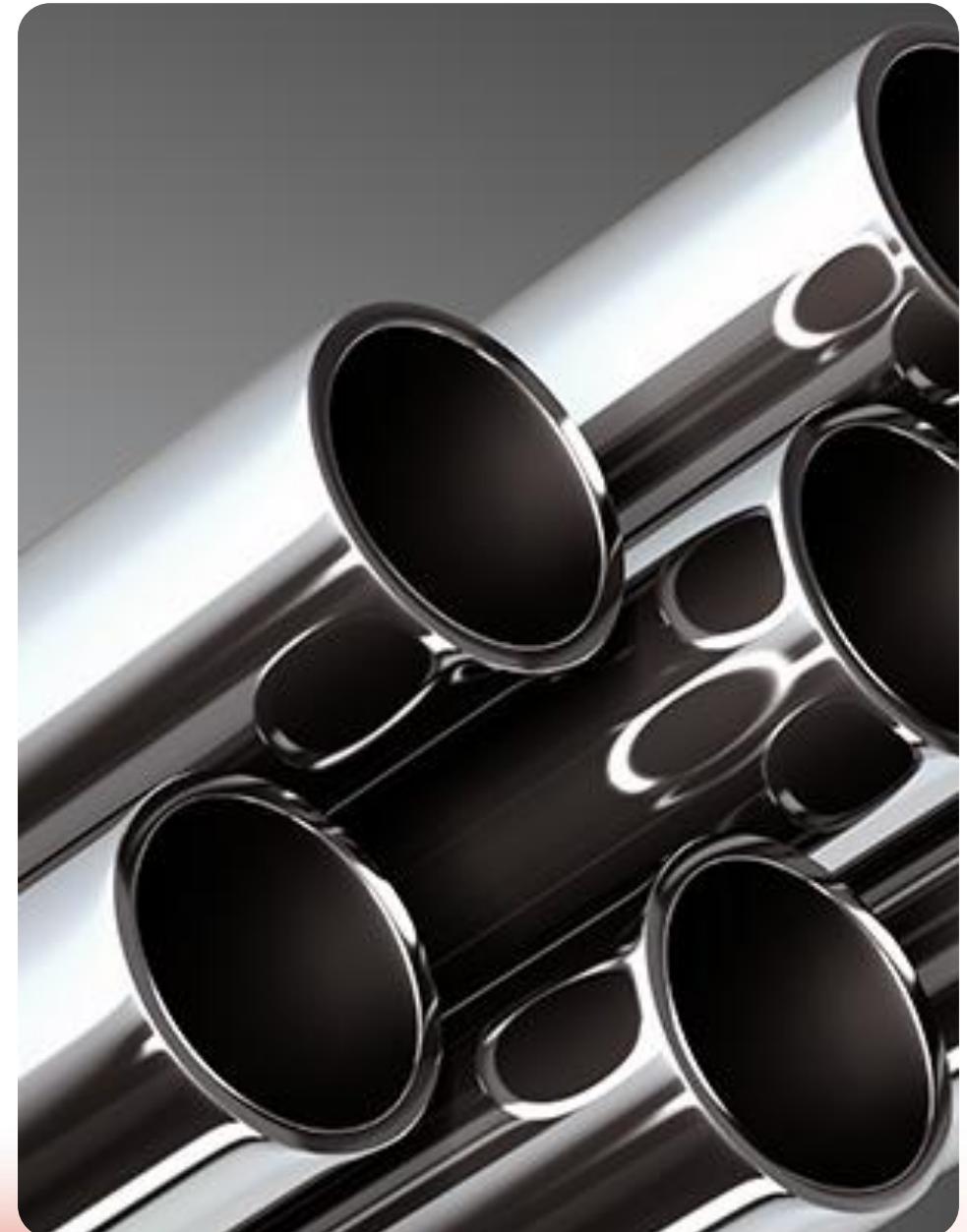




# Perspectives on the *Critical Metallic Components* Landscape

White Paper  
December 2025



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# Executive Summary

- The U.S. critical metallic components sector is undergoing a shift as demand surges across **high-spec, performance-critical applications** in **aerospace, defense, medical devices, clean energy technologies, and electrified vehicles**. These components, often small in size but vital in function, are becoming increasingly central to health, security, and industrial competitiveness
- U.S. demand for critical metallic components is expected to enter **a sustained growth cycle**, fueled by:
  - **Rising performance requirements** in several industrial end markets, driven by demands for **pressure, temperature, corrosion, strength, and weight**
  - Accelerating **reshoring** and **nearshoring** in response to geopolitical and sourcing risk
- At the same time, the landscape for advanced materials and production is evolving, with:
  - **Rapid development of renewable energy sources**
  - **Supportive U.S. policy moves** to strengthen supply chains
- We believe these trends are reshaping not just how components are sourced and produced, but also who leads the market, creating opportunities for **qualified niche players** with **engineering depth, regulatory credibility, and embedded customer integration**. Investment interest is growing, and strategic platforms are emerging
- Cogenuity is actively supporting businesses behind these shifts, scaling niche leaders like **Tech Tube** – which supply **mission-critical, specialty metallic tubing** for aerospace, medical, energy transition, and industrial applications – through **operational excellence and commercial focus**

# Why This Topic Matters To Us

Our team has significant experience investing and operating across the critical metallic component landscape and have developed this white paper to share our perspectives on trends impacting the sector. We remain passionate about supporting the value creation plans of businesses operating in the sector

## About Cogenuity Partners:

We bring **Collaboration and Ingenuity** to partner with management teams to **build advanced industrial businesses**

**We are more than simply a source of capital** – we are collaborative investment and operating partners with decades of relevant experience across the advanced industrial market

Our Cogenuity Collaborative Operations (CoOp) Program™ is a **multi-phased, growth-oriented framework** that combines sector experience, hands-on resources, and strategic networks to help management teams achieve their ambitions

## Our Strategy:

- Collaborative partnership
- Customized approach to growing and transforming businesses
- Investing in people, equipment, and systems
- Pursuing organic expansion and high-impact acquisitions

## **Critical Metallic Components – How We Can Help**

We combine **deep industrial experience** with **active capital** to scale businesses serving **critical sectors** of the **advanced industrial** economy. Our team members have decades of investing and operating experience across **critical components and systems**

1. **Strategic sectors:** aerospace, defense, medical, energy transition, automotive, and more
2. **Critical products:** high-spec materials, high-performance components
3. **Value creation:** organic growth, operational excellence, add-on acquisitions

**Our edge:** Embedded partnerships, operational playbooks, and flexible capital to grow niche leaders

*Let's build the future of the critical metallic components – together!*

# What Are Critical Metallic Components?

## Four Major Pillars in Advanced Industrials



### Advanced Manufacturing

Advanced Manufacturing includes precision components and systems serving high-performance, high cost-of-failure applications



### Critical Industrial Services

Critical Industrial Services include testing, maintenance, field service, compliance, and other services that ensure uptime, safety, and standards across industrial and infrastructure markets



### Industrial Technology

Industrial Technology includes automation, sensing, and control tools that boost precision, uptime, and intelligence across manufacturing through connected systems



### Infrastructure Solutions

Infrastructure Solutions include power, energy, water, and transportation that support the reliable operation and modernization of the built environment

## What Makes Metallic Components Critical?

Precision-engineered metallic components are essential to the safety, performance, and regulatory compliance of critical systems across aerospace & defense, medical, energy, and industrial markets



Spec'd-in and difficult to substitute



Made from high-performance alloys (e.g., titanium, Inconel, precious metals)



Often operate under extreme stress, heat, or corrosive conditions



High cost-of-failure (Small in cost, large in consequence)

## Industry Applications



### Aerospace & Defense



### Medical Devices & Components

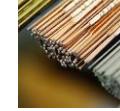


### Automotive



### Energy Transition

# Raw Materials Overview

	More Commoditized	Specialized			
	Base Metals	Superalloys	Exotic Alloys	Precious Metals	
<b>Key Properties</b>	Foundational materials used broadly in structural, electrical, and general components	Engineered metals designed to perform under high heat and stress	High-performance metals for high-temperature, high-strength, and corrosion resistance	Rare, high-value elements critical to advanced electronics and defense systems	
<b>Selected Materials</b>	 Stainless Steel  Copper Alloys  Zinc	 Nickel-Based Alloys  Cobalt	 Titanium  Molybdenum	 Gold  Silver	
<b>Typical Components</b>	Electrical wiring, piping, structural elements, general fasteners	Jet engines, turbines, power generation, thermal shielding	Aerospace structures, medical implants, defense components	Electronics, medical devices, sensors, connectors, catalytic converters, solar panels	
<b>Market Dynamics</b>	Large and often commoditized markets, with broad global production. Prices are highly sensitive to energy costs and cyclical demand fluctuations	Produced by a small group of qualified suppliers. Growth supported by aerospace & defense and energy demand	Constrained supply due to high production complexity and limited certified sources	Limited and geographically concentrated supply with demand from both industrial and financial sectors, leading to volatile prices	
<b>CRITICALITY</b>	 Versatile and widely available, specialty applications exist	 Essential for extreme heat and strength	 Irreplaceable in weight-sensitive applications. Tend to be lower-volume	 Application-dependent, high cost limits widespread use	

# Raw Materials Deep Dive (1/6)

## – Stainless Steel

Cogenuity Thoughts



Tends To Be Commoditized

### Intro To Stainless Steel

#### What Is Stainless Steel?

Stainless steel is a **corrosion-resistant** alloy of **iron**, containing at least **10.5% chromium** by mass. The chromium forms a passive oxide layer on the surface, which **protects** the material from **rust** and **staining** – even in harsh environments

#### Illustration



#### Key Characteristics

- Corrosion Resistance
- Durability and Strength
- Hygienic and Low Maintenance

### Typical Industry Applications

#### Medical Industry



**Surgical Instruments:** Stainless steel's smooth, non-porous surface can be repeatedly sterilized without degrading, making it ideal for infection control



**Implantable Devices:** Biocompatibility and corrosion resistance allow stainless components to remain stable and inert inside the human body over time

#### Chemical Industry



**Storage Tanks:** Stainless steel resists corrosion from harsh chemicals, ensuring long-lasting containment and minimizing risk of leaks or contamination



**Process Piping:** Strength and thermal stability allow stainless steel to handle high-pressure, high-temperature chemical flows without degrading or leaching

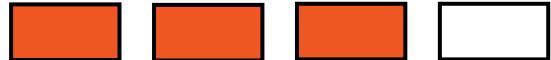
### Outlook

- Stainless steel is **essential** for **structural** and **corrosion-resistant** applications, making it a strategic material in defense, energy, and advanced manufacturing
- Reliance on critical inputs like nickel and chromium, often from **unstable regions**, underscores the need for **resilient, diversified supply chains**
- Stainless steel's **high recyclability** enhances **circular economy** and **material security**, while supporting **domestic resource independence**

# Raw Materials Deep Dive (2/6)

## – Nickel / Nickel-Based Alloys

Cogenuity Thoughts



Highly Specialized

### Intro To Nickel (Alloys)

#### What Are Nickel-Based Alloys?

Nickel-based alloys are **high-performance** metals mainly composed of **nickel** and elements like **chromium** or **molybdenum**. They resist **heat**, **corrosion**, and **stress**, making them essential in **extreme** environments

#### Illustration



#### Key Characteristics

- 🔥 High Temperature Resistance
- 🛡️ Corrosion and Oxidation Resistance
- 💪 Fatigue Resistance

### Typical Industry Applications

#### Aerospace Industry



**Turbine Engines:** Nickel alloys are used in jet engine components (e.g., turbine blades, combustors) due to their ability to maintain strength under high heat and mechanical stress



**Exhaust and Afterburner Systems:** Withstand extreme thermal cycling and corrosive gas exposure over long lifecycles

#### Energy Industry



**Nuclear Reactors:** Components such as heat exchangers, steam generators, and reactor tubing require high-temperature and corrosion-resistant materials



**Downhole Oil & Gas Equipment:** Tools and piping in deep, high-pressure wells use nickel alloys for their resistance to cracking and corrosion

### Outlook

- Nickel-based alloys are **indispensable** in **extreme-performance** environments, securing their role in aerospace, energy, and advanced manufacturing systems
- Continuing demand in **aerospace** and emerging needs in **hydrogen**, **nuclear**, and carbon capture systems is anticipated to drive continued demand for **high-performance** **nickel** **alloys**
- However, heavy reliance on **nickel** ties the industry to volatile, **geopolitically sensitive** **supply chains**

# Raw Materials Deep Dive (3/6)

## – Copper / Copper-Based Alloys

Cogenuity Thoughts



Somewhat Commoditized

### Intro To Copper (Alloys)

#### What Are Copper-Based Alloys?

Copper and its alloys have excellent **electrical and thermal conductivity and malleability**, making them important for the electronics and construction industries. Copper's corrosion resistance and antimicrobial properties also lead to additional applications

#### Illustration



#### Key Characteristics

- ⚡ High Electrical Conductivity
- 🔨 Malleability and Ductility
- 🛡 Corrosion Resistance

### Typical Industry Applications

#### Electrical Industry



**Wire & Cabling:** Copper is used for power distribution as it carries minimal energy loss, especially compared to other relatively low-cost metals



**Motors:** Copper increases efficiency by reducing electrical losses, resulting in durable and cost-effective solutions

#### Datacenter Industry



**Heat Exchangers:** Transfer thermal energy from one fluid to another, without mixing the fluids; copper's thermal conductivity ensures rapid and efficient heat transfer



**Switchgear:** Copper is used in busbars, contacts, and wiring, helping to control and regulate electrical power systems

### Outlook

- Increasing "traditional" demand from growing electricity consumption as developing economies increase standards of living
- Growing needs of **energy transition products** including renewables and electric vehicles; copper offers nearly **60% higher electrical conductivity** than cost-competitive alternatives
- Nascent demand from significant **power needs** driven by **datacenters and AI**, driven by copper's superior thermal connectivity

# Raw Materials Deep Dive (4/6)

## – Titanium / Titanium-Based Alloys

Cogenuity Thoughts



Highly Specialized

### Intro To Titanium (Alloys)

#### What Are Titanium-Based Alloys?

Titanium and its alloys are **strong**, **lightweight** metals known for their exceptional **corrosion resistance**, **high strength-to-weight ratio**, and **biocompatibility**. While more costly to produce than steel or aluminum, they are often the superior option where performance, weight savings, and durability are critical

#### Illustration



#### Key Characteristics

- High Strength-to-Weight Ratio
- Biocompatibility
- Corrosion Resistance

### Typical Industry Applications

#### Aerospace Industry



##### Airframes & Engine Components:

Titanium alloys offer strength, fatigue resistance, and heat tolerance, critical for jet structures, fan blades, and engine housings



##### Landing Gear & Fasteners:

Withstand cyclic stress and exposure to harsh conditions, including salt spray and de-icing fluids



#### Medical Industry

**Orthopedic Implants:** Used in joint replacements and bone screws due to excellent biocompatibility and ability to integrate with human bone



**Dental Applications:** Titanium alloys are preferred for implants and posts, resisting corrosion and bonding well with bone tissue

### Outlook

- Titanium and its alloys are **essential** in **aerospace**, **defense**, **medical**, and **subsea** systems where **high performance**, **weight efficiency**, and **durability** are critical
- Use in **military aircraft**, **naval** systems, and **missiles** positions titanium alloys as a priority material in defense applications
- Production remains **energy-intensive**, and sourcing relies on **geopolitically sensitive** materials (e.g., sponge titanium), driving **supply risk** and **cost pressure**

# Raw Materials Deep Dive (5/6)

## – Lithium / Lithium-Based Alloys

Cogenuity Thoughts



Highly Specialized

### Intro To Lithium (Alloys)

#### What Are Lithium-Based Alloys?

Lithium and its alloys are **used most frequently in batteries**, as their very high energy density, light weight, long lifespan, and lack of pollution make it the preferred solution. **Lithium production has grown nearly tenfold over the past 15 years** as clean energy solutions have proliferated

#### Illustration



#### Key Characteristics

- 🔋 High Energy Density
- ⌚ Long Lifespan
- 🛠️ Low Maintenance

### Typical Industry Applications

#### Energy Transition



**Batteries:** Lithium-ion (Li-ion) batteries generate electricity by moving lithium ions between an anode and cathode through an electrolyte, allowing for high energy density



**Grid-Scale Storage:** Grid-scale storage can store and release large amounts of electricity, which is essential for stabilizing the grid and meeting high-demand periods

#### Medical Industry



**Implantables:** Used as the primary power source for batteries in pacemakers, neurostimulators, and cochlear implants



**Portable Devices:** Lithium-ion batteries are used to power devices such as hearing aids, infusion pumps, surgical tools, and ventilators

### Outlook

- Lithium and its alloys are primarily used in rechargeable batteries for electronics, electric vehicles, and grid storage
- Lithium can also be added to other alloys (such as aluminum) to **reduce weight, improve strength, and bolster stiffness**
- Lithium can be subject to **significant price swings**, as there are mismatches between demand and supply; further, China holds the majority of refining capacity

# Raw Materials Deep Dive (6/6)

[Cogenuity Thoughts](#)



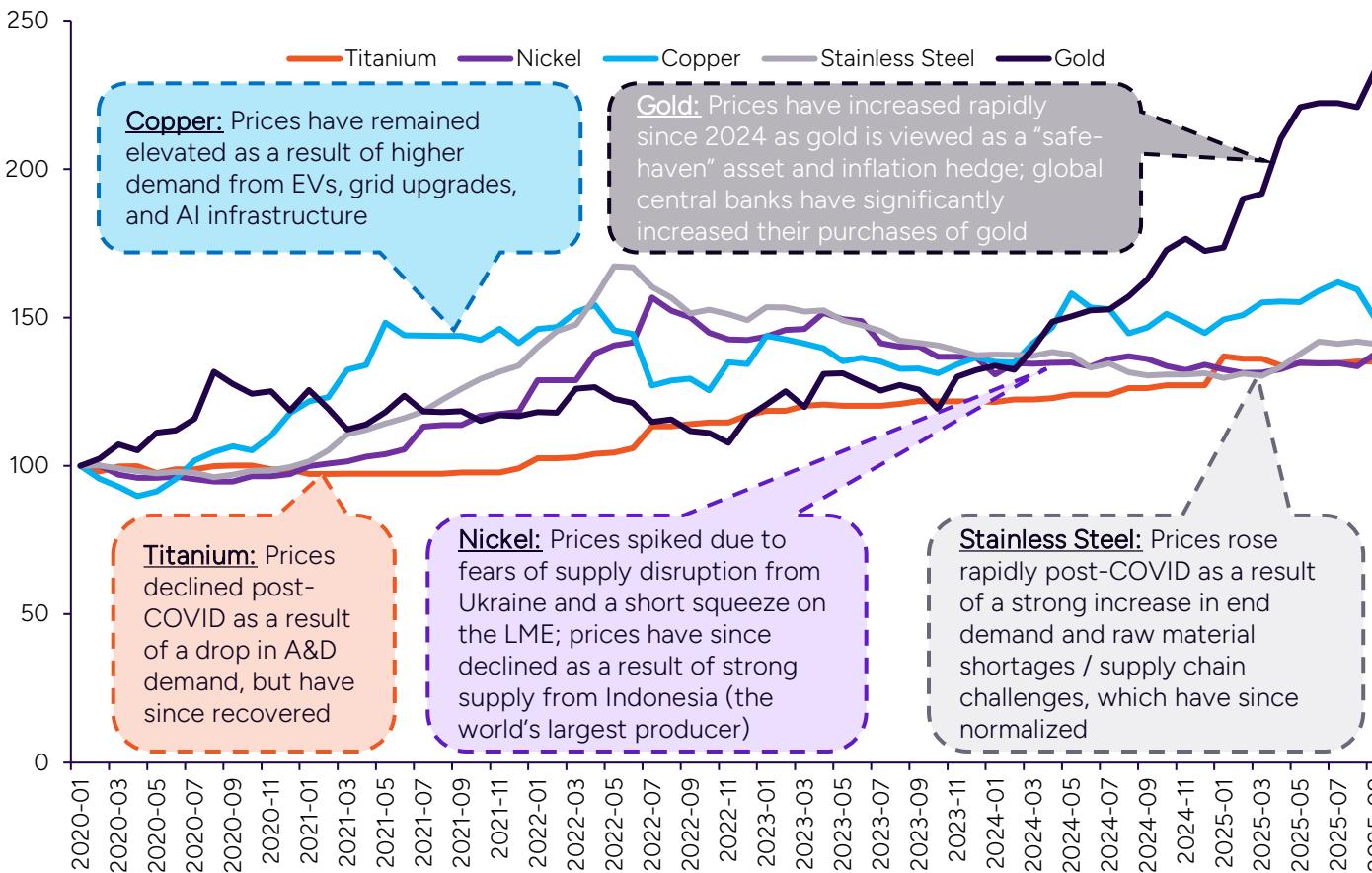
Extremely Specialized

**Proprietary**

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# Recent Trends (1/2) – Commodity Price Volatility

## Historical Commodity Price Trend (2020-2025, 2020=100)



## Near- To Medium-Term Catalysts

### Demand Surge Across Sectors

Aircraft builds, EV growth, and AI infrastructure are driving strong demand for titanium, copper, and nickel

### Reshoring and Supply De-Risking

U.S. and EU buyers are shifting from Russian and Chinese metals, investing in local capacity and scrap recovery

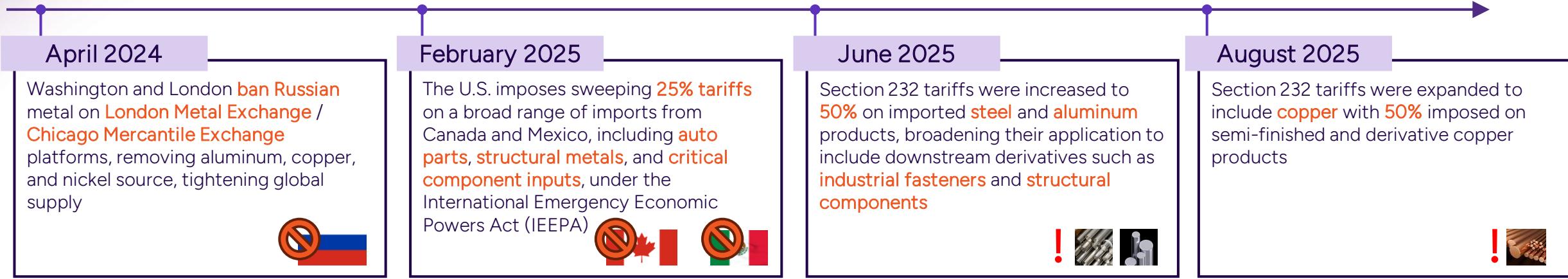
### Policy and Trade Volatility

Export controls, tariffs, and geopolitical tension are disrupting global trade and adding stress to supply chains

### Capacity Constraints

Limited qualified producers are tightening near-term supply across metals

# Recent Trends (2/2) – Tariffs & Regulations\*



## Emerging Risks & Policy Moves

- 2024–2025 U.S. tariff expansions on Chinese EV and metal components
- Rising geopolitical trade tools
- Incentives (e.g., IRA, Chips Act) may offset costs associated with local sourcing

## Business Impacts

- Tariffs raise prices, especially for components heavily reliant on imported materials
- Contracts may have pass-through challenges, limiting margin recovery
- Tariffs encourage nearshoring or dual-sourcing, upending supply chains

## Spotlight: Rare Earth Elements



- Rare earth elements (“REEs”) are a group of 17 elements that are **used in high-technology devices** such as smartphones, cameras, computers, lighting, clean energy, and defense technologies
- While found across the globe, **China controls ~70% of REE production and ~85% of processing capacity**. Mining REEs carries high environmental risk
- China has export controls on select REEs**, notably for semiconductor and defense applications. Foreign firms must apply for specific approvals from the Chinese government
- The situation remains fluid and local supply chains are benefitting**; the U.S. authorized \$1B to bolster supply chains of critical minerals and materials, while also providing direct support to MP Materials, Vulcan Elements, and ReElement Technologies

# Critical Metal Applications Across Sectors

Growth

## Proprietary

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- Aerospace & defense has high **criticality**, driven by a lengthy qualification process. Growth prospects are elevated from increasing build rates across defense, military, and space markets
- Medical devices have increasing **component complexity**. High criticality, macro medical tailwinds (aging populations, advanced technologies, etc.), and biocompatibility lead to strong reliance on specialized metals such as titanium
- Low-differentiability segments face **commoditization risk**. HVAC, automotive, and other industrial markets have relatively low differentiability, using relatively less specialized metal components; electric vehicles represent a bright spot given their use of advanced alloys

## Component Differentiability

# Selected Sector Details

## Key Use Cases & Applications



### Aerospace & Defense

- Lightweight, high-strength components for airframes, engines, and landing gear
- Corrosion- and heat-resistant parts for military aircraft, missiles, and spacecraft
- Critical tolerances in navigation and avionics hardware

- Titanium landing gear and jet engine blades and discs
- Nickel jet engine hot sections, exhaust systems, and high-temperature parts
- Stainless steel landing gear, structural fittings, and fasteners



## Critical Metallic Components



### Medical Devices & Components

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contact  
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discuss our  
insights*



### Automotive

- Lightweight and crash-resistant parts for structural frames and chassis
- Precision thermal and electrical management in EVs
- Powertrain and battery system enclosures and fittings

- Stainless and nickel alloy exhaust manifolds
- Copper connectors, busbars, and battery tabs
- High-strength fasteners for drivetrain and suspension
- High-strength steel structures, suspensions, and safety components



### Other Industrial Markets

- Power Utility and Shipbuilding: Corrosion- and pressure-resistant components for harsh environments
- Agriculture: Long-life parts for heavy-duty rotating equipment
- HVAC and Building Systems: Electrical and thermal interfaces in industrial systems

- Copper and stainless steel heat exchangers
- Lithium cathodes and electrodes
- Rare earth elements in wind turbine generators and EV motors
- Steel fasteners for high-load equipment



## Illustrative Examples

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Source: Cogenuity analysis.

# Critical Metallic Components – Aerospace & Defense

## Growth Drivers

Next-gen aircraft programs and fleet modernization

Increasing global defense budgets

Efficiency demands with "no fail" applications



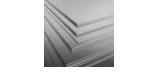
~ 5%

Forecast CAGR in airline revenue passenger kilometers (RPKs)

~ 8%

Projected CAGR of global defense budgets

## Key Materials and Applications

Material	Characteristics	Applications
 	<ul style="list-style-type: none"><li>✓ Heat / creep resistance, maintaining strength</li><li>✓ Corrosion resistance</li></ul>	<p>Proprietary Please contact Cogenuity to discuss our insights</p>
 	<ul style="list-style-type: none"><li>✓ High strength-to-weight ratio</li><li>✓ Compatible with carbon fiber</li><li>✓ Corrosion resistance</li></ul>	
 	<ul style="list-style-type: none"><li>✓ Lightweight</li><li>✓ Easy to machine</li><li>✓ Cost effective</li></ul>	
 	<ul style="list-style-type: none"><li>✓ Fatigue and impact resistance</li><li>✓ High tensile strength</li><li>✓ Long component life</li></ul>	

## Selected Players

**Proprietary**  
Please contact Cogenuity to discuss our insights

## Cogenuity's Perspective

- Aluminum has long been the dominant material for A&D structures, but is being displaced by **materials with added performance characteristics** (e.g. titanium and nickel for temperature, corrosion, and strength benefits)
- The A&D critical metallic components sector is experiencing **growing demand**, driven by **next-gen aircraft programs, specified material requirements**, and increasing defense budgets in several countries
- Value capture** depends on managing the **qualification process** and **material input volatility** in a highly technical market
- We see strong potential with companies making **major investments to expand capacity and vertically integrate**

# Critical Metallic Components – Medical

## Growth Drivers

Aging population and rising chronic conditions

Shift towards minimally-invasive surgeries

Material innovation for biocompatibility



>6%

Projected CAGR of minimally-invasive surgeries

~5%

Projected 2025-2030 CAGR of U.S. population >65 years old

## Key Materials and Applications

Material	Characteristics	Applications
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**Proprietary**

*Please contact Cogenuity to discuss our insights*

## Selected Players

**Proprietary**

*Please contact Cogenuity to discuss our insights*

## Cogenuity's Perspective

- Demand for **implant-grade metals** is accelerating, driven by aging populations and shifts to **alloys with advanced properties** (e.g., titanium, platinum-iridium)
- The market presents opportunities for **scaling niche leaders** in regulated precision environments, where **lifecycle integration, deep OEM alignment, and demanding product requirements** can unlock durable value
- With fragmented supplier bases, lengthy qualification processes, and regulatory bottlenecks, we believe **qualified niche players with strong capabilities** can gain disproportionate value

# Critical Metallic Components – Automotive

## Growth Drivers

Lightweighting demands driven by efficiency goals

Accelerating electrification and battery protection

Advanced materials for safety and performance



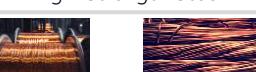
>10%

Forecast CAGR for global EV sales through 2030 (concentrated with Chinese OEMs)

>10%

Projected CAGR of the vehicle electrification market

## Key Materials and Applications

Material	Characteristics	Applications
 Aluminum Alloys	<ul style="list-style-type: none"><li>✓ Lightweight</li><li>✓ Infinitely recyclable</li><li>✓ Low cost</li></ul>	<p><b>Proprietary</b> Please contact Cogenuity to discuss our insights</p>
 High-Strength Steel	<ul style="list-style-type: none"><li>✓ Fatigue resistance</li><li>✓ Spreads energy upon impact</li><li>✓ High tensile strength</li></ul>	
 Copper Alloys	<ul style="list-style-type: none"><li>✓ Electrical conductivity</li><li>✓ Thermal conductivity</li><li>✓ Corrosion resistance</li></ul>	
 Lithium	<ul style="list-style-type: none"><li>✓ High energy density</li><li>✓ Long lifespan</li><li>✓ Low maintenance</li></ul>	

## Selected Players

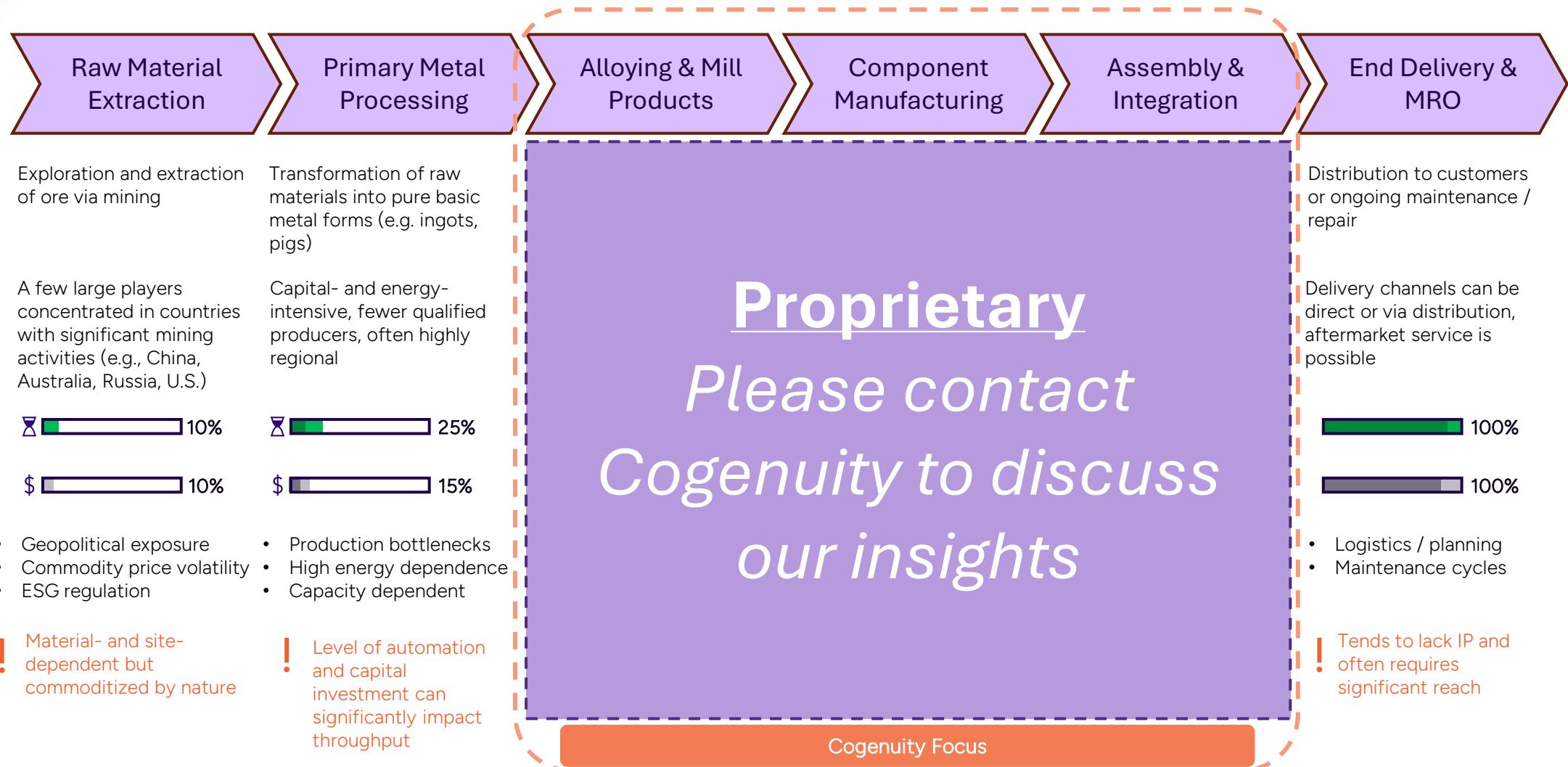
### Proprietary

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### **Cogenuity's Perspective**

- Demand for advanced metallic components is rising, fueled by **electrification, lightweighting initiatives, crashworthiness, and growing structural complexity** in next-gen automobiles
- As automakers focus on thermal resilience and battery integration, we see a shift toward **engineered (super-)alloys and exotic alloys**
- This creates opportunity to scale niche specialists with materials expertise, embedded engineering capabilities, and platform-level alignment, where ongoing development and **product lifecycle integration** can create value

# Critical Metallic Components Value Chain



# Critical Metallic Components – Select Manufacturing Processes



## Casting

Pouring molten metal into molds to achieve desired shape



## Forging

Shaping metal using compressive forces



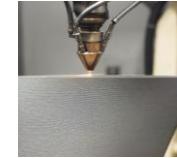
## Stamping

Converting flat metal sheets into specific shapes



## CNC Machining

Computer-guided subtractive process for high precision



## Additive Manufacturing

Layer-by-layer construction of parts from powder or wire

Industrial Components

Industry Characteristics

Value Add

Future Outlook

Proprietary

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# Cogenuity Case Study – Tech Tube

## Introduction to Tech Tube

### Business intro

Specialized manufacturer of high-precision metal tubing, primarily from specialty alloys, for critical uses across the aerospace, medical, and industrial sectors

### Partnership Date

June 2025

### Headquarters

King of Prussia & Bridgeport, PA



Stainless Steel



Nickel-Based Alloys



Other Alloys

**cogenuity**

### Selected Offerings



Engine Tubes



Vascular Care Stents



Aircraft Wing Tubes



Aerospace



Medical



Industrial

Source: Tech Tube. Cogenuity.

## What Makes Tech Tube Unique?



Mission-critical, precision tubing that is foundational to **high-spec aerospace systems** and **life-saving medical devices & components**



Long-standing customer relationships anchored in **technical integration** and **rigorous quality standards**, driving high customer retention and stickiness



Strong value creation potential through Cogenuity's proprietary **CoOp program** via operational excellence, commercial expansion, and strategic add-on acquisitions

**"We're proud of what we've built at Tech Tube since our father acquired the business in the 1980s. We feel that in partnering with Cogenuity, we will be able to unlock the companies' full potential and better serve our customers, employees, and community"**

– Brian & Kevin Johnson (Co-Presidents, Tech Tube)

# About Cogenuity Partners

Our team has deep experience with products serving the critical metallic components landscape

## Our Team:

**14** Investment and operating professionals

**100+** Years of combined private equity experience across Cogenuity's team <sup>(1)</sup>

## Select Investment Criteria:

Revenue:

**\$25-250M**

EBITDA:

**\$5-35M**

- 1) Critical products & services
- 2) Experienced management teams
- 3) U.S. or Canada headquarters
- 4) Strong revenue growth & margins

## Our Philosophy:

We are more than a source of capital. We take pride in our investment and operating partners working side-by-side with management teams, industry professionals, and advisors to execute on value creation initiatives and work towards achieving attractive outcomes

## Critical Metallic Components:

Our team members are experienced investors and operators across the critical metallic components landscape:

- Multiple leading companies providing critical products across high cost-of-failure applications and markets
- Flexibility in partnership, including numerous family- and founder-owned businesses
- Deep experience scaling businesses across commodity and regulatory cycles

## Key Contacts:



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