



THE WORLD LEAD FACTBOOK 2023



INTERNATIONAL LEAD AND ZINC STUDY GROUP (ILZSG)



International Lead and Zinc Study Group

The **ILZSG** was set up by the United Nations in 1959 as an intergovernmental organization with 27 members, and is one of the longest-established International Commodity Organizations.

The main role of the **ILZSG** is to ensure transparency in the markets for lead and zinc worldwide. This is achieved by producing a continuous flow of information to the market place on supply and demand developments in lead and zinc through the monthly publication of high-quality statistics, in-depth market research and specifically targeted economic studies. The Group also organizes international sessions and special conferences bringing together industry and governments to discuss matters of concern in the lead and zinc sectors.

The **ILZSG** provides opportunities for regular intergovernmental consultations on international trade in

lead and zinc, and considers possible solutions to any problems or difficulties which are unlikely to be resolved in the ordinary development of world trade. The Group also publishes continuous information on the supply and demand position of lead and zinc and its probable development and prepares special studies on a range of subjects related to the world lead and zinc market.

The work of the Group is largely carried out by four committees: Standing, Statistical and Forecasting, Mine and Smelter Projects, Economic and Environment. Each committee is chaired by a representative from one of the ILZSG's national delegations, who directs the program of work. The committee chairpersons report back to the whole Study Group during formal sessions which are held at its headquarters in Lisbon, Portugal, or by government invitation in a member country.

WORLD LEAD FACTBOOK 2023



International Lead and Zinc Study Group

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SELECTED CURRENT PUBLICATIONS

1. Lead and Zinc Statistics - Monthly Bulletin + Interactive Database (data 1960 – current year)
2. Lead and Zinc Mine and Smelter Database
3. Lead and Zinc New Mine and Smelter Projects 2023
4. Environment and Health Controls on Lead 2023
5. The World Lead Factbook 2023
6. World Directory: Lead and Zinc Mines 2023
7. World Directory: Primary and Secondary Lead Plants 2023
8. World Directory: Primary & Secondary Zinc Plants 2023
9. World Directory: Continuous Galvanizing Lines 2022
10. The Chinese Primary and Secondary Lead Metal Sector 2022
11. Lead and Zinc: National Trade Tariffs and Measures 2021
12. Lead and Zinc End Use Industry Statistical Supplement 2020
13. The World Zinc Factbook 2020
14. Solid Wastes in Base Metal Mining, Smelting and Refining 2019

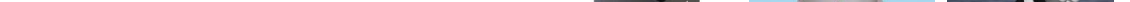
For further details please refer to www.ilzsg.org

Image of Cover Page: Courtesy of Consortium for Battery Innovation (CBI)

WORLD LEAD FACTBOOK 2023

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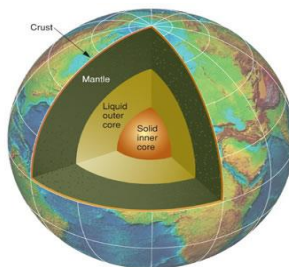


- Soft, highly malleable
- Relatively poor conductor of electricity
- Resistant to corrosion but tarnishes upon exposure to air
- Attenuation of X-rays, gamma rays and sound waves



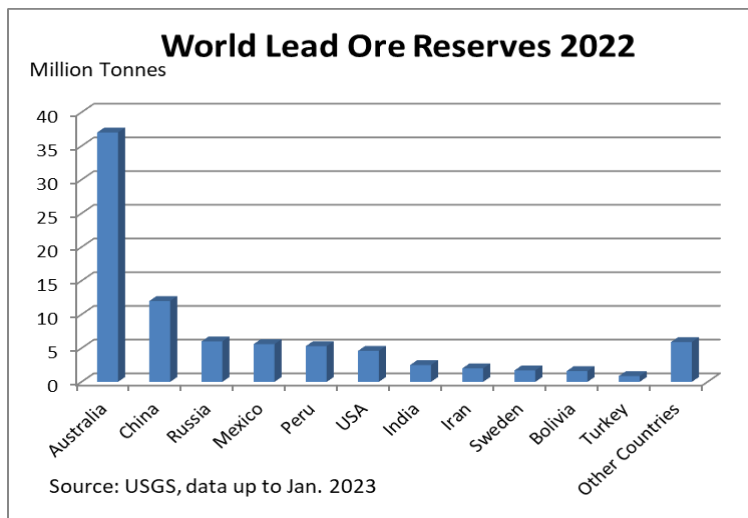
CHAPTER TWO: LEAD RESOURCES

Galena is the main ore of lead along with cerussite (PbCO_3) and lead sulfate (PbSO_4). In addition, a small amount of lead also exists in various uranium and thorium mines. Lead ores are abundant worldwide and there were 41 countries mining lead across Europe, Africa, the Americas, Asia and Oceania in 2022. Lead ores are mined at a rate close to 5 million tonnes (calculation based on lead contained in concentrate) a year. Lead ore is mainly mined as a byproduct of zinc and silver.

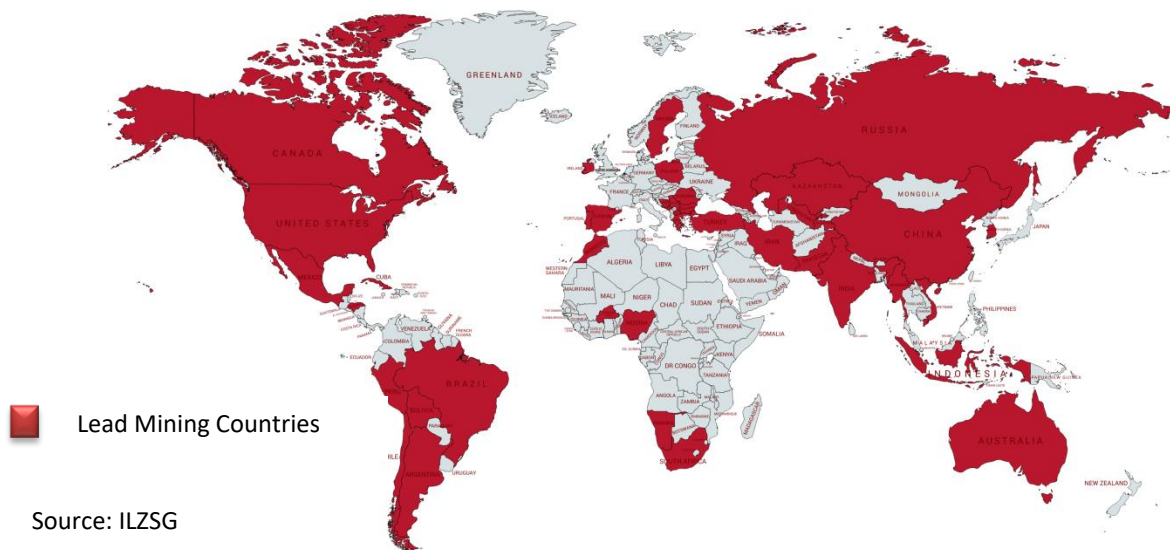


Lead Reserves

The proven lead ore resource is over 2 billion tonnes, and the reserve volume is about 90 million tonnes. The world's lead resources are mainly distributed in: Siberia, Russia; the central and western regions of China; Queensland, New South Wales in Australia; the southeastern area of Missouri and the Mississippi River valley area in the US; Zacatecas and San Luis Potosi in Mexico; Cerro de Pasco and Morococha in Peru.



Lead Mining Countries 2022

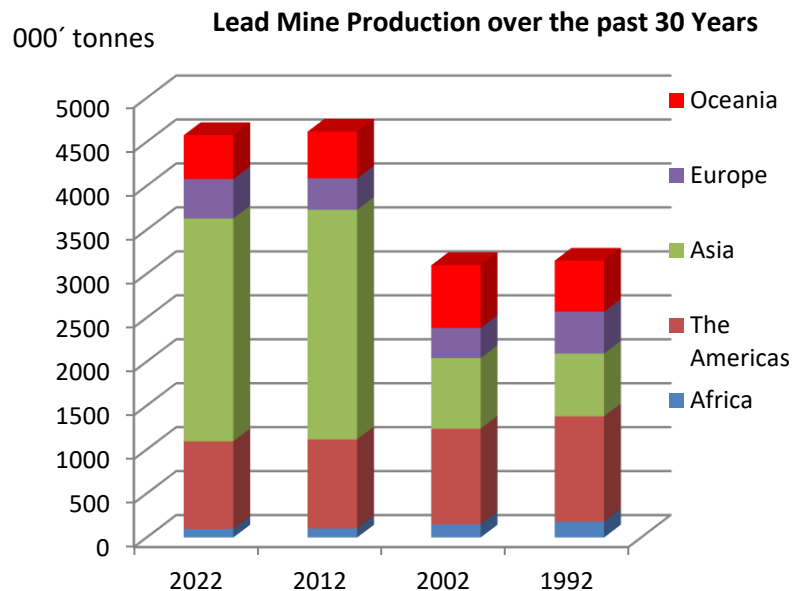


- There are over 40 countries mining lead ore since the 1990s across 5 continents
- 41 countries in 2022 mined lead ore

Lead Mine Production by Continent (Lead Contained in Concentrate)

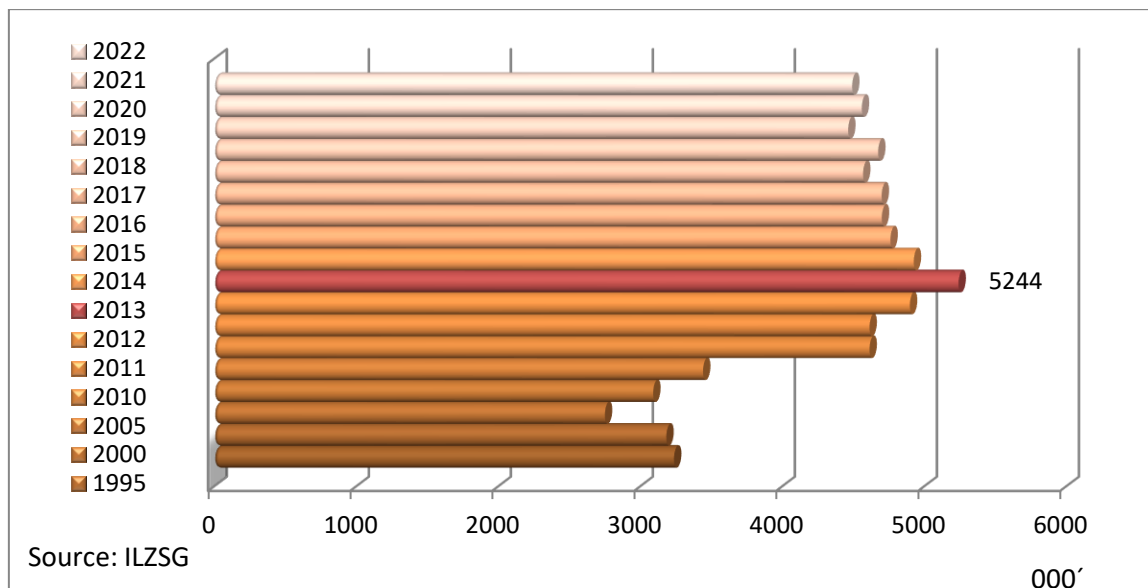
ILZSG data shows,

- In the Americas, output has been stable at between 1-1.2 million tonnes,
- In Asia, production has experienced fast growth and reached 2.51 million tonnes in 2022,
- In Europe, output in 2022 recovered to the level in 1990s at around 0.46 million tonnes after a sharp decrease from 1980s level of 0.9-0.7 million tonnes,
- In Africa, output dropped to about 0.1 million tonnes,
- In Oceania, output has been stable at a level between 0.45-0.7 million tonnes.



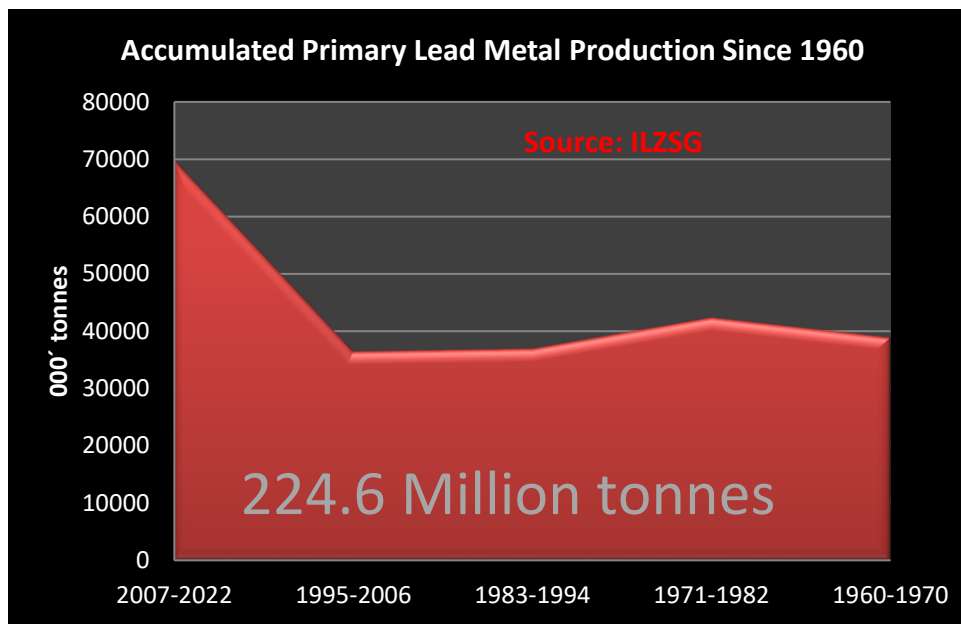
Source: ILZSG

Lead Mine Production Trends (Lead Contained in Concentrate)



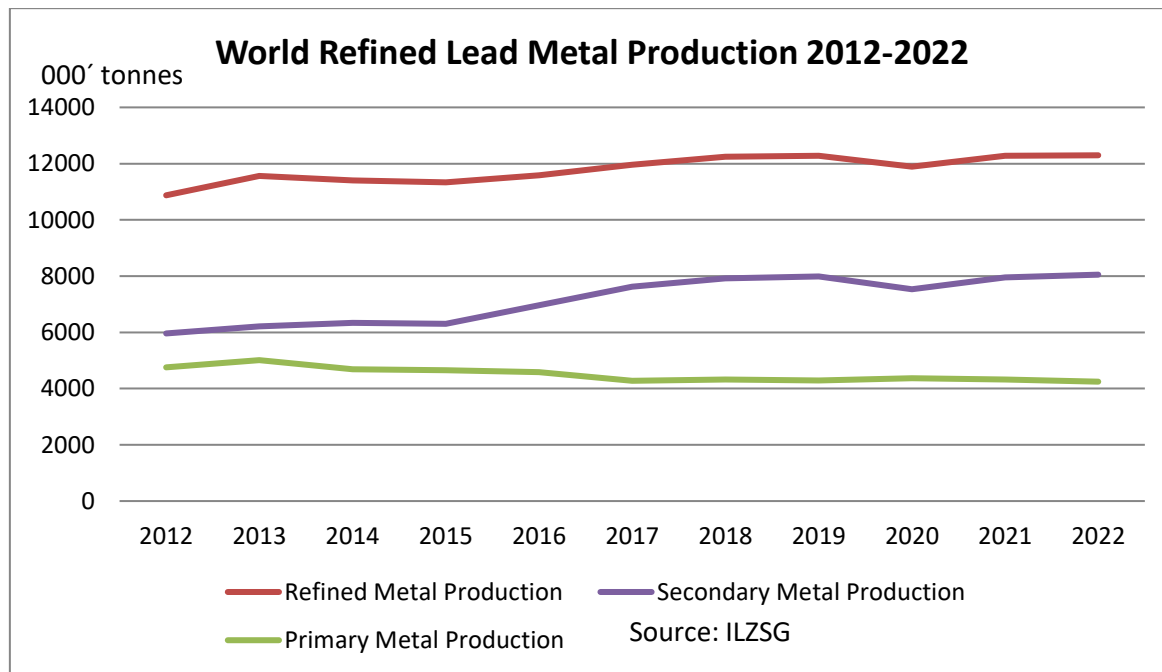
- World lead mine production peaked in 2013
- World lead mine production surpassed 4 million tons in 2010

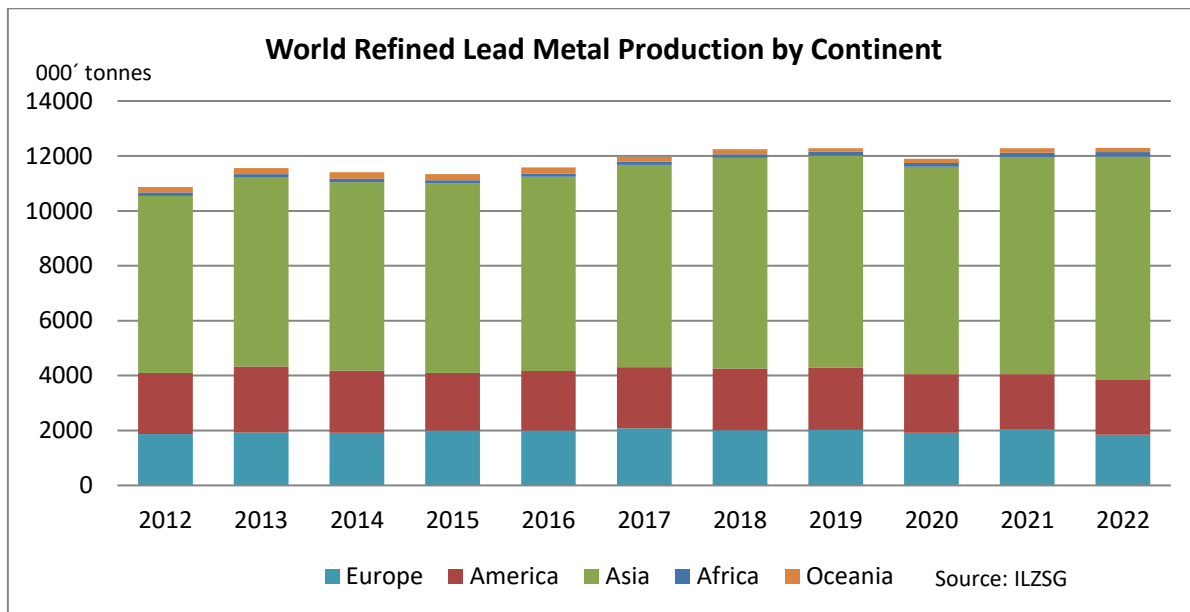
Accumulated Primary Refined Lead Metal Production



- By the end of 2022, cumulative primary refined lead production had reached 224.6 million tonnes.

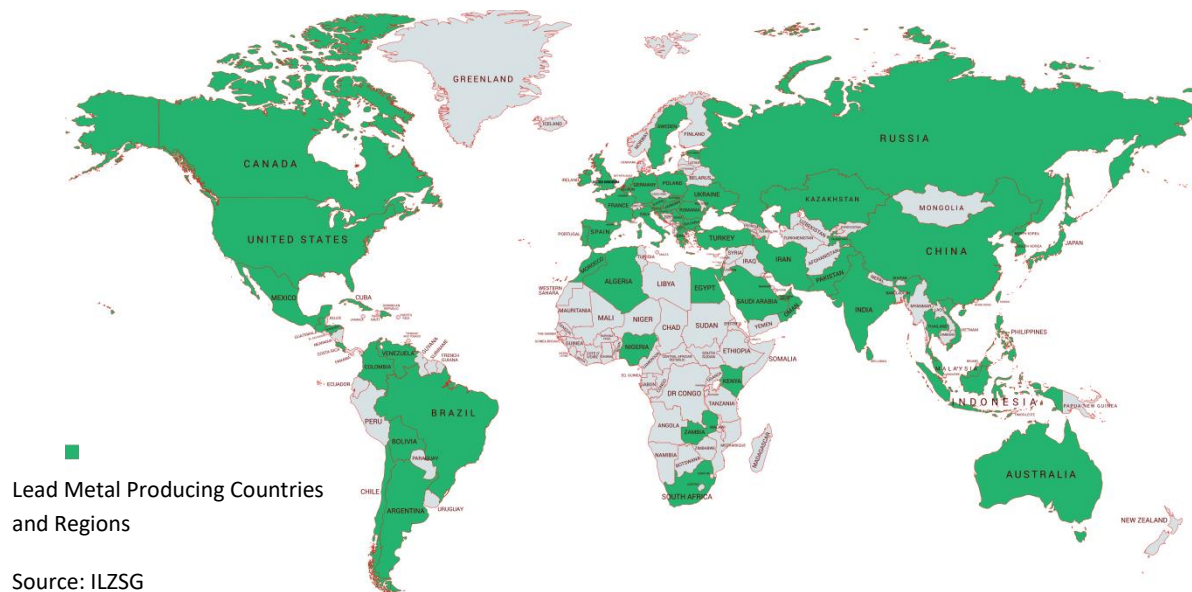
CHAPTER THREE: REFINED LEAD METAL PRODUCTION





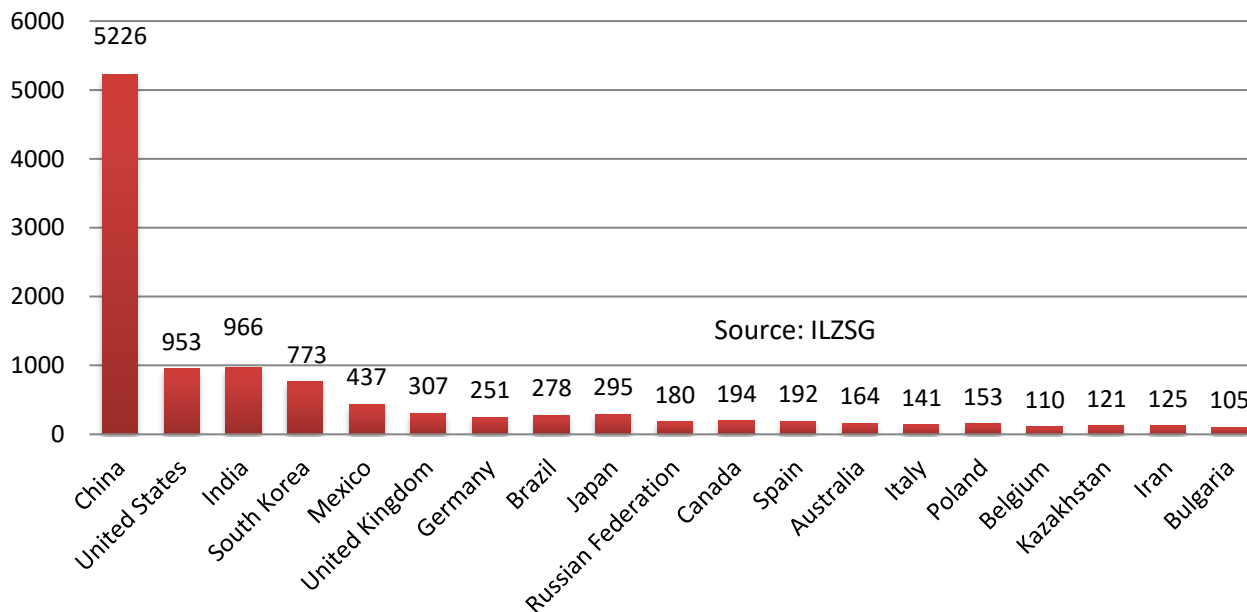
- Production in Europe and the Americas has been stable, whereas output in Asia has increased from 6.5 million tonnes to 8.1 million tonnes over the observed period

World Refined Lead Metal Producing Countries and Regions 2022

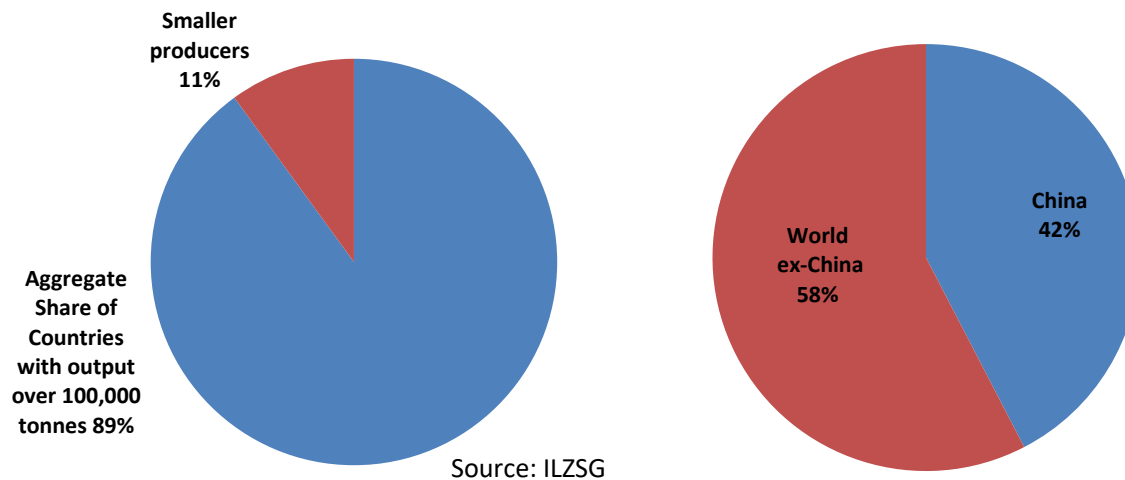


- 80+ countries across the world had lead smelting and/or refining capacities in 2022

000' tonnes **Refined Lead Metal Producing Countries with an Output Above 100,000 Tonnes in 2022**

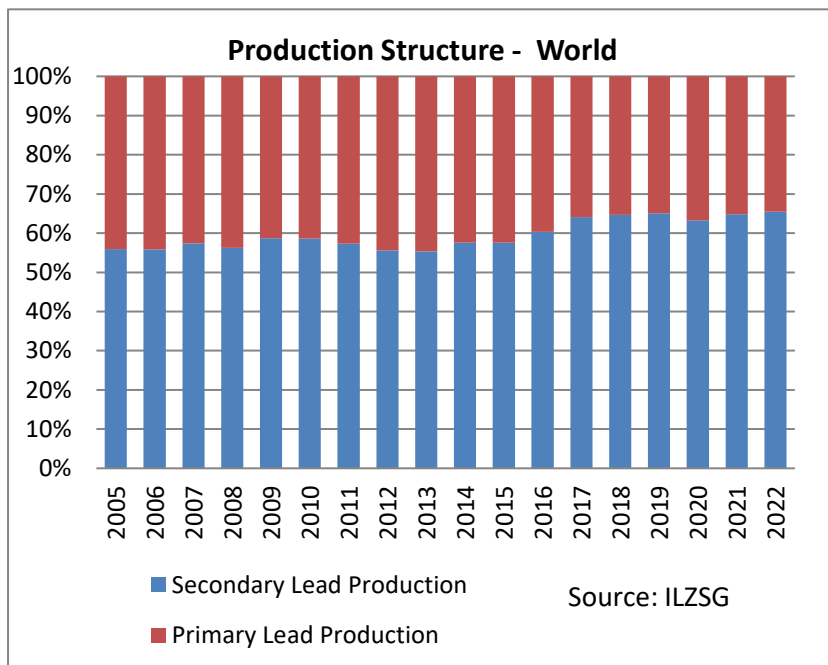


World Refined Lead Metal Production Concentration Rate 2022



- Refined Lead Metal Production is a highly concentrated industry with those producing countries with an output above 100,000 tonnes in 2022 contributing 89% of world production
- China's refined lead production contributed 42% of the world's production in 2022

Refined Lead Metal Production Breakdown



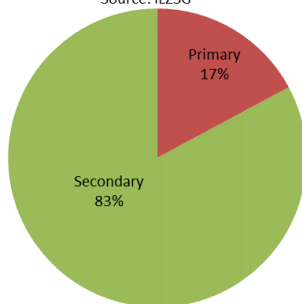
ILZSG data shows,

- The proportion of total output accounted for by secondary production was between 55% and 65% of the total refined lead production during the observed period,
- The secondary production proportion surpassed the 60% threshold in 2016.

World Refined Lead Metal Production Breakdown

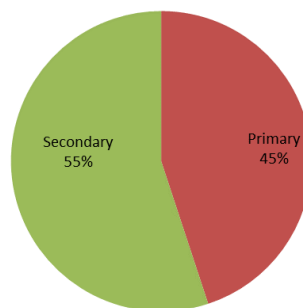
Production Structure - Europe 2022

Source: ILZSG



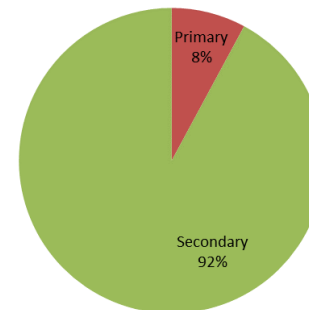
Production Structure - Asia 2022

Source: ILZSG



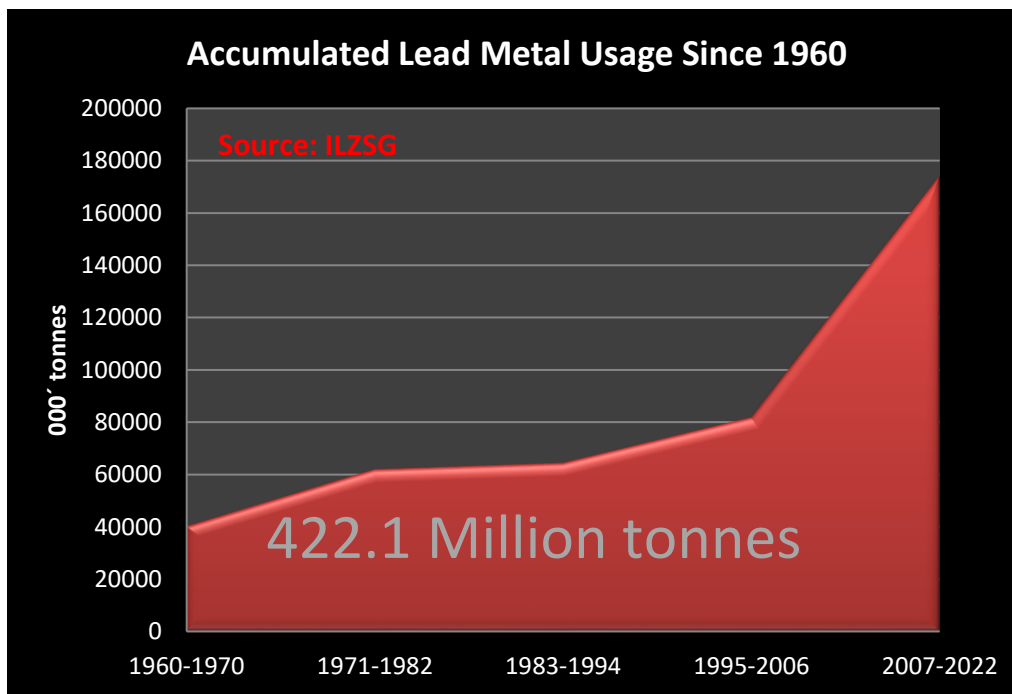
Production Structure - the Americas 2022

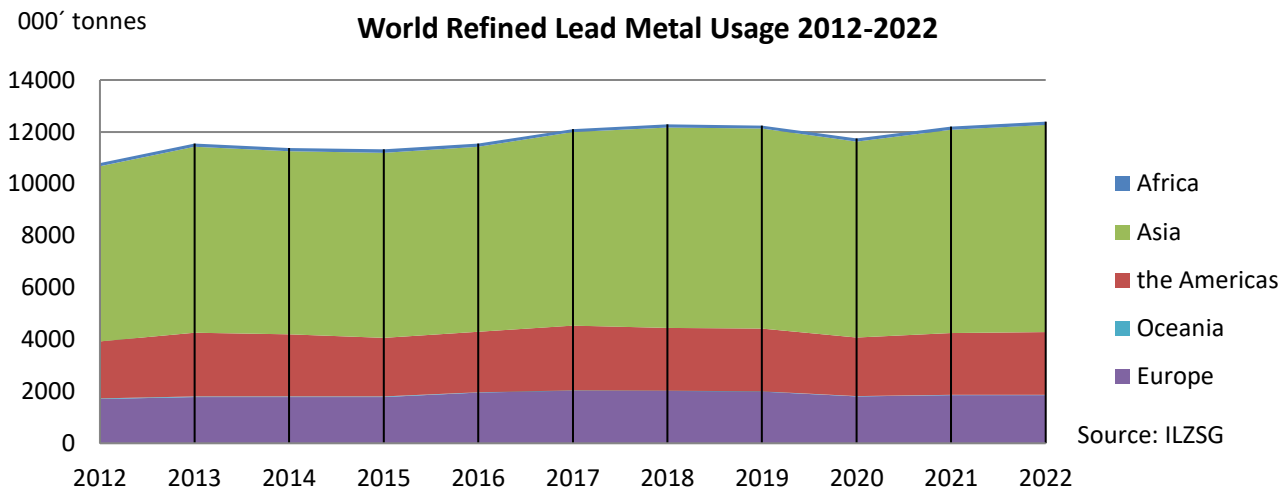
Source: ILZSG



- In 2022, secondary refined lead production accounted for 92% of total refined metal production in the Americas
- The proportion of secondary refined lead production in Europe was 83%
- The proportion of secondary refined lead production in Asia was 55%
- There is a huge potential for growth in secondary refined lead output in Asia

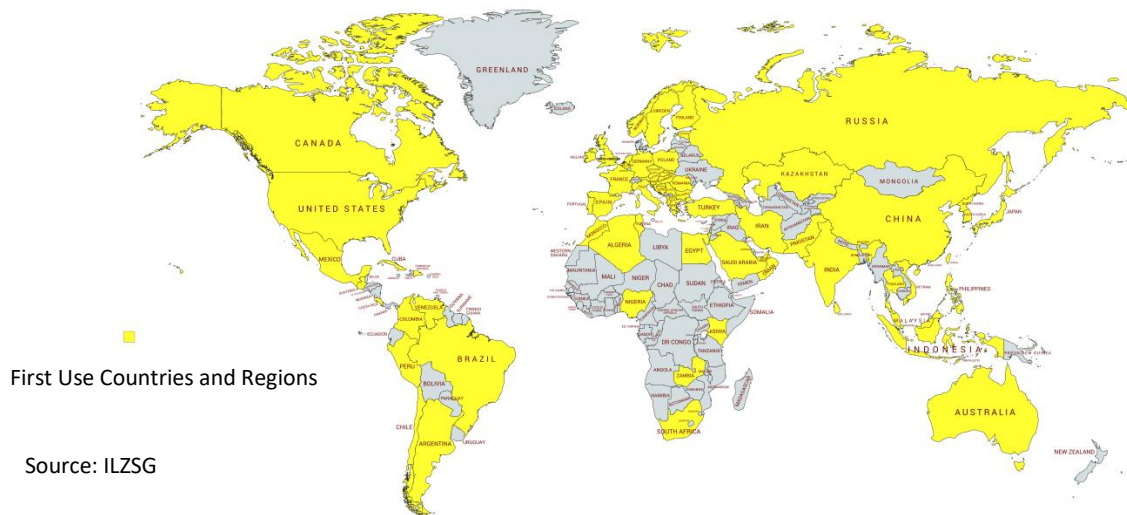
CHAPTER FOUR: LEAD USAGE





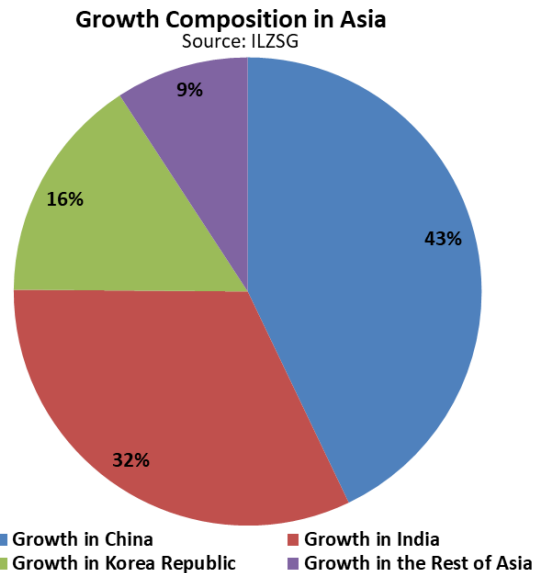
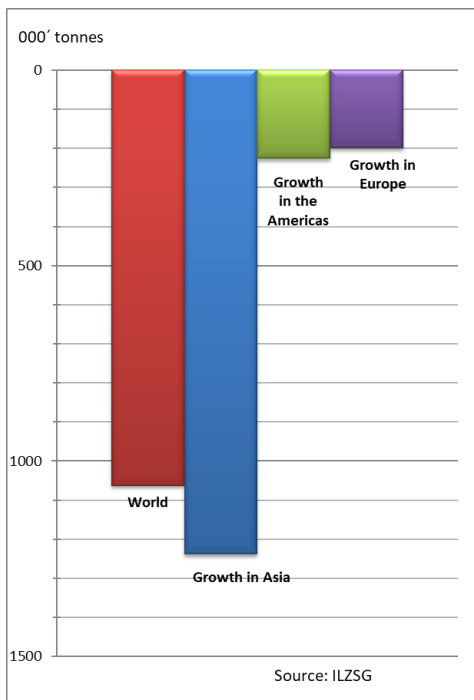
- Usage volume in Europe and the Americas has been stable over the observed period,
- Growth has been mainly in Asia with an overall global increase of around 1.2 million tonnes over the observed period,
- World refined lead usage has plateaued at the level of around 12 million tonnes in recent years. It was briefly impacted by the COVID-19 Pandemic in 2020 before recovering in mid-2021.

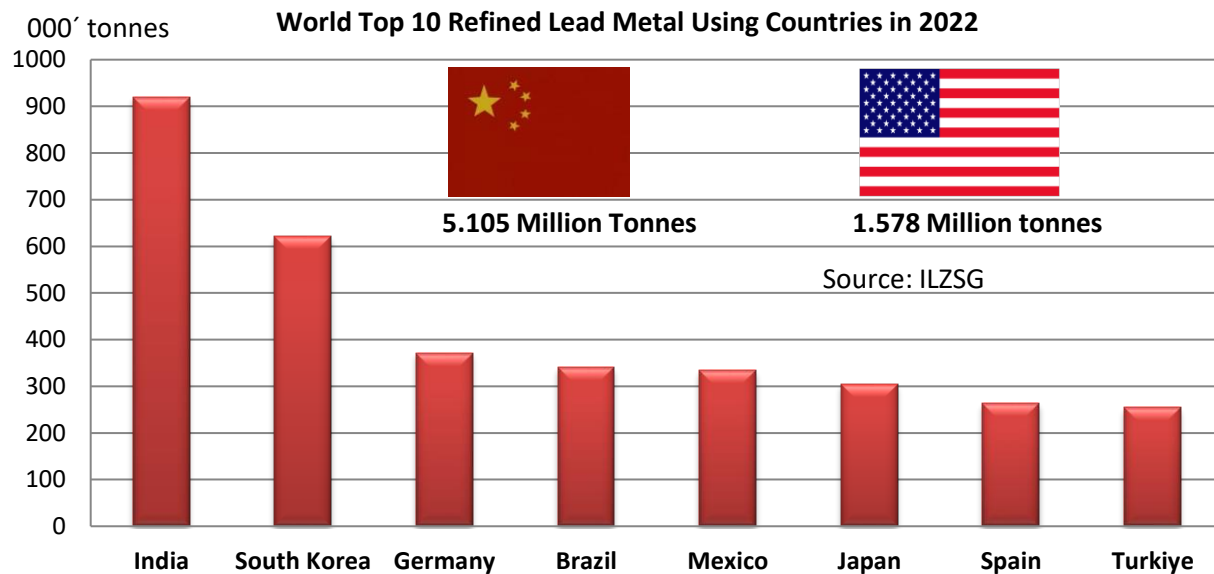
Countries and Regions with First Use of Refined Lead Metal in 2022



- There are 80+ countries and regions across the world using refined lead metal as a material to produce downstream products
- Indirect lead usage is at every corner of the world since lead is mainly used to produce LABs

World Refined Lead Metal Usage Growth 2022 vs 2012





- China used more than 5 million tonnes of refined lead in 2022, accounting for 42% of global demand and the United States used close to 1.6 million tonnes accounting for 13%

kg/per capita **World Refined Lead Metal Usage per Capita 2022**

United States 4.7

P.R. China
3.62

EU 27
3.35

Europe
2.5

The Americas
2.34

Asia
1.68

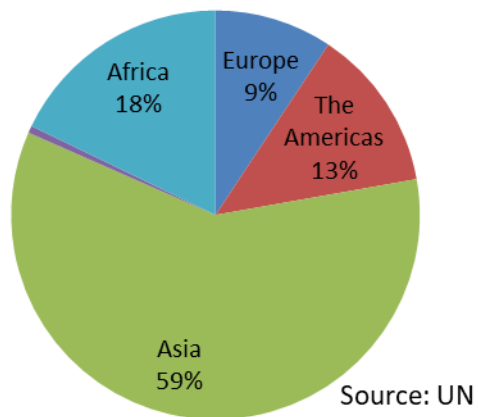
World Average
1,55

Oceania
0,27

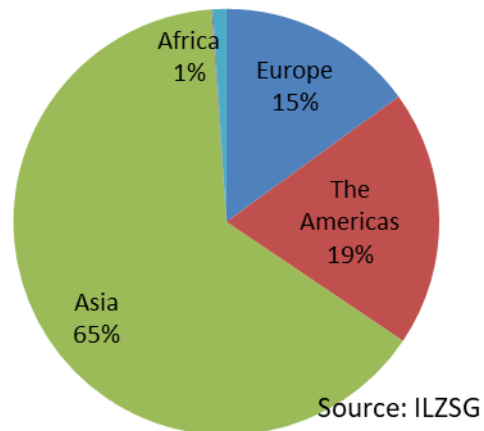
Africa
0,09

Source: ILZSG

World Demographic Breakdown 2022



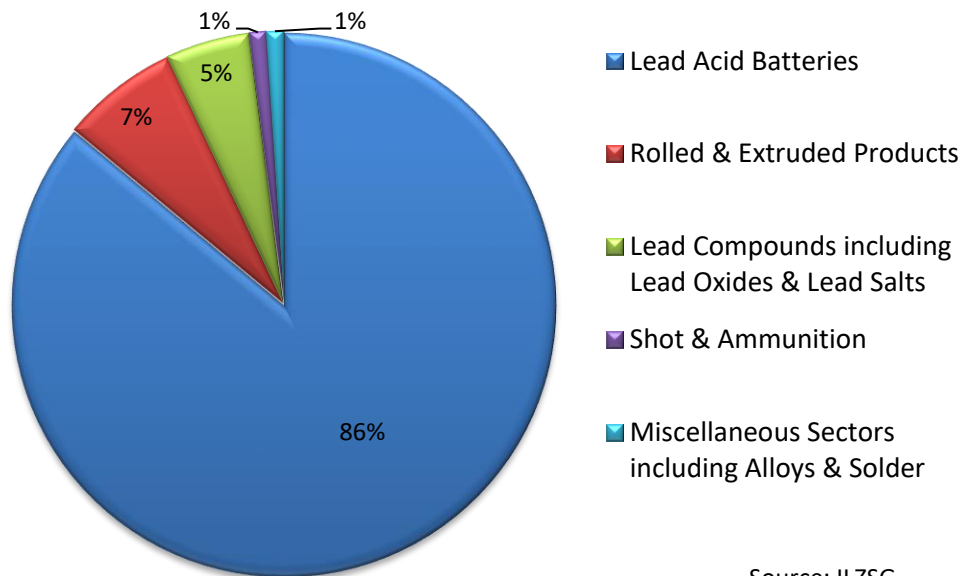
World Refined Lead Metal Usage
Geographic Allocation 2022



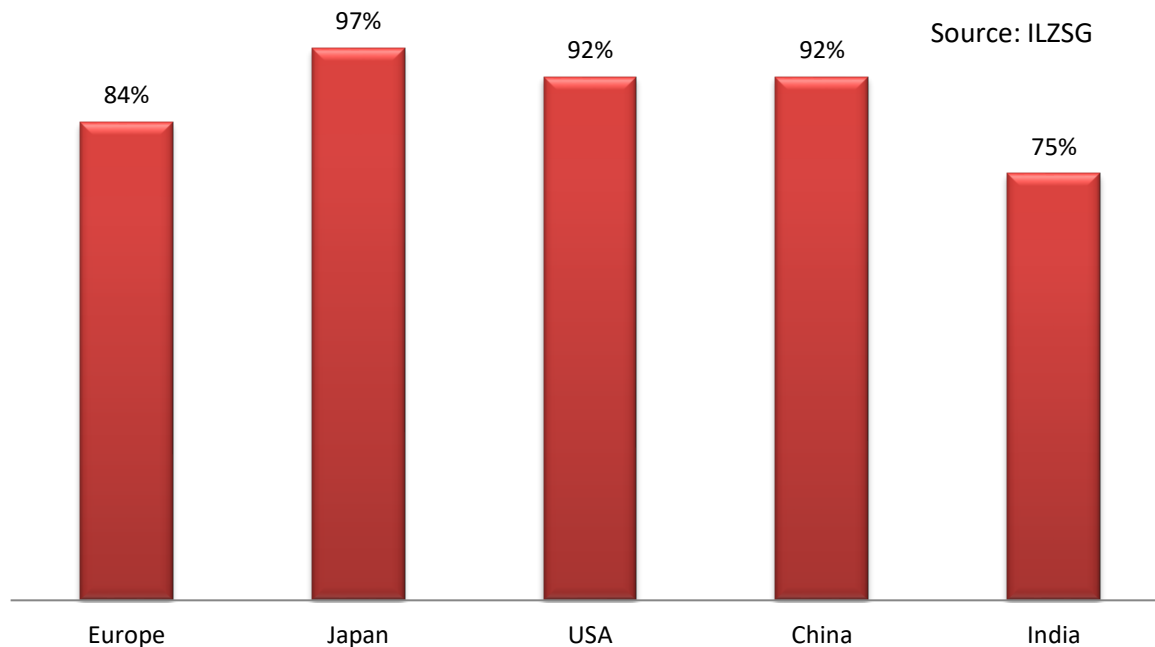
World Refined Lead Metal Usage

- Lead is one of the earliest metals to be discovered and used in human history
- Its usage has evolved from ancient times in piping by the Romans and coin forging by the Chinese to roofing and decorating and in batteries, shot and ammunition, rolled and extruded products, cable sheathing, lead compounds, and other alloys
- Nowadays, the battery industry is the single largest lead-using industry worldwide thanks to the continuing growth of the automobile industry and the potential growth of the renewable energy sector that will require a cost-effective and efficient means of storage
- It is estimated that the battery industry accounted for 92% of refined lead metal usage in China and in the US respectively, and 84% in Europe in 2022
- Lead usage in other sectors has been declining over the past 30 years, mainly for environmentally related reasons

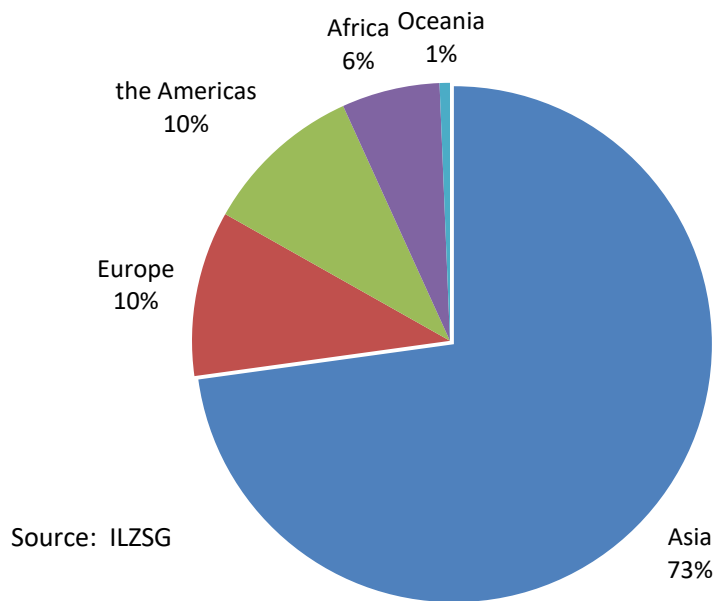
World Refined Lead Metal Usage by Sector 2022



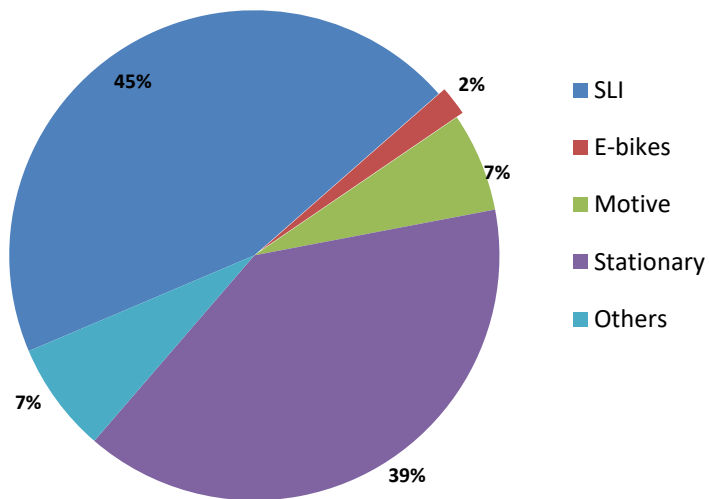
**% of Lead Usage Accounted by LAB Production
in the Main Lead-using Regions and Countries 2022**



Geographical Location of LAB Producers



Estimated Value Distribution in % of the World LABs Market 2022

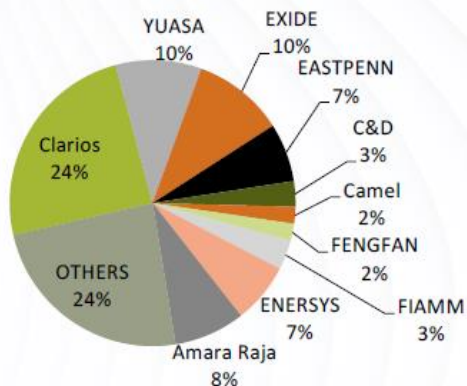


Source: Avicenne Energy 2023

- Avicenne Energy reported a global LAB market of 590 GWH with a value of USD53 billion for 2022.

Global LAB Market Share by producers 2022

Global market share on lead acid battery market (B\$ 53)



	SLI	Others	TOTAL
Clarios (ex JCI)	36%	4%	24%
YUASA	9%	11%	10%
EXIDE	10%	11%	10%
EASTPENN	7%	6%	7%
C&D		8%	3%
Camel	3%		2%
FENGFAN	3%		2%
FIAMM	3%	4%	3%
ENERSYS		19%	7%
Amara Raja	8%	8%	8%
OTHERS	21%	29%	24%

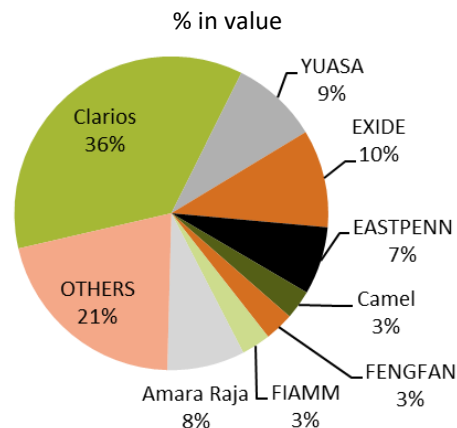
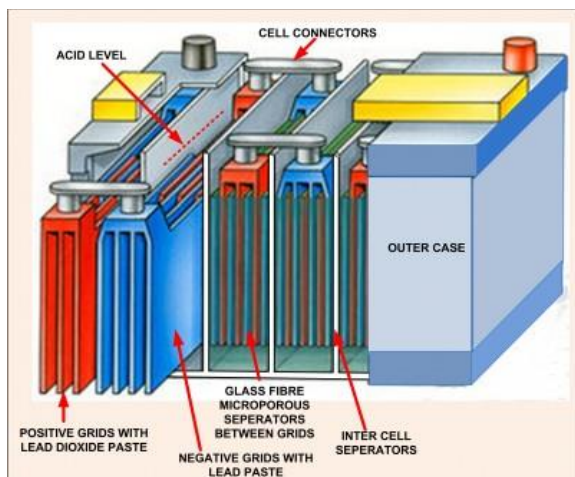
Over the past 15 years, the global lead-acid battery industry has experienced significant consolidation and currently the main international players are EnerSys, Exide Technologies, Johnson Controls, Inc., and GS Yuasa Corporation ("GS Yuasa").

Source: Avicenne Energy 2023

SLI Lead-Acid Batteries

Standard SLI batteries are installed in all vehicles with an internal combustion engine. On average, LABs for automobiles contain 9-14kg lead per unit. With the ongoing development of alternative battery chemistries and the accelerating adoption of EVs, it is possible that the traditional SLI LAB market will be negatively impacted although any change is likely to be gradual. In 2022, the global market value of SLI LAB reached \$24 billion.

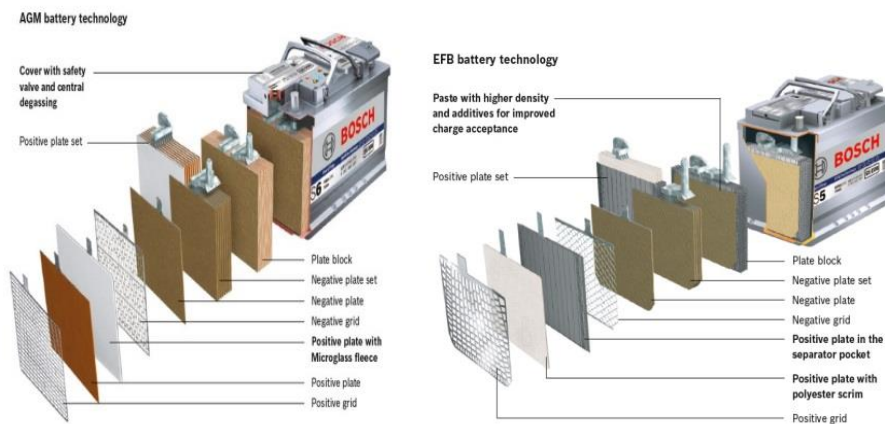
SLI Market Share by Producers 2022



Source: Avicenne Energy 2023

Start/Stop Lead-Acid Batteries

Advanced Absorbent Glass Mat LABs and Enhanced Flooded LABs have been developed to offer improved deep-cycle resistance and charge recovery in order to facilitate start/stop functionality for fuel saving. AGM and EFB batteries require about 20% more lead compared to traditional SLI batteries. It is expected that the adoption of Start/Stop LABs in both the OEM and replacement battery market will continue to increase.

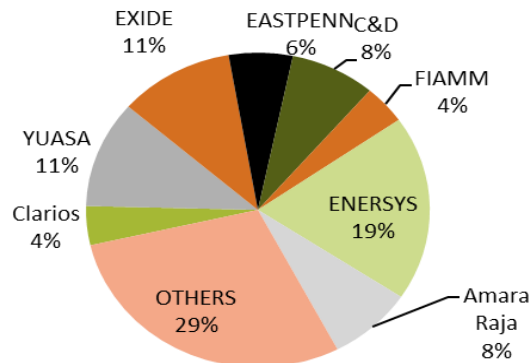


Industrial Lead-Acid Batteries

Currently, nearly 80% of industrial batteries are lead-acid batteries. Depending on the scale of the energy storage capacity, the lead content varies. Nearly 60% of storage unit weight is estimated to be refined lead Metal. Industrial LABs are used in the fields of UPS, telecommunication, renewable energy storage, etc.. Avicenne Energy reported an industrial LAB market worth USD29 billion for 2022.



Industrial LAB Market share by producers 2022
% in value



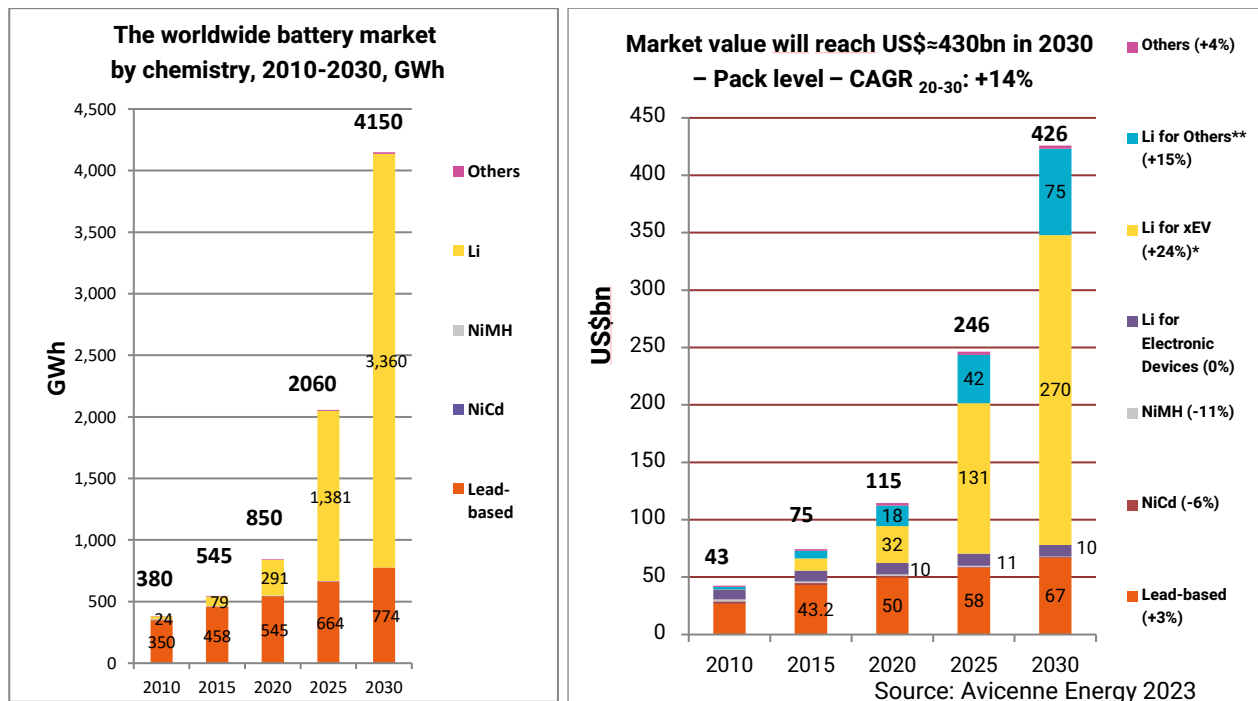
Source: Avicenne Energy 2023

Motive Lead-Acid Batteries

Motive Lead-Acid Batteries are used in forklift trucks, airport ground support equipment, golf carts and backup energy for transportation, etc.



Development Trends in the World Battery Market to 2030 by Value and Volume



Lead Wire, Lead Sheet, Lead Pipe and Cable Sheathing



Lead wire is used for a variety of applications such as lead anodes, lead weights, tying fishing flies, small casting used by lead bullet and model racing car manufacturing. Lead wire provides excellent resistance against heat, cold and chemicals.



Lead sheet is mainly used in the construction sector as a roofing material. According to the European Lead Sheet Association, over 100,000 tonnes of lead sheet are used globally each year. Other uses of lead sheet include radiation protection and X-ray shielding protection (lead sheet is an ideal quality product applicable to radiology for equipment such as linear accelerators, gamma knives, post-loading equipment, PET-CT rooms, CT rooms, DR rooms, DSA rooms, and X-ray machines in modern high-grade hospitals).

Lead Wire, Lead Sheet, Lead Pipe and Cable Sheathing



Lead pipe is now mainly used for carrying acids and corrosive chemicals.

Lead Sheathed Cables



Lead has been used to sheathe cables for more than 130 years, but it was substituted substantially by other materials due to technological advancement in the cable industry. It is estimated that less than 10 percent of land and underwater cables are currently sheathed with metal. Lead accounts for a small portion of this market.

Lead Shot and Ammunition



Lead is still widely used for making shot and bullets. However, its usage in shot is under threat for environmental reasons. It is therefore likely that lead will be substituted by other materials such as steel and its usage volume in this sector will decrease.



Administered by UNEP, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) & Convention on Migratory Species (CMS) have engaged in phasing out the use of lead shot for hunting in wetlands.

Based on Article 69(1) of the REACH Regulation, the EU prepared a restriction dossier on lead in shot used in wetlands. Member States are required to set up supervision mechanisms to monitor compliance with the proposed restrictions.

On the day before President Trump's inauguration, the outgoing Obama administration passed a directive banning the use of lead ammunition and fishing sinkers on federal land.

Lead Compounds, Alloys and Solder

PbS	PbO_2	Pb_3O_4
PbO	Pb_2SCl_2	PbI_2
PbCrO_4	PbCl_2	Pb(OH)_2
PbSO_4	$\text{Pb}_2(\text{OH})_2\text{CO}_3$	PbBr_2
Pb(CN)_2	$\text{Pb}_2(\text{PO}_4)_2$	Pb_5O_3

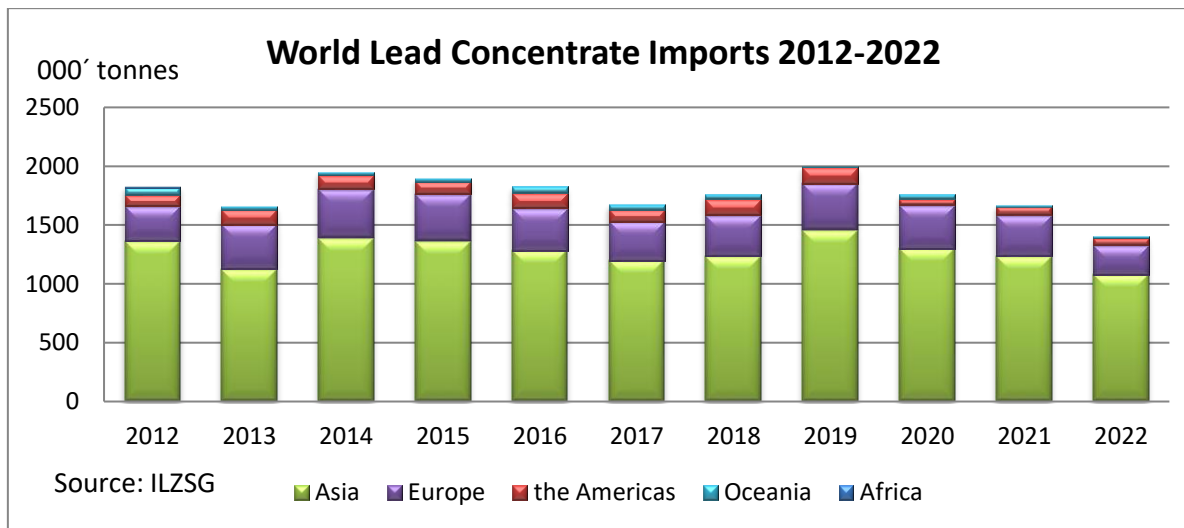


Lead compounds include lead monoxide (PbO), lead tetroxide known as red or orange lead (Pb_3O_4), tribasic lead sulphate, lead dichloride, dibasic lead phthalate, dibasic lead sulphate, neutral lead stearate, dibasic lead stearate, dibasic lead sulphite etc.

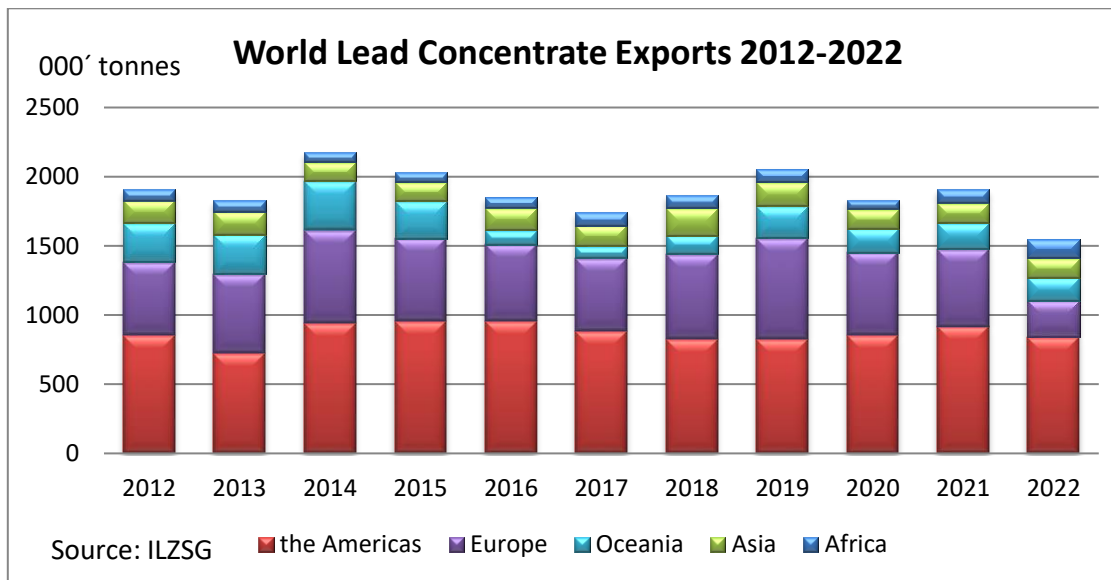
Lead-acid batteries are the main end-use sector for lead compounds. Other applications include plastic stabilizers, pigments and frits, glass crystal, and antiknock agents in gasolines. Apart from batteries, usage in these sectors has decreased due to environmental legislation and subsequent substitution.

Lead alloys are used as type metal, window and fishing weights, etc. Lead solder was widely used in the electronics sector. However, its use in consumer products such as electronic devices has been banned in many jurisdictions; the trend of being substituted by lead-free alternatives such as tin, silver and copper is considered to be irreversible.

CHAPTER FIVE: LEAD MARKET & TRADE

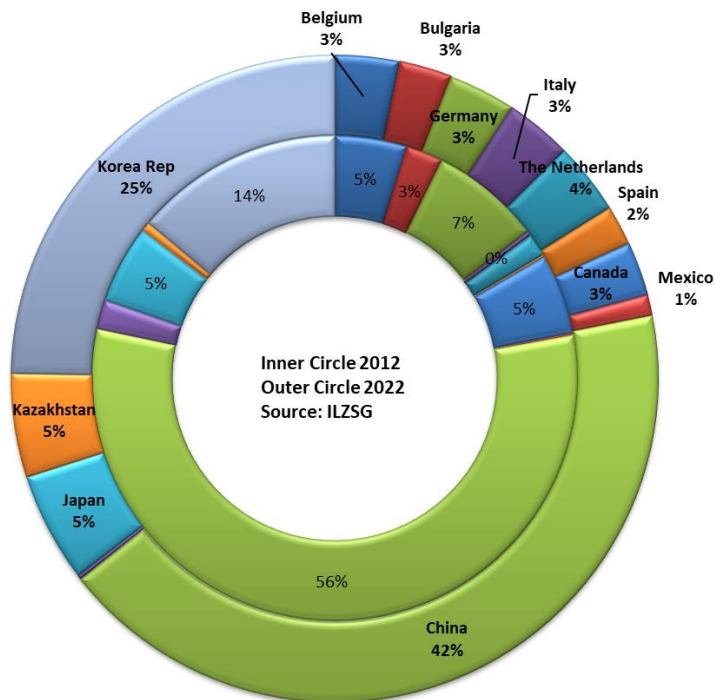


- Asian and European countries are major lead concentrate importers.
- Asia and Europe together accounted for over 95% of the world lead concentrate import trade volume in 2022.



- Countries in the Americas, Europe, and Oceania (Australia) are the major lead concentrate exporters.
- Australia's export volume decreased substantially over 2016-2017 due to mine closures but saw a recovery thereafter.

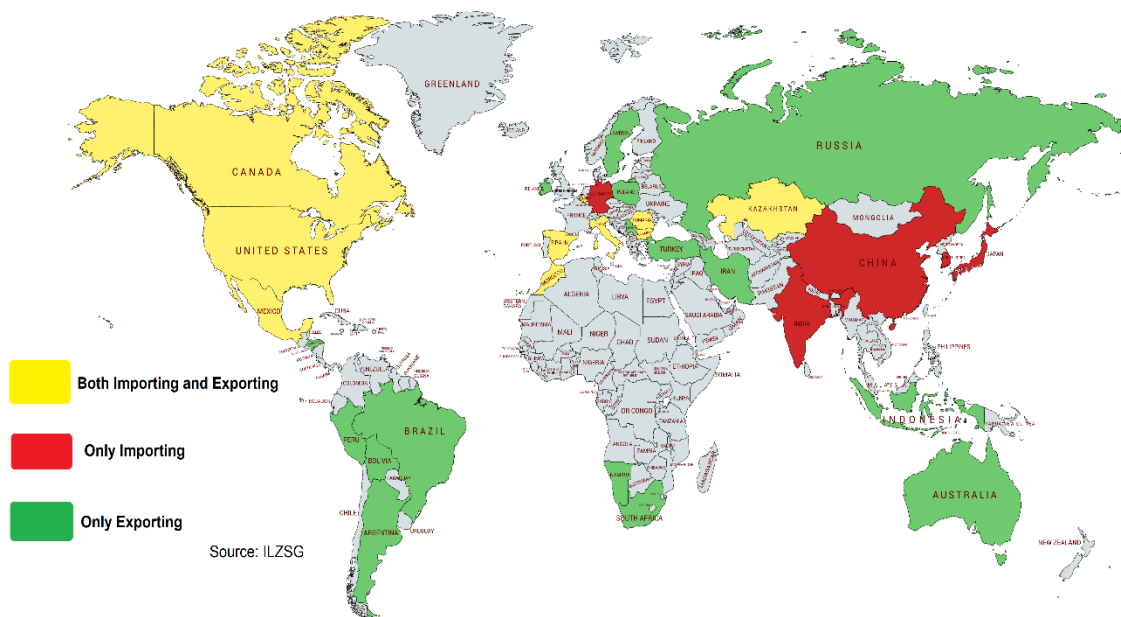
Concentrate Import Breakdown 2012 and 2022



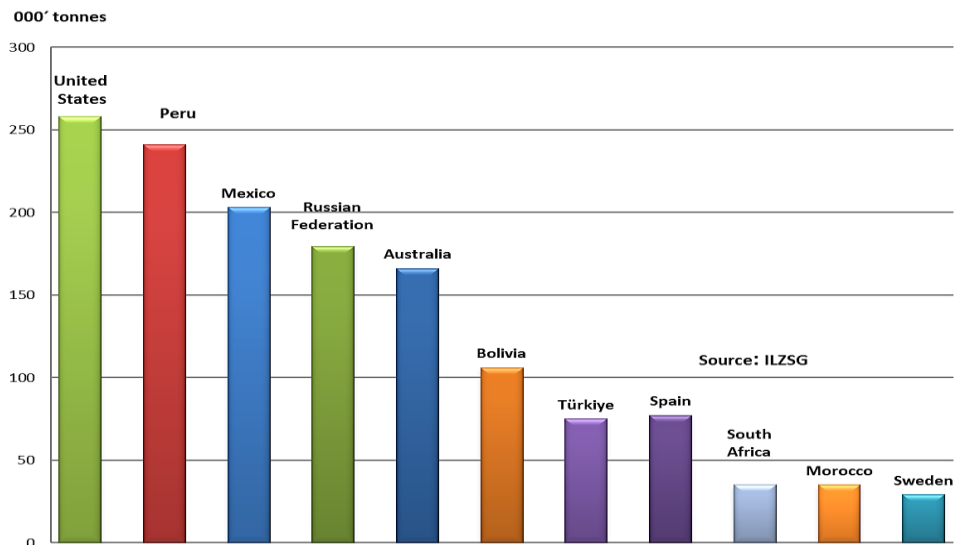
ILZSG data shows that

- China was the largest importer of lead concentrates over the period 2012-2022. However, its share dropped by nearly 15% over this time.
- South Korea's import volume grew substantially over this time.
- Canada's imports almost halved over the same period.
- Kazakhstan has recently emerged as a significant importing country.

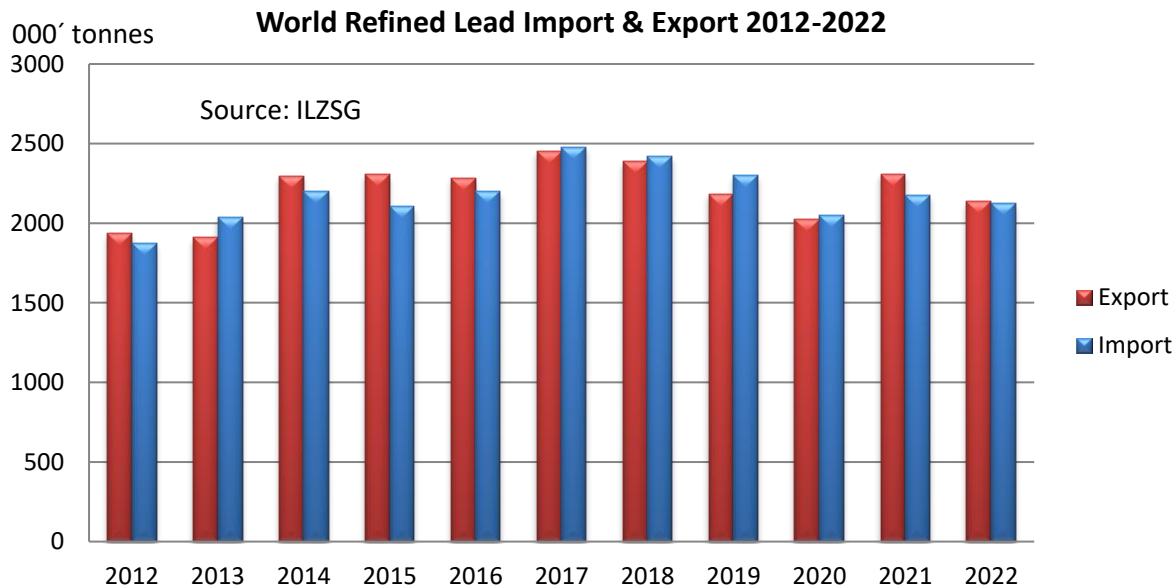
Main Lead Ore & Concentrate Importers & Exporters in 2022



Leading Lead Ore & Concentrate Exporters 2022

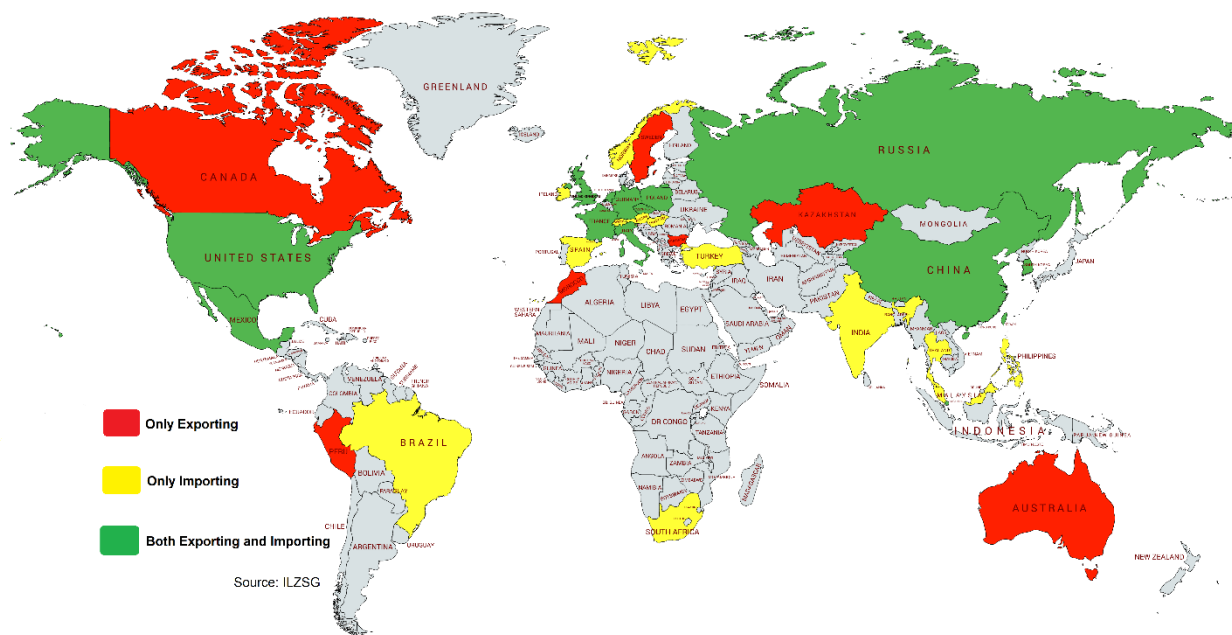


- The United States was the largest lead concentrate exporting country in 2022.
- Russia exported 230,000 tonnes of lead concentrate and ranked the third-largest exporter in 2021, it halted data report in Feb. 2022, and the mirror data for 2022 was 179512 tonnes.



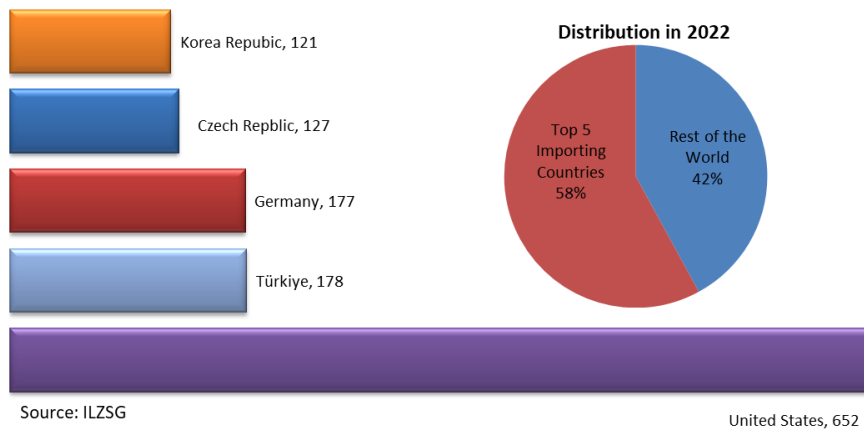
Over 2 million tonnes of refined lead metal are currently traded annually.

Main Refined Lead Metal Importers & Exporters in 2022

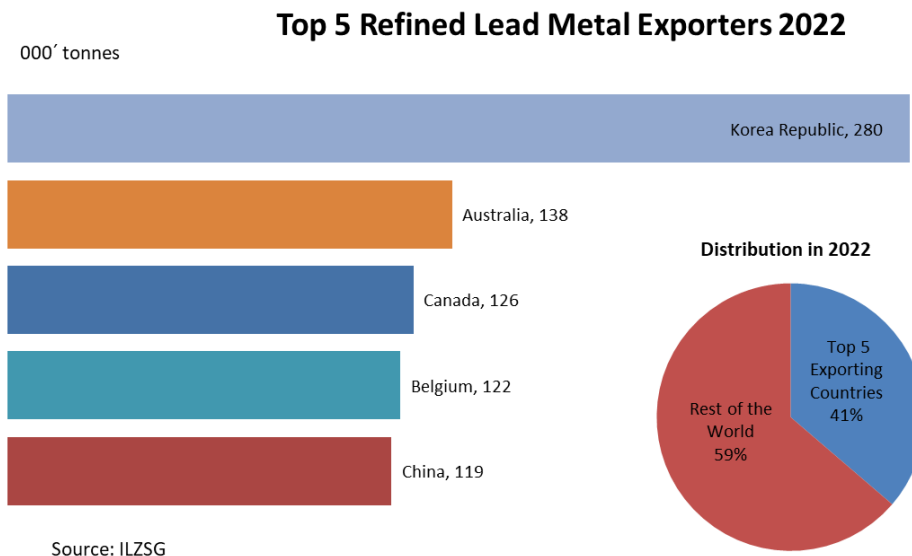


Top 5 Refined Lead Metal Importers 2022

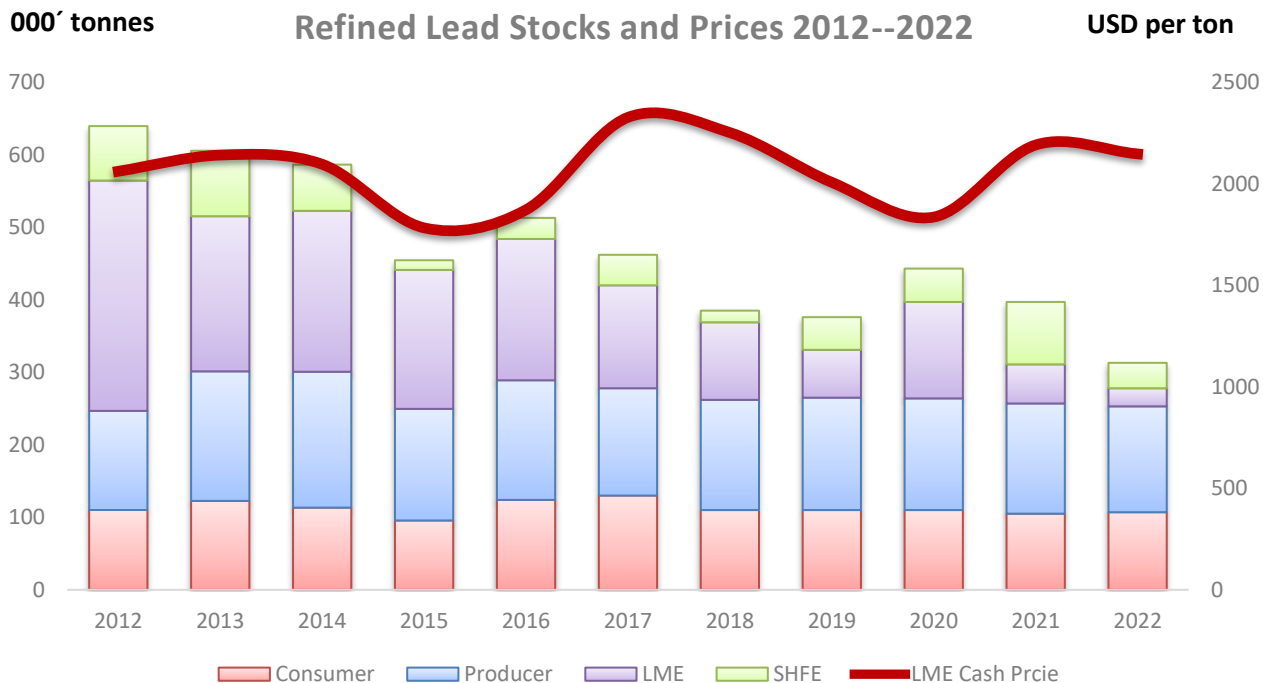
000' tonnes



- The United States was by far the largest refined lead importer in the world. Its imports exceeded the combined volume of the next 4 countries in the ranking for 2022
- The top 5 importing countries accounted for 58% of total world refined lead imports



- The Republic of Korea was the largest refined lead metal exporter in 2022
- The top 5 exporting countries accounted for 41% of total world refined lead exports



CHAPTER SIX: HEALTH, ENVIRONMENT AND SAFETY ISSUES

Pure lead is rare in nature. Currently lead is usually found in ores together with zinc, silver, and copper and is extracted together with these metals.

Over the past 50 years, there has been a significant reduction in the use of lead in gasoline, paint, and water transportation systems. In addition, the adoption of advanced and strict emission and exposure control measures has resulted in a substantial decrease in the levels of lead concentration in air, soil, and water.

The negative image of lead was inflated among the general public largely due to the wide use of leaded gasoline which generated lead particles in the air. With the ban on leaded gasoline in most countries in the world, lead levels in the air decreased substantially and are no longer a major source of lead exposure. Other atmospheric sources of lead in the air include forest fires, volcano eruptions, and the combustion of coal and wood. The most recent study by International Lead Association (ILA) suggests that approximately 50% of atmospheric lead in the environment originates from natural sources. Emission legislation regarding the lead mining, smelting, and lead-acid battery industries promoted the development of pollutant control technology and equipment. In addition, many production facilities have been upgraded to meet revised emission level requirements. Lead can accumulate in water and soil via a variety of channels. Lead pipes are still in use as a means of water transportation in a number of countries and corrosion of these pipes can result in the transmission of lead into the human body. The use of lead in paints, ceramics, leaded glasses etc. are also a source of lead emissions into water and soil.

In 2023, the ILZSG published an updated edition of its Environment and Health Controls on Lead report with detailed information on relevant legislation, initiatives, and regulations pertaining to lead.

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