S&P Global
Energy

Germanium Market Report

Germanium (Ge)

August 2026

Preamble

This draft **Germanium Market Report** aims to increase transparency within the germanium supply chain, helping public and private stakeholders make more informed investment decisions across the commodity lifecycle. It briefly outlines current supply chain bottlenecks, resiliency issues, and the market signals needed to support a more robust and diverse supply base.

S&P Global conducted a bottom-up, asset-level analysis of production costs for germanium extraction refining. These production cost curves are based off the germanium refining production processes, and provide an independent view of supply economics and identify the marginal supplier in a structurally tight market. The analysis excludes assets located in Russia, China, and North Korea, as well as any assets worldwide that are majority-owned by Chinese companies.

This analysis reflects a multi-year effort combining bottom-up asset modelling, proprietary market intelligence, extensive research, expert assumptions, and industry consultation to overcome significant data limitations across the opaque mineral value chain.

The market values in this report represent a fundamentals-based assessment of the cost and the break-even range required for germanium production sources to remain economically viable and meet sufficient G7+Australia demand. This enhanced cost transparency can facilitate better-informed offtake agreements and investments throughout the supply chain. However, actual transactions also factor in inventory levels, broader market conditions, global trade dynamics, and other variables not included in this analysis.

These values are different to the spot market price assessments published by Platts, part of S&P Global Energy (link).

Given the limited availability of public data, this report is based on S&P Global's proprietary market and mineral intelligence and our analysis of company disclosures, and market information. We welcome input from market participants to support the ongoing refinement of future editions.

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Key Takeaways

- S&P Global estimates that the germanium refineries require a structural cost[1] of between $2,100-2,300/ kg Ge metal[1] in 2028 to sustain the current or announced capacity pipeline
- Germanium demand is expected to grow 3.3% per year between 2026 and 2030, driven by growing demand for infrared technologies, supported by defense modernization and wider thermal-imaging adoption across industrial and automotive applications
- New capacity additions in Canada, South Korea and the USA, are expected to add 95 t (metric tons) of Ge metal, increasing total ex-China refining capacity to 126 t
- Under the announced project pipeline, a total of five ex-China refineries could be operating by 2030; capacity would still cover only ~48% of 2030 ex-China demand.

Introduction

Germanium is a specialty metal valued for its ability to transmit infrared light and control the movement of light and electrical signals. Its infrared transparency makes it important for thermal-imaging lenses, night-vision systems and targeting equipment, while germanium dioxide adjusts the refractive index of optical-fiber cores to enable low-loss data transmission. In electronics, germanium's electron mobility is nearly three times that of silicon, supporting high-frequency SiGe chips, while germanium substrates are used in high-efficiency solar cells for satellites and other space systems.

From a supply perspective, germanium is not mined directly and is instead primarily recovered from germanium-bearing residues and side streams generated during zinc processing, with additional production from coal-related residues and recycled materials. Because it exists in trace concentrations, its economics are dwarfed by zinc operations, offering little commercial incentive to allocate capital recovery circuits rather than maximizing zinc output. Commercial markets are broadly divided between germanium dioxide and high-purity germanium metal, which is refined to electronic and optical grades.

More than 90% of germanium refining capacity is concentrated in China, while the manufacture of germanium-based components is more geographically distributed. China introduced export licensing in August 2023 and banned exports to the United States in December 2024 and to Japan in January 2026. Although the ban was suspended through November 2026, licensing requirements and restrictions on military uses remain, prompting new recovery, refining and stockpiling initiatives outside China to reduce supply-chain exposure.

Germanium's Properties

Infrared transmission:
~14 µm

Wider than silicon (~7 µm) or sapphire (~5 µm)

Light refraction index:
~4.0 (light travels 4× slower)

Highest of common lens materials – vs. silicon ~3.4

Electron mobility:
~3,900 cm²/V·s

Electrons move ~3× faster than in silicon (~1,500 cm²/V·s)

1. Assumes costs are shared with gallium production, reducing standalone capital and operating requirements.
Sources: S&P Global, USGS

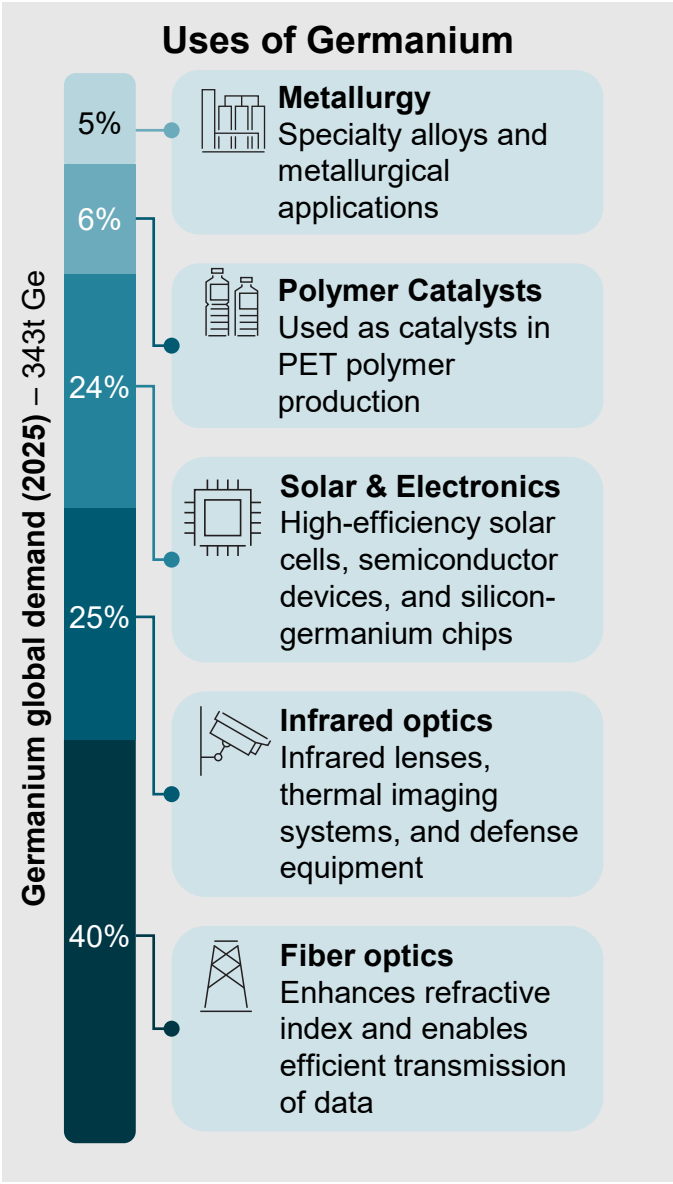
Germanium demand

Demand for germanium is primarily driven by fiber-optic communications, infrared optics, and satellite-grade solar cells, although end-use demand spans a broader range of telecommunications, semiconductor, defense, industrial, and aerospace applications. Germanium is consumed in forms including germanium dioxide (GeO_2), germanium metal, wafers, and silicon-germanium (SiGe) materials used across these technologies.

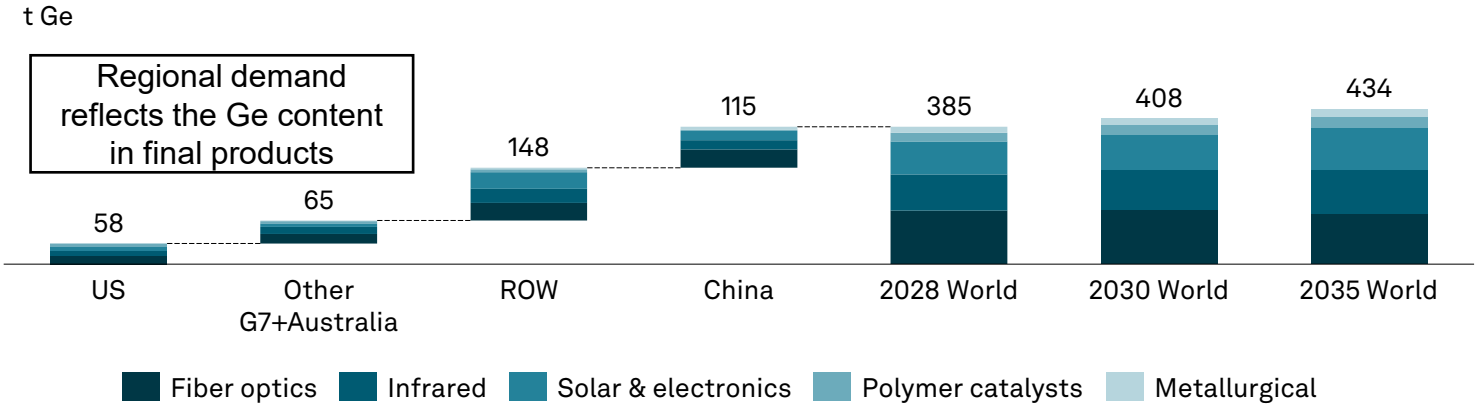
Germanium is typically used in very small quantities across its end-use applications, making consumption difficult to track through traditional trade and production statistics. As a result, official and accurate estimates of global demand remain uncertain. Nevertheless, our analysis estimates global germanium demand at approximately 343 t in 2025.

Fiber optics remain the largest germanium end-use sector, accounting for 142 t of demand in 2026 and peaking at 153 t in 2030. China and G7 + Australia each represent ~30% of demand through 2030. Infrared optics drive demand growth, supported by defense and advanced commercial applications, with global consumption increasing 34% through 2035 with growth led by China (+43%). China remains the largest germanium end-use market, while infrared accounts for most incremental demand growth.

Substitution remains difficult in infrared optics and fiber optic applications, where germanium's optical and refractive properties are hard to replicate.



Germanium end-use demand outlook 2028 - 2035



Sources: Demand volumes are S&P Global analysis

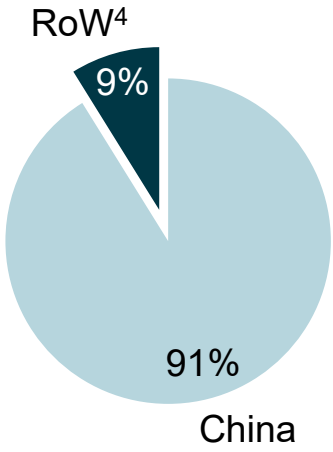
Germanium supply

China represents 91% of primary germanium metal production, while the majority of the remaining 9% is produced at the Umicore facility in Belgium[2], which sources some of its feedstock from a tailings processing plant in the D.R. Congo. Canada also produces primary germanium, in oxide form, from Alaska feedstock. The United States also has substantial germanium recovery potential from germanium-rich zinc ores in Tennessee, which contain approximately 300-400 ppm Ge[3].

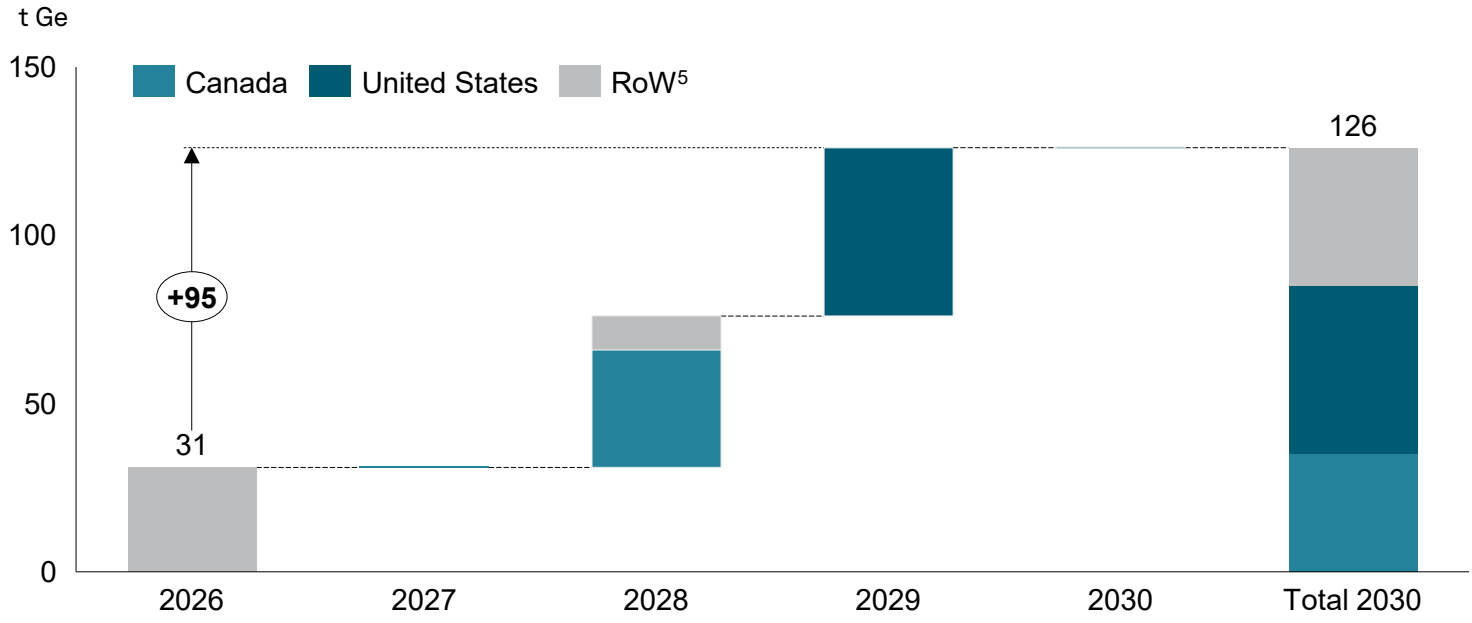
Germanium is consumed either as germanium dioxide (GeO_2) and germanium tetrachloride ($GeCl_4$) for fiber-optic and infrared applications or used directly as metal in wafer and alloy production.

Current primary germanium metal capacity outside of China is limited to 31 t. An additional 95 t could develop from projects in Canada, the United States, and South Korea by 2029. Subject to investment, capital access, and strategic alignment, germanium recovery at existing ex-China zinc refineries could expand potential supply to multiples of current production. Current secondary germanium metal supply is ~39t[4].

Primary germanium metal supply [1] (2025)



Germanium production potential (primary metal) ex-China capacity



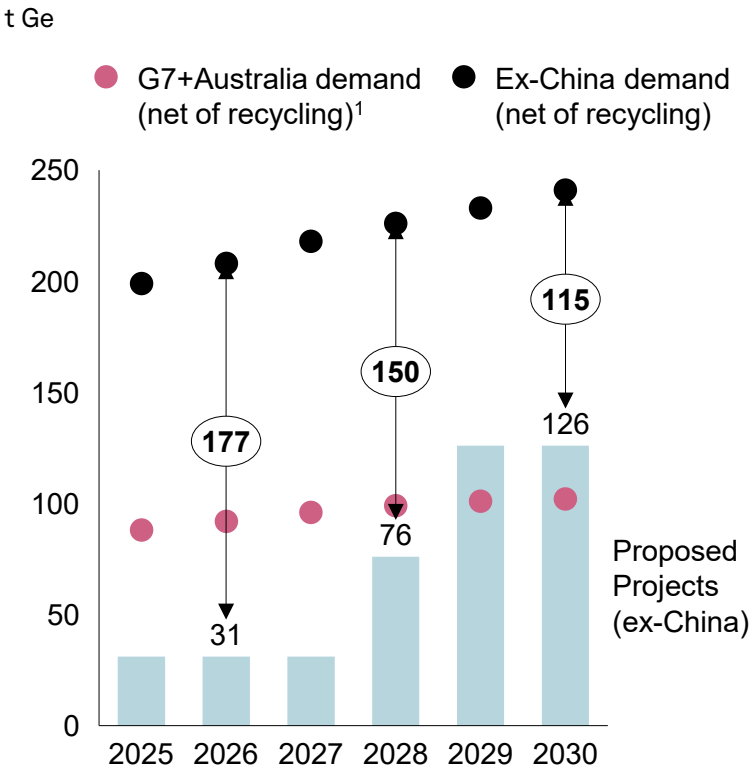
The supply chart represents potential risked supply pipeline based on company announcements

1. Based on data from : *Quantifying Potential Effects of China's Gallium and Germanium Export Restrictions on the U.S. Economy* report (USGS, 2024); 2. In addition, the Iijima refinery in Japan is currently operating, although production is estimated at less than 1 t; 3. Reported Ge content ranges between 100 and close to 1000, with most being below Tennessee's 300 to 400; 4. Source: Project Blue; 5. Rest of the World

Sources: S&P Global

Supply demand balance

Supply demand balance outside of China and Russia



- A supply gap of approximately 177 t Ge metal is expected in 2026, with available ex-China supply totaling only 31 t Ge.
- In 2028, 45 t of planned new capacity in North America would still result in a gap of ~150 t due to demand growth.
- By 2030 an additional 50 t in capacity, totaling 95 t growth over the existing base, would potentially surpass G7 + Australia demand. However, a 52% supply deficit would remain relative to ex-China 2030 demand.

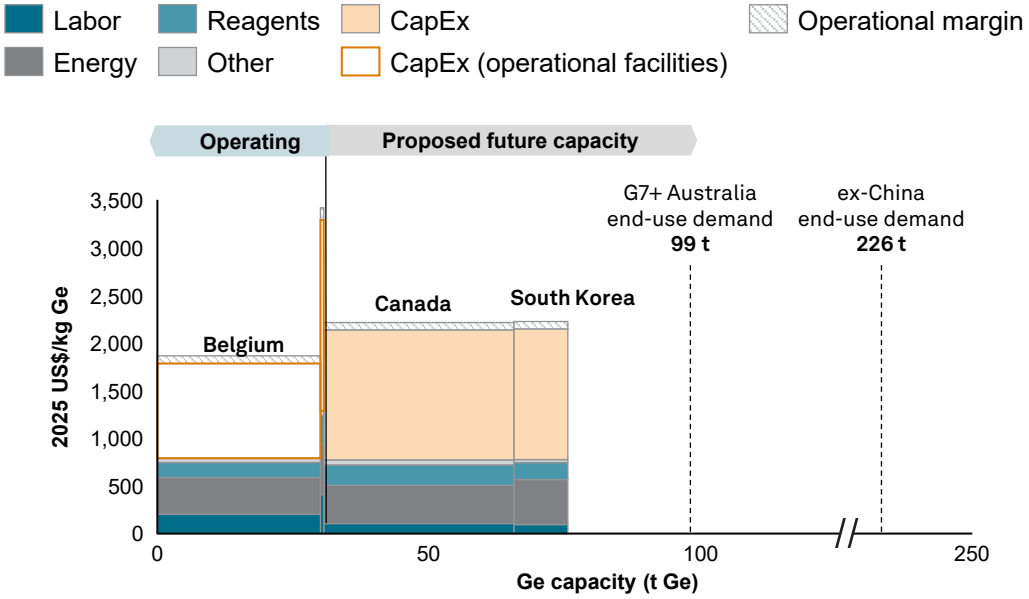
Recent market events

- The Canadian government signed an investment agreement establishing a commercial framework for an equity-like investment by Canada Growth Fund (CGF) of up to C$400 million as part of Teck's broader potential investment of up to C$850 million to expand critical minerals production capacity at Trail. [Platts, July 2026]
- Teck Resources is working with Titan Mining Corp. to evaluate germanium content at the Empire State Mines in New York, while Bunker Hill (Idaho) is scheduled to begin commercial production by end-2026, with initial concentrate bound for Teck's Trail smelter in Canada. [Platts, July 2026]
- SUEK, Russia's largest thermal coal producer, reached 50 kg/month of germanium raw material output extracted from coal combustion ash, with plans to begin producing germanium concentrate in 2026. [Platts, June 2026]
- Korea Zinc officially launched Crucible Zinc Inc. and completed the acquisition of Nyrstar US's Clarksville, Tennessee smelter to build a $7.43 billion integrated critical metals facility. The site holds ~620,000 t of smelting by-products containing germanium, gallium, and indium. [Platts, April 2026]

Sources: S&P Global, Project Blue for recycling figures

Germanium structural cost structural cost

2028 Germanium metal primary production structural cost curve



Structural Cost: Represents the full cost required for an asset to achieve its target return on investment, assuming projects are developed in line with announced timelines and operate at capacity. This cost considers an unrisked projection subject to normal industry attrition and delays

Structural cost - Findings

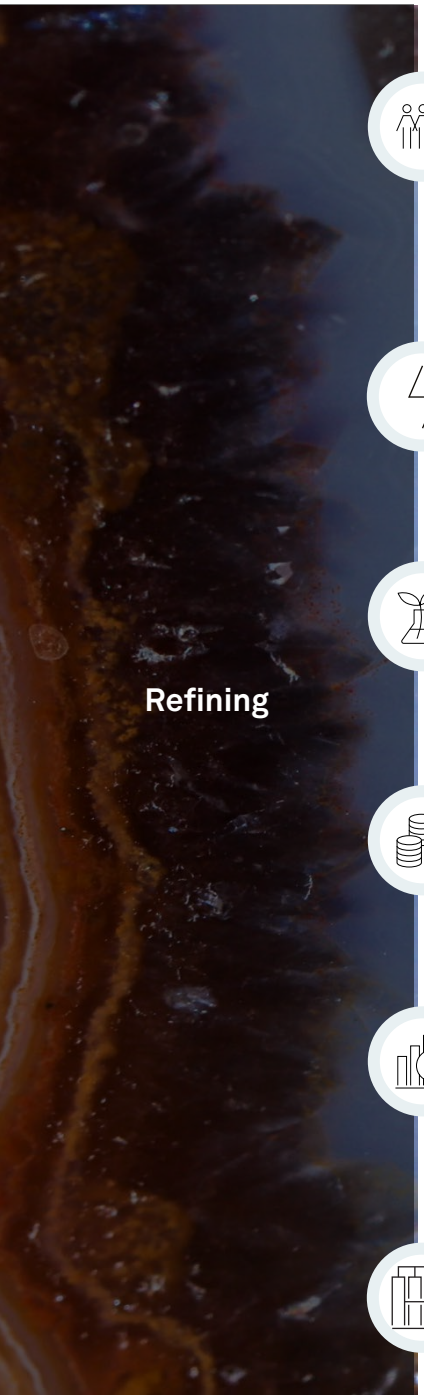
- S&P Global CERA estimates that a structural cost range of between **$2,100/kg and $2,300/kg** would support all announced ex-China germanium metal supply, or 75t Ge by 2028. Excluding CapEx, a cost range between **$830/kg to $910/kg** would be sufficient to sustain operation of these projects once commissioned
- Zinc-based projects produce gallium as well, providing support to germanium economics. Both metals are recovered from the same zinc side streams, allowing infrastructure, labor, utilities, and some reagent costs to be shared across both
- Unlike gallium, germanium must be removed from zinc side streams early on. This is done by power-intensive electrowinning. As a result, energy consumption represents the most significant share of germanium metal production costs after capital expenses
- Cost differences are attributable to location, scale and gallium and germanium content impacting power, reagents and labor costs

Structural cost - Approach

- Reflects Market Complexity: Built on extensive research and bottom-up modelling, incorporating asset-level data, industry consultation, benchmarking, and expert assumptions to navigate a highly opaque supply chain
- Targets the Marginal Supplier: The 80th-90th percentile identifies the highest-cost producers. Long-term commodity prices naturally gravitate toward the cost of the last unit needed to meet demand. This percentile filters out extreme outliers while capturing the true marginal cost
- Incentivizes Supply Resiliency ex-China: It establishes a long-term structural benchmark - not a short-term forecast - capturing the full asset economics
- Feedstock costs were not considered because germanium is recovered from side streams generated during zinc processing

Sources: S&P Global

Challenge of cost components and methodological approach



Labor: Labor costs were estimated by combining the number of full-time equivalent employees (FTEs), regional processing/refining wage rates, and a regional multiplier to account for additional mining and refining labor costs. FTE requirements were estimated using an S-curve relationship between plant capacity and workforce size, calibrated with available industry data.

Energy: Power and utility costs were estimated based on the electricity consumption required per ton of production and the local wholesale electricity price.

Reagents: Reagent costs were estimated using chemical consumption rates per ton of production and corresponding regional prices. Estimates were based on a combination of reagent-specific consumption data and reported overall reagent costs. Reagents used exclusively in germanium refining were fully allocated to germanium.

Operational margin: A 10% operational margin was applied to facility OPEX costs to represent facility-level profitability. This adjustment shifts the curve from a cost basis to a price-like basis.

CAPEX: Includes levelized initial CAPEX, allocated to each facility and recovered over a 20-year project life using a 7% discount rate to reflect the time value of money, as well as sustaining CAPEX representing ongoing investments required to maintain operations and productive capacity, estimated as 2% of initial CAPEX.

Feedstock: Feedstock costs were not considered as germanium is typically recovered as a by-product from side streams generated during zinc processing

All cost components were estimated at the facility level and converted to a unit cost based on annual capacity.

Co-product cost allocation: Shared costs were allocated based on gallium and germanium share of expected revenue, while costs attributable to mineral-specific processes were assigned entirely to the corresponding mineral. Expected revenue was estimated as production volume multiplied by expected prices of gallium and germanium. Values are preliminary and will be refined through further S&P Global analysis, data review, industry consultation and stakeholder review.

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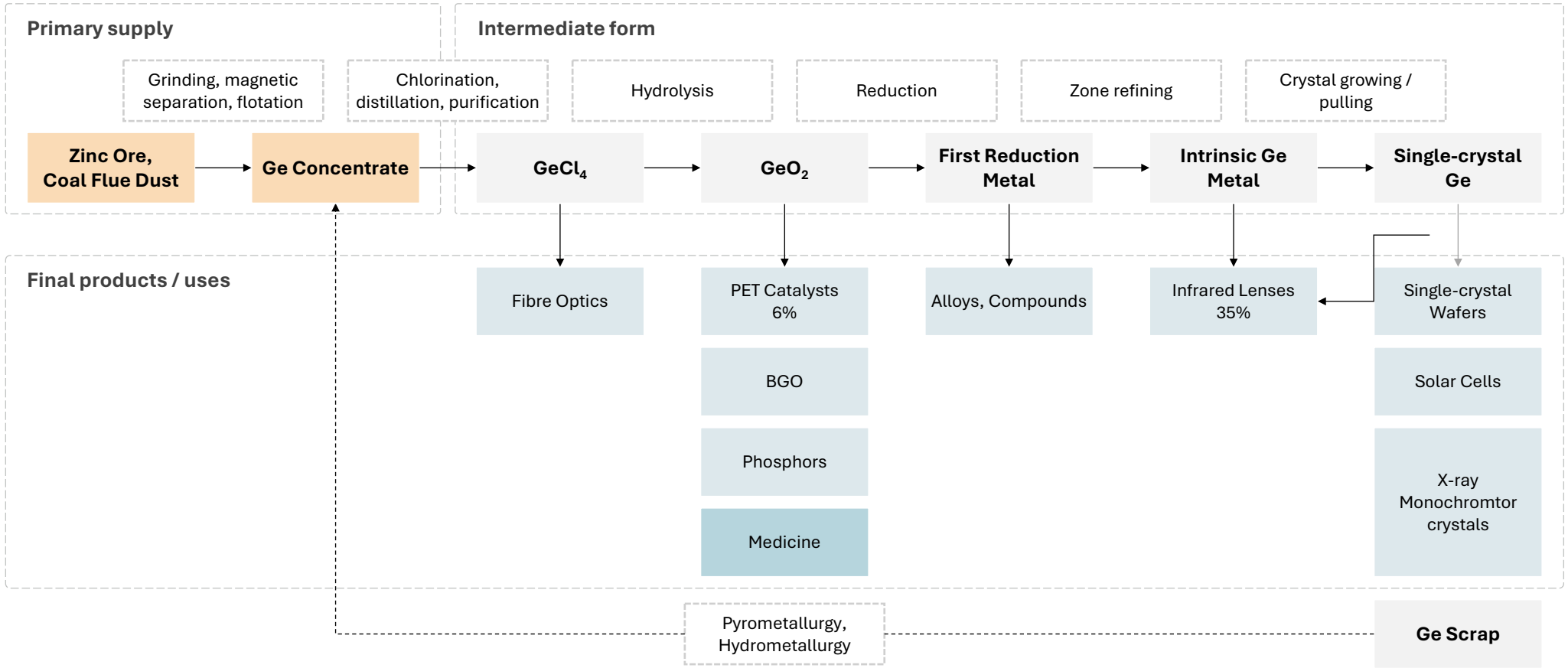
Ge value chain



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