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TUNGSTEN POWDERS
A Group Company of MITSUBISHI MATERIALS

Value Chain, Supply Risks and Outlook

RohstoffRadar Webinar: Tungsten – market dynamics, supply chains and industrial perspectives

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Agenda

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Introduction to H.C. Starck Tungsten Powders

The Tungsten Value Chain

Tungsten in Critical Industries

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The Role of Recycling

Outlook

Introduction to H.C. Starck Tungsten Powders

A global player in tungsten processing and recycling

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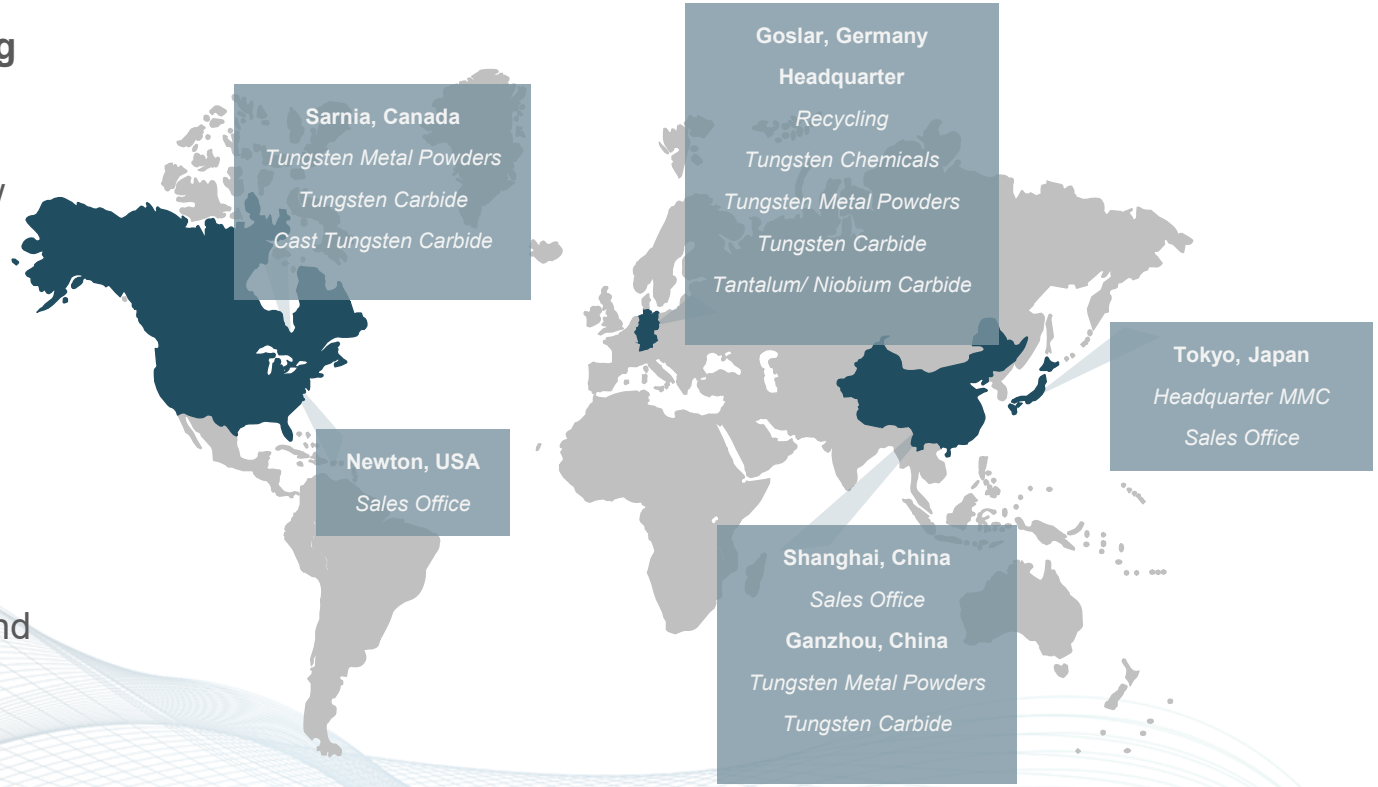
- More than **100 years of experience in tungsten processing** and materials development
- **Deep expertise across the tungsten value chain**, from raw materials to advanced powder products
- Technology leader in **tungsten recycling** with the ability to process a wide range of tungsten scrap
- Around **550 employees** combining long-standing experience with highly qualified young professionals
- Part of the **Mitsubishi Materials Group**, with global reach and industrial network



Tungsten Value Chain

The tungsten value chain from raw material to finished product is complex with a wide variety of intermediary products

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Raw Material: Secondary	Tungsten Recycling	Tungsten Chemicals	Tungsten Metal Powders	Tungsten Carbide Powders	*Cemented Carbides*

H.C. Starck Tungsten Powders' Product Portfolio

- H.C. Starck Tungsten primarily uses **secondary raw materials** (tungsten-containing scrap) as input for its processes
- **Wolframite and scheelite** are the main commercially relevant tungsten ores used as primary raw material

- Both types of raw material are chemically processed to produce ammonium paratungstate (APT), the **key intermediate** in the tungsten value chain
- APT is typically calcined into **yellow or blue tungsten oxides**
- Tungsten oxides are **reduced with hydrogen** to produce tungsten metal powder

- Tungsten metal powders can be further processed by **pressing, sintering, heating, drawing or rolling**
- A large share is converted into tungsten carbide powder via **carburization with carbon at high temperature**
- Tungsten carbide is the **most widely used tungsten compound** and the main constituent of cemented carbides

Tungsten in Critical Industries

Enabling performance in key industrial and strategic applications, with tungsten classified as a critical and strategic raw material under the CRMA

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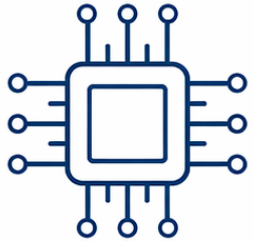
Automotive

Energy & Chemicals

Aviation & Aerospace



Electronics

Medical

Additive Manufacturing

Tungsten Chemicals

Tungsten Metal Powders

Tungsten Carbides

Supply Chain Challenges

Dependencies, concentration and increasing supply risks

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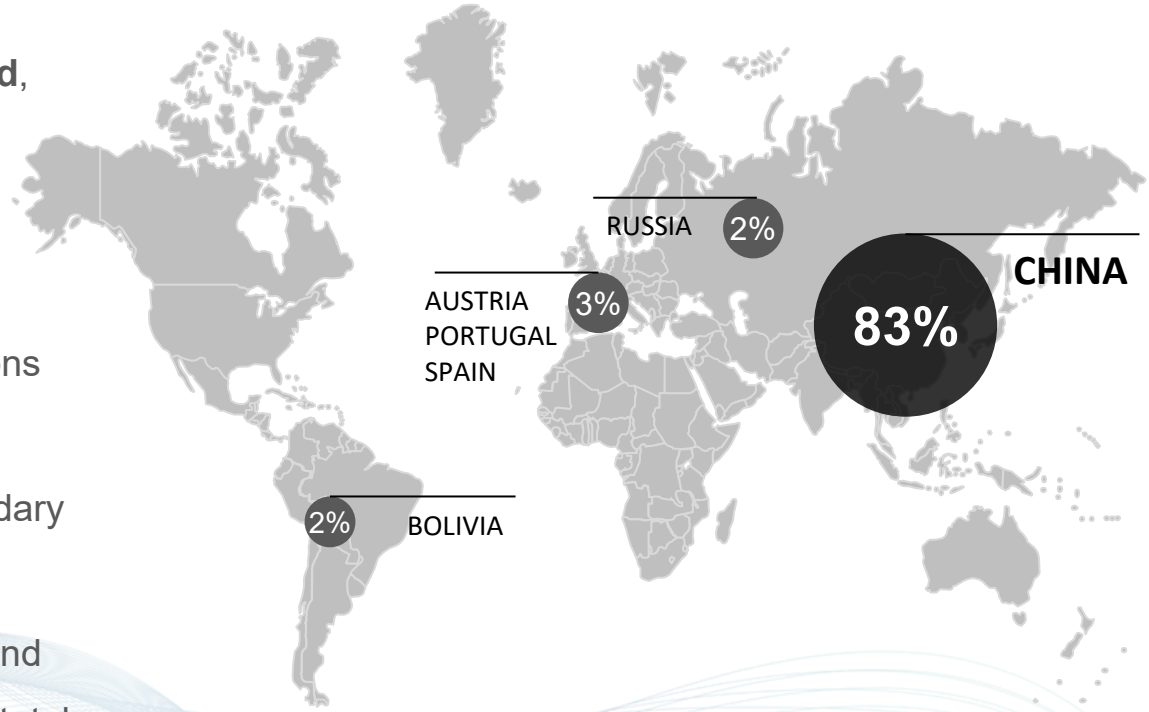
- Over **80% of global tungsten mine production** originates from China
- Over decades, exports of tungsten ores have been **effectively restricted**, with additional controls on intermediates through limited export licenses
- Since 2002, China has **regulated tungsten mining** through production quotas, licensing and environmental requirements
- Ongoing **industry consolidation** has integrated smaller mining operations into large state-owned enterprises
- **China is a major importer of tungsten ores** and increasingly of secondary raw materials, including from Europe
- Primary raw material availability in **Europe is limited**: in 2024, only around 2,000 tonnes of tungsten ores were processed in Europe out of a global total of 81,000 tonnes



Source: USGS 2025

The Role of Recycling

Strengthening supply security through circular material flows: H.C. Starck Tungsten achieves >80% recycling rates at its Goslar site

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- Depending on the region, recycling rates vary between 15 and 50%.
- About 25-30% of the total tungsten demand is covered by recycling.

- Direct recycling processes (incl. the zinc process) are less costly compared to chemical recycling, but disadvantageous to product quality and flexibility

- For hardmetal tools and heavy metal parts recycling rates are relatively high (50-75%);
  - however, tungsten-containing chemicals are virtually not recycled.

- To increase recycling rates, processes and logistics are to be improved and downcycling avoided;
- highest potential to increase recycling in energy and chemical applications

Outlook

Tungsten is not only a critical material, but a strategic issue for industry and policy.

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Demand growth meets structurally constrained supply

Geopolitical influence on raw material markets is expected to increase further

Ensuring supply security requires a supportive and reliable policy framework

Recycling and circular value chains will be key to reducing dependencies

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