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Nevada Copper Processing Study

Domestic Critical Mineral Production Nevada's Copper Opportunities

NCPS

By: Ralston T. Pedersen[1], Sara Thorne[2], Carl Nesbitt[2], Nathan Robison[2], Terry Munson[2]

Editors: Tim Arnold, Avrey Callis, Robert Ghiglieri, Simon Jowitt, and Lucia Patterson

Illustrations by: Lucia Patterson

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01 EXECUTIVE SUMMARY

The Nevada Mining Association and the Nevada Division of Minerals commissioned Convergent Mining, LLC to conduct a study focused on copper processing in Nevada. The purpose of the study was to identify existing and potential copper resources and to evaluate both current and prospective processing infrastructure. This analysis was conducted within the broader objective of supporting the development of a closed-loop domestic supply chain for refined copper in the United States (U.S.), while assessing the opportunities and challenges associated with resource development and processing capacity in the state.

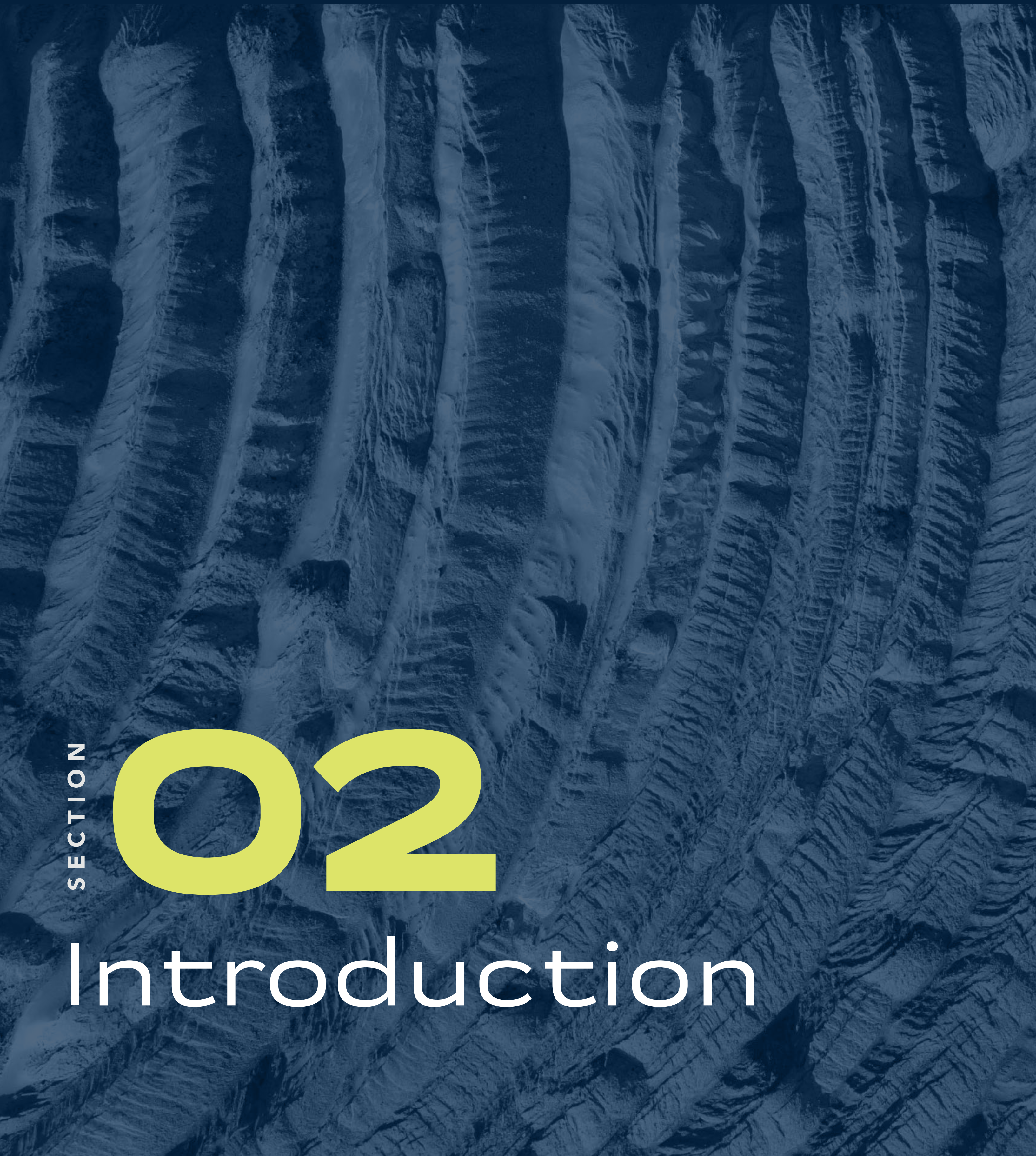
The study found that copper resources in Nevada are geologically and geographically limited to specific copper producing districts. Given these constraints and the current and projected scale of production, available orebodies are unlikely to support a centralized copper processing facility without sourcing additional concentrate from nearby western states, such as Arizona, which both processes concentrate internally and exports large volumes for processing abroad. While regional infrastructure exists, most processing facilities, whether active or inactive, are tied to individual mining projects. Full cycle copper processing capacity in the U.S. remains limited, with only two operating smelters. As a result, between 300 and 400 Kt of copper in concentrate is exported, and new mine operations lack domestic options for processing sulfide ore concentrate.

Potential sites for processing facilities in Nevada were examined in greater detail due to this national capacity gap. The assessment builds upon findings from Nevada Division of Minerals and Nevada Bureau of Mines and Geology Report 057 and updates them to reflect current production trends, resource estimates, and infrastructure access, including transportation and energy availability. Nevada continues to offer a favorable permitting environment for mining and industrial processing projects, particularly on private lands and in regions with minimal air quality constraints with suitable infrastructure. The state also maintains a favorable tax structure that incentivizes investment in large infrastructure projects through programs administered by state agencies such as the Governor's Office of Economic Development (GOED).

As of this writing, there is a strong federal focus on strengthening domestic supply chains for critical raw materials, such as copper, within the U.S. A series of executive orders issued by both current and past presidential administrations have promoted the analysis of and investment in projects that enhance supply chain resilience. Executive orders issued in 2025 have further elevated the visibility of these initiatives and are expected to create an investment climate that benefits from both federal programs and private capital.

This focus on domestic supply chains is critical given the global collapse of treatment and refining charges, driven by China's overcapacity and subsidization of processing facilities. The collapse is threatening to shutter facilities worldwide that are unsubsidized or less efficient, which could result in China controlling an even larger share of global refined copper production. Current conversion rates for copper concentrate processing and refining are unsustainably low, with Asian smelters operating at a loss to maintain feedstock. This presents a unique opportunity for a new facility to fill the production gap likely to emerge from global closures prompted by the market pressures imposed by Asian copper processors.

While Nevada presents a supportive geographic, tax, regulatory and geological setting for copper processing facility development, project viability will be strongly influenced by federal prioritization, the availability of investment capital, and efforts to streamline permitting processes. Globally, the economics remain complex due to existing Asian excess smelting and refining capacity, which places pressure on the competitiveness of new domestic facilities.



SECTION

02 Introduction

02 INTRODUCTION

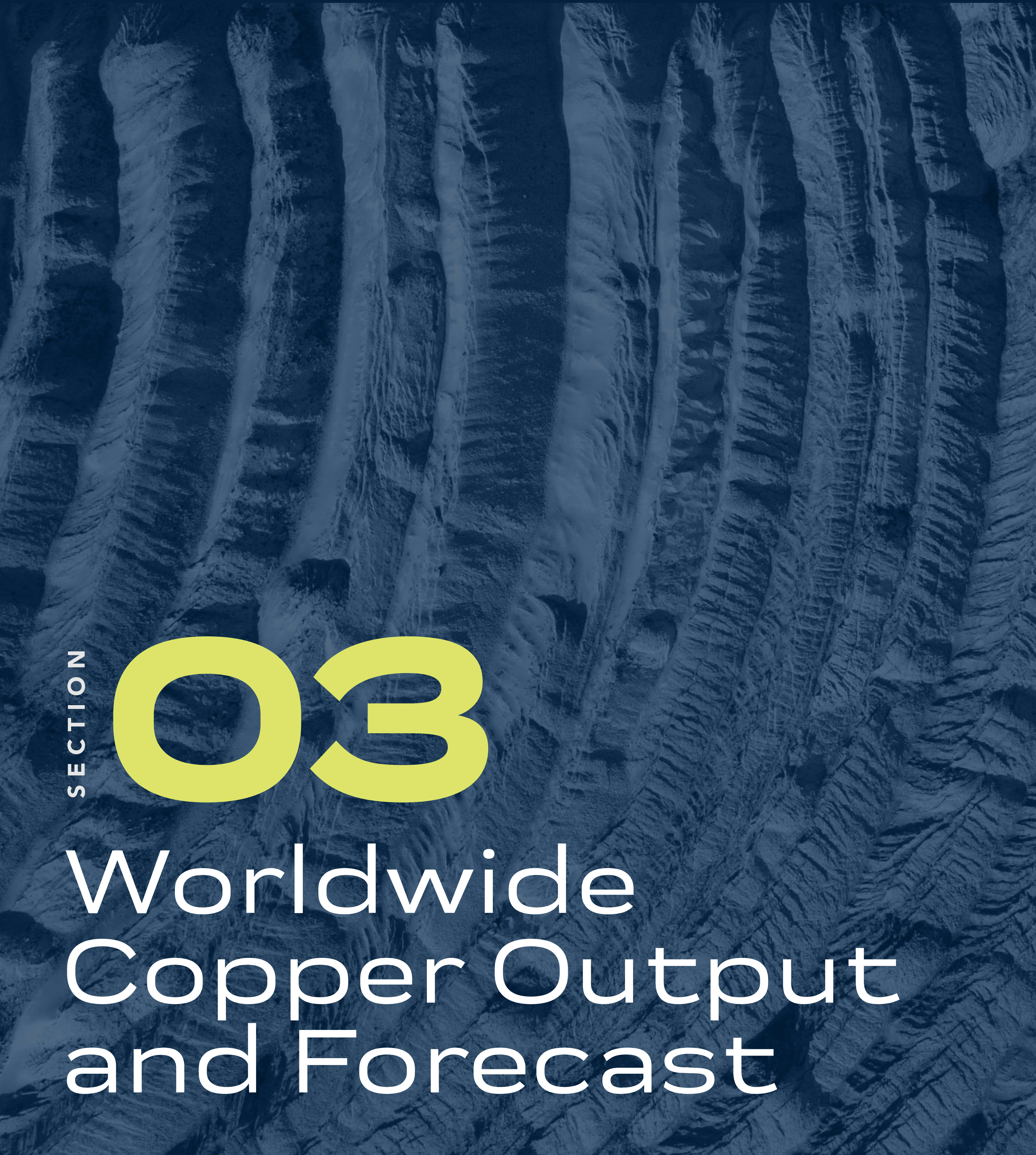
In 2025, the Nevada Mining Association (NvMA) and the Nevada Division of Minerals (NDOM) commissioned Convergent Mining, LLC, along with its subconsultants, to conduct a comprehensive evaluation of the copper industry in Nevada. The scope of the study spans the full copper production cycle, from in-ground ore extraction to refined copper suitable for wire production and other industrial uses, with a focus on assessing the feasibility of developing copper processing facilities within the state.

This work builds upon the foundation established by the 2018 NDOM and NBMG Report 057, *Opportunities for Precious Metals Toll Processing and Copper Concentrate Processing in Nevada*, and incorporates updated analysis and data from the March 21, 2025 publication *Pathfinder Liberty Smelter: An Analysis of Strategic and Financial Considerations*. These sources provide context and continuity for the current evaluation.

Nevada is rapidly emerging as a key player in the exploration and development of critical minerals essential to National Defense, modern technologies, and the energy transition. The state hosts a wide range of critical mineral resources with active operations and exploration efforts concentrated primarily on gold, silver, copper, lithium, barite, magnesium, vanadium, and Tungsten. Historically Nevada also produced zinc, antimony, uranium, manganese, and other critical minerals with 60% of Nevada's Historic Mining districts having past production of critical minerals. Over the past three decades, Nevada has consistently produced more than 70% of the U.S. gold production and often would rank in the top 5 in the world for gold production. In addition to current activity, there is significant potential for future development using modern exploration and by reviewing historic mining districts and past operations. Just as the same for copper, any critical mineral development will be limited by milling and processing infrastructure. However, Nevada has multiple companies currently developing e-waste and other recycling facilities with goals of recovering over 95% of critical minerals such as lithium, nickel, cobalt, manganese, and copper.

This study focuses on copper and reflects contributions from professionals across a broad spectrum of the mining industry, including academic researchers, consultants, and individuals with direct experience in permitting, surveying, and financial operations for mining companies. It is intended to serve as an objective resource for private enterprises, government agencies, non-governmental organizations, and members of the public interested in the future of copper mining and beneficiation in Nevada and neighboring states with relevant supporting infrastructure.

To support the findings, accompanying maps and figures present existing infrastructure,and identified resources, for consideration concerning the siting of copper ore and concentrate processing facilities. Additionally, the study considers federal initiatives such as existing tax incentives and the FAST-41 program, highlighted by the Executive Order on Immediate Measures to Increase American Mineral Production. Projects designated under FAST-41 benefit from enhanced federal coordination and permitting transparency via the Federal Permitting Dashboard, reflecting their importance to national mineral supply chain resilience.



SECTION

03

Worldwide Copper Output and Forecast

03 WORLDWIDE COPPER OUTPUT AND FORECAST

SUMMARY

Section 3 provides an overview of global copper need, production, refining, and supply chain dynamics in 2023–2024. The U.S. ranks fifth globally in copper production, with Arizona accounting for most domestic output. However, the U.S. remains heavily reliant on imports of refined copper due to limited domestic smelting capacity.

Globally, Chile, the Democratic Republic of the Congo (DRC), Peru, China, and Indonesia dominate mine production, with China leading in refining, accounting for nearly half of global output. Refining is highly concentrated in a few countries, especially China, creating vulnerabilities in the U.S. domestic supply chain. China's dominance is reinforced by their strategic overseas investments and modernized smelting technology. The U.S. has only two operating primary smelters, with efforts underway to restart a third in Arizona to improve self-sufficiency.

The copper supply chain, from mining and concentration to smelting, refining, and fabrication, is complex and faces numerous challenges. Key bottlenecks include the geographic concentration of production in Chile and Peru, a global shortfall in refining capacity (particularly outside China), declining ore grades, aging infrastructure, permitting delays, logistical constraints, and political instability in key producing nations such as the DRC and Peru.

The global smelting industry is under pressure from overcapacity in China, declining treatment charges, economic strain on unsubsidized facilities worldwide, and aging infrastructure, as illustrated by mechanical failures at facilities like Glencore's Altonorte smelter in Chile, which led to an unplanned shutdown. These trends highlight the urgent need for investment in diversified production, modernized processing infrastructure, and secure supply chains.

3.1 GLOBAL AND DOMESTIC COPPER DEMAND

The copper market is in a period of dynamic change, defined by historic price volatility, geopolitical realignments, and a widening gap between supply and demand. According to the U.S. Geological Survey's *Mineral Commodity Summaries 2024*, copper remains a vital metal for modern technologies, underpinning clean energy infrastructure, advanced electronics, and military applications. In 2024, the U.S. consumed approximately 1.6 million metric tons (Mt) of refined copper, maintaining its position as the world's second-largest consumer after China (U.S. Geological Survey, 2025). While prices for other critical minerals like lithium and nickel plummeted in 2023, copper reached a record $11,460 per metric ton on the London Metal Exchange (LME) in May 2024 (London Metal Exchange, 2024). This surge reflects a perfect storm of structural demand growth and constrained supply, with Charles (2025) warning of a 30% global shortfall by 2035 if production fails to accelerate.

Copper's rally stems from its irreplaceable role in two transformative sectors: renewable energy and artificial intelligence. Electric vehicles (EVs) require roughly 2.5 times more copper than internal combustion engines, while solar farms demand 5 tonnes per megawatt of installed capacity (International Energy Agency, 2021). The International Energy Agency (IEA) estimates that achieving net-zero targets by 2050 will require annual copper production to double by 2035, but current mining projects and recycling rates fall short (International Energy Agency, 2023). Compounding this pressure is the AI boom, with data centers projected to add 1 Mt to annual copper demand by 2030, equivalent to 4% of 2023's global consumption (McKinsey & Company, 2024). Each AI server rack alone consumes up to 165 pounds of copper for power and cooling systems (McKinsey & Company, 2024).

3.2 CURRENT NEED, PRODUCERS, AND PROCESSORS

The U.S. is the fifth-largest copper producer globally, with the seventh-largest reserves and second-largest resources (U.S. Geological Survey, 2025; Mudd & Jowitt, 2018). In 2024, U.S. mines produced approximately 1.1 million tonnes (Mt) of recoverable copper

Table 1 2024 Copper Production, Reserves, and Refining by Country

2024 PRODUCTION, RESERVES, AND REFINING BY COUNTRY			
COUNTRY	**RESERVES TONNES (000S)**	**PRODUCTION TONNES (000S)**	**REFINING CAPACITY TONNES (000'S)**
Chile	190,000	5,300	2,080
DRC	80,000	3,300	2,170
Peru	100,000	2,600	400
China	41,000	1,800	12,000
United States	48,000	1,100	850
Indonesia	21,000	1,100	225

(U.S. Geological Survey, 2025). Arizona leads U.S. copper production with about 70% of output, or 770,000 tonnes, followed by Utah at 15.5% or about 170,000 tonnes; other states, including Nevada, contributed smaller amounts (U.S. Geological Survey, 2024). Despite yearly fluctuations in the global market, U.S. output has remained relatively stable between 1.1 and 1.3 Mt. Due to limited refining capacity, the U.S. imported about 890,000 tonnes of refined copper on top of the 850,000 tonnes of copper refined domestically in 2023 to meet demand (International Trade Administration, 2024).

Based on the USGS Mineral Commodity Summaries for copper, the largest non-U.S. copper-producing countries were:

Chile: 5.3 Mt
Chile is the world's largest copper producer with about 23% of global output and holds the largest copper reserves. Chile's copper reserves were estimated at 190 Mt at the end of 2023, and mine production totaled 5.25 Mt. The top producers include state-owned Codelco, which produced 1.42 Mt in 2023, and large private operators such as BHP at Escondida ~1.2 Mt. Chile's refinery capacity stood at 2.08 Mt in 2023, primarily in smelters at Chuquicamata and Ventanas.

DRC: 3.3 Mt
DRC is the second-largest miner, having overtaken Peru in 2023 for total output, with reserves of 80 Mt and production of 2.93 Mt in 2023. Major operations include Kamoa-Kakula (Ivanhoe Mines) and Tenke Fungurume (Glencore). The DRC's refining capacity is limited ~2.17 Mt in 2023, so most concentrate is exported, primarily to China, for smelting and refining.

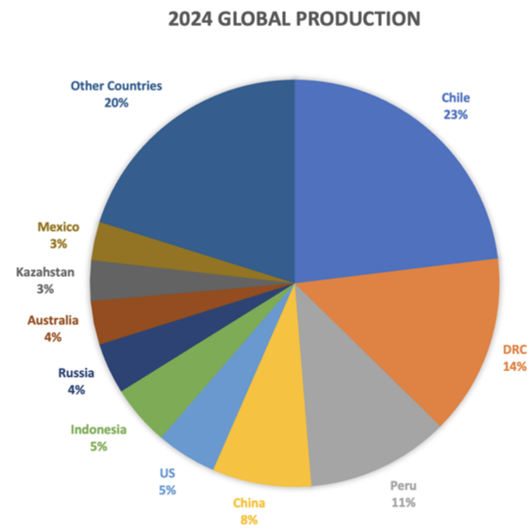
Peru: 2.6 Mt
Peru ranks third and remains the top exporter, with 100 Mt of reserves and recorded mine production of 2.6 Mt in 2023. Leading producers include Cerro Verde ~0.50 Mt and Antamina ~0.45 Mt. Peru's refinery output is modest at 0.40 Mt, so it exports the bulk of its concentrate ~2.95 Mt in 2023 to smelters in Asia and Europe.

China: 1.8 Mt
China is the fourth-largest miner and the world's largest refiner, with reserves of 41 Mt and mine production of 1.82 Mt in 2023. China dominates global refining, with 12.0 Mt of refinery capacity processing both domestic concentrate and large imports from Latin America. Major refining hubs are in Jiangxi and Yunnan provinces, operated by firms such as Jiangxi Copper.

Indonesia: 1.1 Mt
Indonesia is tied for the fifth-largest miner with the U.S. with reserves of 21 Mt. Mine production reached 0.907 Mt in 2023, with 2024 output projected to rise to 1.10 Mt. The flagship Grasberg complex (Freeport-McMoRan & Indonesian government) which accounts for roughly half of the nation's copper output. Indonesia's refining capacity is limited ~0.225 Mt in 2023, and most concentrate is exported to Chinese smelters.

Table 2 2024 Global Copper Production

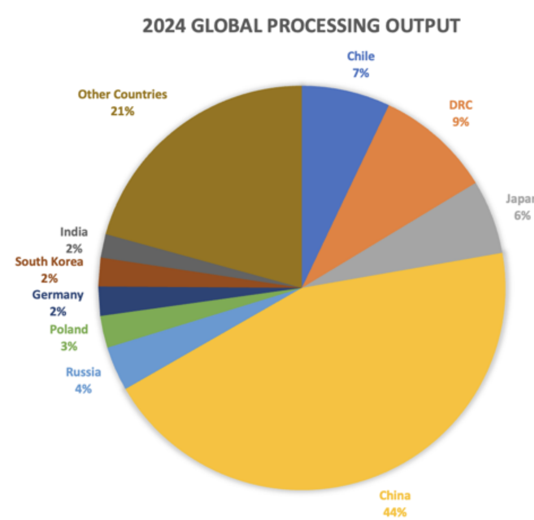
2024 GLOBAL COPPER PRODUCTION		
COUNTRY	PRODUCTION (MT)	% GLOBAL TOTAL
Chile	5.30	23.04%
DRC	3.30	14.35%
Peru	2.60	11.30%
China	1.80	7.83%
US	1.10	4.78%
Indonesia	1.10	4.78%
Russia	0.93	4.04%
Australia	0.80	3.48%
Kazahstan	0.74	3.22%
Mexico	0.70	3.04%
Other Countries	4.63	20.13%
Sum	23.00	100.00%



3.3 REFINING & PROCESSING HUBS

Table 3 2024 Global Copper Processing Output

2024 GLOBAL COPPER PROCESSING OUTPUT		
COUNTRY	REFINED COPPER (MT)	% GLOBAL TOTAL
Chile	1.90	7.57%
DRC	2.50	9.96%
Japan	1.60	6.37%
China	12.00	47.81%
Russia	0.96	3.82%
Poland	0.69	2.75%
Germany	0.63	2.51%
South Korea	0.62	2.47%
India	0.51	2.03%
Other Countries	5.59	22.27%
Total	25.10	100.00%



In 2024, refining capacity exceeded 27 Mt of cathode production, with several countries processing more than 0.5 Mt annually (U.S. Geological Survey, 2025).

The sum of the top 5 refining countries, excluding the U.S., account for 74% of global refined copper production.

Major smelting complexes are located in China (Jiangxi's Dexing smelting complex), DRC (Ivanhoe Mines and Zijin's Kamoa-Kakula complex - currently under construction), Chile (e.g., ENAMI's Chuquicamata smelter), Japan (Pan Pacific Copper), and India (Hindalco's Dahej complex).

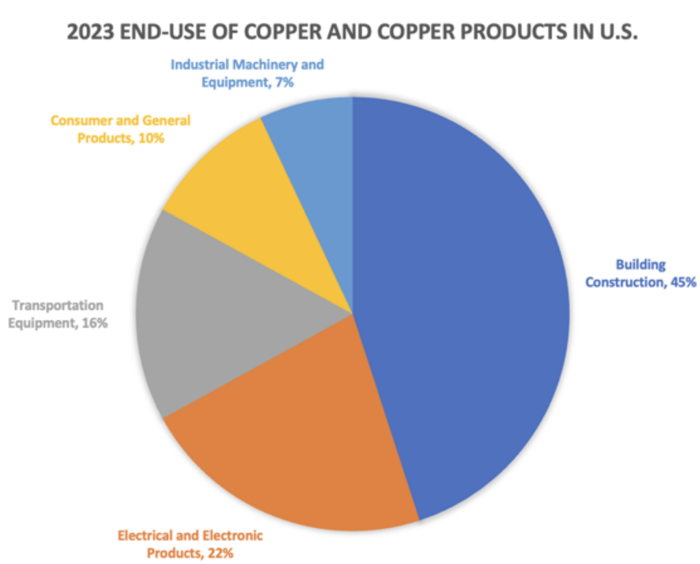
3.4 SUPPLY- CHAIN OVERVIEW

Stages of the Copper Supply Chain

1. Mining & Concentration: Copper ore is mined from both open-pit and underground operations around the world. Ore is blasted, loaded into trucks, and hauled to minesite facilities for initial ore processing. Copper ore is often low-grade (rock that generally contains less than 0.3% copper), and large volumes must be moved to extract meaningful quantities.
2. Ore Processing (Milling and Concentrating): Mined ore, especially sulfide ore types (see Section 5), is crushed and ground into fine particles, then processed using froth flotation to create a concentrated product. This copper concentrate typically contains 20–30% copper, along with valuable byproducts like gold, silver, and molybdenum. Concentrating reduces transport costs and prepares the material for smelting.
3. Smelting: Copper concentrate is smelted in specialized furnaces to remove sulfur and iron, producing "blister copper" or matte. Smelting is energy-intensive and emits sulfur dioxide, subjecting smelters to strict environmental regulations. Many countries lack sufficient domestic smelting capacity, including the U.S., leading to the export of concentrates for processing elsewhere.
4. Refining: Blister copper is purified at refineries through electrorefining, producing 99.99% pure copper cathodes, the standard form sold on the market. In many cases, refined production does not meet national demand, creating opportunities for expansion or increasing copper imports to meet demand.
5. Solution Extraction - Electrowinning (SX-EW): In parallel with smelting, many operations use hydrometallurgy for oxide or low-grade ores. Copper is leached from ore using acid, extracted with solvents, and then plated onto cathodes via electrowinning. This method bypasses smelting, has lower emissions, and is widely used in places like Chile, Peru, the U.S., and parts of Africa. Emerging technologies such as Rio Tinto's Nuton could replace the traditional method of concentrating sulfide ore from low grade copper deposits for smelting with heap leaching, similar to the process used for oxide ore. However, it would not be a substitute for concentrate processing of higher grade deposits and would not capture secondary critical minerals, such as tellurium and selenium, which can be recovered during smelting and refining

6. Manufacturing and End-Use: Refined copper cathodes are sent to fabricators and converted into wire, rods, sheets, and tubes. Recycling plays a critical role, often supplying over a third of total copper demand in mature markets.
7. Recycling: In the U.S. and especially in Nevada, the concept of a full commodity loop from exploration to recycling is gaining momentum, supported by the construction and implementation of advanced recycling technology facilities. In 2024, the USGS estimated that 136,000 tonnes of copper scrap were recycled, and approximately 650,000 tonnes of copper were recovered from manufacturing scrap generated during fabricating operations. Refining capacity is needed to process both scrap and recycled materials.

Table 4 End Use of Copper and Copper Products in the U.S.



3.5 KEY BOTTLENECKS

This study identifies several critical bottlenecks that constrain the efficiency, reliability, and scalability of the global copper supply chain. These arise from a combination of geographic concentration, infrastructure limitations, political instability, and market dependencies that make the system increasingly vulnerable to disruption.

3.5.1 Geographical Concentration

One of the most significant issues is the geographical concentration of copper production. More than 34% of the world's mined copper comes from Chile and Peru (U.S. Geological Survey, 2025). The combined production from the top three producers, Chile, the Democratic Republic of the Congo, and Peru, accounts for nearly 50% of global copper output. This dependency on a narrow set of producers creates a fragile supply scenario. Any operational disruption in these countries, such as labor strikes, adverse weather, regulatory delays, or community protests, can ripple through the global market. Disruptions drive up prices and impact availability. The limited number of alternative suppliers capable of quickly scaling production means that net-consuming countries, such as the U.S., are particularly exposed. As a result, diversifying copper production across more jurisdictions, including through domestic or regional development strategies such as the FAST-41 program in the U.S., has become a strategic priority for many nations seeking to secure critical mineral supplies and safeguard the supply chain.

The same concept applies to copper smelting and refining. With China controlling the copper processing market by a significant margin, quickly achieving supply chain diversification is difficult. The Chinese smelting industry, heavily subsidized by the government, is driving global conversion rates down due to significant overcapacity in order to secure a steady supply of copper concentrate for its smelters and refineries.

3.5.2 Refining Capacity Constraints

There is an imbalance between concentrate production and refining capacity. In many producing nations, and particularly in the U.S., Latin America and parts of Africa, local refining infrastructure is limited or nonexistent, forcing producers to export copper concentrates, largely to Asian smelters, rather than higher-value refined metal. This dependence on Chinese smelters can create significant bottlenecks in the supply chain. When Chinese on-boarding of concentrate or unrefined copper slows due to policy shifts, trade restrictions, or weakening market demand, U.S. producers, with only two primary copper smelters currently operating domestically, have a limited ability to control value-added stages of the copper supply chain. These value-added stages include converting copper concentrate to pure copper metal and semi-fabricating the pure copper into intermediate and marketable shapes and products such as copper wire, billets, sheets, and tubes. A drive for increased security of domestic supply chains requires heavy investment in smelting and refining as well as semi-fabricators - the products that are most frequently consumed and used in manufacturing domestically.

3.5.3 Aging Infrastructure & Declining Grades

Another major constraint is the declining quality of copper ore and the aging infrastructure of the world's most productive mines. Operations such as Escondida and Chuquicamata in Chile are now extracting ore with significantly lower copper content. More rock must be mined, crushed, and processed to produce the same amount of metal. This increases water and energy consumption, generates more tailings, and raises the cost of production per tonne. Much of the supporting infrastructure, such as milling circuits, water systems, and electrical equipment is outdated. A reduction in efficiency increases maintenance requirements and downtime. These factors drive up copper prices and highlight the growing importance of new exploration and mine development, modernization of existing operations and facilities, and the adoption of cost-efficient technologies to maintain supply competitiveness. These trends are global in nature, but their effects also have significant impacts in the U.S., where many mines face similar issues.

3.5.4 Environmental & Regulatory Delays

Regulatory and environmental permitting delays are another globally shared constraint. Across jurisdictions, including federal and state-level processes in the U.S., environmental reviews under the National Environmental Policy Act (NEPA), consultations under the Endangered Species Act, and requirements related to stakeholder engagement and water quality often lead to multi-year delays for new mining and processing projects. These regulations serve critical environmental and social purposes; however, the lack of coordination, limited agency staffing, and litigation risks can significantly slow the pace of responsible domestic development. Proposed projects with high strategic value, such as Resolution in Arizona, have faced years-long permitting timelines or stalled approvals due to permitting related delays. The regulatory complexities found in the U.S., Australia, and Canada involve advanced and comprehensive permitting processes that ensure proper environmental protections but can also cause significant delays in project development. The length of these processes puts these countries at a disadvantage compared to the permitting procedures in Asia and Africa.

3.5.5 Logistics & Transport

Transport and logistics present additional vulnerabilities. In South America, limited port infrastructure and aging rail networks can create chokepoints in moving concentrates from mines to global markets. Freight rate volatility, extreme weather events, and congestion at major shipping lanes compound the issue. The closure or underutilization of domestic smelters also creates inefficiencies, as concentrate must often travel long distances, often overseas, before it can be processed. In the U.S., while infrastructure is comparatively advanced, the country still faces challenges in ensuring reliable rail and port access for new mining regions, particularly in the western states. There is currently no economically competitive port in the Western U.S. for copper concentrate exports. Some producers, like Robinson, are shifting shipments from the Port of Vancouver to Guaymas, Mexico, due to new requirements mandating the use of rotainers. This change would require major capital investments in infrastructure and equipment. Although alternative engineering solutions exist to control fugitive dust during vessel loading, the Port of Vancouver has indicated that rotainers are the only acceptable method, limiting flexibility and increasing costs.

3.5.6 Political & Social Risks

Political and social instability remains a major concern in several rapidly growing copper producing countries. Nations such as the DRC and Zambia have experienced recurring disruptions due to regulatory uncertainty, local protests, labor disputes, and changes in mining policy. Another example is the Cobre Panama copper mine, which was closed in 2022 after negotiations broke down between the Panamanian government and the operator. In 2023, the Panamanian Supreme Court ruled the mine's recent operating contract unconstitutional, despite the mining company having received the original permits back in 1997. These risks deter foreign investment and highlight the importance of good governance, community engagement, and stable legal frameworks for securing long term copper supply. For the U.S., developing alternative sources of supply, either within the country or through partnerships with trusted allies, can help reduce reliance on politically unstable regions.

The trade tensions with China in 2025 have emphasized China's dominance in the copper processing market and highlighted the U.S.' dependence on foreign smelting, refining, and partial manufacturing of copper. Beyond its leading position at home, China has expanded aggressively abroad, investing over $10 billion in mining and processing infrastructure across the DRC, including smelters and export corridors that now move most of the Congolese refined copper eastward. In Peru, Chinese firms control more than 30 percent of national copper production through stakes in major mines such as Las Bambas and Toromocho. In Chile, long term offtake agreements and infrastructure partnerships have deepened Beijing's influence in the Andean copper region, reinforcing its control over both supply and midstream processing on a global scale.

3.5.7 Siting for New Processing Facility

Traditionally copper smelting and refining were generally located near the mine site to increase efficacies and save transportation costs. However, if that mine's production stopped, permanently or temporarily, or the mine performed a layback where copper concentrate feedback was delayed, the processing operations economics would faulter or fail. The concept of a new processing facility with the U.S. would need to facilitate the offtake of copper concentrate from multiple operations to better absorb the fluctuation of individual mine production. Ensuring proper infrastructure for the transportation of copper concentrate, environmental permitting (both covered in Section 6), and a consistent supply of copper concentrate feedstock from regional operations all play a vital role in the siting of a smelting facility.

3.6 GLOBAL COPPER CONCENTRATE PROCESSING

As of 2024, global copper smelting and refining production has held steady at approximately 27 Mt, maintaining the record high set in 2023 and representing a 4% increase over 2022 (USGS, 2025).

China remains the dominant player in the copper smelting industry, accounting for over half of the world's total smelting capacity and 49% of global output of refined copper.

Since 2000, China has accounted for 75% of all global smelter capacity growth.

In 2024, China's smelting capacity was estimated at 14.26 Mt, with projections indicating growth to 16 Mt in 2025 and nearly 17 Mt by 2027 (Wood Mackenzie, 2024). China dominates the copper supply chain, accounting for nearly half of the $55 billion invested in new copper mine development in overseas projects (Wood Mackenzie, 2024). It has significantly expanded its fabrication capacity, adding nearly 11 Mt of copper and alloy capacity, which represents 80% of global growth in this sector (Wood Mackenzie, 2024).

Despite this expansion, the global copper smelting sector faces challenges. In the first half of 2024, an average of 16.1% of global smelter capacity was inactive, a significant increase compared to previous years (Earth-i, 2024). This inactivity is attributed to factors such as maintenance shutdowns and tight copper concentrate supply, which have led to reduced utilization rates. Without a consistent concentrate supply, a smelter cannot run efficiently.

The rapid growth in smelting capacity, particularly in China, has also led to a decrease in treatment and refining charges, impacting the profitability of smelters worldwide. As a result, some smelters have curtailed operations or undergone maintenance to manage the oversupply and maintain market stability. This creates challenges for existing facilities, as capacity expansions through retrofitting require extended downtime and substantial capital investment. During these periods, domestic operators often export greater volumes of concentrate for overseas processing, further diminishing the domestic supply of refined copper. Meanwhile, idle smelters continue to incur significant costs without generating revenue, compounding the financial strain on operators. In a change from previous Chinese state-owned enterprise goals of economic growth over profitability, China has modernized its smelters by replacing outdated furnaces with cost efficient, environmentally advanced technologies such as Shuikoushan (SKS), side-blown furnaces, and flash smelting.

Despite the volume of domestic production, the U.S. faces significant challenges in copper smelting capacity. Currently, there are only two primary copper smelters in operation: Freeport-McMoRan's Miami smelter in Arizona and Rio Tinto's Kennecott smelter in Utah.

This limited capacity has led to a reliance on exports; in 2024, the U.S. exported 320,000 tonnes of domestically mined copper ore and concentrate to other countries for refining.

Currently, any new domestic operation that produces copper concentrate would need to find a smelter outside of North America. Additionally, Mexico's two functioning smelters are operating at capacity, resulting in Mexican operations exporting 1.5 Mt of copper ores and concentrates—over 93% of which is sent to smelters and refineries in China as of 2022 (World Bank, 2022). Canada has one functioning smelter operating at capacity, leading Canadian operations to export 0.414 Mt of concentrate—over 35% of which goes to smelters and refineries in China as of 2023 (World Bank, 2023).

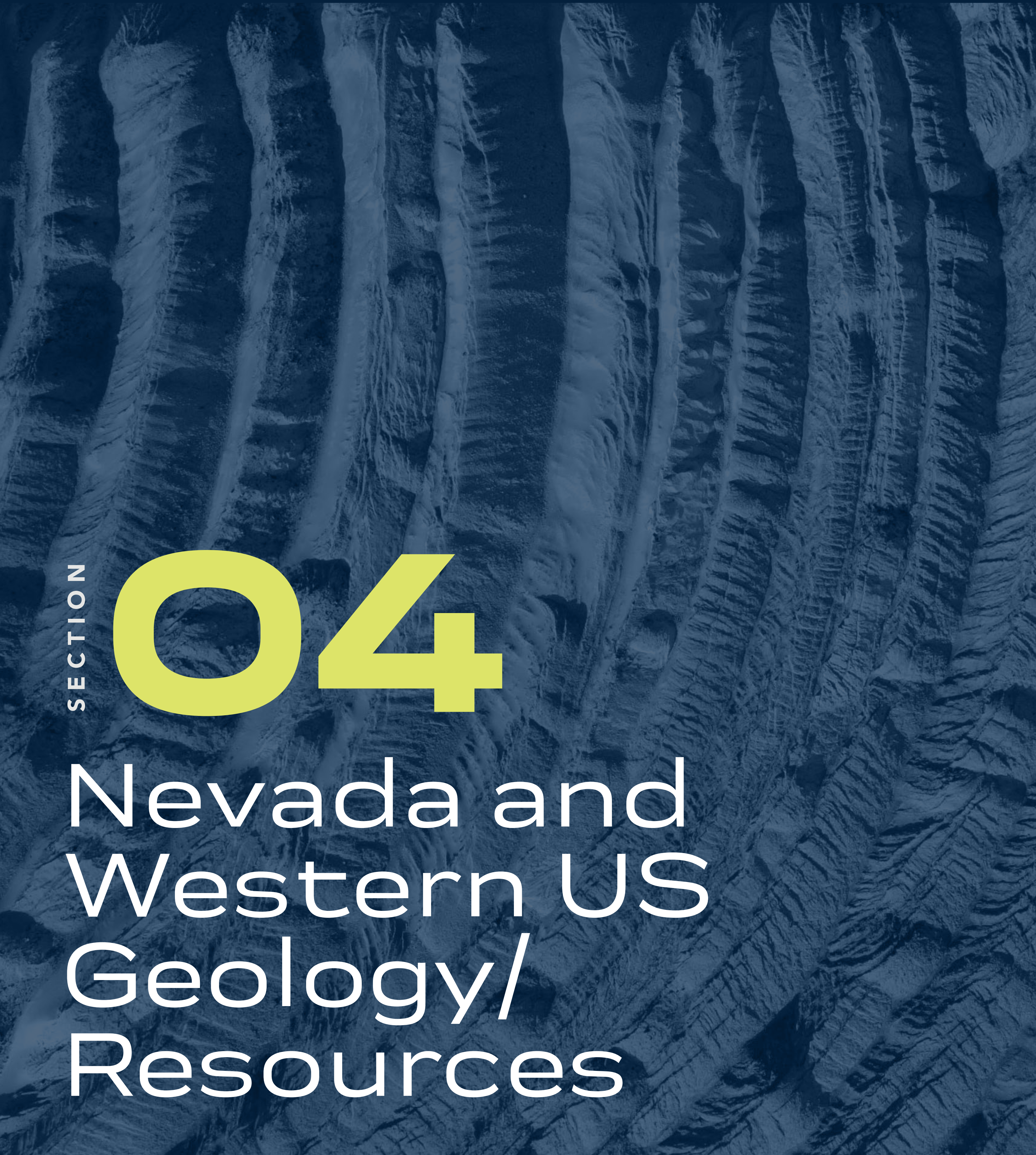
Efforts are underway to address these challenges. Grupo Mexico's ASARCO plans to restart its Hayden smelter in Arizona, which has been inactive for over four years. However, the capacity added by Hayden is insufficient to address the oversupply of concentrate in the U.S. and would add only a limited capacity of around 0.15 Mt of copper annually (Reuters, 2024).

3.7 OTHER GLOBAL DEVELOPMENTS

Glencore's smelter in Australia has approached both the Queensland and Australian federal governments for support due to challenges threatening the viability of its Mount Isa copper smelter. The smelter is facing the loss of feedstock from local Mount Isa copper mines, which have historically supplied a critical portion of its input material. More importantly, a dramatic decline in treatment and refining charges (TCRCs), the sharpest drop in 25 years, has significantly reduced profitability. This pricing pressure is intensified by international competition, as smelters in China and Indonesia benefit from government subsidies, highlighting the additional strain on unsubsidized operations in Australia and the U.S.

Another global note on smelting comes from Glencore's halt of the Altonorte Smelter in Chile in March 2025 due to technical complications with the facility's primary furnace. The Altonorte smelter, with an annual capacity of 349,000 tonnes, is a significant facility in Chile's copper production chain. This shutdown has exacerbated the global supply constraints of copper during a period of high copper demand.

The sharp decline in profitability due to the drop in treatment charges driven by China's processing overcapacity, as well as intense competition for raw materials, has put the global copper processing and refining industry into significant economic headwinds.



SECTION

04

Nevada and Western US Geology/ Resources

04 NEVADA AND WESTERN US GEOLOGY/RESOURCES

This study is focused on Nevada and surrounding states. Mining and mineral production starts with geologic resources, and this section presents existing operations and known resources, whether developed or potential.

SUMMARY

Section 4 examines copper resources and processing infrastructure in Nevada and the broader Western U.S., providing a foundation for evaluating domestic concentrate supply potential. It catalogs existing copper processing facilities in Nevada, including concentrators, dump leach operations, and mills, alongside a comprehensive overview of sulfide and oxide copper resources. The section also profiles historic, active, and potential copper projects in neighboring states, highlighting major contributors to current and future concentrate production. Export routes, logistics, and associated costs are analyzed, revealing significant reliance on overseas smelters. The analysis discusses treatment and refining charges (TCRCs), with a focus on recent volatility caused by global smelting overcapacity. The growing volume of Western U.S. concentrate supports the strategic case for domestic smelter development to enhance supply chain resilience, reduce export and logistics costs, and align with energy transition objectives.

4.1 EXISTING COPPER ORE PROCESSING FACILITIES IN NEVADA

4.1.1 Methodology

Report 057 included an inventory of precious metal and copper ore processing facilities in Nevada. The precious metals information from Report 057 is omitted from this study, except to include mine locations that are illustrated in figures to show the context of complimentary facilities (similar infrastructure and access use). Copper facilities and data have been updated and expended based on Report 057.

All reports rely on company websites, company annual reports, company regulatory filings, NI 43-101 technical reports, publications from the Nevada Bureau of Mines and Geology, and other sources. Additionally, conversations, whenever possible, with representatives of the operating companies to verify or put context to public information have been performed. Refer to references for additional information.

4.1.2 Data Analysis

Flotation concentrator and copper processing facilities are presented in Table 5.

Figure 12 interprets major infrastructure, including highways, railways, gas pipelines, and power transmission lines that would be required to support energy-intensive industrial activities such as copper smelting

4.1.3 Nevada Processing Facility Summaries

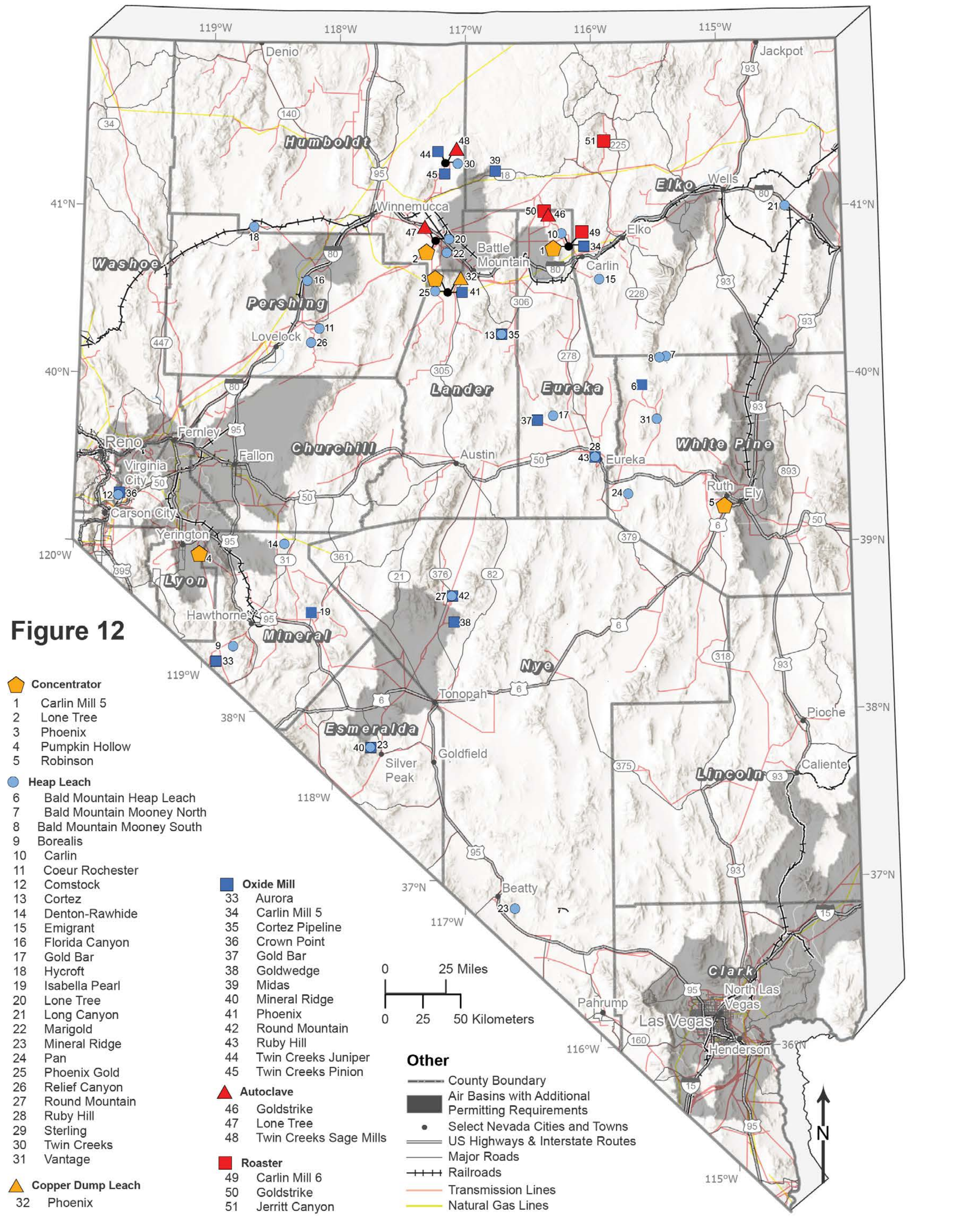
The following summarizes the copper processing facilities detailed in Table 5 and illustrated in Figure 12. Autoclave mills, including Carlin Mill 5 and Lone Tree, are included in this report because autoclave technology can process copper concentrates from sulfide operations as well as gold (see Section 5). While these mills are or will be operating at capacity with gold mine feedstock, the technology is relevant to copper extraction and is therefore incorporated into this report.

Carlin Mill 5

Nevada Gold Mines operates Carlin Mill 5, which is located on the Carlin Mine Complex just north of the town of Carlin in Eureka County. The mill

Table 5 Concentrators and Copper Processing Facilities in Nevada

CONCENTRATORS AND COPPER PROCESSING FACILITIES IN NEVADA					
FACILITY NAME	OWNER/ OPERATOR	MINE	CAPACITY, (TONNES/DAY)	OPERATING	COUNTY
Carlin Mill 5 (Gold Concentrator)	Nevada Gold Mines	Carlin	11,800-15,400	Yes	Eureka
Lone Tree	I-80	Lone Tree	5,400	No	Humboldt
Pumpkin Hollow	Southwest Critical Materials	Pumpkin Hollow	4,500	Yes	Lyon
Phoenix Copper Leach	Nevada Gold Mines	Phoenix	Varies	Yes	Lander
Phoenix Concentrator	Nevada Gold Mines	Phoenix	30,000-34,500	Yes	Lander
Robinson Concentrator	KGHM International, Ltd.	Robinson - Ruth Pit	45,000	Yes	White Pine


Concentrator
1 Carlin Mill 5
2 Lone Tree
3 Phoenix
4 Pumpkin Hollow
5 Robinson
Heap Leach
6 Bald Mountain Heap Leach
7 Bald Mountain Mooney North
8 Bald Mountain Mooney South
9 Borealis
10 Carlin
11 Coeur Rochester
12 Comstock
13 Cortez
14 Denton-Rawhide
15 Emigrant
16 Florida Canyon
17 Gold Bar
18 Hycroft
19 Isabella Pearl
20 Lone Tree
21 Long Canyon
22 Marigold
23 Mineral Ridge
24 Pan
25 Phoenix Gold
26 Relief Canyon
27 Round Mountain
28 Ruby Hill
29 Sterling
30 Twin Creeks
31 Vantage
Copper Dump Leach
32 Phoenix
Oxide Mill
33 Aurora
34 Carlin Mill 5
35 Cortez Pipeline
36 Crown Point
37 Gold Bar
38 Goldwedge
39 Midas
40 Mineral Ridge
41 Phoenix
42 Round Mountain
43 Ruby Hill
44 Twin Creeks Juniper
45 Twin Creeks Pinion
Autoclave
46 Goldstrike
47 Lone Tree
48 Twin Creeks Sage Mills
Roaster
49 Carlin Mill 6
50 Goldstrike
51 Jerritt Canyon
0 25 Miles
0 25 50 Kilometers
Other
County Boundary
Air Basins with Additional Permitting Requirements
Select Nevada Cities and Towns
US Highways & Interstate Routes
Major Roads
Railroads
Transmission Lines
Natural Gas Lines
N
Humboldt
Washoe
Pershing
Elko
Lander
Eureka
Churchill
White Pine
Lyon
Mineral
Nye
Esmeralda
Lincoln
Clark
Winnemucca
Battle Mountain
Carlin
Elko
Wells
Jackpot
Denio
Lovelock
Reno
Fernley
Fallon
Virginia City
Carson City
Yerington
Hawthorne
Austin
Eureka
Ruth
Ely
Tonopah
Goldfield
Silver Peak
Beatty
Pioche
Caliente
Pahrump
Las Vegas
North Las Vegas
Henderson
Figure 12

processes both oxide and refractory ore from the Carlin Mine on a campaign basis. The mill contains circuits for processing oxide ores by cyanidation and for concentrating refractory ores by flotation. Tonnage capacity varies with the character of the feed material from 12,000 to 15,000 tonnes per day. Refractory ore is processed by flotation to produce a gold-bearing pyrite concentrate that is processed in either Carlin Mill 6 or the Twin Creeks Sage Mill.

Lone Tree

Nevada Gold Mines' predecessors operated a flotation concentrator at Lone Tree from 1997 to 2006 in Humboldt County approximately 20 miles (32.2 km) from Battle Mountain. The circuit consists of a semi-autogenous grinding (SAG) mill and ball mill grinding, inert gas flotation, thickeners for concentrate and tailings, and pressure filters for concentrate. The plant produced a gold-bearing sulfide concentrate that was further processed for gold recovery in the Lone Tree Autoclave or off site. The nameplate capacity of the plant was 5,400 tonnes per day. I-80 Gold is currently reinitiating operations at Lone Tree.

Phoenix Copper Dump Leach

Nevada Gold Mines operates a run-of-mine (ROM) copper dump leach at the Phoenix property near Battle Mountain. Run-of-mine ore is stacked on the leach pad where it is irrigated with a dilute acid solution. Solution discharge is processed by solvent extraction to produce a purified and concentrated electrolyte. The electrolyte is transferred to an electrowinning circuit, where the final copper cathode product is produced. Tonnage to the leach pad varies with the mine plan. Cathode production varies from 1 million to 2 million pounds per month.

Phoenix Concentrator

Nevada Gold Mines also operates the Phoenix Mill at the property near Battle Mountain. The mill is both a copper concentrator and a gold cyanidation plant. Tonnage capacity of the mill varies from 27,000 to 36,000 tonnes per day depending on the character of the feed. Ores containing gold, copper, and silver values are processed by crushing, SAG and ball mill grinding, gravity concentration for free gold, flotation to produce concentrate containing copper, gold, and silver, cyanidation and carbon-in-pulp (CIP) on the flotation tailings. Loaded carbon from CIP is processed by desorption and electrowinning, with the gold product from gravity concentration and electrowinning smelted off-site.

Flotation concentrate production varies from 91 to 363 wet tonnes per day depending on ore grade and mineralogy. Annual concentrate production varies from 36,000 to 73,000 wet tonnes. The grade of the concentrate is between 15% and 20% copper and contains impurities that require specialty treatment at a plant such as Glencore's Horne smelter. Concentrate is trucked to a rail siding at Dunphy where it is transloaded into rail cars. A portion of the concentrate is railed to the Horne smelter in Quebec, Canada. The remainder is railed to either the Port of Vancouver, WA, or the Port of Oakland, CA. At the ports, the concentrate is transloaded into ships for transport to smelters in Asia.

Robinson Concentrator

KGHM International, Ltd. owns and operates the Robinson Concentrator located near the town of Ruth in White Pine County, just west of the County seat of Ely. The capacity of the plant is 42,000 tonnes per day. The plant

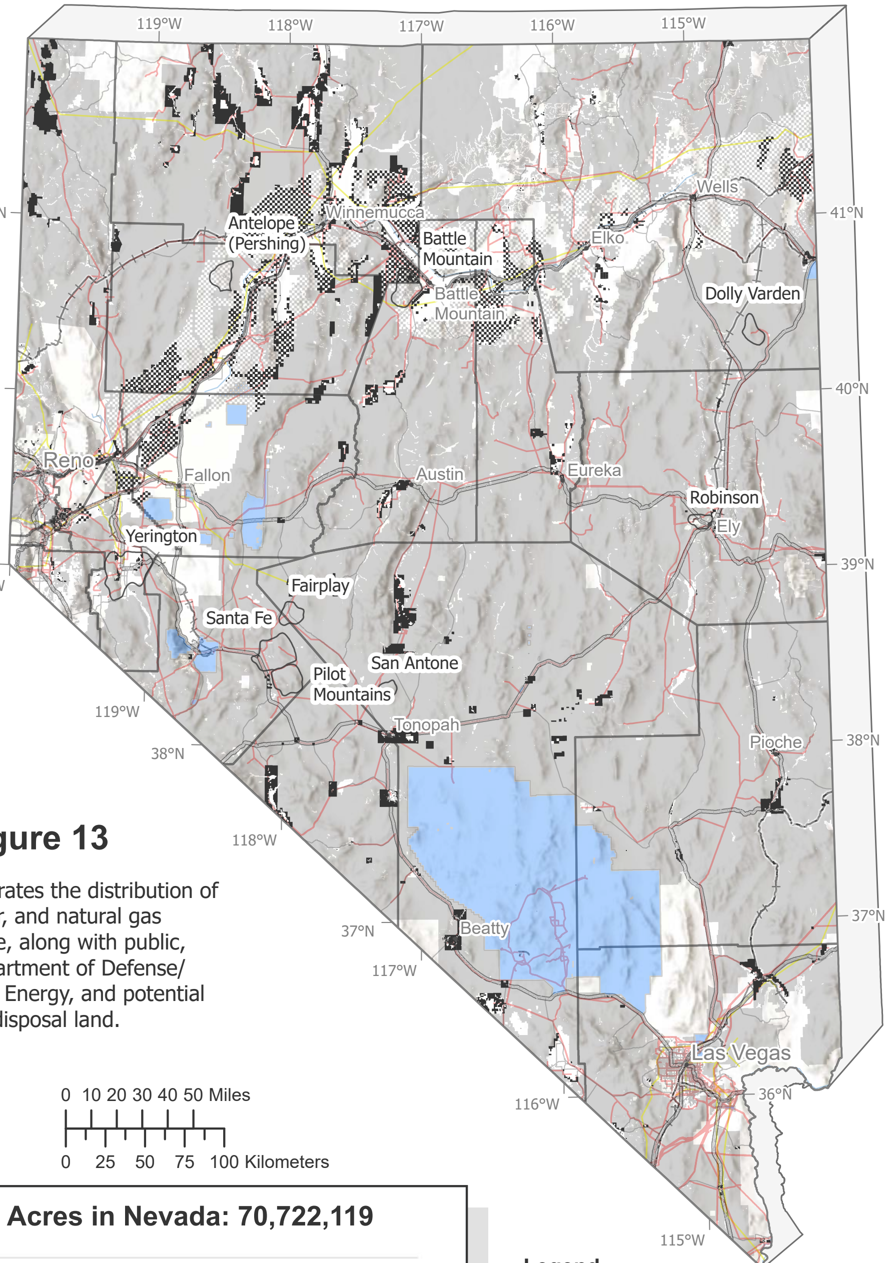


Figure 13

This figure illustrates the distribution of rail, power, and natural gas infrastructure, along with public, private, Department of Defense/ Department of Energy, and potential BLM disposal land.

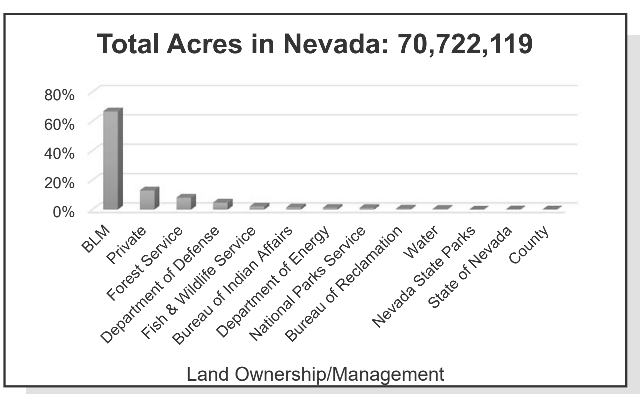


Figure 13 builds on Figure 12 by mapping the broader distribution of infrastructure alongside public, private, Department of Defense/Department of Energy lands, and potential BLM disposal areas.

flowsheet is a conventional copper concentrator comprising crushing, SAG mill and ball mill grinding, followed by flotation to recover copper. The concentrator produces some 272,000 wet tonnes of concentrate per year, grading from 17% to 22% copper on dry basis. Concentrate from Robinson is trucked from the plant to Wendover where it is transloaded into rail cars. A small portion of the concentrate is railed to Kennecott's Garfield smelter in Magna, UT. The majority of the concentrate travels by rail to various Ports in either America or Mexico, where it is transloaded onto ships for transport to Asian smelters.

4.2 NEVADA COPPER SULFIDE RESOURCES

Table 6 presents a list of sulfide copper resources in Nevada, which are typically processed by concentrating sulfide ores using several technologies for delivery to a concentrate processing facility. These resources are the primary focus of this study, and the table includes both operating and known resources.

4.2.1 Yerington District

Mason Project

The Mason Project, located in Lyon County approximately 4 miles (6.4 km) west of Yerington, is owned by Hudbay Minerals. It is a large porphyry copper system with additional values in molybdenum, gold, and silver. Hudbay's Preliminary Economic Assessment proposes development as an open pit mine with a conventional concentrator operating at 120,000 tonnes per day. Average annual production is projected at 248 million pounds of copper over a 27-year mine life, with a concentrate grade of 30% copper and life-of-mine concentrate output of roughly 1,200 wet tonnes per day. Total production would include 6.7 billion pounds of copper, 70.5 million pounds of molybdenum, 696,000 ounces of gold, and 14.6 million ounces of silver. Concentrate is expected to be shipped to Asian smelters at a treatment cost of $80 per tonne, with shipping costs estimated at $120 per wet tonne for copper concentrate and $73 per wet tonne for molybdenum concentrate. The Mason deposit is hosted in Mesozoic intrusive rocks of the Yerington Batholith, with copper occurring primarily as chalcopyrite and bornite, and molybdenum as molybdenite. Average copper grades are approximately 0.29% copper, with feed grades between 0.2% and 0.4% copper.

Blue Hill - Sulfide

The Blue Hill deposit, located about a mile (1.6 km) northwest of the Mason deposit, is also controlled by Hudbay Minerals. While not included in the Mason Project's Preliminary Economic Assessment, Blue Hill is viewed as a potential future development. It contains both oxide and sulfide resources, with conceptual plans suggesting an initial oxide leach, solvent extraction, and electrowinning operation, followed by sulfide processing at the Mason Project mill. Due to its lower grade of approximately 0.17% copper, the Blue Hill deposit would likely be developed after Mason's resources are exhausted. Although insufficient data exists to estimate concentrate production, the deposit could potentially supply future feed to a copper concentrator. Geologically, Blue Hill is part of the same Yerington Batholith as Mason, with copper mineralization occurring primarily as disseminated chalcopyrite and minor bornite, and molybdenite present in small amounts.
The anticipated concentrate grade is similar to Mason at around 28–30% copper, with low levels of deleterious elements and minimal supergene enrichment.

Table 6 Copper Sulfide Resources in Nevada

**Resources are historic and may not be code compliant*

COPPER SULFIDE RESOURCES IN NEVADA					
DEPOSIT NAME	**YEAR**	**TONNES (000)**	**% CU**	**CLASSIFICATION**	**CONTAINED CU POUNDS (000)**
YERINGTON DISTRICT					
Mason Project	2021	2,219,000	0.29%	Measured & Indicated	14,157,220
Mason Project	2021	237,000	0.24%	Inferred	1,137,600
Blue Hill - Sulfide	2017	45,000	0.17%	Inferred	169,524
MacArthur - Sulfide	2022	13,500	0.20%	Measured & Indicated	59,185
MacArthur - Sulfide	2022	8,200	0.204%	Inferred	36,942
Pumpkin Hollow - Open Pit	2019	502,000	0.452%	Measured & Indicated	5,000,000
Pumpkin Hollow - Open Pit	2019	25,000	0.358%	Inferred	197,000
Pumpkin Hollow - U'ground	2019	49,000	1.39%	Measured & Indicated	1,503,000
Pumpkin Hollow - U'ground	2019	27,000	1.09%	Inferred	636,000
Yerington - Sulfide	2023	112,000	0.30%	Measured & Indicated	732,500
Yerington - Sulfide	2023	73,000	0.24%	Inferred	385,938
Subtotal Yerington District		3,310,700	0.33%		24,014,909

COPPER SULFIDE RESOURCES IN NEVADA					
DEPOSIT NAME	**YEAR**	**TONNES (000)**	**% CU**	**CLASSIFICATION**	**CONTAINED CU POUNDS (000)**
OTHER DISTRICTS					
Phoenix	2018	221,000	0.18%	Measured & Indicated	890,000
B and C Springs - Open Pit	2007	96,000	0.07%	Measured & Indicated	144,027
B and C Springs - U'ground	2007	2,600	0.34%	Inferred	19,011
Desert Scheelite	2018	8,200	0.15%	Indicated	13,200
Desert Scheelite	2018	1,500	0.16%	Inferred	2,800
Pathfinder - Liberty	2024	650,000	0.088%	Measured & Indicated	1,254,745
Pathfinder - Liberty	2024	135,000	0.072%	Inferred	215,345
Majuba Hill*	1965	27	3.0%	Unclassified	1,800
New York Canyon - Copper Queen*	1979	129,000	0.35%	Unclassified	996,520
Pine Tree	2011	219,000	0.09%	Measured & Indicated	433,512
Pine Tree	2011	179,000	0.09%	Inferred	354,168
Victoria*	1981	1,200	2.15%	Measured & Indicated	59,125
Robinson	2024	221,342	0.45%	Measured & Indicated	2,191,445
Subtotal Other Districts		1,863,869	0.16%		6,575,698
Grand Total		5,174,569	0.27%		30,590,607

*Resources are historic and may not be code compliant

Mining District	Deposit/Project Name	Year	Tonnes (000)	%Cu	Classification	Contained Cu Pounds (000)
Antelope	Majuba Hill	1965	27	3.00%	Unclassified	1,800
	District Total:		**27**	3.00%		**1,800**
Battle Mountain	Phoenix Mine	2018	221,000	0.18%	M & I	890,000
	District Total:		**221,000**	0.18%		**890,000**
Dolly Varden	Victoria	1981	1,200	2.15%	M & I	59,125
	District Total:		**1,200**	2.15%		**59,125**
Fairplay	B and C Springs - Open Pit	2007	96,000	0.07%	M & I	144,027
Fairplay	B and C Springs - Underground	2007	2,600	0.34%	Inferred	19,011
	District Total:		**98,600**	0.08%		**163,038**
Pilot Mountains	Desert Scheelite	2018	8,200	0.15%	Indicated	13,200
Pilot Mountains	Desert Scheelite	2018	1,500	0.16%	Inferred	2,800
Pilot Mountains	Pine Tree	2011	219,000	0.09%	M & I	433,512
Pilot Mountains	Pine Tree	2011	179,000	0.09%	Inferred	354,168
	District Total:		**407,700**	0.09%		**803,680**
Robinson	Robinson	2014	325,000	0.45%	M & I	3,565,000
	District Total:		**325,000**	0.45%		**3,565,000**
San Antone	Pathfinder - Liberty	2024	650,000	0.09%	M & I	1,254,745
San Antone	Pathfinder - Liberty	2024	135,000	0.07%	Inferred	215,345
	District Total:		**785,000**	0.09%		**1,470,090**
Santa Fe	New York Canyon - Copper Queen	1979	129,000	0.35%	Unclassified	996,520
	District Total:		**129,000**	0.35%		**996,520**
Yerington	Mason Project	2021	2,219,000	0.29%	M & I	14,157,220
Yerington	Mason Project	2021	237,000	0.24%	Inferred	1,137,600
Yerington	Blue Hill - Sulfide	2017	45,000	0.17%	Inferred	169,524
Yerington	MacArthur - Sulfide	2022	13,500	0.20%	M & I	59,185
Yerington	MacArthur - Sulfide	2022	8,200	0.20%	Inferred	36,942
Yerington	Pumpkin Hollow - Open Pit	2019	502,000	0.45%	M & I	5,000,000
Yerington	Pumpkin Hollow - Open Pit	2019	25,000	0.36%	Inferred	197,000
Yerington	Pumpkin Hollow - Underground	2019	49,000	1.39%	M & I	1,503,000
Yerington	Pumpkin Hollow - Underground	2019	27,000	1.09%	Inferred	636,000
Yerington	Yerington - Sulfide	2023	112,000	0.30%	M & I	732,500
Yerington	Yerington - Sulfide	2023	73,000	0.24%	Inferred	385,938
	District Total:		**3,310,700**	**0.33%**		**24,014,909**
		Total All Districts:				**7,949,253**
M & I - Measured and Indicated		**Grand Total:**				**31,964,162**

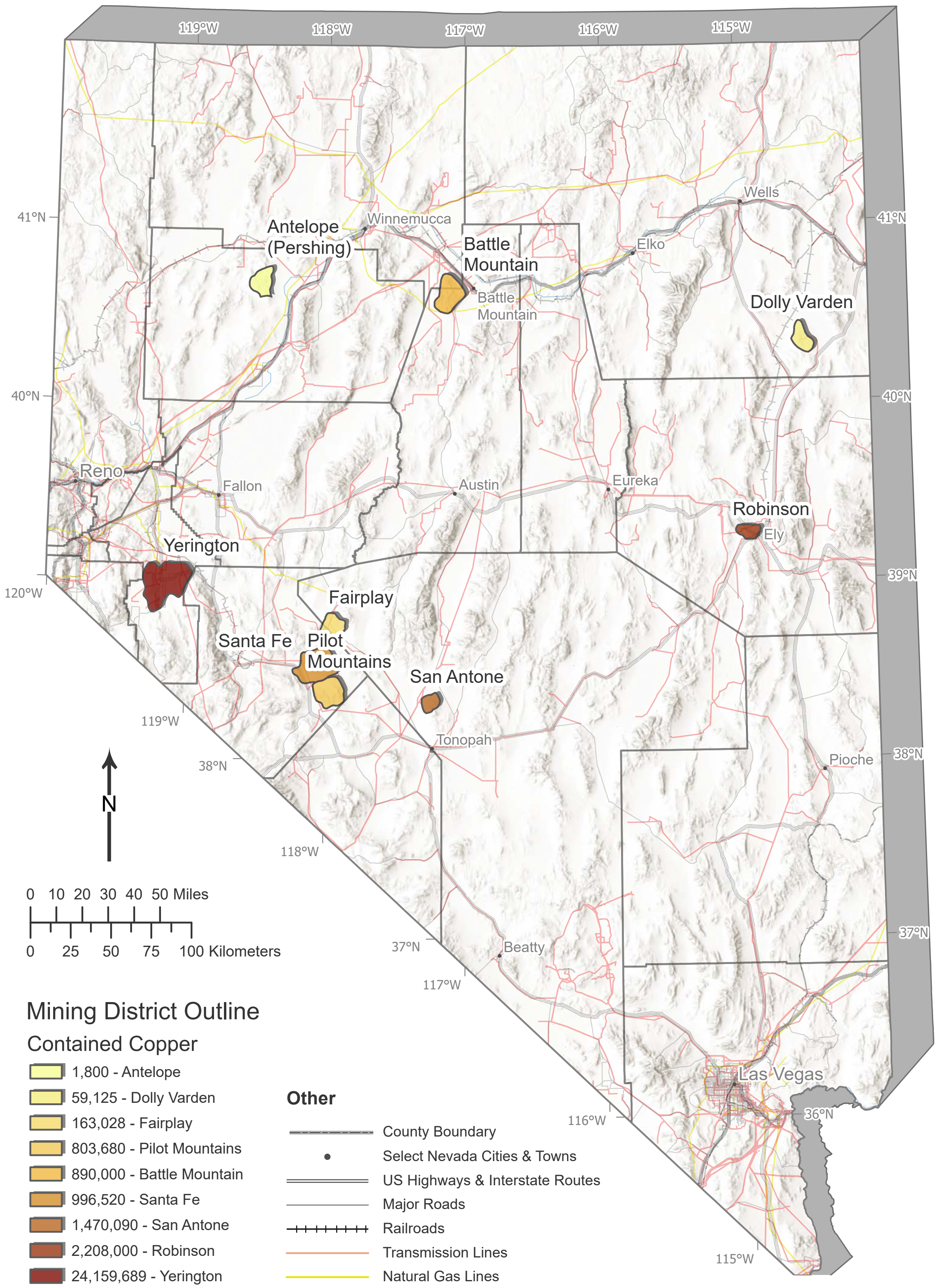


Figure 14 provides a visual summary of Nevada's copper districts, detailing total copper resources and grades within each district.

MacArthur - Sulfide

The MacArthur deposit, owned by Singatse Peak Services LLC (a subsidiary of Lion Copper and Gold Corp.), is part of a large, complex, and only partially defined porphyry system. The current development plan focuses on oxide and mixed-zone leaching, with the proposed installation of a leach pad and solvent extraction/ electrowinning (SX/EW) facility. From 1994 to 1997, Arimetco mined 6.1 million tonnes of oxide ore averaging 0.30% copper from an open pit at MacArthur. In addition to its oxide potential, MacArthur hosts a sizable sulfide resource that could be developed using Rio Tinto's Nuton technology, a novel leaching process that eliminates the need for traditional concentrators, tailings impoundments, and smelters. If Nuton is deployed, the project could directly produce Grade A cathode copper from leach solutions. Alternatively, MacArthur may eventually produce concentrate to supply a processing facility. Geologically, the deposit is a calc-alkaline porphyry system within a Mesozoic intrusive complex of quartz monzonite and granodiorite. Sulfide mineralization consists of disseminated and vein-hosted chalcopyrite and bornite, with minor molybdenite, gold, and silver. The average sulfide copper grade is approximately 0.2% copper.

Yerington

Singatse Peak Services LLC also holds the Yerington copper property, previously mined by Anaconda from 1952 to 1979 and later by Arimetco, which recovered copper from existing heaps between 1989 and 1999. Combined operations produced over 1.8 billion pounds of copper through acid leaching of oxide ore and milling of sulfide ore. The deposit, adjacent to the town of Yerington, is a partially mined porphyry system containing both oxide and sulfide mineralization. Proposed redevelopment involves open pit mining and leaching of both ore types using Rio Tinto's Nuton technology. This process is expected to produce 1.4 billion pounds of Grade A cathode copper over a 12-year mine life, averaging 117 million pounds annually. Geologically, Yerington is a calc-alkaline porphyry copper-molybdenum system within the Mesozoic Yerington Batholith, hosted mainly in quartz monzonite and granodiorite. Copper occurs primarily as disseminated and stockwork chalcopyrite and bornite, with molybdenite and minor gold and silver by-products. Average sulfide grades in unmined zones are around 0.30% copper, with projected feed grades between 0.25–0.35% copper. The deposit includes an oxide cap and mixed zones amenable to leaching.

Pumpkin Hollow

Southwest Critical Materials, LLC is developing the Pumpkin Hollow deposits, located about 7 miles southeast of Yerington, Nevada. The property includes 5 skarn deposits split between shallower Western Area open pits and deeper Eastern Area underground mines. The project plans a 4,500 tonne-per-day underground operation and a 63,500 tonne-per-day open pit, with underground development complete and a conventional copper concentrator in place. Concentrate production is expected to average 280 tonnes per day at 26% copper underground and 1,040 tonnes per day at 25.5% copper from the open pit. Concentrates may be shipped to domestic smelters like Kennecott and Asarco or to Asian smelters, with shipping costs ranging from $45.87–$73.64 per wet tonne domestically and $114.37–$119.62 per wet tonne for Asia. Pumpkin Hollow is a high-grade carbonate-hosted copper-iron skarn formed at contacts between Mesozoic granodiorite and Paleozoic sedimentary rocks. Mineralization is mainly chalcopyrite and magnetite, with copper grades averaging 1.4% underground and 0.5–0.7% in open pits. Concentrates grade 25.5–26% copper and contain minor gold, silver, and iron, with low deleterious elements.

4.2.2 Other Nevada Deposits

Phoenix

The Phoenix Mine, located about 12 miles southwest of Battle Mountain in Lander County, is operated by Nevada Gold Mines, a joint venture between Barrick (61.5%) and Newmont (38.5%) formed in 2019. This open-pit operation produces significant gold and copper, featuring a flotation mill, carbon-in-leach plant, copper leach pad, and solvent extraction-electrowinning facility. In 2016, it yielded 209,000 ounces of gold and 42 million pounds of copper, with copper concentrate grading 17% to 25% copper, shipped mainly to smelters in Asia and Canada. The mine also averages around 200,000 ounces of gold annually, with silver credits. Phoenix is a complex skarn-porphyry system along Jurassic granodiorite intrusions in the Battle Mountain-Eureka Trend. Alteration includes intense skarn with garnet, magnetite, and pyroxene, plus localized phyllic and potassic zones. Copper mineralization, mainly chalcopyrite and lesser bornite, occurs in carbonate and intrusive rocks, while gold is disseminated in skarn-altered sediments and intrusives. Copper feed grades range from 0.15%–0.25% copper, with higher-grade zones.

Robinson

The Robinson Mine near Ely in White Pine County, Nevada, is a major porphyry copper deposit operated by KGHM Polska Miedź through its subsidiary Robinson Nevada Mining Company. The mine includes three main open pits—Ruth (active), Liberty, and Tripp-Veteran—and uses conventional open-pit mining with on-site processing to produce copper-gold and molybdenum concentrates. The concentrator handles about 45,000 tonnes per day. As of 2024, measured and indicated resources totaled roughly 221 million tonnes grading 0.45% copper and 0.006 oz/ton gold. Concentrates are trucked to East Wendover, Utah, then railed to Kennecott or other processors. Geologically, Robinson is a porphyry copper system hosted in Jurassic quartz monzonite and granodiorite intrusions, with mineralization in stockwork veins and disseminated zones. Copper minerals include chalcopyrite, bornite, and chalcocite, with molybdenite in discrete zones; gold occurs mainly within sulfides or quartz veins. Alteration halos are potassic, phyllic, and propylitic. The deposit shows minor oxide mineralization and moderate supergene enrichment. Concentrates are marketable with low deleterious elements, though arsenic blending is sometimes needed.

B and C Springs

In 2007, Adanac Molybdenum Corp. reported that the B and C Springs deposit in Nye County contains an estimated 163 million pounds of copper and 115 million pounds of molybdenum, with both open pit and underground resources. This calc-alkaline porphyry molybdenum-copper system is hosted in Jurassic intrusive rocks of the Ione–Excelsior Batholith and features disseminated and stockwork molybdenite and chalcopyrite, with minor bornite and pyrite. The deposit shows typical porphyry alteration—potassic and phyllic zones overprinted by propylitic alteration—and lacks significant supergene enrichment or oxide development, limiting leach processing potential. It is geochemically clean, with low arsenic, antimony, and mercury, favoring high-quality concentrate production. The open pit resource totals about

96 million tonnes grading 0.048% molybdenum and 0.068% copper, while the underground resource is 2.6 million tonnes grading 0.234% molybdenum and 0.334% copper. Copper feed grades may range from 0.07% near surface to over 0.33% at depth, with expected copper concentrate grades between 20% and 25% depending on processing and recovery.

Pathfinder

The Pathfinder-Liberty copper-molybdenum project in Nye County, about 25 miles northwest of Tonopah, was previously mined intermittently from 1980 to 2002 and is now owned by Pathfinder Development Corporation, which plans to redevelop it as an open pit mine with a 55,000 tonne per day-throughput, producing molybdenum and copper concentrates coupled with a SXEW plant producing copper cathode. Current copper production is currently projected to reach 24,210 tonnes of copper annually. Annual molybdenum production is estimated to be 8,000-9,000 tonnes of molybdenum metal in concentrate. The deposit is a porphyry molybdenum-copper system hosted in Cretaceous quartz monzonite and granodiorite, featuring disseminated and vein-hosted molybdenite and subordinate chalcopyrite within a large hydrothermal system marked by potassic, phyllic, and propylitic alteration. Copper grades average 0.1–0.27%, mainly in deeper zones, with minimal oxide development. The deposit has favorable geochemistry with low arsenic and other deleterious elements, making it suitable for bulk open pit mining and conventional flotation recovery, producing a clean concentrate with minor silver byproducts.

New York Canyon - Copper Queen

The New York Canyon deposits, owned by Emergent Metals and optioned to Ivanhoe Electric, are located 30 miles east of Hawthorne in Mineral County. The Longshot Ridge oxide deposit has been the focus of most work, including a 2010 NI 43-101 compliant resource, while the Copper Queen prospect hosts a historical sulfide resource. This calc-alkaline porphyry copper system is hosted in Jurassic granodiorite and quartz monzonite intrusions within the Walker Lane structural belt. Mineralization mainly consists of disseminated and vein-hosted chalcopyrite with lesser bornite and minor molybdenite, accompanied by typical porphyry alteration zones (potassic, phyllic, and propylitic). The deposit shows weak supergene enrichment but is primarily hypogene, with copper grades from limited data ranging 0.20%–0.35% copper. The geochemistry is favorable, with low deleterious elements, supporting potential for clean concentrate production. Further exploration and metallurgical testing are needed to define resources and development potential.

Pine Tree

The Pine Tree copper-molybdenum prospect, owned by IEMR Resources Inc., is located in the Pilot Mountains near Mina and is proposed for open pit mining with a concentrator. The low-grade deposit, hosted in Mesozoic quartz monzonite and granodiorite intrusions, features disseminated chalcopyrite and molybdenite within typical porphyry-style potassic, phyllic, and propylitic alteration zones. With limited supergene enrichment and minimal oxide zones, processing would rely on conventional flotation. Copper grades average 0.2–0.3%, with favorable geochemistry showing low levels of deleterious elements like arsenic and mercury.

4.2.3 Minor Deposits

Desert Scheelite, Majuba Hill, and Victoria are small copper deposits in Mineral, Pershing, and Elko counties, respectively. Desert Scheelite is held by Guardian Metals Resources and is primarily a tungsten project with a small copper resource. Majuba Hill, held by Giant Mining Corp, is a porphyry deposit with historical copper production of 2.8 million pounds. The resource data for Victoria resource is dated (1981) and it does not appear to be a large deposit. However, the operator, US Mine Corp. is proposing to re-open the Victoria copper mine. None of these would result in significant copper concentrate production.

4.3 COPPER OXIDE RESOURCES IN NEVADA

Table 4.4 presents a list of oxide copper resources in Nevada, typically processed using acid leaching, solvent extraction, and electrowinning. This method yields cathode copper as the final product rather than concentrate. These deposits would not serve as feedstock for a copper concentrate processing facility. They are included in this study for the sake of completeness, despite not being directly relevant to the current discussion on concentrate processing in Nevada. However, should a concentrate processing plant be developed, cathode copper could potentially be utilized in downstream copper production facilities established alongside it.

Table 7 Copper Oxide Resources in Nevada

COPPER OXIDE RESOURCES IN NEVADA					
DEPOSIT NAME	YEAR	TONNES (000)	% CU	CLASSIFICATION	CONTAINED CU POUNDS (000)
Yerington District					
Contact	2016	193,000	0.20%	Measured & Indicated	831,494
Contact	2016	12,000	0.19%	Inferred	52,188
Blue Hill - Oxide	2017	43,000	0.17%	Inferred	179,370
Blue Hill - Mixed	2017	23,000	0.18%	Inferred	98,210
MacArthur - Oxide	2022	259,000	0.165%	Measured & Indicated	941,223
MacArthur - Oxide	2022	134,000	0.147%	Inferred	434,772
Yerington - Oxide	2023	31,000	0.038%	Measured & Indicated	159,533
Yerington - Oxide	2023	30,000	0.038%	Inferred	122,221
New York Canyon - Longshot	2010	15,000	0.43%	Measured & Indicated	139,750
New York Canyon - Longshot	2010	2,700	0.31%	Inferred	17,980
Total Oxide Copper		742,700	0.17%		2,976,741

4.4 OTHER IMPORTANT WESTERN MINES & RESOURCES

The mines and development-stage projects outlined in this section either currently produce or are expected to produce copper concentrate.

This growing volume of domestic copper concentrate production creates a compelling opportunity to establish a U.S.-based smelter in the Western U.S., enhancing value capture, supply chain resilience, and alignment with long-term energy transition goals.

Morenci

The Morenci Mine in Greenlee County, Arizona, operated by Freeport-McMoRan (72%) and Sumitomo (28%), is North America's largest copper producer with over 900 million pounds of annual output. This long-running porphyry copper operation processes both sulfide and oxide ores, with a concentrator handling 50,000–60,000 tonnes per day of sulfide ore to produce concentrate averaging 25–30% copper. The concentrate is shipped off-site for smelting, while SX/EW facilities produce most of the cathode copper. Morenci is a complex Laramide-age calc-alkaline porphyry system hosted in Proterozoic basement rocks, featuring disseminated and vein-hosted chalcopyrite and bornite with supergene enrichment. Copper grades range from 0.2–0.5%, with potassic, sericitic, and propylitic alteration zones. Minor molybdenum, silver, and gold occur, but copper dominates economically.

Bagdad

The Bagdad Mine in Yavapai County, Arizona, operated by Freeport-McMoRan, is a large porphyry copper-molybdenum system producing about 200,000 tonnes of copper annually. The open-pit mine processes sulfide ore through a 60,000 tonnes per day concentrator producing copper concentrate grading 28–30% copper, supplemented by SX/EW facilities for cathode production. Concentrate is shipped to domestic and international smelters. Geologically, Bagdad features Laramide-age quartz monzonite intrusions and volcanic rocks hosting disseminated and vein chalcopyrite and molybdenite, with near-surface supergene enrichment including chalcocite and covellite. Copper grades range from 0.2–0.4%, with typical potassic, phyllic, and propylitic alteration zones. Minor gold and silver occur with sulfides, and low deleterious elements support favorable concentrate marketing.

Sierrita

The Sierrita Mine, about 30 miles southwest of Tucson in Pima County, Arizona, is a Freeport-McMoRan-operated porphyry copper-molybdenum deposit with gold and silver byproducts. It features an open pit operation with a concentrator processing roughly 70,000 tonnes per day, producing copper concentrate grading 27–30% copper. Annual copper output ranges from 100,000 to 120,000 tonnes, alongside significant molybdenum recovery. Concentrate is shipped to domestic and international smelters. The deposit is a Laramide-age calc-alkaline system hosted in Tertiary quartz monzonite and volcanic rocks, with disseminated chalcopyrite and molybdenite mineralization, plus supergene chalcocite enrichment near the surface. Copper grades range from 0.2–0.4% copper with molybdenum around 0.01%, with typical porphyry alteration zones (potassic, phyllic, propylitic). Minor gold and silver occur mainly with sulfides, and deleterious elements like arsenic and mercury are low.

Table 8 Other Important Mines and Resources

OTHER IMPORTANT MINES AND RESOURCES					
DEPOSIT NAME	**YEAR**	**TONNES (000)**	**% CU**	**CLASSIFICATION**	**CONTAINED CU POUNDS (000)**
OTHER WESTERN MINES					
Morenci	2023	1,270,000	0.36%	Measured & Indicated	10,000,000
Morenci	2023	273,000	0.34%	Inferred	2,000,000
Bagdad	2021	1,969,000	0.24%	Measured & Indicated	11,300,000
Sierrita	2018	3,057,000	0.23%	Measured & Indicated	16,400,000
Chino	2019	294,000	0.45%	Measured & Indicated	2,700,000
Mission Complex	1992	531,000	0.67%	Measured & Indicated	7,800,000
Resolution	2022	1,700,000	1.52%	Inferred	51,400,000
Copper World	2021	1,172,000	0.41%	Measured & Indicated	10,600,000
Pinto Valley	2023	1,270,000	0.29%	Measured & Indicated	8,960,000
Mineral Park	2025	188,000	0.15%	Measured & Indicated	587,000
Total Sulfide Copper		11,724,000	0.40%		121,747,000

Chino

The Chino Mine near Silver City, New Mexico, is a large porphyry copper-molybdenum deposit owned and operated by Freeport-McMoRan. It features an open pit operation with an integrated concentrator and SX/EW facilities. The concentrator processes about 50,000 to 60,000 tonnes per day, producing copper concentrate grading 28–30% copper. Annual copper production is approximately 100,000 tonnes, with molybdenum recovered as a byproduct. The concentrate is shipped to domestic and international smelters. Geologically, Chino is a Laramide-age calc-alkaline porphyry system hosted in Tertiary quartz monzonite and volcanic rocks, with mineralization mainly as disseminated chalcopyrite and molybdenite, plus localized supergene chalcocite enrichment. Copper grades range from 0.3–0.5% copper, with molybdenum around 0.01%. Alteration zones include potassic, phyllic, and propylitic assemblages, with minor gold and silver associated with sulfides. The deposit has low levels of deleterious elements such as arsenic and mercury.

Mission Complex

The Mission Complex in Pima County, Arizona, owned by Asarco LLC (Grupo Mexico), is a large porphyry copper deposit with byproducts of molybdenum, gold, and silver. It operates as an open-pit mine with a concentrator and SX/EW facilities. The concentrator processes about 55,000 tonnes per day, producing copper concentrate grading 28–30% copper. Annual copper production is around 200,000 tonnes, with valuable byproducts recovered. Concentrate is shipped to domestic and international smelters. Geologically, Mission is a Laramide-age calc-alkaline porphyry system hosted in Tertiary intrusive and volcanic rocks, with disseminated chalcopyrite and molybdenite mineralization and supergene chalcocite and covellite near the surface. Copper grades range from 0.3–0.7%, with molybdenum averaging 0.01%. Alteration zones include potassic, phyllic, and propylitic assemblages. Minor gold and silver are associated with sulfides, and low deleterious element levels.

Mineral Park

The Mineral Park Mine, located about 14 miles northwest of Kingman, Arizona, is owned by Origin Mining Company (a Waterton Copper subsidiary) and hosts a porphyry copper-molybdenum-silver deposit. Origin is working to restart and modernize the historic open pit and concentrator, which is expected to have a capacity of 45,000 to 54,000 tonnes per day. Past production exceeded 646 million pounds of copper, 46.8 million pounds of molybdenum, and 5 million ounces of silver. Concentrate production is anticipated to average several hundred wet tonnes per day, with grades typical of porphyry systems, and will likely be shipped to overseas smelters. The deposit is a calc-alkaline porphyry system hosted in Late Tertiary monzonitic intrusions into Middle Proterozoic basement, featuring chalcopyrite, molybdenite, and a supergene chalcocite zone with copper grades of 0.1–0.15% and molybdenum around 0.04%. Alteration includes potassic, phyllic, and propylitic zones, with later polymetallic veins locally overprinting. Low deleterious elements support favorable metallurgy.

Pinto Valley

The Pinto Valley Mine, located in Gila County, Arizona, and operated by Capstone Copper Corp., is an open-pit porphyry copper-molybdenum operation with a concentrator capacity upgraded from its original 36,287 tonnes per day in 1973 to a current base of 56,000 tonnes per day. In 2024, the mine processed an average of 49,461 tonnes per day, producing about 184,460 tonnes of copper, a 12% increase from the prior year. The deposit is hosted in Precambrian Lost Gulch Quartz Monzonite and features hypogene mineralization dominated by chalcopyrite, pyrite, and minor molybdenite, with typical potassic, phyllic, and propylitic alteration zones. As of March 2021, proven and probable reserves totaled 381 million tonnes at 0.32% copper and 0.006% molybdenum, with measured and indicated resources of 1.4 billion tonnes at 0.29% copper and 0.006% molybdenum.

Resolution

The Resolution Project, located near Superior in Pinal County, Arizona, is a joint venture between Rio Tinto (55%) and BHP (45%) and represents one of the largest undeveloped deep underground porphyry copper deposits globally. The proposed block cave mining operation, outlined in a Rio Tinto Prefeasibility Study, targets production of about 120,000 tonnes per day, with annual copper output around 1.3 billion pounds at peak and a total of over 40 billion pounds over a 40-year mine life. Concentrate grades are expected to range from 25–30% copper, with shipments likely by rail to domestic or international smelters. The deposit is hosted in Proterozoic granitic and metamorphic rocks beneath the Apache Leap Tuff, featuring quartz monzonite porphyry intrusions with potassic and phyllic alteration. Copper mineralization mainly comprises chalcopyrite and bornite, with molybdenite at depth, averaging about 1.5% copper. Situated over 7,000 feet underground, Resolution requires advanced underground mining and extensive geotechnical control.

Copper World Complex

The Copper World Project in Pima County, Arizona, owned by Hudbay Minerals, is a large porphyry copper-molybdenum system consisting of the East deposit and seven satellite deposits. Hudbay's development plan includes Phase I, featuring an open-pit mine and a 54,000 tonnes per day sulfide concentrator with heap leaching and SX/EW facilities on private land, producing an average of 187 million pounds of copper annually over 20 years. Phase II could expand capacity to 82,000 tonnes per day on federal land, extending the mine life to 44 years and raising production to about 223 million pounds annually, with total copper output exceeding 8.7 billion pounds. Copper will be produced both as cathode on site and as concentrate, with a domestic leach facility reducing overseas shipments. Geologically, the project is hosted in Proterozoic granitic and metamorphic rocks intruded by quartz monzonite porphyry, with copper mainly as chalcopyrite and bornite and an average grade of 0.54% copper. The deposit features typical porphyry alteration zones and low deleterious element levels.

4.5 COPPER PRODUCTION

In Nevada, net concentrate exporters are Nevada Gold Mine's Phoenix mine, and KGHM's Robinson mine. The Phoenix mine exports concentrate to Glencore's Horne smelter in Quebec, Canada and to Asia. On occasion, Robinson sends a portion of concentrate to Kennecott's smelter in Utah, but the majority if not all of the concentrate is exported to Asia. Other exporters to Asian smelters in the Western U.S. include Freeport-McMoRan, Origin Mining and Hudbay Minerals. Other deposits in Nevada that are expected to export concentrates to Asia are Pumpkin Hollow (Southwest Critical Materials), Pathfinder, and Mason (Hudbay). At the time of this writing, no new copper processing facilities are planned in the U.S. or other western states. New operations, including Resolution (Rio Tinto), would need to export their concentrate.

Companies exporting concentrate must pay for transportation and smelting of the concentrate as well as refining of the blister copper produced. Transportation costs of concentrate shipped domestically from Nevada, based on available technical reports and adjusted for inflation based on the Producer Price Index for rail transportation, range from approximately $32 to $99 per tonne depending on the distance transported by rail ranging from approximately 300 miles to 1,100 miles. Transportation of concentrate to Asia requires transporting of domestic concentrates to a deep sea port, such as the Port of Vancouver (Washington), Port of Oakland (California), and Port of Stockton (California), and handling of concentrate for export ranges in price from around $25 to $47 per tonne. Ocean Freight Rates for copper concentrate to Asia are similar for most U.S. deep sea ports and range from $25 and $28 per tonne. Total charges for freight of U.S. sourced concentrate to Asia is approximately $90 to over $200 per wet tonne.

TCRCs are typically quoted per dry tonne of concentrate. Treatment charges (TCs) are expressed in U.S. dollars per dry tonne of concentrate, while refining charges (RCs) are generally quoted in U.S. cents per pound of copper. TCRCs are presented as a combined figure and tend to maintain consistent global benchmarks, primarily influenced by the supply and demand dynamics for copper concentrate.

Smelter operators aim to run their facilities at or near full capacity to maximize efficiency. As a result, they compete for available concentrate feed, and TCRCs fluctuate accordingly. When smelters operate at or above capacity, TCRCs tend to rise; conversely, when utilization is low, TCRCs typically decline. In 2024, treatment charges saw a significant reduction, as evidenced by agreements between Chilean copper producer Antofagasta and China's Jiangxi Copper, which set terms at $21.50 per tonne for TC and 2.125 cents per pound for RC. This marked a steep decline from the 2023 benchmark of $80 per tonne (TC) and 8 cents per pound (RC).

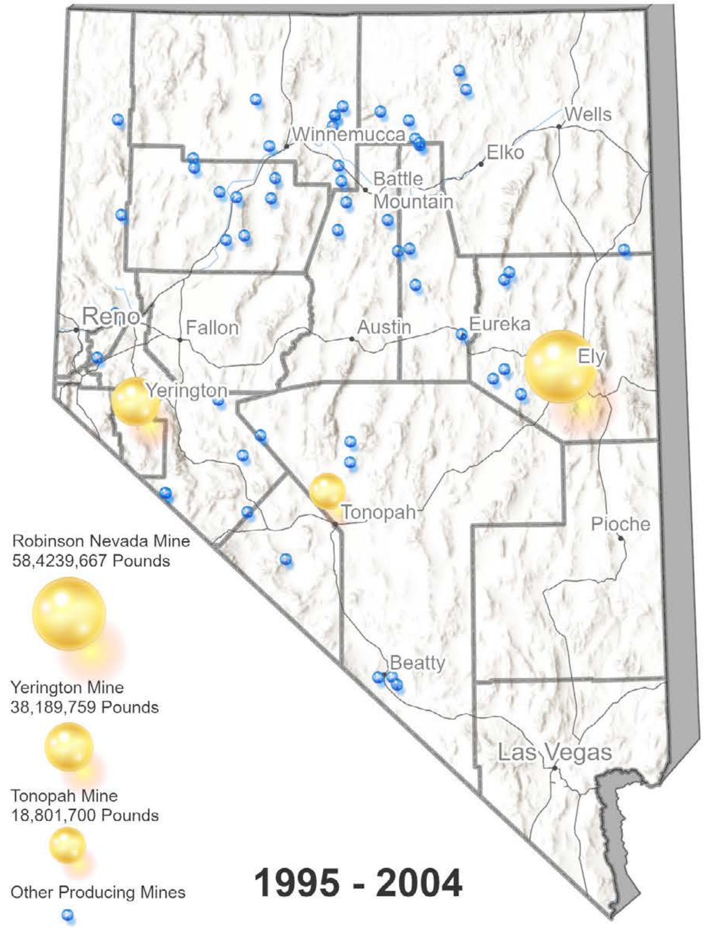
While global copper supply remained stable, the sharp drop in TCRCs was largely attributed to China's overexpansion of its smelting capacity, which outpaced the available concentrate supply (Reuters, 2024; Mining Journal, 2024).

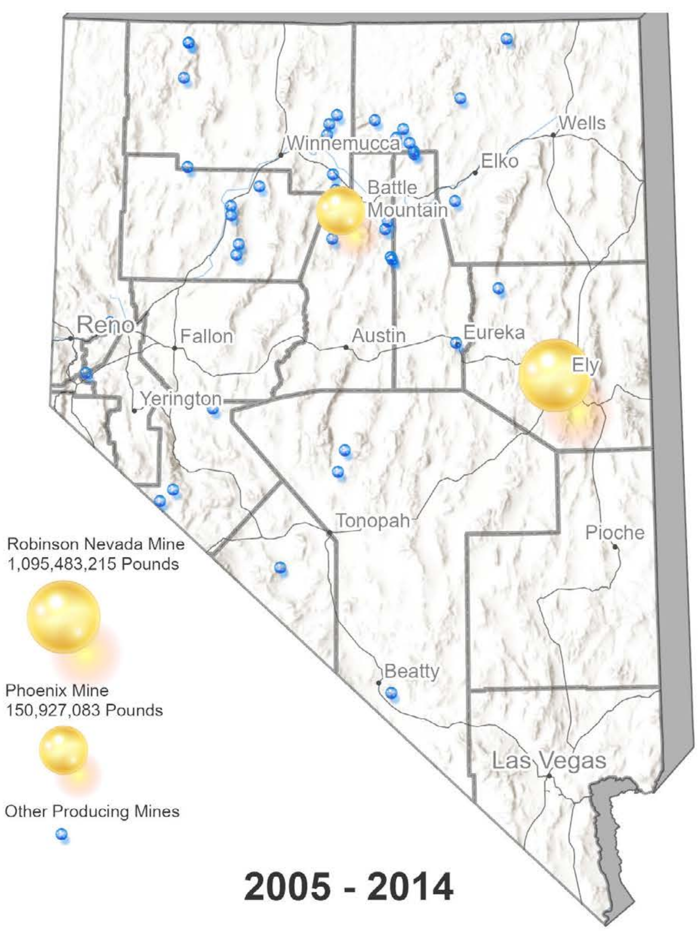
This imbalance also led Chinese smelters to increasingly target scrap copper as an alternative feedstock, with the U.S. ranking as the second-largest supplier of scrap copper to China, after Malaysia.

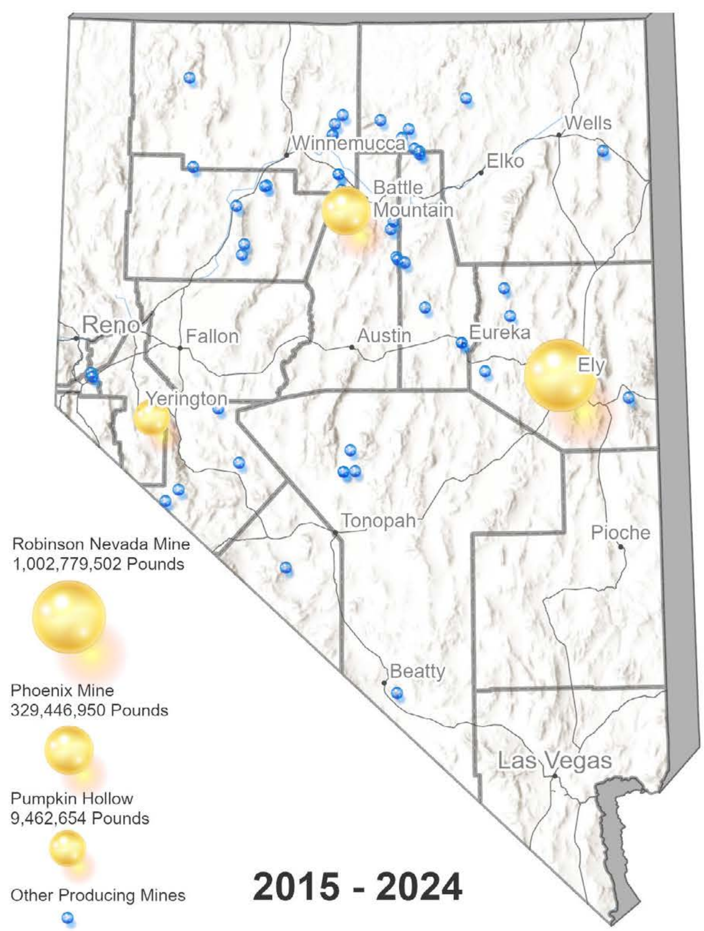
Excluding the anomalous year 2024, when fees were drastically reduced, average TCs over the last 10 years have been around $90.5, with RCs averaging 9 cents per pound. Including 2024, TCs have averaged $83.5 per year, with RCs averaging around 8.5 cents per pound of copper. Given the competition for concentrate and scrap to feed Chinese smelters, along with the new Adani smelter in India and planned smelters in Indonesia and the DRC, TCRCs could remain low until copper mine growth accelerates to meet feed demand or less cost-efficient smelters begin to shutter. Currently, global annual growth in concentrate production is between 3.5% and 5%.

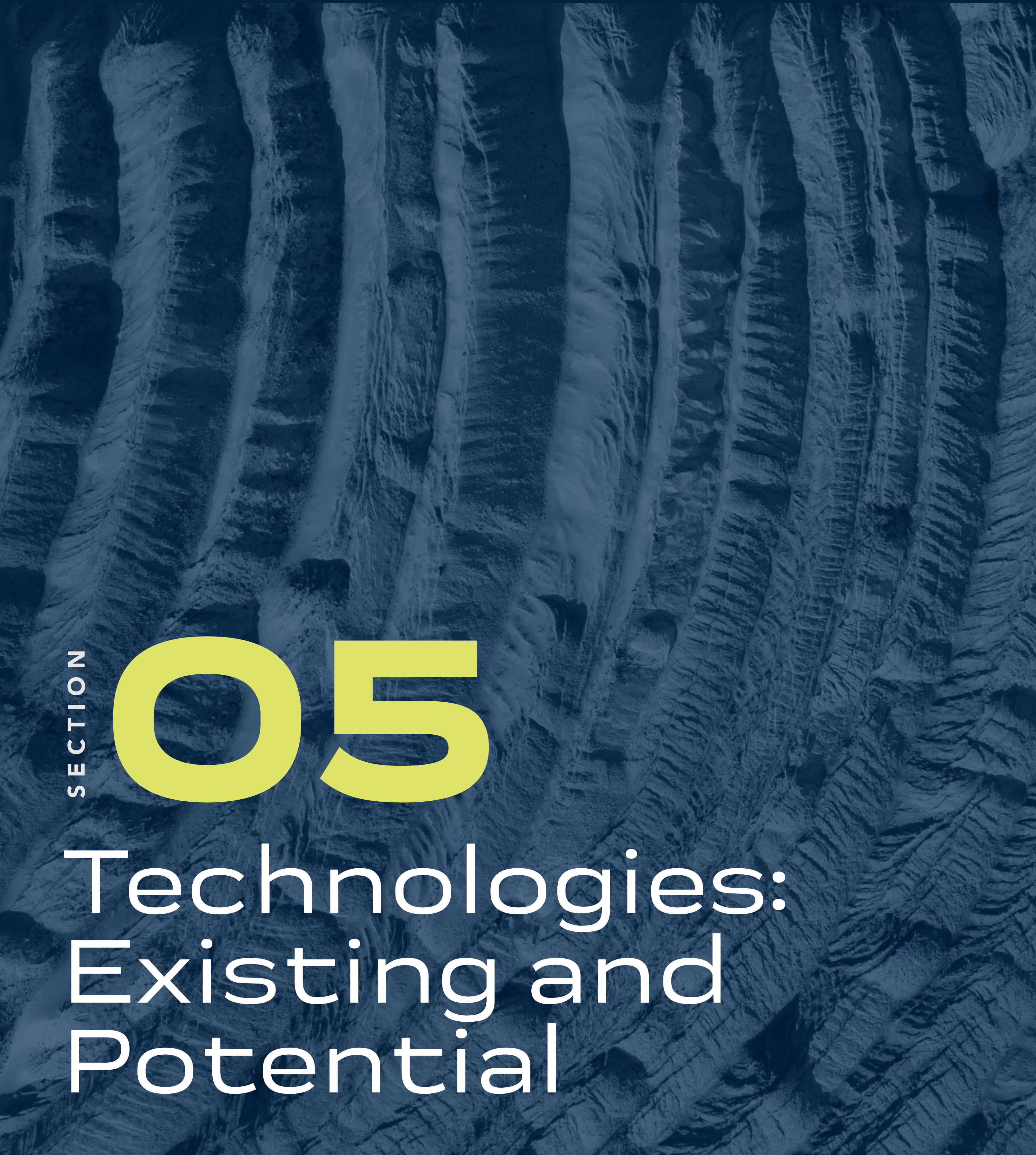
Figure 15

This figure illustrates copper production, measured in pounds by mine, across decade intervals over the past 30 years to highlight the primary sources of recent copper output in Nevada. Figure 15 depicts active mines, offering insight into historical and recent production trends across the state.









SECTION

05

Technologies: Existing and Potential

05 TECHNOLOGIES: EXISTING AND POTENTIAL

SUMMARY

Section 5 reviews the history, current practices, and future potential of copper processing technologies in Nevada. It traces the state's legacy from early 20th-century smelters and concentrators to modern operations like the Robinson Mine. The section distinguishes between oxide and sulfide copper minerals, explaining their differing chemical properties and processing methods, including ambient leaching for oxides and milling plus high-temperature or high-pressure refining for sulfides. Key active Nevada sulfide mines and significant undeveloped deposits are highlighted. The analysis covers smelting and autoclave refining options, weighing their costs, capacities, environmental considerations, and infrastructure needs. Potential sites for a new Nevada smelter are identified, alongside the strategic benefits and challenges of expanding domestic refining capacity.

5.1 HISTORY OF PROCESSING IN NEVADA

Nevada has a rich history of copper smelting and processing dating back over a century. In 1912, industrialist Boyce Thompson established a copper smelter in Mason Valley near Yerington, founding the townsite of Thompson, named in his honor. This smelter had a capacity ranging from 640 to 900 tonnes of copper per day and was strategically located at the northern terminus of the Nevada Copper Belt Railroad. The railroad played a vital role in transporting ore from numerous nearby mines as well as delivering essential supplies to the smelter. Over its operational life, which lasted intermittently until its final closure in 1928, the facility received shipments from more than 200 small mines scattered throughout the region.

Further east in White Pine County, copper mining began in the early 1900s around the town of Ruth. Here, open-pit and underground mining methods were employed to extract copper ore, which was transported via a newly constructed rail line to the town of McGill for processing. The McGill site housed both a concentrator and a smelter, for refining the ore into marketable copper products. The Nevada Northern Railroad extended northward from McGill to connect with the Southern Pacific rail line, enabling efficient shipment of raw materials to the mine and finished copper products to national and international markets. However, fluctuating market conditions ultimately led to the closure of the McGill mill and smelter in 1983, marking a temporary halt to large-scale copper smelting in the region. Mining activity resumed in the 1990s when a new concentrator was constructed near the Ruth mine, modernizing the processing capabilities. Since reopening, the mine has undergone changes in ownership, with the Polish mining company KGHM currently operating the Robinson Mine and Concentrator, which remains a significant contributor to Nevada's copper production today.

Nevada's copper processing history underscores the state's longstanding role in the copper industry, marked by evolving technologies, infrastructure development, and market dynamics. The legacy of past smelters and concentrators has laid the groundwork for modern projects that continue to benefit from Nevada's rich mineral resources and strategic transportation and energy infrastructure.

5.2 COPPER PRODUCTION – STRATEGIES AND PROCESSES FROM MINE TO METAL

Copper minerals generally fall into two categories: copper oxides and copper sulfides. Copper oxide minerals consist of various chemical formulas in which copper is chemically bound to oxygen and other oxide components such as silica or water in their crystal structures. A key characteristic of copper oxide minerals is their ready solubility in acid solutions, which makes acid leaching using weak or strong acids the most common and effective method for recovering copper from these oxides.

Most, if not all, copper orebodies contain both oxide and sulfide minerals in varying quantities, meaning that a combination of different processing methods is required to efficiently extract copper from the ore.

Copper sulfides can come in a broad array of compositions, but specifically have matrices that involve copper with sulfur and other metals in the different mineral structures. Table 9 shows the chemical formulas for several copper sulfide minerals. Included in Table 9 is the percent of the mineral that is copper; that is, in a pure piece of chalcocite, it would assay nearly 80% copper. Sulfide ore bodies can contain a broad range of any of these minerals simultaneously. In all ores, sulfide and oxide copper are never pure; instead, they are diluted by gangue minerals or minerals which have no value. An ore that assays 1% copper (with only chalcocite minerals of copper) would contain 1.25% Cu_2S (or ($^{1}/_{0.798}$) % Cu_2S). If no other mineral is present, this ore would have 98.75% of the mass (gangue) that must be removed to get the mineral of value. Assay labs typically determine the copper weight percent.

All minerals have unique specific gravities (densities), magnetic susceptibility and surface chemistries—differences between valuable minerals and host rock can be exploited to separate minerals from gangue rock. In order to recover the metal from these minerals, chemical bonds must be broken. Hydrometallurgical processes are performed by adding an acidic aqueous solution to the ore; pyrometallurgical processes use high temperature reactions with gaseous, liquid or solid materials to produce the elemental metal.

Both sulfide and oxide copper minerals have different physical and chemical properties that lead to different processing strategies that can be applied to them. A process that works for one copper oxide will generally work for all copper oxide minerals; likewise, a process that works for one sulfide mineral will work on all copper sulfide minerals. Each available processing strategy is discussed by the mineral type.

Table 9 Typical Copper Sulfide Minerals Sought as a Copper Source

TYPICAL COPPER SULFIDE MINERALS SOUGHT AS A COPPER SOURCE		
NAME	**FORMULA**	**% COPPER IN PURE MINERAL**
Chalcocite	Cu2S	79.8%
Covellite	CuS	66.5%
Chalcoyrite	CuFeS2	34.5%
Bornite	Cu5FeS4	63.3%
Enargite	Cu3AsS4	48.4%

5.3 OXIDE COPPER PROCESSES

5.3.1 Ambient Leaching Processes through Solvent Extraction and Electrowinning

Copper oxide minerals dissolve readily in acidic solutions, producing copper-rich solutions containing Cu^{+} and Cu^{2+} ions. The choice of hydrometallurgical process depends on ore grade, acid availability (e.g., sulfuric acid), and leaching method.

Copper oxide ores have been processed in Nevada since the 1950s. From 1952 to 1977, the Yerington Mine used vat leaching—passing acid through vats of crushed ore to extract copper, leaving behind low-copper tailings. Since the late 1990s, the Phoenix Mine near Battle Mountain has used similar methods, where leach solutions drain naturally from ore piles, eliminating the need for complex dewatering. These copper-bearing outputs are known as pregnant leach solutions (PLS).

Leaching methods vary with ore grade: low-grade run-of-mine ore is placed on lined pads for dump leaching, while moderate-grade ore is crushed and stacked for heap leaching. Acid is applied via drip lines, dissolving copper into PLS, which is collected through sloped pads or drainpipes. Heaps may be restacked with fresh ore and irrigated until copper recovery targets are met. At closure, heaps are rinsed and revegetated.

PLS typically contains several grams of copper per liter. In the 1950s, Yerington used cementation, where scrap steel precipitated copper as crude "cement copper" (60–70% Cu). By the 1980s, solvent extraction/electrowinning (SX-EW)—developed in Canada in the 1960s—became the industry standard, now accounting for ~40% of the U.S. and ~25% of global copper production. In SX-EW, copper is extracted from PLS into an organic solvent, then stripped into an electrolyte and deposited onto cathodes via electrowinning. This process upgrades PLS from 1–2 g/L Cu to ~50 g/L in the final electrolyte, enabling efficient copper recovery.

Electrowinning recovers high-purity copper by passing an electric current through electrolyte solutions between anodes and cathodes.

Figure 3 Schematic of the SX-EW process

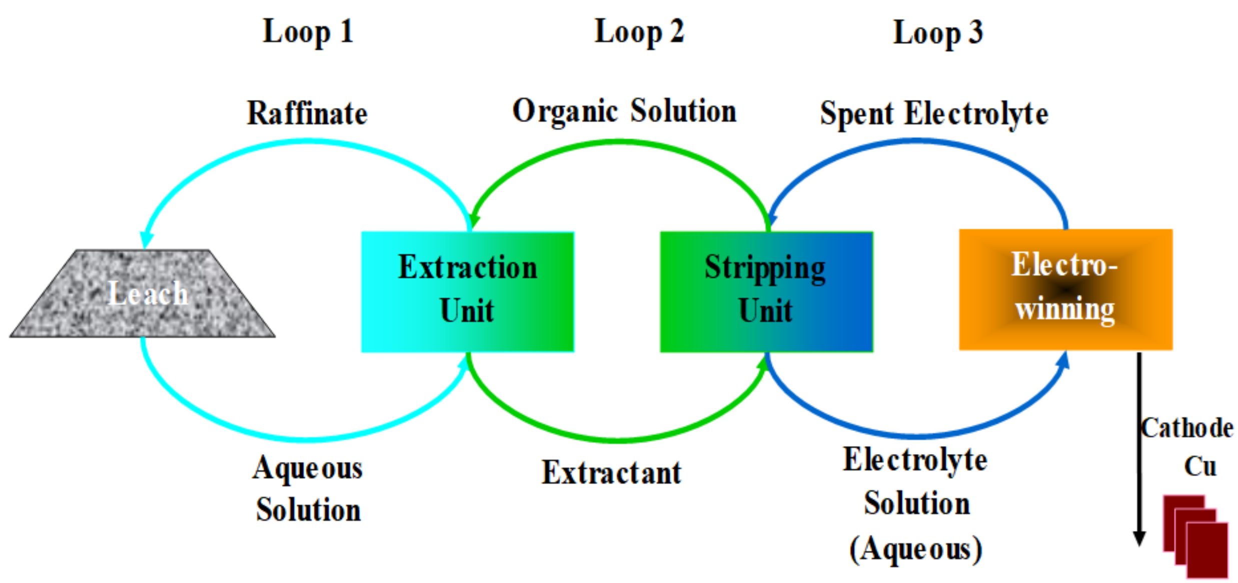


Figure 3: Copper cycles from the aqueous solutions to the organic solvent in the first cycle. The second cycle has copper being stripped from the organic into the aqueous electrolyte. Stripped aqueous solutions ("Raffinate") and stripped organic solutions are recycled to the leach, and extraction units pick up more copper, in this continuous process.

Copper ions plate onto the cathodes as 99.99% pure "cathode-grade copper." Spent electrolyte, depleted in copper, is returned to the SX strip circuit for reuse.

The process runs continuously in tank houses containing hundreds of cells, each with 30–60 electrode pairs. Copper is plated 24/7, with cathodes harvested every 7–10 days, each weighing up to 200 lbs. Tank houses can produce 45,000–180,000 tonnes of copper per year, requiring 13,000–45,000 tonnes of ore daily and around 30 MWh of electricity per day.

Heap leach–SX-EW operations typically cost $9–11 per tonne of ore, or $1.20–1.50 per pound of cathode copper at 0.3–0.4% Cu head grades.

In summary, copper oxide mines can extract and refine copper on-site using heap leaching followed by solvent extraction and electrowinning, producing cathode-grade copper without the need for off-site smelting.

5.3.2 Current and Potential Oxide Ore Processing in Nevada

As of 2025, Nevada has one SX-EW operation at the Phoenix Mine near Battle Mountain which uses sulfuric acid to leach oxide ore and produces approximately 6,000 tonnes of cathode-grade copper annually.

SX-EW remains a cost-effective method for processing oxide ores and some low-grade sulfide ores, such as those targeted by Rio Tinto's Nuton process. While the Robinson Mine near Ely has some oxide potential, it currently processes sulfide ore only. Prospective sites for oxide copper production include Yerington's

Mason Valley and MacArthur deposits, both near Fort Churchill Power Station and close enough to potentially share processing infrastructure.

Permitting is required before constructing heaps or SX-EW facilities. While mine permitting is relatively standard, the leach pads and plant footprints add complexity. Proximity to power infrastructure is also critical. Capital costs for a full-scale SX-EW operation, including mining, leaching, and a tank house with about 100 electrowinning cells, are estimated at $200–$400 million, with each EW plant capable of producing roughly 350 tonnes of cathode copper annually.

5.4 SULFIDE COPPER PROCESSES

Sulfide copper minerals are more complicated than oxide copper minerals. Chemically, the Cu-O bond is much less stable than the Cu-S bond. Few of these minerals will react with acid under ambient conditions to produce a PLS solution with enough copper to be economical. Sulfide minerals extracted from a mine must first be concentrated by removing gangue minerals. The mines will produce concentrates (typically between 15-30% copper) which is the product that gets shipped off-site to a refinery. The refinery can use either a pyrometallurgical process or a high pressure hydrometallurgy process to produce high purity copper plates.

This section analyzes and compares these processes and considers apt locations for each. Currently in Nevada, only three mines are processing sulfide ores: Pumpkin Hollow (near Yerington), Phoenix Mine (near Battle Mountain) and the Robinson Mine (near Ely). However, the potential for sulfide deposits to be mined in Nevada is great. These key resources include:

- ✓ At least three identified sulfide deposits near Yerington
- ✓ The Pathfinder deposit near Tonopah (copper sulfide with molybdenum credits), known since the 1980s
- ✓ The Mt. Hope deposit near Eureka
- ✓ The Victoria Mine north of Ely

The opportunity for sulfide mining in Nevada is plentiful, as many of the deposits on the list above have been, or will be, fully explored and defined.

The processing of these ores is well known—mills remove gangue minerals to make concentrates, and these concentrates are shipped to high temperature processes that refine the copper. In Nevada, the last copper smelter was dismantled in McGill in the 1980s.

5.4.1 Concentrators

Copper sulfide minerals have a unique surface chemistry composed of copper and sulfur atoms that can be exploited. Specialized chemicals can be added to ore/water slurries to selectively adsorb onto metal sulfide minerals,such as chalcopyrite, chalcocite, etc. These reagents, known as "collectors," make these mineral surfaces hydrophobic (water repelling).

As slurries pass through an up-flowing air injector, the hydrophobic minerals will adhere to air bubbles rising through the slurries, concentrating the sulfide minerals in the froth at the top. The process, known as flotation, is a concentrating process that collects a purer copper sulfide mineral and leaves the gangue minerals to be carried out by the flow of water. The entire process must be performed at a mine; the facility that completes this step-by-step concentration is known simply as a concentrator.

The driving force for the concentrating process is predicated on having discrete, individual particles of copper minerals and gangue minerals. The mined ore must be crushed and ground to complete the liberation of the individual minerals, making individual, discrete particles of sulfides and gangue. Crushing and grinding is the only way to eliminate "middlings" (particles of both copper sulfide and gangue) which can report to the tailings as copper lost or to the concentrate as lower copper grade. Crushing rock is the most expensive part of the process due to energy consumption and wear.

Sequential crushing and grinding, known as comminution, reduces the size of the ore throughout the process. Ores are first coarsely ground, and a first separation is used to remove most the waste minerals which are sent to a tailings impoundment on the mine property. The first stage concentrate is then finely ground to afford a cleaner, purer final concentrate. The waste from this section is also sent to tailings.

The goal for the final concentrate is to produce 90-95% pure copper sulfide minerals and less than 5% quartz. The assayed percent copper of the final concentrates depends mostly on the minerals that are present. If the concentrate is mostly chalcocite (Cu_2S) then the concentrate grade could be as high as 75% copper. If the copper is mostly chalcopyrite ($CuFeS_2$), the copper concentrates will assay up to about 30% copper. Other sulfide minerals, such as galena (PbS), molybdenite (MoS_2), pyrite (FeS_2), and sphalerite (ZnS), can float with the copper minerals and may dilute the final concentrates. Some, like the molybdenite, can be collected separately in flotation processes for added revenue to the mine.

Flotation has been used in Nevada for nearly a century. Near Ely, the Kennecott Copper operation (now run by KGHM) began producing copper concentrate through flotation in the 1920s. The original Ruth Mine had ore averaging 0.8% copper, and the concentrator produced a 30% copper concentrate. The operation ran off and on from 1925 to 1978, with later reopenings by BHP in 1996, Quadra Mining in 2004, and KGHM in the late 1990s—continuing production today at the Robinson Mine.

At Yerington, sulfide copper was found beneath the oxide layer. A small concentrator built in 1960 produced a 30% copper concentrate until operations ended in 1978. From 1953 to 1978, the site produced both cement copper and concentrate, which were shipped by rail from Wabuska to a smelter in Anaconda, Montana.

The Phoenix complex near Battle Mountain uses the flotation process to produce a copper concentrate. In this operation, the flotation of copper sulfide minerals is a means of removing it from the gold concentrates. The flotation process produces a copper-rich concentrate and the tailings contain the gold which is leached by cyanide on-site.

To summarize, mines with a copper sulfide deposit generally require use of the flotation process to produce a concentrate. The concentrate grade is dependent on the types of copper minerals and other sulfide minerals present in the deposit, and the degree of size-reduction that the ore undergoes in the comminution sections of the concentrator. The final product of these mine sites is a copper concentrate, which needs to be processed by a smelter or other refining process for conversion of the copper into cathode-grade copper. Unlike copper oxide minerals which allow mines to make cathode-grade copper on site, copper sulfide mineralization needs further refining off the mine site to recover the copper value from the concentrates.

Few new copper sulfide mines have opened up in the U.S. in recent years, so it is rather difficult to determine how much capital must be invested in a new copper sulfide mine in Nevada. However, based on similar mines, moderate to large copper concentrators would cost about $300 million installed with about $100 million for the mining equipment. Approximately $500 million would be needed for a start-up of a moderate to large concentrator capable of producing 500 to 1,000 tonnes of concentrate per day.

5.4.2 Copper Refining Processes

Copper concentrates are "purified sulfide minerals." Inasmuch, the copper must be extracted from these using either a high temperature process (known as a smelter) or a high pressure and temperature process (known as an autoclave). The smelting process produces a crude copper product that must be further refined to produce cathode-grade metal; the autoclave process solubilizes the copper which can be electrowon into cathode-grade copper.

5.4.2.1 Copper Smelter Operations

With the advent of copper sulfide flotation in the 1920s, the copper smelting process was born. The smelters would melt the concentrates into a matte and slag. The slag was sent to a waste pile, but the molten matte is further processed in "converters" to recover nearly pure copper. Figure 4 shows the overall process of smelting copper from concentrates to anode-grade copper.

Figure 4 Smelting of Copper Sulfide Concentrates

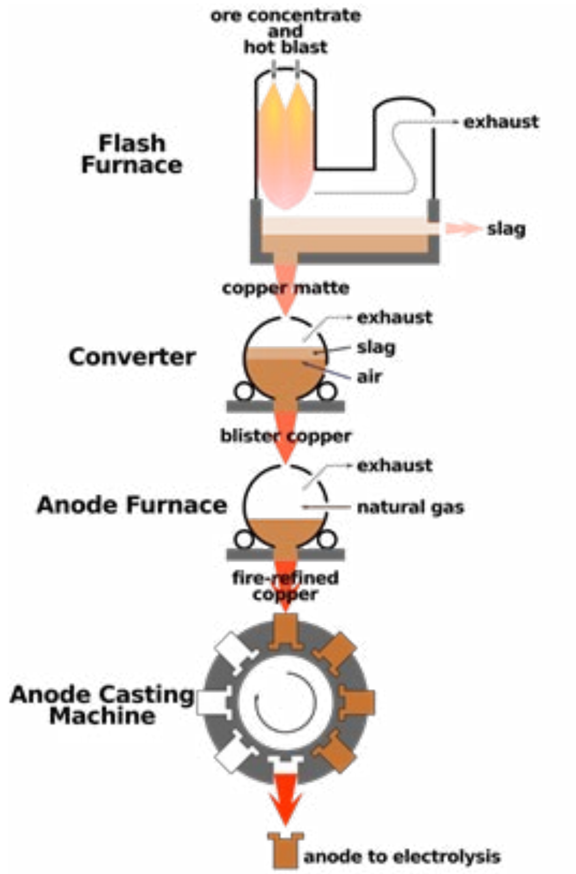
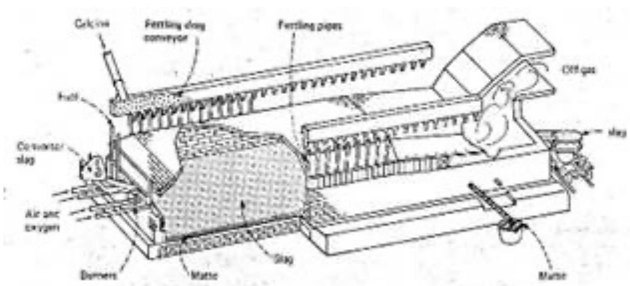


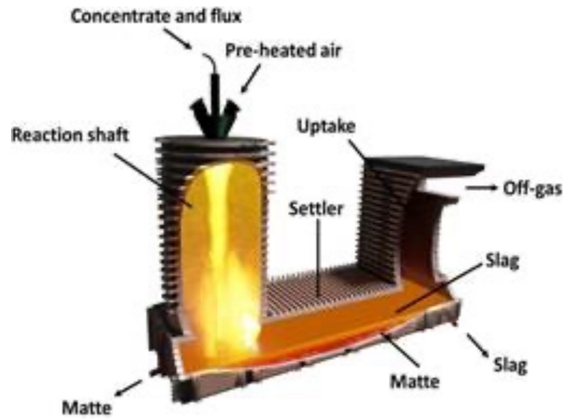
Figure 4: The furnace melts concentrates into matte and slag. The matte is "converted" into blister copper. An anode furnace is used to remove the majority of the contaminants in the copper, with the fire-refined copper being poured into anode molds. (after U.S. EPA, 2015)

Through the 1940s until about 1990, the copper smelting process, including the previous McGill smelter in Nevada, used a reverberatory furnace (reverb) to initially melt copper concentrates into a matte and a slag phase. In the 1980s, a cleaner smelter technology, the flash smelter, was introduced to produce matte and slag. The only difference between the two was how the concentrates are melted.

Figure 5 Two Types of Copper Smelters



A) The Reverberatory Furnace in which fuel is added to create a melting atmosphere over the matte and slag.



B) The Flash Smelter in which fuel, air and concentrates are mixed in the burn zone, allowing molten matte and slag to accumulate in the hearth below.

Figure 5 shows diagrams of both the reverb and the flash smelters. In the reverb, concentrates are fed to the smelter in which the heat source is fuel oil, natural gas, coal or any available fuel. The reverberatory name is from the fact that radiant heat from the flame is reflected back into the melt from the curved shape of the roof of the smelter. These were single story furnaces that had large hearths for holding the matte and slag.

In the flash smelter, concentrates, air and fuel are added to the hot combustion zone, melting the concentrates into matte and slag. The smaller footprint of the nearly vertical flash smelters allows for better off-gas collection while maintaining the high temperature to melt and heat the molten matte and slag. Over the years, reverbs were used in several operations, such as White Pine (MI), Magma Copper in San Manuel (AZ), and McGill (NV), but flash smelters have replaced them in the U.S.

The matte from either smelter consists of approximately equal parts copper, iron (Fe) and sulfur (S), which must be further treated to recover the copper as molten metal. Other sulfide concentrates can be added to the smelter for heat value and to moderate the composition of the matte. Molten matte is tapped from the smelter into ladles, which are poured into a converter.

The converter uses air injected into the melt to first remove Fe as an iron oxide slag which is poured off periodically, leaving molten Cu-S in the converter. Air is again injected into the converter to remove the S as SO_2 gas, which is collected to make sulfuric acid. After treatment in a small holding furnace (the anode furnace in Figure 4), the molten copper known as "blister copper" is cast into anodes for further processing.

The blister copper anodes (which are 98+% Cu) are placed opposite cathode sheets in an electrolytic cell. A current is passed through the cell to simultaneously dissolve the copper in the anode and plate pure copper on the cathode. This process is similar to the electrowinning process, but differs only by the source of the copper for the cathode plating.

In electrowinning the solutions from solvent extraction are the source, and in electrorefining the anode copper dissolves into the electrolyte to be plated on the cathode. Electrorefining is a much less energy intensive process, but the cost of smelting makes this process overall slightly higher than SX-EW to produce cathode-grade copper. Anodes are loaded into the cell, and will remain until they are dissolved; cathodes are periodically removed to harvest the copper sheet, then are replaced to collect more copper. Like electrowinning cells, every anode and cathode are rotated on 7 to 10 day cycles. The entire process of smelting and refining has been estimated to be as much as $2.50 per pound of cathode-grade copper for small smelters, and less than $2.00 per pound for larger smelters. Fuel costs, labor, electricity, and capacity of the smelter are factors.

One advantage to matte smelting and converting is that contaminant metals follow the copper through the process. For instance, precious metals, selenium, tellurium, and others are reduced in the converter and will remain with the copper into the anodes. The electrorefining process causes most base metals (iron, zinc, etc.) to dissolve into the electrolyte.

Precious metals do not dissolve from the anodes but settle to the bottom of the cell as "slimes." Periodically the slimes are collected and sold to gold, silver, selenium and tellurium refiners who collect these valuable metals. In fact, copper refiners around the world produce the majority of selenium which is used in solar panels and xerography equipment.

At present, there are only three operating smelters in the U.S.: the Miami smelter (Freeport-McMoran in Miami, AZ), Kennecott (Rio Tinto, Salt Lake City), and the Hayden smelter (Asarco/Grupo Mexico, Hayden, AZ). It should be noted that the Miami smelter is running at low capacity, and the Hayden smelter is currently non-operational with plans to re-open in 2 to 3 years. At nameplate capacity, these three could cumulatively produce about 690,000 tonnes of copper annually. At present, they produce approximately 300,000 tonnes annually, accounting for 2% of the total smelter capacity in the world.

Historically, Nevada has hosted two copper smelters over the past century: the Thompson Smelter site in Mason Valley, which operated from the 1910s to the 1920s, and the McGill Smelter, built in the 1930s and active until it was decommissioned and demolished in the mid-1980s.

Smelting is an energy-intensive process that relies on extreme heat generated through combustion to process copper concentrates. Higher flame temperatures—and thus more efficient smelting—can be achieved by introducing pre-heated air into the combustion process, as demonstrated in the flash smelter shown in Figure 5B.

While smelters consume relatively little water compared to other industrial operations, the water they do use is primarily for cooling purposes—such as quenching cast anodes, cooling the smelter shell, and supporting sulfuric acid production and other ancillary systems. In contrast, water plays a much more critical role in the refinery. For smelters, the key inputs are fuels like natural gas and electricity. For example, the Bingham Canyon smelter and refinery consumes approximately 2.8 billion cubic feet of natural gas, 200 gigawatt-hours of electricity, and 410,000 tonnes of oxygen annually to produce about 300,000 tonnes of pure cathode copper. This scale of operation requires a daily feed of roughly 2,300 to 2,700 tonnes of concentrate. It should also be noted that excess heat may be captured through waste heat recovery (WHR) during the smelting and refining process to generate additional energy, helping to offset the total electrical load required.

To build and operate a stand-alone smelter is atypical in the mining industry. Historically, smelters have been built adjacent to large mines. As examples, the smelter in McGill was built specifically to handle the concentrates collected from the Ruth Pit; the reverb smelter in White Pine, MI was built for the concentrates generated by Copper Range Mine. The Anaconda Minerals Company had a smelter in Anaconda, MT which processed the concentrates from Weed Heights and the massive Berkeley Pit in Butte, MT. Most smelters and refineries are located near large mines because the cost of operation is large, and a larger margin for profit is needed. If the concentrates being fed to the smelter cost the company a few dollars per pound of copper, the smelter operation is added to that smaller cost.

Tolling concentrates must include the purchase of the material from a concentrator (with their profit included) and a tolling fee must be assessed to treat these concentrates. Even with a large fee, the profitability margin is decreased for tolling processes, compared to "integrated" smelters with mines.

A stand-alone smelter could be built in a central location, or near an expanding mining district and could be operated as a toll refinery for most if not all of the concentrates in Nevada. For example, a smelter that could take the current concentrates from KGHM, Phoenix, and Pumpkin Hollow would need to process about 1,600 tonnes of copper concentrates per day, yielding about 160,000 tonnes of copper cathode each year. Such a facility would be slightly more than half the size of the smelter in Bingham Canyon, and larger than either the Miami or Hayden smelters.

If the capacity of a new smelter was sized to 2,400 tonnes of concentrate per day, the smelter and refinery could produce over 272,000 tonnes of cathode copper. This could make the U.S. the sixth largest copper smelting country in the world.

Smelters are built to a specific capacity and are nearly impossible to expand unless additional capacity is planned and space for an additional furnace is accounted for. If the smelter is constructed to handle 1,600 tonnes of sulfide concentrate, the smelter would not be able to grow its capacity to a higher throughput, even as new mines open in Nevada that add new concentrates to the market.

5.4.2.2 Pressure Oxidation of Copper Concentrates

In the late 1960s, a pressure oxidation process known as autoclaving (or simply P_{ox}) was invented and operated by Inco at the Sherritt-Gordon operation in Ontario, Canada. The autoclave uses high pressure gases (air or oxygen) and high temperatures to dissolve minerals that are otherwise impossible to dissolve. Figure 6 shows a diagram of the inside of these pressure leaching vessels. Slurries of mixed sulfides of copper and nickel were treated in the original autoclaves in Canada.

Autoclaves have since found opportunities in several other mining applications. In Nevada, autoclaves are used to oxidize "single-refractory gold ores." These ores have extensive sulfide mineralization that impedes the recovery of gold using cyanide. But, if the ores are oxidized in a high pressure of oxygen, the sulfide minerals are converted to acid and metal oxides, exposing the gold for subsequent cyanidation. The First Miss mine north of Golconda, Nevada—the present-day location of the Twin Creeks mine—was among the first gold operations to use an

Figure 6 Split view of a typical autoclave

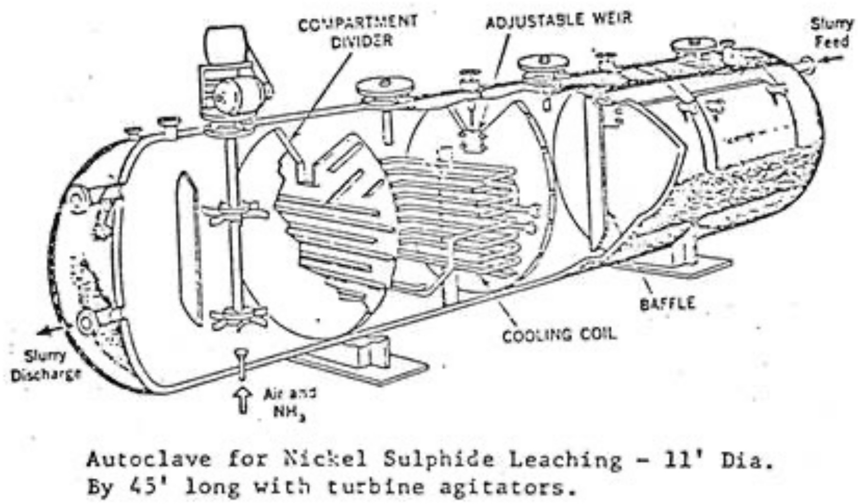
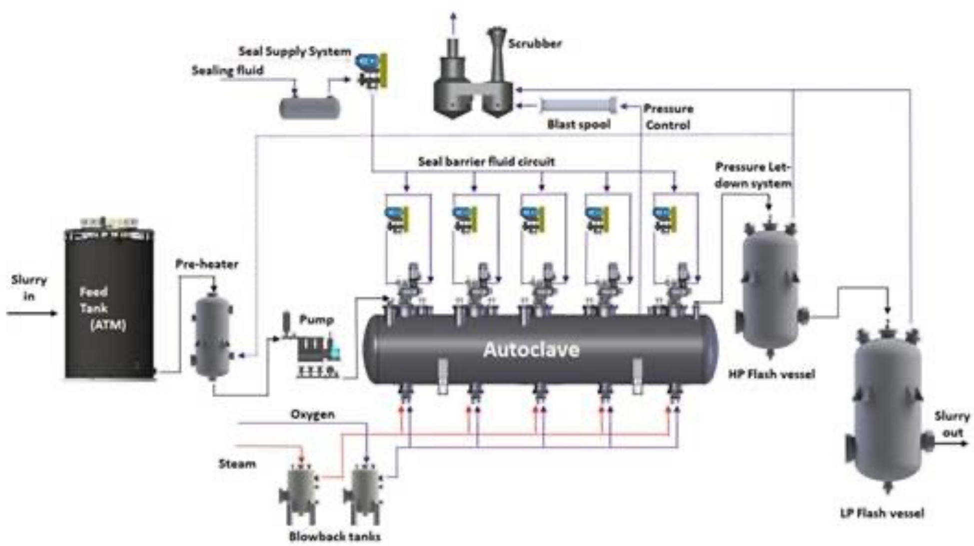


Figure 7 The typical flowsheet of an autoclave circuit



autoclave pretreatment to recover gold. Today, several mines in Nevada have autoclaves, including Twin Creeks (NGM), Goldstrike (NGM) and Lone Tree (I-80 Gold).

In the late 1990s Phelps-Dodge (now Freeport-McMoran) built autoclaves at the Bagdad Mine, south of Kingman, AZ and the Morenci Mine west of Phoenix, AZ. The process is illustrated in Figure 7.

Sulfide concentrates are fed into the autoclave as a slurry and pressurized to as much as 200 psia air or oxygen. The sulfur in the sulfide concentrates is converted to sulfuric acid in the autoclave. The acidic, oxidative conditions in the autoclave fully dissolve the metal value from the concentrates. Copper, iron, zinc, etc. are all "pushed" into the solution. The high pressure slurries, comprised of PLS and leached ore residue, are flashed which generates steam that is used to preheat the feed.

Once it has been depressurized, the preg solution (now with high concentrations of copper, and other metals) can be directly electrowon in a standard electrowinning cell like the ones on oxide copper mines. This is the "straight-forward" part of the operation. The process can be complicated by several things, however.

Autoclaves rely on a heat source for the process either externally (steam) or internally (the heat of reaction). For instance, if the concentrate contains less than about 4% sulfur, steam must be added to the coils to heat the unit up. Mined ores with less than 2% sulfides would need steam to be added to the autoclave. Concentrates with more than 10% sulfides will generate excessive heat, so a relatively clean source of cooling water must be added to maintain a given temperature.

The concentrate oxidation reaction results in the formation of sulfuric acid in the autoclave. However, copper concentrates do not generate the high volumes of acid. For instance, in chalcopyrite concentrates, the sulfur content is about 30% in the feed. This means that in the high temperature and pressure of the autoclave, the acid content is relatively low. If pyrite (FeS_2) were fed to the autoclave (the mineral is over 50% sulfur) significantly more acid would be generated. Most autoclaves in operation at gold mines blend the feed from several feed sources to improve the heat load of the autoclave.

Copper concentrates can be added to the autoclave, but a source of pyrite would be a welcomed addition to the process. In most metal mines, pyrite is considered a nuisance mineral to be rejected during concentration. However, one of the "single refractory gold ores" that is common in Nevada is gold locked in pyrite. Borealis, Tonkin Springs, Rawhide, etc. are all mines that have gold locked in pyrite. These mines are in care and maintenance because there isn't an oxidation process capable of including their concentrates (which are gold-bearing pyrite concentrates).

An autoclave of copper concentrates could toll the pyrite concentrates (for the added acid generation) and make an oxidized residue that could be leached by cyanide to recover the newly exposed gold. However, in the electrowinning process, iron ions (Fe+2 and Fe+3) greatly reduce the "current efficiency" of plating copper. Freeport discovered that operating the autoclave at a slightly lower temperature (around 200°C) will reject most of the iron as iron hydroxides that leave with the solids of the autoclave. This implies that the steam generated from the autoclave will be relatively low grade (200°C) but should be an excellent by-product for co-generating power if a power plant is located nearby.

Figure 8 shows the flowsheet anticipated for the autoclave leaching of copper sulfide concentrates and pyrite blends. Copper concentrates and pyrite will be added into a slurry that is preheated and pre-pressurized. The solution discharged from the autoclave will have copper concentrations as high as 40 g/L copper. The autoclave discharges into a clarifier (which is a large settling basin for solids to fall to the bottom) with the overflow PLS liquor going directly to the electrowinning cells for copper cathode recovery.

The slurry in the bottom of the clarifier will be about 60% solids, but 40% solution of PLS grade. A counter-current decantation circuit (CCD) can be used to rinse and collect this lost solution. The rinsed solution will have diluted copper concentrations and can be fed into a small solvent extraction unit to reclaim this copper and create a solution that can be recycled to the autoclave mixing unit. PLS and solvent strip will be sent to the electrowinning circuit to plate copper.

In several of the gold mines of Nevada, the Carbon-in-Leach (CIL) process is used to recover gold from oxide ores and oxidized ores from roasters and autoclaves. The rinsed solids (in Figure 8) will be sent directly to the CIL circuit in which cyanide is mixed with the ores to dissolve gold and adsorb it onto activated carbon.

The loaded carbon is collected and treated in a carbon strip plant. The gold on the activated carbon is eluted with hot cyanide solutions; the eluent solutions feed an electrowinning cell to recover gold on cathodes. The gold can be smelted in small furnaces on-site to form ingots for shipping to the gold refiners.

By simply oversizing the carbon-stripping circuit, the operation could perform toll stripping of carbon for smaller gold mining companies. Many companies collect the loaded carbon from their operation, and send the loaded carbon to companies like Just Refiners in Reno. Just Refiners burns the carbon to recover metal value, requiring mining companies to purchase new carbon as a consumable, unlike in carbon stripping where the carbon is recycled.

Estimated cost of autoclaving copper concentrates through electrowinning is $1.50 with cost off-sets of electricity from co-generation. The cost of electricity and labor are the largest contributing factors for this cost estimate. By-product gold can increase the net proceeds from the autoclave unit, depending on the cost of the Au-bearing pyrite.

5.4.2.3 Comparisons of Smelter/Refinery and Autoclave Processing

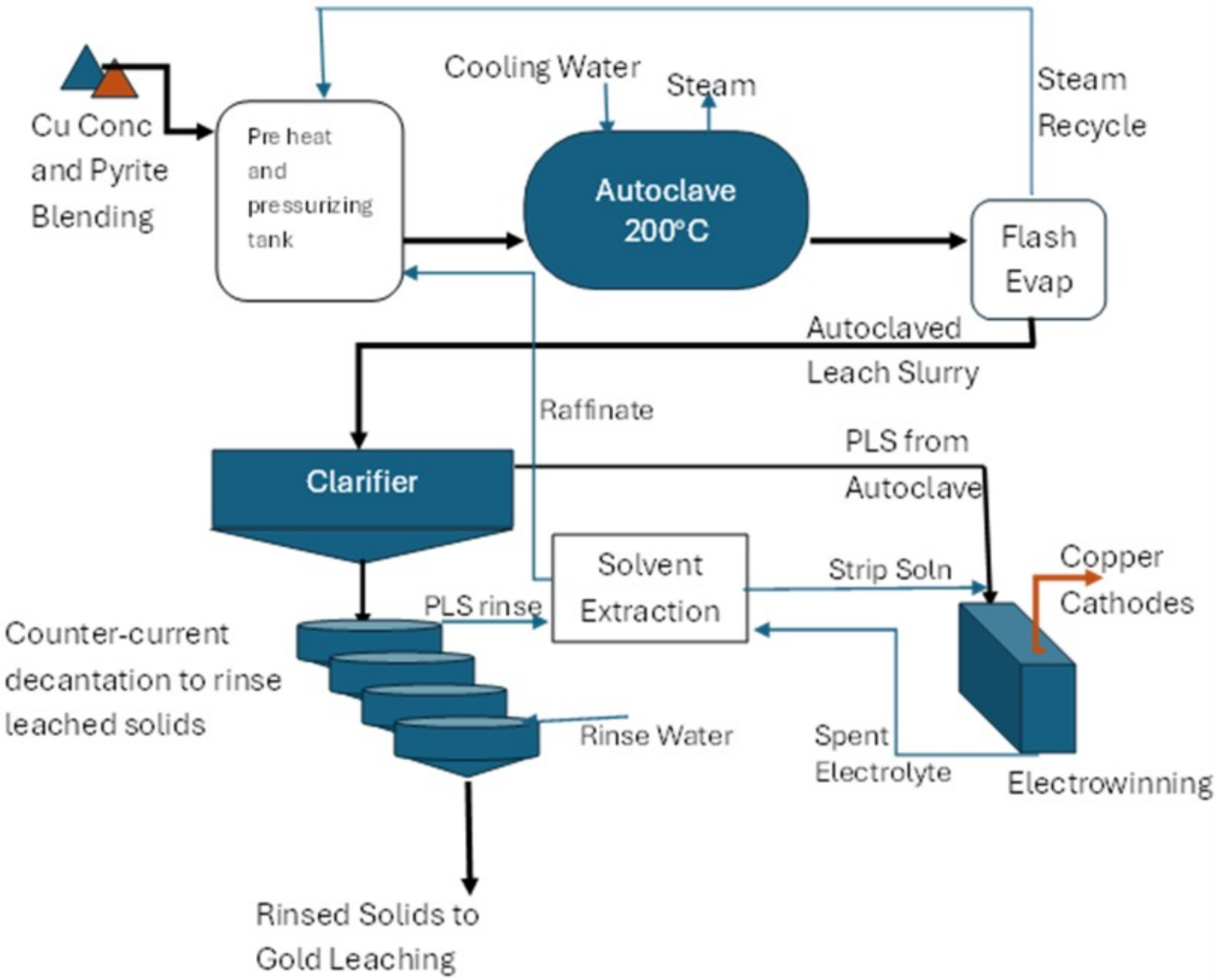
Both processes produce sulfuric acid which can be sold or recycled in the circuit. Smelters produce pure sulfuric acid from the SO_2 off-gases, while autoclaves produce acid in the pressure vessel and in the electrowinning circuit.

A smelter and refinery plan would require permits that cover water use, land use, storage of slags, and air permits. Autoclaves will require similar permits except the air permits. No volatile substances come from the pressure oxidation/reduction of copper sulfide concentrates. However, tailings impoundments with cyanide destruct permits would have to be added to the operation, that is, if gold-locked pyrite is added to the autoclave.

Autoclaves of concentrates will generate steam from the cooling of the reactor. This steam could be given to power plants to potentially off-set electricity costs to the electrowinning circuit.

Smelter and refinery plants are capital intensive, with 2,000 tonne-per-day facilities costing around $1.3 billion, while autoclave with electrowinning systems offer a lower-cost alternative at approximately $500 million and allow for modular expansion. Smelters can process gold-bearing pyrite, recovering gold in copper anodes and improving matte quality. Autoclaves can also treat Au-locked pyrite, boosting acid production but requiring a separate cyanide circuit for gold recovery. Adding carbon strip capacity would enable processing of loaded carbon from small Nevada mines for reuse. While operating costs are similar, autoclaves may see cost advantages through discounted steam from nearby co-generation plants.

Figure 8 Schematic of an autoclave circuit for pressure oxidation of copper sulfide concentrates



SECTION

06

Facility Siting Criteria and Permitting Requirements

06 TECHNOLOGIES: EXISTING AND POTENTIAL

SUMMARY

This section describes the critical factors for siting new copper mines and processing and production facilities in Nevada, emphasizing access to transportation infrastructure (highways and rail), energy sources (electric grid and natural gas), water, and air quality considerations. Existing freight and rail systems, primarily along the I-80 and US-95 corridors, support logistics, while Nevada's growing renewable energy projects and transmission upgrades offer opportunities for reliable power supply. Water rights management is vital due to limited surface water requiring careful acquisition of groundwater rights. Nevada has an extensive mining and processing workforce already within the state, however access to said workforce will be key for any new facility. Statewide workforce development programs are aimed at developing additional members of the skilled workforce necessary to mine, process, and produce copper in Nevada.

Environmental permitting for copper mining, processing, and producing concentrate and/or cathode involves coordinated approvals from federal, state, and local agencies. Key state permits include water pollution control, reclamation, and air quality operating permits. Federal permitting is managed primarily by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS), with National Environmental Policy Act (NEPA) reviews required for land disturbance. Ongoing permitting reform efforts aim to streamline processes and reduce timelines while maintaining environmental safeguards.

For siting, a standalone copper smelter in Nevada could be developed either in a central location or near an expanding mining district and could operate as a toll refinery for concentrates produced throughout Nevada, the western United States, and potentially beyond. Site selection must account for sufficient land area for the smelter, refinery, gas handling systems, and slag storage. Additional constraints include the height of the facility's stack, which may conflict with military airspace near installations such as Hawthorne, Fallon, Nellis, and Indian Springs. Brownfield sites may offer advantages in permitting and schedule compared to development on previously undeveloped land. Candidate regions for siting of a copper processing facility include Valmy, Mason Valley, Big Smokey Valley, Ely, Mineral County, areas north of Winnemucca, Fernley, and Jean. Each location presents a unique combination of strengths and challenges related to infrastructure, permitting, workforce availability, proximity to existing operations, and compatibility with military and environmental constraints. Determining long term feedstock availability is essential, as smelters are designed to fixed capacities and are not easily expanded once constructed.

6.1 FACILITY SITING

To site a new mineral processing facility, regardless of the commodity, at a minimum will need to evaluate the following aspects to be considered a viable project:

- ✓ Infrastructure
- ✓ Environmental Permitting
- ✓ Workforce and Expertise
- ✓ Feedstock of Concentrate
- ✓ Regional and Worldwide Processing Economics

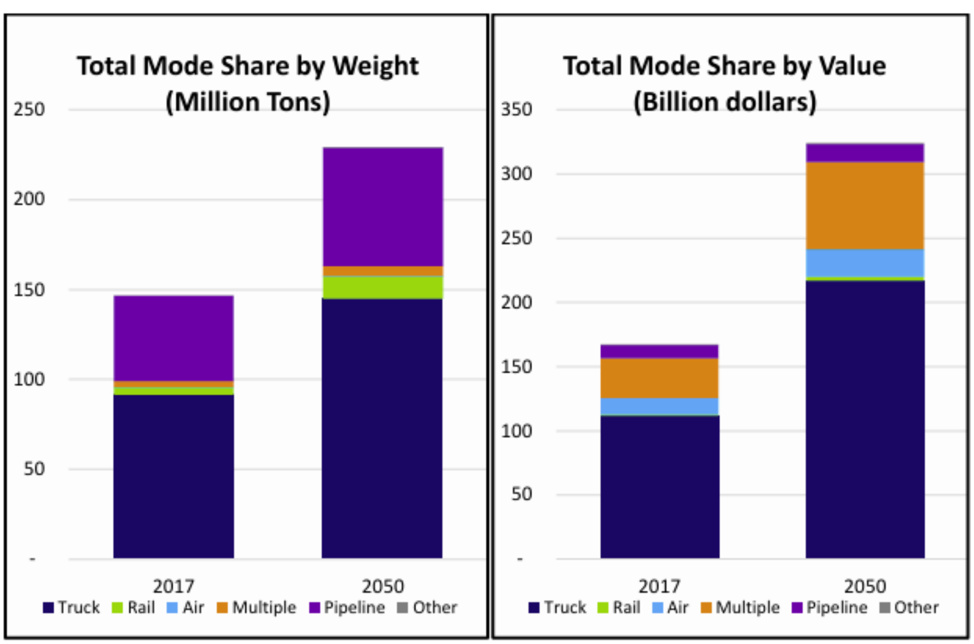
This section describes existing infrastructure necessary for copper mining and processing and opportunities for new facilities.

6.1.1 Existing Infrastructure

Transportation of concentrate to a new processing facility requires accessibility to highway and rail systems. Proximity to the electrical grid and natural gas pipelines is important to supply the energy to operate the concentrate processing facility and refinery. A source of water nearby is also required, as well as a location within an air basin available for industrial development.

Nevada freight system trends are influenced by population and employment growth, logistics practices of Nevada's economic sectors, the transition toward a green economy to reduce and mitigate climate change, and national freight trends. Other influences include Nevada's trade with other states, availability of alternative freight modes, the types of commodities shipped, and the growth of industries in Nevada supporting e-commerce. Safe and efficient freight movement is essential to Nevada's economic prosperity and is a key driver of transportation infrastructure needs.

Figure 9 Modal Distribution of Freight Trips by Weight and Value, 2017 and 2050 from the 2022 Nevada Freight Plan Update



Highway

Existing highways in Nevada include Interstate-80 (I-80) that traverses the northern portion of the state in an east-west direction as shown on Figure 12. I-80 is the primary highway freight system in Nevada. U.S. Highway 95 (US-95) and 95A trend north-south in the western portion of the state and connect Yerington to I-80 in the north and US-6 in the central portion of the state. US-6 trends east in the western portion of the state and northeast in the eastern portion of the state. US-6 intersects US-93 and 93A in the eastern portion of the state, which trend north-south from Ely to Wells and West Wendover.

Rail

Three main lines, owned by Union Pacific on the Overland Route, traverse northern Nevada from east to west and serve as key connections between California and the rest of the country. The railroad construction boom in Nevada during the first decade of the 20th century included the construction of 22 independent short lines. None of these 22 short lines have survived as a common carrier of freight, and almost all have been abandoned and scrapped. Rail mileage in Nevada peaked in 1914 at 2,422 miles, diminishing over time to its current 1,193 active rail miles.

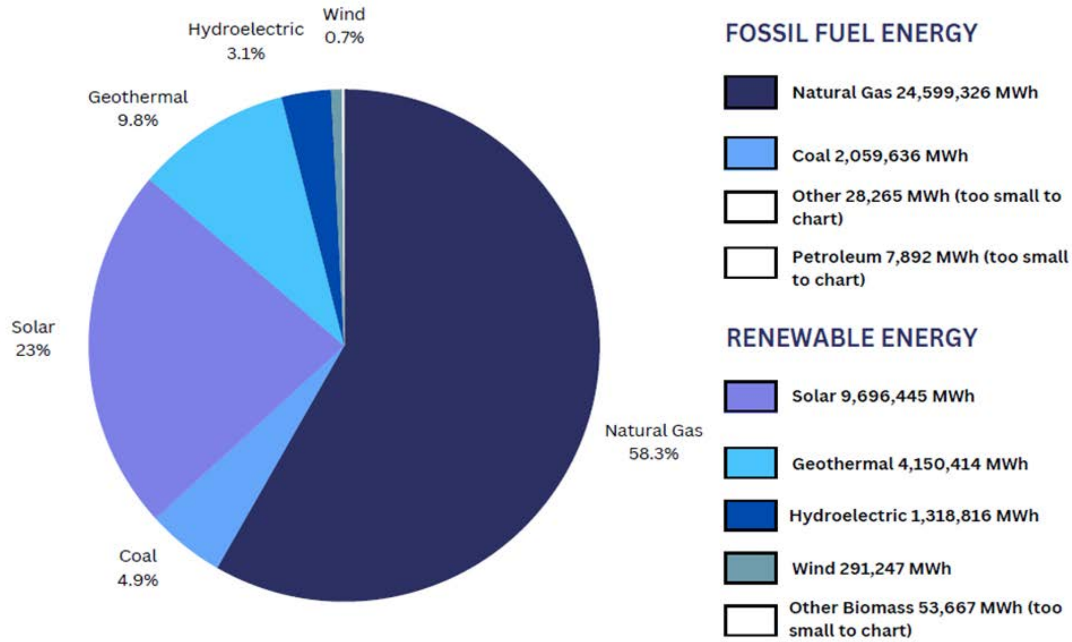
The 2021 Nevada State Rail Plan (NVSRP), designates eight rail-development regions in Nevada. Existing rail that could serve copper mines and processing facilities are located mainly in the northern and central portions of the state. Regions 4, 5, and 6, or the Overland Route and Central Corridor, service and parallel the I-80 corridor. The Overland Route is the main freight line in the state and currently has rail yards located in Sparks, Winnemucca, and Elko. Regions 5 and 8 the Fallon Branch, Mina Subdivision, and Thorne Branch, connect to the Overland Route and parallel the US-95 and 95A in the western portion of the state in a north-south direction, then continue south past Yerington. Region 3, the Northern Nevada Railway, parallels US-93 and 93A in the eastern portion of the state connecting Ely to the I-80 corridor and Overland Route between Wells and West Wendover.

Power

Nevada's energy portfolio is composed of fossil fuel energy including, but not limited to, natural gas, coal, and petroleum and renewable energy including solar, geothermal, hydroelectric, wind, and other biomass. As shown on Figure 12, transmission lines occur throughout the state and near the highways and rails discussed above. Natural gas pipelines are located along the I-80 corridor, as well as along the US-95 corridor.

Nevada produces far less energy than it uses. In 2021, energy produced in-state comprised only 17 percent of the total energy consumed. Nevada is at the forefront of solar power potential in the US, currently ranking sixth in total solar capacity and eighth in generation. Since 2016, the state's solar energy generation has nearly tripled. As of 2023, renewable energy sources account for 39 percent of Nevada's overall electricity generation, derived from both utility-scale and small-scale facilities (Figure 10).

Figure 10 2023 Electricity Generation Chart from the Nevada Governor's Office 2024 Status of Energy Report



Nevada is the largest area of geothermal potential in U.S. and the second largest geothermal producer in the U.S. Nevada's geothermal electrical generation plants are located predominantly in the northern portion of the State. Nevada's geothermal plants can generate up to 827 megawatts of power collectively in any given hour. A megawatt is 1,000 kilowatts, which is enough electrical power to serve up to 800 typical households. Nevada has 26 plants in 17 different locations. The 2018 gross electrical output for Nevada's 25 geothermal plants was 4,544,175 MWh, with net output (sales) being 3,587,219 MWh.

Water

In Nevada, water can be acquired by appropriation or by purchase from a municipality through public water systems. The Nevada Division of Water Resources (NDWR), manages a number of programs to conserve, protect, manage, and enhance the State's water resources. Although water belongs to the public, individuals or entities can obtain the right to use it by acquiring a water right because water is subject to appropriation for beneficial use. Any person who wants to place water to use within Nevada, except water that is used for domestic purposes as defined in NRS 534.013, must first obtain a water right from the NDWR.

Securing enough water to construct, operate, and close mines and associated processing facilities is a challenge in rural Nevada. The NDWR issues the approval to use surface and groundwater for mining, milling, and domestic purposes for the life of the mine. The mine may source water supply in the basin where the water will be used from surface or groundwater sources using existing water rights, by leasing or purchasing water rights from other water right owners, and/or by applying to appropriate new water rights (in basins that are not over-appropriated).

Open Air Basins

Stationary sources of air pollution, including mineral processing facilities located in the state are required to operate in a manner that does not result in an exceedance of the National Ambient Air Quality Standards (NAAQS); however, in some areas of the state are subject to additional standards under the Clean Air Act provisions for the Prevention of Significant Deterioration (PSD) pursuant to 40 Code of Federal Regulations Part 52.21. The standards for PSD increment limit the amount of additional pollution that is allowed from new and existing sources of pollution in an area relative to a baseline conditions. The baseline conditions are established when a permit application for a major stationary source of emissions is submitted to the permitting authority. In Nevada, when the PSD increment requirements are triggered the geographic boundary that is subject to these additional standards are the hydrographic area in which the triggering source is or will be located in and any nearby hydrographic areas in which the triggering source significantly impacts. Currently, only 26 of the more than 250 hydrographic areas in Nevada are subject to the PSD increment standards.

Environmental evaluations are used to ensure that the manner in which a new or modified source of air pollution is proposed to operate will not exceed the applicable quality standards. The process by which environmental evaluations are completed can vary depending on the permitting authority, but in general an application is submitted that contains information about how the company is proposing to operate the facility. The physical characteristics, operational parameters, and representative meteorological data are used to run air quality models to determine the expected impacts on air quality. The air quality models calculate the concentration of air pollution caused by the source being evaluated in the areas outside of the fenceline of the facility. The evaluation for the NAAQS typically considers only the impacts of the proposed source, but the analysis for the PSD increment accounts for the net change in emissions from all sources since the baseline. The PSD increment standards can be the limiting factor for new sources entering a hydrographic area that has been triggered for one or more pollutants, especially in areas where multiple sources are located close to each other.

6.1.2 Proposed Infrastructure

Highway

In 2022, The Federal Highway Administration-Nevada Division Office approved the Nevada Freight Plan Update. The objective of the plan is to provide a strategic framework for enhancing freight mobility along with improving transportation safety and sustainability. The plan also makes specific recommendations on improving the state's freight infrastructure to strengthen and diversify Nevada's economy. These efforts are a part of broader initiatives dedicated to enhancing the economic well-being of the freight related sector within the state of Nevada. As an outcome of the Bipartisan Infrastructure Law and the Infrastructure Investment and Jobs Act, each state has been awarded an allotment of formula funds over a five-year period, from fiscal years 2022 through 2026. Total National Highway Freight Program Estimated Funds for Nevada equals $118,028,540.

No new highways are planned for construction that would improve copper mine facility siting at this time; however, the I-80/I-580 interchange in Reno is being improved through a five phase project over a 20-year period that will help the increasing transportation on the I-80 corridor.

The concept of an I-11 from Las Vegas to Reno has been discussed and evaluated over multiple decades. If this was to come to fruition, it would improve truck transportation from Arizona to Northern Nevada.

Rail

The NVSRP includes projects to preserve rail lines, rehabilitate rail lines to improve service, and restore or improve freight service on rail lines that are potentially subject to abandonment. Nevada's latest state freight plan was completed in 2017. The primary purpose of the Nevada Freight Rail Strategic Plan is to serve as a statewide long-range freight planning document, fully integrated with other state planning initiatives. Freight rail development in Nevada should progress as a response to two dynamics contributing to the state's commercial development. One is the increasing demand for strategic minerals of which Nevada has an abundance. Mining continues to be a major industry in the Nevada economy. The other is locating warehouse and distribution centers in Nevada that primarily serve California's economy and population. The Nevada Freight Rail Strategic Plan within the NVSRP includes a detailed plan for rehabilitation of the existing lines to improve service and the State is currently seeking funding to implement the program.

Power

Power is transmitted from substations located around the state in the vicinity of the transmission lines shown on Figure 12. The substations are powered by a combination of fossil fuel energy and renewable energy. In many cases, new power can be transmitted by upgrading these existing substations. If existing power needs to be upgraded, it is likely that new substations will need to be constructed to transform the upgraded distribution voltage. Collaboration with the local power companies early in the engineering process is highly recommended to learn about the range of options to power a mine and process facility. This may involve expanding existing right-of-ways (ROWs) or establishing new ROWs, which should be taken into consideration when planning baseline studies for environmental permitting.

In March 2023, Governor Joe Lombardo issued Executive Order 2023-007 directing Nevada to pursue a diverse and balanced portfolio of energy generation resources, including natural gas and renewables (defined in NRS 704.7811 as biomass, geothermal, solar, waterpower, and wind). The Greenlink North and West Transmission Project was designed to enhance Nevada's electrical grid by integrating renewable energy sources and improving energy reliability. Greenlink North, which spans over 500 miles, will connect renewable energy generation facilities in northern Nevada to the existing transmission network to be transmitted to urban and rural consumers. Greenlink West complements these efforts by enhancing interconnections with neighboring states, fostering regional cooperation, and energy sharing. Together, this project will reduce greenhouse gas emissions and advance Nevada's renewable energy goals. This near-term project presents an opportunity to supply energy to potential locations for copper mining and processing.

NDOM is the state's regulatory authority for all geothermal wells drilled in Nevada regardless of whether they are on public or private land. The BLM issues geothermal leases on public land and permits geothermal drilling in coordination with NDOM on public lands. Greenlink targets geothermal zones along the I-80, I-50, and US-95 corridors which are potential transportation corridors for copper mines and process/production facilities (Figure 11).

A naturally occurring geothermal system (a hydrothermal system), requires three key elements to generate electricity: heat, fluid, and permeability, which is when fluid can move freely through the underground rock. In many areas the underground rock is hot; however, there is not enough natural permeability or fluids present. In those cases, an enhanced geothermal system (EGS) can be used to create a human-made reservoir to tap that heat for energy. DOE previously funded a successful EGS demonstration project in Nevada at Desert Peak.

Figure 11 Greenlink Project Renewable Energy Zones

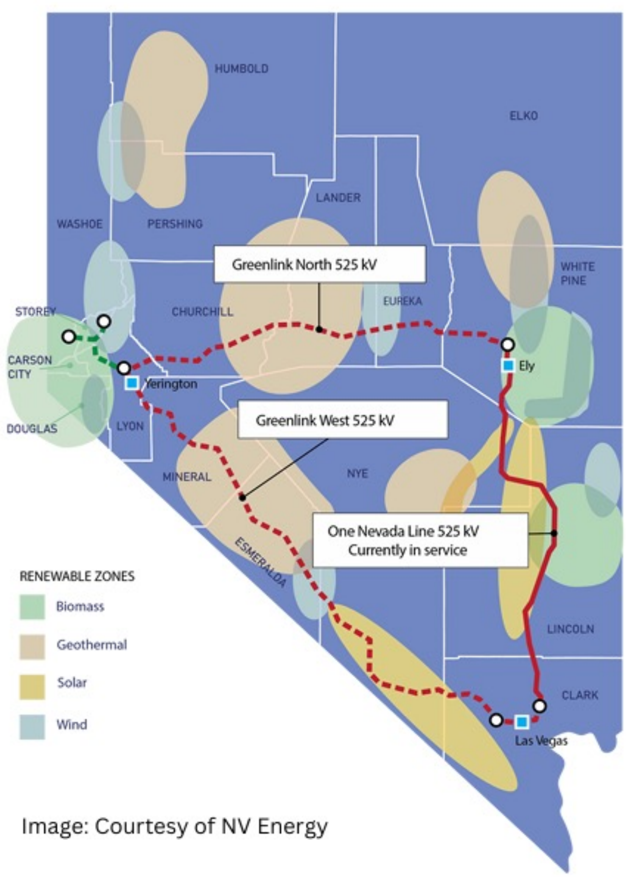


Image: Courtesy of NV Energy

At this project, Ormat Technologies stimulated a non-commercial well on the periphery of its operating conventional geothermal system. The stimulation successfully created an EGS reservoir and added 1.7 MW of electricity production at the existing geothermal power plant. Nevada has significant EGS potential and the USGS has recently estimated that the Great Basin can provide up to 10% of the U.S. energy needs with the use of EGS (USGS EGS 2025).

Water

Water rights in Nevada involve two types: surface water and groundwater. Because surface water is scarce in copper bearing basins, this analysis assumes groundwater appropriation. Nevada's prior appropriation doctrine means rights are granted based on application date, with earlier permits considered senior and later ones junior. Operators typically purchase water rights in the basin, file change applications, and install wells near diversion points for mining, milling, and dewatering. Groundwater permits require totalizing meters for accurate measurement and specify diversion limits in cubic feet per second (cfs) and annual volume (acre feet). Ensuring adequate water rights is critical for successful mining and processing.

Proof of work completion such as installing wells and meters must be submitted within the permit's timeframe. Final proof of beneficial use confirms the water has been applied as permitted; if less water or acreage is used, rights adjust accordingly. Expanding water use requires a new permit. After proofs are filed and conditions met, the State Engineer under NDWR issues a Certificate of Appropriation, officially recording the right. Certificates can be lost by forfeiture or abandonment if unused. Beneficial use is the basis and limit of water rights.

Vested rights established before water laws (1905 for surface water, 1913 and 1939 for underground sources) are confirmed through adjudications led by the State Engineer. Claimants must file proofs and maps prepared by licensed Water Right Surveyors to document diversion points and uses. This process protects existing rights and informs new applicants of claims on the water source.

Workforce

A skilled workforce is important for the future of mining in Nevada. Mining employment in Nevada is 10 times the national average, with the state leading the nation in production of gold and various other minerals. There are many programs in place that encourage careers in the mining industry. The Governor's Workforce Development Board Industry Sector Council - Mining and Materials Sector Council identifies workforce needs and develops initiatives to educate Nevada's workforce in support of the economic development goals of the State. Nevada offers successful programs to fill industry needs through Great Basin College and the Mackay School of Earth Sciences and Engineering at University of Nevada, Reno. Both educational institutions have tremendous support from the mining industry. Workforce Innovations for the New Nevada (WINN) represents the first workforce development training program of its kind in Nevada and is a commitment to businesses to arm them with the skilled employees that they need. Current partnerships with College of Southern Nevada, Great Basin College, Truckee Meadows Community College, and Western Nevada College offer programs in many skilled trades that are necessary in mining, processing, and manufacturing with a 2024-2025 budget of $10,000,000. In addition, many operating mines fund student internships and opportunities to promote existing employees to encourage mining career development in Nevada.

6.2 NEVADA ENVIRONMENTAL PERMITTING REQUIREMENTS

Permitting a new copper mine, process/production facility or expanding operations at an existing copper mine and process/production facility will require approvals and authorizations from federal, state, and local agencies, even if the mine and supporting infrastructure (e.g., access roads, powerlines, pipelines, railway, etc.) are entirely on private land. If supporting infrastructure crosses federal land to the project location it requires a ROW. This is considered a connected action and potential effects from the proposed action (project) will be reviewed through the U.S. Federal environmental permitting process. Most mine operations in Nevada overlap federal land and require some level of federal permitting. This section explains the requirements to permit a copper mine and process facility in Nevada taking into consideration infrastructure and siting. The primary permits necessary to mine are listed in Table 10.

Table 10 Primary Permit Requirements Needed Prior to Construction and Operations

PRIMARY PERMIT REQUIREMENTS NEEDED PRIOR TO CONSTRUCTION AND OPERATIONS	
PERMIT	**REGULATORY AGENCY**
FEDERAL PERMITTING	
Mine Plan of Operations/Record of Decision	United States Department of the Interior, Bureau of Land Management
Incidental Take Permit (Golden Eagle)	U.S. Fish and Wildlife Services
Explosives Permit	U.S. Department of Treasury, Bureau of Alcohol, Tobacco, Firearms, and Explosives
Hazardous Waste Identification Number	Environmental Protection Agency
STATE PERMITTING	
Water Pollution Control Permit	Nevada Division of Environmental Protection - Bureau of Mining Regulation and Reclamation
Reclamation Permit	Nevada Division of Environmental Protection - Bureau of Mining Regulation and Reclamation
Air Quality Permit	Nevada Division of Environmental Protection - Bureau of Air Pollution Control
Water Rights Appropriation	Nevada Division of Water Resources
Stormwater National Pollutant Discharge Elimination System (NPDES) General Permit	Nevada Division of Environmental Protection - Bureau of Water Pollution Control
Rapid Infiltration Basin (RIB) Permit	Nevada Division of Environmental Protection - Bureau of Water Pollution Control
Notice of Dam Construction1	Nevada Division of Water Resources
Water Rights Appropriation	Nevada Division of Water Resources
Dam Safety Permit1	Nevada Division of Water Resources
Public Water System Permit	NDEP, Bureau of Safe Drinking Water
Hazardous Waste Management Permit	NDEP, Bureau of Waste Management
Industrial Artificial Pond Permit	Nevada Department of Wildlife, Habitat Division
Septic System Permit	Nevada Division of Public Health
Hazardous Materials Permit	State Fire Marshal
Hazardous Materials Storage Permit	State Fire Marshal
LOCAL (COUNTY)	
Project Notification	County
Special Use Permit	County
Building Permit(s)	County
Business License	County

[1] These permits may be required if a tailings impoundment is proposed.

6.2.1 State Permitting

If a proposed mine and/or processing infrastructure are located entirely on private land, environmental permitting will be completed with several state agencies and require authorizations from local agencies. At a minimum, an Explosives Permit and a Hazardous Waste Identification Number will be required by federal agencies. The three most comprehensive state permits for operating and producing mines in Nevada include the Reclamation Permit, Water Pollution Control Permit (WPCP), and Air Quality Operating Permit; all issued by branches of the Nevada Division of Environmental Protection (NDEP).

The State of Nevada requires permits for all mineral exploration and mining operations regardless of the land status. The NDEP-Bureau of Mining, Regulation, and Reclamation (BMRR) is the primary State agency regulating mining. The Bureau of Water Pollution Control (BWPC) protects the Waters of the State from the discharge of pollutants. The BWPC regulates all discharges to Waters of the State through issuing permits and enforcing the State's water pollution control laws and regulations. NDEP Bureau of Air Pollution Control (BAPC) works closely with NDEP-BMRR on mining projects and issues permits to construct facilities that emit gases or particulate matter to the atmosphere. NDWR issues appropriations to use groundwater and/or surface water for mining, milling, and domestic purposes.

Reclamation Permit

An operator must obtain a Reclamation Permit prior to construction of any exploration, mining, or milling activity that proposes to create disturbance over 5 acres from the NDEP-BMRR. The Reclamation Plan is the main permit application for the proposed operation. In determining the proposed surface area disturbance, an operator must account for all land proposed to be disturbed as well as existing disturbances that will be part of the project. Land shall be considered disturbed until all reclamation activities have been completed to establish a productive post-mining use of the land. Reclamation Permit exemptions include the following:

1. A small mining operation that is limited to a surface disturbance of not more than 5 acres in any calendar year (the operator must file a Small Mining Operations Information and Documentation form); and
2. Aggregate or sand pit operations.

This assessment analyzes a mining operation that disturbs greater than 5 acres in a calendar year because most copper mine operations fit into this category. Reclamation is regulated in Nevada under the authority of the Nevada Revised Statues (NRS) 519A.010 - NRS 519A.280 and the Nevada Administrative Code (NAC) 519A.010 - NAC 519A.415. The Reclamation Permit application includes the Plan of Operations, which is described in detail in the federal land environmental permitting process; however, in the private land only scenario, the Plan of Operations is within the Reclamation Plan and these are not separate documents like they are when a mine is located on federal land. In addition to obtaining a Reclamation Permit, an operator must file a reclamation bond with the NDEP to ensure that reclamation will be completed, should an operator default on the project. The reclamation bond cost is evaluated in three-year updates through the NDEP-BMRR to ensure it reflects current costs and inflation.

Water Permits

NDEP-BMRR administers the State of Nevada WPCP application process for the mine, ore processing, and operation of the fluid management system in accordance with NAC 445A.350 through NAC 445A.447. A WPCP includes requirements for the management and monitoring of the mine and ore processing operations, including the fluid management system, to prevent the degradation of Waters of the State. A WPCP requires a detailed level of engineering and issued-for-construction (IFC) drawings. Once authorized, a WPCP is valid for a duration of 5 years, provided the operator remains in compliance with the regulations.

NDWR issues the approval to use groundwater for mining, milling, and domestic purposes for the life of the mine. The Project will source water supply from surface or groundwater sources using existing and/or new water rights that are owned by the proponent or have been leased or purchased from other water right users in the basin.

Discharge permits define the quality of a permitted discharge to protect the Waters of the State as defined in NRS 445A.415. The Bureau of Water Pollution Control (BWPC) may issue individual, general, or temporary permits. The types of discharge, duration, and potentially impacted waters are considered when deciding on the type of permit required.

While NDEP has primacy for issuance of National Pollutant Discharge Elimination System (NPDES) permits, the EPA oversees the federal program and has authority to review draft permits issued by NDEP. In addition, any disturbance below the ordinary high-water mark of nearby waterways or wetlands would require involvement by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act, if the wetland or waterway is jurisdictional to the US Army Corps of Engineers (USACE). While dredge and fill activities below the high-water mark will trigger USACE involvement under Section 404 (including some level of associated NEPA review), dewatering discharge to wetlands or waterways alone will not involve Section 404.

Air Permit

NDEP - BAPC issues Air Quality Permits for the construction and operation of mine and process facilities to maintain ambient air quality. Permits are issued in accordance with NAC 445B.001 through NAC 445B.3689. NDEP - BAPC has primacy from the Environmental Protection Agency (EPA) for air quality activities under the Federal Clean Air Act of 1970, as amended. Like the WPCP, the Air Quality Permit application will be submitted after the operator has confidence that their project design will be approved in the Reclamation Permit. The type of Air Quality Permit is dependent upon threshold exceedances (e.g., Class I, Class II). As part of the air permitting process, the Project's Potential to Emit (PTE) is reviewed to determine whether it constitutes a major stationary source. If it is determined that a Class I permit is needed, the federal EPA will also have jurisdiction over the Air Quality Permit. The different types of Air Quality Permits that apply to mining operations include:

- ✓ Class I - Typically for facilities that emit more than 100 tonnes per year for any one regulated pollutant or emit more than 25 tonnes per year total Hazardous Air Pollutant (HAP) or emit more than 10 tonnes per year of any one HAP or is a Prevention of Significant Deterioration (PSD) source or major Maximum Achievable Control Technology (MACT) source.
- ✓ Class II - Typically for facilities that emit less than 100 tonnes per year for any one regulated pollutant and emit less than 25 tonnes per year total HAP and emit less than 10 tonnes per year of any one HAP.
- ✓ SAD - Surface Area Disturbance of greater than 5 acres.

Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) requires that all federal agencies planning actions defined as undertakings (i.e., activities making use of federal funds or requiring federally-issued permits, licenses, or approval)- or even state agencies, municipalities, or other parties making use of pass-through federal funds or approvals for their projects "take into account" the potential effects of their proposed projects on historic properties. The State Historic Preservation Office (SHPO) administers the State Historic Preservation Program, reviewing proposed undertakings that may affect historic properties, and represents the concerns of people in the State. As a service to state and local agencies conducting projects for which there is no federal nexus (i.e., private land project undertakings), SHPO reviews projects for potential effects to cultural resources under the authority of state statutes in accordance with NRS 383.121. Any proposed mining or processing project is considered an undertaking whether it will result in effects to historic properties, or not, and a checklist must be submitted to the SHPO to complete a review of the proposed undertaking.

Biological Resources

In 1877, the Nevada Legislature established the State Office of Fish Commissioner, which changed in 1917 to the State Fish and Game Commission. Now called the Nevada Department of Wildlife (NDOW), this agency has statutory authority to manage and conserve the nearly 900 wildlife species found in Nevada. NDOW will review the application, analyze how the proposed action may affect wildlife, and coordinate with operators on mitigation for impacts to those species.

The Nevada Division of Forestry (NDF) regulates flora in Nevada per NRS 232.090. A species or subspecies of native flora shall be regarded as threatened with extinction when its existence is endangered and its survival requires assistance because of overexploitation, disease, or other factors, or because its habitat is threatened with destruction, drastic modification or severe curtailment. NDF is charged by NRS 527 with adding and removing species from the list of Critically Endangered species (NAC 527.010) and for managing the special take permitting process on all lands within Nevada.

Based on the baseline study results, a mine or processing project may require an Incidental Take Permit with the U.S. Fish and Wildlife Service (USFWS) under the Bald and Golden Eagle Protection Act (50 Code Federal Regulations [CFR] 22). If an Incidental Take Permit is required, USFWS will also be required to conduct some level of review under NEPA and will likely be a cooperating agency on the Federal NEPA process, if the project overlaps federal land.

Hazardous Waste

As prescribed in NRS 459.400, the Bureau of Sustainable Materials Management (BSMM) administers the hazardous waste program and is responsible for permitting and inspecting hazardous waste generators and disposal, transfer, storage and recycling facilities. It is also responsible for enforcing state hazardous waste statutes and regulations and program staff are authorized to enforce Federal hazardous waste regulations instead of the EPA. Operators will apply for their Hazardous Waste Identification Number and Hazardous Waste Management Permit through the BSMM.

6.2.2 Local Permitting

Operating a mine or processing facility in any County in Nevada requires a business license followed by a Project Notification. The County can issue a Special Use Permit authorizing mining and/or processing for the Project. The County Building Department will also issue various permits to construct and inhabit structures and facilities including building, electrical, plumbing, and mechanical permits, and will conduct inspections of these structures and facilities.

6.2.3 Federal Permitting

The BLM and the USFS administer their own respective lands. The BLM is under the Department of the Interior (DOI) while the USFS is under the Department of Agriculture (USDA) and therefore, they have different policies and permitting processes. The BLM is administered under the Federal Land Policy and Management Act (FLPMA) of 1976 while the USFS is managed under the National Forest Management Act. Surface disturbing activities on both BLM land and USFS land are reviewed through the National Environmental Quality Act (NEPA), which was established by the Council on Environmental Quality (CEQ) in 1970, within the Executive Office of the President. CEQ consults and coordinates with federal agencies, providing guidance on the implementation of NEPA for environmental review and permitting processes across the Federal government. Table 11 lists the potential baseline surveys and studies to obtain permit authorizations to mine, process, and produce copper.

Table 11 Potential Baseline Surveys and Studies

COPPER OXIDE RESOURCES IN NEVADA	
STUDIES	**SCOPE OF WORK**
Wetlands, seeps and springs, and Waters of the US	• Geomorphology survey • Hydrology (field measurements and water quality sampling) • Vegetation and fauna observations • Soils and moisture observations • Proper functioning conditions • Aquatic resources (e.g., spring snails and macroinvertebrates)
Groundwater and surface water characterization	• "Groundwater baseline characterization (groundwater level and water quality sampling) • Aquifer testing • Pit lake and groundwater flow model (water balance, dewatering rate(s), temporal water quality changes) • Groundwater contaminant transport model • Stream delineation (flow rates and water quality sampling)"
Geochemistry characterization	• Drilling and characterization for pit lake water infiltration galleries • Waste rock characterization • Static testing (discrete and composite): Acid Base Accounting (ABA)and paste pH, Net Acid Generation (NAGpH) and Net Acidity Testing • Kinetic testing: Humidity Cell Testing (HCT) on waste rock, and Trickle Leach Column Testing on synthesized heap leach/ore composite(s). • Pit lake modeling"
Vegetation and wildlife	• Biological inventory • Ecological risk assessment • Golden eagle consultations"
Cultural resources and Native American religious concerns	• Class III (intensive) cultural resources inventory Tribal consultation"
Air quality	• Baseline data collection • Dispersion air modeling • Green House Gas (GHGs) emissions inventory
Noise	• Baseline data collection • Noise modeling
Soil and rangeland	• Desktop review of publicly available information and previous studies/surveys
Geology and mineral resources	• Desktop review to characterize the physiographic and topographic setting, regional geology, site geology, mineralization, past mining, and geologic hazards and features of the Project Area
Traffic and transportation study	• Traffic study • Desktop review of public access, transportation, and traffic patterns in the area
Recreation	• Review of federal, state, and local laws, regulations, and guidelines for recreation and wilderness resources management to describe recreational use
Socioeconomic	• Study to describe the socioeconomic characteristics and conditions • Environmental justice assessment
Visual resources	• Viewshed analysis • Digital photography survey and computer-generated visual simulations

Plan of Operations / Reclamation Permit Application

For surface disturbance of 5 acres or more on BLM land or 1 mile of road or greater on USFS land, operators must file a Plan of Operations and Reclamation Permit Application. The Plan of Operations and Reclamation Permit Application will include the details around constructing, operating, and closing an open pit or underground mine, ore processing facility, and facilities for producing copper concentrate and/or copper cathode. The characterization of environmental resources at the project will need to be adequate to support development of the major permit applications, support analyses, and modeling to complete NEPA analysis under an Environmental Impact Statement (EIS) as a result of the potential for the project to impact air quality and/or Waters of the State.

Once a Plan of Operations is determined to be complete, an environmental analysis is prepared. Since most of the copper resources or operations occur on BLM land, an EIS permitting process on BLM land is the emphasis of this analysis. BLM's Nevada Instruction Memorandum (NV-IM) 2023-003 provides the current protocol all Nevada BLM offices must follow for processing and approving federal actions, including implementation and procedural guidance for project initiation and pre-planning, NEPA compliance, and ensuring consistent compliance with applicable regulations when authorizing federal actions.

NV-IM-2023-003 describes the initial project review process which includes submittal of a project proposal, multi-agency/stakeholder baseline kickoff meeting, and determination of baseline surveys requirements.

Under this NV-IM, all baseline reports as determined by the baseline data needs assessment, the Mine Plan of Operations and Reclamation Plan Permit Application, Supplemental Environmental Reports (SERs), and Supplemental Information Report (SIR) need to be completed and approved by BLM prior to initiating the NEPA process. In addition to the BLM, the NDEP will review the Mine Plan of Operations and Reclamation Plan Permit Application, dispersion air modeling, groundwater modeling, and geochemical modeling.

NEPA requires BLM to assess the environmental effects of the proposed action prior to making decisions. It is anticipated that the BLM will determine that an EIS-level review will be required for permitting a copper mine and processing operation because there is the potential to degrade Waters of the State or impact air quality.

The NEPA process begins with BLM issuance of a Notice of Intent (NOI) in the Federal Register. NV-IM-2023-0003 outlines the typical process by which BLM will complete an EIS and receive a Record of Decision (ROD) within 365 days. A ROD explains the agency's decision, describes the alternatives the agency considered, and discusses the agency's plans for mitigation and monitoring, if necessary.

Water, Rock Chemistry, Air Permits

A regional numerical groundwater model to assess potential impacts to the surface and groundwater system from processing and pumping water for operations. Along with the air quality model, these are the most time-consuming and labor-intensive studies for permitting. Available information will need to be reviewed to identify potential data gaps. As part of the State permitting, consultation with regulatory agencies such as NDEP and NDWR to refine the baseline data needs that will support the preparation of a Reclamation Plan, WPCP, Air Permit is strongly advised.

If the project proposal includes a copper smelter, there are four federal regulations that copper smelters may be subject to:

1. 40 CFR 60 Subpart P – Standards of Performance for Primary Copper Smelters
2. 40 CFR 63 Subpart QQQ – National Emission Standards for Hazardous Air Pollutants for Primary Copper Smelting
3. 40 CFR 63 Subpart EEEEEE – National Emission Standards for Hazardous Air Pollutants for Primary Copper Smelting Area Sources
4. 40 CFR 63 Subpart EEEEEEE – National Emissions Standards for Hazardous Air Pollutants: Gold Mine Ore Processing and Production Area Source Category

Subpart P applies to concentrate dryers, roasters, smelters, and converters and establishes standards for emissions of particulate matter, sulfur dioxide, and visible emissions. Monthly monitoring is required for specified metals in the smelter charge, continuous visible emission monitoring for concentrate dryers, and continuous sulfur dioxide monitoring for roasters, smelters, and converters.

Subpart QQQ applies to primary copper smelters that are a major source of hazardous air pollutants and establishes standards for particulate emissions for concentrate dryers, smelters, and slag cleaning vessels. This subpart prohibits the use of batch copper converters in new facilities. Continuous monitoring is required for emissions capture systems for converters.

Subpart EEEEEE applies to copper smelting facilities that include concentrate dryers, flash furnaces, bath furnaces, converters, combination smelting and converting reactors, anode shaft furnaces, and anode refining furnaces. This subpart establishes standards for emissions of particulate matter and requires continuous monitoring.

Subpart EEEEEEE applies to gold ore processing facilities and establishes standards for mercury vapor emissions. Facilities, where 95% or more of the metal(s) produced are other than gold, are not considered part of a gold processing plant.

The Multilateral Investment Guarantee Agency (MIGA) is a member of the World Bank Group, which promotes direct investment in developing countries. MIGA proposes guidelines for air and water quality for smelters. For air emissions, guidelines are provided for sulfur dioxide, particulates, and heavy metals including arsenic, cadmium, copper, lead, and mercury. Air emission control systems include a double contact acid plant for producing sulfuric acid as a byproduct for sale. Particulates are captured by fabric filters and volatilized arsenic and mercury are condensed by cooling the off-gas. Continuous monitoring for sulfur dioxide and particulates is recommended, with monthly monitoring for the other parameters.

MIGA guidelines for water quality parameters are pH, total suspended solids, and the same heavy metals as for air emissions with the addition of zinc. Control of pollutants in liquid emissions would be by precipitation and filtration. Daily monitoring of liquid effluents is recommended for pH and suspended solids along with monthly monitoring for the other parameters. While MIGA guidelines are not directly relevant to standards that might be applied to a smelter in Nevada, where they are more stringent than federal requirements, the

MIGA guidelines may be viewed by regulators and financiers as representative of best practices, becoming de facto targets for air and water emissions for a new domestic facility.

Smelters also produce solid waste in the form of slag. MIGA recommends managing this solid waste by landfilling or granulating. Granulated slag may be sold as a byproduct. MIGA summarizes key issues of production and control as follows:

- ✓ Give preference to processes that are energy efficient and produce high sulfur dioxide concentrations (e.g., flash smelting).
- ✓ Use oxygen for enrichment of sulfur dioxide.
- ✓ Use the double contact double absorption process for sulfuric acid production.
- ✓ Reduce effluent discharge by maximizing wastewater recycling.
- ✓ Maximize the recovery of dust and sludges.
- ✓ Minimize fugitive emissions by encapsulation of process equipment and use of covered or enclosed conveyors.
- ✓ Give preference to dry dust collectors over wet scrubbers.

The MIGA guidelines highlight a key advantage for a smelter. A smelter would produce a readily marketable, concentrated sulfuric acid byproduct, whereas a leach plant produces dilute acid, which must be neutralized for disposal if there is no facility nearby with a use for the dilute acid.

The technology exists to design, build, and operate an environmentally compliant smelter. Nevada remains one of the most mining-friendly jurisdictions in the world. These factors improve the chances for success in obtaining the necessary permits for a new smelter.

While undeniably complex and potentially controversial, environmental permitting should not be considered a fatal flaw.

A concentrate leach plant would be similar in many ways to the autoclave pressure oxidation facilities that have been built in Nevada to process refractory precious metal ores. The primary environmental concerns for a smelter are sulfur dioxide and particulate emissions, which are reduced for a concentrate leach plant. The federal regulations cited above, 40 CFR 60 Subpart P, 40 CFR 63 Subpart QQQ, and 40 CFR Subpart EEEEEE, address air emissions from copper smelters and associated facilities, but probably would not apply to concentrate leach plants. The primary source of air emissions from a concentrate leach plant is the vent on the autoclave flash cooler, which is not listed as a regulated source in the federal regulations. Subpart EEEEEEE, 40 CFR 63, would likely not apply to the pressure oxidation, solvent extraction, or electrowinning portion of a concentrate leach plant, but could apply to a precious metal recovery circuit processing concentrate leach residue.

Leach residue from the concentrate leach plant must be disposed of and stored in an engineered facility. The MIGA water quality guidelines for liquid emissions from a smelter would seem to also be appropriate for a concentrate leach plant.

6.2.5 Permitting Reform

The current Presidential Administration has proposed changes to environmental permitting to create efficiencies, reduce the timeline, and reduce redundancies in the process. As reported earlier in this section, the CEQ guidance on the implementation of NEPA is guidance and not in statute. The BLM and USFS agencies are currently working on issuing their own NEPA regulations. The proposed changes to environmental permitting in the Executive Orders that have been issued on energy and minerals were aimed for implementation during the budget and reconciliation process; however, they will be implemented in a later phase because they require judicial review.

The Nevada NV-IM-2023-003 process is being considered the model for how BLM will reform NEPA. This includes a 6-month Environmental Assessment and a 12-month EIS. BLM will continue to allow for proponent-funded third party NEPA contractors. The Nevada NV-IM-2023-003 process doesn't cut corners on the pre-work that needs to be done by proponents such as a detailed economic analysis for mineral reserve disclosure, baseline studies, and engineering designs in accordance with regulations. The proponent will need to continue to develop a well thought out Plan of Operations and Reclamation Plan that is backed by sound science to complete environmental permitting and to avoid litigation.

Currently, after a proponent receives a Record of Decision (project approval) from the BLM, there is up to 6 years where the BLM can be sued for the Decision. This adds uncertainty to the NEPA process. BLM is also working on reducing the timeline to a 12-28-day limit before publication of notices to the Federal Register. Permitting reform includes reducing these timelines. BLM is looking at recommendations to increase the 5-acre Notice permit to 20-acres. This will help address issues such as the 5-acre disturbance being consumed by access road construction and improvements during exploration drilling and discovery.

The USFS is also developing their own NEPA regulations. Proposed changes are similar to what was approved in 2020 in the previous Presidential Administration. The USFS is looking at expanding their Categorical Exclusion to a 5-acre permit for mineral exploration, similar to the current BLM Notice, which would be an improvement and reduce timelines for mineral exploration and discovery.

Another route for mine permitting is FAST-41. FAST-41 is for surface projects. It is a two-year timeframe and has been opened up for mining projects. To be eligible for FAST-41, a proposal must meet the definition of a "covered project" under the statute. A covered project is one that: (1) is subject to NEPA; (2) is likely to require a total investment of more than $200,000,000; and (3) does not qualify for abbreviated authorization or environmental review processes under any applicable law. To become a covered project under FAST-41, project sponsors need to submit a FAST-41 Initiation Notice (FIN) with information described in the FAST Act. FAST-41 still requires baseline studies and modelling to analyze potential environmental impacts and sound science that will stand up to litigation.

6.3 NEVADA SITING OPTIONS

As stated in Section 5, a stand-alone smelter could be built either in a central location or near an expanding mining district. It could operate as a toll refinery for most, if not all, concentrates in Nevada and could receive copper concentrates from operations across the western U.S., and potentially even farther. Determining the potential long-term feedstock will be vital for the smelter's design, as these facilities are built to a specific capacity and are difficult to expand. Figure 16 of this report details potential site locations and their rankings based on factors such as rail mileage, road mileage, population, access to power transmission, access to natural gas, air basin designation, and sage-grouse habitat designation.

Factors that must be considered when choosing a site for such a large facility:

- ✓ **Access to Fuel and Electricity-** Processing facilities can operate on a variety of fuels, and proximity to electric transmission infrastructure is essential due to high energy demand.
- ✓ **Large Land Footprint-** Significant acreage is required for the smelter, refinery (tank house), gas handling systems, and slag storage.
- ✓ **Water Availability-** Smelting and refining require substantial volumes of water for cooling and processing.
- ✓ **Transportation Infrastructure-** Rail and interstate access is critical for transporting concentrates to the facility and shipping out refined copper.
- ✓ **Height and No-Fly Zones-** The height of the stack, often over 1,000 feet tall, will require consideration of domestic and military flight patterns.
- ✓ **Air Quality Regulations-** Some basins in Nevada have additional permitting requirements when certain Clean Air Act measures are triggered for major industrial processing, limiting potential siting options.
- ✓ **Brownfield vs. Greenfield Locations-** A facility built on previously undeveloped and unpermitted land is a "greenfield" project, while one on developed or permitted land is "brownfield." Brownfield projects often benefit from reduced permitting requirements and faster timelines due to prior site disturbances or existing permits.

Areas that should be considered for a copper processing facility in Nevada include:

- ✓ **Valmy Area (East of Winnemucca)-** The Valmy area offers several advantages, including access to rail and the Interstate, natural gas, electric transmission lines, and well water. A suitable footprint and existing infrastructure make this a promising option, with sections potentially available for brownfield development. It is near an existing copper operation and benefits from significant regional mining infrastructure and processing experience. However, constraints include limited water availability, the need for additional air permitting, and a minimal local workforce, which would necessitate transporting workers to the site. There are no known height restrictions.
- ✓ **Mason Valley and Surrounding Region-** Located in the largest copper district in Nevada, near both current and former copper mining operations. The area has access to rail and major highways, as well as direct access to a workforce through the town of Yerington. It is located near Greenlink West, which will provide additional energy access. The region also has strong solar and geothermal potential. Constraints include the need for additional air permitting. A local workforce is present and a benefit. Mason Valley is a restricted air basin, and depending on the specific location of a proposed facility, air permitting requirements could increase. There is potential for brownfield development or land disposal opportunities. The site is only 1.5 hours from Reno, which has a large environmental and engineering workforce. There are no known height restrictions. However, as Mason Valley is an agricultural community, careful analysis will be required to determine the availability and appropriation of water rights.
- ✓ **Big Smokey Valley (Near Tonopah)-** Remote and sparsely populated, the area is ideal for a large industrial footprint with minimal community pushback; however, this also results in a limited

available workforce. Water availability appears to be good. There is potential for a copper/molybdenum operation in the region, along with opportunities for development on a brownfield site. Air basin restrictions could apply, and building height restrictions may exist due to nearby military activity in the Tonopah area. The site has highway access but lacks Interstate and rail connectivity. Good solar potential could provide alternative power sources.

- ✓ **Ely Area-** The region is home to an established copper mining operation with supporting infrastructure and a skilled local workforce. It offers access to rail, power, and water through a designated basin, and has highway access, though no direct Interstate connection. There is also potential for brownfield development. The area has no known height restrictions and historically hosted the McGill Smelter. While it is located near the Robinson Mine, it remains relatively isolated. The air basin designation may require additional permitting.
- ✓ **Mineral County (Near Hawthorne)-** The area features existing industrial zoning and infrastructure, with good road access and potential for utility expansion. It has highway access but no Interstate connection and limited rail access. Water would need to be acquired through a designated basin. There is potential for solar energy development, and the site may be located on or near military lands. While there are no air basin restrictions, height restrictions may apply due to the military presence in the region. The available workforce is limited and the site is close to the Yerington District, but otherwise relatively isolated.
- ✓ **North of Winnemucca Along U.S. 95-** The area is accessible by highway, with Interstate and rail lines located a short distance away. Utility proximity varies by specific site, offering potential for infrastructure build-out. Located within a checkerboard land pattern, there may be opportunities for development on private land. This is a strong mining region with direct access to an experienced mining and processing workforce based in Winnemucca. There are no known height restrictions or air basin limitations. Water would need to be acquired through a designated basin.
- ✓ **Fernley Area-** The area offers access to a strong workforce, as well as rail, Interstate, natural gas, and water. It is only 45 miles from the Yerington District and has rail access for most of the route. The region also lies just 45 minutes from Reno, providing access to a large environmental and engineering workforce. There is strong potential for solar and geothermal energy development, along with opportunities for land disposal and the proposed development of an inland port. However, the area's air basin designation could impact project permitting, and building height restrictions may apply due to the nearby military base.
- ✓ **Jean Area–** The area offers access to a workforce, power sources including solar and natural gas, rail, Interstate, and the potential development of an inland port. Its geographic location places it closest to Arizona's copper producers and near Las Vegas, providing access to a large labor pool and Arizona concentrate producers. There is also potential for land disposal opportunities. However, key constraints include air permitting and, most significantly, water availability.
- ✓ **Existing Military Facilities in Nevada for Consideration-** The State of Nevada, along with various federal agencies, is evaluating the disposal of public lands for uses that align with agency goals or federal initiatives. Several sites within Nevada may be suitable for the development of a copper processing facility. A primary concern at these locations is the potential height of the facility's stack, which, due

to the likely proximity to military installations and designated flight areas and the frequency of military air traffic, would serve as a key limiting factor in siting the facility. For the purposes of this study, military facilities that could influence the feasibility of a copper processing facility include:

- ✓ Hawthorne
- ✓ Fallon
- ✓ Nellis
- ✓ Indian Springs

6.3.1 Nevada Siting Analysis:

Some Locations for potential smelter sites were analyzed for this report are referred to as Big Smokey Valley (area proximal to Tonopah and highway 95), Fernley (industrial center), Hawthorne (department of defense land), Jean (proximity to many favorable infrastructure requirements), Mason Valley (proximity to largest known copper resources), McGill (previous copper smelting site), Valmy (brownfields site), and N. Winnemucca area (centralized location within the state). The sites evaluated within the report are not the only potential locations in Nevada, but rather they are sites that seem to come up as favorable locations in discussions with industry.

Parameters taken into consideration for this high-level siting analysis include mileage via highway and rail; proximity to transmission lines greater than 100 kV, natural gas lines, and population centers for workforce; air basins; and Sage-Grouse Habitat Management areas. Below are details on the datasets, parameters, and scoring methodology. See Figure 16 for a map summarizing this analysis.

Road Mileage:

Calculated mileage from potential copper concentrate sources to potential site locations were documented using google maps. Mileage from each copper concentrate source location (Bagdad, Chino, Copper World, Mineral Park, Mission, Morenci, Phoenix Mine, Pinto Valley, Pumpkin Hollow/Yerington District, Resolution, and Robinson) to each potential site location was documented and a total sum was taken of the mileages for each potential smelter site. The mileage sums were broken up into statistical populations (min, max, average, 80th percentile, 90th percentile, and 95th percentile) and scored with 1 being the lowest score (highest cumulative mileage) and 6 being the highest score (lowest cumulative mileage).

RAIL MILEAGE PARAMETER	SCORE
Mileage 0 – 3,541	6
Mileage 3,542-4,868	5
Mileage 4,896-5,417	4
Mileage 5,418-5,506	3
Mileage 5,507-5,598	2
Mileage 5,599-5 690	1

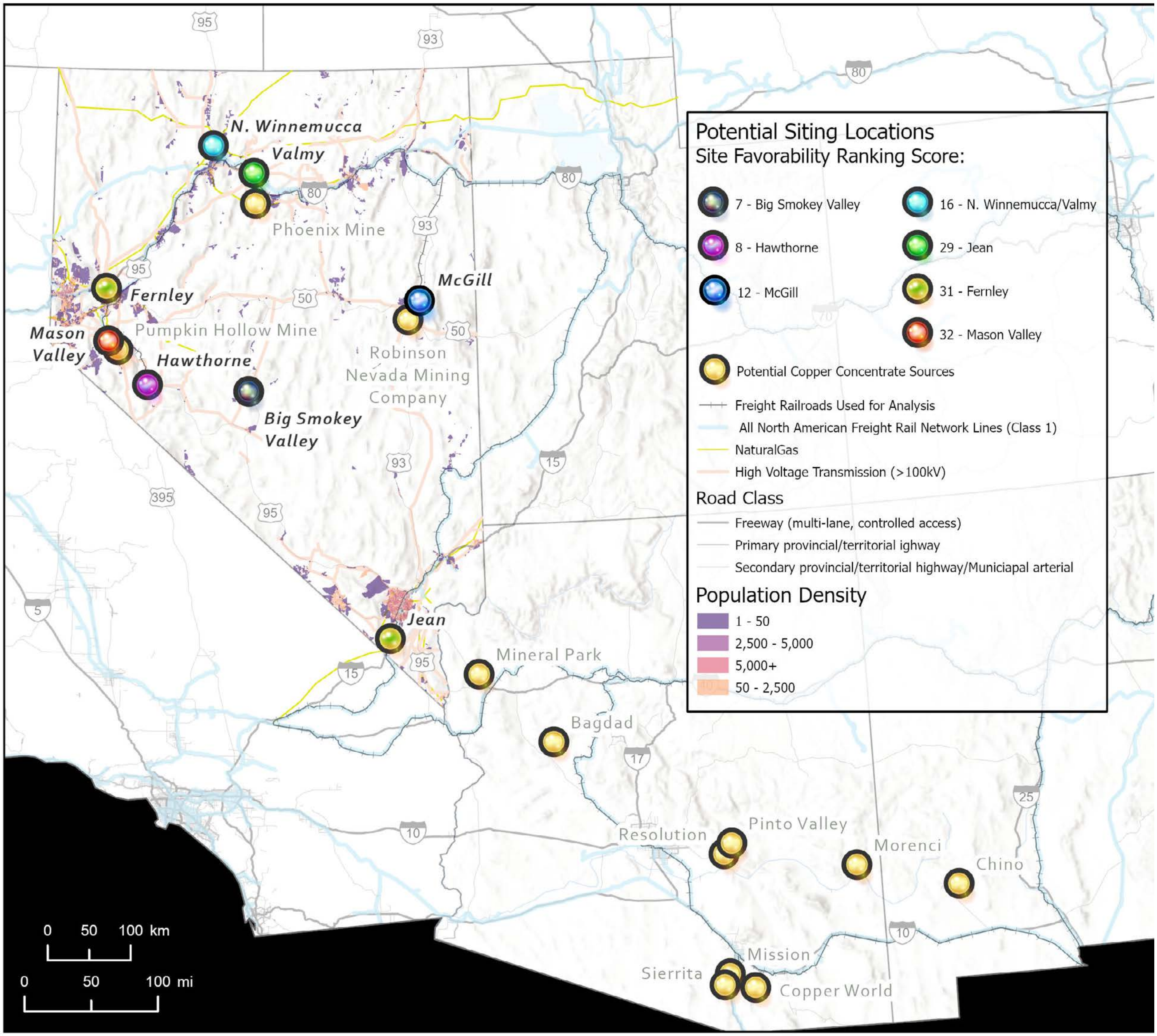


Figure 16 shows a ranking of potential copper processing sites in Nevada related to the various factors listed below.

Site Name	Rail Mileage	Road Mileage	Population	Power Transmision	Natural Gas	Air Basin	Sage-Grouse	Total
Mason Valley	3	4	21	2	2	0	0	**32**
Fernley	4	4	19	2	2	0	0	**31**
Jean	6	6	14	2	1	0	0	**29**
N. Winnemucca	5	1	8	2	2	-1	-1	**16**
Valmy	5	3	6	2	0	0	0	**16**
McGill	5	5	3	1	0	0	-2	**12**
Hawthorne	1	4	3	1	0	-1	0	**8**
Big Smokey Valley	0	5	0	2	0	0	0	7

			Population Density 30 mi. Radius			Population Density 60 mi. Radius			Power Transmission		Natural Gas	
Site Name	Rail Mileage (shortest route)	Road Mileage (Google Maps)	>10,000	5,000 - 10,000	2,000 - 5,000	>10,000	5,000 - 10,000	2,000 - 5,000	5 mi. Radius	10 mi. Radius	5 mi. Radius	10 mi. Radius
Big Smokey Valley	No Rail	4185	0	0	0	0	0	0	2	0	0	0
Hawthorne	11513	5179	0	0	2	0	0	1	0	1	0	0
McGill	9665	4385	0	0	2	0	0	1	0	1	0	0
N. Winnemucca	10134	5690	0	4	0	0	3	1	2	0	2	0
Valmy	9910	5427	0	0	2	0	3	1	2	0	0	0
Fernley	11058	5377	6	4	0	5	3	1	2	0	2	0
Jean	8284	3541	6	0	0	5	3	0	2	0	0	1
Mason Valley	11364	5157	6	4	2	5	3	1	2	0	2	0

Rail Mileage:

Class 1 freight lines were extracted from the North American Rail Network Lines data set obtained from the National Transportation Atlas Database, United States Federal Railroad Administration, and Bureau of Transportation Statistics Database then subsequently were merged with Railroad Mainlines extracted from the 2021 Nevada State Rail Plan. Mileage from each copper concentrate source location to each potential site location was documented and a total sum was taken of the mileages for each potential smelter site. The milage sums were broken up into statistical populations (min, max, average, 80th percentile, 90th percentile, and 95th percentile) and scored with 1 being the lowest score (highest cumulative milage) and 6 being the highest score (lowest cumulative mileage).

RAIL MILEAGE PARAMETER	SCORE
Mileage 0-8,284	**6**
Mileage 8,285 – 10,275	**5**
Mileage 10,276 - 11,303	**4**
Mileage 11,304 - 11,424	**3**
Mileage 11,424 - 11,468	**2**
Mileage 11,469 - 11,513	**1**
Big Smoke has no rail access	**0**

Population Density:

The Population Density layer was sourced from Kucinski GIS and was utilized to obtain a sense for siting with respect to workforce. Sixty- and ninety-foot Buffers were placed around all proposed siting locations. Scores were given as follows:

RAIL MILEAGE PARAMETER	SCORE
Population Density >10,000 proximity within 30 Miles	6
Population Density >10,000 proximity within 60 Miles	5
Population Density 5,000 – 10,000 proximity within 30 Miles	4
Population Density 2,000 – 5,000 proximity within 30 Miles	3
Population Density 2,000 – 5,000 proximity within 30 Miles	2
Population Density 2,000 – 5,000 proximity within 60 Miles	1

Power Transmission:

Utilizing aerial imagery and the BLM's Mineral and Land Records System (MLRS), NDOM staff digitized power transmission lines throughout the state and documented voltage where possible. All potential siting locations within five miles of a 100 kV line or higher were given a score of 2 and Potential siting locations between 5-10 miles were given a score of 1.

Natural Gas:

Utilizing the U.S. Energy Information Administration's Natural Gas Interstate/Intrastate Pipelines of the US data layer, all potential siting locations within five miles of a natural gas pipelines were given a score of 2 and all sites between 5-10 miles of a natural gas pipeline were given a score of 1.

Air Basin:

Utilizing the Nevada Bureau of Air Quality Planning's Air Prevention of Significant Deterioration (PSD) data, all potential siting locations within a PSD basin were deducted 1 point.

Sage-Grouse:

Utilizing the Habitat Management Areas as provided on the Sagebrush Ecosystem Council's website, all potential sites located within Primary Habitat Management Areas (PHMA) would have been deducted 3 points, those within General Habitat Management Areas (GHMA) deducted 2 points, and those within Other Habitat Management Areas (OHMA) deducted 1 point.

Conclusion:

Using these analytical criteria, it appears that Mason Valley is a very favorable location for a smelter within Nevada, followed by Ferley, Jean, and then the area just north of Winnemucca. Again, this is a high-level analysis but should give the reader a sense of the complexities associated with siting. There are many more parameters that will need to be considered.

SECTION 07

Investment and Funding

07 INVESTMENT AND FUNDING

A drive for increased security of domestic supply chains requires heavy investment in smelting and refining as well as semi-fabricators - the products that are most frequently consumed and used in manufacturing domestically.

SUMMARY

This section highlights the critical need for substantial investment to secure domestic copper supply chains by expanding smelting, refining, and semi-fabrication capacities. It details federal tax structures, incentives, and loan programs designed to support these industries, including corporate income and payroll taxes, excise taxes, and significant credits like the 48C Advanced Energy Project Credit and 45X Advanced Manufacturing Production Credit. Key federal funding avenues include DOE loan guarantees and grants, Defense Production Act programs, and Export-Import Bank support.

Legislative and executive actions emphasize copper's designation as a critical mineral, with recent executive orders aiming to reduce import reliance, expedite permitting, and boost domestic production through streamlined regulations and enhanced incentives.

Nevada is showcased as a highly advantageous location for copper processing, offering no corporate income tax, favorable payroll and property tax policies, and abatements through the Governor's Office of Economic Development. The state's Industrial Development Revenue Bond program provides additional low-cost financing opportunities.

Private sector momentum is strong, with major investments in copper recycling and smelting projects by firms such as Aurubis AG and Wieland North America, supported by federal grants and driven by demand for clean energy and advanced technologies. Large mining companies and innovative firms are also investing heavily to build resilient, domestic copper processing capacity aligned with national security and climate goals.

7.1 FEDERAL INCENTIVES AND LEGISLATIVE SUPPORT

7.1.1 Federal Tax Structure

7.1.1.1 Federal Corporate Income Tax

Corporations are subject to the federal corporate income tax, which is levied at a flat rate of 21% on net taxable income as of 2025. This rate was established under the Tax Cuts and Jobs Act of 2017 and remains current.

7.1.1.2 Payroll Taxes

Employers are responsible for collecting and contributing several types of federal payroll taxes, most of which are shared between the employer and the employee. These taxes fund key federal programs such as Social Security, Medicare, and unemployment insurance.

7.1.1.2.1 FICA (Federal Insurance Contributions Act) Taxes

FICA taxes fund Social Security and Medicare and are split equally between employers and employees. For Social Security, both employer and employee pay 6.2% of wages, for a combined total of 12.4%. This applies only to wages up to an annual limit, which is $168,600 in 2025 and adjusts annually for inflation. For Medicare, both employer and employee contribute 1.45% each, totaling 2.9%. Employees earning more than $200,000 annually are subject to an extra 0.9% Medicare surtax, which is not matched by the employer.

7.1.1.2.2 FUTA (Federal Unemployment Tax Act)

FUTA taxes are paid solely by employers and fund federal unemployment insurance programs. The base FUTA tax rate is 6.0%, applied only to the first $7,000 of each employee's annual wages. Employers in states with compliant unemployment systems, such as Nevada, typically receive a credit of 5.4%, effectively reducing the FUTA tax rate to just 0.6%.

7.1.1.3 Federal Excise Taxes

Fuel Taxes: Smelters often consume large quantities of fuel, such as gasoline, diesel, or natural gas, to power their furnaces and equipment. Federal excise taxes apply to these fuels, with rates varying by type.

Chemical Taxes: Certain chemicals used in copper processing, such as sulfuric acid or other processing chemicals, may be subject to excise taxes or regulatory fees, especially if they are classified as hazardous or controlled substances.

Environmental Fees: Although not strictly excise taxes, copper processing facilities may be subject to federal environmental fees and penalties related to emissions and pollution control under laws like the Clean Air Act. These fees can effectively act like excise taxes by imposing costs tied to emissions of sulfur dioxide, heavy metals, or greenhouse gases.

Toxic Substances and Waste: If the copper processing generates or uses taxable waste products or by-products, excise taxes or disposal fees may apply, and are regulated by the EPA.

7.1.1.4 Federal Income Tax Withholding

Employers are required to withhold federal income taxes from their employees' wages according to the withholding allowances and instructions provided on each employee's Form W-4. These withheld amounts must be accurately calculated, withheld, and remitted regularly to the Internal Revenue Service (IRS). Beyond withholding, employers must also file periodic employment tax returns that report the amounts withheld and paid, ensuring ongoing compliance with federal tax laws.

7.1.2 Federal Tax Incentives and Credits

The U.S. federal government has enacted several tax incentives to bolster domestic copper smelting and processing capabilities. Both 48C and 45X credits may be applied to the same operation, provided that not all production units are fully covered under a single credit program. Federal incentives are currently:

Section 48C Advanced Energy Project Credit: Expanded under the Inflation Reduction Act (IRA), this credit offers up to 30% of qualified investment costs for projects that establish, expand, or re-equip facilities to process critical materials, including copper. The initial funding round saw applications totaling over $42 billion for a $4 billion allocation, indicating high demand. A second round is anticipated soon (Mayer Brown, 2024).

Section 45X Advanced Manufacturing Production Credit: This provision provides tax credits for the domestic production of critical minerals, such as copper, used in clean energy technologies. It aims to incentivize the onshore production of components essential for renewable energy systems.

7.1.3 Federal Loan Programs, Guarantees, and Grants

The Department of Energy's (DOE) Loan Programs Office, strengthened by the Inflation Reduction Act (IRA), provides robust financial support for large-scale industrial and energy projects. In addition to loan guarantees, substantial grant funding has recently been made available and may or may not reopen soon through programs administered by both the DOE and the Department of Defense (DOD):

Title 17 Clean Energy Financing Program: This program provides loan guarantees for projects that retool or repurpose existing energy infrastructure, including facilities processing critical minerals like copper. It can cover up to 80% of eligible project costs, facilitating access to capital for large-scale industrial projects.

DOE - Industrial Demonstrations Program (IDP): This program has completed its first round, and if available for a second round, would provide large-scale grant funding for first-of-a-kind or major retrofit projects in hard-to-abate industrial sectors, including copper processing and refining. Administered by the Department of Energy's Office of Clean Energy Demonstrations (OCED), it supports projects that significantly reduce greenhouse gas emissions through innovative technologies or clean energy integration. Grant awards can reach up to $500 million, particularly for strategically important or co-funded initiatives located in energy communities.

DOD – Defense Production Act Title III (DPA Title III): This program provides direct federal support, including grants, loans, and purchase agreements, for projects that strengthen the domestic industrial base for materials and technologies critical to national defense. Administered by the Department of Defense's Office of Industrial Base Policy, it targets sectors such as critical minerals, metals, semiconductors, and energy storage. Copper processing and refining projects may qualify if they address supply chain vulnerabilities, increase domestic capacity, or support national security applications such as grid infrastructure or defense manufacturing. Funding awards have ranged from tens of millions to over $300 million, with larger awards possible for highly strategic projects. Title III funding has previously supported upstream and midstream critical mineral projects and is often coordinated with DOE and other agencies. The DPA Title III is currently in force through 2025 and may be reauthorized.

Export-Import Bank of the United States (EXIM): The Export-Import Bank of the United States (EXIM) may support a domestic copper processing facility if there is a clear export component, or for example, if the facility's products are sold directly to foreign buyers or to domestic manufacturers that, in turn, export finished goods. EXIM can provide assistance through working capital guarantees, export credit insurance, buyer financing (via loan guarantees or direct loans), and supply chain finance.

7.1.4 Federal Legislative Developments

Recent legislative efforts have focused on recognizing copper as a critical material:

Critical Mineral Consistency Act (S. 5274 / H.R. 8446): This bipartisan legislation aims to align the definitions of critical minerals across federal agencies, officially designating copper as a critical material. This designation would make copper projects eligible for various federal support programs, enhancing the domestic supply chain and reducing reliance on foreign sources.

7.1.5 Executive Orders and Presidential Actions

In early 2025, the U.S. government initiated an investigation to determine whether imports of copper and its derivatives pose a threat to national security, given copper's essential role in military hardware, advanced technology, and infrastructure. This review focuses on the impact of foreign copper imports, particularly from countries like Chile, Canada, and Mexico, and aims to protect the domestic copper industry from unfair trade practices that could undermine U.S. security.

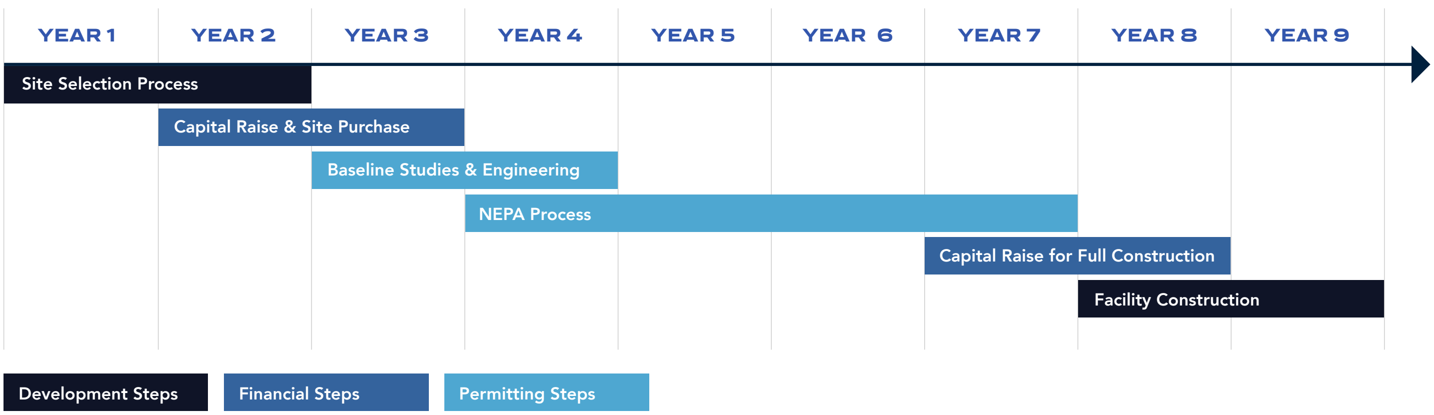
Following this, emergency measures were introduced to enhance domestic production of critical minerals, including copper. These measures prioritize federal lands with known mineral deposits, streamline permitting processes to reduce delays, and provide financial incentives to encourage private investment. Additionally, a federal council was established to coordinate efforts, gather industry feedback, and recommend strategies to strengthen domestic mineral production. Together, these actions seek to reduce reliance on foreign mineral sources and bolster national security through increased American mineral production.

Presidential Proclamation – Strengthening America's Copper Industry

(July 30, 2025)

Imposed 50% tariffs on semi-finished and copper-derivative imports, effective August 1, to reduce U.S. dependence on foreign copper and strengthen national security. Followed a Section 232 investigation finding that reliance

Estimated Timeframe of Developing a Copper Processing Facility



on foreign-controlled smelting and refining capacity threatens defense and industrial resilience. Established domestic copper content requirements starting at 25% in 2027 and rising to 40% by 2029.

Based on current permitting, development, and capital-raising timelines, no new U.S. smelters will be operational in time to meet these targets, and existing smelting capacity is inadequate to process the required feedstock. Below is a generalized timeline for a new copper processing facility.

A list of relevant executive orders pertaining to domestic copper processing are as follows:

Executive Order 13817 – A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals (December 20, 2017)
Directed federal agencies to develop a comprehensive strategy for critical mineral supply chains, including copper, focusing on domestic production, processing, and recycling.

Executive Order 13953 – Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries (September 30, 2020)
Declared a national emergency to address the United States' reliance on foreign adversaries for critical minerals, including copper. It directed immediate actions to identify and expand domestic exploration, mining, and processing capabilities and instructed federal agencies to streamline permitting and provide financial assistance where necessary.

Executive Order 14017 – America's Supply Chains (February 24, 2021)
Ordered a government-wide review of supply chains, focusing on critical minerals like copper, and outlined actions to strengthen domestic mining, processing, and manufacturing capacity.

Executive Order 14030 – Climate-Related Financial Risk (May 20, 2021)
Emphasized sustainable supply chains for minerals critical to clean energy technologies, including copper, to support climate risk mitigation.

Executive Order 14072 – Strengthening the Nation's Supply Chains (April 26, 2023)
Reinforced policies to improve supply chain resilience, including for critical minerals essential to manufacturing, clean energy, and national defense.

Executive Order 14220 – Addressing the Threat to National Security from Imports of Copper (February 28, 2025)
Initiated a Section 232 investigation into copper imports and their potential threat to U.S. national security. The order emphasized copper's role in defense, infrastructure, and clean energy systems, and called for immediate federal action to strengthen domestic production and reduce import dependence. The investigation aims to assess the impact of foreign copper imports on the domestic industry, particularly considering copper's critical role in military hardware, advanced technology, and infrastructure

Executive Order 14241 – Immediate Measures to Increase American Mineral Production (March 20, 2025)
Directed federal agencies to expedite the permitting and development of domestic mining projects, prioritize federal lands with known mineral deposits, and utilize the Defense Production Act to boost investment in critical mineral production, including copper.

7.2 NEVADA SPECIFIC INCENTIVES AND POLICY ADVANTAGES

Nevada offers one of the most business-friendly tax environments in the U.S., with no corporate income tax and no inventory tax. The state is uniquely positioned to host a new-generation copper smelter through a combination of factors: a supportive tax and regulatory environment, proximity to major copper concentrate sources, access to renewable energy and infrastructure, robust federal support through the IRA, DOE, and critical mineral legislation, and growing interest from global private investors and offtake partners.

Additional incentives are available to mining and processing operations through the following:

7.2.1 Nevada Tax Structure

Nevada does not impose a corporate income tax on businesses. Both C corporations and pass-through entities, such as LLCs and S corporations, are not subject to state-level income taxes on their earnings. This tax policy serves as a major incentive for incorporating or operating a business in Nevada. Nevada does not levy a franchise tax, unlike states such as Texas, nor does it impose a tax on business inventory. The absence of these taxes reduces ongoing business costs and simplifies compliance with state tax regulations. Nevada also does not impose a personal income tax on individuals.

7.2.1.1 Commerce Tax (Gross Receipts Tax)

Although Nevada does not have a corporate income tax, it imposes a Commerce Tax on businesses with annual gross revenue exceeding $4 million. This is a gross receipts tax assessed on total revenue, with the rate varying by industry classification. Rates vary by industry, typically ranging from 0.051% to 0.331%. Commerce Tax paid can be used as a credit against Modified Business Tax (MBT) liabilities.

7.1.2.2 Modified Business Tax (MBT)

Nevada levies a payroll tax known as the Modified Business Tax, applicable to businesses that employ workers.

7.2.1.3.1 General Businesses:

1.378% on gross wages that exceed $50,000 per quarter.

7.2.1.3.2 Financial Institutions and Mining Businesses:

2.0% on total gross wages, with no threshold exemption with a quarterly filing frequency.

7.2.1.4 Property Tax

Nevada levies property taxes at the county level, with rates varying by jurisdiction. The state constitution caps property tax rates, helping maintain a relatively moderate tax burden compared to other states.

7.2.1.5 Sales and Use Tax

Nevada imposes a statewide base sales tax of 6.85%, with local jurisdictions allowed to add up to 1.53%, bringing the maximum combined rate to 8.375%. This tax applies to tangible personal property; most services are exempt. Machinery and equipment used directly in manufacturing or mining may be exempt if certain conditions are met.

7.2.1.6 Industry-Specific Taxes and Fees (Not Applicable to a Copper Processing Facility Unless Involved in Mineral Extraction)

Nevada imposes additional taxes and fees on certain industries:

7.2.1.6.1 Net Proceeds of Minerals Tax (Mining):

Assessed on the net proceeds from mineral extraction, with rates ranging from 2% to 5% of net proceeds.

7.2.1.6.2 Gold and Silver Excise Tax

Nevada imposes an excise tax on businesses engaged in the extraction of gold and silver within the state. The tax features tiered rates, with 0.75% applied to taxable revenue between $20 million and $150 million, and 1.1% on revenue exceeding $150 million. This tax applies to all entities extracting gold, silver, or both.

7.2.1.6.3 Gaming Taxes:

Levied on gross gaming revenues and based on the type and scale of gaming operations.

7.2.2 Nevada Governor's Office of Economic Development (GOED)

Nevada offers a comprehensive suite of tax abatements and incentives designed to attract large-scale industrial projects, such as copper smelters. These incentives, administered by the Governor's Office of Economic Development (GOED), aim to reduce the financial burden on businesses while promoting job creation, rural investments, and economic diversification.

Sales and Use Tax Abatement: offered by GOED reduces the sales and use tax rate on qualified capital equipment purchases to as low as 2%. To qualify, businesses must meet at least two of the following criteria: pay employees at or above the statewide average wage, make a significant capital investment, or create a specified number of new jobs. If approved, the abatement can be applied for up to two years, offering substantial savings on upfront project costs and improving financial feasibility for large-scale industrial developments.

Modified Business Tax (MBT) Abatement: Nevada offers a Modified Business Tax (MBT) Abatement that provides a 50% reduction on the standard 1.17% tax rate applied to quarterly wages exceeding $50,000. To qualify, businesses must satisfy at least two of three criteria: paying employees at or above the statewide average wage, making a substantial capital investment, or creating a specified number of new jobs. The abatement is available for up to four years and is designed to support companies that contribute to Nevada's economic growth through quality employment and investment.

Personal Property Tax Abatement:
Companies that invest in Nevada may be eligible for a Personal Property Tax Abatement of up to 50% for a duration of up to 10 years. Eligibility is based on meeting at least two of the standard criteria: offering competitive wages, making significant capital investments, and generating new jobs. This long-term incentive helps reduce operating costs for businesses undertaking major equipment or infrastructure investments.

Real Property Tax Abatement for Recycling:
Nevada provides a Real Property Tax Abatement for businesses engaged in significant recycling activities. This program offers up to a 50% reduction in both real and personal property taxes for a period of up to 10 years. To qualify, businesses must recycle at least 50% of raw materials or intermediate products on-site. This incentive aligns with the state's commitment to environmental sustainability and encourages the development of resource-efficient operations.

Large Capital Investment Abatements:
For businesses undertaking exceptionally large investments, Nevada offers enhanced tax abatements. A capital investment of $1 billion may qualify for a sales and use tax reduction to between 4.6% and 6.125% for 15 years, a 75% MBT abatement for 10 years, and a 75% property tax abatement for 10 years. Projects investing $3.5 billion or more are eligible for even greater incentives, including a 100% MBT and property tax abatement for 10 years and a sales and use tax reduction for 20 years. These benefits are designed to attract transformative industrial projects to the state.

A copper processing facility in Nevada can benefit significantly from GOED's tax abatement programs, which reduce upfront capital costs through Sales and Use Tax abatements (as low as 2% for two years) and cut payroll taxes by 50% for up to four years via the Modified Business Tax abatement. Long-term savings come from Personal Property Tax abatements of up to 50% over 10 years, and additional reductions apply if the smelter recycles materials onsite. Large-scale investments receive enhanced benefits, including up to 75–100% abatements on business and property taxes and extended sales tax reductions for 15 to 20 years, improving the project's financial viability and competitiveness.

7.2.3 Nevada Industrial Development Revenue Bond (IDRB)

The Nevada Industrial Development Revenue Bond (IDRB) Program, overseen by the Nevada Department of Business & Industry, offers an alternative financing mechanism that may be appropriate for a copper processing facility seeking to establish or expand operations within the state. The program allows private entities to obtain tax-exempt municipal bonds issued by the state to finance eligible manufacturing or processing projects. These bonds can potentially offer lower interest rates than traditional commercial loans, which may result in reduced long-term financing costs.

The IDRB Program is structured to support capital-intensive developments, covering costs associated with land acquisition, facility construction, and equipment procurement. Bonds issued under this program are repaid solely from the revenues of the project itself, without pledging the credit or financial backing of the state. This non-recourse approach ensures that repayment obligations remain with the project sponsor, limiting public financial exposure.

Participation in the program may also facilitate access to other state-level economic development resources. Depending on the specifics of the project and location, these may include tax abatements, workforce development assistance, and infrastructure-related support. The program's focus on promoting manufacturing and job creation aligns with broader state economic development initiatives and could support efforts to expand Nevada's role in the domestic critical minerals and industrial supply chain.

7.2.4 Private Sector Involvement in Similar Projects

The transition to a clean energy economy, increasing demand for critical minerals, and recent legislative and presidential efforts have spurred significant interest in private sector investment in copper processing infrastructure within the U.S. Recognizing copper's essential role in electric vehicles, renewable energy systems, and advanced technologies, both domestic and international companies are committing substantial capital to expand and modernize U.S. copper production and recycling capabilities. These investments not only aim to strengthen the domestic supply chain but also reduce reliance on foreign sources and processing facilities. The following highlights key projects and major players driving momentum in copper processing across the country.

7.2.4.1 Aurubis AG – $700 Million Secondary Copper Smelter in Georgia

Aurubis AG, a leading global provider of non-ferrous metals and one of the world's largest copper recyclers, is investing approximately $700 million to build a state-of-the-art secondary copper smelter in Augusta, Georgia (Reuters, 2023). This will be the first facility of its kind in North America, designed to process up to 163,000 tonnes of complex recycling materials annually, including printed circuit boards and insulated copper cables (Reuters, 2023). The project supports the Biden-Harris Administration's Investing in America agenda, is expected to create over 200 long-term jobs, and will contribute significantly to the U.S. circular economy by reducing reliance on primary copper imports (Reuters, 2023).

7.2.4.2 Wieland North America – $270 Million Advanced Copper Recycling Facility in Kentucky

Wieland North America is expanding its recycling capacity through a $270 million investment from the Department of Energy in an advanced copper recycling facility located in Shelbyville, Kentucky (U.S. Department of Energy, 2025). This facility will process a diverse mix of copper scrap into high-purity copper, helping reduce carbon emissions and strengthen the resilience of the U.S. copper supply chain. The project is part of the U.S. Department of Energy's Industrial Demonstrations Program, which supports commercial-scale decarbonization initiatives in energy-intensive industries.

7.2.5 Other Private Sector Trends

Several notable private entities are actively investing in copper-related infrastructure and advanced processing technologies, creating strategic partnerships and funding opportunities. KoBold Metals, backed by high-profile investors such as Bill Gates and Jeff Bezos, has raised over $1 billion to apply AI-driven techniques in mineral development and is pursuing global copper projects (Streetwise Reports, 2025). Major mining companies Rio Tinto and BHP are also heavily investing in the development of the U.S. copper supply chain. Both companies are actively seeking partnerships to establish domestic copper processing facilities, with the goal of reducing dependence on overseas smelters and enhancing supply chain security (Financial Times, 2025).

SECTION

08

Economics

08 ECONOMICS

SUMMARY

This section details the substantial investments and economic impacts involved in establishing a copper smelter and integrated refinery in Nevada. Key capital needs include transportation infrastructure (rail and highway), power supply (electricity and natural gas), and worker housing, with costs varying widely based on scale and location. A smelter with a capacity of 300,000–400,000 tonnes/year is identified as strategically optimal, balancing scale as a factor of potential concentrate feedstock, financeability, and operating costs per tonne, and environmental performance.

Economic benefits to Nevada include significant direct employment (450–650 workers) and indirect job creation through supply chains, generating increased tax revenues and supporting local infrastructure. The facility would continue to diversify Nevada's economy beyond tourism, enhance domestic copper supply chains, and bolster the state's position in battery manufacturing and recycling, especially given copper's critical role in EV batteries and renewable energy.

Integrated smelting and refining co-location improves operational efficiency, reduces costs, and supports environmental goals. Operating costs are driven mainly by energy, and labor, with water use and taxes also significant. Capital expenditures range from $900 million to $1.8 billion and are typically financed through a 70/30 debt-to-equity split, public-private partnerships, or other opportunistic avenues that support the project.

Overall, while financial viability depends on complex market and operational variables, a large-to-mid-sized, integrated copper processing facility presents strong strategic, and economic advantages for Nevada and the broader U.S. industry.

8.1 INVESTMENT NEEDED

Additional investments are necessary for building and operating a new smelter, including transportation, power, and housing for workers. These costs must be considered when selecting a location.

8.1.1 Transportation

8.1.1.1 Rail

Rail transportation provides higher capacity, lower fuel consumption, and may reduce congestion. However, its construction and maintenance are more expensive. Building new rail infrastructure costs between $1 to $4 million per mile, with higher costs depending on the terrain (FreightWaves, 2020). Rail transportation expenses range from $0.05 to $0.16 per ton-mile (Costmine, 2024).

The highest estimated rail requirement for siting was between 100 and 150 miles to access Big Smokey Valley in central Nevada, while most evaluated sites would likely require spur lines of approximately 1 to 20 miles.

8.1.1.2 Highway

Highway haulage offers flexibility compared to rail haulage and has lower construction and maintenance costs. However, transportation costs for highways tend to be higher. The cost of building a new highway ranges from $500,000 to $3 million per mile, and haulage costs vary between $0.12 and $0.22 per ton-mile (Bureau of Transportation Statistics, 2023).

8.1.2 Power

8.1.2.1 Electricity

The cost to construct industrial power lines in Nevada varies by voltage, type, and project specifics. Overhead lines cost $2M to $3M per mile, while underground lines are 10 to 15 times more expensive (U.S. Energy Information Administration [EIA], 2023).

8.1.2.2 Natural Gas

The cost to construct a natural gas pipeline can vary widely, with recent estimates ranging from $2 million to $5.5 million per mile (EIA, 2022).

8.1.3 Other

8.1.3.2 Housing for Direct Workers

Operating a copper smelter and refinery with a 300,000 tonne annual capacity requires approximately 450 to 650 employees. Housing costs per person range from $212,000 to $360,000 in northern Nevada.

8.1.3.3 Housing for Indirect and Induced Workers

The facility would stimulate indirect and induced employment through its supply chain and service providers, with an estimated 2 to 3 additional jobs created per direct job (United Nations Industrial Development Organization [UNIDO], 2025; U.S. Department of Commerce [USDOC}, 1997). Based on the number of additional jobs per direct job, a facility employing 450 to 650 personnel would require the construction of an additional 900 to 1,900 homes.

8.2 POTENTIAL BENEFITS TO STATE

8.2.1 Benefits from Employment

The establishment of a copper processing facility in Nevada would not only create substantial employment opportunities and generate significant tax revenues but also reinforce the state's position as a leader in battery manufacturing and recycling. By enabling downstream industries and promoting economic diversification, such a facility would contribute to the long-term economic resilience and sustainability of Nevada.

8.2.1.1 Direct Job Creation

The construction phase of a facility of this magnitude could generate between 800 and 1,500 temporary jobs over a two- to three-year period, encompassing roles in engineering, civil, mechanical, and electrical trades. Once operational, the facility would support 250 to 650 full-time, high-paying positions, including metallurgists, process engineers, plant operators, electricians, mechanics, and logistics staff.

These roles offer competitive salaries, contributing to long-term economic stability for Nevada residents. The facility would stimulate indirect and induced employment through its supply chain and service providers, with an estimated 2 to 3 additional jobs created per direct job in the broader regional economy, spanning sectors such as retail, education, health, and housing. This multiplier effect is consistent with findings from the U.S. Bureau of Economic Analysis, which indicates that each direct job in the mining sector supports approximately 2.5 additional jobs in the economy (UNIDO, 2025; USDOC, 1997).

8.2.2 Tax Revenues and Other Economic Contributions

The operation of a copper processing facility would generate substantial tax revenues for both state and federal governments. Tax revenues would include payroll taxes, sales taxes, modified business tax, property tax, and commerce tax from increased economic activity. The facility would contribute to other revenue streams such as royalties and fees associated with mineral processing. The increased economic activity could also lead to higher property values and, consequently, higher property tax revenues for local governments.

The Modified Business Tax (MBT) would provide a source of revenue through payroll taxes collected from employees directly engaged in mining, processing, and related activities. Sales and use taxes are levied on equipment, materials, and services required for construction, maintenance, and ongoing operations. Real property taxes on industrial facilities and improvements represent another major contribution, reflecting the substantial capital investments involved in establishing and expanding these operations.

Locally, counties would benefit from increased general fund revenues derived from property taxes and utility fees associated with industrial activities. Infrastructure improvement fees and public service contributions from operators support the maintenance and enhancement of essential services such as roads, emergency response, and utilities, improving community welfare and supporting sustainable growth..

8.2.3 Other Revenue and Economic Activity

A key benefit to Nevada would be economic diversification, which helps reduce Nevada's historical dependence on the tourism and gaming industries. By establishing a long-term industrial asset with the potential to operate for over 30 years, the state can strengthen its economic resilience and create a more balanced and sustainable economic base. Based on gross income, a smelter refinery producing 300,000 tonnes of copper annually, at the current LME 3-month average price of approximately $10,000 per tonne, would generate an annual gross income of $3 billion. This would amount to approximately 20 percent of the gross gaming revenue in the State of Nevada, which is estimated at $15.6 billion in 2024 (Statista, 2025). If classified as manufacturing, a facility of this size would increase Nevada's gross manufacturing revenues by 35 percent, from $8.6 billion to $11.6 billion, making manufacturing one of the largest revenue generators in the state (YCharts, 2024).

A local processing facility increases domestic demand for copper concentrates, which could make existing operations more profitable by, at a minimum, reducing freight and logistics charges and encouraging the development of new copper projects within the state and region by providing a local means for concentrate processing, thereby reducing the financial burden on operators evaluating SX-EW circuits or other on-site processing methods. For mines developed in the state, this would result in higher Net Proceeds of Minerals Tax revenue for Nevada, with approximately 50% allocated to the counties where the mines operate and the remaining 50% directed to the State's General Education Fund. From 2020 to 2024, the estimated average annual contribution to the State General Education Fund ranged between $85 million and $100 million (NVMA, 2025). New operations would also stimulate additional investment in exploration.

Domestic processing promotes export substitution, keeping value-added activities, such as smelting and refining, within the U.S. This supports national economic interests by improving the trade balance and ensures downstream revenues from the copper value chain are captured domestically rather than being exported overseas.

8.2.4 Impact on Battery Manufacturing and Recycling

Nevada's strategic focus on becoming a hub for battery manufacturing and recycling would be bolstered by the presence of a copper smelter and refining facility. Copper is a critical component in electric vehicle (EV) batteries and renewable energy systems. By processing copper domestically, Nevada could ensure a stable supply of this essential material for its growing battery manufacturing sector. Similar to Glencore's Horne Smelter, the facility could play a pivotal role in recycling copper from end-of-life batteries and electronic waste, aligning with sustainable practices and reducing reliance on imported materials. With its proximity to the Tesla Gigafactory, Redwood Materials, and other major battery-related investments, the state is well-positioned to integrate copper processing into the broader electric vehicle (EV) and stationary energy storage supply chains.

In addition to supporting upstream production, copper processing infrastructure enables closed-loop recycling systems. By providing the means to recover copper from electronic waste and end-of-life batteries, the facility could reduce landfill volumes and promote circular economy principles. Such a system could also foster partnerships with established battery recyclers, offering a local solution for processing black mass and recovering copper foils, components that are otherwise costly to recycle at scale.

Beyond its economic and environmental benefits, domestic copper processing aligns with national security objectives by strengthening U.S. capabilities to refine and recycle critical materials essential to electrification and energy storage. Reducing reliance on foreign processing and increasing strategic material independence reinforces the resilience of the nation's clean energy supply chain.

8.2.5 Downstream Copper Cathode Opportunities

Producing copper cathodes within the state would open avenues for downstream industries, such as wire, rod and cable manufacturing, electrical equipment production, and construction materials. It would be important for the state to incentivize downstream facilities in order to capture the value stream from copper production, retain value-added processing, and avoid losing economic activity to neighboring states through domestic export. This vertical integration could attract new businesses to Nevada, fostering industrial diversification and creating additional employment opportunities. The availability of locally produced copper cathodes could reduce supply chain disruptions, simplify complex shipping logistics with importing raw materials and, ideally, lower costs for manufacturers, enhancing the competitiveness of Nevada's industrial sector.

This development could foster a robust industrial ecosystem, creating strong synergies with sectors such as electrical equipment manufacturing, renewable energy systems, and construction materials production.

These interconnections can drive innovation and growth while opening avenues for public-private partnerships and access to Department of Energy funding aimed at bolstering domestic manufacturing capabilities.

Producing export-ready copper cathode would provide Nevada with a strategic advantage by allowing surplus production to be shipped through West Coast ports as higher-value exports. This not only increases revenue potential compared to exporting raw concentrates but could also strengthen the state's position in global copper markets by supplying a refined product.

8.3 SMELTER SIZING AND INTEGRATED REFINING

For a new copper processing facility in the U.S., a mid- to lower large-sized facility in the range of 300,000–400,000 tonnes per year of copper produced would likely offer the most strategic value. A smelter of this size would be capable of processing concentrates from multiple regional mines while remaining financeable. This scale supports modern environmental performance, adds meaningful domestic refining capacity, and improves U.S. copper supply chain resilience without the oversupply risks, financing issues, and political hurdles that come with mega-scale projects. A smelter in this range could also feasibly integrate sulfuric acid sales and renewable energy inputs, making it competitive and sustainable by U.S. and global standards. Table 12 gives a breakdown of smelter sizing, and Table 13 provides details on similar sized

Table 12 Copper Processing Facility Scale by Tonnes of Copper Produced

COPPER PROCESSING FACILITY SCALE BY TONNES OF COPPER PRODUCED		
SMELTER SIZE	**ANNUAL CAPACITY (CU)**	**TYPICAL DESCRIPTION**
Small	<100,000 t/y	Regional or specialized operations
Mid-sized	100,000–300,000 t/y	Common for mature, standalone sites
Large	300,000–600,000 t/y	Integrated or export-focused plants
Mega	>600,000 t/y	China, Chile, or custom smelters

Table 13 Example Copper Processing Facilities

EXAMPLE COPPER PROCESSING FACILITIES			
FACILITY	**SMELTER CAPACITY**	**REFINERY CAPACITY**	**TYPE**
Freeport-McMoRan Miami (AZ)	~300,000 t/y	~200,000 t/y	Integrated
Kennecott (Rio Tinto, UT)	~300,000 t/y	~250,000 t/y	Integrated
Jinchuan Group (China)	>1,000,000 t/y	>900,000 t/y	Mega
Atlantic Copper (Spain)	~300,000 t/y	~275,000 t/y	Integrated

smelters in the U.S. and abroad. All tonnages referenced in this section and tables are metric (tonnes).

8.3.1 Integrated Refining

Co-locating a copper smelter and refinery offers strong process, cost, environmental, and strategic advantages. Molten blister copper can flow directly from the smelter to the refinery, avoiding the energy loss and logistics of cooling, transporting, and reheating. Waste heat from smelting can also be reused in refining or acid plant operations, improving overall site efficiency. Shared infrastructure, such as utilities, labs, and waste treatment, reduce capital and operating costs, while joint permitting and compliance simplify regulatory obligations. Eliminating the need to transport intermediate products lowers logistics expenses and associated emissions.

Integrated facilities have a smaller land and water footprint, and can consolidate emissions control and waste management systems. On-site refining produces London Metal Exchange (LME)-grade cathode ready for sale or downstream manufacturing, with the option to produce value-added products like rods or billets. This improves product traceability, quality control, and Environmental, Social, and Governance (ESG) alignment. Strategically, co-located plants retain more of the copper value chain domestically, support local job creation, and may qualify for additional government incentives tied to reshoring and critical mineral development. Finished cathode is also easier to store and export than blister copper or anodes.

Co-location may not be ideal when flexibility in refining capacity is needed, permitting is constrained, or capital is limited. In a scenario like this, phased development may be a better approach. For most U.S. projects, integrating smelting and refining is the preferred approach for maximizing efficiency, reducing costs, and supporting long-term competitiveness.

8.3.2 Small smelters

Smelters producing less than 100,000 tonnes per year are best suited for regional or specialized applications. These facilities often serve niche or remote operations and offer advantages in permitting flexibility, initial capital cost, and localized job creation. Smaller facilities lack the economies of scale needed to compete on cost with larger facilities, and they may struggle to integrate advanced environmental controls and refining capabilities cost-effectively.

8.3.3 Mid-sized smelters

Ranging from 100,000 to 300,000 t/y, mid-sized facilities strike a balance between operational flexibility and capital efficiency. These facilities are common at mature mining sites or in regions where ore sources are more fragmented. This scale allows for sufficient investment in modern emissions controls and energy recovery systems, while remaining agile in adapting to shifting feedstocks or regulatory environments. A mid-sized smelter is large enough to benefit from basic economies of scale, likely without major infrastructure changes or the financing complexity associated with mega-projects. This scale can justify investment in a matching electrolytic refinery (typically producing 90–95% of the smelter's anode output as LME-grade copper cathode), allowing for vertical integration and domestic value capture.

8.3.4 Large smelters

Annual capacities between 300,000 and 600,000 t/y, are typically integrated with mine-mill operations, such as Kennecott or Miami, or serve export markets. These facilities maximize unit cost efficiency through high throughput and benefit from advanced technologies in off-gas handling, sulfuric acid production, and slag recovery. These facilities require more complex permitting and supporting infrastructure, and depend on consistent, large-volume concentrate supply. Feed for large integrated smelting and refining facilities may be challenging in the U.S. given the distribution of feed sources, permitting, and development timelines of new mining projects. These facilities can support an adjacent refinery capable of producing 90-95% of the smelter's anode output as LME-grade copper cathode, depending on recovery and system design.

8.3.5 Mega-scale smelters

Exceeding 600,000 t/y, these facilities are found primarily in China, Chile, and other top-producing nations. These serve global commodity chains and are often built adjacent to major port infrastructure. While they offer unmatched unit-cost efficiency and superior sulfur capture efficiency, they require an enormous capital outlay (often >$2 billion), very high throughput, and substantial governmental

8.4 COPPER SMELTER AND INTEGRATED REFINING COST TO OPERATE

The below information is used for the purposes of evaluating costs to operate a Smelter and Integrated refinery:

Table 14 Table Estimated Capital Costs

COPPER PROCESSING FACILITY SCALE BY TONNES OF COPPER PRODUCED				
SCALE	**CAPEX (SMELTER ONLY)**	**CAPEX (SMELTER + REFINERY)**	**PERMITTING (SMELTER ONLY)**	**PERMITTING (SMELTER + REFINERY)**
Small	**$300M–$500M (one-time)**	**$400M–$650M (one-time)**	**$5M–$10M & 1–3 years**	**$5M–$10M & 1–3 years**
Mid	**$500M–$900M (one-time)**	**$700M–$1.2B (one-time)**	**$8M–$20M & 2–4 years**	**$8M–$20M & 2–4 years**
Large	**$700M–$1.2B (one-time)**	**$1.2B–$2.0B (one-time)**	**$10M–$25M & 2–4 years**	**$10M–$25M & 2–4 years**
Mega	**$1.5B–$3B (one-time)**	**$2.0B–$4.0B (one-time)**	**$20M–$50M & 4–6+ years**	**$20M–$50M & 4–6+ years**

or corporate backing. Such a scale is likely excessive considering the current U.S. domestic copper production environment.

* These are rough estimates based on publicly available information from a variety of sources, including:

✓ Ivanhoe Mines. (2023). *Ivanhoe Mines announces outstanding economic results of updated independent integrated development plan (2023 IDP) for world-leading Kamoa-Kakula Copper Complex.* [Press release]. https://www.ivanhoemines.com/news-stories/news-release/ivanhoe-mines-announces-outstanding-economic-results-of-updated-independent-integrated-development-plan-2023-idp-for-world-leading-kamoa-kakula-copper-complex

✓ Sen, S. (2024, March 1). *Adani's $1.2 billion copper smelter to import concentrates from Peru, Chile, Australia.* Reuters. https://www.reuters.com/markets/commodities/adanis-12-billion-copper-smelter-import-concentrates-peru-chile-australia-2024-03-01

✓ Metso. (n.d.). *Factors to Consider When Investing into a New E-Scrap Smelter.* https://www.metso.com/insights/blog/mining-and-metals/factors-to-consider-when-investing-into-a-new-e-scrap-smelter

✓ U.S. Environmental Protection Agency. (1975). *Proposed new source performance standards for the primary copper smelting subcategory and the primary copper refining subcategory of the copper segment of the nonferrous metals manufacturing point source category* (EPA-440/1-75-019). National Service Center for Environmental Publications. *(Cost figures adjusted for inflation using the Consumer Price Index from 1975 to 2025.)*

✓ International Copper Association. (2023). *Copper – The Pathway to Net Zero.*

✓ Wikipedia contributors. (n.d.). *ISASMELT*. In *Wikipedia*. Retrieved [July 1, 2025], from https://en.wikipedia.org/wiki/ISASMELT

Where data was unavailable, professional assumptions were made based on engineering judgment and comparable project benchmarks. This is also true for tables 15 and 16.

Table 15 Estimated Smelter Operating Costs Per Year

ESTIMATED SMELTER OPERATING COSTS PER YEAR				
SCALE	ENERGY	PERSONNEL	WATER	TAXES
Small	$5M–$8M/year	$15M–$25M/year	$1.5M–$3M/year	$2M–$5M/year
Mid	$10M–$16M/year	$30M–$45M/year	$3M–$6M/year	$5M–$10M/year
Large	$14M–$22M/year	$40M–$55M/year	$4.5M–$9M/year	$8M–$15M/year
Mega	$25M–$40M/year	$60M–$90M/year	$9M–$15M/year	$15M–$30M/year

Assumptions: *Energy is based on estimated 500–800 kWh per tonne of copper produced and average electricity cost of $0.08/kWh. Personnel includes direct employees (operations, maintenance, environmental) with an average loaded cost of ~$110,000/year. Water includes process usage (cooling, scrubbing, slag) at $1.50/m³. Taxes include property, severance/net proceeds, and estimated income tax as % of EBITDA. CAPEX covers smelter, acid plant, utilities, slag handling, and basic infrastructure. Permitting includes air, water, cultural, zoning, and federal (if applicable), and can vary significantly by location and federal involvement.*

Table 16 Smelter with Estimated Integrated Refining Operating Costs Per Year

ESTIMATED SMELTER OPERATING COSTS PER YEAR				
SCALE	ENERGY	PERSONNEL	WATER	TAXES
Small	$5M–$8M/year	$15M–$25M/year	$1.5M–$3M/year	$2M–$5M/year
Mid	$10M–$16M/year	$30M–$45M/year	$3M–$6M/year	$5M–$10M/year
Large	$14M–$22M/year	$40M–$55M/year	$4.5M–$9M/year	$8M–$15M/year
Mega	$25M–$40M/year	$60M–$90M/year	$9M–$15M/year	$15M–$30M/year

Assumptions: *Refining Energy Use: 100–200 kWh/ton (mostly for electrorefining). Refining CAPEX Add-On: $100M–$300M depending on size and tech (e.g., ISA Cells, tankhouses). Electrolyte Management: Ongoing cost and maintenance increases with scale. Automation: Refineries benefit more from automation, reducing marginal personnel cost at large scale.*
Product Output: Electrolytic copper cathode (99.99% Cu), aligned with LME Grade A specs.

8.4.1 Energy Costs

A 300,000 ton-per-year copper smelter with integrated refining is estimated to consume between 500 and 800 kilowatt-hours (kWh) of electricity per tonne of copper produced in the smelting stage, resulting in an annual energy demand of 150 to 240 gigawatt-hours (GWh) (Coursol, 2015; U.S. Department of Energy [DOE], 2013). Refining adds a significant additional energy load, particularly for electrolytic copper refineries, which generally require 200 to 300 kWh per tonne of cathode production. For a matched refinery processing the full 300,000 tonnes per year, this adds 60 to 90 GWh annually (Coursol, 2015; USDOE, 2013).

In total, a co-located smelter-refinery complex might consume 210 to 330 GWh per year, depending on process design and efficiency. At an industrial electricity rate of $0.08 per kWh based on rates from NV Energy / Sierra Pacific Power Company, the combined energy cost would range from $16.8 million to $26.4 million annually, with a midrange estimate of around $21 million based on 260 GWh of total usage.

Electricity is one of the largest recurring operating costs for these facilities. The smelting process itself is energy-intensive due to the high temperatures required (over 1,200°C), while refining involves sustained low-voltage, high-current electrolysis, which draws significant power continuously. Power is consumed by associated systems including gas treatment, materials handling, acid plants, and water treatment.

Integrated operations offer multiple opportunities to reduce energy costs and improve efficiency. One major advantage is the use of flash smelting technology, such as that developed by Metso Outotec, which uses the exothermic oxidation of sulfide-rich copper concentrates to generate most of the process heat internally. This significantly reduces fuel and electricity requirements compared to older technologies like reverberatory furnaces.

Waste heat recovery systems can capture energy from smelter off-gases or slag cooling streams to generate steam or electricity that supports both smelting and refining operations. This internal energy recirculation improves site efficiency and reduces purchased electricity needs.

Integrated complexes often include a sulfuric acid plant that processes sulfur dioxide (SO_2) from smelter off-gases. The conversion of SO_2 to sulfuric acid is highly exothermic, producing substantial amounts of recoverable heat. This heat can be used for onsite steam-driven power generation or for process heating in the refinery, further offsetting energy costs.

By co-locating the smelter and refinery, thermal losses associated with cooling and re-heating blister copper are eliminated. Molten copper can be transferred directly to anode casting and then to electrolytic refining without the need for intermediate transport or solidification. This seamless material flow reduces handling time, energy losses, and auxiliary power use.

An integrated smelter and refinery complex can achieve significant energy and cost savings, potentially reducing overall energy demand per tonne of finished cathode by 10–20% compared to separate facilities.

These gains also translate into lower carbon intensity, which is increasingly important under ESG frameworks, regulatory mandates, and customer-driven decarbonization targets.

Table 17 Estimated Personnel Requirements

ESTIMATED PERSONNEL REQUIREMENTS	
AREA	**ESTIMATED FTES**
Smelter Operations	150–200
Refinery Operations	100–150
Utilities & Acid Plant	30–50
Environmental & Safety	20–30
Maintenance & Engineering	70–100
Quality, Lab, & Metallurgical	20–30
Administration & Logistics	60–90
TOTAL	450–650

8.4.2 Personnel Costs

It is estimated that operating a fully integrated copper smelter and electrolytic refinery with an annual capacity of around 300,000 tonnes would require between 450 and 650 full-time employees, based on employment statistics for similarly sized smelters such as Glencore's Horne Smelter. The average all-in cost per employee, including wages, benefits, taxes, and overhead, is estimated at $110,000 to $130,000 per year for Nevada labor market conditions, resulting in a total annual personnel cost ranging from approximately $49.5 million to $84.5 million (U.S. Bureau of Labor Statistics, 2023). A typical baseline scenario with 550 employees at $120,000 per employee would yield a total of about $66 million annually.

Personnel is usually the second-largest operating expense after energy, and thoughtful workforce planning and investment in training are critical to long-term cost efficiency and plant performance.

8.4.3 Water Costs

It is estimated that operating a fully integrated copper smelter and electrolytic refinery with an annual capacity of around 300,000 tonnes would require significant water resources. Water consumption for smelting can range from 10 to 20 cubic meters per tonne of copper produced, resulting in an annual demand of approximately 3 to 6 million cubic meters (Zhang, 2022; Ministry of Industry and Information Technology, PRC, 2019). However, over 90% of the new water added can be reused. (Zhang, 2022). At an average cost of about $1.50 per cubic meter, this translates to a water expense of roughly $4.5 to $9 million per year, with a midpoint estimate of 4.5 million cubic meters and $6.75 million annually (Nevada Division of Water Resources [NDWR], 2025).

Beyond smelting, an integrated refinery would require substantial water usage, primarily for electrolytic refining, which involves rinsing cathodes, electrolyte management, and cooling. This can add an additional 0.5 to 1.5 cubic meters of water per tonne of finished copper, increasing total site consumption to approximately 4.5 to 10.5 million cubic meters per year depending on plant design and water recycling effectiveness (Zhang, 2022; U.S. Environmental Protection Agency [EPA], 1980) . Water is also critical for acid plant operations, where it supports cooling towers, off-gas scrubbing, and sulfuric acid dilution processes. These components contribute to the overall water demand of an integrated smelter-refinery complex.

Facilities commonly adopt water reuse and recycling systems, such as closed-loop cooling and reclaiming process water from condensate or tailings, to reduce fresh water intake.

While these systems significantly lower net water consumption, they often require additional capital investment and complex permitting under local water rights regulations.

8.4.4 Land Requirements

An integrated copper smelter and refinery designed to produce 300,000 tonnes of copper cathode annually comes with substantial land requirements. While the exact footprint depends on the facility's layout, process technology, environmental controls, and supporting infrastructure, recent benchmarks indicate that a total area of approximately 200 to 300 acres (about 80 to 120 hectares) is achievable with modern designs. A likely scenario for obtaining access to the required acreage for a project of this scale is through federal or state land disposal lands.

Several existing facilities help illustrate this scale. Asarco's Hayden Smelter in Arizona occupies around 180 acres, while Freeport-McMoRan's Miami smelter operates within an approximately 130-acre footprint. Larger facilities such as Rio

Table 18 Processing Facility Components and Estimated Area Requirements

PROCESSING FACILITY COMPONENTS AND ESTIMATED AREA REQUIREMENTS		
COMPONENT	**AREA (ACRES)**	**NOTES**
Smelting plant (concentrate handling, furnaces, converters)	50-65 acres	Flash smelting or ISA/ Outotec-type furnace
Electrolytic refinery	40-55 acres	Including tankhouses, anode/cathode handling
Sulfuric acid plant (byproduct)	15-25 acres	Often integrated to capture SO_2
Oxygen plant	8-12 acres	Required for modern flash smelting
Slag and tailings handling	30-40 acres	Could be off-site depending on design
Raw material and product storage	25-35 acres	Copper concentrate, blister cop-per, cathodes
Utilities, maintenance, labs, admin	15-25 acres	Power substation, workshops, etc.
Buffer zones, roads, stormwater ponds	30-50 acres	Environmental compliance, haul roads, safety
TOTAL ESTIMATED AREA	**213-307 ACRES**	

Tinto's Kennecott smelter and refinery complex spans roughly 350 acres. Freeport Indonesia's Gresik smelter, which is designed to produce over 600,000 tonnes of cathode per year, maintains a highly integrated layout within a 250-acre core site.

Several factors influence how much land is ultimately required. The choice of smelting technology, such as flash smelting versus older reverberatory systems, can dramatically affect layout efficiency. Co-location with an acid plant, or rail facilities, can reduce on-site logistics and storage needs. Environmental regulations, particularly related to SO_2 and water treatment, may increase space demands for compliance infrastructure. Facilities that recover byproducts like gold, silver, or selenium often need additional processing space. Permitting requirements and public safety standards typically necessitate buffer zones that expand the overall footprint.

8.4.5 Taxes

For a comprehensive analysis of federal and state tax obligations, see Section 7.

The comprehensive tax burden for a copper processing facility with integrated refining operations in Nevada including property taxes, net proceeds taxes, commerce taxes, and regulatory fees would typically equate to 6% to 10% of Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA). During periods of elevated commodity prices, or in a high-cost jurisdiction, this burden could exceed 12%. With effective utilization of Nevada GOED's incentive packages, eligible projects may reduce this burden significantly, particularly during the first 5–10 years of operation. This reduction in the initial years of operation lowers financial pressure and enhances the facility's competitiveness as it becomes established.

8.4.6 Financing to Build

Developing a greenfield copper smelter with integrated refining capacity in Nevada, sized at approximately 300,000 tonnes per year (t/y) of concentrate throughput based on rough estimates, requires a capital investment ranging from $900 million to $1.8 billion. This estimate is partially based on other recent global benchmarks, such as PTFreeport Indonesia's Gresik smelter which as of 2024 had cost $3.3 Billion for a 590 Kt per annum integrated facility (Reuters, 2024)

Financing for large-scale metallurgical infrastructure in the U.S. is typically structured with a 70/30 debt-to-equity ratio (Financial Modelling Handbook, 2024; World Bank, n.d.). Equity contributions could be provided by strategic mining companies seeking secure, long-term refining capacity for U.S.-sourced concentrates. Private equity firms could also participate, generally requiring internal rates of return (IRRs) between 15% and 25%, for greenfield projects that carry permitting, construction, and commodity market risks (Weber, 2021). Public-private partnerships (P3s) or infrastructure funds with longer investment horizons may contribute equity as well.

Debt financing is commonly secured through commercial project finance lenders, which typically require completion guarantees and long-term concentrate offtake agreements. Additional debt could come from development banks or energy transition infrastructure funds. Considering a copper processing facility would be considered a strategically important facility, the U.S. federal loan guarantee programs, such as those offered by the Department of Energy (DOE) or the Export-Import Bank (EXIM), could be available if the project qualifies under critical mineral or domestic manufacturing criteria. The typical blended cost of capital for such projects ranges from 7% to 12%, depending on the project's credit profile, risk structure, and prevailing interest rates (Martin, 2022).

While GOED incentives do not directly contribute equity capital, they can materially improve a project's economics by lowering effective tax burdens and enhancing internal rates of return. In addition, a Nevada-based smelter with integrated refining capacity aligns with national priorities related to critical mineral security and domestic manufacturing. This alignment may strengthen the case for federal support under DOE Title 17 loan guarantees, Inflation Reduction Act (IRA) incentives, and other programs aimed at reshoring industrial capabilities, particularly if secondary metals such as tellurium, selenium, or precious metals can be recovered during the refining process.

8.4.7 Pre and Post-Construction Permitting Costs

8.4.7.1 Pre-Construction Phase:

In Nevada, the permitting process for a new copper processing facility with integrated refining could take 24 to 48 months, influenced by the site's proximity to federal lands and the complexity of environmental reviews. Key permits and approvals include air quality permits, water rights and discharge permits, resource conservation and recovery act (RCRA) authorization for slags and spent electrolytes, cultural and environmental assessments, local zoning and industrial siting.

The combined cost for legal counsel, environmental consulting, engineering studies, air and water modeling, baseline environmental surveys, public engagement, and preparation of permit applications could range from $10 to $25 million, or around 1 to 1.5% of estimated project capital costs (Kramer et al., 2020). Integrated refining complexity can drive costs toward the higher end of this range due to additional emissions and waste management considerations.

8.4.7.2 Post-Construction Compliance:

Once operational, the processing facility must maintain adherence to permit conditions through regular air and water monitoring, reporting and record keeping, emissions trading or offset programs, stormwater and waste management, tail gas treatment and process optimization.

Annual environmental compliance costs, including monitoring equipment maintenance, permit fees, laboratory testing, reporting, and staff, could range from $2 million to $5 million per year for a 300,000 tonne per year processing facility (U.S. EPA, 2024).

8.5 EXAMPLE ECONOMICS OF A CO-LOCATED SMELTING AND REFINING FACILITY

Calculating return on investment (ROI) for a copper smelter or concentrate leach plant requires estimating capital expenditures (CAPEX), forecasting operating costs (OPEX), and projecting revenues from processing concentrate. While it would be premature to deem ROI a fatal flaw without performing detailed financial modeling, the economic viability of such a facility is highly sensitive to several complex factors, including current and projected treatment and refining charges (TCRCs), concentrate supply availability, energy costs, environmental compliance, and copper market pricing.

The following is for a 300,000 tonne per year smelter and co-located refinery designed to process 1 million tonnes of copper concentrate annually.

At today's TCRC levels, which are historically low due to global smelter overcapacity in China and a tight market for clean concentrates, a standalone smelter in the U.S. may struggle to generate a competitive return without government support. However, if reducing reliance on imports of critical minerals and increasing domestic copper processing and product manufacturing are national priorities, then such efforts become essential. In 2024–2025, benchmark TCRCs have dipped below $80 per dry tonne (DMT) and 8¢ per pound of copper, rates that favor smelters but reduce revenue for concentrate sellers, creating economic headwinds for new entrants. A new domestic smelter must not only compete with these international benchmarks but also justify higher capital and regulatory compliance costs.

Although copper is the primary product of smelting facilities, byproducts for minerals such as gold, and sulfuric acid add to the economics of operating a smelter.

Preliminary economic assessments using rough order-of-magnitude cost estimates are therefore a critical first step. These should include sensitivity analyses on copper price forecasts, TCRC volatility, sulfuric acid byproduct revenue (if applicable), and fluctuations in energy, labor, and reagent costs. Financing structure and debt service must also be considered, as the capital investment required for a new smelter typically ranges from $1 to 3 billion depending on size, technology, and permitting requirements.

To operate profitably, a domestic smelter must secure long-term concentrate supply contracts for consistent feedstock, maintain low-cost energy access, especially electricity and natural gas, recover byproducts efficiently to diversify revenue, and comply with EPA and state environmental regulations. It must also build strong relationships with downstream customers to ensure stable copper offtake and remain agile in responding to market volatility driven by global copper prices, treatment charges, Chinese smelting capacity, and other macroeconomic factors.

As an example: to achieve the target internal rates of return (IRR) over a 30-year project life for an integrated facility capable of processing 1 million tonnes of concentrate annually with a capital cost of $1.8 billion and annual operating costs of $103 million, the smelter would need to generate the following annual gross margins (treatment and refining charges minus opex):

- ✓ 15% IRR: approximately $282.6 million per year ($283 per tonne in TCRCs)
- ✓ 25% IRR: approximately $383.6 million per year ($384 per tonne in TCRCs)

Using the 10-year average benchmark, treatment charges (TCs) were set at $83.50 per tonne, and refining charges (RCs) at 8.5 cents per pound, totaling a combined TCRC of $270.90 per tonne of concentrate, excluding shipping costs. Under these conditions, and without any federal subsidies or state-level support, the processing facility modeled in this example would operate at an estimated loss of $12 per tonne at 2024 benchmark rates when targeting a 15% internal rate of return (IRR).

Considering this same scenario, the inclusion of Nevada state tax incentives through GOED, combined with the federal 48C Investment Tax Credit, low-interest financing from the DOE Title 17 Loan Programs Office, and a potential grant under programs like DOE's IDP or DPA Title III, could enable a new smelter to operate at globally competitive levels. A major driver of this competitiveness is the significantly lower transportation cost for domestically sourced copper concentrate, which can be 100% to over 300% less than shipping to Asia.

Re-running the economic model with these advantages—reduced tax exposure and operating costs—the project becomes substantially more viable. For a smelter with a $1.3 billion capital cost, offset by a $500 million federal grant, and annual operating costs reduced to $77 million through incentives, the required annual gross margins (treatment and refining charges minus operating costs) over a 30-year project life would be:

- ✓ 15% IRR: approximately $185 million per year ($185 per tonne in TCRCs)
- ✓ 25% IRR: approximately $250 million per year ($250 per tonne in TCRCs)

At a 10-year average combined treatment and refining charge (TCRC) of $270.90 per tonne of concentrate, excluding shipping costs, a U.S.-based copper processing facility, supported by federal loans, grants, and state incentives, would operate at an estimated profit of $21 per tonne, even while targeting a 25% internal rate of return (IRR).

By comparison, 2025 has seen historically low benchmark rates in Asia, with treatment charges at $21.25 per tonne and refining charges at 2.125 cents per pound, resulting in a total TCRC of just $68.09 per tonne (Reuters, 2024). However, when factoring in approximately $100 per wet tonne in shipping and port handling costs from Nevada to Asian smelters, the effective TCRC for offshore processing rises to about $170 per tonne.

Despite the temporary collapse in TCRCs, these conditions are not expected to persist long-term. The current environment presents a strategic window to establish domestic smelting capacity that can capitalize on future recovery in conversion rates, strengthening U.S. supply chain security while maintaining competitive economics. Considering the expected global supply deficit of 30 percent by 2035, caused by constrained supply facing significantly higher demand growth for copper, the price of copper is expected to remain stable, and production is expected to increase slightly in an attempt to meet demand. Current TCRC pricing is not expected to serve as a benchmark for a new facility, given the timelines required to permit and construct a facility of this scale. This could place a newly commissioned facility within a period of significantly higher processing and refining prices.

SECTION

09

Strengths, Weaknesses, Opportunities, and Threats (SWOTs) Analysis

09 STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS (SWOT) ANALYSIS

SUMMARY

This section evaluates the feasibility of establishing a centralized copper processing facility in Nevada through a SWOT framework, focusing on copper concentrate supply, environmental permitting, infrastructure, land use and siting.

Strengths include Nevada's strategic resource availability from existing and relatively near-term copper mines such as Yerington, MacArthur, and Mason; access to regional concentrates, including sources from Arizona; a large domestic supply of scrap copper; well-developed logistics and infrastructure along major corridors (I-80, US-95); and a clear permitting pathway supported by state and federal policies. Additional strategic opportunities exist from byproducts like gold, silver, tellurium and selenium.

Weaknesses highlight insufficient current in-state concentrate supply to meet commercial-scale processing needs, high capital and operating costs influenced by energy prices, complex and lengthy U.S. regulatory requirements, and low smelter revenue benchmarks challenging profitability without subsidies.

Opportunities arise from U.S. policy priorities to reshore critical mineral processing, utilizing exported concentrates and scraps domestically, byproduct monetization, and potential federal or state incentives supporting project development.

Threats include global copper market volatility, environmental opposition and litigation risks delaying permits, and international competition benefiting from lower costs and relaxed regulations.

Detailed analysis covers copper concentrate supply limitations and growth potential from regional mines and scrap recycling, environmental permitting timelines with recommended strategies to mitigate delays, land use preferences favoring private or strategically transferred public lands, and infrastructure considerations, highlighting transport, power, gas, and water availability within a promising corridor along I-80 and US-95.

Overall, while challenges exist, strong resource availability, excellent geographic proximity to copper producers, supportive infrastructure, emerging technology, and policy alignment present a viable opportunity for domestic copper processing expansion in Nevada.

SIMPLE SWOT

Considerations of a centralized processing facility in Nevada are subject to opportunities and challenges which are considered here in the format of Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. Major considerations subject to SWOT evaluation are considered in this section:

1. Copper Concentrate and Supply
2. Environmental Permitting
3. Land Use Policy
4. Accessibility and Infrastructure

STRENGTHS

Strategic Resource Availability

- Existing copper production from Nevada (Phoenix, Robinson) and near-term projects (Pumpkin Hollow, Mason) can supply substantial feedstock.
- Potential access to Arizona concentrates (Copper World, Pinto Valley, Mineral Park, Resolution Copper) adds regional support.

Scrap Copper Feedstock: U.S. generates >900,000 tonnes tonnes of scrap annually, most of which is exported. Redirecting domestic scrap offers stable, high-quality input.

Logistics & Infrastructure

- Favorable infrastructure along I-80 and US-95 corridors (rail, road, HV power lines, natural gas, potential water sources).
- Proximity to mines reduces transportation costs; estimated international shipping savings range from $90–$150 per wet tonne.

Environmental & Regulatory Framework

- Clear permitting pathways in Nevada through NDEP and other state agencies; potential federal alignment via strategic mineral designation.
- Opportunities for land acquisition via disposal of public lands for critical mineral infrastructure projects.

WEAKNESSES

Insufficient Current In-State Supply

Existing concentrate production in Nevada (~730–910 tonnes tonnes/day) falls short of commercial-scale smelter needs (~1,800–2,700 tonnes tonnes/day).

High Capital & Operating Costs

CAPEX for a smelter or leach plant is $1–$3 billion, depending on technology and compliance costs.
Energy-intensive operations with volatile natural gas and electricity prices impact OPEX.

Stringent U.S. Regulatory Burden

RCRA, NPDES, Title V Air Permits, NEPA, and wildlife regulations increase complexity and permitting timelines (24–48 months).
Higher compliance costs vs. international smelters, especially in China, will hurt competitiveness without subsidies.

TCRC Market Dynamics

2024–2025 benchmark TCRCs are low (~$27/DMT, $0.02/lb), limiting smelter revenues. May require policy support or market shifts to ensure ROI.

OPPORTUNITIES

Re-shoring Industrial Capacity
Aligns with U.S. federal critical mineral strategies and domestic supply chain security goals. Captures value currently lost in concentrate and scrap exports (>350,000 tonnes concentrate and >960,000 tonnes scrap exported in 2023).

Emerging Technologies
Deployment of low-emission leaching processes (e.g., Rio Tinto's Nuton) could improve economics and permitting viability.

Byproduct Revenue Streams
Potential to recover and monetize gold, silver, sulfuric acid from concentrates enhances economic feasibility.

Public-Private Partnerships
Potential for federal or state incentives, grants, or tax credits to support development under the Inflation Reduction Act or DOE initiatives.

THREATS

Global Market Volatility
Copper prices and TCRC rates are highly sensitive to macroeconomic conditions and Chinese smelting capacity.

Environmental Opposition & Legal Delays
Risk of litigation, public opposition, and lengthy EIS processes, particularly for siting near sensitive habitats or federal lands.

Competition from Foreign Smelters
International facilities benefit from lower costs, economies of scale, and more lenient regulatory environments.

9.1 CONCENTRATE SUPPLY

Table 19 Selected Potential Processing Facility Feeds

PROCESSING FACILITY COMPONENTS AND ESTIMATED AREA REQUIREMENTS				
MINE NAME	**STATUS**	**DAILY CONC. TONNES**	**CONCENTRATE %CU**	**DAILY CONTAINED CU POUNDS**
NEVADA PROCESSING FACILITY FEEDS				
Phoenix	Production	140	25%	75,000
Robinson	Production	450	25%	250,000
Pumpkin Hollow	Care and Maintenance	270	25.5%	150,000
Mason	Development	1,100	30%	720,000
Pathfinder - Liberty	Development	290	22%	145,900
TOTAL NEVADA PROJECTS		2,250	27%	1,340,900
OTHER PROCESSING FACILITY FEEDS				
Copper World	Production	820	28%	454,000
Morenci	Production	4,500	26%	2,500,000
Bagdad	Production	820	26%	460,000
Mission	Production	590	26%	332,000
Sierrita	Production	820	25%	450,000
Chino	Production	680	25%	360,000
Pinto Valley	Production	540	28%	300,000
Mineral Park	Development	110	32%	70,000
Resolution	Development	6,000	33%	4,000,000
TOTAL OTHER MINES		14,880	29%	11,607,800

Developing a centralized processing facility in Nevada will require feed. Three mines in Nevada, KGHMs Robinson, Nevada Gold Mine's Phoenix mine, and Southwest Critical Materials's Pumpkin Hollow Mine (currently not producing), can produce or are capable of producing copper concentrate at the time of this study. As of 2024, Phoenix and Robinson produce an average of approximately 450 to 640 tonnes of concentrates per day containing an estimated 300,000 to 400,000 pounds of copper. When Pumpkin Hollow re-opens the underground operations may be capable of contributing an additional 270 tonnes of concentrate daily for an additional 150,000 pounds of copper. This output is likely not sufficient to sustain operations at a new smelter of a reasonable commercial size of 1,800 and 2,700 tonnes daily.

Projects such as Mason and the Yerington Mine, located in the Yerington District and owned by Hudbay and Lion Copper and Gold, respectively, could contribute significant volumes to Nevada's copper concentrate mix. The Mason project, containing a resource that is 99% sulfide, would contribute an additional 910 to 1,200 tonnes of concentrate daily containing approximately 700,000 pounds of copper. While the Yerington Mine is evaluating the use of Nuton technology for copper processing, the recovery of byproduct minerals could be introduced if a processing facility offered access to alternative processing methods. Other sites such as Pathfinder's project outside of Tonopah, Nevada would contribute an additional 160 tonnes of concentrate daily containing 90,000 pounds of copper. These future projects would likely bring the state production into the realm of realistically supplying a smelter without contribution from surrounding states

Outside of Nevada, Hudbay Minerals has recently opened the Copper World project with projected production of approximately 820 tonnes of concentrate, contributing an additional 454,000 pounds of copper daily that would be available for domestic smelting. Capstone Copper's Pinto Valley Mine in Arizona produces approximately 540 tonnes of concentrate per day containing an estimated 300,000 pounds of copper. Origin Mining's Mineral Park project is transitioning to milling and will likely generate a concentrate for smelting and refining. Based on available information, Mineral Park would contribute at least 110 tonnes of copper concentrate daily containing approximately 70,000 pounds of copper. Resolution Copper is slated to open in approximately 2029 after receiving "FAST-41" status, streamlining its permitting process. Based on available information, from a concentrator designed to handle 120,000 tonnes per day of ore at a grade of 1.5% copper, Resolution Copper would be capable of contributing 6,000 tonnes of copper concentrate daily for contained copper of 4 million pounds.

Considering the currently available concentrate from Nevada and excess capacity from neighboring states with the ramp up of projects such as Hudbay's Copper World, there is currently sufficient capacity to support an additional domestic smelter. With the addition of projects such as Resolution, and in the future, Mason, the domestic production of concentrate would greatly increase the current deficit of domestic processing, even with the addition of a new smelter within the state of Nevada.

In 2024, U.S. producers exported 320,000 tonnes of copper as concentrate, equivalent to approximately 3,100 tonnes of concentrate per day (USGS, 2025). The current volume of exported copper is sufficient to feed a new processing facility with capacity approximately equivalent to one of the two domestic smelters currently in operation. In addition to the project pipeline for developing projects, there is an adequate domestic supply of concentrate to justify the installation of a new smelter and/or concentrate leach plant utilizing technology such as Rio Tinto's Nuton. Considering the current economic environment and the U.S. government's support for domestic production of minerals, including copper, domestic concentrate producers would likely favor domestic facilities over shipping to foreign smelters due to the reduced transport costs lending to an overall reduction in production costs.

9.1.2 Processing of Scrap Copper

In 2023, the U.S. exported approximately 875,000 tonnes of copper scrap. During the same period, domestic melt shops consumed around 906,000 tonnes of copper-bearing scrap (Recycling Monster, 2024). China remained the largest export destination, receiving approximately 350,000 tonnes, or about 19.5% of total U.S. copper scrap collected in the U.S. (Recycling Today, 2024).

Utilizing a portion of this material in U.S.-based smelting operations could contribute to a more resilient domestic copper supply chain, reduce reliance on imports, and support federal critical minerals initiatives. Much of the exported scrap originates from high-quality industrial sources, including manufacturing offcuts and electronic waste, offering a consistent and viable feedstock for domestic processing.

A relevant example is Glencore's Horne Smelter in Canada, which processes a diverse mix of feedstocks, including electronic scrap. Roughly 15% of its copper production is derived from e-waste, illustrating the feasibility of recovering high-purity copper from complex secondary materials.

9.2 ENVIRONMENTAL PERMITTING AND ANTICIPATED TIMELINES

The timelines for mineral exploration and engineering are often commingled into the permitting timeline. In Nevada, the actual timeline to complete environmental permitting is in the range of 2 to 4 years from the time baseline studies and modeling are completed to the timeline to complete NEPA analysis and obtain the major State permit authorizations. If projects are skillfully managed, employ a defensible baseline study, modeling program, and community outreach program, keep engineering timelines on track, and the proponent makes timely decisions on project design, the actual length of time for environmental permitting can be accomplished efficiently and successfully without litigation through the NV-IM-2023-003 process.

Threats and Weaknesses to avoid that result in permitting delays and increased costs with copper mines and process facilities include:

- ✓ Class I air permits involve the federal EPA, whereas Class II air permits are handled with the state NDEP.
- ✓ Water must be put to beneficial use to maintain the full allocation.
- ✓ New ROWs may be necessary to connect ancillary facilities to mine and processing infrastructure.
- ✓ Siting power supply can be a long lead item for engineering and permitting copper mines and process facilities.
- ✓ Geochemistry characterization work may identify waste rock material as acid generating which complicates engineering and permitting for short and long term storage of this material.
- ✓ There may be uncertainty in the permitting process requirements for local, state, and federal agencies as permitting reform is implemented, although the Nevada NV-IM-2023-003 process ensures a 6-month Environmental Assessment and a 12-month Environmental Impact Statement once engineering and baseline studies are complete and the Plan of Operations is deemed complete for NEPA.

- ✓ Direct or indirect opposition by various stakeholders (including tribes and/or supporting NGOs) could stall the project. This could affect the timeline during the permitting process (lengthen the permitting process) and/or be an ongoing issue after permits are secured via litigation.
- ✓ Opposition from the communities associated with impacts to viewshed from construction of process facilities along with increase in ambient noise levels and dust generation may impact project schedules.
- ✓ Strengths and Opportunities to consider that help maintain permitting timelines and costs for copper mines and process facilities include:
- ✓ Agencies should be consulted early on the proposed project and baseline studies, even if permitting only requires State and local involvement. Be proactive in considering new federal policy directions.
- ✓ Develop and implement a robust Stakeholder Engagement Plan to keep stakeholders engaged.
- ✓ Require the permitting team to routinely interface with the design team.
- ✓ Recognize and develop a plan for addressing key technical aspects early.
- ✓ Maximize use of existing baseline information and NEPA, if possible, when developing ROWs.
- ✓ Seek common/shared copper concentrator locations between nearby copper projects.

9.3 LAND USE AND POTENTIAL LOCATIONS

The installation of a smelter or concentrate leach plant, along with its supporting infrastructure, requires a substantial parcel of land. Regulatory agencies such as the NDEP's Bureau of Air Quality, NDWR, and NDOW enforce stringent regulations on land use, air emissions, water rights, and habitat protection that will significantly influence the siting of a processing facility.

While theoretically possible to locate a processing facility on public land, the preferred option is typically private land that is already zoned, or can be rezoned, for heavy industrial use to streamline permitting and compliance. There are opportunities to site processing facilities on public lands that are available for disposal, meaning these lands can be transferred to private ownership if their intended use aligns with the strategic goals of state and federal agencies. This concept also aligns with the principles of brownfield development by siting a processing facility on disposal lands, presenting an opportunity to redevelop state or federal lands. Given the economic and strategic importance of copper processing, facilities of this type often qualify for such land transfers under government initiatives aimed at supporting critical mineral development and industrial growth.

Nevada is geographically well positioned to capture copper concentrate currently exported from within the state and neighboring copper-producing regions such as Arizona. As new mines come online in Nevada and across the West, a domestic processing solution becomes increasingly necessary if domestic processing capability is a primary concern, especially given that copper smelters are fixed-capacity facilities that generally cannot be expanded once built. Several locations within Nevada align well with the critical siting criteria for a smelter and refinery complex, including access to fuel and electricity, rail infrastructure, sufficient water supply, and an adequate land footprint. The Valmy area, east of Winnemucca, stands out as a prime candidate due to its rail access, availability of natural gas, electric transmission lines, and well water, as well as the potential for brownfield development, which may streamline permitting. Mason Valley, already home to active and historic copper operations, offers proximity to feedstock but sits within a restricted air basin that could complicate air permitting. Big Smokey Valley and the Ely area are remote and historically industrial, offering suitable space and mining infrastructure, though both face similar air basin challenges. The U.S. 50 corridor east of Fallon provides access to key utilities but lacks rail, which could affect concentrate logistics. Mineral County near Hawthorne has favorable zoning, infrastructure, and road access, with potential for further utility development. The area north of Winnemucca along U.S. 95 and the Fernley region also present viable options, though permitting constraints tied to air quality may influence final site feasibility. It should be noted that air-bains restrictions are not a barrier to development, but will require additional effort for permitting and compliance. Together, these locations highlight Nevada's strategic advantage in becoming a central hub for domestic copper processing.

9.4 ACCESSIBILITY AND INFRASTRUCTURE

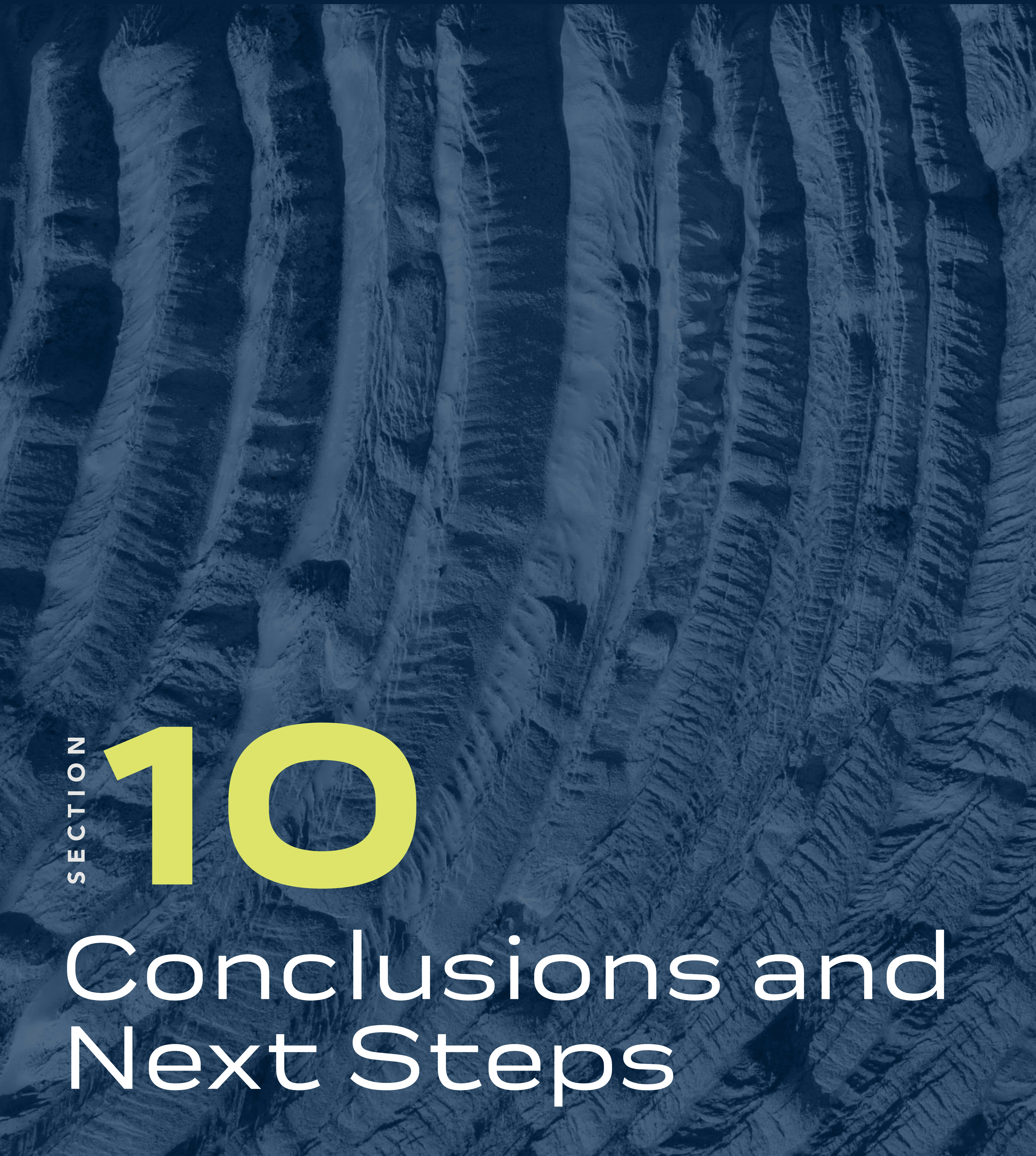
Transportation of copper concentrate to a new processing facility requires reliable access to major highway and rail systems to ensure efficient and cost-effective logistics. Equally critical is access to high-voltage transmission lines capable of supporting the substantial power demands of a copper processing facility. In Nevada, the availability of high-voltage power is generally good along key corridors, including the I-80 and US-95 corridors, where substations and transmission infrastructure support industrial loads. Access to natural gas pipelines is also essential, as natural gas is frequently used as a primary energy source for smelting operations, providing both heat and fuel for various processes.

A sufficient and sustainable water supply is another crucial requirement, given that copper processing plants consume significant amounts of water for cooling, dust control, and chemical processing. A processing facility will need to secure water rights and access to reliable water sources, as this is a key component of site feasibility and regulatory approval.

Tentatively, a corridor of potential locations has been identified along the I-80 highway, extending westward from Wells to Fernley, and then southward between highways US-95 and US-95A toward Yerington. This corridor offers a favorable combination of transportation infrastructure, electrical grid access including high-voltage transmission lines, natural gas pipeline availability, and potential water sources.

Preliminary analysis of this land suggests it could support the logistical and utility needs of a copper concentrate processing facility.

Any potential siting would be subject to compliance with land use regulations, environmental restrictions, water rights, and stakeholder and public input processes. Coordination with agencies such as NDEP, NDOW, NDWR and local planning authorities will be essential to address permitting, zoning, and environmental concerns.



SECTION 10

Conclusions and Next Steps

10 CONCLUSIONS AND NEXT STEPS

The opportunities presented by a facility of this type primarily include reducing the United States' dependence on foreign copper refining facilities and positioning Nevada strategically as a national processing and manufacturing hub. Additionally, it reduces the increasingly challenging logistical burden on domestic operators for shipping concentrate internationally and offers the benefit of value-added activities, such as manufacturing copper products to support domestic manufacturing growth. A copper processing facility in Nevada represents a sound and competitive opportunity to expand domestic critical mineral processing capacity within the evolving global copper market. Driven by rising global demand fueled by electrification, clean energy technologies, battery manufacturing, recycling, and infrastructure development, ensuring a secure and resilient supply chain has become a national imperative. If a project capitalizes on substantial federal and state incentives, favorable permitting frameworks, and streamlined land acquisition processes available in Nevada, it thereby establishes a highly conducive environment for investment and development.

Nevada's strong mining infrastructure, expanding battery and EV manufacturing sector, and supportive regulatory environment make it an ideal location to add value across the copper supply chain. This processing facility would reduce reliance on overseas processing, cut transportation costs, and strengthen regional and national supply chain security. It would also advance Nevada's economic goals by creating jobs, driving industrial diversification, and fostering innovation in clean technologies. Aligned with national decarbonization and critical minerals strategies, and backed by state and federal partnerships, the facility would anchor long-term sustainable growth, advanced manufacturing, and supply chain resilience.

The economic viability of a copper processing facility is underpinned by several key factors. Capital investment requirements are expected to be significantly reduced compared to typical industry standards, largely due to the potential availability of substantial federal grant support and access to low-interest financing programs. These financial incentives play a critical role in enhancing project affordability and alleviating the initial capital burden. Operating costs are also projected to be notably lower through the application of state tax incentives combined with federal investment tax credits, which together improve ongoing cost efficiency and support long-term profitability.

From a revenue perspective, the project is designed to achieve competitive returns over a multi-decade operational lifespan. The treatment and refining charges necessary to meet these return targets are consistent with global industry benchmarks as a ten-year average, especially when factoring in the considerable transportation cost savings realized by processing concentrate domestically rather than overseas. The strategic location of the facility in Nevada provides a distinct logistics advantage, with significantly reduced transportation and port handling expenses compared to international shipping routes. This advantage contributes to greater margin stability and strengthens overall supply chain resilience.

NEXT STEPS

To advance the development of a copper processing facility in Nevada, the immediate priority would be to establish a comprehensive public-private partnership (PPP) that engages a diverse range of stakeholders. This collaboration should include the Nevada Governor's Office of Economic Development (GOED), which administers key incentive programs such as tax abatements and infrastructure support designed to attract industrial-scale investment to the state. Local governments, tribal representatives, regional economic development agencies, and private sector investors should be incorporated early to ensure the PPP framework is inclusive, strategically aligned, and capable of leveraging public and private resources effectively.

Effective stakeholder management is essential to advancing copper processing in Nevada. Engagement must be structured across local, state, and federal levels to align priorities, unlock support, and build long-term project legitimacy.

At the local and regional level, early collaboration with Regional Development Authorities (RDAs), community leaders, tribal representatives, is critical. These stakeholders help shape workforce strategies, permitting readiness, infrastructure planning, and community engagement, ensuring that projects reflect local needs and secure broad-based support.

Statewide, Nevada offers powerful economic development tools including GOED-administered tax abatements, Industrial Development Bonds, and permitting coordination through NDEP and State Lands. Alignment with the Nevada Battery Coalition, Tech Hub efforts, NVMA, and rural development agencies further strengthens the ecosystem for industrial-scale investment.

Federally, copper processing projects may qualify for support through the DOE's 48C Investment Tax Credit, IRS's 45X Tax Credit, Title 17 loan guarantees via the LPO, and Industrial Demonstrations Program, as well as DOD's DPA Title III authorities. EXIM may also support globally oriented investments tied to strategic supply chains.

Together, these layers of engagement provide a clear roadmap for project advancement, ensuring that stakeholders are aligned, resources are leveraged, and financing tools are unlocked. Through these integrated steps, Nevada is well-positioned to become a national leader in copper refining and a cornerstone in the secure, sustainable supply of critical minerals.

Finally, the development of a comprehensive project roadmap is essential to guide execution. This document should establish critical milestones spanning site acquisition, permitting, detailed engineering, financing, and construction, ensuring all workstreams progress in alignment with regulatory timelines and investment goals. Through these integrated steps, Nevada is well-positioned to become a national leader in copper refining and a cornerstone in the secure, sustainable supply of critical minerals.

GLOSSARY OF TERMS

Anode Copper - Copper in the form of large plates or slabs and used as the starting material in electrolytic refining.

Autoclave Leaching / Pressure Oxidation (POX) – High-pressure, high-temperature chemical leaching of sulfides.

BAPC (Bureau of Air Pollution Control) - State agency that partners with NDEP-BMRR on mining projects and issues Air Quality Operating Permits for facilities emitting gases or particulates.

BLM (Bureau of Land Management) – Federal agency that oversees mining permitting and rights-of-ways on federal lands.

Blister Copper – Intermediate product (~98–99% Cu) from smelting, prior to final refining.

BMRR (Bureau of Mining, Regulation, and Reclamation) - Is the primary State agency regulating mining and issuing Reclamation Permits.

BSMM (Bureau of Sustainable Materials Management) - State agency that oversees permitting and compliance for solid and hazardous waste, issuing Hazardous Waste IDs and Management Permits.

Byproducts – Secondary materials such as gold, silver, molybdenum, sulfuric acid

BWPC (Bureau of Water Pollution Control) - State agency that regulates discharges to state waters by issuing permits and enforcing water pollution control laws.

Capex (Capital Expenditure) – Upfront cost to build infrastructure or a plant.

Cathode Copper – Final purified copper (~99.99% Cu) after electrorefining.

Cathode Production – Refined copper output.

CEQ (Council on Environmental Quality) - Federal agency within the Executive Office of the President, established by NEPA in 1970, that advises on environmental policy, guides NEPA implementation, and coordinates federal environmental reviews to support environmental quality, economic prosperity, and energy security..

Conductivity – Copper's ability to conduct electricity, a key demand driver.

Cu/Fe Ratio – Ratio of copper to iron in the ore, indicating suitability for smelting or processing.

Customs Duty/Export Control – Government-imposed restrictions on imports/exports, especially relevant for Chinese policy.

DOI (Department of the Interior)

DPA Title III (Defense Production Act) – U.S. authority for strategic material funding.

Electrification – Broad trend increasing demand for copper across EVs, grid infrastructure, etc.

EGS (Enhanced Geothermal System) - Generates geothermal electricity without natural convective hydrothermal resources.

EIS (Environmental Impact Statement)

FAST-41 – Federal permitting streamlining initiative for major infrastructure projects.

Flotation – A process to separate minerals by using chemical reagents to make target minerals hydrophobic.

FLPMA (Federal Land Policy and Management Act) - Federal law that governs the management and use of public lands overseen by the Bureau of Land Management (BLM).

Grid Modernization – Upgrading power systems; a key end use for refined copper.

HAP (Hazardous Air Pollutant) - Also known as air toxics, these pollutants can cause cancer, birth defects, or other serious health or environmental effects. The EPA works with state, local, and tribal agencies to reduce emissions of 187 toxic air pollutants.

Heap Leaching – Process of extracting metals from crushed ore using leaching solutions in heaps.

Hypogene/Supergene – Primary (deep) vs. secondary (surface-enriched) mineralization zones.

Kat (Kilotonnes) – Thousand tonnes; used in some global market data.

LME (London Metal Exchange) – Major global exchange for base metal trading and pricing.

LPO (Loan Programs Office) – DOE office providing loan guarantees for innovative projects.

MACT (Maximum Achievable Control Technology) - EPA standards that limit hazardous air pollutants from industrial sources to ensure significant emission reductions.

Milling – The mechanical process of crushing and grinding ore.

Mt (Million Tonnes) – Used for annual copper production or reserves.

NAAQS (National Ambient Air Quality Standards) - Regulations established by the EPA to protect public health and the environment from harmful air pollutants.

NHPA (National Historic Preservation Act) - Enacted on October 15, 1966, it provides a framework for preserving historic and archaeological sites in the U.S.

NPDES (National Pollutant Discharge Elimination System) - A regulatory program that controls water pollution by regulating point-source discharges into U.S. waters.

NAC (Nevada Administrative Code) - The codified administrative regulations of Nevada's Executive Branch.

NEPA (National Environmental Policy Act) – A federal law passed in 1969 and signed in 1970 that promotes environmental protection by requiring federal agencies to assess the environmental impacts of their actions and established the President's Council on Environmental Quality (CEQ).

NDEP (Nevada Division of Environmental Protection) - State agency that administers Nevada's key mining permits: Reclamation, Water Pollution Control, and Air Quality Operating Permits.

NDOW (Nevada Department of Wildlife) - State agency that manages nearly 900 wildlife species and their habitats in Nevada.

NDF (Nevada Division of Forestry) - Protects and enhances Nevada's ecosystems and communities through natural resource stewardship and wildfire management.

NDWR (Nevada Division of Water Resources) - Created in 1903 to adjudicate water rights in Nevada, with authority to enforce Nevada's Water Law under Title 48 of the Nevada Revised Statutes.

NSR (Net Smelter Return) – Value received after smelting/refining and transportation deductions.

NRS (Nevada Revised Statues) - Are the current codified laws of the State of Nevada.

NVSRP (Nevada State Rail Plan) - Establishes policy and strategies for freight, passenger, and commuter rail in Nevada, guiding investments to improve rail service for the public.

Opex (Operating Expenditure) – Ongoing costs of running a facility.

Ore Grade – The percentage of copper contained in the ore.

Oxide Ore – Copper ore where the copper is bound in oxide minerals (e.g., malachite, azurite).

Payable Metal – The percentage of recovered metal a smelter pays for (often 95–97% of total).

PLS (Pregnant Leach Solution) – The copper-rich liquid extracted from leaching processes.

PSD (Prevention of Significant Deterioration) - A regulatory program focused on maintaining and improving air quality in areas meeting or exceeding national standards.

Reclamation Permit - State permit from NDEP-BMRR required before construction of exploration, mining, or milling activities disturbing over 5 acres on private land; the Reclamation Plan is the primary application for operation.

ROD (Record of Decision) - A formal document summarizing the findings of an Environmental Impact Statement (EIS) or Environmental Assessment (EA) under NEPA, explaining the decision and its rationale after environmental review.

SX-EW – Solvent Extraction and Electrowinning; used for oxide copper ores.

Smelter – A facility that extracts metal from ore or concentrate via heat and chemical reduction.

Sulfide Ore – Copper ore where copper is bound in sulfide minerals (e.g., chalcopyrite, bornite).

SERs (Supplemental Environmental Reports) - Reports compiling baseline studies and modeling results for inclusion in NEPA reviews.

SIR (Supplemental Information Report) - Reports providing supplemental information required for NEPA review.

SAD (Surface Area Disturbance) - Air quality permit issued by BAPC for disturbances exceeding 5 acres in Nevada.

Tailings – Waste material left over after metal is extracted from ore.

Throughput – Amount of ore processed per day or year (e.g., tonnes/day).

Toll Smelting – Contracting a third-party smelter to process concentrate.

TCRC (Treatment and Refining Charges) – Fees charged by smelters to process concentrate into metal.

tpd (Tonnes Per Day) – Throughput capacity of a facility.

USACE (U.S. Army Corps of Engineers) - Permits are required for disturbances below the ordinary high-water mark of jurisdictional waters or wetlands.

USDA (U.S. Department of Agriculture) - Federal agency supporting agriculture, food safety, natural resource protection, rural development, hunger relief, and managing the USFS.

EPA (U.S. Environmental Protection Agency) - Federal agency that establishes and enforces national pollution control standards.

USFWS (U.S. Fish and Wildlife Service) - Federal agency responsible for conserving and managing fish, wildlife, plants, and their habitats for the American people.

USFS (U.S. Forest Service) - Federal agency overseeing mining permits on federal lands.

Vat Leaching – Controlled leaching in a tank or vessel.

Wet Tonnes vs Dry Tonnes – Wet includes moisture content; relevant for TCRC negotiation.

Workforce Innovations for the New Nevada (WINN) - Workforce development program partnering with industry and education to create or expand training in skills needed by state companies.

WPCP (Water Pollution Control Permit) - Covers mine, ore processing, and fluid management system operations, including management and monitoring to prevent degradation of Waters of the State.

SECTION 11

Appendices

State	Operation	Operator	Mine	Operating	Process Type	Capacity or Recent Production (Short Tons)	Summary Descriptions
NV	Borealis	Borealis Mining Co., LLC Elko Mining Group, LLC	Borealis Mine	YES - PARTIAL (LEACH ONLY)	Heap Leach	N/A	Oxide. Heap rinsing and carbon processing
NV	Coeur Rochester Heap Leach	Coeur Rochester, Inc.	Rochester Mine	YES	Leach	In 2024, approximately 23.5 million tons (with an average of 64,456 tons per day.	Oxide. Crushing, Heap Leach, Merrill-Crowe for silver and gold recovery
NV	Comstock Heap Leach	Comstock Mining, Inc.	Lucerne Pit	NO	Heap Leach	Permitted Capacity: 10,950 tons per day Actual Operating Rate: Average 1,780 tons per day	Oxide.Crushing, heap leach, Merrill-Crowe for silver and gold recovery
NV	Crown Point Mill	Crown Point Holdings Corporation		NO	Oxide Mill	125 tons per day	Oxide. Crusing, ball mill grinding, cyanidation, counter current decantation, Merrill Crowe
NV	Gold Bar Mill	Ely Gold and Minerals, Inc. - optioned to Fremont Gold Ltd. 9/2017	Gold Bar Mine	NO	Oxide Mill	3,500 tons per day for oxide 2,000 tons per day for refractory	Oxide or Refractory. Grizzly, wet screen, impact crusher, SAG mill, ball mill, hybrid Leach/CIL, ADR
NV	Jerritt Canyon Mill	First Majestic Silver	Jerritt Canyon Mine	NO	Roaster	4,000 - 4,500 tons per day	Refractory. Dry grinding, two stage, roasting, and CIL
NV	Florida Canyon Heap Leach	Florida Canyon Mining, Inc. Rye Patch Gold Corp.	Florida Canyon	YES	Heap Leach	24,000 tons per day	Oxide. Crushing, heap leaching, CIC, ADR
NV	Pan Heap Leach	Calibre Mining Company; GRP Pan , LLC	Pan Mine	YES	Heap Leach	50,000 tons per day.	Oxide. ROM Heap Leach, CIC and ADR for gold recovery
NV	Hycroft Heap Leach	Hycroft Mining Corporation	Hycroft Mine	YES PARTIAL (LEACH ONLY)	Heap Leach	N/A Mining and Stacking Ceased in 2015	Oxide. Residual Leaching on Heaps, Merrill-Crowe for Gold & Silver Recovery

	County	Commodity	Source if other than Company	Remarks	Start Date	Mining Ended	District	Available for Ore Tolling
	Mineral	Gold Silver		1981 - Mine production started, but not certain when mill was built	1981	1990	Borealis	NO
	Pershing	Gold Silver	Coeur Mining Inc. Form 10-K filed 02/19/2025 www.coeur.com	1986 - Mine production started, but not certain when plant was built	1986		Rochester	Yes, if the circumstances and economics are right
	Storey	Gold Silver	NDM16 Comstock Mining Form 10-K for 2017	Mining at Lucerne ceased in 2015 and leaching continued until the end of 2016	1990s		Comstock	No
	Storey	Gold Silver	info@crownpoint-mill.com	Mill ceased operations in 1942. Mill was upgraded in late 1980's by The Art Wilson Co. Current owners have attempted to permit an renewed operation, but has encountered local resistance. Estimated cost to further update the plant is $2 to $3 million. In the past there have been discussions with miners to custom process ores.	1930's	1942		N/A
	Eureka	Gold Silver	Western Mining History	Dates are of beginning and ending of mining according to MI; UTMs from Google Map; uncertian if Ely Gold owns mill	1984	1994	Antelope	N/A Plant may not be fully intact and no remaining space for tailing
	Elko	Gold Silver		Currently in care and maintenance.	1981	2024	Independence Mountains	Yes, if the economics are right
	Pershing	Gold Silver	Rye Patch Amended NI 43-101 Technical Report Jan. 2017	1986 - Mine production started, but not certain when plant was built	1986	2011	Imlay	No
	White Pine	Gold Silver	https://efaid-nbmnnnibpca-jpcglclefind-mkaj/https://s204.q4cdn.com/793454556/files/doc_finan-cials/2024/q4/Calibre-MD-A-for-YE2024-Final.pdf	Gold; mining was suspended in June 2015 as a result of poor percolation on the leach pad; GRP acquired the mine in May 2016; improvements in operations were undertaken in January 2017 to rectify percolation problems on the heap; A single stage crushing circuit was installed in 2019. Completed 3rd leach pad expansion in 2024.	2015		Pancake	NO
	Humboldt	Gold Silver			2011		Sulphur	NO

NV	Lone Tree Autoclave	i80 Gold Corp.	Lone Tree Mine (Lone Tree Complex) Brooks Project	YES PARTIAL (LEACH ONLY)	Mill Autoclave CIL Flotation CIP Heap Leach	Autoclave Circuit 2,500 tons per day, Flotation circuit 5,000 tons per day	Refractory. SAG mill, ball mill, autoclave, CIL, tailings Flotation. SAG mill, ball mill, Flotation, SIP of tails, thickened and filter press for concentrate. ROM Heap Leach Current: Residual Leaching with carbon processed off site	
NV	Ruby Hill Mill	i80 Gold Corp.	Ruby Hill Mine	YES PARTIAL (LEACH ONLY)	Oxide Mill Heap Leach	Mill 1,000 tons per day Heap leach 7,000 short tons per day	Oxide. 3 stage crushing, ball mill, vat leach, thickener, belt filters, ADR Heap leach with agglomeration of mill tailing Current: Residual Leaching with carbon processed off site	
NV	Bald Mountain Heap Leach (North Operations Area)	KG Mining, Inc.	Bald Mountain Mine	YES	Heap Leach	20,000,000 tons ore/year	Oxide. ROM Heap Leach, CIC circuit for recovery	
NV	Bald Mountain Mooney North and South Heap Leach (North Operations Area)	KG Mining, Inc.	Bald Mountain Mine	YES	Heap Leach	30,000,000 tons ore/year	Oxide. ROM Heap Leach, CIC circuit for recovery	
NV	Bald Mountain Mooney South Heap Leach (North Operations Area)	KG Mining, Inc.	Bald Mountain Mine	YES	Heap Leach	See Mooney North production (combined)	Oxide. ROM Heap Leach, CIC circuit for recovery	
NV	Vantage Heap Leach (South Operations Area)	KG Mining, Inc.	Vantage Basin	YES	Heap Leach	18,000,000 tons ore/ year	Oxide. ROM Heap Leach, CIC circuit for recovery	
NV	Robinson Concentrator	KGHM International, Ltd.	Robinson Mine - Ruth Pit Producing Copper/Gold Concentrate and Molybdenum Concentrate Ship Approximately 300,000 Wet Tons of Copper Concentrate per year	YES	Concentrator	46,000 tons per day	Concentrator. SAG Mill/Ball Mill, Flotation	
NV	Midas Mill	Klondex Mines, Ltd.	Midas Mine; Fire Creek Mine; Hollister	YES	Oxide Mill	1,200 tons per day	Oxide. For Midas and Fire Creek: Crushing, ball mill and vertimill grinding, gravity, pre-leach thickener, cyanidation, CCD, Merrill-Crowe. For Hollister: Crushing, grinding, gravity, cyanidation, and CIL	

	Humboldt	Gold Silver		1991 First gold poured, 1994 Autoclave commissioned, 1997 Flotation commissioned	1988	2022	Buffalo Mountain	Potentially, Engineering for Autoclave restart is underway with plans to process material from i-80 sites.
	Eureka	Gold Silver		1997 - Mine production started, but not certain when crusher was built	1997	2021	Eureka	N/A
	White Pine	Gold Silver		2016: Kinross acquired from Barrick	Late 1980's		Bald Mountain	N/A
	White Pine	Gold Silver		2016: Kinross acquired from Barrick	1999		Bald Mountain	N/A
	White Pine	Gold Silver		2016: Kinross acquired from Barrick	2012		Bald Mountain	N/A
	White Pine	Gold Silver		2016: Kinross acquired from Barrick	2016			N/A
	White Pine	Copper Gold Molybdenum		Total Shipping Cost for Concentrate Ranges from $100 to $190 per wet ton Montana Resources might be a customer of a smelter in Nevada Concentrate Grade Ranges from 17% to 22% Copper	1995		Robinson	Yes, Will Consider
	Elko	Gold Silver			1998	2019	Gold Circle	Yes, if the circumstances and economics are right

NV	Aurora Mill	Klondex Mines, Ltd.	Processing Loaded Carbon from Hollister Produced at Midas Mill Possible Future Hollister Mine	YES	Oxide Mill	350 tons per day (limited by permit)	Oxide. Crushing, milling, CIL
NV	Gold Bar Heap Leach	McEwen Mining Inc.	Gold Bar Mine	NO- Under Construction	Heap Leach	Projected 6,000 tons per day	Oxide. Combined ROM and Screened with Fines Agglomerated, Truck Stacking and Conveyor Stacking, Heap Leach, CIC and ADR for Gold Recovery
NV	Goldwedge Mill	Mineral Ridge Gold, LLC	Goldwedge Mine	NO	Oxide Mill	450 tons per day	Oxide. Care and maintenance Grinding and gravity concentration
NV	Mineral Ridge Mill	Mineral Ridge Gold, LLC	Mineral Ridge Mine	No	Oxide Mill	4,000 tons per day	Oxide. Two Stage Crushing, Ball Milling, CIL, Off-site carbon processing
NV	Mineral Ridge Heap Leach	Mineral Ridge Gold, LLC	Mineral Ridge Mine Residual Leaching on Heap Only	YES	Heap Leach	4,000 tons per day	Oxide. Four Stage Crushing, Heap leach with ADR for gold and silver recovery, loaded carbon processed off-site
NV	Goldstrike Roaster	Nevada Gold Mines	NGM Carlin Complex Cortez Underground Operations	YES	Roaster	17,500 tons per day	Refractory. Dry grinding in 2 double rotators, two stage fluid bed roasting, quench tank and lime neutralization, CIL for recovery
NV	Goldstrike Autoclave	Nevada Gold Mines	NGM Carlin Complex	YES	Autoclave	13,700 tons per day	Refractory & Oxide. SAG mill/ball mill grinding, acid or alkaline pressure oxidation (Oxide ore bypasses the autoclaves), lime neutralization CIL for recovery.
NV	Carlin Heap Leach	Nevada Gold Mines	NGM Carlin Complex	YES	Heap Leach	Varies with the mine plan	Oxide. ROM Heap Leach South Area has crusher capacity, gyratory and cone crusher; North Area ROM
NV	Carlin Mill 5	Nevada Gold Mines	NGM Carlin Complex	NO	Oxide Mill Concentrator	13,700 tons per day	Processes both oxide and refractory ores. Oxide ore: SAG mill/ball mill grinding, cyanide leaching Refractory ore: flotation to produce gold pyrite concentrate for feed to Mill 6 and Twin Creeks Autoclave
NV	Carlin Mill 6	Nevada Gold Mines	NGM Carlin Complex Cortez Underground Operations Concentrates from Golden Sunlight and Phoenix	YES	Roaster	11,800 tons per day	Refractory ore and concen-trate. Dry grinding, roasting, and CIL Acid from Phoenix
NV	Cortez Heap Leach	Nevada Gold Mines	Cortez Hills Complex and Pipeline Complex Open Pit and Underground	YES	Heap Leach	46,000 to 64,000 tons per day	Oxide. ROM heap leach, CIC for recovery

	Mineral	Gold Silver		Nov. 2013: Mine Temporary Shut Down; Waterton Global Resource Management, Inc., now Carlin Resources; Early 2014: processed and sold gold from stockpiles at mill; dates for Aurora Mine; Feb. 2017 reprocessing tailing from the Aurora Mill The Aurora Mill was formerly known as the Esmeralda Mill	1930s	1998	Aurora	Yes, if the circumstances and economics are right
	Eureka	Gold Silver	NI 43-101F1 Technical Report March 2018				Antelope	N/A
	Nye	Gold	www.scorpio-gold.com	Potential customer for custom milling has requested that Scorpio add a flotation circuit				Yes
	Esmeralda	Gold Silver	NDM16 NI 43-101 Technical Report Jan. 2018	1991- Mine production started, but not certain when crusher was built	1991		Silver Peak	Yes
	Esmeralda	Gold Silver	NDM16 NI 43-101 Technical Report Jan. 2018	1991- Mine production started, but not certain when plant was built	1991		Silver Peak	
	Eureka	Gold Silver			2000		Lynn	Yes, sulfide ores on a selective basis
	Eureka	Gold Silver			1980s		Lynn	Yes, sulfide ores on a selective basis
	Eureka	Gold Silver					Maggie Creek	No
	Eureka	Gold Silver		MSHA 2017 mill/prep plant employment: Genesis 30; South Area 363	1988		Maggie Creek	Yes in certain cases
	Eureka	Gold Silver		MSHA 2017 mill/prep plant employment: Genesis 30; South Area 363	1994		Maggie Creek	Yes in certain cases
	Lander	Gold Silver		Operations ceased on Area 28 as the leach pad has reached maximum capacity Operations on Area 30 commenced in 2013 Operations commenced on Area 34 in March 2011	1997		Bullion	No

NV	Cortez Pipeline Mill	Nevada Gold Mines	Cortez Hills Complex and Pipeline Complex Open Pit and Underground	YES	Oxide Mill	14,000 tons per day 1.2 million tons per year of refractory ore shipped to NGM Carlin Complex for processing in the roaster	Oxide. SAG mill/ball mill grinding, grind thickener, CIC for thickener overflow, CIL, tailing CCD	
NV	Emigrant Heap Leach	Nevada Gold Mines	Emigrant Mine	NO	Heap Leach	Varies with the mine plan	Oxide. ROM Heap Leach	
NV	Long Canyon Heap Leach	Nevada Gold Mines	Long Canyon Mine	YES	Heap Leach	N/A residual leaching only.	Oxide. ROM Heap Leach	
NV	Phoenix Gold Heap Leach	Nevada Gold Mines	Phoenix Mine	NO	Heap Leach	N/A	Oxide ROM Heap Leach	
NV	Phoenix Copper Dump Leach	Nevada Gold Mines	Phoenix Mine	YES	Copper Dump Leach	Varies with the mine plan	ROM Copper Dump Leach, SX/EW	
NV	Phoenix Mill	Nevada Gold Mines	Phoenix Mine	YES	Concentrator Oxide Mill	33,000 to 38,000 tons per day	Concentrator. Gyratory crusher, cone crusher, SAG mill and ball mill grinding, gravity concentration; flotation, cyanidation and CIP on flotation tailing; carbon desorption and electrowinning; EW sludge melted off-site	
NV	Twin Creeks Heap Leach	Nevada Gold Mines	Twin Creeks Mine	YES	Heap Leach	Varies 200,000 to 2,000,000 tons per year	Oxide ROM Heap Leach	
NV	Twin Creeks Juniper Mill (Formerly Chimney Creek)	Nevada Gold Mines	Twin Creeks Mine	YES	Oxide Mill	3,000 tons per day	Oxide. SAG mill/Ball mill, Slurry combined with POX Slurry from Sage for cyanide leaching, ADR	
NV	Twin Creeks Pinyon Mill (Formerly Rabbit Creek)	Nevada Gold Mines	Twin Creeks Mine	NO	Oxide Mill	N/A	Oxide. Tailing Impoundment Has Been Reclaimed	
NV	Twin Creeks Sage Mill	Nevada Gold Mines	Twin Creeks Mine and Turquoise Ridge Mine Possible future pyrite concentrates from Phoenix and Golden Sunlight	YES	Autoclave	12,000 tons per day	Refractory. Grinding, POX, POX Slurry combined with ground Slurry from Juniper, cyanide leaching	
NV	Denton-Rawhide Heap Leach	Rawhide Mining, LLC	Denton-Rawhide Mine	YES PARTIAL (LEACH ONLY)	Heap Leach	850 tons per hour, estimated 14,000 tons per day	Oxide. Two stage crushing, heap leaching, Merrill-Crowe and CIC	
NV	Round Mountain Heap Leach	Round Mountain Gold Corp.	Round Mountain Mine (Smoky Valley Common Operation)	YES	Heap Leach	74,800 tons per day (2023) 23,000 tons per day (2024)	Heap Leach ADR Refinery	

	Lander	Gold Silver		1997 - Mine production started, Construction of the mill started in 1996	1997		Bullion	No
	Eureka	Gold Silver			2012		Carlin	No
	Elko	Gold			2016		Pequop	No
	Lander						Battle Mountain	No
	Lander	Copper Cathode		Production is 1,000,000 to 2,000,000 pounds per month			Battle Mountain	No
	Lander	Gold Silver Copper Concentrate		2005 - Latest mine production started; mined off and on since 1967; mill began operation in 2006. Current production is 100 to 400 tons of copper concentrate per day and 40,000 to 80,000 tons per year. Concentrate grade ranges from 15% to 20% copper. Concentrate is trucked to Dunphy, then railed to Glencore Noranda smelter in Quebec or to Port of Oakland or Port of Vancouver WA for ocean shipping to China. Shipping costs range from approximately $80 per wet ton to more than $160 per wet ton, depending on the routing and destination. Be aware of penalty elements in concentrates produced in Nevada.	2005		Battle Mountain	Yes, would consider
	Humboldt	Gold Silver						No
	Humboldt	Gold Silver		1993 - Mine production started, but not certain when mills were built	1993		Potosi	Yes in certain cases
	Humboldt	Gold Silver		1993 - Mine production started, but not certain when mills were built	1993		Potosi	No
	Humboldt	Gold Silver			Abt. 1996		Potosi	Yes, concentrates for sulfur
	Mineral	Gold Silver		1989 - Mine production started, but not certain when mill was built	1989		Rawhide	No
	Nye	Gold Silver		1976 - Mine production started, but not certain when plant was built	1976		Round Mountain	N/A

NV	Round Mountain Mill	Round Mountain Gold Corp.	Round Mountain Mine (Smoky Valley Common Operation)	YES	Oxide Mill	11,200 tons per day (2023) 10,000 tons per day (2024)	Crushing Grinding Gravity Concentration Leaching	
NV	Marigold Heap Leach	Marigold Mining Company (100% owned by SSR Mining, Inc.)	Marigold Mine	YES	Heap Leach	18,500 tons per day average for 25 years 1990 - 2014 83,400 s.ton/day 2024	Oxide. ROM heap leach, ADR for gold recovery	
NV	Isabella Pearl Heap Leach	Walker Lane Minerals Corp.	Isabella Pearl	YES	Heap Leach	2018-2024: 4,275,000 short tons 670,000 short tons in 2024	Oxide. %/8 cursh heap leach, ADR for gold recovery	
	Pumpkin Hollow Underground Mine	Southwest Critical Materials LLC	Pumpkin Hollow	NO	Milling	5,000 tons per day	Sulfide milling. SAG mill/Ball mill flotation.	

Nye	Gold Silver			1997		Round Mountain	N/A
Humboldt	Gold Silver		Mill ceased operation and was dismantled by 1998 Crushing circuit for the mill is now used for producing overliner for leach pad expansion	1988		Battle Mountain	
Mineral	Gold Silver		NI 43-101 Technical Report Dec. 2022 www.fortitudegold.com	2019		Pilot Mountains	N/A
Lyon	Copper Gold Silver		Purchased by Southwest Critical Minerals in 2024	2020	2023	Yerington	N/A

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