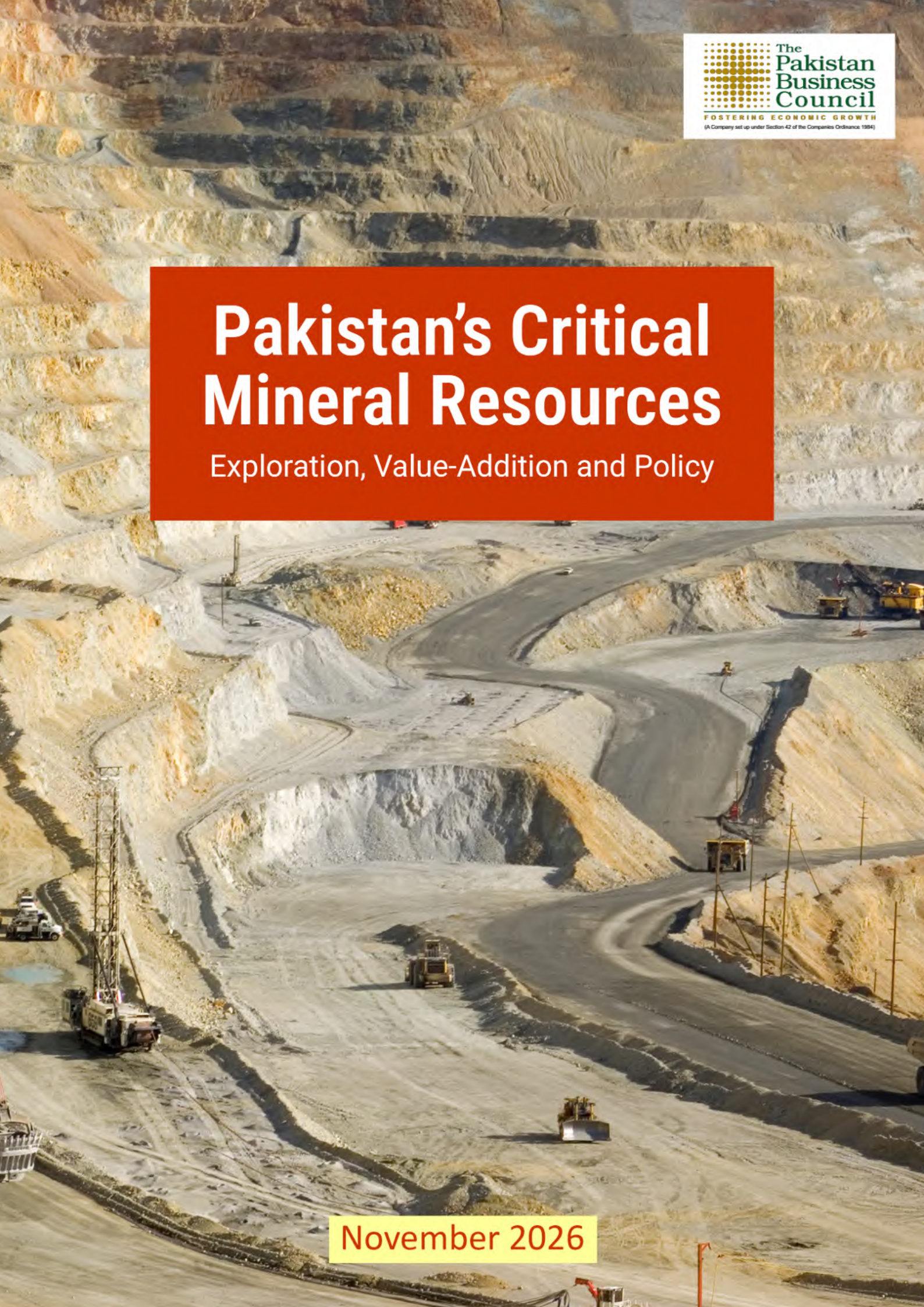


The Pakistan Business Council
FOSTERING ECONOMIC GROWTH
(A Company set up under Section 42 of the Companies Ordinance 1984)

Pakistan's Critical Mineral Resources

Exploration, Value-Addition and Policy

November 2026



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Acknowledgements

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Disclaimer

The findings, interpretations and conclusions expressed do not necessarily reflect the views of the Board of Directors and Members of The Pakistan Business Council or the companies they represent. Any conclusions and analysis based on the data from the ITC Trade Map, the State Bank of Pakistan (SBP), Pakistan Bureau of Statistics (PBS), the United States Geological Survey (USGS) Mineral Commodity Survey, the World Mineral Production database of the British Geological Survey (BGS), the International Energy Agency (IEA), the World Mining Data (WMD) published by the Austrian Federal Ministry of Finance, the annual reports of the Metallurgical Corporation of China (MCC) and expert interviews are the responsibility of the author and do not necessarily reflect the opinion of the above organizations. Although every effort has been made to crosscheck and verify the authenticity of the data, The Pakistan Business Council, or the author, do not guarantee the data included in this work. All data and statistics used are correct as of October 27th, 2026 and may be subject to change.

For any queries or feedback regarding this report, please contact **samir@pbc.org.pk** or **huzaifa@pbc.org.pk**

The Pakistan Business Council: An Overview

The Pakistan Business Council (PBC) is a research-based business advocacy platform established in 2005. It is now supported by over 100 private sector local and multinational businesses with significant investment in, and long-term commitment to sustainable growth of the country. They come from 14 countries, have leading roles in 17 major sectors of the formal economy, generate 40% of annual exports, contribute a third of Pakistan's total tax revenues and employ three million. Their combined sales represent every 6th Rupee of Pakistan's GDP.

PBC's major objectives are to advocate polices that lead to creation of jobs, value-added exports and reduction in import reliance through improved competitiveness of manufacturing, services and the agriculture sectors. It also promotes formalization of the economy.

PBC's over-arching theme, "Make-in-Pakistan" consists of three pillars: "Grow More/Grow Better", "Make More/Make Better" and "Serve More/Serve Better." Its evidence-based advocacy is backed by over a hundred studies to date, through its full-time research team, supplemented by collaborative research with renowned industry experts and economists. Through its Centre of Excellence in Responsible Business (CERB), PBC works to build capacity and capability of businesses beyond its membership, to adopt high environmental, social and governance standards. PBC holds conferences, seminars and webinars to facilitate the flow of relevant information to all stakeholders in order to help create an informed view on the major issues faced by Pakistan. Through its presence in Islamabad and Karachi, it works closely with relevant government departments, ministries, regulators and institutions, as well as other stakeholders including professional bodies, to develop consensus on major issues impacting the economy.

PBC is a pan-sectoral, not-for-profit, Section 42 entity. It is not a trade body; therefore, it does not advocate for any specific business sector. Rather, its key advocacy thrust is on easing barriers that thwart competitiveness of businesses in Pakistan.

Further information on the PBC is available on: www.pbc.org.pk.

The PBC's Founding Objectives

- To provide for the formation and exchange of views on any question connected with the conduct of business in and from Pakistan.
- To conduct, organize, set up, administer and manage campaigns, surveys, focus groups, workshops, seminars and fieldwork for carrying out research and raising awareness in regard to matters affecting businesses in Pakistan.
- To acquire, collect, compile, analyze, publish and provide statistics, data analysis and other information relating to businesses of any kind, nature or description and on opportunities for such businesses within and outside Pakistan.
- To promote and facilitate the integration of businesses in Pakistan into the World economy and to encourage in the development and growth of Pakistani multinationals.
- To interact with governments in the economic development of Pakistan and to facilitate, foster and further the economic, social and human resource development of Pakistan.

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Note on the Data

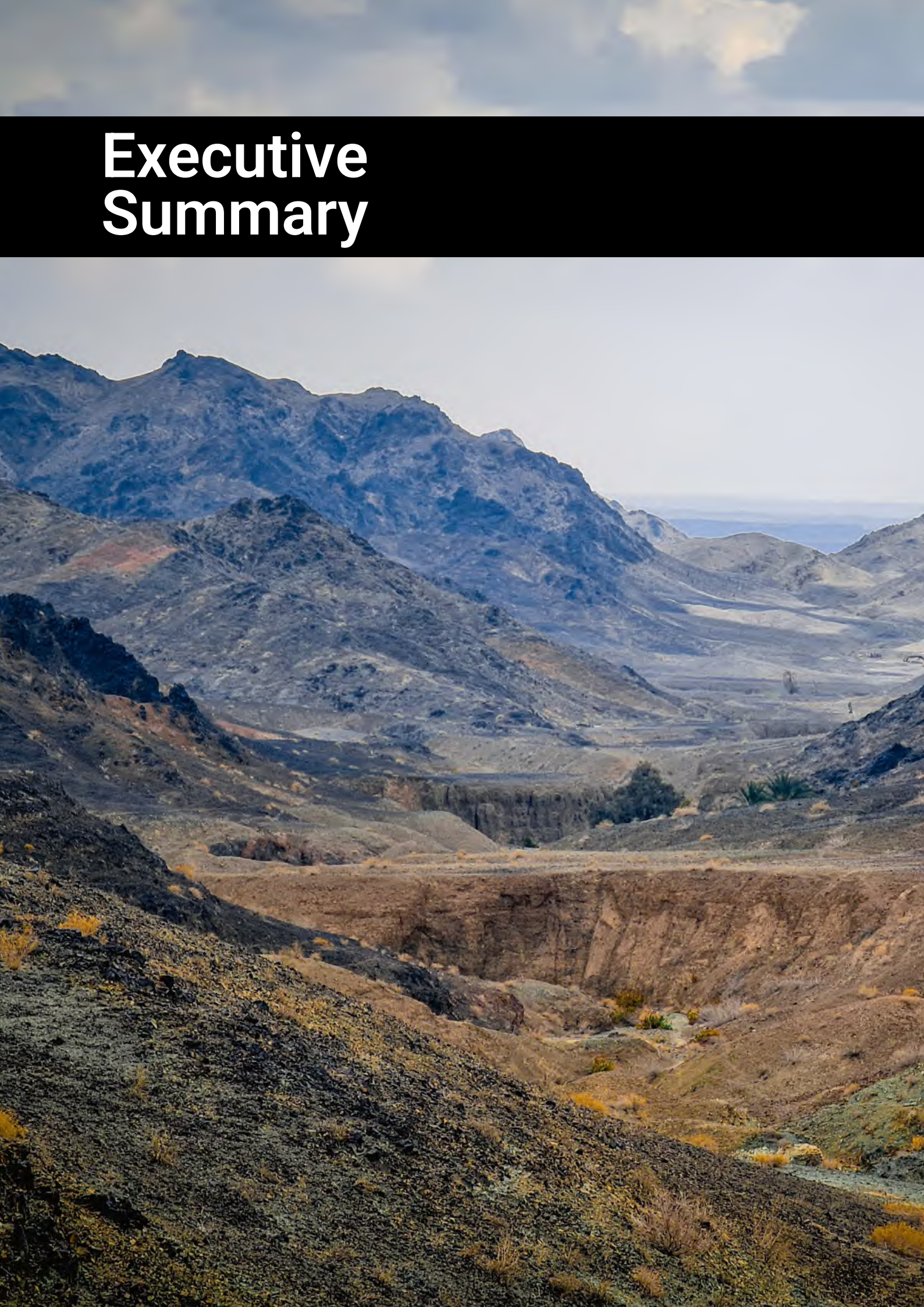
All data related to mine production have been taken from the 2026 versions of the United States Geological Survey (USGS) Mineral Commodity Survey, the World Mineral Production database of the British Geological Survey (BGS), the International Energy Agency (IEA) and the World Mining Data (WMD) published by the Austrian Federal Ministry of Finance. All production values are in metric tonnes and refer to the mineral/metal content unless specified otherwise. Pakistan's production of blister copper, zinc and lead taken from the above sources, have been cross-checked with the annual reports of the Metallurgical Corporation of China (MCC) and every attempt has been made to maintain continuity between sources and to represent accurate figures. With regards to trade data, significant discrepancy exists between Pakistan and China and in some cases between Pakistan's own sources. See section 4.3 and Appendix 3 for more details.

List of Acronyms

Acronym	Full Form
ASM	Artisanal and Small-scale Mining
BHP	Broken Hill Proprietary Company
CME	Chicago Mercantile Exchange
COMEX	Commodity Exchange Division of the New York Mercantile Exchange
CSR	Corporate Social Responsibility
DRC	Democratic Republic of the Congo
EITI	Extractive Industries Transparency Initiative
EL	Exploration License
EPCM	Engineering, Procurement and Construction Management
EPZ	Export Processing Zone
ESIA	Environmental and Social Impact Assessment
EV	Electric Vehicle
FDI	Foreign Direct Investment
GB	Gilgit Baltistan
GoB	Government of Balochistan
GoP	Government of Pakistan
GSP	Geological Survey of Pakistan
IBA	Impact Benefit Agreement
ICEV	Internal Combustion Engine Vehicle
IEA	International Energy Agency
IRR	Internal Rate of Return
ITC	International Trade Centre
KPK	Khyber Pakhtunkhwa
LME	London Metal Exchange
MCC	Metallurgical Corporation of China
ML	Mining License
MoU	Memorandum of Understanding
Mt	Metric tonne
MMt	Million metric tonnes
MRE	Mineral Reserve Estimates

Acronym	Full Form
NdFeB	Neodymium-Iron-Boron (magnets)
NdPr	Neodymium and Praseodymium
NSR	Net Smelter Return
PMIF	Pakistan Minerals Investment Forum
QP/CP	Qualified Person/Competent Person
RDMC	Reko Diq Mining Company
REEs	Rare Earth Elements
SHFE	Shanghai Futures Exchange
SX-EW	Solvent Extraction–Electrowinning
TCRC	Treatment and Refining Charges
USGS	United States Geological Survey
WMD	World Mining Data

Executive Summary



Executive Summary

The Reason Why Pakistan's Mining Sector Never Reached its Potential

Pakistan's mineral wealth in theory has been estimated in the trillions of dollars but it has never actually been quantified in size and most importantly the economic feasibility of mining has never been measured using internationally accredited standards. The Geological Survey of Pakistan has scanned nearly all of Pakistan's outcrop areas to establish a baseline of crustal concentrations for 69 elements. But proving that these are mineable reserves requires a detailed exploration plan covering geophysical surveys and extensive drilling to reach Mineral Reserve Estimate (MRE) reports which are indicative of the true potential.

Unfortunately, and for various valid reasons, capital has not been patient in the country and this has historically led to a blanket skepticism of long gestation period domestic investments. Mining projects by their very nature have long gestation periods and in the absence of patient investment Pakistan to date has not independently developed any of its existing large-scale critical mining projects. As a result, the infrastructure, human capital and ecosystem never really developed.

At a time when interest has been created in mining, Pakistan's position is sensitive primarily owing to the security concerns in two of its most important provinces with sizeable potential for critical minerals exploitation. Further the agenda of mineral ownership and control itself has become a deeply politicized topic between the state and the provinces as neither has the authority or the ability to fully direct a large-scale project on its own.

Which Critical Minerals Hold the Potential for Pakistan

Copper is front and center primarily owing to the massive porphyry deposits in the Tethyan Belt that runs across the Chagai district, covering Saindak, Siah Diq and Reko Diq and which is considered one of the largest undeveloped tier-one copper deposits in the world. Pakistan's copper resources are estimated at approximately 22 MMt (as a sum of the above three projects) and this estimate is incredibly conservative given much of Chagai still remains unexplored. There is no consolidated figure for Pakistan's copper reserves but Reko Diq's reserves alone are greater than those of India and Canada. Ore grades average around 0.4% (meaning 4 kg of copper is obtained per tonne of ore mined) and this is comparable with global porphyry deposits.

Copper is no longer an industrial metal but has evolved into a strategic input. Supply chains are struggling to meet demand due to declining ore grades (majority of the high-grade ores closer to the surface have already been mined) and as a result a 10 million metric tonne copper shortage is expected by 2040. The combination of these factors along with tariff uncertainty especially in the US have led to record copper prices of above USD 14,000 per metric tonne in 2026, making exploration and development prospects very promising for senior mining companies[1].

In Pakistan, domestic exploration by junior mining companies[2] (both state-owned enterprises and private sector consortiums) is concentrated in the Chagai belt aimed at proving additional large

1. Senior mining companies also known as majors focus mostly on mine construction and extraction -the operations serving as the main source of their revenue- but often conduct exploration as well.
2. Junior mining companies are those that focus on the discovery and exploration of mineral resources with little to no production. If successful, they often sell their mineral assets or partner with a senior mining company to advance a project towards production.

deposits as per internationally accredited standards. Once the deposits have been proved, the resulting bankable feasibility is a major step in operationalizing projects. The long-term plan is foreign collaboration with senior mining companies -similar to Barrick for Reko Diq- to fund, design and develop those mines which can be profitable for decades.

Antimony deposits are mostly regionally concentrated and Pakistan is one of the seventeen countries commercially mining it albeit at a small-scale. Unlike the massive porphyry-style copper deposits, the metal is found in veins, lenses and irregular masses located in the Pishin Basin, the Washuk district and areas of Chitral. Antimony ores in Pakistan are also of a significantly higher grade (10-35%) compared to the global average (1-5%) and thus lends itself to better margins in the upgradation process.

Zinc is predominantly mined at Duddar on the Khuzdar-Lasbela belt in south-eastern Balochistan where majority of the country's zinc deposits are located. Head-grades at the mine average at around 8 percent which is comparable to major Australian zinc mines.

Rare Earth Elements are not mined commercially in Pakistan but geological potential is high in KPK, GB and in the Chagai Raskoh arc in Balochistan. Prospects are unquantified in tonnage and exploration is challenged by the terrain, presence of heavy minerals and radioactive elements.

Tungsten has very strong prospects but is being mined on an artisanal level in Chitral and GB. Similar to REEs there are currently no proven reserves to support commercial operations.

Policy and the Way Forward

The 2025 Fraiser Survey Institute of Mining Companies reported that 42 percent of the investment decisions in exploration were determined by policy factors, while 58 percent were based on the assessment of mineral potential. This indicates that ultimately geological endowments still need to be matched with attractive policies for a developing mineral state like Pakistan to stand out.

The different aspects of the mining policy discussed in this report are highly interconnected: The political consensus dictates how well the fiscal regime can deliver; the total revenue earned depends on the transparency in valuation and trade; the state equity and royalties out of this determine the level of funding available for community development aspects like training and employment, and these things feed back into creating a mining ecosystem that is self-sustaining in the long-run.

It is important that measures mentioned below are put in place from the start if the sector is going to contribute meaningfully to the economy.

- **Fiscal Incentives:** The risk appetite needs to be built in for junior mining companies to undertake exploration and hence restructuring the frequency of tax returns to a balloon payment, import tax concessions, immediate or an accelerated depreciation of exploration expense and longer loss carry forward periods need to be introduced.

- **Gradually Setting Export Restrictions:** As projects transition into the production stage, a minimum standard of copper in concentrate form and then as blister copper should be set to create value within borders. This could become enforceable by building a collective beneficiation plant to be followed by a smelter as the feedstock, power and financial constraints are mitigated.

- **Transfer of Technology:** Measurable standards should be introduced from the very beginning such as a fixed number of QP/CP qualifications for local geologists, clauses in contracts for training of locals for machinery/equipment and eventually building an ecosystem where everyday mining consumables are produced domestically.

- **Monitoring Traceability:** A cross-verification process is needed that matches export volumes, grades and by-product declarations from the mine's production reports to the ones estimated by feasibility reports.

- **Social Licensing:** Setting a disbursement system with set percentages of mining income allocated for purposes like district administration and geology departments in universities to avoid any discretionary spending. The main aim should be self-employment for local communities by supporting local businesses in agriculture and other familiar industries.

Chapter 1

Critical Minerals in Pakistan and the World

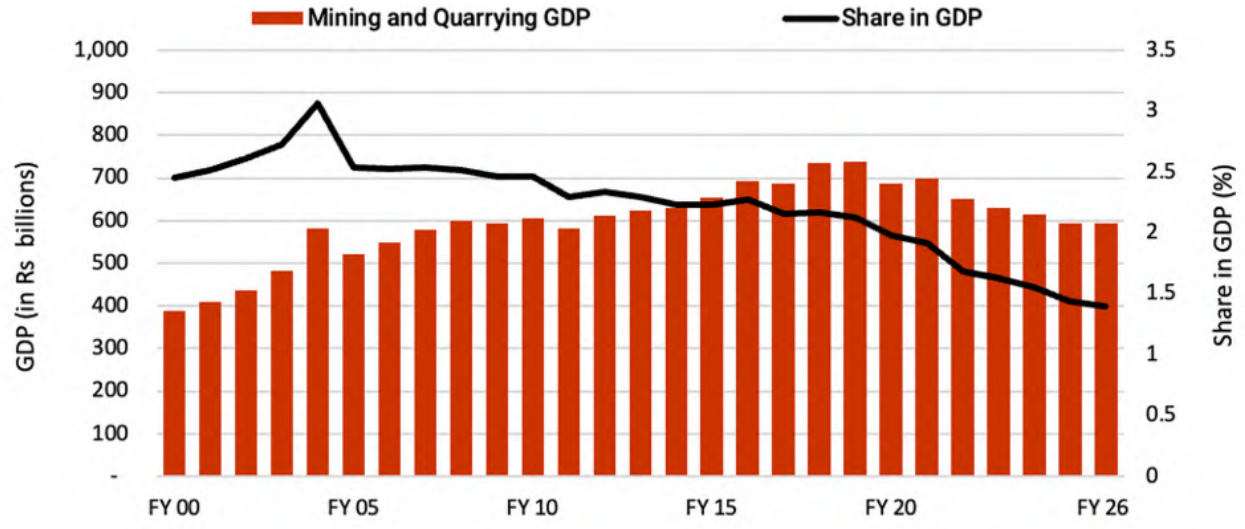


Critical Minerals in Pakistan and the World

1.1 An Introduction to Pakistan's Mining Sector

Pakistan's mineral wealth is estimated at between $6 - 8 trillion which is still an unverified figure, actual confirmation requires extensive mapping and drilling analysis before it can be labelled as a 'measured resource'. And finally, it needs to be economically extractable to be classified as 'reserves' [3]. Despite the stated potential, Pakistan has been unable to make the mining sector as the forefront of its economic identity with the sector historically contributing less than 3 percent of the country's GDP.

Figure 1: Contribution of Mining to Pakistan's GDP



Source: Pakistan Bureau of Statistics. Note: GDP is taken at constant basic prices of 2015-16

Pakistan has 92 identified mineral resources out of which 52 are commercially mined; Sindh has one of the largest coal deposits in Thar, Punjab is rich in iron and industrial minerals like gypsum and rock salt, Gilgit-Baltistan and Azad Kashmir are renowned for their gemstones, Balochistan is embedded with metals like copper, chromite and antimony while KPK has reserves of non-ferrous metals, industrial minerals, marble and gemstones.

3. See Appendix 1 for definitions of mineral resources and reserves

Table 1: Overview of Minerals Produced in Pakistan

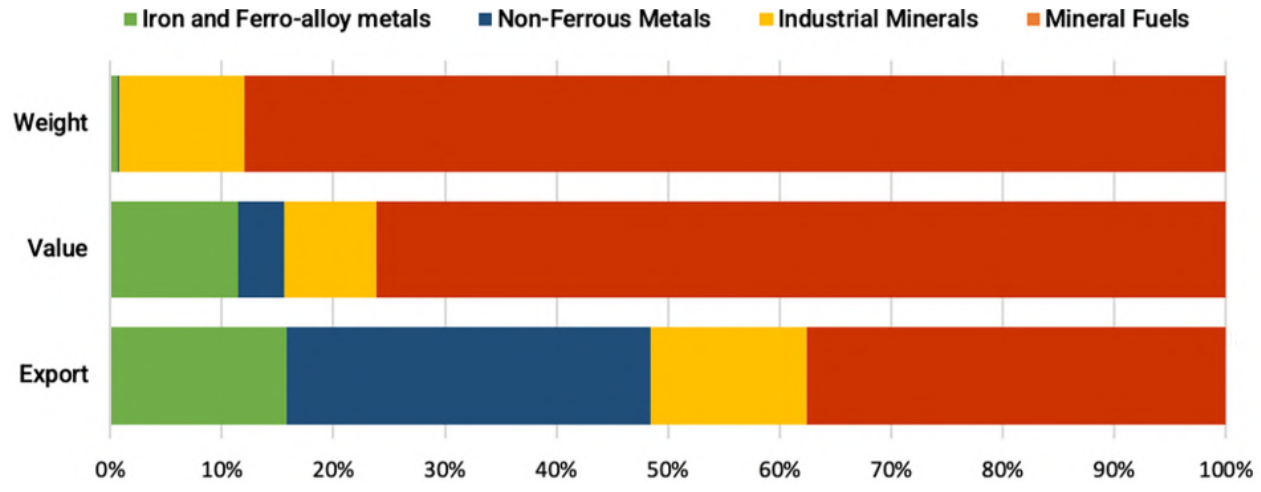
Mineral	Mine production (in metric tonnes)			CAGR (2022-24)	Estimated Reserves	Global Rank	Exports in 2024 (millions USD)	Producing Regions and Deposits
	2022	2023	2024					
Ferrous-Metals								
Iron (Fe content)	272,570	143,250	257,000	-1.9%	> 1,400 million tonnes of ore	35/55	110.38	Punjab: Kalabagh, Chiniot, Rajoa Balochistan: Chilghazi, Chigendik, Pachin Koh (all in Chagai district) KPK: Dammel Nissar, Langrial
Chromium (Oxide content)	78,000	62,250	101,140	9.0%	> 2.5 million tonnes of ore	12/21	124.64	Balochistan: Muslimbagh, Wad, Baran Lak, Drakalo, Sonaro, Greshak KPK: Boya, Dargai, Malakand
Manganese	170	100	60	-29.3%	> 600,000 tonnes of ore	35/35	0.39	Balochistan: Khuzdar, Lasbela, Chagai and Zhob districts KPK: Mingora, Abbottabad, FATA
Non-Ferrous Metals*								
Antimony	0	40	270	48.7%	26,000 tonnes	12/17	1.1	Balochistan: Pishin Basin, Washuk KPK: Chitral
Bauxite	70,965	52,245	95,595	10.4%	~74 million tonnes	24/30	1.4	Punjab: Khushab district
Blister Copper	16,346	17,042	23,865	13.4%	>22 million tonnes*	36/58	340.3	Balochistan: Chagai district KPK: Waziristan and Chitral districts
Lead	8,886	7,838	8,359	-1.1%	>23 million tonnes of lead-zinc ore	30/48	19.6	Lasbela and Khuzdar districts
Zinc	42,349	41,295	40,941	-2.0%		25/54	124.1	Lasbela and Khuzdar districts
Industrial Minerals								
Baryte	127,600	140,970	139,821	3.1%	13.7 million tonnes	11/30	8.57	Balochistan: Khuzdar and Lasbela districts, Koh-i-Sultan KPK: Haripur and Hazara districts
Bentonite Clay	30,707	26,775	11,578	-27.8%	36 million tonnes in Karak	36/46	0.24	Punjab: Jhelum, Dera Ghazi Khan KPK: Karak district
Feldspar	402,529	499,150	307,473	-8.6%	> 6 billion tonnes	18/48	0.51	KPK: Swat and Chitral districts GB: Gilgit and Skardu Sindh: Nagar Parkar
Fluorspar	11,326	17,090	39,525	51.7%	> 0.18 million tonnes	9/22	13.54	Balochistan: Maran, Pad Maran and Dilband in the Kalat district, Zhob ophiolitic belt
Gypsum and Anhydrite	2,325,400	1,639,730	2,079,593	-3.7%	> 4.9 billion tonnes	19/79	1.02	Found in all four provinces. Major deposits are in Kewra, Daud Khel and Buri Khel, Safed Koh, Jatta, Barkhan and Rakhni, Spintangi and Chamalang
Kaolin (China Clay)	16,815	14,126	15,441	-2.8%	3.6 million tonnes in Nagar Parkar	40/54	0.04	Sindh: Nagar Parkar and Islamkot in the Tharparkar district KPK: Shah Deri in Swat district
Magnesite	5,886	4,954	2,078	-29.3%	>12 million tonnes	19/21	0.35	Balochistan: Wad and Baran Lakh in Khuzdar district, Qilla Saifullah district KPK: Shahkot in Malakand district and Sherwan in Abbottabad district
Phosphate (pentoxide content)	34,610	35,670	45,330	9.4%	~26 million tonnes	28/35	15.30	KPK: Hazara division

Mineral	Mine production (in metric tonnes)			CAGR (2022-24)	Estimated Reserves	Global Rank	Exports in 2024 (millions USD)	Producing Regions and Deposits
	2022	2023	2024					
Industrial Minerals								
Salt	2,914,609	3,149,120	3,350,994	4.8%	25-30 billion tonnes	16/100	76.77	The salt range in Punjab
Sulfur	16,288	11,692	9,535	-16.3%	85,000 tonnes	51/54	0.00	Koh-i-Sultan volcano in Balochistan
Talc	301,369	164,158	220,760	-9.9%	600,000 tonnes	10/34	90.49	Sherwan, Swat, Jamrud, Kurram, Safed Koh and Landi Kotal in KPK
Mineral Fuels								
Steam coal	9,678,000	15,069,760	19,260,600	25.8%	> 186 billion tonnes (all types of coal)	12/51	0.00	Sindh: Thar, Lakhra, Thatta and Badin districts Balochistan: Musakhel, Loralai, Sibi, Quetta, Mastung, and Kalat districts, KPK: Hangu, Dara Adam Khel, Cherat
Petroleum	3,656,900	3,459,800	3,521,400	-1.3%	354 million barrels	46/101	559.00	Oilfields are present across Pakistan
Natural Gas (million cubic metres)	35,035	33,683	32,299	-2.7%	19-23 trillion cubic ft	22/91	0.00	Balochistan: Sui, Pir Koh, Uch, Sindh: Mari, Qadirpur, Kandkhot Punjab: Adhi, Bahu, Dhok Sultan
Uranium	53	53	53	0.0%	~6,180 tonnes	14/15	0.00	Dera Ghazi Khan in Punjab

Source: WMD (2026), ITC Trade Map, GSP Mineral Map. Notes: 1) Other minerals like molybdenum, tungsten, gold, silver and rare earth elements are also mined but in limited quantities. 2) Pakistan's reported export values are used except for copper, lead and zinc where a significant trade discrepancy exists with China (see section 4.3 and Appendix 3). To better represent the data China's reported values are used in the table above. 3) Exports only include the mineral in its raw/ore form and in metal form if refined domestically. It excludes articles made from the mineral or recycled metal. 4) Copper resources are mentioned as a sum of Figure 13.

Comparing the Mineral Groups by their Volume and Value Reveals that Non-Ferrous Metals Have the Lowest Share by Weight (0.13%) and Value (4.20%) but are the Second Biggest Contributor to Exports With a 33% Share in 2024.

Figure 2: Split of Mineral Groups by Weight, Value and Exports in 2024



Source: WMD (2026), ITC Trade Map. Notes: 1) Exports only include the export of the mineral in its raw/ore form or in metal form if refined domestically. 2) For non-ferrous exports China's reported values are used to better represent the data given there are significant trade discrepancies (see section 4.3 and Appendix 3).

1.2 Defining Critical Minerals

There is no universal subset of minerals that are deemed as 'critical' but rather it changes based on each country's individual assessment of its evolving needs. The US considers minerals as critical based on the criteria of it being 1) essential to the economic and national security needs, 2) if its absence in manufacturing will have significant consequences for those economic and security needs and 3) if it's prone to supply chain disruptions. In 2025 it added ten new minerals including copper and lead to bring its tally to 60 critical minerals. Critical mineral lists for different countries and regions can be found in Appendix 2.

Table 2: The US Critical Minerals List

Existing Critical Minerals		Newly Added Minerals in 2025	Rare-Earth Elements
Aluminium	Manganese	Boron	Light REEs:
Antimony	Nickel	Copper	Cerium
Arsenic	Niobium	Lead	Europium
Barite	Palladium	Metallurgical coal	Gadolinium
Beryllium	Platinum	Phosphate	Lanthanum
Bismuth	Rhodium	Potash	Neodymium
Cesium	Rubidium	Rhenium	Praseodymium
Chromium	Ruthenium	Silicon	Samarium
Cobalt	Scandium	Silver	
Fluorspar	Tantalum	Uranium	Heavy REEs:
Gallium	Tellurium		Dysprosium
Germanium	Tin		Erbium
Graphite	Titanium		Holmium
Hafnium	Tungsten		Lutetium
Indium	Vanadium		Terbium
Iridium	Zinc		Thulium
Lithium	Zirconium		Ytterbium
Magnesium			Yttrium

Source: USGS. Note: Minerals that Pakistan commercially produces (except uranium and by-product metals) are underlined

Broadly speaking, the two main parameters for judging mineral criticality are:

1) Its Importance in Economic, Technological and Security Needs:

- Rare earth permanent magnets such as the neodymium-iron-boron (NdFeB) magnets are integral to the defense systems of the F-35s, Tomahawk missiles and radar systems. An F-35 needs more than 900 pounds of Rare Earth Elements (REEs), 5,200 pounds for an Arleigh Burke DDG-51 class destroyer and for a Virginia-class submarine, the requirements go all the way up to 9,200 pounds [4].

- The 'twin transition' towards green and digital technologies extensively use critical minerals. For example, the construction of a wind farm requires nine times more critical minerals than a traditional natural gas-power plant while an Electric Vehicle (EV) consumes six times more minerals than a gasoline-powered car [5].

Figure 3: Critical Mineral Requirements in Clean Energy Technologies

Newly Added Minerals in 2025	Copper	Chromium	Zinc	Aluminium	REEs
Solar PV	High	Low	Low	High	Low
Wind	High	Moderate	High	Moderate	High
Hydro	Moderate	Moderate	Moderate	Moderate	Low
Concentrated Solar Power	Moderate	High	Moderate	High	Low
Bioenergy	High	Low	Moderate	Moderate	Low
Nuclear	Moderate	Moderate	Low	Low	Low
Electricity networks	High	Low	Low	High	Low
EVs and battery storage	High	Low	Low	High	High

Source: IEA

2) Supply Chain Volatility Includes Everything from:

- **Mineral production being concentrated in select countries.** As per the 2025 estimations by the United States Geological Survey (USGS), the Democratic Republic of Congo (DRC) mined 74 percent of the global cobalt output and held half of the global cobalt reserves; Indonesia held 44 percent of the global nickel reserves and accounted for two-thirds of its mined production, and finally more than half of all REE reserves are in China with around 70 percent of the mined output in 2025.

- **Refining capacity being concentrated in selected countries** with China processing three-quarters of the world's lithium and cobalt, 83 percent of the magnet REEs and 94 percent of the refined battery-grade graphite in 2025 according to the International Energy Agency (IEA). With regards to REE refining, China has an absolute monopoly with its safeguarded solvent extraction processing techniques that have been met with environmental concerns regarding toxic waste and long operationalizing times for facilities in the west.

4. Todd Lopez, "DOD Looks to Establish 'Mine-to-Magnet' Supply Chain for Rare Earth Materials," U.S. Department of War, March 11, 2024.
5. "What Are Critical Minerals, and Why Are They So Important?," United Nations University, May 2, 2024

Table 3: Export Restrictions on Critical Minerals by Country

Country	Mineral	Share in Global Mined Output (2025)	Export Control
Zimbabwe	Lithium concentrates	10%	An export ban on lithium ores was applied in December 2022 while concentrate exports were suspended in February 2026
Malaysia	Raw rare earths	0.03%	Export ban since January 2024
Phillipines	Nickel	7%	Proposed ban on raw mineral exports to start in 2030
Gabon	Manganese	25%	Proposed ban on raw mineral exports to start in 2029
Indonesia	Nickel ores	67%	Export ban since 2020
	Copper concentrates	3%	Export ban since 2023
	Bauxite	2%	Export ban since 2023
China	Antimony	36%	Export licensing requirements were introduced in 2025. For antimony, gallium and germanium the export ban to the US was suspended until November 2026. Foreign firms exporting are required to obtain a license and must provide detailed documentation identifying the end-user and application for the minerals. Magnets that contain traces of Chinese-origin REEs (even 0.1%) or are processed using Chinese technologies come under this umbrella. This is also applicable on rare earth extraction and separation technologies, lithium battery and artificial graphite anode materials
	Bismuth	88%	
	Gallium	98%	
	Germanium	N/A	
	Graphite	78%	
	Indium	69%	
	Molybdenum	37%	
	Rare earths	69%	
	Silver	13%	
	Tellarium	80%	
	Tungsten	79%	
DRC	Cobalt concentrates	74%	Export ban since August 2026
	Copper concentrates	14%	Export ban since August 2026

Source: USGS (2026), IEA (2026)

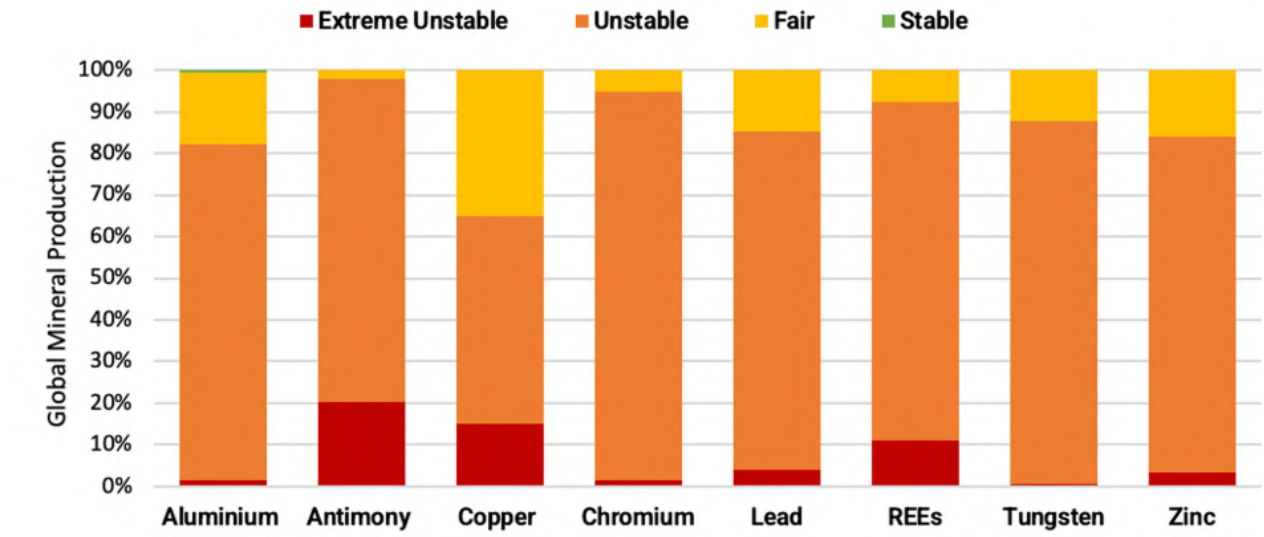
- **Minerals occurring in naturally low concentrations in ores** for example ruthenium, rhodium and iridium rarely exist on their own and are often extracted as by-products of platinum. REEs do exist abundantly, but in tiny concentrations and are incredibly difficult to separate because of their identical chemical properties.

  Some strategic minerals like gallium and germanium are not produced as stand-alone commodities but are recovered during the processing of copper, zinc, nickel and bauxite ores. This ties their supply directly to the supply of the primary metals above.

- **Natural disasters and mine accidents** such as the wet mud flooding in the Grasberg mine in Indonesia -the world's second largest copper mine- in September 2025 where seven workers were killed. Operations were halted immediately and were set to restart in July 2026 with copper and gold production expected to decrease by 35 percent for the year.

- **The political stability of countries with mineral production and refining leverage.** The figure below shows that more than half of the production for the minerals below, comes from countries classified as unstable or extremely politically unstable. This has implications from the geopolitical risks associated with maintaining supply chains as well as the weak governance power of regulatory institutions

Figure 4: Political Stability of Selected Critical Mineral Sources in 2024



Source: WMD (2026)

- **Armed conflicts and human rights violations** for example in February 2025, the EU parliament adopted a resolution to suspend the EU-Rwanda Memorandum of Understanding (MoU) on sustainable raw materials value chains, this was following the Rwandan-backed rebel group M23's occupation of eastern DRC. A peace deal between the two countries, brokered by the US and Qatar was signed later in June.

- **Weak substitutability** as in the case of titanium in aerospace, where few materials possess the metal's strength-to-weight ratio and corrosive resistance.

Chapter 2

Copper



Copper

2.1 Global Outlook on Copper

2.11 Supply Outlook

The USGS estimated identified copper resources to contain 1.5 billion Mt of unextracted copper and that undiscovered resources contained around 3.5 billion Mt of copper as of 2015. Global copper 'reserves' on the other hand -which by definition are technically and economically extractable- were estimated to be around 980 MMt in 2025.

Figure 6: Copper Mine Production by Country in 2025 (MMt)

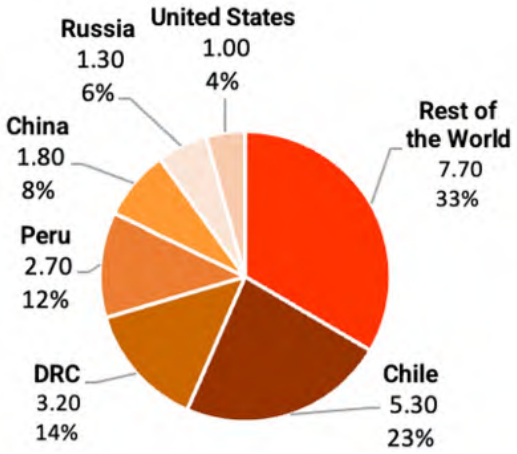
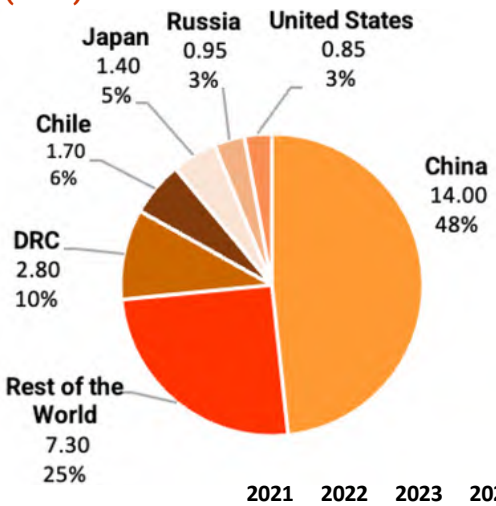


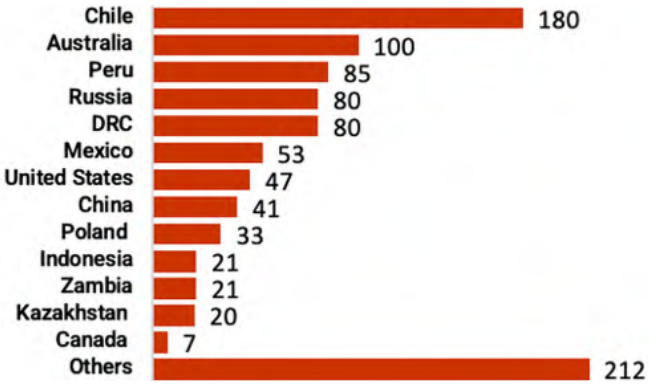
Figure 7: Copper Refining by Country in 2025 (MMt)



	2021	2022	2023	2024	2025
Mine Production (in MMt)	21.20	21.90	22.60	23.00	23.00
Refinery Production (in MMt)	25.30	25.90	27.00	27.60	29.00

Source: USGS (2026)

Figure 5: Copper Reserves by Country in 2025 (MMt)



Source: USGS (2026)

Chile and Peru accounted for more than a third of mined copper and are estimated to hold reserves greater than Australia, Russia and the DRC combined. In fact, out of the top 20 copper mines ranked by capacity, 12 are in these two countries -the largest of which is Escondida in Chile with an annual production capacity of 1.35 MMt of copper and a resource base of over 26 billion Mt.

The majority of the mines in Latin America hold **porphyry-style deposits** which have lower ore grades of under 1 percent (meaning on average 10 kg of metal is obtained per tonne of ore), but make up 65 percent of global copper deposits. According to BHP, ore grades have declined by 40 percent since 1991, mostly because majority of the high-grade ores closer to the surface have been mined out.

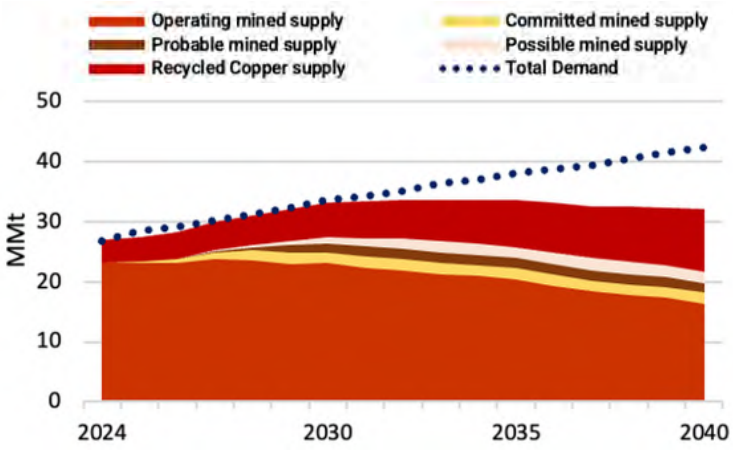
In the last decade though high grade ores are being mined from **sediment-hosted mines** of the Central African Copper Belt that have a more uniform and concentrated mineralization. A good example of this is the Kamoa-Kakula copper mine in the DRC which is considered one of the richest copper mines in the world with an average head grade of around 3 percent

Ore grades play a big part in determining the economic feasibility of new mining projects (greenfield investment) as deposits with low grade ores are unprofitable to mine.

A 10 MMt Shortfall in Copper Supply is Expected by 2040, Even with Recycled Copper Intake

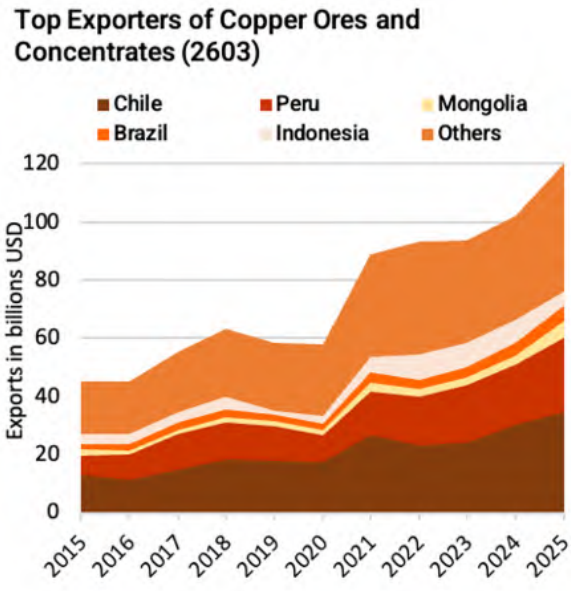
According to S&P Global, amongst the 239 copper mine discoveries from 1990-2023, only 17 had come in the last ten years and 4 in the last five years. This is problematic because more sophisticated engineering techniques like block-caving are now required to access the deeper sections of existing mines (brownfield expansion). The higher up-front capital, increased operating expenses and energy requirements, bump up the per unit cost of mining because now more ore needs to be processed to obtain the same amount of copper.

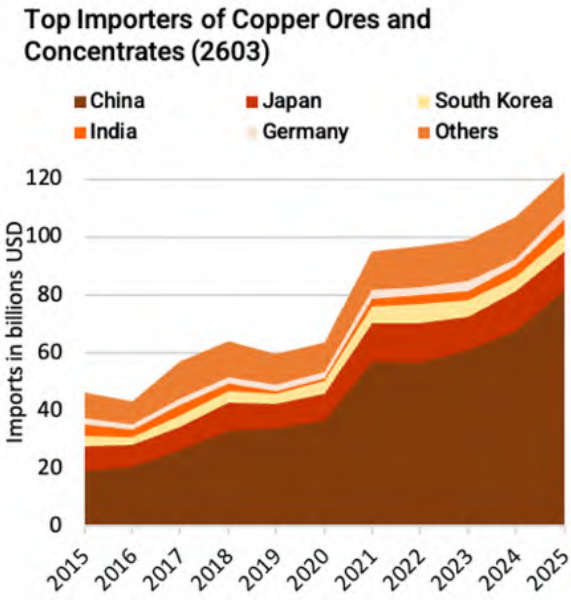
Figure 8: Baseline Supply Projections for Copper till 2040



Source: S&P Global

Figure 9: Trade Dynamics of Copper Ores and Concentrates





Source: ITC Trade Map

How Does the Smelting Market Work?

Smelting operations fall into two categories: vertically integrated smelters owned by mining firms like Codelco and Freeport McMoran that process a portion their own ores, and then custom third-party smelters in China, Japan and India that process concentrates on behalf of the mines. The mine receives payment for their copper content, deducted smelting fees also known as Treatment and Refining Charges (TCRC). (See how copper is priced in section 4.3)

Global smelting capacity has increased by 8 MMt in the last decade but copper concentrate production has only risen by 3 MMt according to S&P Global. The deficit in copper concentrate has increased competition and pushed the spot TCRC into the negative territory (-$182/Mt as of August 2026) forcing many custom smelters to reduce capacity or shut down. The skyrocketing prices of by-products like gold, silver and sulfuric acid have helped recover lost revenue but might not be sustainable in the long-run.

Much of the smelting overcapacity stems from China which refines nearly half of the world's copper with around 60-65 smelters compared to 15 in Europe and just 3 in the US. Smelters in China are able to maintain their margins because of their lower maintenance, electricity and labor costs and most of them are state-owned and thus receive government support in tight periods. Smelting decisions are significantly influenced by the ownership of mines rather than its geographical location. Integrated mining companies in Japan have started acquiring shares in South American mines to secure supply lines for their smelters.

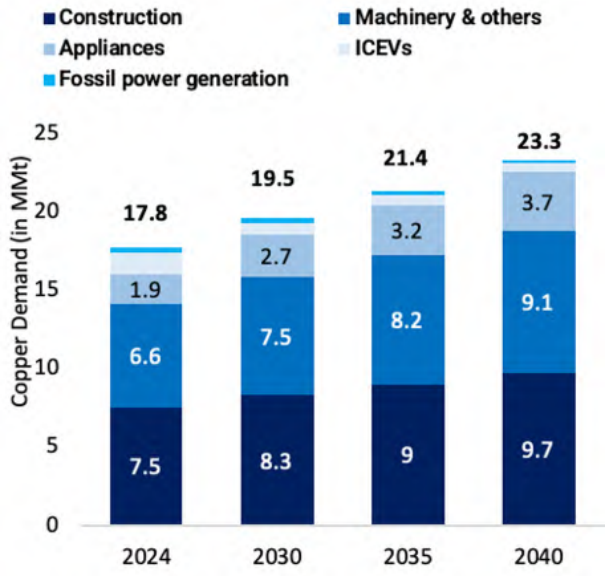
2.12 Demand Outlook

The importance of copper cannot be understated in modern machinery, infrastructure, security and green technology and is reflected by the fact that the US added the metal to its critical mineral list in October 2025 while it already existed in the lists of India, Japan and the EU.

S&P Global Predicts That Copper Demand Will Increase From 28 MMt in 2025 To 38 MMt in 2035 And By 2040 That Figure Will Reach 42 MMt.

The Asia-Pacific region is expected to account for almost 60 percent of this demand growth, while the Middle-East will be one of the fastest growing regions with an estimated Cumulative Average Growth Rate (CAGR) of 4 percent. The main drivers of copper demand are categorized below:

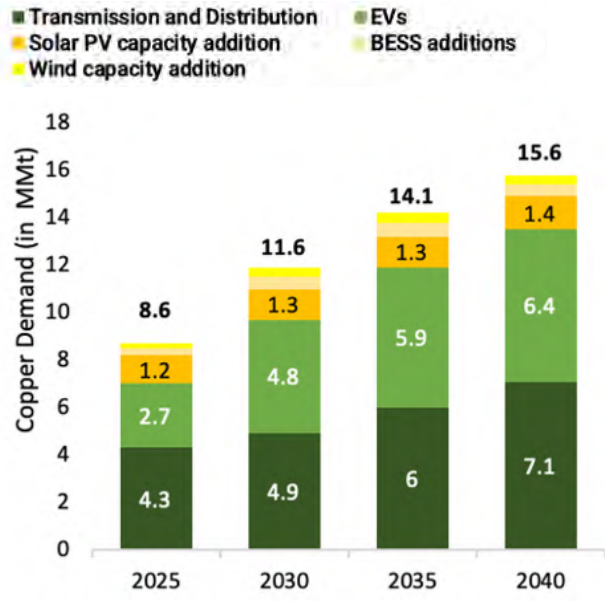
Figure 10: Expected Increase in Copper Demand from Core Economic Activities



Source: S&P Global

Core economic demand is expected to be the biggest contributor with 55% of the global copper share in 2040 and is highly correlated with growing urbanization. Copper is the preferred material in electrical appliances like air conditioners and in industrial applications like wiring, motors and generators due to its electrical conductivity and durability. Usage in Internal Combustion Engine Vehicles (ICEVs) and in fossil fuel power plants are the only categories where demand is expected to decline due to global decarbonization efforts.

Figure 11: Expected Increase in Copper Demand from Energy Transition and Addition



Source: S&P Global

Copper is indispensable in **reducing carbon emissions through clean energy generation** and wider electrification will be a copper-intensive process. S&P Global estimates that by 2040 solar PV, wind and battery storage will account for 47 percent of power generation and 62 percent of the installed capacity. The metal is crucial in multiple components like PV module and cell connections, turbines, inverters, cables, transformers, and as a foil inside the shell of lithium-ion batteries (for battery energy storage systems). In EVs the preference for SUVs over sedans -which require bigger battery packs- and the move towards Lithium Iron Phosphate (LFP) batteries -which are more copper intensive- have added to the increased demand.

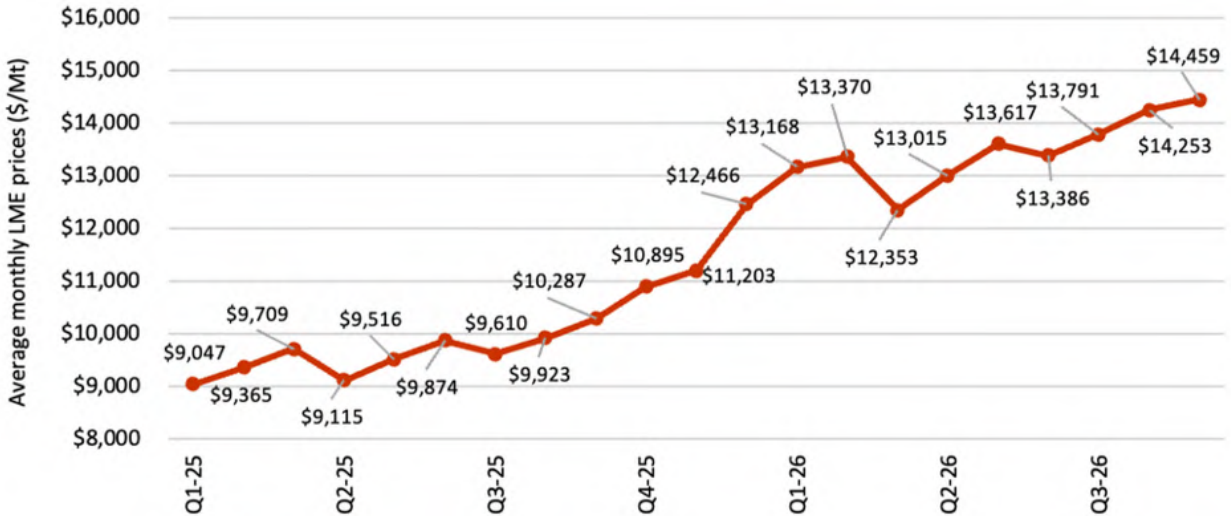
Copper is also surfing the mega-wave of **AI and data centers** that are notoriously electricity-hungry. According to estimates by S&P Global, a large, greenfield AI training data center with a 230 MW capacity can consume nearly 10,000 Mt of copper. The metal is once again preferred to hedge against overheating since the servers are closely packed together and is further used in cooling system, distribution equipment and server backups.

Government spending on **defense** is expected to increase as tense relations amongst regional blocs pushes the need for militarization. Copper continues to be used in warfare equipment like ammunition, submarines and missile launch systems in particular where the metal's thermal conductivity again reduces the risk of overheating and malfunction.

2.13 Price Outlook

Tariff uncertainty remains the biggest cause for fluctuation in copper prices. Prices have risen dramatically since mid-2025 following a looming threat of a blanket tariff on copper products by the Trump administration. This had led to rapid stockpiling -with 491,000 metric tonnes of refined copper moving into the Chicago Mercantile Exchange (CME) warehouses[6] - with the objective that any refined metal already inside the country would increase in value.

Figure 12: The Surge in 3M Copper Futures since 2025



A similar tariff-driven accumulation has occurred this year following speculation of a **15 percent tariff on refined copper beginning 2027 and which would be increased to 30 percent in 2028.** This has again been viewed as part of president Trump's vision of rebuilding domestic manufacturing and reducing reliance on critical minerals from foreign supply chains. A decision was supposed to come in June which has been delayed but nonetheless **fears have led to 3-Month London Metal Exchange (LME) futures contracts to break into USD 14,000 per metric tonne in August and September.**

Stockpiling has once again led to regional stress in where the metal sits, where it has been delivered and which exchange is causing the tightness. Inventories in Asian and European exchanges have fallen considerably as the metal has flown into American warehouses, effectively locking the metal in the US market until some clarity on the tariff decision is provided. If a 15 percent tariff does go forward it would increase the premium of the Commodity Exchange Division of the New York Mercantile Exchange (COMEX) over LME copper but both benchmarks could move higher.

6. Andrea Hotter. "US copper build-up intensifies on tariff risk: Hotter Commodities" Fastmarkets, June 8, 2026.

2.2 Pakistan's Copper Outlook

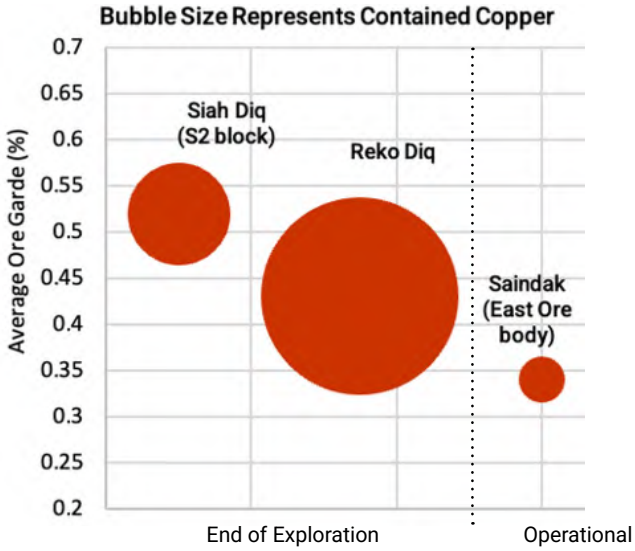
2.21 Balochistan

Copper mineralization in Balochistan is primarily in the Chagai porphyry copper belt that extends around 300 km east-to-west from Saindak to Dasht-e-Kain (Perello et al., 2008).

The Belt Comprises of More Than 48 Prospects and Deposits of Porphyry Copper and Gold including Reko Diq followed by deposits at Siah Diq, Saindak, Dasht-e-Kain, Koh-i-Sultan, and numerous less studied but high potential prospects in eastern Chagai (Khalil et al., 2022).

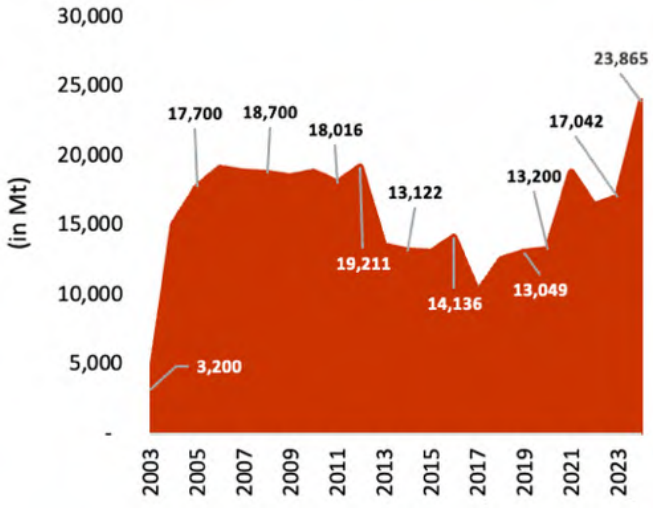
The belt is part of the wider Tethyan metallogenic belt -a mineralized zone rich with porphyry copper, gold, molybdenum and other base metals that stretches from central Europe to Turkey, Iran and western Pakistan.

Figure 13: Comparison of Reko Diq, Saindak and Siah Diq by Size and Ore Grade



There is no consolidated figure for Pakistan's copper reserves but Reko Diq's proven reserve estimates of 15 MMt alone is greater than the reserves for Canada (see Figure 5). Total copper resources are estimated at approximately 22 MMt (as a sum of the Reko Diq, Siah Diq and Saindak projects) and this estimate is incredibly conservative given much of Chagai still remains unexplored. Pakistan's contribution to global copper production stood at less than 0.1 percent in 2024 according to the World Mining Data (WMD) ranking it 36 out of 58 countries. The disparity in resources and real mine production means that the minerals are present but are not being extracted, often because of difficult investment or mining conditions (OECD, 2026).

Figure 14: Blister Copper Production at Saindak



Source: MCC, USGS.

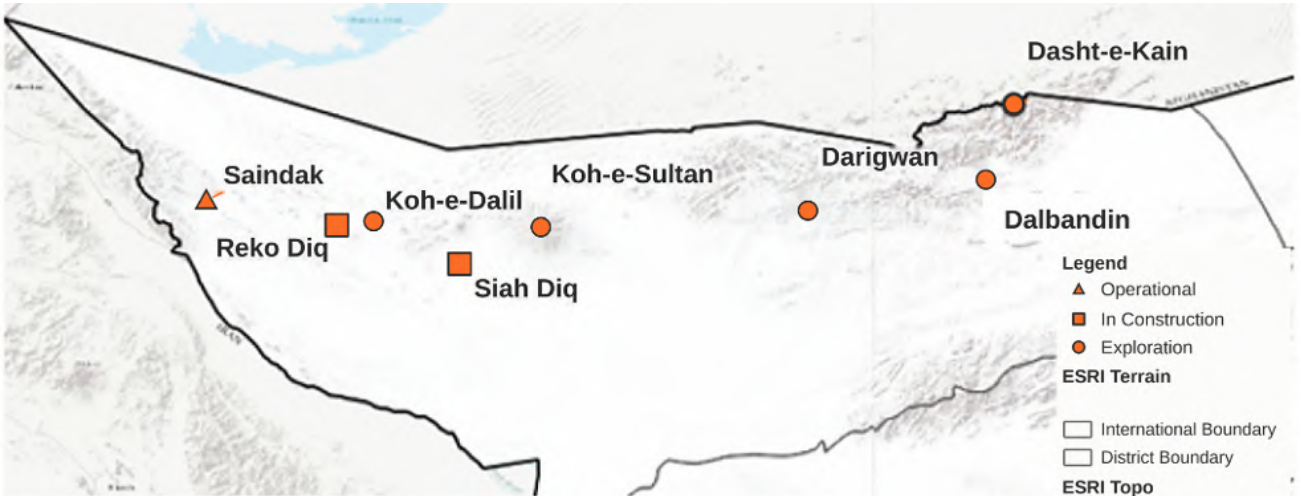
The Saindak mine in Chagai operated by the Metallurgical Corporation of China (MCC) is the largest operational mine in the country with an annual capacity to produce 20,000 Mt of blister copper, followed by the Muhammad Khel Copper Mine in North Waziristan.

The Saindak project is also the only one in Pakistan that is equipped with an integrated smelter which produces blister copper (98% pure copper) Commercial production started in 2003 with stable output but it dropped in 2013 due to maintenance work on the reverberatory furnace in the smelting plant. Problems such as reduction in mineable ore and hardness of ore continued to erode production in the following years.

Copper deposits had been documented in the Chagai district well before the exploration for Reko Diq began (see section 5.1 in stakeholder outlook). Showings were described as isolated green copper oxide mineral stains on fracture surfaces; some containing chalcopyrite, bornite, and chalcocite with supergene enrichment having taken place within 2 or 3 feet of the surface (Nagell, 1964).

Porphyry copper deposits are massive, low-grade rock bodies where mining operations can last for decades. Ore grades for Pakistan's major mines hover around the 0.4 percent mark which is comparable to other global mines (see Figure 20) with Reko Diq's tonnage standing out.

Figure 15: Copper Mines and Deposits Across Chagai District



Other than the foreign-operated mining projects, there are a number of domestic exploration projects being led by state-owned enterprises and private consortiums across the Tethyan belt in Chagai. The locations mentioned above are some of the exploration sites but are not exhaustive.

Table 4: Development Status of Major Copper Mines in Pakistan

Mine	Location	Status	Ownership	Notes
Saindak	Chagai, Balochistan	Operational	MCC (Operator), Saindak Metals Limited (SML)	MCC is currently operating in its fourth lease period that was granted in 2022 and will continue for 15 years. In 2020 the overburden removal for the east ore body began given that the north and south ore bodies of the mine were expected to be completely depleted by 2021. The east ore body is estimated to have 273 MMt of copper reserves at an ore grade of 0.34%. MCC reported the estimated copper resource reserves of the project at 1.79 MMt by mid 2025.
Muhammad Khel	Boya, North Waziristan, KPK	Operational	FWO	The open-pit mine has been operational since 2019 with a daily beneficiation capacity of 1,500 tonnes.
Reko Diq	Chagai, Balochistan	In Construction	Barrick, Government of Pakistan, Government of Balochistan	Concentrate production is expected to begin in 2028. Two major porphyry deposits -Western porphyry and the Tanjeel- have an estimated 3 billion Mt of proven copper ore reserves, and 15 MMt of contained copper with an ore grade of 0.48%.
Siah Diq	Chagai, Balochistan	In Construction	MCC, Siakoh Mineral Development Limited (SMDL)	Based on an updated feasibility study, resources in the S2 block were estimated at 883 MMt with a 0.52% average ore grade and total contained copper of 4.55 MMt. Capital investment would round up to 2 billion USD, with around 400,000 tonnes of concentrates produced annually and a mine life of more than 27 years.

Source: MCC, PMIF (2025), FWO, Barrick, Balochistan Mines and Minerals Department

2.22 KPK and GB

The General Mineralization in KPK And GB Consists of Smaller but Concentrated Deposits with Higher Ore Grades Which Makes It Very Conducive for Small to Medium Scale Mining. Copper Exists as Independent Deposits and in Polymetallic Veins with Base Metals Like Iron, Lead-Zinc, and Tungsten.

In KPK, copper resources are found in the districts of Chitral, Hazara, Dir, Bajur, Mohmand, Kurram and Waziristan. Unlike the porphyry style deposits in the Chagai belt, mines in North Waziristan are Volcanogenic Massive Sulfide (VMS) deposits as part of the Waziristan Ophiolite Zone.

Figure 16: Copper Mines and Exploration Blocks Across KPK and GB

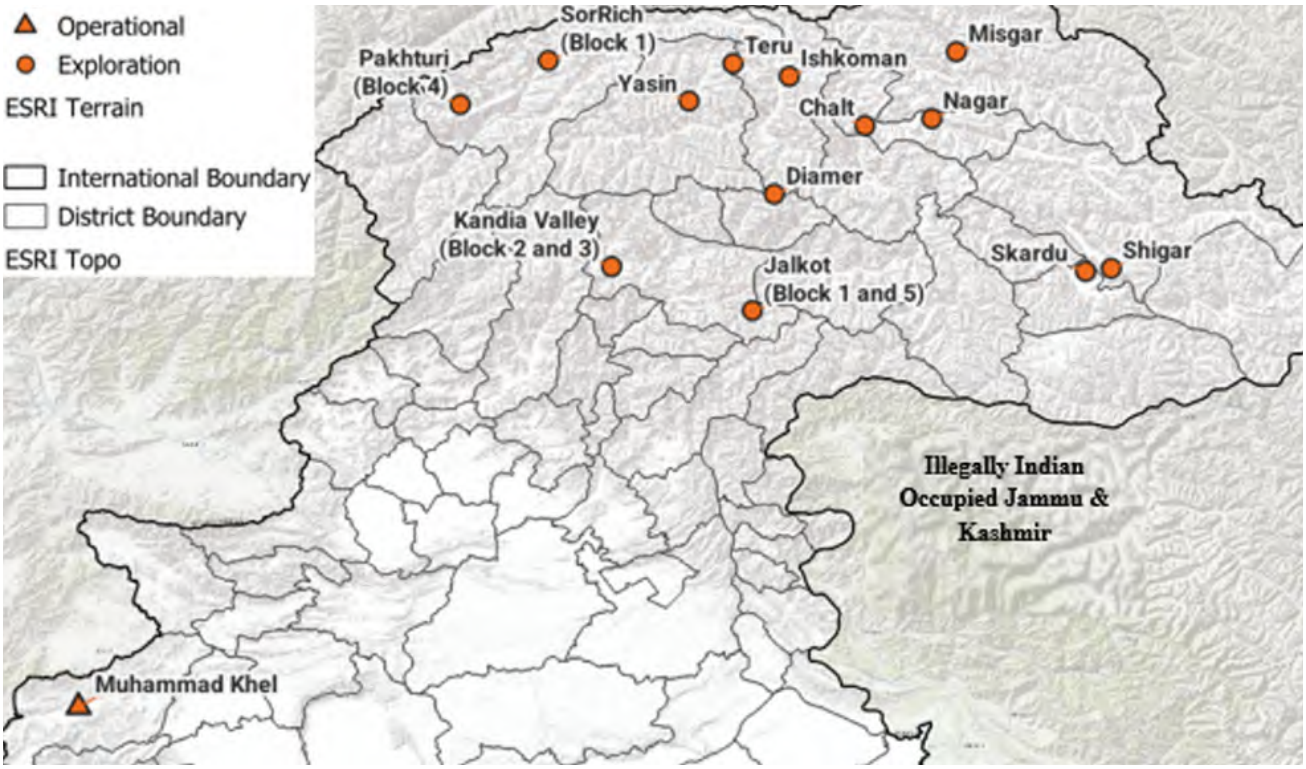


Table 5: Exploration Blocks for Copper and Other Metals in KPK

Mine Location	District	Area (in sq km)	Known Mineralization and Anomalous Metals/Path Finders
SorRich (Block 1)	Upper Chitral	175	Low-grade Au bearing metamorphic quartz veins in Rich valley. Strata bound W+ Pb-Zn-Cu in Garam Chasma & Rich valley
Pakhturi (Block 4)	Upper Chitral	175	Calcareous sandstone hosted Cu-Pb-Zn mineralization of metamorphogenic type in Mulko area.
Jalkot (Block 1 and 5)	Upper Kohistan	77 and 173 respectively	Sporadic showing of copper mineralization. Copper is also associated with quartz veins and sheared zones Block 1: Cu-Au-Pb-Zn, Hg, As, W, Sb Block 5: Cu-Ni-Zn-Pt-Te, Hg, As, W, Sb
Kandia Valley (Block 2 and 3)	Upper Kohistan	196 and 200 respectively	Scattered copper mineralization in the form of malachite & azurite and chalcopyrite associated with quartz veins Block 2: Cu-Au-Zn-Pb-Ni-Co, Sb, W, As, Bi Block 3: Cu-Au-Zn, Sb, W, As, Bi

Source: PMIF (2025), KPK Mines and Minerals Development Department.
Notes: 1) The KPK Mines and Minerals Development Department identified a number of metallic mineral blocks in Chitral district and the Hazara division for exploration and bidding to potential investors in 2014 but they have not been awarded for detailed exploration yet. 2) Exploration license issued for blocks will be valid for a period of 8 years followed by a mining license for a period of 30 years. 3) Other delineated blocks like Koghazi and Arandu also contain copper mineralization. See report link in references 4) Abbreviations for metals are as follows- Au: Gold, As: Arsenic, Bi: Bismuth, Co: Cobalt, Cu: Copper, Fe: Iron, Hg: Mercury, Ni: Nickel, Pb: Lead, Pt: Platinum, Sb: Antimony, Te: Tellurium, W: Tungsten, Zn: Zinc

2.23 Prospects for Value-Addition Within the Country

Currently value-addition to copper extends only till ores, concentrates and blister copper (see dotted section in Figure 17). **The challenges in setting up a smelter in Pakistan are briefly outlined below:**

- Constructing a smelter is a multi-billion-dollar investment that requires a continuous supply of concentrates which is as of now missing from domestic mines. Smelters prefer to operate at peak capacity and the global shortages in concentrates mean that these foreign smelters are willing to charge lower prices to secure feedstock. These cost dynamics show that at present it is more commercially viable to export concentrates with little value in functionally upgrading into smelting.
- Smelters require uninterrupted large-scale electricity and a reliable grid network. The nearest grid is 600km away from the Chagai district.
- Although lower than the beneficiation process, water is still needed for cooling which is extremely scarce in hyper-arid zones like Chagai, where reliance on vulnerable underground aquifers or costly coastal desalination adds massive overhead costs.
- Traditional smelters yield huge volumes of sulfuric acid as by-products that requires a dedicated local industrial off-taker to remain viable. Transporting hazardous reagents across risky corridors like the N-40 highway exposes operations to security risks and high insurance costs.

Figure 17: Copper Processing from Ore to Cathode



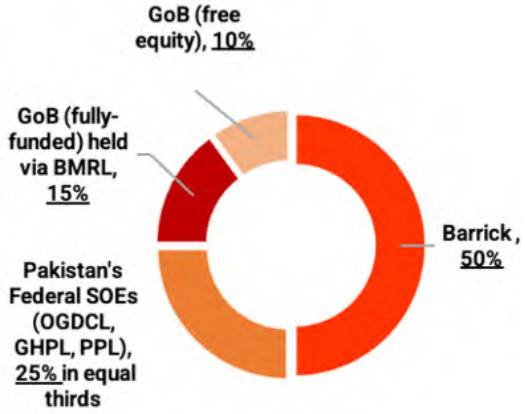
Other than using traditional smelters, the majority of mining companies have adopted **Solvent Extraction and Electro-Winning (SX-EW)** Method as it allows low-grade oxide ores to be efficiently exploited by using sulfuric acid as a leaching reagent. The DRC produces almost 45 percent of its copper using leaching as compared to 20 percent by Chile according to the IEA. The process accounted for 21 percent of refined copper production in 2025.

Smelting and SX-EW processes are viewed as complementary because the significant quantities of sulfuric acid as a by-product from the former can then be used for heap leaching later. Sulfuric acid has faced shortages since the Strait of Hormuz closure and this has been compounded by China's export ban from May 2026. SX-EW can be undertaken separately as well with relatively lower capital and scale requirements but is very electricity intensive, and needs to be done at the mouth of the mine.

2.24 The Reko Diq Project

Regarded as the flagship project of Pakistan's mining portfolio, Reko Diq is one of the world's largest undeveloped copper and gold deposits with a potential tier-one[7] rank. The project is a joint venture between the governments of Pakistan, Balochistan and the Canadian mining company Barrick Gold Limited which is also the operator.

Figure 18: Ownership Split of Reko Diq Project

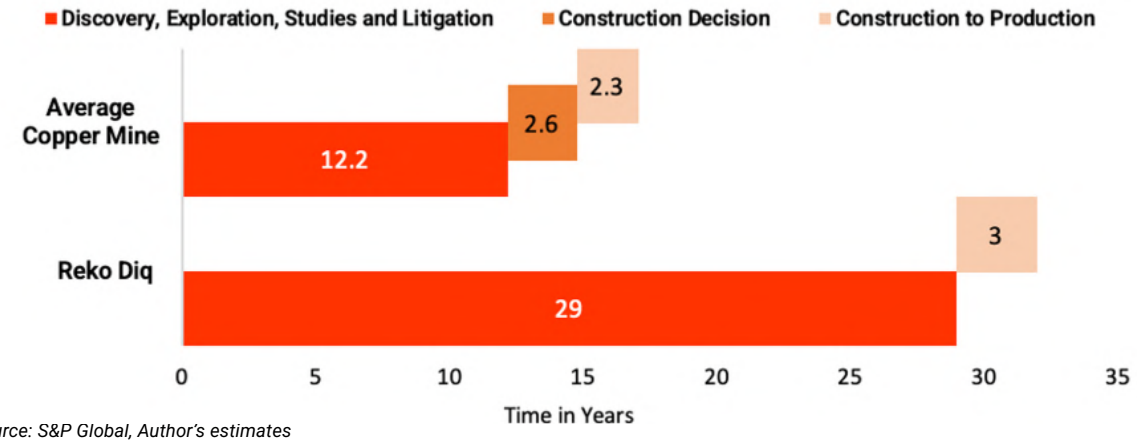


The project financing is supported by a number of institutions and countries such as the Asian Development Bank (ADB), the World Bank's financing arm the International Finance Corporation (IFC), the Japan Bank for International Cooperation (JBIC), the Export-Import (EXIM) Bank of the United States and others[8]. As reported in September 2025 the estimated cost for phase one had increased to 7.7 billion USD due to lender contingencies and is expected to increase further following the US-Iran war and its global effect on fuel, freight and insurance costs.

Source: Barrick Technical Report. BMRL: Balochistan Mineral Resource Limited, OGDCL: Oil and Gas Development Company Limited, GHPL: Government Holdings Private Limited, PPL: Pakistan Petroleum Limited. The SOEs hold their interests through the Pakistan Minerals Private Limited (PMPL)

Copper mines on average take 17 years between the point of early exploration to when the first concentrates are produced -this has risen from the 13-year estimated development period of the late 2000s. In Reko Diq's case, that figure has now swelled to 32 years mainly because of the legal dispute which resulted in a standstill even though the first drilling occurred all the way back in 1996. Estimates by the USGS in 2006 indicated that Reko Diq's copper production would have overtaken Saindak in 2010, positioning the country as a significant copper producer in the South Asia region.

Figure 19: Reko Diq's Development Period Compared to the Global Average



Source: S&P Global, Author's estimates

7. A Tier One Copper Asset/Project is an asset with a $3.00/lb reserve with potential for +5 million metric tonne contained copper in support of at least 20 years life, annual production of at least 200ktpa, with costs per pound in the lower half of the industry cost curve.
8. The contributions reported as of 2025 are as follows: ADB -$300 million in senior loans to RDMC and a $110 million partial credit guarantee to cover GoB's equity component, IFC- an A-loan of $300 million and a subordinated loan of $400 million, EXIM- $1.25-$1.3 billion, JBIC- $300 million

Table 6: A Summary of the Reko Diq Mining Project

Subject	Description	Notes
Mine Location	Chagai district of Balochistan	The nearest settlement is Humai approximately 19 km away and the closest major regional centre is Nok Kundi 75 km away. The Afghan border is approximately 35 km north and the Iranian border is about 55 km west.
Size of Mine Area	The surface rights lease (SL-211) covers an aggregate area of 643 km². The exploration license (EL-249) covers an area of 312 km². RDMC has acquired 2 mining leases: Eastern Lease (ML-19) with an area of 100 km² Western Lease (ML-20) with an area of 93 km²	RDMC has the right to convert any part of land in the exploration license to a mining lease by written request to the GoB. The two mining leases gives RDMC the exclusive rights to extract, process, transport and sell for its own account copper, gold, molybdenum and/or other mineral deposits (including other base and precious metals and rare earth minerals) from the areas covered by the mining leases. Both of these leases will expire in 2052 with an initial extension to 2082.
Mine Life	Around 37 years	From commissioning of plant in 2028. Mining is expected to finish by 2061 but processing of stockpiles will last till 2064
Strip Ratio	Life of mine: 1.07 First 10 years: 0.64	Strip ratio is defined as the waste rock to ore ratio. For the life of mine 3,205 million tonnes in waste rock to 3,008 million tonnes in ore is expected to be produced
Average Ore grade	0.48% for copper, 0.26 g/t for gold	Meaning 4.8 kg of copper is obtained per tonne of ore mined
Recovery rate	Life of mine: 89.9% for copper, 69.9% for gold First 10 years: 90.1% for copper	Recovery rate is defined as the percentage of mineral obtained after processing to the amount originally present in the ore.
Capital and Operating Costs	Capital Costs: Phase 1 (initial capital): 5.69 billion USD Phase 2 (expansion capital): 3.30 billion USD Sustaining Capital (Life-of-mine): 3.82 billion USD Total Capital: 12.82 billion USD Operating Costs: Phase 1: 5.95 billion USD, 25.42 $/ton Phase 2: 50.12 billion USD, 18.58 $/ton Total Operating Costs: 57.48 billion USD with per unit costs of $19.11/ton	Capital costs mainly consist of the direct costs for open pit mining equipment, processing plant, tailings facilities, and both on-site and off-site infrastructure construction. Indirect costs include EPCM, temporary services, community engagement etc. Operating costs include mining costs (blasting, hauling, equipment maintenance, labour, fuel), processing costs (labour, power, reagents), general administrative costs (accommodation, security, water treatment etc.), freight and refining costs and royalty. **Costs are presented as of 31st December 2024, without allowance for inflation.**
Financial Analysis (Feasibility Study case)	Undiscounted after-tax net cash flow: 70.17 billion USD After-tax NPV (at 8% discount rate): 13.01 billion USD After-tax project IRR: 21.32% After-tax payback period: 6.16 years	Projections are based on the price of copper as $4.03/lb and gold prices as $2,045/oz. Sensitivity analysis on copper prices shows that at the highest price of $5.00/lb, the net cash flow would increase to 94.71 billion USD with an IRR of 26%
Royalty Structure	GoB: 5% NSR royalty payable GoP: 1% NSR royalty final tax regime payable (subject to a 15-year exemption following commercial production) and a 0.5% NSR royalty Export Processing Zone (EPZ) surcharge.	NSR (Net Smelter Return) royalty is a payment made by the mine operator to the royalty holder, on the basis of the gross revenue generated from the sale of minerals minus allowable deductions. In Reko Diq's case as outlined in the FIPP Act (see section 4.2), allowable deductions include the costs of smelting/refining/SX-EW and charges for the presence of delirious elements only.

Source: Barrick Technical Report. Abbreviations: NPV: Net Present Value, IRR: Internal Rate of Return

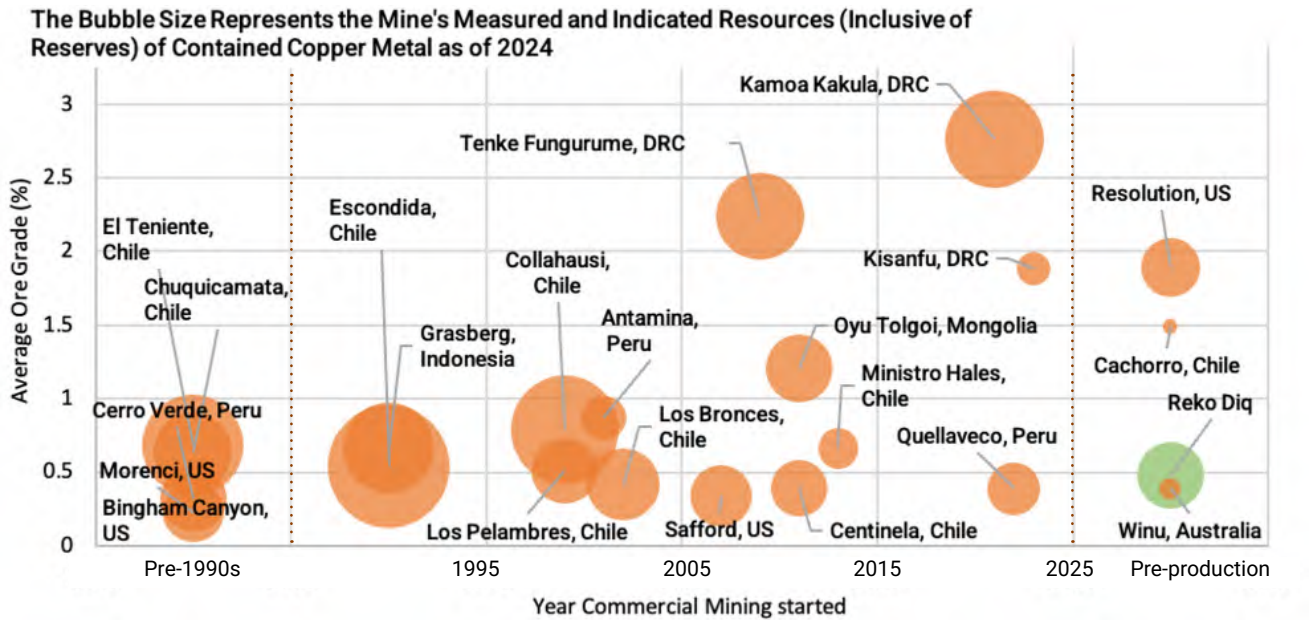
The mine is currently in its construction phase that started in 2025, with the first concentrates expected to be shipped by 2028. The project is divided in the two phases below:

Phase 1 (2028-2033): 45 MMt of ore will be processed per annum
Phase 2 (2034 onwards): A total of 90 MMt of ore will be processed per annum

Reserves and Ore Grades

The mine's potential can be demonstrated by the fact that S&P Global ranked it 12th in the largest copper discoveries in the last 30 years, third in the Asia Pacific region, only behind Oyu Tolgoi (Hugo Dummett mine) in Mongolia and the Grasberg mine (Kucing Liar deposit) in Indonesia. Reko Diq's ore grades are consistent with the global porphyry deposits that are common in South America, averaging at 0.5 percent. Ore grades above 2 percent are characteristic of *stratiform* mineralization found in the Central African Copper Belt which includes countries like the DRC and Zambia.

Figure 20: Comparison of Reko Diq with Major Copper Mines in Exploration and Operation



Source: Company Annual Reports.
Notes: 1) Resources are taken as of December 2024 to maintain continuity with the economic conditions of Reko Diq's estimates. 2) Contained copper was calculated by tonnage and ore grades where not available. 3) Ore grades were taken of the largest deposit or an average depending on the size of tonnage if multiple mine extensions existed. 4) Mining projects of tier-one mining companies like Anglo-American, Rio Tinto etc. are mostly chosen. The mines in the figure are not exhaustive.

The two main deposits in the Reko Diq lease are the Western Porphyry and Tanjeel but 13 others porphyry surfaces have been defined by exploration works which range from conceptual targets to advanced targets with drilling and assays.

Table 7: Reko Diq's Copper Resources, Reserves and Ore Grades by Deposit

Location	Copper Resources						Copper Reserves (Proven and Probable)		
	Inferred			Measured + Indicated					
	Tonnes (MMt)	Grade Cu (%)	Contained Cu (MMt)	Tonnes (MMt)	Grade Cu (%)	Contained Cu (MMt)	Tonnes (MMt)	Grade Cu (%)	Contained Cu (MMt)
Western Porphyries	1,276	0.3	4.2	3,653	0.42	15	2,861	0.48	14
Tanjeel	102	0.3	0.3	277	0.45	1.3	147	0.62	1
Reko Diq Total	1,378	0.3	4.5	3,930	0.43	17	3,008	0.48	15

Source: Barrick Technical Report.
Notes: 1) All values were estimated as of December 31st 2024. 2) To determine the economic viability of extraction as per the definitions of 'mineral resource' and 'mineral reserve', the prices of copper were taken as $4.00/lb. and $3.00/lb. respectively. 3) Mineral reserves have been estimated from indicated mineral resources as there are no measured mineral resources (see Appendix 1 for definitions). 4) Numbers may not add up due to rounding.

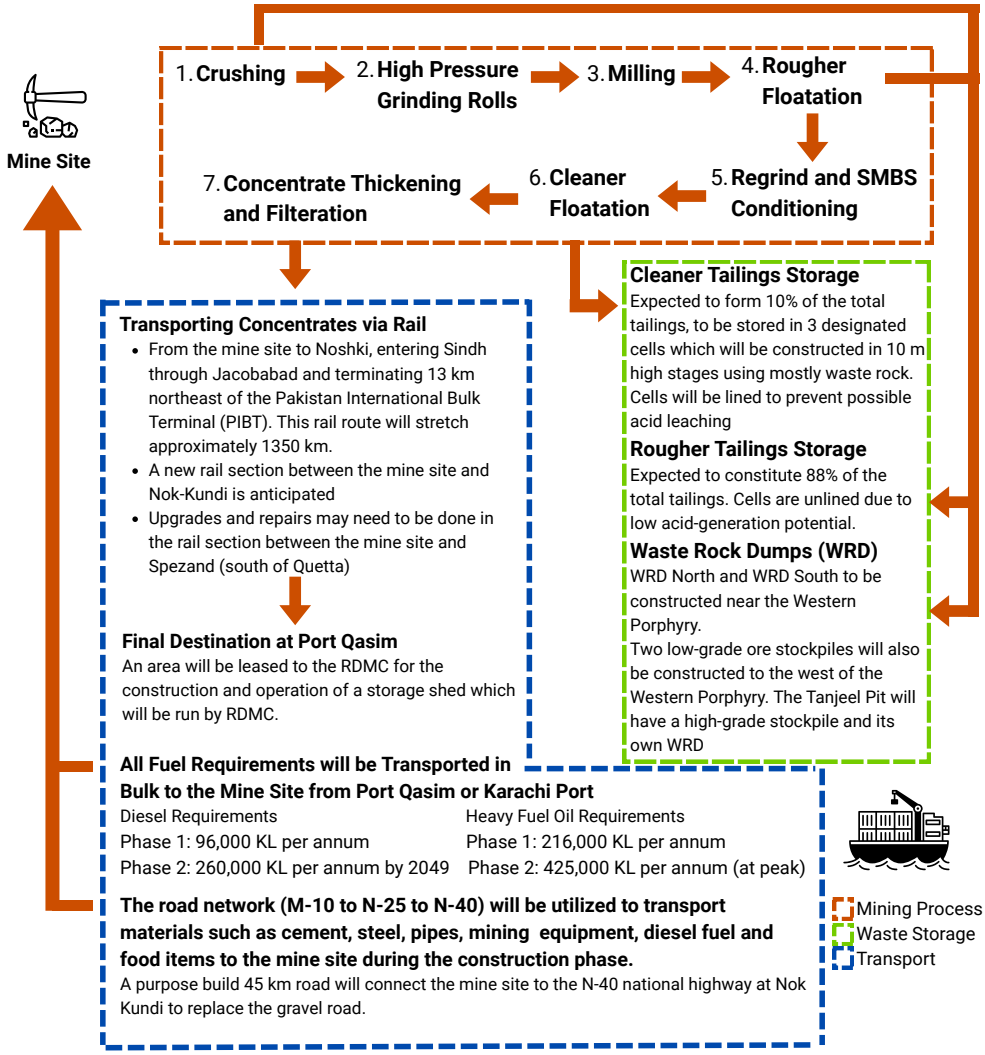
Operations and Mining Methods

The project will run using the traditional truck-and-shovel open pit mining method along with all the necessary infrastructure like processing facilities and tailings storage. Fluor had been selected as the project's lead Engineering, Procurement, and Construction Management (EPCM) partner.

A 440 million USD agreement was also reached with the Japanese equipment provider Komatsu that covers the delivery of haul trucks, electric rope shovels, excavators etc. This would be Komatsu's first placement in its Middle East territory and it intends to create Komatsu Pakistan Mining Limited to further support the project. A 200 million EUR agreement is also underway with the Finnish firm Metso for crushing, grinding, floatation and dewatering equipment.

The entire workflow from the ore being mined to processed and transported is outlined in the figure below. Mining is expected to be carried out 24 hours a day, year-round.

Figure 21: Flow of Operations in the Reko Diq Project



Source: Reko Diq ESIA

The processing stage is limited to the production of copper concentrates, which would be exported to third-part smelters for further refinement. As per the technical report, Letter of Intent (LOIs) for the long-term supply of copper concentrate have been executed with six potential offtakers, distributed between Japan, Korea, Germany, Sweden and Finland. There were no offtake contracts in place at the time of publishing of the technical report.

Chapter 3

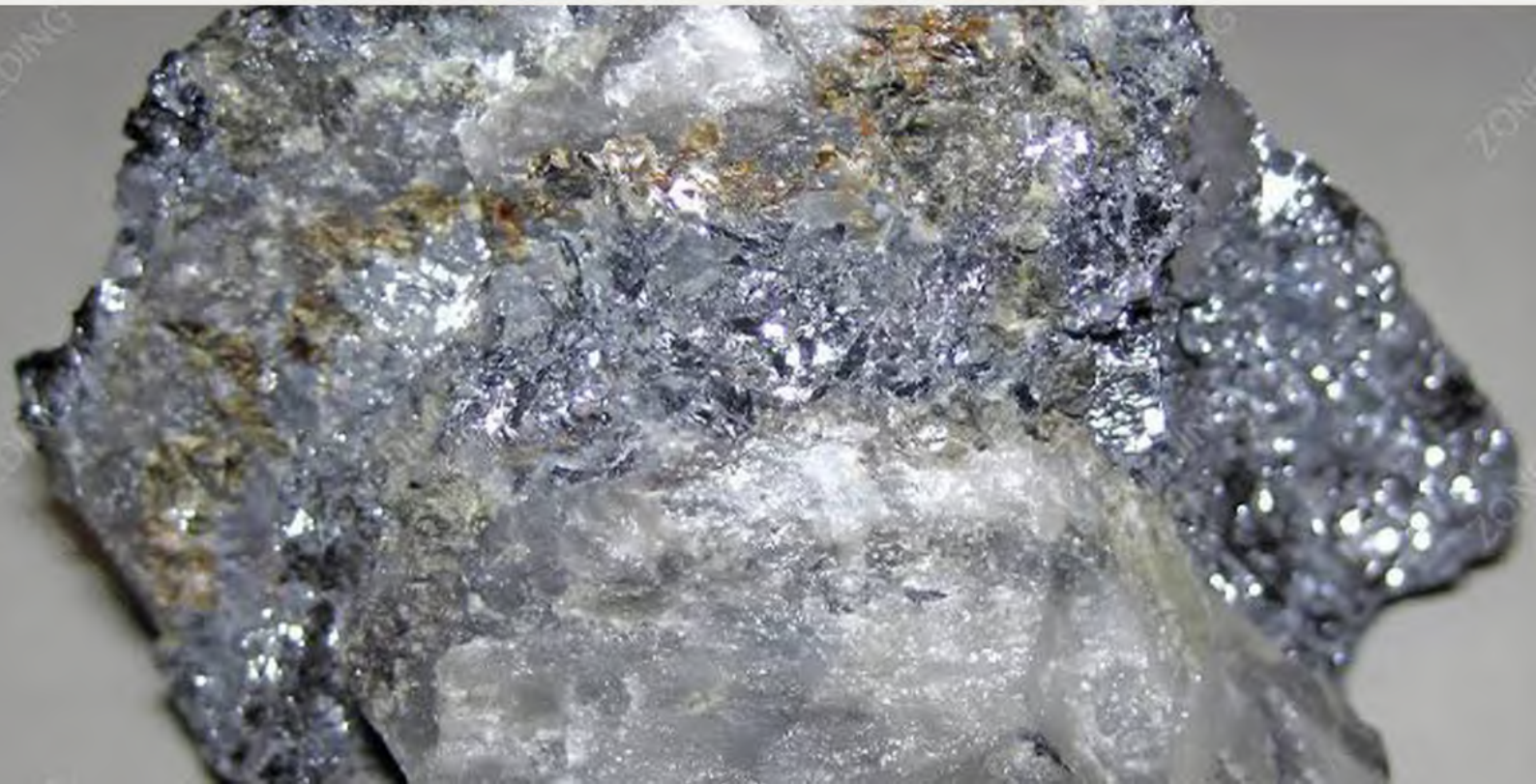
Other Critical Minerals











Other Critical Minerals

3.1 Antimony

Global Supply Outlook:

Mine production of antimony is regionally concentrated compared to metals like copper and zinc. The USGS estimates only 17 countries that produce significant outputs of the metal with China and Russia having the largest combined share (65%) in the mined output for 2025, holding more than half of the reserves. The rest of the mined output originates from Central and South East Asia while Europe is completely reliant on imports of the metal. Global mine production is mentioned below (in Mt).

2021	2022	2023	2024	2025	Reserves
112,000	83,100	106,000	119,000	110,000	>2,000,000

Figure 23: Antimony Production by Country in 2025 (Mt)

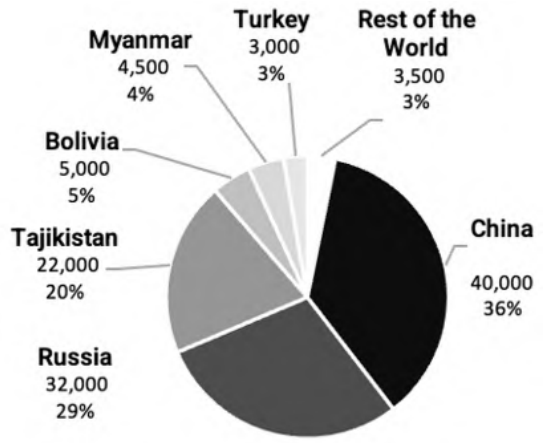
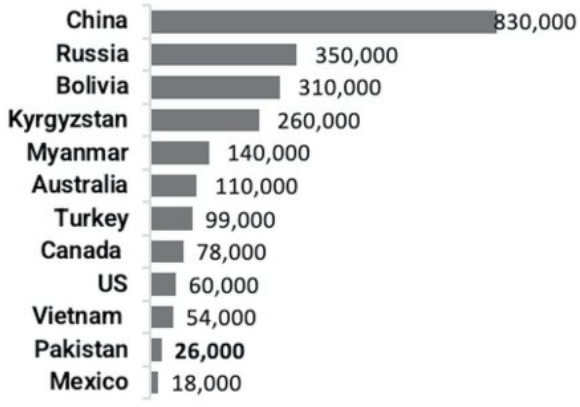


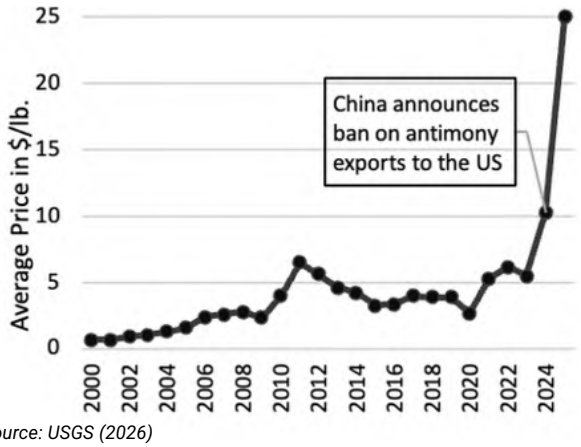
Figure 24: Antimony Reserves by Country in 2025 (Mt)



Source: USGS (2026)

Price Outlook:

Figure 22: Antimony Prices (min 99.65% metal)



Source: USGS (2026)

Prices have stayed stable for a large part of the last 25 years but shot up dramatically to an all-time high of $59,750/Mt on July 4, 2025 from around $14,000/Mt a year before. This was following China's export ban to the US in December 2024. The US was hit hard as 72 percent of its antimony oxide imports came from China pre-ban as compared to the EU which is firstly a net exporter of antimony oxides and secondly has diversified its metal sources.

However, prices are expected to come down as China lifted the ban in November 2025 for another year. But export-control measures are still in place and exporters will still need a license for foreign sales. A direct prohibition on shipping dual-use items to US military users is also in place.

The US also added antimony to its stockpiling plans to ensure its critical mineral supply as a part of the wider 'Project Vault'. Around 3,000 tonnes of antimony metal ingots in a contract worth 245 million USD is to be procured for the National Defense Stockpile (NDS) over five years. **The USGS estimated a 91 percent net import reliance of antimony (as oxides, unwrought metal and powders) for the US** in line with its consumption in 2025 which drives the above stockpiling efforts.

Global Trade and Demand Outlook

The antimony ore (stibnite) is smelted to produce two main forms of the metal that are used in the following applications:

1) Metallic ingots/blocks/powders

- Lead-acid batteries where it improves hardness, mechanical strength and corrosion resistance. It is the primary consumer of the metal accounting for 31 percent of global demand
- Armor-piercing ammunition as hardening agent
- Alloys such as pewter

2) Antimony trioxide and other compounds

- Flame retardants that are used in plastics, textiles, ceramics, rubber and electronics
- Compounds are used in night-vision goggles, infrared sensors and precision optics
- Sodium antimonate is used as a glass clarifier in photovoltaic glass, helping to reduce melting temperatures and improve light transmission

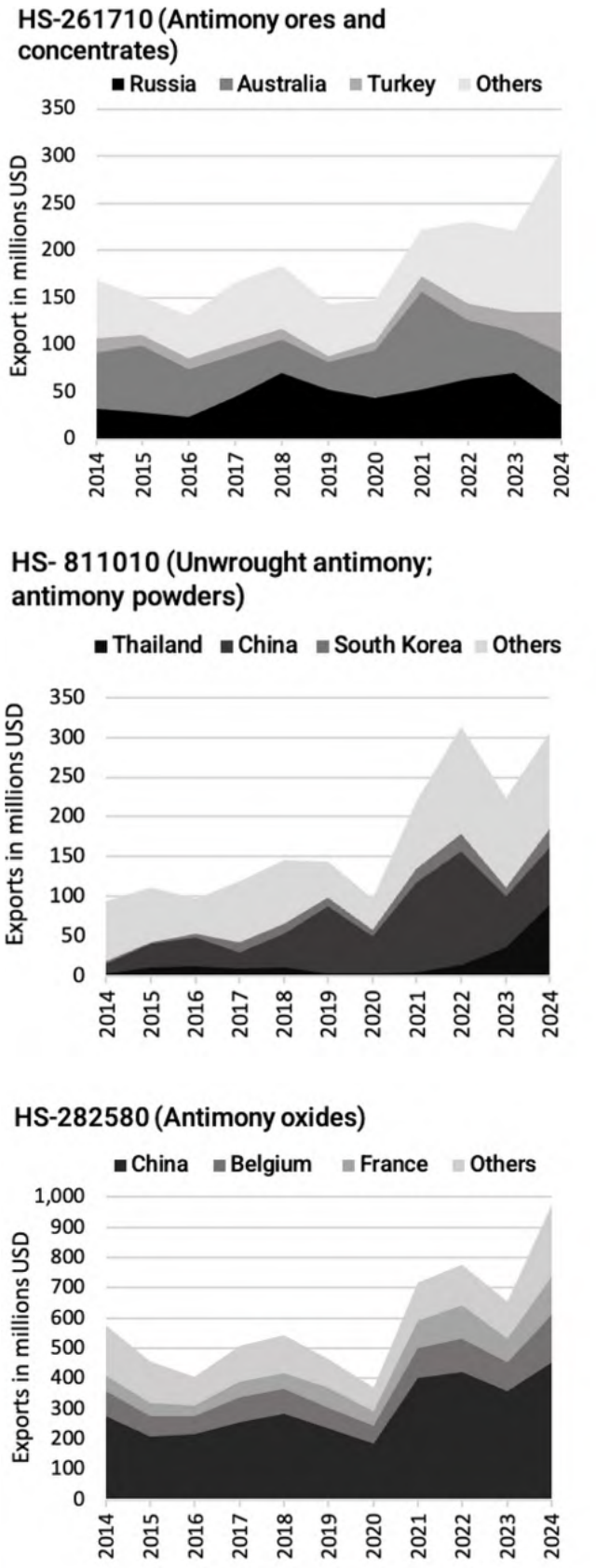
As per S&P Global, Antimony Demand is Expected to Grow Slightly from 179 Kt in 2025 to Around 183 Kt in 2035.

The substitution of ICEVs by EVs factors in the decline in demand but it is offset by growing electronics production that requires fire resistant wiring.

The figures on the right show how the production of antimony becomes more regionally concentrated as we move down the value chain. Ores and concentrates have the highest share of 'other' producers outside the top three which includes Bolivia and Tajikistan (Thailand anomalously had the highest exports in 2024 despite having no reserves which indicates transshipped material most probably from China given the its US-ban).

Antimony metal is still relatively diversified with India, Vietnam, Turkey and the US as other producers but exports of compounds like antimony oxides/trioxides is very tight with China having almost 50 percent of the share and all producers outside the top three being under 5 percent.

Figure 25: Antimony Exports by Form and Country



Source: ITC Trade Map.

Pakistan's Outlook for Antimony

Pakistan ranked 12th out of the 17 countries that mine marketable quantities of antimony, however, making up only 0.24 percent of the global output in 2025. The USGS estimates Pakistan's antimony reserves at 26,000 Mt with deposits in the Pishin Basin and Siahan ranges of Balochistan, Chitral in KPK and the valleys of Gilgit Baltistan.

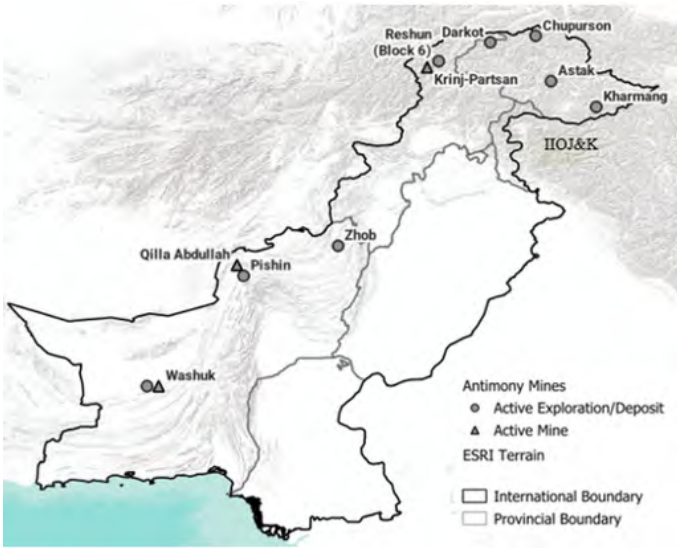
Antimony deposits have historically been documented in the Qilla Abdullah district (Klinger et al., 1975) and the Krinj, Awireth Gol and Partsan areas of Chitral (Calkins et al., 1981) The metal has been mined in Krinj since 1939 and earliest reports mention the ore being transported to Mumbai where it was smelted into antimony metal. Post-partition antimony oxide was even produced and shipped to the US and UK through Karachi.

Minerology and Ore Grades

Antimony deposits vary significantly by formation and size as compared to the massive, low-grade porphyry copper deposits which are mined through large open-pit operations. They occur predominantly as **lenses, irregular masses and narrow, high-angle hydrothermal veins of stibnite ores** along faults and fractures. Thus, antinomy extraction relies on low-tonnage, targeted underground methods such as adits and cut-and-fill mining followed by localized crushing, gravity separation, and flotation to yield high-purity concentrates or volatile-roasted oxides.

Antimony ores naturally exist containing a higher metal content as compared to copper where ore grades vary from 0.5-2%. Antimony deposits in Pakistan display significantly higher raw ore grades **(10% - 35% + antimony content)** even compared to standard global underground mine head-grades that vary between 1-5%.

Figure 26: Antimony Mines and Deposits Across Pakistan



Mines and Exploration Prospects

The majority of antimony currently being mined in Pakistan is by the Artisanal and Small-scale Mining (ASM) sector that exploits deposits in small but high-grade veins. For example, the Krinj mine was classified as a medium-sized deposit with 3,000 Mt of proven ore reserves, averaging at 15-20% antimony content (Gamerith, 1989). The lack of large reserves coupled by the remoteness of the area and mountainous terrain deterred any investment in a large-scale mining project. The delineated block of Reshun in the same Krinj-Partsan area was detected to contain polymetallic mineralization of antimony-lead-silver. Antimony is also detected as an anomalous metal/path finder in the Jalkot and Kandia Valley blocks (see table 5).

In Balochistan, the Pakistan Mineral Development Corporation (PMDC) holds two exploration licenses in Pishin and one in Zhob that have completed magnetic surveys and are undergoing drilling to develop commercially viable and mechanized mining projects. Multiple private sector firms also hold exploration licenses in the Washuk district, which is one of the main antimony producing districts alongside the Qilla Abdullah and Pishin districts.

In Gilgit Baltistan deposits have been identified in valleys across the Hunza, Ghizer and Skardu districts with a number of private firms having applied for exploration and subsequently mining leases. But these are again limited to seasonal ASM operations.

Prospects for Value-Addition

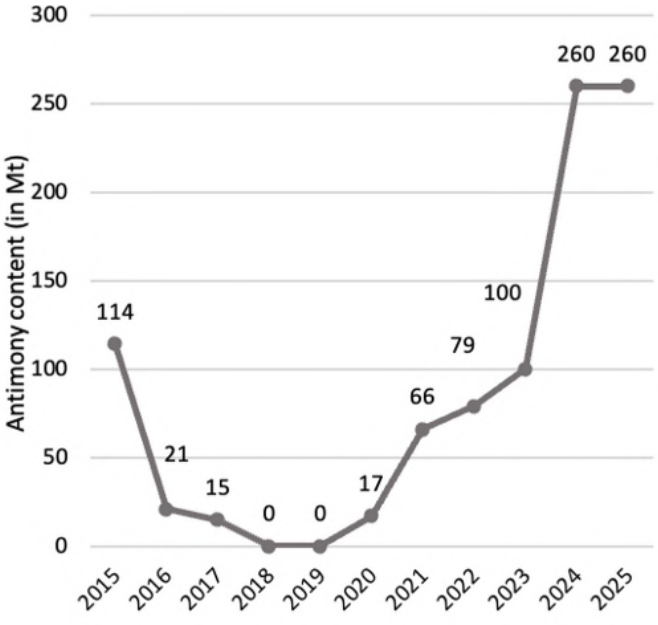
Antimony in Pakistan is exported entirely as hand-sorted stibnite ores given the artisanal scale of operations. As per the International Trade Centre (ITC), in 2025 the value of these exports was recorded at 1.84 million USD sent to Cambodia (31%), the UAE (24%), Thailand (21%), Vietnam (12%), China (11%) and Japan and Turkey with shares under one percent.

However, there exist significant opportunities for downstream processing facilities. The nature of Pakistan's high-grade deposits means that stibnite ores need to be upgraded from around 10% -35%+ antimony content to 99% purified antimony metal ingots (stibnite from Chitral is even upgradable to 62% antimony concentrates). By comparison copper is processed from 0.5% ores to 30% concentrates and then to 99.99% purified cathodes in multi-billion-dollar smelters and refineries.

Antimony Form and Market	Unit	Price
China Stibnite Conc (Sb 55% min) (Antimony Concentrate Price)	USD/ tonne	16,315
China Antimony 99.65% Sb min (Antimony Ingot Produced and Sold in China)	USD/ tonne	16,241
USA Antimony 99.65% Sb min (Antimony metal imported and sold to consumers within the US market)	USD/lb	14.30
Europe Antimony 99.65% Sb min (Antimony imported into Europe stored through warehouses in Rotterdam)	USD/ tonne	23,000
99.5% Antimony Trioxide FOB (Antimony with specified min purity produced in China and exported globally)	USD/ tonne	25,450

Source: Shanghai Metals Market. Prices are mentioned as of 1st July 2026

Figure 27: Antimony Production Over the Years



Source: USGS

Antimony smelters and roaster setups require relatively lower capital expenditure and the margins between ore, metal and oxides are significant as mentioned in table. However operational risks exist such as an erratic feedstock which is a direct result of unproven mining without any formal exploration techniques or bankable mineral reserve estimates. This is also reflected in Pakistan's antimony production which has shot up in the last two years but has been largely unpredictable over the last ten years nonetheless.

Environmental hazards also exist such as toxic arsenic dust, sulfur dioxide emissions during roasting, and large volumes of hazardous liquid waste if the leaching route is taken.

3.2 Lead-Zinc

Figure 28: Zinc Production by Country in 2025 (MMt)

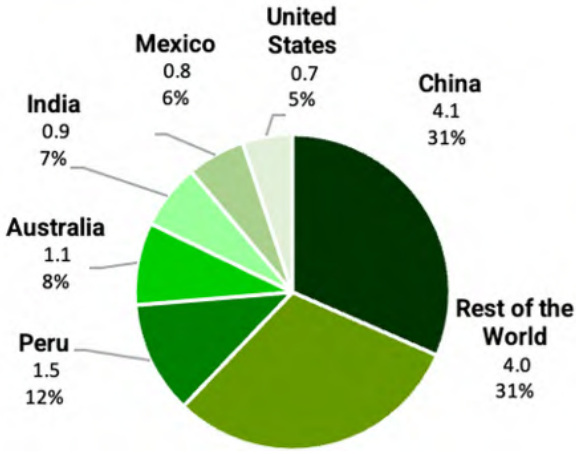
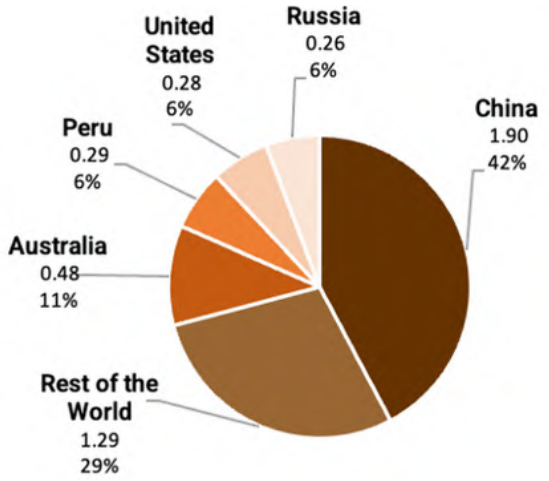
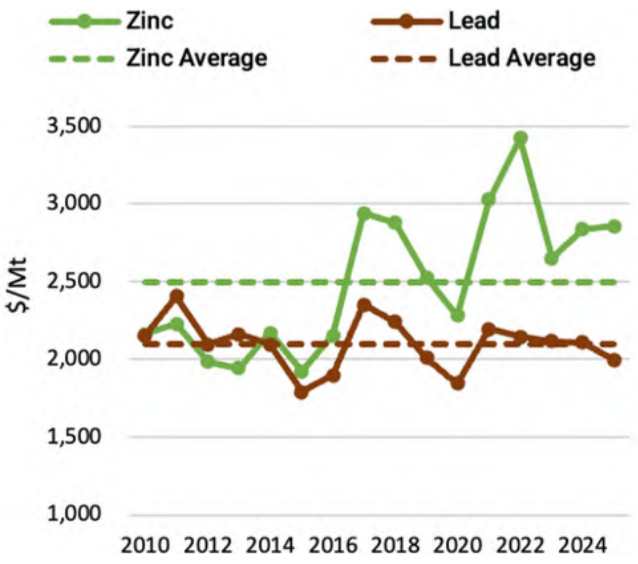


Figure 29: Lead Production by Country in 2025 (MMt)



Source: USGS

Figure 30: Zinc and Lead Prices



Global Supply Outlook

Zinc and lead sulfides form under similar pressure and temperature conditions and are hence often found in the same ore bodies. China dominates the mine production for both base metals and stockpiling at Shanghai Futures Exchange (SHFE) which has led to declining inventories in other exchanges creating instances of severe supply tightness. This has been worsened by tightening feedstock and falling TCRC.

Declining ore grades, increased capital intensity and longer project timelines (S&P Global estimates that an average zinc mine takes 17.7 years to develop from the point of discovery to when the first ores are mined) have discouraged spending on greenfield projects and as a result exploration spending on zinc reached its five-year lowest in 2024 as per the IEA.

However, By-Products Like Gold and Silver Have Recently Contributed to Immense Profitability in Zinc Mining Contributing to Around 25 Percent of the Mine Revenue -Fully Offsetting Operating Costs for Some Mines.

Global mine production, reserves and resources are mentioned in the table below (in MMt):

	2021	2022	2023	2024	2025	Reserves	Resources
Zinc	12.70	12.50	12.10	11.90	13.00	240	1.9 billion
Lead	4.55	4.46	4.37	4.60	4.50	95	>2 billion

Price Outlook:

Zinc prices are highly cyclical and mainly tied to two main factors:

1) **Smelter efficiency** which is affected by feedstock constraints, volatile TCRC and smelter disruptions. Reduced production from smelters in Europe caused by high energy costs and the permanent closure of a smelter in Canada caused prices to hit a 15-year high in 2022. In June 2026 a fire at the Young Poong Seokpo's zinc smelter in South Korea caused LME prices to reach $3,638/Mt -close to a record high.

2) Demand-led premiums dependent on the **growth or slump in China's real-estate and industrial sectors.**

Global Demand and Trade Outlook:

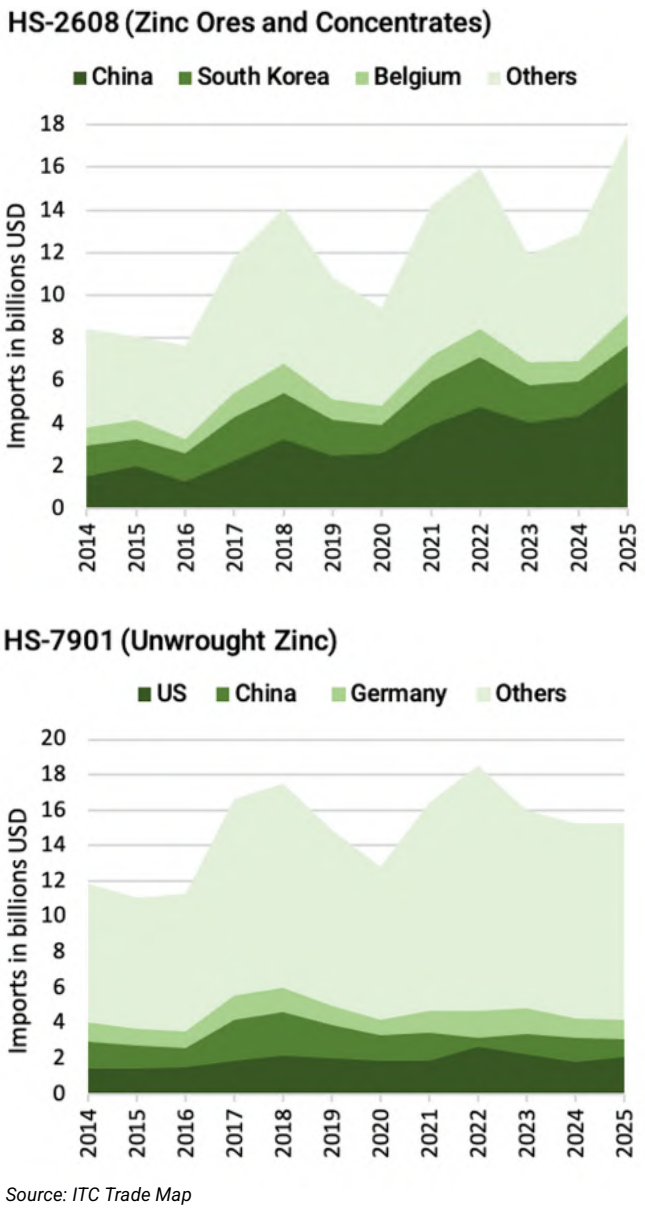
China is the biggest producer, consumer and importer of zinc concentrates with a 34 percent share and despite record imports mounting to almost 6 billion USD, smelters faced intense competition which led to falling TCRC as in the case of copper.

The metal has extensive industrial applications as listed below which is why it holds great interest to the powerhouse economies of the US, Germany and China which were the top three largest importers in 2025. In 2025 India overtook the US to become the second largest zinc consumer globally, with its rising middle class and growing auto sector infrastructure investments.

Primary Applications of Zinc

- Galvanized steel makes up 60 percent of global zinc demand, with almost half of it going into construction and about 20 percent each going into the transportation and infrastructure sectors.
- Electroplating, thermal spraying and zinc rich paints are used to reduce corrosion and extend life of steel objects.
- Rolled zinc in the form of strip, sheet, rod and wires that are used in roofing, drain pipes and ornaments to prevent corrosion.
- Alloys such as brass (copper-zinc) and others with aluminum and magnesium
- Zinc die casting to produce complex components

Figure 31: Zinc Imports by Form and Country



Source: ITC Trade Map

Global lead trade in 2025 was worth 18 billion USD, dominated by refined lead and lead as ores and concentrates. According to the International Lead and Zinc Study Group (ILZSG) in 2022, 86 percent of refined lead was used in the production of lead-acid batteries of all types such as the standard Starting, Lighting and Ignition (SLI) battery used to start vehicles with an internal combustion engine and its variations like the Absorbent Glass Mat (AGM) battery and Enhanced Flooded Battery (EFB).



An SLI battery on average uses 9-14 kg of lead per unit, with AGM and EFB consuming around 20% more (ILZSG, 2023)

The rise in EVs is expected to reduce demand but lead-acid batteries are still used for industrial grade use and as backups in transportation. Secondary uses for lead include ammunition, cable sheathing, pipes, compounds and alloys. Plastics have started to replace lead in covering and other metals like copper and tin have replaced it permanently in electronic devices for consumer protection.

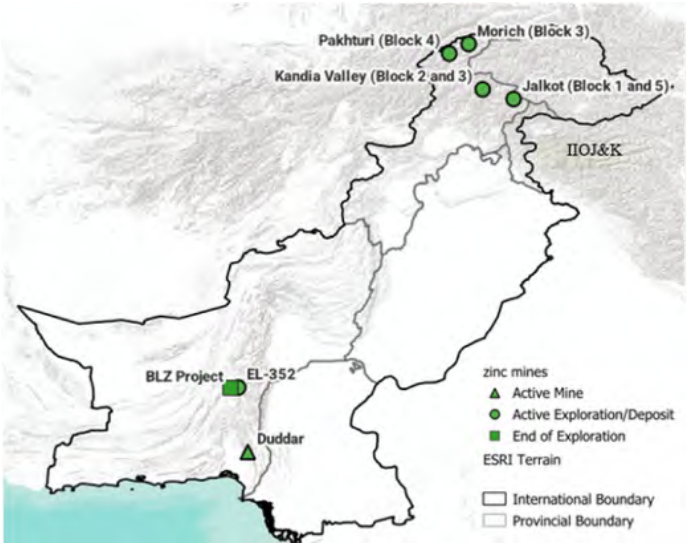
Pakistan's Outlook for Lead-Zinc

Pakistan ranked 25th in global zinc production with 0.33 percent of the share and 30th in global lead production with 0.17 percent of the share in 2024. The country's deposits are part of a 600km belt that runs sinuously from Zhob in the north through Khuzdar to Lasbela in the south where the country's flagship Duddar mine is located.

Mineralogy and Ore Grades

Mineralization is associated with pyrite-marcasite, sphalerite (zinc sulfide ore), and the less abundant galena (lead sulfide ore) in SEDEX and Mississippi Valley type deposits (Ahsan & Malick, 1996) with the latter two ores being the most important sources of zinc and lead respectively in the world.

Figure 32: Zinc Mines and Deposits Across Pakistan

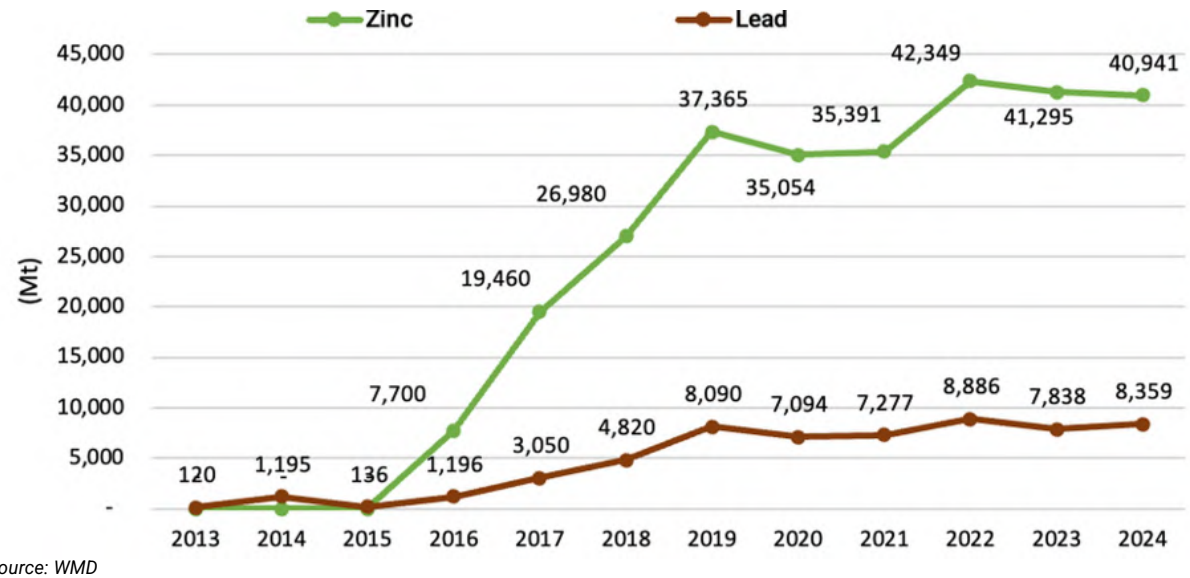


The Duddar deposit contains a combined lead-zinc head grade averaging **11.8% (~8.6% zinc and ~3.2% lead)** with nearby prospects routinely exceeding 10-12% combined metal. For comparison, global zinc ore grades average between 4-8% with the largest zinc mine Red Dog in Alaska having a total reserve ore grade of 11.2% zinc as of 2025 followed by the McArthur River (8.85%) and Mount Isa (6.62%) mines in Australia.

Silver, Gold and Germanium are the Most Lucrative By-Products That are Recovered

Silver concentrations vary from **30-120 grams per tonne** in galena and sphalerite which can be captured by standard floatation whereas trace amounts of germanium are embedded in the sphalerite lattice at 10 to 100 parts per million (ppm) and requires advanced hydrometallurgical leaching to be extracted.

Figure 33: Lead-Zinc Production at Duddar Mine



Source: WMD

Mines and Exploration Prospects

The Duddar mine is the only operational lead-zinc mine in the country as well the only underground metal-mining project, built with a network of tracks to bring the ores out of the mouth of the mountain. The project recommenced in 2014 operated by the MCC Huaye, Duddar (MHD) Mining Company after being shut down immediately after construction in 2005 due to difficult mining conditions and the risk of the mountain collapsing.

The mine produces lead-zinc in concentrate form and exports it to China for further processing and refinement. This does unfortunately mean that the by-products are captured by foreign smelters. It is also unclear if the by-products are factored into the price paid (See section 4.3 for further trade analysis).

A number of lead-zinc projects are underway in the exploration stages, all of them in the Lasbela-Khuzdar segment. Lead-zinc mineralization is also present in the polymetallic exploration blocks in the Chitral district while Mississippi Valley type deposits are known in the Mansehra district as well.

Table 8: Development Status of Lead-Zinc Mines Across Pakistan

Mine	District	Status	Ownership	Notes
Duddar	Lasbela, Balochistan	Operational	MCC- operator (75%), PMDC (12.5%), Govt of Balochistan (12.5%)	The lower system of the mine went through reconstruction with an aim to maximize capacity. By the end of 2019 the mine reached its peak annual production capacity of 500,000 tonnes. By the end of 2024, the estimated retained lead and zinc resources amounted to 321,100 tonnes and 642,900 tonnes respectively. It is anticipated that these resources will double by 2025 as the interim results of the supplementary exploration in the northern part of the mining area met expectations.
Baryte-Lead-Zinc (BLZ) Project	Gunga region Khuzdar, Balochistan	Execution Phase	Bolan Mining Enterprises (BME) BME is a 50:50 joint-venture between Pakistan Petroleum Limited (as the operator) and the Government of Balochistan	A bankable feasibility study was completed in 2019 by the engineering consultancy firm DMT Germany and a Project Management Consultancy (PMC) contract was signed in June 2026. Reserves are estimated at 69 MMt, with a projected mine life of 34 years and is expected to generate an annual revenue of 150-230 million USD. The project would end up as one of the largest open-pit mining operations in the country
EL-352	Khuzdar, Balochistan	Exploration	National Resources Limited (NRL)	The exploration license covers an area of 37 sq/km with the area exhibiting Mississippi Valley-type (MVT) or SEDEX-type lead-zinc sulphide deposits.
Morich (Block 3) Pakhturi (Block 4)	Chitral, KPK	Exploration Blocks	Government of KPK	Morich: Zn mineralization in association with mafic/ metabasite in the Tirich Mir Suture Zone Pakhturi: Calcareous sandstone hosted Cu-Pb-Zn mineralization of metamorphogenic type in Mulko area
Jalkot (Block 1 and 5) Kandia Valley (Block 2 and 3)	Kohistan districts, KPK	Exploration Blocks	Government of KPK	See Table 5. Mineralization is also known in Battagram and Mansehra districts (Block-04 (Allai), Block-06 (Kaghan) and Block-07 (Lahor-Pazang))

Source: MCC (2024), KPK Mines and Minerals Department.

3.3 Rare Earth Elements

Figure 34: Magnet REE Mine Production by Country in 2025 (Mt)

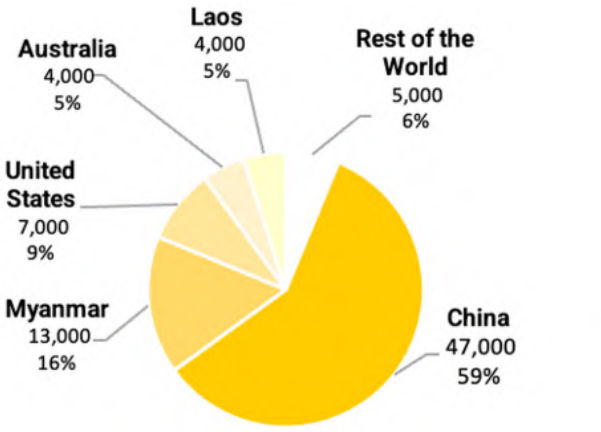
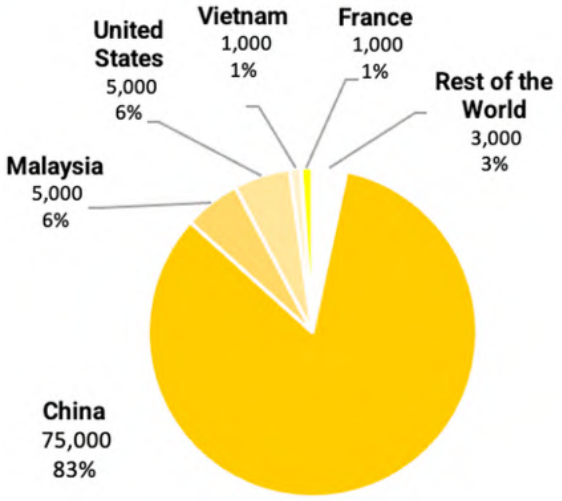
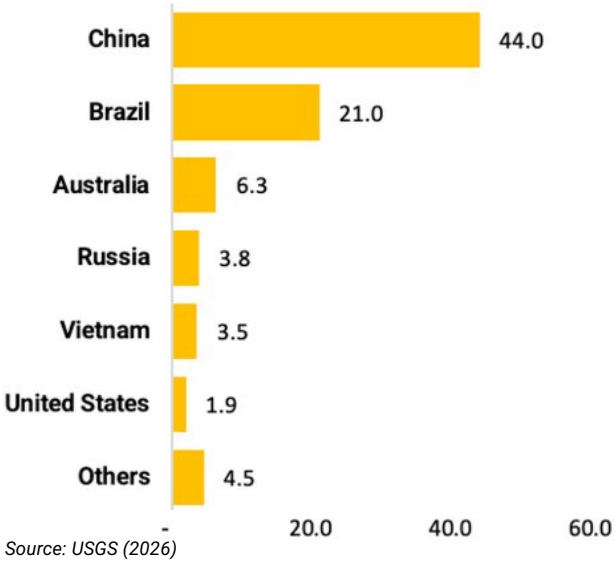


Figure 36: Magnet REE Refining by Country in 2025 (Mt)



Source: IEA (2026)

Figure 35: REE Reserves by Country in 2025 (MMt)



Source: USGS (2026)

Supply Outlook:

REE reserves are estimated to be greater than 85 MMt by the USGS and although they occur abundantly in the earth's crust, mineable concentrations are less common compared to other minerals. This section focuses on REEs used in permanent magnet manufacturing -neodymium, praseodymium, dysprosium and terbium- that make up around 30 percent of total REEs by volume but over 80 percent by market value [9]. China's overarching dominance in the magnet REEs is unmistakeable: According to the IEA, it mined around 60 percent of the global output, refined 92 percent, produced 80 percent of bonded magnets (used in electronics) and 94 percent of sintered magnets (common in clean energy) in 2024.

Why does China have an Edge?

This advantage comes from a combination of geological endowments and technical expertise. China's REE deposits are found in the form of soft ionic-absorption clays that are richer in heavy REEs like terbium and dysprosium, are less contaminated with radioactive elements and the REEs are weakly bonded to the clays hence making processing easier. Operations only involve digging the top 20 metres of the earth as compared to harder REE ores like monazite and bastnaesite which are extracted by blasting deep deposits, making the process more energy-intensive. But the downstream stage of mine-to-magnet – where concentrates are converted into metals and oxides is considered as the real chokepoint. China has an intellectual monopoly of REE separation using engineering techniques that were perfected over decades and are now heavily safeguarded by the state using export restrictions (see Table 3)

Outside of China, the Australian firm Lynas Rare Earths operates the biggest REE processing facility in Malaysia and opened a domestic facility in 2024. The US mining company MP Materials is the only significant miner of REEs in the US. Some oxides and metals are refined but not on a commercial scale. The US Department of Defence has announced a 400 million USD private-public partnership with MP materials to produce a second magnet manufacturing plant -the '10X'- which will add 10,000 Mt of magnet producing capacity.

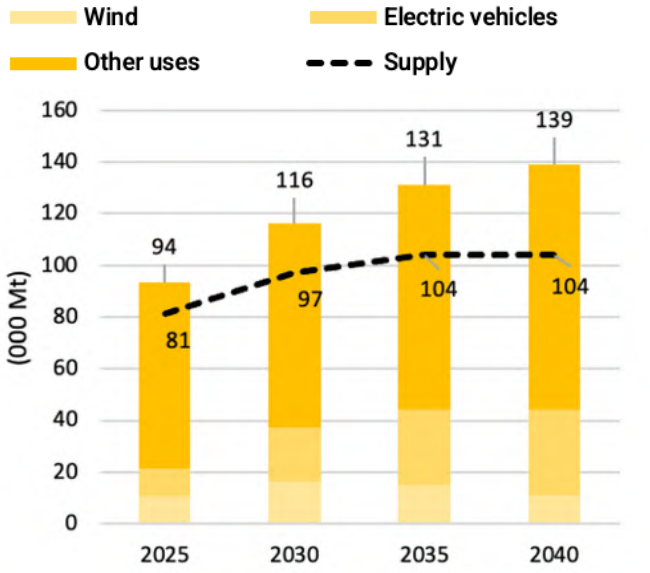
9. Euan Sadden, "RARE EARTHS: Policy, economic resilience drive new magnet supply chains", S&P Global, April 1, 2026

Demand Outlook:

The IEA estimates that demand for magnet REEs has doubled in the last decade, crossing 90,000 Mt in 2024. This is mainly driven by the use of light REEs- Neodymium and Praseodymium (NdPr) compounds in high-strength NdFeB permanent magnets, which are enhanced by heavy REEs -dysprosium and terbium to improve heat-resistance and coercivity.

Permanent magnets are key in the motors and generators used of clean energy technologies with few effective substitutes. **The generators in a wind turbine uses up to two tons of magnets while a single Toyota Prius consumes 2.2 pounds of neodymium**[10].They are also used in the taptic engine of smartphones which makes them vibrate and are used extensively in defence as listed below:

Figure 37: Projected Demand for Magnet REEs by Sector



Source: IEA (2026). Note: Demand and supply projections are based on stated policies and base case scenarios respectively

Defence Applications of Permanent Magnets:

- A single F-35 Lightening II uses over 900 pounds of REEs, most of which is used in its permanent magnets for its electric actuation systems, radar, and engine. Legacy fighters (F-16, F/A-18) and modern stealth aircraft (B-2, B-21 bombers) similarly use NdFeB magnets in radar and targeting systems.

- Drones and other Unmanned Aerial Vehicles (UAV). A typical quadcopter-style drone motor uses between 12 and 60 NdFeB magnets, and with up to 8 motors per UAV, even a single drone can contain several hundred magnets.

- The Joint Direct Attack Munition (JDAM) guidance kit used by the US Navy and Air Force and Tomahawk cruise missiles use REE magnets in their navigation and control systems.

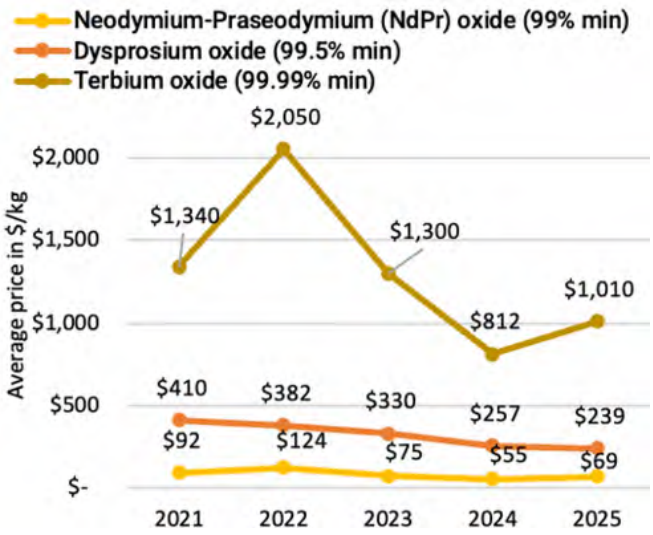
- A Virginia-class attack submarine requires about 9,200 pounds of REEs. It incorporates large permanent-magnet motors for quieter electric propulsion.

According to demand projections based on the Stated Policies Scenario and base-case supply projections, there is expected to be a 19,000 Mt shortage of magnet REEs by 2030 which would expand to 35,000 Mt by 2040.

As a result, countries have started to heavily invest in exploration and recycling projects for REEs. For example, India's Atomic Minerals Directorate is carrying out exploration along the coastal / inland / riverine placer sands of the country for the augmentation of REE-bearing ores like monazite and xenotime. Recycling projects such as those under the RESourceEU Action Plan are expected to restrict exports of permanent magnet scrap and waste from EU countries but such operations require a large number of end-of-life products like hard drives to become profitable.

10. Davey, J. Enduring Attraction: America's Dependence on and Need to Secure Its Supply of Permanent Magnets, 2012

Figure 38: Prices of Magnet REE Compounds



Source: USGS (2026). Note: The prices for NdPr oxide have doubled since October 2025 to $125/kg in February 2026 but are likely to be temporary

Price Outlook:

In general price agreements on REEs outside China are confidential and custom made with very limited trader input available for pricing agencies.

The MP Materials deal with the US Department of a Defence guarantees a 10-year price floor of $110/kg for NdPr materials -which is twice the market rate in China which has been operating between $50-70/kg in the last two years (the heavy REEs trade at much higher prices). Excess capacity in China has pushed the prices down so the price floor acts as a subsidy and guarantee of predictable revenue.

Pakistan's Outlook for Rare-Earth Elements:

REEs have immense geological potential in Pakistan but currently most prospects remain early-stage and unquantified in tonnage, with no commercial mining taking place. Proving these bankable reserves is difficult due to the absence of advanced core drilling, further extraction is challenged by the presence of heavy minerals like zircon, tourmaline and rutile as well as radioactive co-elements like uranium and thorium.

Mines and Deposits

The primary prospective zones include the Peshawar Plain Alkaline Igneous Province stretching through Loe Shilman (Khyber), Sillai Patti (Malakand), Koga (Swabi), and Swat; the carbonatite and pegmatite targets in the Chagai and Raskoh arcs of Balochistan; and heavy mineral sand concentrations in Gilgit-Baltistan and Chitral. Although REEs are not independently being mined in the country, the Balochistan Mines and Minerals Act under section 74 specifically instructs a title holder to notify the licensing authority in case a deposit is discovered.

Mineralogy and Ore Grades

Due to their high reactivity REEs do not exist as individual metals like copper or gold but rather occur in numerous ores or minerals as major or minor constituents. The deposits mentioned above are predominantly enriched in light REEs, featuring significant concentrations of Cerium (Ce), Lanthanum (La), and magnet metals like Neodymium (Nd) and Praseodymium (Pr), along with minor heavy REEs like Yttrium (Y) and Dysprosium (Dy) hosted in minerals like bastnäsite, monazite, and pyrochlore (which is also the primary source of another critical mineral niobium).

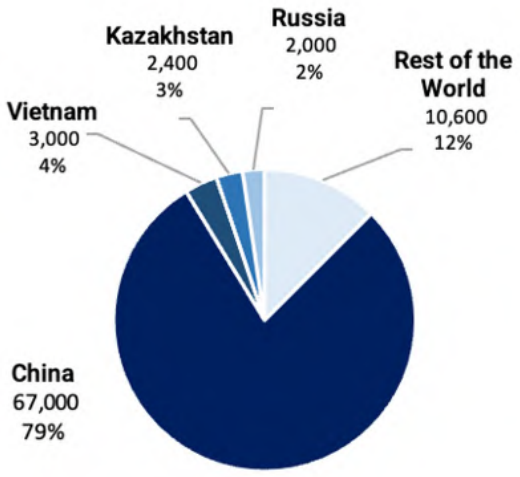
Total concentrations of all REEs in monazite, bastnäsite, xenotime in the Himalayan bauxites is 174-344 parts per million (ppm) while in phosphorites total concentration of all REEs plus yttrium is around 503 micrograms per gram (µg/g). Surface assays and stream sediment surveys show encouraging total REE grades (often between 0.2% and 1.0% oxide equivalent).

3.4 Tungsten

Global Outlook:

Tungsten faces the same dynamics as antimony characterised by a **high concentration of suppliers in a relatively low volume market, limited substitute potential and strategic importance across multiple end-use applications.** China continues to be the largest producer, consumer and importer of tungsten concentrates and this influence was exerted when the it applied its export restrictions in early 2025 after the US had placed additional tariffs on tungsten imports from the country. As a result, prices of a Chinese tungsten bar delivered to the US skyrocketed from $64/kg at the beginning of 2025 to $424/kg in August 2026 – more than six-fold increase.

Figure 39: Tungsten Production by Country in 2025 (Mt)



Source: USGS (2026)

Demand for the metal has stayed steady on the back of the electronics, defence and aerospace sectors -which have expanded due to the wars in Iran and Ukraine- where it's valued for its hardness and extreme heat resistance properties. The US has not commercially mined tungsten since 2015 and to maintain supply chains it banned exports of tungsten scrap in August 2026 to push recycling efforts. It is also in the process of developing the Northern Katpar and Upper Kairakty deposits in Kazakhstan -which are some of the largest undeveloped tungsten deposits in the world, with the EXIM Bank issuing a letter of interest to fund up to 900 million USD for mining and downstream processing facilities.

Pakistan's Outlook for Tungsten

Tungsten deposits have been identified in the Chitral and Mansehra districts of KPK with scheelite as the main metal-bearing ore. **In Mansehra**, the Sarhad Development Authority identified tungsten mineralization through surface exploration in the Oghi area. The area has potential and needs follow-up exploration to establish commercial viability. Tungsten is also found anomalous in stream sediment samples of this area and has been listed in the Jalkot and Kandia Valley exploration blocks.

In Chitral, stratabound type mineralisation is reported in Garam Chashma and Rich Valley which is also associated by copper-lead-zinc sulphide veining at some places. Earlier studies by Leake et al. (1989) of the British Geological Survey reported mineralized zones in the Miniki Gol Valley (located in the Lutkho Valley near Garam Chasma) with average tungsten grades ranging from 0.08-0.39%, 0.46% and 0.85% for layers with different widths.

Globally tungsten mines are viable at around **0.3-0.4% grades** (the Barruecopardo mine in Spain operated by Saloro is one of the largest open-pit mines in Europe and reported a measured resource grade of 0.34% in its initial Mineral Resource Estimate). Grades in Pakistan have been reported above that average at **0.7-0.8%** at 30-40 m trenching with surface level grades being higher at 3-4%. Tungsten mining in these regions remains artisanal, targeting high-grade surface outcroppings and gem-bearing pegmatites. Currently there are no proven reserves to support commercial mining but the opportunity exists for detailed exploration to establish a resource base followed by a bankable study.

Chapter 4

Building a Framework for Pakistan's Mining Policy: Gaps, Constraints and Recommendations



Building a Framework for Pakistan's Mining Policy:
Gaps, Constraints and Recommendations

4.1 Policy Jurisdiction and Harmonization

The legislative framework for the mineral sector in Pakistan is provided by the Regulation of Mines and Oilfields and Mineral Development (Government Control) Act (enacted in 1948 and last amended in 1976), the provincial Mines and Minerals Acts, and the National Mineral Policy (enacted in 1995 and amended in 2013). A common misconception is citing the 18th amendment as the constitutional verdict that gives rights over all minerals to the provinces which is incorrect as the control of all minerals (excluding mineral oil, natural gas and nuclear substances) has always rested with the provinces.

The points of contention have recently arisen regarding certain administrative roles which have been allocated to the Federal Mineral Wing under the updated Mines and Minerals Act of 2025 and thus have been criticised for federal overreach in a provincial subject (the Act has not been passed by the KPK assembly and the province still follows the 2017 version). The updated Act was specifically tailored by the Special Investment Facilitation Council (SIFC) alongside the law firm White and Case, and the consultancy Wood Mcenzie with the primary intention of harmonizing mining laws within and amongst provinces by removing any overlaps, contradictions and regulatory inconsistencies.

The updated act is a major step towards a modern regulatory framework that clarifies the rights and obligations of title holders and aspects of compliance. A good example is the case of idle mining titles that had been problematic for a long time because not only was the land left unexplored by the current title holder but it blocked other investors from undergoing exploration in the lease area, wasting the mineral potential of the land.

Reviewing the Roadmap for Pakistan's Mineral Sector Has Become Necessary Because Pakistan's Realized Mineral Potential Has Outmoded Laws That Were Set in the Context of Bulky Industrial Minerals and Ferrous Metals Like Iron Ore.

The upcoming large-scale projects, discoveries and the global race for securing critical mineral supply chains would undeniably require federal involvement not just for their administrative capabilities but also because **fiscal aspects like tax exemptions can only really be granted by the state.** And after the Reko Diq case it was even more unlikely that any foreign mining company would settle on a joint-venture without the backing of the federal government.

Ultimately, unpredictable regulatory environments and scepticism on contract stability deter long-term commitments and these risks disproportionately affect smaller, junior mining companies (the level where most of Pakistan's domestic exploration is currently happening), who contribute to over 60% of new discoveries today (OECD, 2026).

4.2 Setting a Fiscal Regime and Stabilization Agreements

The simple objective of an efficient fiscal regime is to maintain an equilibrium where the government can maximize its *rents* while still leaving enough incentive for private investors to undertake projects. Mining projects have major macroeconomic implications and are historically a very attractive tax base for the state where they can account for over 20 percent of their revenue (IMF, 2012). **FDI always has a decision in terms of destination and an internationally competitive regime is needed to attract it.**

The government designs a fiscal regime through a series of tax and non-tax instruments to capture rents at different stages of a mining project. A summary of these in Pakistan's context is provided below:

Table 9: Fiscal Instruments and their Implementation in Pakistan

Fiscal Instrument	Description	How is it Implemented?
Licensing Fees	Are a lump-sum payments in the form of security deposits, bank guarantees etc. paid when acquiring an exploration or mining license. Such fees are an important mode for the state to secure early revenue. The entire risk in the case of an EL is borne by the investor in the form of sunk costs if the geological results are unsuccessful, but this is generally small in the context of total capital invested.	For a large-scale EL in Balochistan the following need to be paid up-front: **Security deposit:** Rs. 10 million **Performance guarantee:** Rs. 40-50 million (4-year Exploration License term) **Annual rent:** Rs. 6-7 million (For a maximum exploration area which is 400 sq/km under the 2025 Act. The rent is determined on a per acre basis)
Royalties	**1) Unit-based royalty:** Mostly applied on bulky and homogenous minerals like gravel, limestone and coal based on their volume/weight. Easy to calculate but not suitable for minerals like copper for example where the ores vary by grade and concentrates contain valuable by-products like gold, silver etc. **2) Ad-valorem value-based:** Is responsive to the price of the commodity and thus applied as a percentage on the sales (gross revenue) with non-production costs like transportation and insurance as well as smelter and refining costs often deducted. However, sales might not always be indicative of market value for a number of reasons such as set futures agreements, long-term contracts, sales to vertically integrated affiliates at low prices etc. **3) Ad-valorem profit-based:** Takes into account the firm's 'ability to pay' judged by its net profit with the allowable deductions now expanded to capital and operating costs. But it's dependence on end profitability may lead firms to undertake excess expenditures and thus overstate their costs for tax purposes. **Sliding-scale royalty** is another modified version where the percentage itself changes based on market conditions like commodity prices. Zambia for example has tied the royalty rates for copper to the average monthly LME prices as per the criteria below: •LME<USD 4,500: 5.5% of norm value •USD 4,500 <LME< USD 6,000: 6.5% of norm value •USD 6,000 <LME< USD 7,500: 7.5% of norm value •USD 7,500 <LME< USD 9,000: 8.5% of norm value •LME > 9,000: 10% of norm value Where norm value is the monthly average LME cash price per tonne multiplied by the quantity of the metal or recoverable metal sold	Under the Balochistan Mines and Minerals Act (2025), a fixed rate is charged on construction and industrial minerals, dimension stone and coal whereas gemstones, precious metals and base and alkali metals come under an ad-valorem rate. Under the KPK Mines and Minerals Act (2017) base and precious metals are charged a royalty of **10.5%** (as of 2024) on an ad-valorem basis (value at first disposal point). Royalty rates are decided and approved by the KPK Mineral Investment Facilitation Authority. The Saindak project applied a **6.5% royalty** on the **sales revenue** payable to the Government of Balochistan in 2024. A 2% levies final tax and a 0.5% EPZ surcharge was also applied on the sales revenue. Under the Mineral Agreement, Reko Diq is expected to apply a **5% NSR (revenue minus TCRC)** royalty payable to the GoB, a 1% NSR royalty final tax regime payable (subject to a 15-year exemption following commercial production) to the federal government and a 0.5% NSR EPZ surcharge.

Fiscal Instrument	Description	How is it Implemented?
State Equity	Gives the government a 'seat at the table' which in effect helps more with the non-fiscal aspects of a project like mitigating political risk and builds trust by avoiding the problem of asymmetric information. State participation can happen through different types of equity: 1) Fully-Funded: The state pays up for its share putting it on equal footing to a private investor, usually through state-owned enterprises 2) Free-Carried: The private investor finances the costs on the state's behalf and they may receive compensation with interest through the state's future share of profits 3) Free: The state receives its share of profits without contributing to any capital or operating costs making it equivalent to a dividend withholding tax.	A bottom-line 10% free provincial equity is mandatory for all large-scale mining projects in Balochistan. This is held by the province's two main mining SOEs: 1) The Balochistan Mineral Exploration Company (BMEC) which is more actively involved in exploration and 2) The Balochistan Mineral Development Company (BMRL) which is more of an equity arm but can re-invest its funds into the project becoming a carried-equity partner. This option is negotiated in contacts via specific equity clauses
Corporate Income Tax (CIT)	In most cases the CIT applied to extractive industries is the same as other sectors as simply the tax of doing business in the country. **However, its effect in conjunction with other rent taxes are important** since in some cases the royalty is deductable against the corporate tax. Other financial specifications like capital allowances, deductibility of interest and carry-forward period for losses also affect the CIT base. A modification of this is the **Variable Income Tax (VIT)** that varies the tax rate according to the ratio of profits to gross revenue. This may introduce distortions, particularly if a high rate of tax incurs during a period of high accounting profit, early in the life of a project, before the required return has been earned. Zambia introduced a 15% variable profit tax on income above 8% of sales, but this was scrapped in 2015 to change the regime from a profit-based tax system to a revenue-based system	Pakistan has a uniform CIT of 29% which is also levied on mining firms. However, exemptions may be granted if the project falls under the parameters of the 2022 FDI Act (for example the Reko Diq project is CIT exempt for the stabilized period of 30 years)
Resource Rent Tax (RRT)	The objective of a RRT is very similar to a **windfall tax** which increases the government's rent capture in periods of high commodity prices when a mining firm's profitability in principle increases. But whereas the latter is an ad-hoc measure that raises fiscal uncertainty, an RRT is disclosed at the beginning and is more neutral tax by design. Zambia for example briefly applied a 25% windfall tax on copper but abolished it after commodity prices crashed following the 2008 financial crisis and foreign mining firms threatened legal action. RRT takes into account excess rents, giving the investors their minimum required return on investment (cost of capital plus a premium that compensates the technical, commercial and political risk undertaken by the investor) which also acts as a threshold for when the RRT would become payable. This should in effect not distort investment decisions while still giving the state fiscal flexibility to extract super rents.	The administrative complexity in: a. determining the risk premium b. deciding on a leally set and prescriptive or negotiation-based RRT approach and c. carrying out tax assessments/auditing has more chances of creating unpredictability, which is why RRT is mostly practiced by countries with strong institutions that could administer such taxes
Community Royalty/ CSR	A royalty structure that has a percentage set aside directly to mining communities beyond the provincial share and royalty. This would be spent on training programs, helping set up local businesses, building infrastructure and human-capital investments (see section 4.3)	Most mining firms do set aside a percentage of their net profits for CSR initiatives e.g. the Saindak project spent **6.5% of their net profits on social uplift programs in 2024.** Under the Mineral Agreement Reko Diq has to commit **1%** of their development and expansion capital costs and **0.4%** of their revenue on social spending.

Source: Otto et al. (2006), Land (2008), Boadway and Keen (2009), SML Financial Statements, RDMC Mineral Agreement

The FIPP Act 2022 and Stabilization Agreements

Stabilization agreements in mining essentially constitute a legal guarantee on the part of the host government to not amend its laws in a way that adversely affects the economic rights of the investor; even if laws are amended, they should theoretically not affect the concession agreements. The primary reason for such contracts is to offer fiscal stability that offsets the *country/institutional risk* perceived by investors.

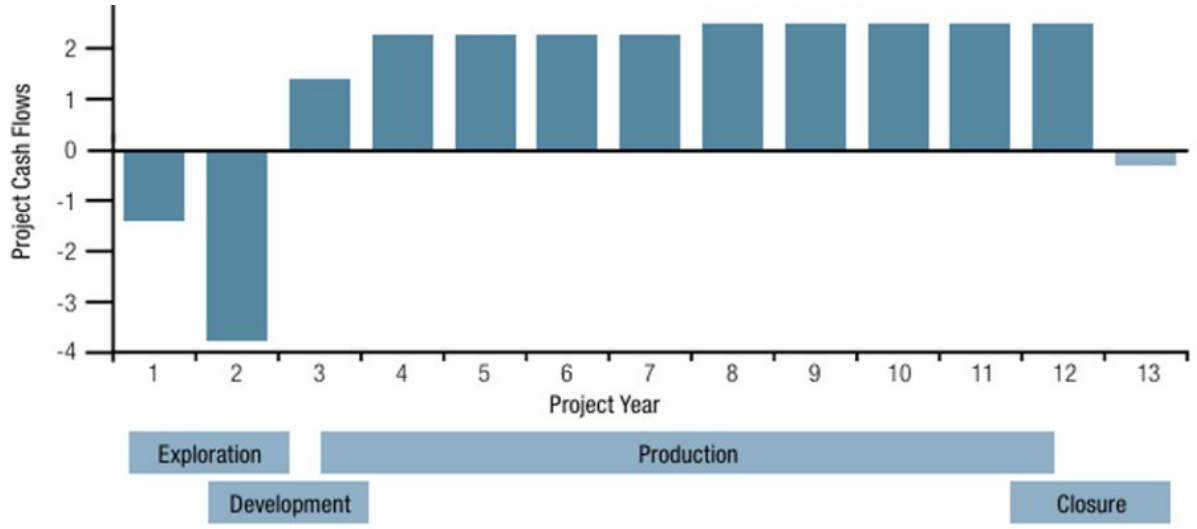
In Pakistan the main example is the RDMC Mineral Agreement bound by the Foreign Investment (Promotion and Protection) Act of 2022, which granted the project a 30-year stabilization period for aspects of fiscal regime discussed in Table 9 amongst other tax holidays. The general criteria to qualify for concessions in the act is investment over 500 million USD although those even below could qualify. The Reko Diq fiscal model is said to be the blueprint for foreign investment in the large-scale mining projects to come[11] and should ideally be extended in some capacity to the domestic projects currently undergoing exploration. The mining industry is known for certain inherently distinctive features as discussed below that require predictability measures:

Why Stabilization Agreements are Common in the Mining Industry?

1) High Sunk Costs, Capital Expenditures and Long Development Times.

The phase of discovery, exploration and studies alone takes on average 12.1 and 11.7 years for copper and zinc mines respectively and are globally expected to stretch further due to permitting challenges and other delays[12]. The exploration stage is also stage-gated meaning unsuccessful results in magnetic surveys for example could nullify previous results, possibly suspending the project leading to sunk costs. Although sunk costs are prevalent in other sectors as well, the sheer scale of it in mining projects tend to make investors reluctant.

Figure 40: Cash Flows Progression in Phases of a Mining Project



Source: Cited from Luca and Puyo (2016)

This is followed by the highly capital-intensive nature on the development phase where majority of the investment is directed towards mine construction and building processing facilities. Investors prefer a regime that allows them to at least recover these capital costs.

11. Terence J Sigamony, "Reko Diq mining project: Settlement with Barrick Gold endorsed by SC," The Business Recorder, December 10, 2022
12. Paul Manalo, "From Discovery to Delay: Mine Permitting Stretches Project Timelines," S&P Global, July 8, 2026

2) Uncertainty in Project Development

This occurs in almost every aspect beginning with geological ambiguity in size of deposits and ore grades. This is followed by determining if resources are even economically mineable which is highly dependent on commodity prices which are used in financial analyses for feasibility studies.

If prices rise then the cut-off for ore grades decreases meaning lower grade ores can also be mined profitably. If prices fall then the cut-off rises meaning lower grade ores can no longer be counted as part of reserves. Other factors like cost estimates (which tend to vary more than production estimates), security concerns especially in Pakistan's case and political risks like fiscal regime changes by successive governments all raise the bar for uncertainty.

3) The Time Consistency Problem

In the pre-exploration phase the government normally commits to a generous tax regime that favors investors but once the costs are sunk and the tax base becomes inelastic, the leverage shifts to the state who has a strong motivation to extract super rents especially when commodity prices are high. The investor with a forward-looking approach would most probably sense the government's lack of credibility in committing to the set tax design and be reluctant to invest in the first place leading to a 'hold-up' situation. A stabilization agreement binds the host government to commit amidst an arbitration threat.

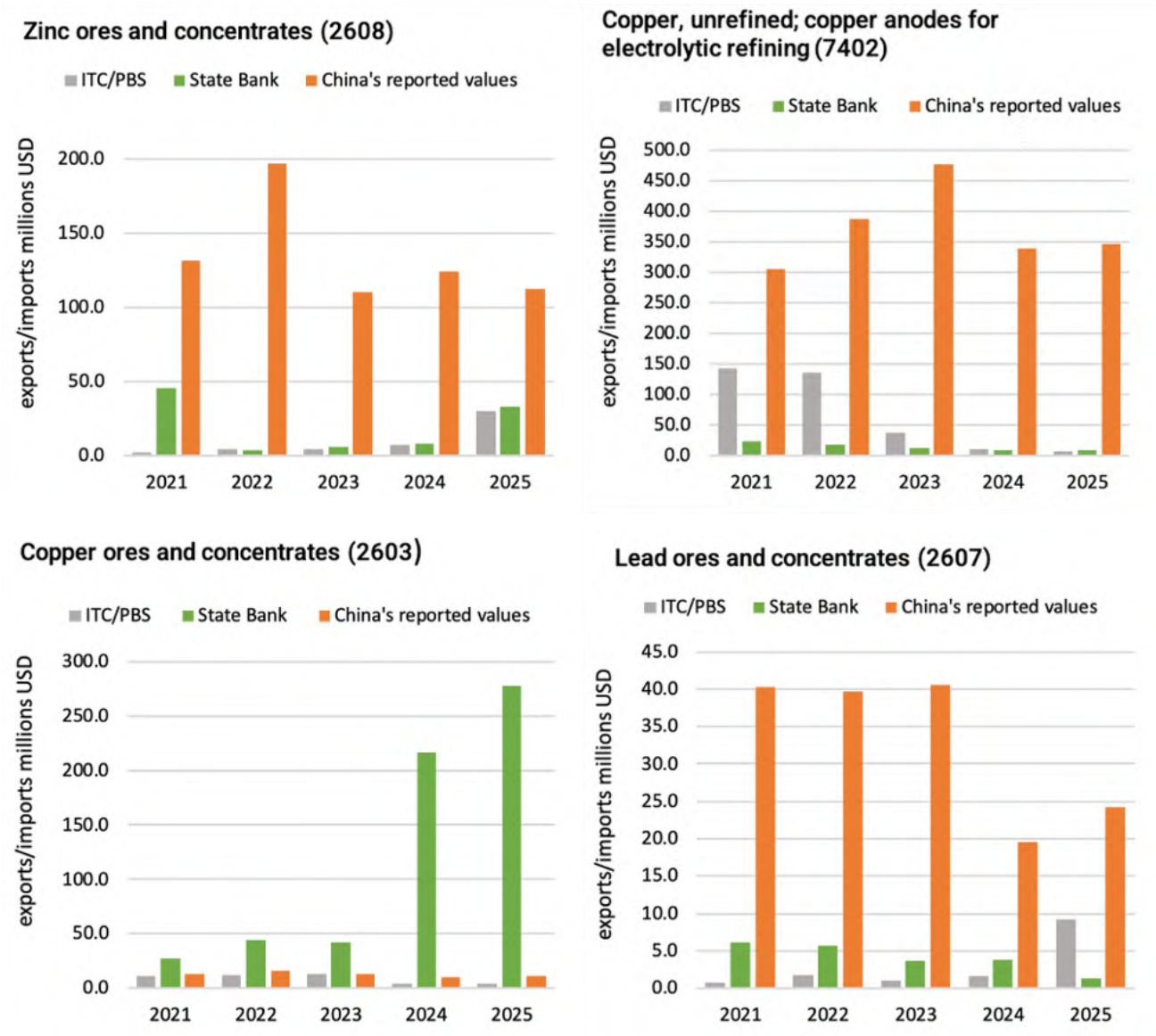
4.3 Transparency in Data and Trade Discrepancies in Pakistan

The documentation of mining data is of immense importance given the industry's potential in contributing to foreign exchange earnings and tax bases, both of which are already major points of struggle in a developing economy. Unlike manufactured products which have a measurable cost of production and a profit margin, the intrinsic value of minerals fluctuates based on global exchanges and capturing these changes requires vigilance especially in countries where the sector is new.

The points of reporting are not limited to custom receipts at borders but start from the feasibility studies to the point of actual mining (raw ores) to when they are processed for example as concentrates and finally when they are exported.

Out of the critical minerals discussed in this study copper ores and concentrates have the highest base of exporters ranging from wholesalers who collect and process from artisanal mines to integrated medium-scale companies. This is followed by antimony ores although the volume of exports is significantly lower. Lead and zinc concentrates along with blister copper are exported predominantly by mining operations of the MCC and to refiners in China

Figure 41: Trade Discrepancy with China on Selected Mineral Exports



Source: ITC Trade Map, State Bank of Pakistan. Notes: 1) Figures vary by scale, 2) See table in Appendix 3 for values.

The Cumulative Trade Discrepancy with China from 2021-2025 Netted to $1.79 Billion for Blister Copper, $580 Million for Zinc Concentrates, $144 Million for Lead Concentrates, while Copper Ores and Concentrates Reported a Negative Trade Gap where Pakistan's Exports were Reported Above China's by $545 Million.

In the case of Saindak reports indicate a dependance on Chinese calculations for revenue and profit distribution because Pakistan on its own didn't *'have a mechanism for determining the quantity of metals extracted and moved out of the country'*[13].

Trade discrepancies in bilateral trade with China are not new and in fact have increased after 2019 when phase II of the Pakistan-China Free Trade Agreement (CPFTA) came into effect, both in absolute terms and also as a percentage of Pakistan's reported exports to China[14]. There are a host possible reasons for these gaps in mineral trade specifically that range from under-invoicing to lack of clarity in mineral valuation (see how copper is priced on the next page) to statistical and logistical blind spots.

Common Factors for Discrepancies in Mineral Valuation and Trade

- **Non-declaration of valuable by-products** like gold, silver and molybdenum in copper concentrates significantly undervalues consignments, especially in recent times when the prices of precious metals have skyrocketed. It remains unclear if these were declared in the case of Pakistan's mining operations.

- **Under-quoting or mis-specifying reference prices.** Prices may be set on a self-assessed or arbitrary basis instead of following rates from exchanges like LME or SHFE. Transfer pricing is also common in case the mining company exports the product in an intermediate form to its vertically integrated operations in another country or if the buyer is a related party. In the case of metals that are not traded on open exchanges like antimony and REEs, finding an international reference price becomes difficult due to private contracts. Markets for blister and anode copper are also opaque because they are traded less frequently. The case is also complicated for products like antimony oxides where the metal percentages can vary by production.

- **Different classifications for the same good.** For example, copper anodes (HS-7402) have consistently been underreported by Pakistan while unwrought, refined copper (HS-7403) have been overreported at instances (see Appendix 3). It could be possible that the two labels have been used interchangeably at customs, although refined, unshaped copper in Pakistan's context most probably refers to metal that was recovered and remelted from scrap like old motors.

- **Destination mismatches** that may occur due to transshipments or different reporting systems. Countries that use a special trade system may not record trade related to special economic zones, bonded customs warehouses or industrial free zones.

13. "Saindak Approval," Dawn, February 11, 2022.
14. Aqib Zaidi, "Evaluating Phase II of the China Pakistan Free Trade Agreement," The Pakistan Business Council, June 2024 ermitting Stretches Project Timelines," S&P Global, July 8, 2026

How is Copper Priced?

Copper concentrates and cathodes are the most commonly traded form of copper. The price of the former depends on the metals in the concentrate mix such as:

a. The copper content which is generally around 30 percent. It is then adjusted for a recovery rate of between 96-97 percent to account for the fact that the smelter cannot recover all the copper during the process. This percentage is then applied to the price of pure copper cathodes traded at prominent exchanges like the LME, Shanghai Futures Exchange (SHFE) or the Commodity Exchange Division of the New York Mercantile Exchange (COMEX). Prices from these exchanges are usually averaged out depending on the quotation period and delivery times.

b. The presence of precious metals like gold and silver which are common by-products. Generally, for gold above 1g/ton and silver above 30g/ton the smelter pays based on the London Bullion Market Association (LBMA) gold/silver spot price. No payment is made if concentrations are below these values as recovery would be uneconomic.

Deductions and penalties are applied such as:

a. TCRC because smelters require payment since concentrates are an intermediate product and need to be processed to make it marketable. Spot market TCRC come into play if mines have an unexpected excess of concentrates, but disregarding that long-term contracts are usually set.

b. Deductions based on 'price participation' clauses that increase TCRC if global copper prices exceed a decided limit. This price-triggered bonus also becomes a sort of cathode premium.

c. Penalties for impurities such as arsenic, cadmium and mercury which pose an environmental and disposal hazard. Other metals like selenium and tellurium cause cracking of final copper products.

d. Penalties for excessive moisture content in concentrates.

For blister copper/copper anodes the above apply except only refining costs are paid. For copper cathodes, spot and futures (3-month future being very common) rates are very easily available on exchanges and refer to a standardized product (Grade A in LME being 99.9935% pure). But premiums are still applied on specific transactions based on delivery times, location of metal etc.

4.4 Building Capacity for Exploration and Production

Establishing Baseline Geological and Mineral Information Systems

Pakistan is undoubtedly endowed with mineral wealth and the first step of quantifying that wealth comes from the quality and availability of geoscientific data. A baseline or inferred level of understanding is important for two main reasons:

1. It lowers the barriers to entry by reducing the geological uncertainty and thus the exploration risk for foreign and domestic junior mining companies.

2. It allows the state to independently verify an asset's true potential, strengthening its negotiating position when it comes to awarding mineral rights.

In Pakistan the national authority for geological mapping is the Geological Survey of Pakistan (GSP) that has scanned nearly all of Pakistan's outcrop areas to establish a baseline of crustal concentrations for 69 elements to prioritize future exploration. They possess robust exploration capabilities (outlined in figure 42) that culminates in drilling to quantitatively and qualitatively delineate three-dimensional ore bodies once exploration filters are passed. GSP's dedicated GIS section in GARL, Islamabad, is currently developing a "Geodata Portal" to boost mineral sector investment.

Mining Infrastructure and Linkages

None of the large-scale critical mineral projects in Pakistan have either been independently explored nor developed by the country; the Saindak and Duddar mines were handed over to the MCC. Reko Diq was started by BHP, later taken over by Barrick and Siah Diq is undergoing construction also operated by the MCC.

As a result, the ecosystem for metallic mining at this scale never developed in the form of trained human capital like geologists, geophysicists and mining engineers. Local EPCM contractors are scarce due to difficulty in access to financing, lack of scale and scope, and marginalization due to weak organizational capacity (see section 5.3 in stakeholder outlook). Similar problems are faced with laboratories with SGS Pakistan being the most reliable, which unfortunately also leads to a major bottleneck in getting results due to a single vendor. Commercial testing services for REEs is currently only provided by Kahuta Research Laboratories and SGS Pakistan.

More recently the global interest in critical minerals followed by the revival of Reko Diq has prompted domestic exploration in a 'junior mining' capacity where a senior company similar to BHP or Barrick can provide the capital and expertise once the Mineral Resource Estimates are established. It is integral that horizontal linkages are created and local content policies are introduced that require mines to procure services like financial management, logistics, and light manufacturing from qualified local firms in partnership with foreign companies (OECD, 2026).

Figure 42: The Life-Cycle of a Mining Project from Exploration to Bankable Feasibility

Remote Sensing

Satellite-based imagery is used to create alteration maps. Over the years these satellites have become advanced enough to correlate the patterns of existing mine sites with potential deposits. Historical geological reports are often used as a starting point.

Geological Mapping

Representative rock samples from outcrops, trenches, surface exposures are assessed. Lithological features, alteration types, structural features and mineralization indicators are documented.
Vendors in Pakistan: FWO, HTMA

Geochemical and Geophysical Surveys

The goal of geochemical surveys is to identify some anomalies that are linked to mineral deposits by sampling lake sediments, stream sediments, groundwater etc. Geophysical surveys include a selection of methods like magnetic surveys (airborne and on-ground), Induced Polarization (IP), Ambient Noise Tomography (ANT) to measure the physical properties of deposits.

Vendors in Pakistan: FWO, HTMA

Drilling

The most definitive but expensive stage accounting for around 60% of exploration costs. Drill core and sample chips are logged along with the location, length of drill holes and type of drilling. Decisions on how far to drill are ultimately based on depth, grade and quantum.

Vendors in Pakistan: FWO, HTMA, Bore and Bore, Deep Rock Drilling

Laboratory Testing

Sample are sent for testing ideally to an ISO-certified laboratory to analyze mineral content, deposit characteristics etc. Sample preparation units might also be set up at mine sites to directly send the samples abroad. Maintaining the integrity of samples through QA/QC is important as it changes hands multiple times

Vendors in Pakistan: SGS Pakistan, Geoscience Advanced Research Laboratory (GARL) by GSP, PCSIR, MTL Peshawar.

Mineral Resource Estimates

MRE is the foundational document for pre-feasibility and bankable feasibility studies that contains:

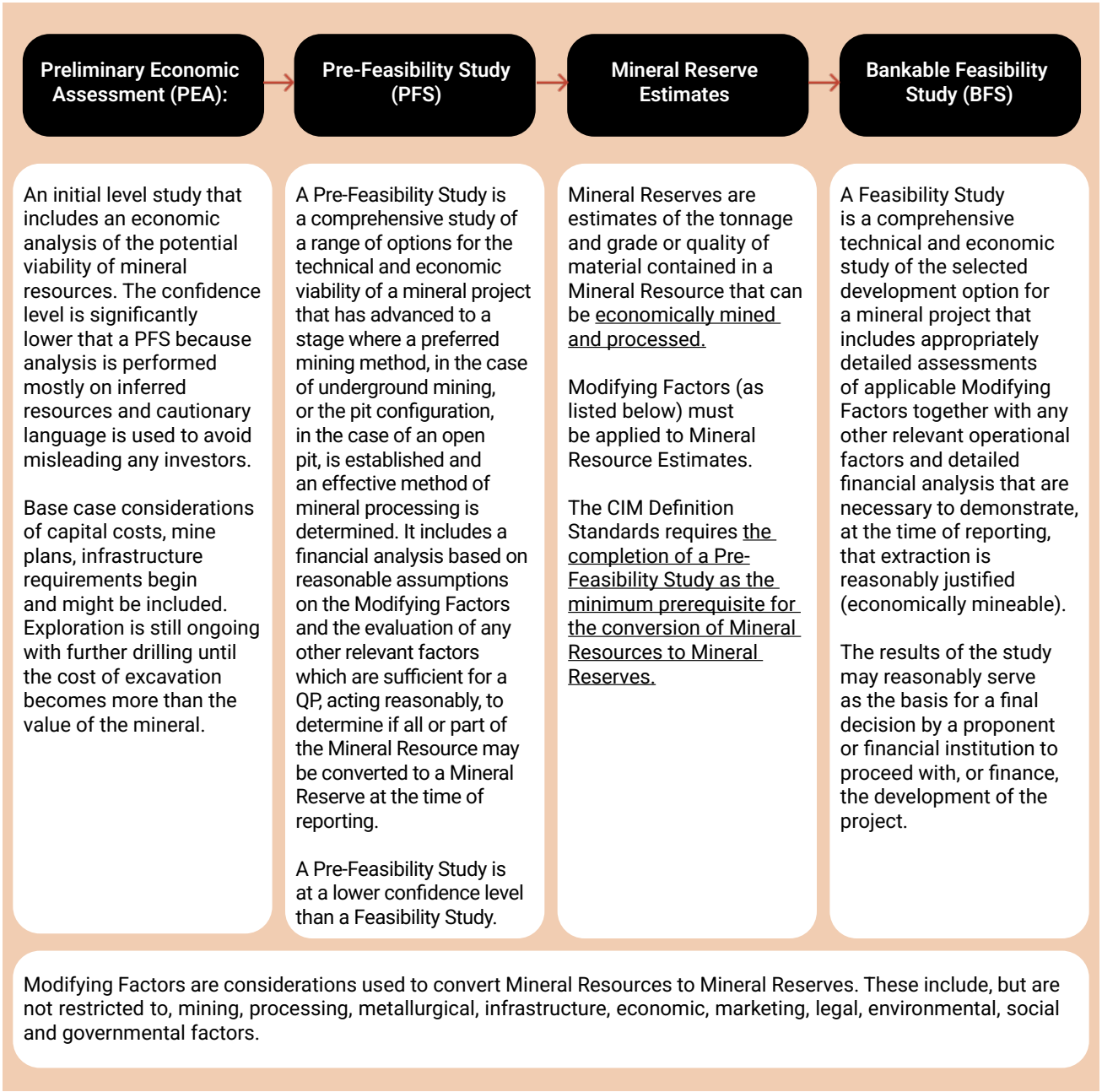
- an evaluation of the tonnage, grade and classification of mineral resource categories (Inferred, Measured, Indicated) meeting the criteria of reasonable prospects for eventual economic extraction (See Appendix 1 for definitions)
- uncertainties/risk factors that could affect the estimates
- factors affecting cut-off grade like prices, recovery rates

The integrity, completeness and quality assurance of assay results is evaluated and certified by a Qualified Person (QP) under the NI 43-101 standards or a Competent Person (CP) under the JORC code. The MRE is prepared under the supervision of the QP/CP.

1. The Exploration Process is Stage-Gated which means Unsuccessful Results at one Stage Halts Any Further Progression. Hence Every Stage Essentially Creates Value by Increasing Investor Confidence in Finding Deposits.

2. The Mine Area Becomes More Defined as the Exact Location of Deposits are Narrowed Down.

3. Mineral Resources Shift from Inferred to Measured Categories as Geological Certainty in Deposit Size Increases.



Source: Canadian Institute of Mining, Metallurgy and Petroleum (CIM), Stakeholder Input

Artisanal and Small Scale-Mining (ASM)

Almost all of Pakistan's antimony, tungsten and lithium is mined by the ASM sector which is characterised as being labour-intensive with minimal use of machinery (although some might be more capital intensive carried out by cooperatives). Traditional mining techniques like excavating using gunpowder-powered explosives often leads to high wastage along with environmental damage but transitioning to mechanised mining is constrained by the lack of financing.

Providing technical assistance and the greater formalization of ASM is critical. Chile stands as a prime example through its ENAMI platform that gave ASM access to ore processing facilities that produce concentrates, blisters, and copper cathodes of the same grades as large-scale miners. As per ENAMI records between 2011 and 2021, there were 1,360 small-scale mining businesses registered (95% of which extract copper) and 8 million USD is set aside annually to support ASM (IGF, 2024).

In Pakistan licensing rules are different for small-scale mining in terms of area granted and fee requirements across both provinces. The KPK Mines and Minerals Department has set up an E-government portal where individuals and firms can apply for lease allocations by district, verify their existing licenses and track their portfolios.

4.5 Addressing Community Development

Mining operations are massive in scale by land-area, are carried out on open lands by open-pit methods, can create irreversible damages to the environment and on land which is often customary and lasts decades. The extractive industry led by the government and mining companies has the tendency to prioritize the large-scale economic benefits of resource extraction over the equally large-scale social inequities which gradually spirals into conflict between stakeholders.

Mining Operations Anywhere in the World Are Predominantly Located in Areas That Are Remote, Under-Developed and Often Have Strong Personal Linkages to the Native Communities Inhabiting it, so these Factors are Not Hurdles Unique to Pakistan.

The extractive sentiment in Pakistan's mining is worsened by some very legitimate social resentment grounded in sparse socio-economic improvement in the lives of those native to the area. The basket case of this is Pakistan's largest gas field of Sui which has been operational since the 1950s in Dera Bugti – a district with a Human Development Index (HDI) of just 0.236, making it a part of the ten least developed districts in the country[15].

- **Balochistan has the highest multidimensional poverty headcount of 70.5% (80.4% in rural areas) with an intensity of 53.6% which means that the multi dimensionally poor on average experience deprivation in more than half of the indicators (PIDE, 2021)**
- **The Environmental and Social Impact Assessment (ESIA) for the Reko Diq Project concluded that 40% of the surveyed households in the local communities were below the poverty line with the average household income being around Rs. 25,000 per month.**
- **Securing stable incomes was recorded as the biggest concern with unemployment rates of 26% for men and 42% for women, which is significantly higher than the Pakistani national average.**

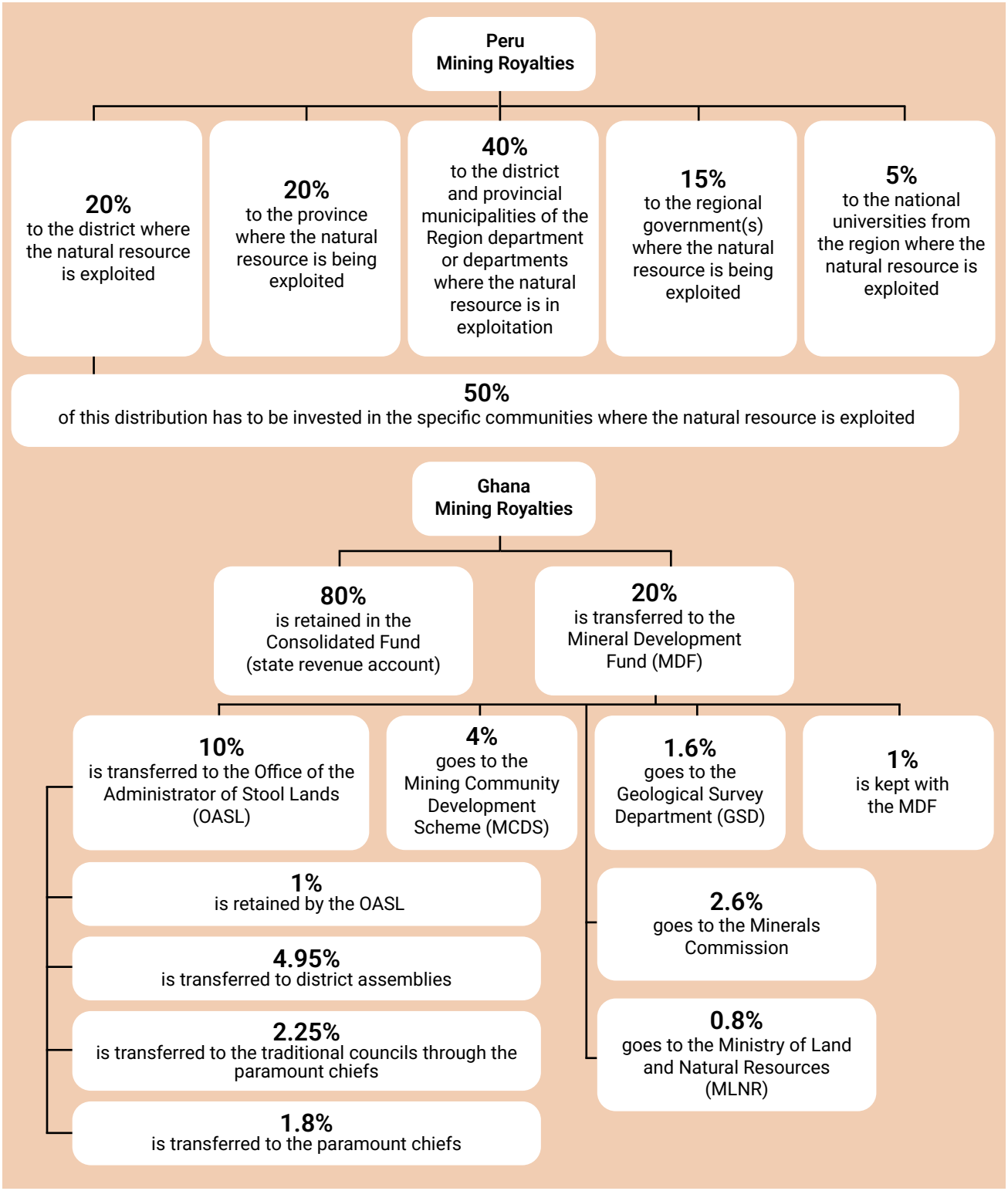
The First Nation and Inuit people in Canada and the Aboriginals in Australia are remarkable examples of protecting the interests of indigenous communities through principles of Free, Prior and Informed Consent and legally binding agreements while also deriving the benefits from mining as a basic economic activity. State legislation does exist regarding many aspects of community development[16] and regardless many foreign joint-ventures and large-scale mining companies do allocate a percentage of their earnings on Corporate Social Responsibility (CSR).

However, CSR initiatives are ultimately voluntary at the end of the day and may be diluted based on changing financial conditions and public regulation has been extensively criticized for being inadequately funded, cumbersome and unresponsive because authorities are reluctant to prosecute (O'Faircheallaigh, 2014)

Many mining jurisdictions like Ghana and Peru have legally split royalty payments for community development initiatives and other mining-related institutions like geology departments of local universities to reduce discretionary spending and avoid any ambiguity on the disbursement of funds.

15. Shahbaz Khan, "The gas that built Pakistan but left Balochistan behind," The Express Tribune, August 17, 2026
16. The 2025 Mines and Minerals Act requires a mining firm to submit a social and environment management plan and sets quantitative targets for local procurement (minimum 50% for large-scale and 75% for small scale mining annually, excluding wages) and training of local communities (at least 1% of total costs incurred for the year, in the first year of operations; and at least 1% of total costs incurred for the previous year, in each subsequent year of operations based on audited accounts of the Title Holder).

Figure 43: Royalty Distribution Systems of Peru and Ghana



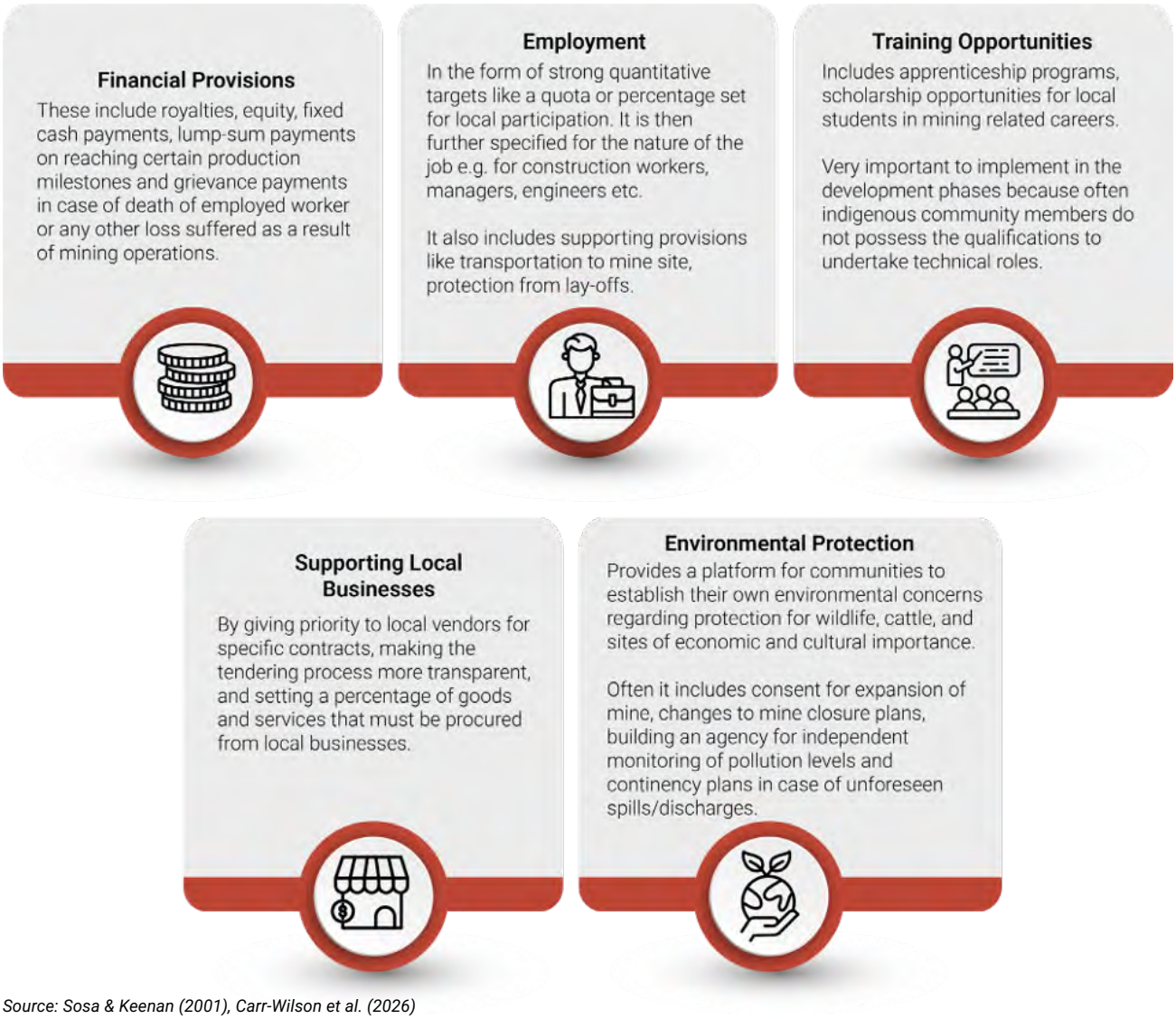
Source: Lujala and Narh (2020), IEA (2022)

Impact Benefit Agreements

An Impact Benefit Agreement (IBA) is also referred to as community development agreement. Benefit sharing agreement or a mutual benefit agreement is a legally binding private contract between a project developer and the affected community with the primary goal to distribute the benefits of a project in a more equitable manner. In short, the community gives its explicit consent or the 'social license' for their mining project to go ahead in return for a package of benefits negotiated by the representatives.

IBA's unique advantage lies in the fact that it directly addresses the needs of the community based on private consultations and designs the above modes of compensation grounded on those specific requirements. Although most of its components as mentioned below are present in provincial legislation in some form or the other, they are not detailed enough to be enforceable. An IBA provides clarity based on the exact needs and hence is more effective even compared to CSR initiatives which can often be very arbitrary and do not include public participation.

Figure 44: Common Components of an IBA



Source: Sosa & Keenan (2001), Carr-Wilson et al. (2026)

For example, a generalized procurement percentage is in most case futile because indigenous communities do not produce mining-related goods to begin with. But if mining companies and community businesses consult on what goods they may require and negotiate contracts in the development phase of a project through an IBA, it's likely that as the project comes in the production phase the businesses would be prepared.

Chapter 5

Stakeholder Outlook



Stakeholder Outlook

5.1 The Exploration Process

The Nature of Copper Deposits

Copper deposits were first screened through the Chagai district in the 1970s by Canadian firms using an aeromagnetic survey which identified the Saindak and the Reko Diq sites as the major anomalies. Unlike coal deposits that occur in uniform seams with a fixed length, porphyry copper deposits occur in disseminated bodies with high-grade and low-grade pockets. In this case blending of ore pits is done as the global trend with tier-one mining companies working on the longevity of mines rather than exhausting resources by processing high-grade ores only. Deposits in Balochistan are low-grade but high volume supporting large-scale mining with a decades long operational mine life while those in KPK are high-grade but low volume being very conducive for small to medium scale mining.

No two copper deposits or their surfaces are the same; some of the surfaces are covered with sand or post-mineralization cover with younger volcanoes that obscure the deposits underneath, while others are exposed with outcrops and visible mineralized layers. Deposits also vary with the associated by-products as some might contain precious metals like gold while others may contain base metals like molybdenum. The uniqueness of metallic mining as compared to oil and gas are the physical characteristics of a sample that can be used to judge the deposit's properties on an inferred level.

The Drilling Stage

The maximum exploration area per license allowed in Balochistan is 400 square km (more than 98,000 acres) and the main objective of geological mapping and other initial surveys is to shorten this massive area and pinpoint it to the main hotspots for drilling. The drilling stage is also when the mineral resources in millions of tonnes, ore grades and by-products are first quantified.

Almost 60-70 percent of the Exploration Cost is Spent on Drilling Making it the Most Expensive Stage of the Entire Process

- **A single bore-hole is approximately 500 m deep and it takes around 1000 USD to drill a single meter. Hundreds of boreholes are drilled in the suspected area**
- **Generally, to reach the mineral resource estimate 25,000 m needs to be drilled but this varies area to area. For a preliminary economic assessment this number goes up to 50,000 m**
- **The process in Pakistan is very slow because there isn't enough trained manpower to operate the rigs. In other regions a single shift drills 15-25 m however, the effective rate in Pakistan is less than half at 2-8m**
- **Currently in Chagai the maximum that is being been drilled is 1,000-1,200 m due to unit economics. The stopping point is when the costs of excavation become more that the value of the resource.**
- **Since April 2026 NOCs for drilling have been halted with rigs currently stranded in Quetta. Clients refuse to pay for the insurance of equipment that costs millions of dollars and insurance company refuse to cover.**

Latest Technologies in Exploration

UAVs: Beyond the military uses, small Unmanned Aerial Vehicles (UAVs) can be used to conduct magnetic surveys when large aircraft cannot be deployed.

ANT: Ambient Noise Tomography (ANT) picks up passive seismic signals from up to 2 km deep using geophones to identify faults and other geological structures under thick covers.

AI Models: Trained on the data of previous mining projects, this can be used for re-vetting results.

5.2 Post Exploration: Reaching Out for Investment

The step from exploration to mine development is massive and in effect switches the capital requirements from billions of rupees to billions of dollars. Independently undertaking it is beyond the scope of domestic firms not just because of the capital but because the expertise to design a mine and operate specialized machinery like crushers and haulers had never developed in the country. Thus, developing a project without foreign participation may not be possible.

The search for foreign investment generally begins after the Mineral Resource Estimate report indicates a promising deposit size and grade after which the preliminary economic assessment and pre-feasibility studies are undertaken to eventually produce a Mineral Reserve Estimate report. This is the most important step in building international trust for investors as these are standardized and bankable reports that indicate clear feasibility that the resources are economically mineable.

Linking with international junior mining companies before majors is preferable as it firstly helps put Pakistan on the map and secondly it eventually forms the pathway for a major player to take over if the deposit is deemed attractive enough after gaining certainty from further exploration (similar to Mincor Resources and Antofagasta/Barrick in the case of Reko Diq). Tier one mining companies have their own criteria when screening for development opportunities like a resource base of more than 100 million tonnes, a 0.5 percent head grade, a 15 percent all equity returns etc. hence they usually acquire a project when the risk of losing the capital is very low. B2B investment is also more attractive as it gains the trust of individual businesses over the geopolitical complexities of G2G FDI.

5.3 Challenges in Pakistan's Mining Environment

1) Financing and Custom Duties

The money markets and financing channels have not yet adapted themselves to the business model of an exploration project. All domestic exploration is currently being done at a junior mining level. This role also has the highest risk as reaching the mineral resource estimate report can take 2-4 years, 2-5 million USD in investment and the exploration process is stage-gated so poor results in one stage can lead to abandonment of the project. Only one in seventeen mines actually end up being commercially viable and with a long gestation period as it can take 12-13 years to recover a dollar invested today.

Banks are reluctant to finance without the backing of a bankable document and that document cannot be reached without the funds required for drilling which can become very costly. The same holds for service providers where collateral is required instead of the authentic contract which in essence should stand as the collateral itself. Limited access to financing also stands as a major hurdle towards mechanized mining for small-scale miners which could significantly improve quality and quantity of ores mined.

Import duties and taxes altogether are also circular in their application because an exploration business 1) does not generate revenue, 2) is export-oriented 3) is highly risky and 4) is still a developing sector in Pakistan. Temporary imports for equipment for 6 months are redundant if it has to be used for 5-7 years and importing it has its own burden of custom duties, withholding taxes and other guarantees. These cannot be recouped due to further purchases down the road and local alternatives do not exist. The exact same fiscal model as Reko Diq might be overly-generous to universally extend to every upcoming international or domestic project. Reko Diq was a case of national obligation due to a looming penalty, but the risk appetite still needs to be built for junior mining companies to explore and that requires an enabling environment where in the worst-case scenario the investor is not diluted out of their own share.

2) Security Concerns

The security situation is perhaps the most pressing problem plaguing the sector. The current environment has severely slowed down the exploration process as security clearance for aeromagnetic surveys and drilling are not granted. There are three aspects of security:

- **At the Mine Site:** Securing the perimeter of the lease area and camps consumes a large part of a project's operating expenditure. All foreign joint-ventures are fenced with private security.

- **During Transportation of Supplies/Minerals:** The vast and rugged roads serve as the primary target points for drilling rigs and other equipment worth millions of dollars.

- **Personnel Movement:** The ease in ground movement for Pakistani and foreign expertise alike is challenging. Charter flights are used for Reko Diq and Saindak's project.

In KPK small and medium scale mine owners especially those with mines further away from Islamabad in the Malakand division for example have to bear high security costs in arranging the travel of foreign investors primarily Chinese nationals seeking joint-ventures. The Washuk district -where many exploration leases for antimony are located- is considered even more dangerous than Chagai

Providing an environment for safe investment is ultimately the state's responsibility. For example, the Duddar project was given free security for ten years. To an extent the security risk is baked in the entire valuation of a project but this is highly dependent on the geological potential of the deposit. If prospects are extraordinarily promising then investment finds a way regardless.

3) Lack of Service Providers

The general direction is that whatever can be procured domestically is, but unfortunately the ecosystem for Engineering, Procurement and Construction (EPC) has never existed. **The absence of local service providers is like the chicken and egg problem:** mining clients are hesitant because the relevant expertise doesn't exist in local service providers and the service providers cannot develop if they don't have enough contracts. Foreign contractors are reluctant to come on the ground due to the security problem and as a result the transfer of skills to locals cannot fully occur. The Washuk district lags again in development because mining activities had never existed in any capacity unlike Chagai where it took some shape and form because of the early foreign exploration of Saindak and Reko Diq.

4) Licensing and Ease of Business

The KPK Minerals Development Department has created an online mining portal system to streamline the online applications and approvals of titles. **However, ambiguity regarding pre-existing lease boundaries that were now overlapping on 'reserve forest areas' was noted.** This led to cancellation of leases since under the Forest Law leases are not granted on areas declared as forest which has created animosity. In KPK the presence of rivers, mountains and forests makes exploration more challenging. Problems regarding archeological sites on lease areas and getting approvals from environmental protection agencies also surface later which leads to cancellation of licenses.

The Balochistan Mines and Minerals Department have also been facilitative following the Minerals Act of 2025. **However, the process for granting NOCs and the time it takes to import equipment/ machinery still takes months.** This has to be shortened alongside removing red tape and all institutions have to come together to create an environment where there is ease of doing business. The main objective moving forward should be to reduce the delay between when a deposit is identified and when its mineral resource estimate report is consolidated.

5.4 Value-Addition and Exports

Smelting has become more of a geopolitical issue rather than a solely economic one. Regardless, smelters require massive billion-dollar investments, scale and power which at the moment is difficult due to no continuous feedstock. Electricity is a major problem as the nearest grid is 600 km away from Chagai which is worsened by transmission losses.

The ASM sector in KPK means that the ores are extracted with traditional techniques which results in low recovery rates and high wastage of valuable minerals. The low volume also means that ores are sold to wholesalers and medium scale processers (in Hattar for KPK) which upgrade them to export-grade standards by grinding and other beneficiation techniques. Upgrading as a whole is necessary because raw ores are bulky and uneconomical to export by themselves given metal content of only around 0.5-2 percent. Most of it is exported to China to take advantage of lower shipping costs on return containers. In fact, the transportation costs from KPK to Karachi (Rs. 7,000/tonne) are higher than exporting from Karachi to China (Rs. 3,500/tonne).

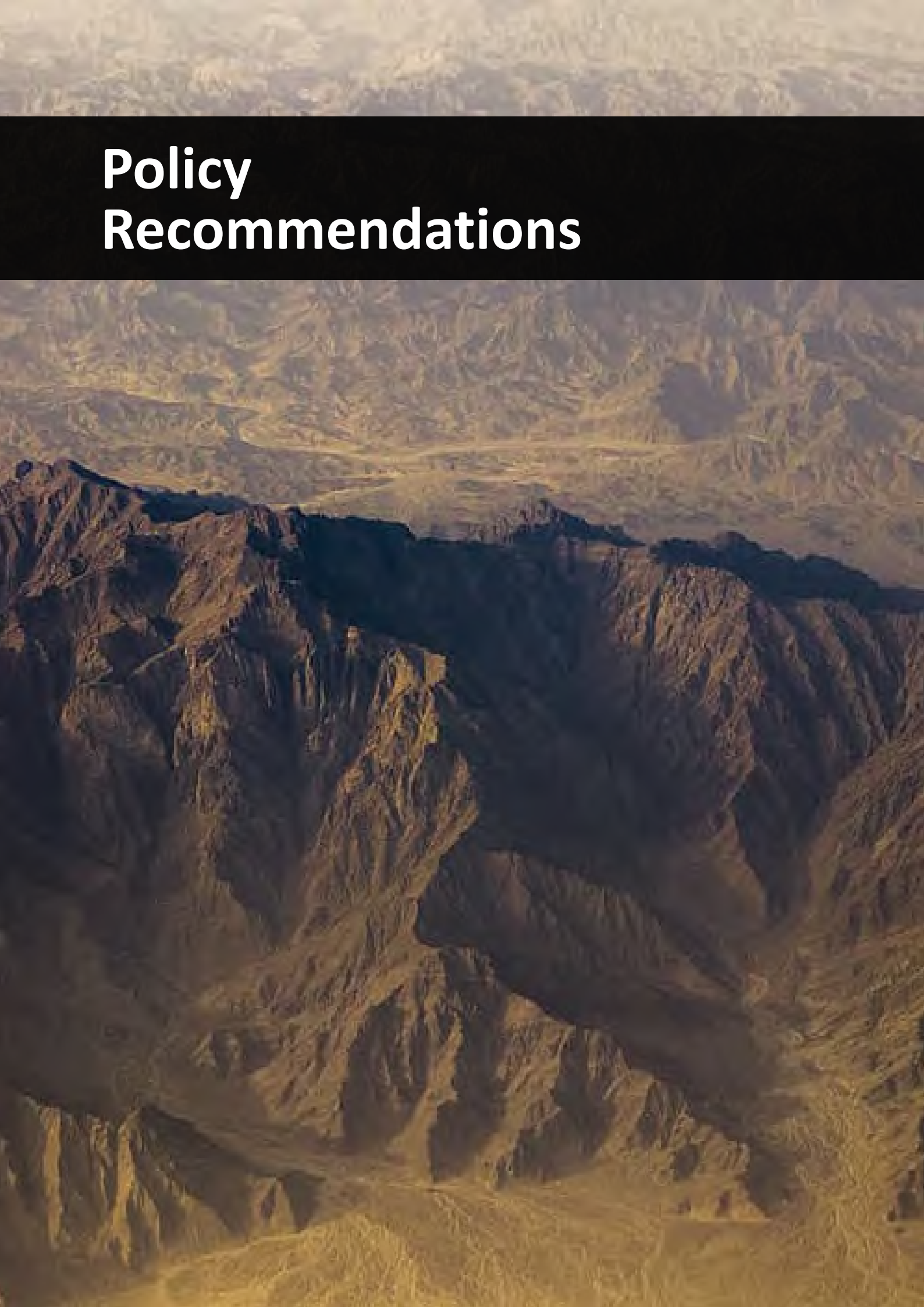
5.5 Community Development

Sustaining a mining project without the community's approval is almost impossible because at the end of the day a foreign entity is moving in and extracting resources from land that belongs to the local community. Unfortunately, the concept of social licensing does not exist in Pakistan -at least to the level where the community actually feel like real stakeholders in the project -and this eventually leads to social unrest.

Generally, communities residing near mine sites are not against projects as long as the benefits are shared or transferred to them in a sustainable manner. **The primary point of concern for communities was identified as creating a source of livelihood** given the extreme poverty before any generic CSR initiatives like building schools are undertaken. Others major needs include access to water and the representation/participation of women.

The financial channel of achieving community development is dependent on the fiscal regime. Introducing a separate community royalty alongside an existing provincial royalty and up to a 10 percent free equity might be excessive and can end up dropping the Internal Rate of Return (IRR) of a project. All firms currently in the production phase do contribute to CSR either through formal or informal means. Exploration companies at the moment do not have a binding percentage allocated for CSR initiatives but rather do it on a case-to-case basis because they are not generating revenue either.

Policy Recommendations



Policy Recommendations

1. Fiscal Incentives

For the Exploration Phase:

Junior mining companies undertaking exploration face the highest financial risk firstly because of geological ambiguity and then secondly in proving that the successful deposits discovered are even commercially viable to mine. The primary objective for junior mining companies is to reach the goal of a Mineral Resource Estimate (MRE) report and for the state to allow enough incentives such that domestic firms a) decide to explore at all and b) reduce the time between when this decision is made and when an MRE report is produced.

Discouraging juniors with little fiscal flexibility in exploration hinders the future pipeline of mine development in the country. Hence to reduce the element of risk in Pakistan where scepticism regarding long-term investments is already high, the following incentives could be considered:

- **Re-structuring the frequency of tax returns** to a balloon payment method where taxes are fully paid when feasibility is proven or even partially in ratios such as 20 percent during exploration and 80 percent at a later date. This offers a cushion for financing that is required during the drilling stages when can be very costly.

- **Import duty concessions** are essential for the simple reason that domestic alternatives do not exist either for exploration equipment or for lubes and tires which are used in the production phase. A blanked concession is not ideal either but rather it should be applied on specific HS codes, permitted only for firms holding valid exploration licenses.

- **An immediate or an accelerated depreciation rate** to allow firms to deduct their exploration costs faster rather than spreading it through multiple years in effect having a lower taxable income base in the initial years. Many mining jurisdictions like Australia, Russia, US, Canada and Zambia permit for immediate expensing for exploration costs while the DRC and Indonesia allow for relatively faster rates at 2-year straight line and 4-year straight line method respectively (IMF, 2022).

- **Longer carry-forward loss period** for the extractive industry compared to others is very common given the long investment recovery period (Benninger et al., 2024) with countries like Brazil, Chile and Mongolia allowing for an unlimited period. However, this policy has to be designed in conjunction with depreciation rates so that the benefit is fully realized.

- **Lease protection** with sovereign guarantees over non-cancellation of exploration leases followed by first right of renewal after expiration.

For the Development and Production Phases:

Stabilization Agreements with mining firms become imperative given the sheer scale of the projects, uncertainty in commodity prices and the political risk involved. This holds even strongly for Pakistan where the sector is in its very early stages of development, is export-centered and fiscal uncertainty is high due to revolving IMF programs. Going forward, the incentives mentioned above should be extended nonetheless but the three most important aspects that must feature in Pakistan's stabilization agreements are that they should be **Time-Bound, Balanced and Resilient to Price Swings:**

- **Certain concessions like tax holidays (5-15 years) and import duty exemptions** are needed at least till the initial capital expenditure is recovered, after which it could revert to the base-case to ensure the state is not losing revenue. The bottom-line fiscal regime should be set such that a project's IRR lies between 16-19 percent.

- **Incorporating clauses that are mutually beneficial to both parties.** For example, Peru offers stability agreements that freeze tax and royalty rates that are in effect on the date of signing the contract on the condition that the income tax rate paid would be 2 percentage points higher than non-stabilized contracts. This acts as an insurance premium for the state while still providing the legal insulation of a stabilized agreement.

- **A re-negotiation clause or a terms and conditions review clause** after a set number of years is also added as a safety measure in case commodity cycles slump or any other external factors affect revenue for the firm and subsequently rent capture for the state.

- **Stabilization may also be promised only on mining-specific rents** like royalties and/or windfall taxes if it makes contracts easy to guarantee and administer.

2. Planning for Value-Addition

Value addition within borders is ultimately a matter of managing costs on the back of efficient infrastructure. If the availability of affordable finance, a skilled workforce and consistent feedstock is missing and the costs of transport and electricity, are unreliable or not low enough then local processing is uncompetitive and restrictions like export bans are not justified. For Pakistan value-addition should be split into two phases.

Phase 1: As mines become operational

The possibility for a collective grinding and beneficiation plant in the Chagai district under a single body should be considered so that individually acquiring the capital for setting up floatation tanks etc., is not a hurdle to processing. Following it copper in concentrate form should be the minimum grade for export; raw ores are the lowest in the chain for value-addition and should be subject to an export ban. A similar principle should be applied to lead-zinc mining with a collective beneficiation plant in Lasbela or Khuzdar.

Antimony exists in veins and is mined by ASM with small quantities as outputs which is uneconomical for mine owners to refine individually. The upgrading processes to metal form using roasters is significantly simpler and less capital-intensive than copper. Hence in the medium to long-run, an export ban on antimony in ore and even concentrate form would be easier to enforce.

Processing collectively most importantly allows **formal participation for ASM** providing them an alternative to sell their output under formal channels rather than resorting to exporting ores, making the export ban more enforceable.

Phase 2: As the infrastructure requirements are checked off

For copper, the construction of a smelter at the moment is not feasible due to feedstock, investment and power constraints and the EPZ planned in Siah Diq is not expected to have a downstream copper processing facility either. However, in the long-run as exploration licenses convert into mining and the infrastructure gradually develops, a collective smelter can eventually be planned and it must take into account the supply of concentrates from nearby mines to become economically viable.

A key lesson from Indonesia is how the export-ban policy for nickel was implemented gradually over a period of 10 years (export permits were only given to firms that were building smelters, evaluated every six months) so that the processing infrastructure could extend towards value-added goods. Similarly, the DRC applied an export ban on copper concentrates in 2026 – after the construction of the single-line smelter of their flagship Kamoa-Kakula mine in 2025, even though the mine itself became operation in 2021.

It is vital that agreements signed with foreign operators preceding this period negotiate the final form of copper leaving the borders as many foreign firms have contractual obligations to secure concentrates for their own integrated smelters or host countries.

3. Building Expertise and a Mining Ecosystem

Indonesia also provides lessons on sustainability of investment as Chinese stakeholders own around 75 percent of Indonesia's nickel refining capacities and have created a path of dependence through fixed assets, specialist engineers, suppliers and finance. Firms should from the very beginning set **measurable standards for the transfer of technology** for example:

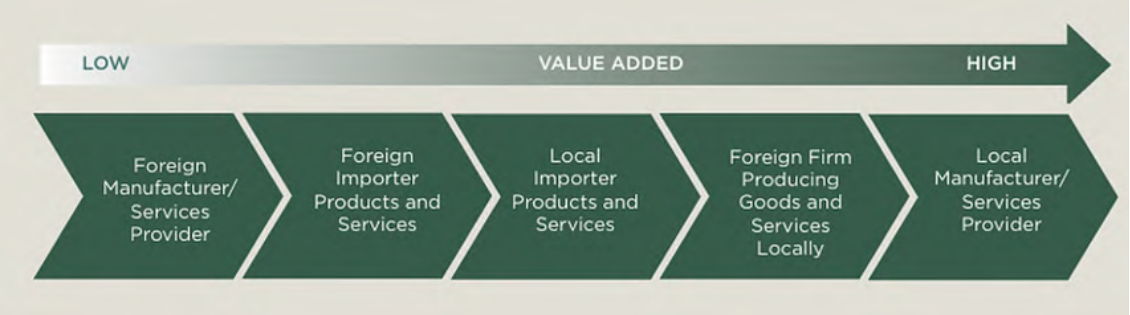
- A set number of local geologists being trained to the positions of a Qualified Person/Competent Person by foreign professionals. This could be extended to other mining-specific roles like metallurgy engineers to build domestic engineering and research capabilities.

- If a foreign training program or scholarship opportunities exist for these, then a set quota for students should be negotiated in before contracts are signed or may be integrated in an IBA.

- Setting clauses in EPCM contracts that would ensure the training of local employees in operating the relevant equipment/machinery.

The long-run vision should be to integrate Pakistan's critical mineral strategies (midstream to downstream processing, human capital capabilities) into national development plans. **A starting point could be setting up domestic medium-scale ancillary industries that produce goods supporting everyday mining operations.** According to Bamber et al. (2021), the strongest presence of local suppliers in host countries is with niche capital equipment and consumables like rubber tires, conveyor belts, grinding balls etc. These have a distinct comparative advantage due to proximity, high volume to value shipping costs, and because niche equipment can be designed by local technical and geological knowledge.

Figure 45: The Long-Term Vision for Value Addition in EPCM



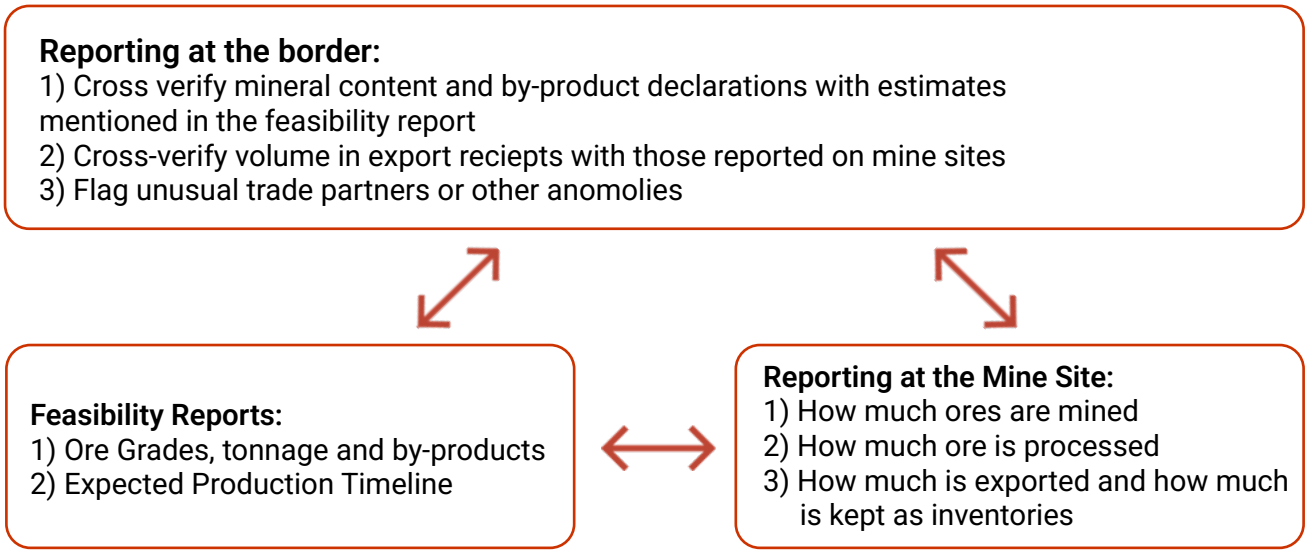
Source: Cited from Bamber et al. (2021)

In the short-run the Dalbandin airport should be made operational again to the level that it serves as a major regional hub for mining activities and would play a huge part in easing connectivity for both domestic and international experts to the mine sites in Chagai. It will also help overcome the dangers of road transport for lightweight equipment and other items like perishables for people on the ground.

4. Tracking Exports from Mine to Border

The traceability of mineral exports needs to be documented by a thorough cross-verification process as proposed below. The recording process should be integrated into the mining cadastre systems/ portals of the provincial mines and minerals departments where mine-owners can digitally submit monthly production reports, stocks and feasibility reports. The proposed plan below outlines this process and would require strong technical coordination between provincial mining authorities and the customs administration to ensure integrity in data management and revenue collection.

Figure 46: Proposed Plan for Cross-Verification of Mining Data



Public trust in the transparency of the entire mining chain is very important and starts from the licensing stage in how mineral rights are awarded, the bidding process is carried out, if the beneficial ownership information is published, to when the feasibility reports are prepared and the mineral is exported.

Pakistan should consider applying for the **Extractive Industries Transparency Initiative (EITI)** which advocates for the governance of natural resources through the standards of transparency, accessibility and quality data disclosure by governments and mining companies so that any decision-making is accounted for by all the stakeholders.

5. A Long-term Approach to Social Licensing

Community engagement has to be integrated into the fabric of mining projects instead of being limited to superficial CSR initiatives as done in other industries. The case of Papua New Guinea demonstrates that mining activities cannot be sustained without social licensing in regions where land is owned by tribal or indigenous communities which is the case with Balochistan and most of the world where mines are developed.

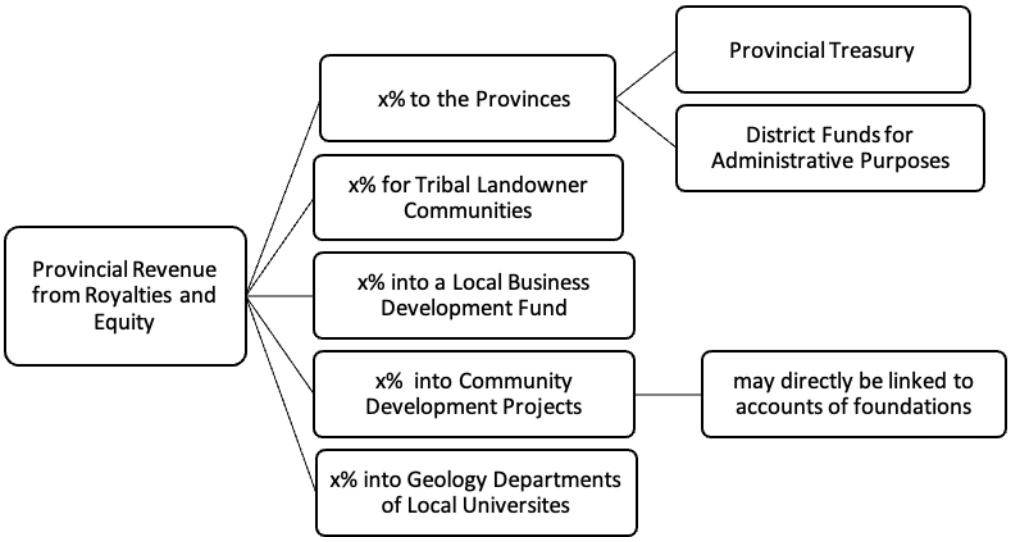
Setting IBAs or Benefit Sharing Agreements

IBAs are not novelty that are limited to the institutional strength of first-world countries. A study by Carr-Wilson et al. (2026) shows that amongst the publicly available agreements (many IBAs are confidential) many were signed in developing countries like Ghana, Mongolia, Chile and Papua New Guinea. The principle in general has become an effective way to obtain social licensing through private negotiations.

Financing Development

The model of a disbursement system with set percentages of mining income allocated to administrative, community development and landowner-tied compensation based on the examples of Peru and Ghana is proposed below to avoid any discretionary spending. The sections are not exhaustive and may be extended to other identified areas of need.

Figure 47: Proposed Criteria for Disbursement of Provincial Mining Revenue



Additionally, firms in the developing phase (or once feasibility is proven) until when production begins, should legally be required to set aside a percentage of their capital costs for 'social spending' (similar to how the Reko Diq model commits 1 percent of their expansion and development costs) so communities are supported pre-production given the long development timelines.

Beyond Compensation

The main priority be it through an IBA, CSR initiatives or state support should be providing a source of livelihood. One way to create financial independence is through helping local businesses in line with the capacity of communities for example helping set up fruit farms, providing drip irrigation facilities, stitching of uniforms for miners etc. For these, consultations become very important as it signals the strengths and needs of the community.

Skill development is the second major way to create meaningful placements that are not limited to laborers and security guards. Training should begin from semi-skilled jobs like carpenters and electricians which are transferable to non-mining projects as well. Technical Education and Vocational Training Authority (TEVTAs) need to be expanded and would have a bigger role to play.

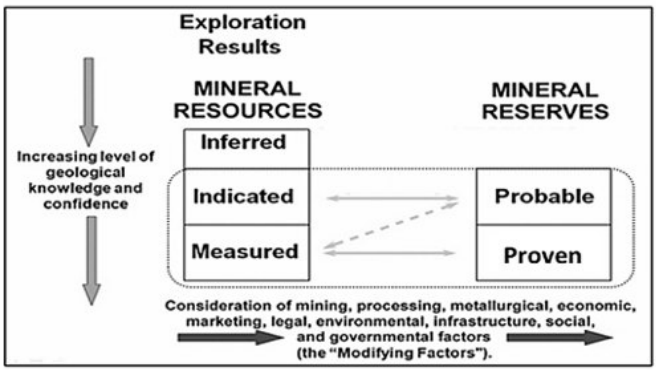
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List of Interviewees

Name	Organization	Designation
Akhtar Ali Shah	KPK Board of Investment & Trade (KP-BOIT)	Manager Mines & Minerals Department
Engr. Asad Ahmad	Pakistan Mineral Development Corporation (PMDC)	Chief Executive Officer/Managing Director
Harris Naeem	HTMA Limited	Chief Executive Officer
Irshad Afridi	KPK Mines and Minerals Department	Additional Director General
Muhammad Ali	Sapphire Chemicals Private Limited	Chief Executive Officer
Omair A. Karachiwala	Orestik Mining Consultants	Director- Business Planning and Mining Strategy
Saifuddin Shamsi	Hilton Pharma	Director- Corporate Finance
Saifullah	Galaxy Gemological Institute	Gemologist
Shamsuddin Shaikh	National Resources Limited (NRL)	Chief Executive Officer
Sherbandi Khan Marwat	Frontier Mine Owners Association KPK	Chairman
Tarib Ahmed	Precision Bird (Pvt) Limited	General Manager Operations
Toufeeque Ahmed	Pakistan Gems and Jewellery Development Company (PGJDC)	Chief Executive Officer
Waleed Ahmed Vohra	Ark Metals	Co-Founder and CEO
Waqar Ahmed	Globacore Minerals Limited Pakistan Corporate Consortium (PCC)	Project Manager
Adnan Ali		Unit Manager
Habib Ur Rehman		Chief Geologist
Zain Ahmed	MHA Industries	Head of International Sales

Appendix 1: Mineral Resources and Reserves Definitions



Source: Canadian Institute of Mining, Metallurgy and Petroleum (CIM)

Mineral Resource: is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

Inferred: is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity

Indicated: is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit

Measured: is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Mineral Reserve: is the economically mineable part of a measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at pre-feasibility or feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

Probable: is the economically mineable part of an indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve.

Proven: is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors.

Modifying Factors: are considerations used to convert Mineral Resources to Mineral Reserves. These include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors.

Appendix 2: Critical Mineral Lists of Selected Countries

Mineral	US	EU	Australia	India	Canada	UK	Japan
Aluminium/Bauxite	✓	✓	✓	×	✓	✓	✓
Antimony	✓	✓	✓	✓	✓	✓	✓
Arsenic	✓	✓	✓	×	×	×	×
Barite	✓	✓	×	×	×	×	×
Beryllium	✓	✓	✓	✓	×	×	✓
Bismuth	✓	✓	✓	✓	✓	✓	✓
Boron	✓	✓	×	×	×	×	✓
Cadmium	×	×	×	✓	×	×	×
Cesium	✓	×	×	×	✓	×	✓
Chromium	✓	×	✓	×	✓	×	✓
Cobalt	✓	✓	✓	✓	✓	✓	✓
Copper	✓	✓	×	✓	×	×	✓
Feldspar	×	✓	×	×	×	×	×
Fluorspar/Fluorine	✓	✓	✓	×	✓	×	✓
Gallium	✓	✓	✓	✓	✓	✓	✓
Germanium	✓	✓	✓	✓	✓	✓	✓
Graphite	✓	✓	✓	✓	✓	✓	✓
Hafnium	✓	✓	✓	✓	×	✓	×
Helium	×	✓	×	×	✓	✓	×
Iron	×	×	×	×	✓	✓	✓
Indium	✓	×	✓	✓	✓	✓	✓
Lead	✓	×	×	×	×	×	×
Lithium	✓	✓	✓	✓	✓	✓	✓
Magnesium	✓	✓	✓	×	✓	✓	✓
Manganese	✓	✓	✓	×	✓	✓	✓
Metallurgical coal	✓	✓	×	×	×	×	×
Molybdenum	×	×	✓	✓	✓	×	✓
Nickel	✓	✓	✓	✓	✓	✓	✓
Niobium	✓	✓	✓	✓	✓	✓	✓
Phosphate	✓	✓	×	✓	✓	✓	✓
PGMs*	✓	✓	✓	✓	✓	✓	✓
Potash	✓	×	×	✓	✓	×	×
REEs	✓	✓	✓	✓	✓	✓	✓
Rhenium	✓	×	✓	✓	×	✓	×
Rubidium	✓	×	×	×	×	×	×
Scandium	✓	✓	✓	×	✓	×	×
Selenium	×	×	✓	✓	×	×	×
Silicon	✓	✓	✓	✓	✓	✓	✓
Silver	✓	×	×	×	×	×	×
Strontium	×	✓	×	✓	×	×	✓
Tantalum	✓	✓	✓	✓	✓	✓	✓
Tellurium	✓	×	✓	✓	✓	✓	✓
Tin	✓	×	×	✓	✓	✓	✓
Titanium	✓	✓	✓	✓	✓	✓	✓
Tungsten	✓	✓	✓	✓	✓	✓	✓
Uranium	✓	×	×	×	✓	×	✓
Vanadium	✓	✓	✓	✓	✓	✓	✓
Zinc	✓	×	×	×	✓	✓	✓
Zirconium	✓	×	✓	✓	×	×	✓

Source: Official Government Announcements: Note: *PGMs include ruthenium, rhodium, palladium, osmium, iridium, and platinum although the US omits osmium and the UK omits both osmium and palladium. UK list also includes borates, magnesite and sodium. Minerals produced commercially in Pakistan (excluding uranium and by-product metals) or have high potential are highlighted in green.

Appendix 3: Trade Statistics with China by Source

Code	Product label	2021	2022	2023	2024	2025	Cumulative Trade (2021-2025)	Cumulative Trade Gap (State Bank)	Cumulative Trade Gap (ITC/PBS)
2603	Copper ores and concentrates								
	ITC/PBS	11.5	12.5	13.3	3.9	4.1	45.3	545	-19
	State Bank	27.3	44.1	42.7	217.0	277.4	608.5		
	China's reported values	13.4	15.7	13.0	10.4	11.3	63.8		
7402	Copper, unrefined; copper anodes for electrolytic refining								
	ITC/PBS	142.3	135.1	36.3	10.3	6.8	330.6	-1,789	-1,527
	State Bank	22.9	17.8	12.1	8.2	7.5	68.5		
	China's reported values	305.6	388.2	476.5	340.3	347.1	1,857.7		
7403	Copper, refined, and copper alloys, unwrought (excl. copper alloys of heading 7405)								
	ITC/PBS	603.6	676.4	704.7	796.9	767.2	3,548.8	-824	121
	State Bank	250.7	516.1	574.7	662.5	600.1	2,604.0		
	China's reported values	734.6	711.7	652.2	593.4	735.7	3,427.6		
7404	Waste and scrap, of copper (excluding ingots or other similar unwrought shapes, of remelted copper waste and scrap, ashes and residues containing copper, and waste and scrap of primary cells, primary batteries and electric accumulators)								
	ITC/PBS	15.5	18.4	13.2	10.4	15.4	72.8	-205	-162
	State Bank	3.7	1.4	12.5	4.9	7.6	30.1		
	China's reported values	26.7	22.8	53.3	73.3	59.1	235.2		
2608	Zinc ores and concentrates								
	ITC/PBS	1.9	4.1	4.1	7.6	29.9	47.6	-580	-629
	State Bank	45.2	3.7	5.5	8.4	32.9	95.7		
	China's reported values	131.7	197.3	110.1	124.1	112.9	676.1		
2607	Lead ores and concentrates								
	ITC/PBS	0.7	1.8	1.0	1.7	9.3	14.5	-144	-150
	State Bank	6.1	5.8	3.6	3.8	1.4	20.6		
	China's reported values	40.3	39.7	40.6	19.6	24.2	164.3		
2617	Ores and concentrates NES (sub-heading for antimony ores)								
	ITC/PBS	0.0	0.1	0.3	1.2	0.2	1.8	0	-2
	State Bank	0.3	0.3	1.2	1.7	0.6	4.1		
	China's reported values	0.1	0.8	1.1	1.8	0.3	4.1		
2611	Tungsten ores and concentrates								
	ITC/PBS	0.000	0.000	0.000	0.000	0.003	0.003	0.113	-0.017
	State Bank	0.114	0.000	0.000	0.005	0.014	0.133		
	China's reported values	0.000	0.000	0.000	0.000	0.020	0.020		

Note: China's reported values have been taken from the International Trade Centre (ITC) which in turn sources it from the General Administration of Customs of the People's Republic of China (GACC). Pakistan's reported values on ITC have been sourced from the Pakistan Bureau of Statistics (PBS).

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