

On Antimony

Energy Strategic Metal

Antimony

Liquid Metal (Molten Salt) Batteries

1) Understanding Antimony ...

Why Antimony named is Antimony?

- The name "antimony" comes from two Greek words: 'anti' meaning *not* and 'monos' meaning *alone*.
- The symbol for antimony, Sb comes from the Latin word *Stibium*, which was derived from the Greek name for the Stibnite powder used as a cosmetic.■

- Antimony was named after the Greek words **anti** and **monos** to mean “a metal not found alone.”
- The chemical symbol, Sb, comes from the element's historical name, stibium.
 - ❑ *Why is Antimony called Stibium?*
 - ❑ *The symbol for antimony, Sb comes **from the Latin word Stibium**, which was derived from the **Greek name for the Stibnite powder** used as a cosmetic.*
 - ❑ *This was in turn taken from the **Coptic word for the same** (Coptic being a language descended from ancient Egyptian).*



Antimony in short ...

Word origin:

- *Antimony* was named after the **Greek words: anti and monos** to mean “a metal not found alone.”
- The chemical symbol, Sb, comes from the element's historical name, stibium.

Discovery:

- *Antimony was a known metal in ancient times and was used heavily thereafter and especially in the 17th century.*

Properties of antimony:

- *Antimony is a silvery, lustrous gray metal.*
- *It is in the metalloid group of elements.*
- *It is a poor conductor of heat and electricity.*
- *The metal and its compound forms can be toxic.*

Sources of antimony:

- ❖ **Antimony is a rare element** but can sometimes be found naturally.
- ❖ However, it's mostly **in the form of its sulfide stibnite**.

Uses of antimony:

- ✓ *The pure form of antimony is used to make certain types of semiconductor devices, such as diodes and infrared detectors.*
- ✓ *An alloy of lead and antimony is used in batteries, low friction metals, small arms and tracer bullets, cable sheathing as well as other products.*
- ✓ *Other compounds of antimony are also used to make paints, glass, pottery, and ceramics.*

What is Antimony (Sb)?

- Antimony is recognised as a strategic metal.
- It is used as a flame retardant in children's clothes, toys, specialty clothing, plastic bottles, plastics, auto and aircraft seat covers, sofas, cushions, fluffy furniture.
- It is used as an alloying element in batteries, ammunition, cable sheaths, pumps and pipes.
- It is also used as a clarifying element in glass bottles and optical products.
- It has the unique property of expanding when cooled.
- Substitution has proved largely unsuccessful (0.64% according to EC report 07/2010)



Antimony ... extensive uses ...

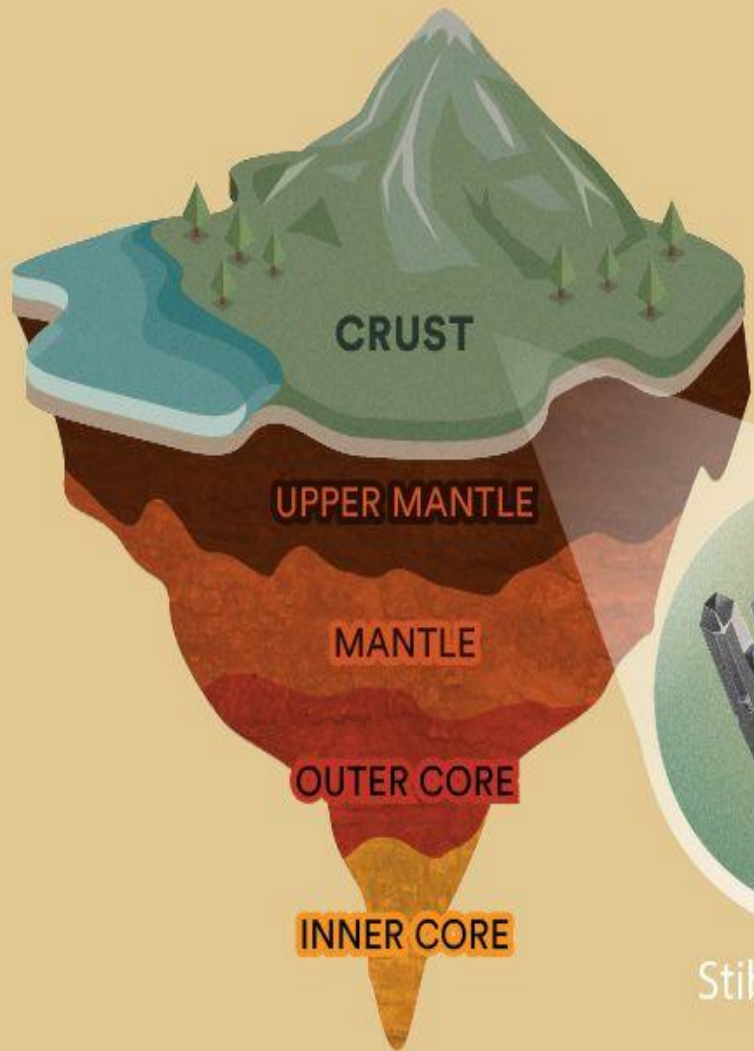
- Antimony is an element found in the **earth's crust**.
- **Rarely found in its native metallic form, it is primarily extracted from the sulfide mineral stibnite.**
- **It has a variety of uses and is found in everything from household items to military-grade equipment.**
- Because it conducts heat poorly, it's used as **a flame retardant in industrial uniforms, equipment, and even children's clothing.**
- Its second most common use, is in **transportation and batteries**. Traditionally, antimony has been combined with lead to create a strong, corrosion-resistant metal alloy, which is particularly useful in **lead-acid batteries**.
- However, recent innovation has found a new use for antimony—it now plays an essential role in **large-scale renewable energy storage**, which is critical to the clean energy movement.

ANTIMONY

LAYERED TYPE
SYSTEM BUILT
FOR CREATIVE
VERSATILITY



Location of Antimony ...



What is Antimony?

Antimony is an element found in the **earth's crust**, rarely found in its native metallic form.

It typically combines with other elements, usually along with sulphur, to form over 100 different minerals.

Stibnite Sb_2S_3



Appearance of Antimony ...



2) Importance of Antimony

Importance of Antimony ...

- ❑ Our current way of life is dependent upon antimony.
- ❑ From wind and hydro turbines to semiconductors and cellphones, *Antimony is a key component of the technology that powers any country, that keeps us entertained and, on the move, as well as the technology that keeps every country safe.*
- ❑ Designated as one of the 35 critical minerals antimony is a very important mineral.
- ❑ It strengthens alloys and makes them resistant to corrosion and is a key ingredient in flame retardants.
- ❑ These properties make it a **highly valuable mineral** *for the military and energy sectors*, as well as preventing our homes and belongings from being fire hazards.
- ❑ **In fact, Antimony has always been an important mineral for national defense.** *During World War II, young men could complete their military service up at Stibnite because antimony was critical to winning the war.*

Importance of Antimony ...

Antimony powers any country-economy-nation:

- ✓ Solar panels, wind turbines, generators, motors, batteries, nuclear reactors, and other energy sources that any nation depends up **contain antimony.**

Antimony keeps us entertained and on the go:

- ✓ Smartphones, computers, semi-conductors, cars, and other high-tech devices and machines depend on antimony **to operate efficiently.**

Antimony keeps any country-economy-nation safe:

- ✓ Communication systems, night vision goggles, ammunition, tanks, infrared sensors, submarines, warships, camouflage, flame retardants, and many other military technologies are dependent upon antimony **to operate effectively.**

Importance of Antimony ...



**DEPENDENT
ON MINING**



Importance of Antimony ...

GLOBAL ANTIMONY MARKET, EXECUTIVE SUMMARY

By Product Type

TRIOXIDES
ALLOYS
OTHERS

By Application

LEAD-ACID BATTERIES
GLASS & CERAMICS
FLAME RETARDANTS
PLASTIC ADDITIVES



By Geography

OVERVIEW
NORTH AMERICA
EUROPE
ASIA PACIFIC
REST OF THE WORLD

COMPANY PROFILES

NIHON SEIKO Co., LTD
HUACHANG ANTIMONY INDUSTRY
RECYCLEX
KOREA ZINC
AMG ADVANCED METALLURGICAL GROUP

GLOBAL ANTIMONY MARKET OPPORTUNITIES AND FORECAST



GLOBAL MARKET IS EXPECTED
TO REACH **US\$ 16.78 Bn**
BY 2026 GROWING AT A CAGR OF
3.17%

Importance of Antimony ...

The market is expected to **REGISTER** a **CAGR** of over

5.8%



27.3%

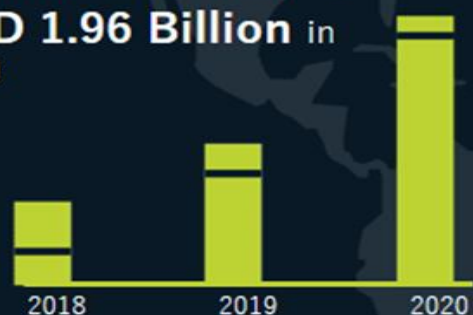
of the market share was accounted for by North America



During the forecast period, the antimony trioxide is segment is expected to register a CAGR of

7.4%

The market was valued at **USD 1.96 Billion** in 2020



The market is **FAIRLY FRAGMENTED** with numerous players accounting for a significant market share



One of the **KEY DRIVERS** of market growth is durability and fire-resistance attribute of antimony

READ
THE
REPORT:

GLOBAL ANTIMONY MARKET 2018–2028

Trends & Latest Highlights



A cluster of translucent, prismatic antimony mineral crystals is positioned on the left side of the slide, partially overlapping the word 'ANTIMONY'. The crystals have various shades of light blue, white, and pinkish-red.

ANTIMONY

**A MINERAL WITH A CRITICAL ROLE
IN THE GREEN FUTURE**

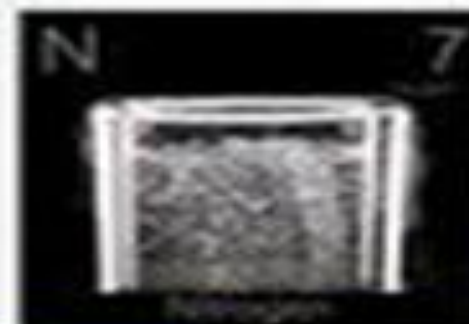
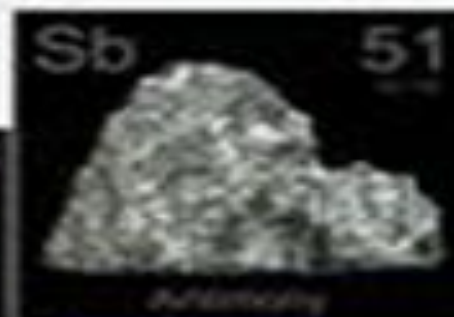
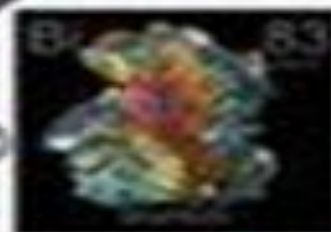
Antimony plays a significant role in our day-to-day lives. Yet many people don't know what it is, how it's used, or why it's considered a critical mineral.

Importance of Antimony ...

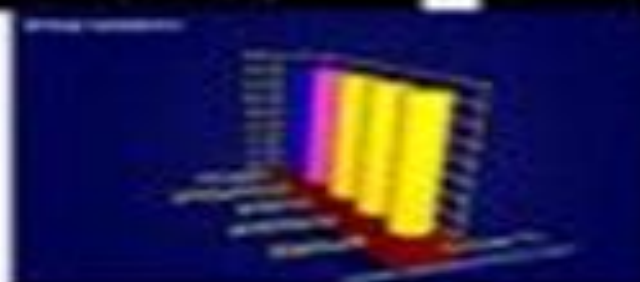
Antimony

Basic Info

The symbol for Antimony is (Sb)
The atomic number is (51)
The average atomic mass is 121.760 (u)
There are 51 protons in Sb
There are 31 neutrons in Sb
There are also 51 electrons in Sb
Antimony is solid
It is classified as a semi metal
Molar mass is 121.760 g/mol



Electron Configuration
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 $3d^{10} 4p^6 5s^2 4d^{10} 5p^3$



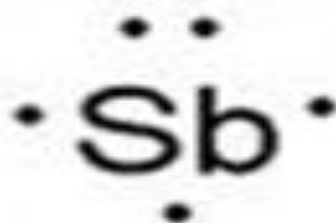
Fun

Antimony is a metal that has been around for very long, but you had to get it out of the ground. It was used for eyes jewelry and pots after it got really hot

Physical Properties

Melting point is 630-63 °C
Boiling point is 1587 °C
Antimony has 5 valence electrons
Oxidation states are (5, 3, -3)
The most stable isotopes are (121 Sb, 123 Sb, 125 Sb)

Antimony is a metalloid. A metalloid is an element that has characteristics of both metals and non-metals



Nitrogen Family

Nitrogen (N),
Phosphorus (P),
Arsenic (As),
Antimony (Sb), and
Bismuth (Bi)

History of Antimony

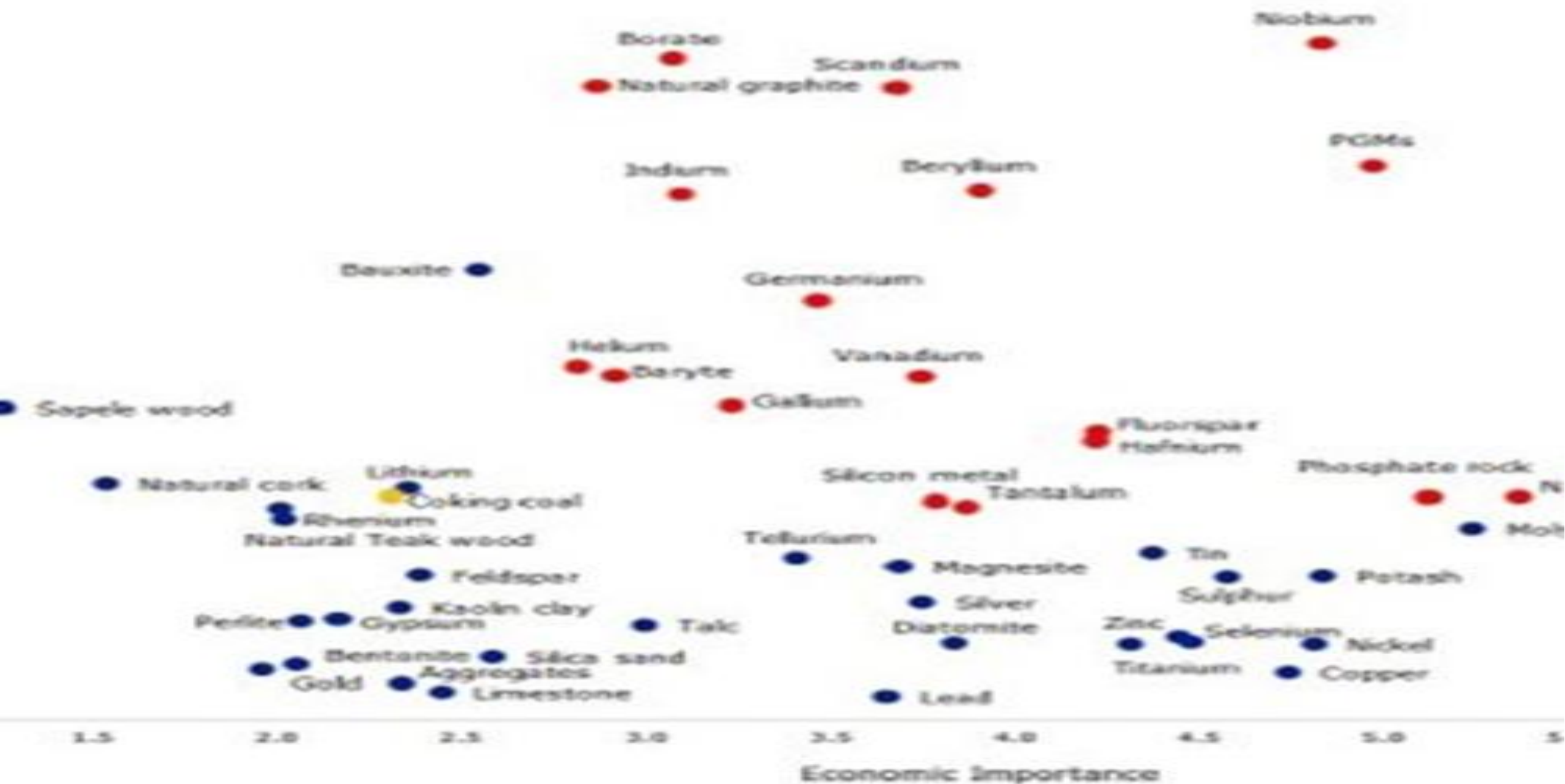
Antimony compounds have been used by humans for centuries. Women of ancient Egypt used stibic stone, antimony sulfide, to darken their eyes. Antimony was also used in making colored glasses for beads and glassware. The chemical symbol for antimony was taken from the ancient name for the element, stibium. Not recognized as a chemical element until the 18th century



Importance of Antimony ...

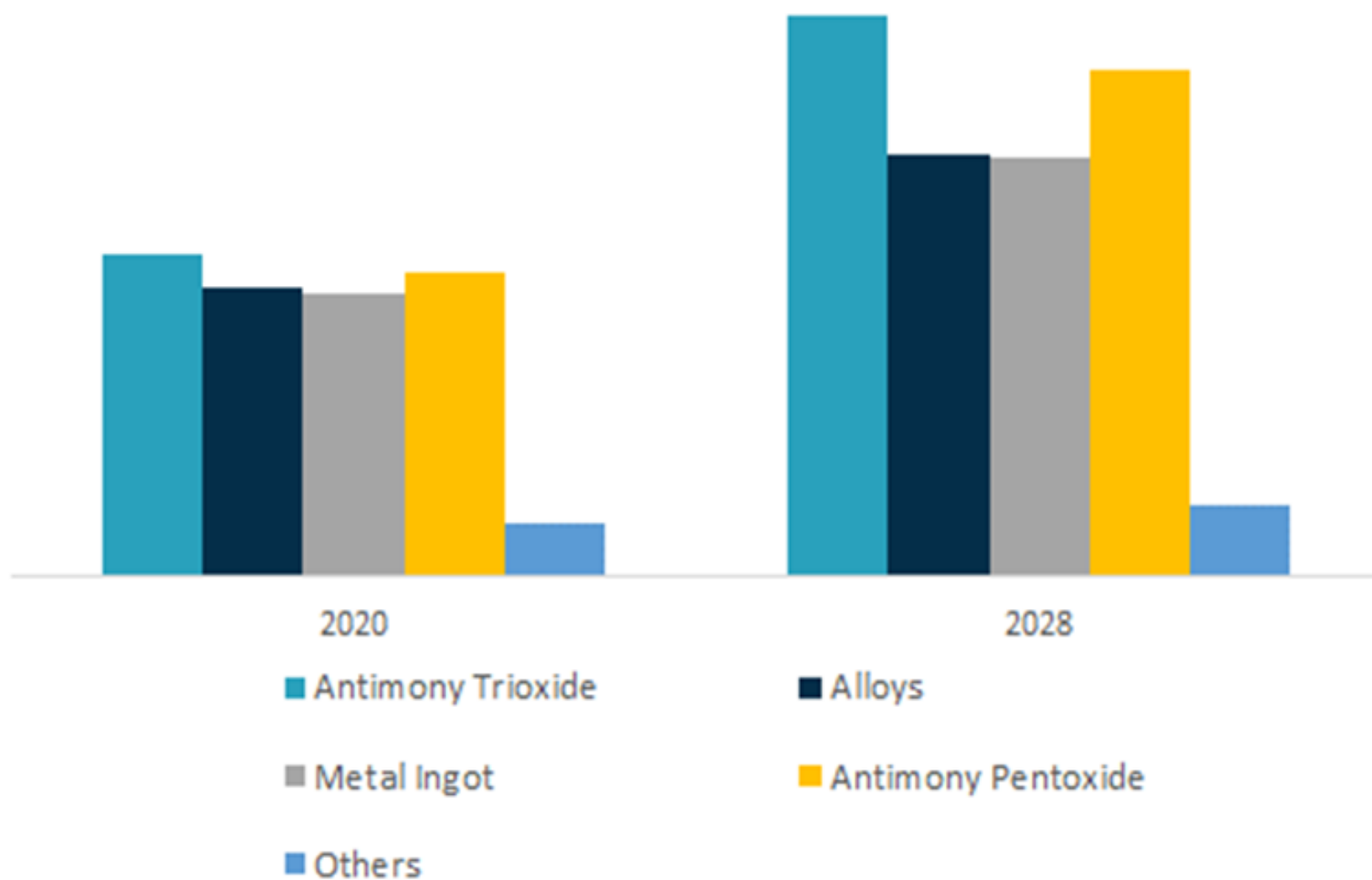


Comparative Economic Importance of Antimony ...*NOW*



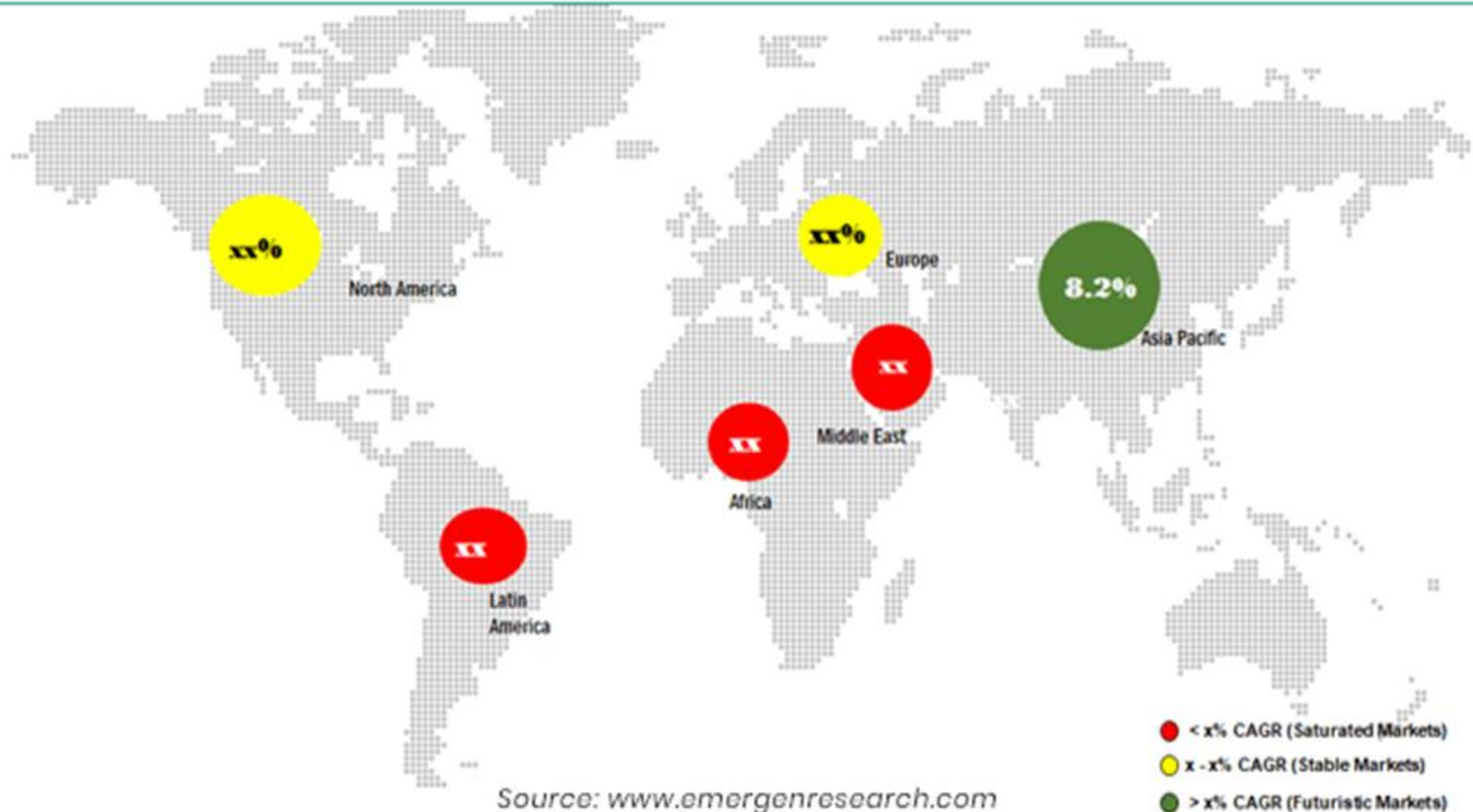
Antimony Dynamics ...

ANTIMONY MARKET: PRODUCT TYPE DYNAMICS (USD BILLION)



Antimony Opportunities ...

REGIONAL DYNAMICS: ANTIMONY MARKET OPPORTUNITIES



objectivecapital

RARE EARTHS, SPECIALITY & STRATEGIC METALS INVESTMENT SUMMIT



Antimony
James Cross –Director, [Adroit Resources](#)



ADROIT
RESOURCES

3) Antimony in the future ...

Antimony is Critical ...

ANTIMONY: IT'S CRITICAL

PUBLISHED MARCH 2, 2021

Critical minerals like [Antimony](#) get a lot of attention. But why?

- Minerals are a key part of our everyday lives.
- Without them we wouldn't have iPhones, safe bridges to drive on, engines for our cars or a well-prepared military to keep us safe.
- Nations and economies rely upon and are dependent on others for:
 - ❑ *Raw Materials (especially minerals)*
 - ❑ *Manufactured Products & Services*
- Even the strongest superpower today, the U.S. depends on foreign countries for half of the key minerals they use and their reliance on foreign nations for mineral resources has doubled in the last twenty years.

Antimony: A Mineral with a Critical Role in the Green Future

- If someone asked you to name the first mineral that came to mind, odds are, it wouldn't be antimony.
- Yet, despite its lack of fanfare, it plays a significant role in our day-to-day lives.
- Antimony's key uses, and the critical role it plays in the movement towards clean energy, among other uses.

Antimony & Green Energy

Antimony's Role in Clean Energy

- **Large-scale renewable energy storage** has been a massive hurdle for the clean energy transition, because **it's hard to consistently generate renewable power**.
- For instance, wind and solar farms might have a surplus of energy on windy or sunny days, but can fall short when the weather isn't sunny, or when the wind stops.
- Because of this, **mass storage of renewable energy is key**, in order to transition from fossil fuels to clean energy.
- Recent research points **to liquid metal batteries as a potential storage solution**—and these batteries heavily rely on antimony.

Therefore, Antimony is important & critical for ...

A) Energy ...

- ✓ Antimony is a rare mineral extremely imperative and vital for the
 - energy industries
- ✓ Due to antimony's hardening properties and corrosion protection, the energy industry — including renewable — utilizes it in **wind turbines** and **nuclear energy**.
- ✓ Finally, when you read something on your **phone or computer**, you can thank antimony as it helps to make glass clear and doesn't impact its color.

... especially ... **for Solar Panels** *...(crucial for Cyprus)...*

➤ **Today, antimony plays a role in SOLAR PANELS for its**

- transparent,
- infrared insulating, and
- electrical conduction properties.

- ❖ *Especially, Antimony selenide may become a key component in solar panels.*
- ❖ *This compound is known as a solar absorbing material which means it can be used to turn light into electricity. What is unique about this semi-conducting compound is that it can self-heal.*
- ❖ *This self-healing characteristic is incredibly unusual and will likely allow the antimony-selenide compound to find widespread application in electronics, solar panels, and other photovoltaics, as well as lighting and display systems.*

B) Batteries ...

- ✓ **The future of antimony is crucial with its use in next-generation technology.**
- ✓ **Antimony's applicability in**
 - ❑ *molten-salt batteries*
 - ❑ *solid-state batteries*
 - ❑ *semi-conductors*
 - ❑ *self-healing solar panels*
- ✓ **MIT has developed an antimony-based liquid battery that will allow for the large-scale storage of renewable energy.**
 - ❖ *This technology is currently being used at a Nevada data center.*
 - ❖ *This development will help renewable energy sources compete with traditional power plants.*
 - ❖ *This further increase the need for a domestic source of antimony.*
- ✓ **Researchers from Texas, Germany, and India have also created various solid-state batteries that use Magnesium-Antimony and Silver-Antimony-Telluride compounds to capture and convert what is known as waste heat into electricity.**
 - *Waste heat refers to the excess energy generated by power plants and other machines or processes that is not converted into usable energy and is typically released as heat.*
 - *This new development will help reduce the amount of wasted energy and further support a more sustainable future.*
- ✓ **Some experts have even theorized that antimony will replace silicon as the key semiconductor for microchips.**
 - *Because 2D antimony is incredibly thin but also maintains high charge mobility.*
 - *Meaning, that the speed at which the charge moves through the antimony is very high.*
 - *Antimony's charge mobility is higher than that of silicon and thus will allow for microchips and next-generation processors to become ever smaller.*

C) Defense ...

- ✓ Antimony is imperative and vital for the
 - energy industries
but also, is very important for
 - defense
- ✓ Antimony is considered a critical mineral by all Defense Department officials.
- ✓ Because the military needs Antimony for
 - * **all conventional munitions, &**
 - * **high-tech electronics**
such as
 - ❑ *night vision goggles*
 - ❑ *communications equipment and*
 - ❑ *infrared sensors*

4) Case Example of Antimony importance for USA ...

Case USA: Antimony Consumption in the USA (2021)	
End Use	% of antimony consumption in the U.S.
Flame retardant	35%
Transportation and batteries	29%
Chemicals	16%
Ceramics and glass	12%
Other	8%

Case USA: Superpowers & Antimony ... *What the USA does ?...*

- Right now, the U.S. gets most of this mineral from China and Russia – which control more than 80 percent of the world's antimony production.
- Yet, the USA dependence on other countries for materials and goods is creating vulnerability.
- In 2017, the USA Department of the Interior declared 35 minerals vital to U.S. interests based on our economic and national security needs.
- The list includes minerals that are key components of electronics, military equipment and weapons, transportation devices, energy generation and many other industries that help power and protect the USA.
- As recognized by multiple Presidential administrations and across political parties, the USA economic growth, safety and way of life is dependent on our ability to access the minerals and metals *that build satellites, missile defense systems, roads and bridges, computers, batteries and other technology.*

Case USA: *Focus on Antimony ...*

- Today, the USA is reliant on China and Russia to meet our antimony demands.
- The USA focuses on critical minerals, and antimony is a key mineral used in essential technology like semiconductors and large-scale battery storage.
- Currently, the USA is in the process of permitting America's only mined source of this mineral.
- *President Joe Biden issued an [Executive Order](#) on February 24, 2021, to further study our reliance on foreign nations and the need for a more resilient supply chain. We are excited by the news because, like the President, we know access to critical minerals is key to a secure and sustainable future for all of us. The Administration will evaluate supply chain risks in four specific areas – semiconductor manufacturing, high-capacity batteries, critical minerals, and pharmaceuticals.*
- **Idaho's Stibnite Gold Project could supply approximately 30 percent of the American demand for antimony in the first six years of production.**
- **The Stibnite Gold Project will provide more minerals from the list of 35 Critical Minerals, because it is essential to the energy, technology, and defense industries.**

Case USA: Mining, Control, and Geopolitics with Antimony ...

- ❖ Unfortunately, the U.S. Geologic Survey (USGS) reports that the domestic supply of this wonder mineral is limited and, worse, at risk with neither a strategic stockpile nor current domestic production.
- ❖ In fact, there was zero domestic mine production of antimony last year and with its importance to our defense and energy industries, we are left with no other choice but to depend on imports — from China which is our leading source of antimony, followed by Russia, another global predator.
- ❑ China produces most of the world's antimony, yet uncertainties abound in the supply chain due to the continually changing political environment in Beijing.
- ❑ Making matters worse, in 2013, the Chinese government imposed antimony export restrictions that reduced availability and increased prices.
- ❑ China has repeatedly used its control of various mineral supply sources and supply chains as a hatchet for political purposes against the U.S. and its western allies.
- ❑ Chinese officials have raised the restriction of critical and rare earth minerals during trade negotiations.

5) Uses of Antimony

Uses of Antimony

Antimony is finding use in semiconductor technology for making infrared detectors, diodes, and hall effect devices.

Uses of Antimony ...

GLOBAL ANTIMONY MARKET, EXECUTIVE SUMMARY

By Product Type

TRIOXIDES
ALLOYS
OTHERS

By Application

LEAD-ACID BATTERIES
GLASS & CERAMICS
FLAME RETARDANTS
PLASTIC ADDITIVES



By Geography

OVERVIEW
NORTH AMERICA
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ASIA PACIFIC
REST OF THE WORLD

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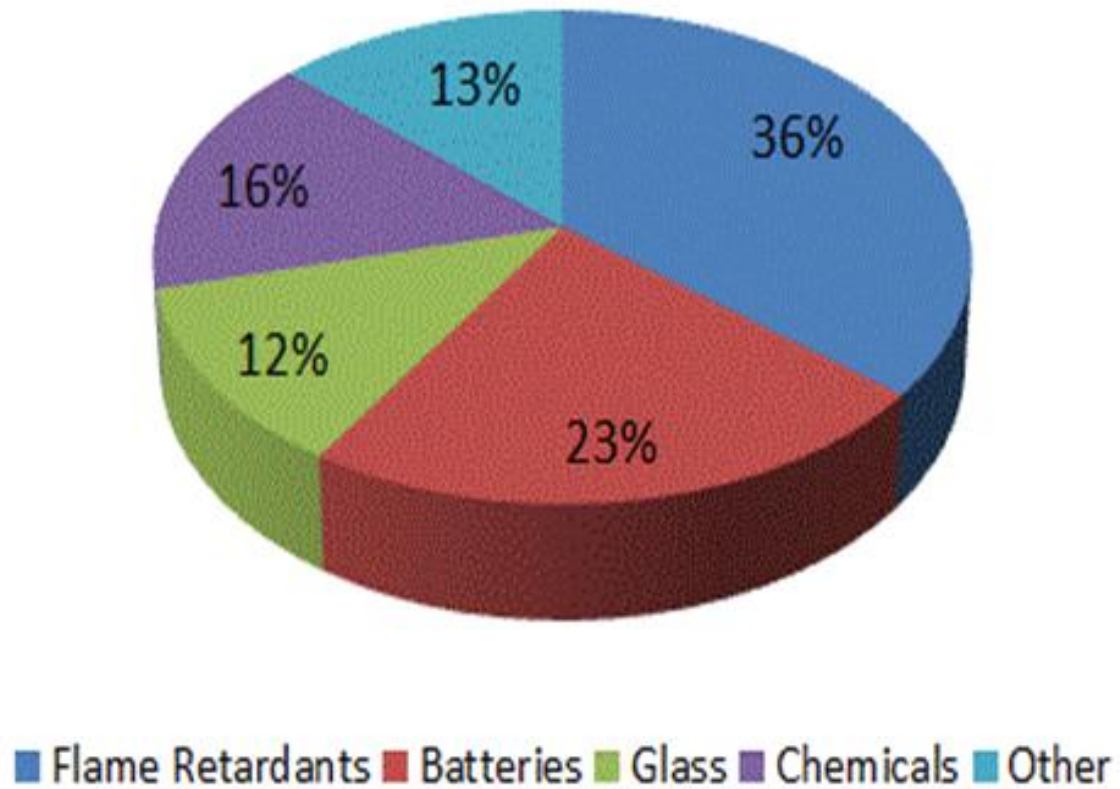
GLOBAL ANTIMONY MARKET OPPORTUNITIES AND FORECAST



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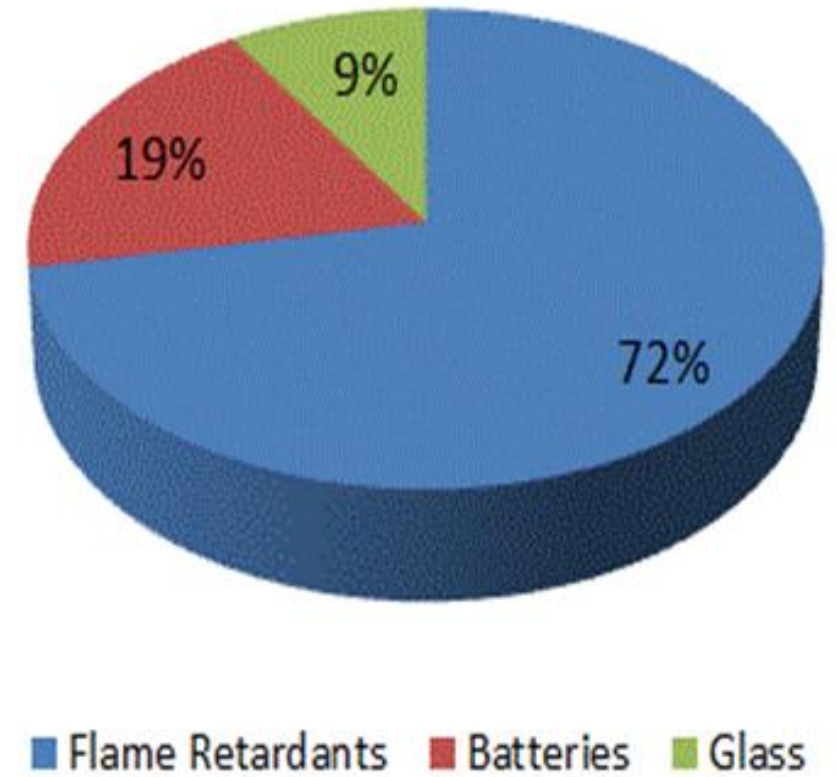
Uses of Antimony ...

Antimony by Use: US Geological Report



Source: USGS, 2012

Antimony by Use: European Commission Report

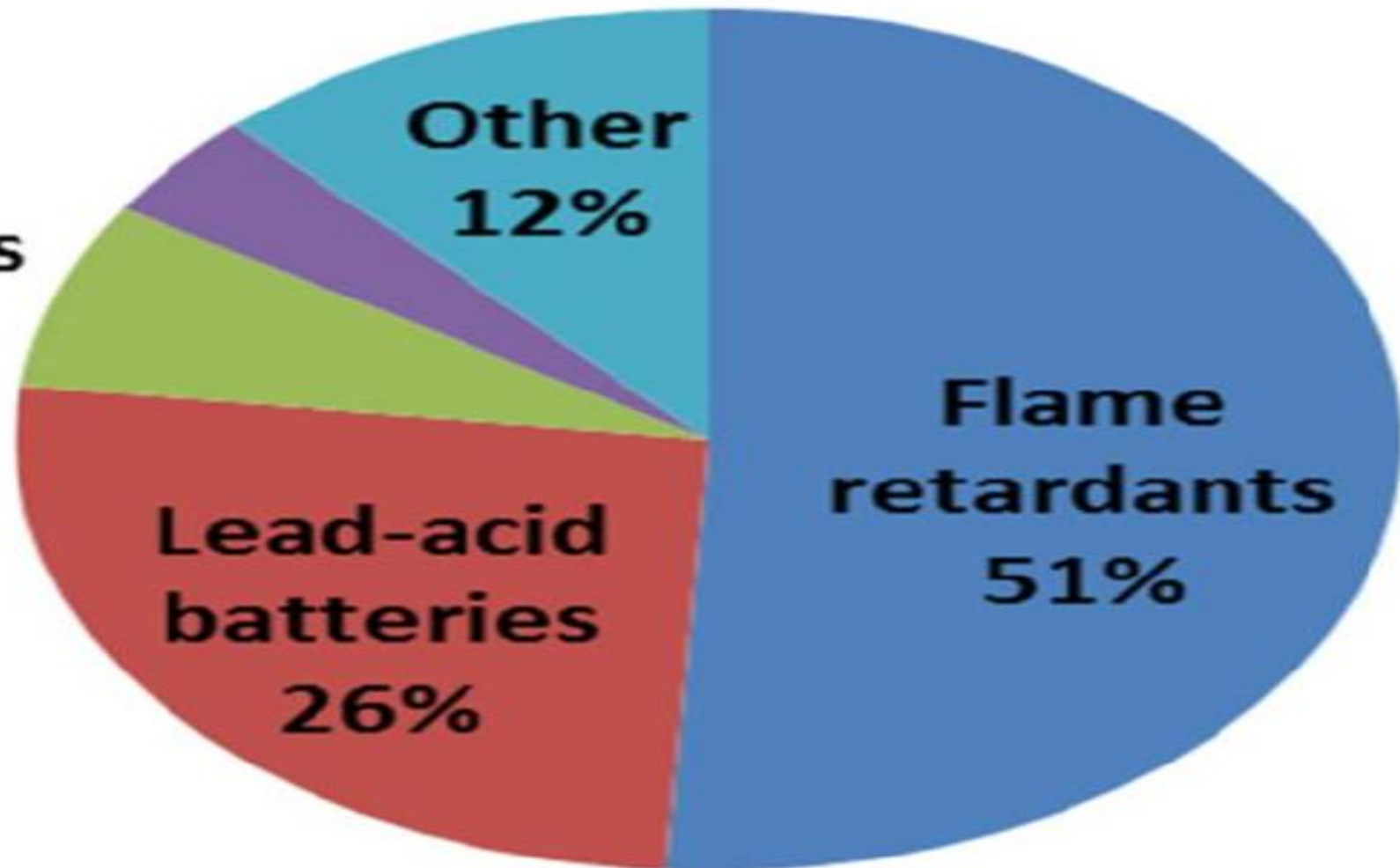


Source: EC, 2010

Principal Antimony End-uses

**Ceramics
and glass
4%**

**Chemicals
7%**



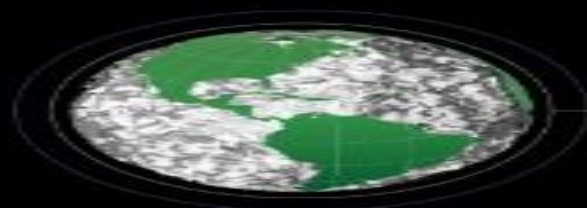
**Lead-acid
batteries
26%**

**Other
12%**

**Flame
retardants
51%**

A N T I M O N Y

FIREPROOF AND SUPPLY-CRITICAL



ANTIMONY IS A NATURALLY OCCURRING ELEMENT IN THE EARTH'S CRUST. IN ITS PURE METALLIC FORM, IT IS SOFT, BRITTLE AND TOXIC TO HUMANS.



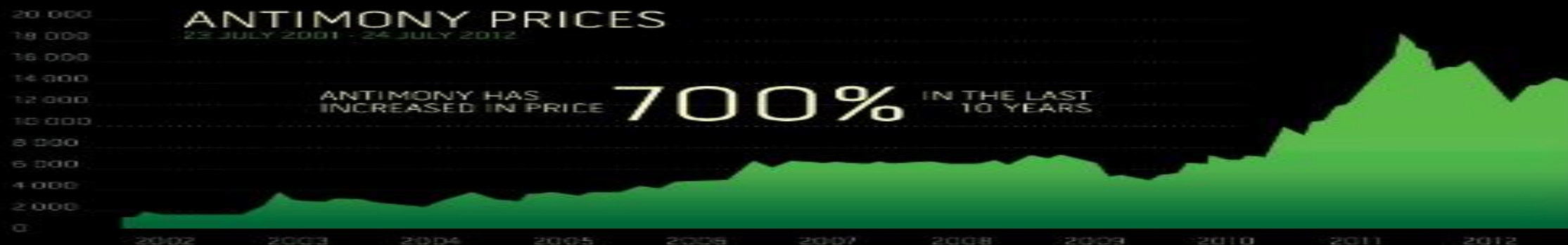
DON'T SWALLOW ANYTHING THAT'S MORE THAN 0.05% ANTIMONY - IT WILL COME RIGHT BACK UP!



ANTIMONY PRICES

23 JULY 2001 - 24 JULY 2012

ANTIMONY PRICE (USD / MT (99.95% S))



ANTIMONY HAS INCREASED IN PRICE **700%** IN THE LAST 10 YEARS

WILL IT CONTINUE ?

ANTIMONY USES

250 000
200 000
150 000
100 000
50 000



2011

OTHER

LEAD ALLOYS

LEAD-ACID BATTERIES

GLASS & CERAMICS

FLAME RETARDANTS



LEAD ALLOYED WITH ANTIMONY IS STRONGER AND HARDER - ESPECIALLY USEFUL IN THE LEAD-ACID BATTERIES FOUND IN CARS.

ANTIMONY ACTS AS A DECOLOURIZING AGENT WHEN ADDED TO OPTICAL GLASS. THIS IS USEFUL IN CAMERAS, BINOCULARS, AND IPAD SCREENS.



WHEN MIXED WITH ANTIMONY, PLASTICS AND ELECTRONICS CAN BE USED IN APPLICATIONS WHERE THEY WOULD OTHERWISE MELT.

NOT ONLY IS ANTIMONY BASED FIRE-PROOFING SUPERIOR TO THE COMPETITION, BUT MOST INDUSTRIALIZED COUNTRIES REQUIRE BY LAW THAT CLOTHES AND HOUSEHOLD PLASTICS ARE FLAME RESISTANT.



CONVENTIONAL DEMAND GROWTH:

3%

ANNUAL GROWTH IN THE FLAME RETARDANT SECTOR WILL DRIVE GLOBAL ANTIMONY CONSUMPTION UPWARD BY MORE THAN **18% BY 2016**.

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FUTURE APPLICATIONS



WHICH COULD BE THE NEXT GENERATION OF COMPUTER MEMORY.

ANTIMONY IS A KEY COMPONENT IN PHASE-CHANGE MEMORY

COULD LEAD TO 1 GIGAHERTZ TRANSFER SPEEDS



A BREAKTHROUGH IN THIS FIELD WOULD CAUSE AN UNPRECEDENTED JUMP IN ANTIMONY DEMAND.

ANTIMONY SUPPLY

GLOBAL PRODUCTION OF ANTIMONY IS DOMINATED BY CHINA, AND RESERVES ARE RUNNING LOW.

GLOBAL RESERVES: 1,831,000 TONNES

2011 MINE PRODUCTION
[203,500 TONNES]

THAT IS JUST NINE YEARS AT CURRENT PRODUCTION RATES

BY COUNTRY

LEGAL CHINESE PRODUCTION

WHILE CHINA ACCOUNTS FOR NEARLY HALF OF ALL REMAINING ANTIMONY RESERVES, IT HAS NEARLY EXHAUSTED ITS SUPPLY OF HIGH GRADE ANTIMONY ORE.



ILLEGAL CHINESE PRODUCTION

17% OF GLOBAL ANTIMONY SUPPLY IS CURRENTLY SOURCED FROM MANY SMALL, POLLUTING, AND ILLEGAL ANTIMONY MINING OPERATIONS IN CHINA. REGULATORS ARE BEGINNING TO IDENTIFY AND CLOSE DOWN THESE OPERATIONS - IF SUCCESSFUL GLOBAL ANTIMONY SUPPLY COULD BE SIGNIFICANTLY REDUCED.

CHINA - LEGAL: 55%
CHINA - ILLEGAL: 17%
OTHER ASIA: 1%
RUSSIA: 5%



FUTURE APPLICATIONS



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THE ONLY ANTIMONY MINE IN PRODUCTION IN NORTH AMERICA IS LOCATED IN EMERAL, NEWFOUNDLAND, CANADA.



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CHINA - LEGAL	55%
CHINA - ILLEGAL	17%
OTHER ASIA	1%
RUSSIA	5%
TAJIKISTAN	5%
NORTH AMERICA	3%
SOUTH AMERICA	3%
MYANMAR	2.5%
SOUTH AFRICA	1.5%
AUSTRALIA	1%

OUTLOOK

WORLD: ANTIMONY DEMAND AND SUPPLY FORECAST
2005-2016 (T SB)



STRONG DEMAND FOR ANTIMONY COMBINED WITH DWINDLING AND PRECARIOUS SUPPLY WILL ONLY EXACERBATE THE CURRENT SUPPLY DEFICIT.

EXPECTED DEMAND

POSSIBLE PRODUCTION RANGE, ACTUAL PRODUCTION DEPENDENT ON HOW MANY ILLEGAL MINES IN CHINA ARE SHUT DOWN.

BY COUNTRY

LEGAL CHINESE PRODUCTION

WHILE CHINA ACCOUNTS FOR NEARLY HALF OF ALL REMAINING ANTIMONY RESERVES, IT HAS NEARLY EXHAUSTED ITS SUPPLY OF HIGH-GRADE ANTIMONY ORE.

THE ONLY ANTIMONY MINE IN PRODUCTION IN NORTH AMERICA IS LOCATED IN CENTRAL NEWFOUNDLAND, CANADA.

17% OF GLOBAL ANTIMONY SUPPLY IS CURRENTLY SOURCED FROM MANY SMALL, POLLUTING, AND ILLEGAL ANTIMONY MINING OPERATIONS IN CHINA.

REGULATORS ARE BEGINNING TO IDENTIFY AND CLOSE DOWN THESE OPERATIONS - IF SUCCESSFUL GLOBAL ANTIMONY SUPPLY COULD BE SIGNIFICANTLY REDUCED.

CHINA - LEGAL:	55%
CHINA - ILLEGAL:	17%
OTHER ASIA:	7%
RUSSIA:	5%
TAJIKISTAN:	5%
NORTH AMERICA:	3%
SOUTH AMERICA:	3%
MYANMAR:	2.5%
SOUTH AFRICA:	1.5%
AUSTRALIA:	1%

OUTLOOK

WORLD: ANTIMONY DEMAND AND SUPPLY FORECAST 2005-2016 (T SB)



STRONG DEMAND FOR ANTIMONY COMBINED WITH DWINDLING AND PRECARIOUS SUPPLY WILL ONLY EXACERBATE THE CURRENT SUPPLY DEFICIT.

EXPECTED DEMAND

POSSIBLE PRODUCTION RANGE.
ACTUAL PRODUCTION DEPENDENT
ON HOW MANY ILLEGAL MINES IN
CHINA ARE SHUT DOWN.

AS THE WORLD SAW WITH GRAPHITE AND RARE EARTH ELEMENTS, SUPPLY DEFICITS CAN LEAD TO LARGE OPPORTUNITIES FOR INVESTMENT. THE PRICE OF ANTIMONY IS EXPECTED TO INCREASE 5% ANNUALLY, REACHING \$20,000 PER TONNE BY 2020.

VISUAL CAPITALIST IS COMMITTED TO PROVIDING INDEPENDENTLY RESEARCHED CONTENT FOR EDUCATIONAL PURPOSES.

THANKS TO VIRAL NETWORK INC. FOR COVERING THE PRODUCTION COSTS OF THIS PROJECT. LEARN MORE AT GREATATLANTICRESOURCES.COM

Properties and uses of Antimony

Properties

- Melting Point: 630.0 °C (903.15 K, 1166.0 °F)
- Boiling Point: 1750.0 °C (2023.15 K, 3182.0 °F)
- Atomic number: 51
- Atomic mass: 121.76
- Color is bluish-white
- Antimony is brittle; 5 forms

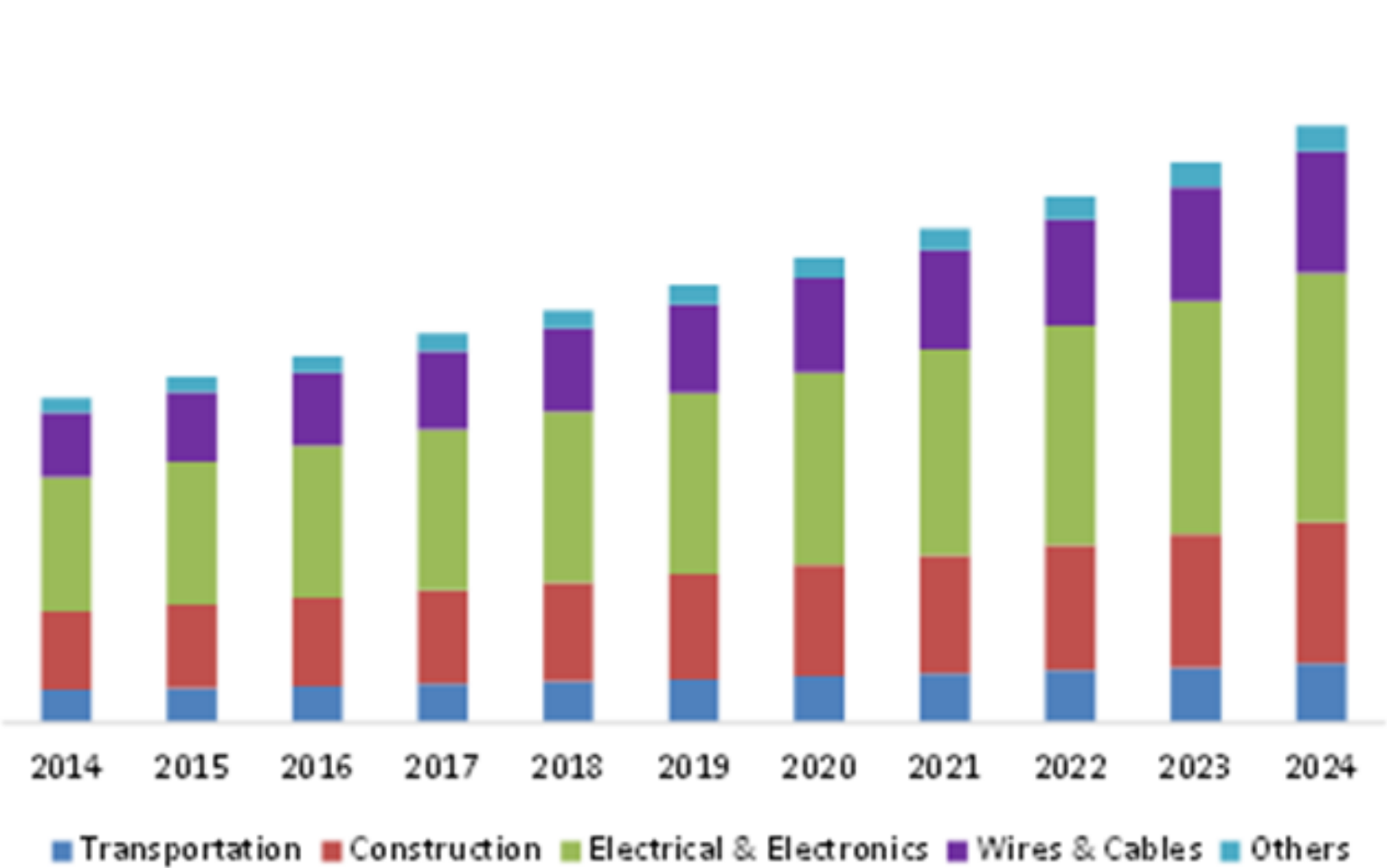
Uses

- Is in batteries
- Used for dyeing
- Used in detectors
- Used in diodes
- Also used in hall-effect devices

The chemical symbol for Antimony, 'Sb', is displayed in a large, white, serif font against a black rectangular background.

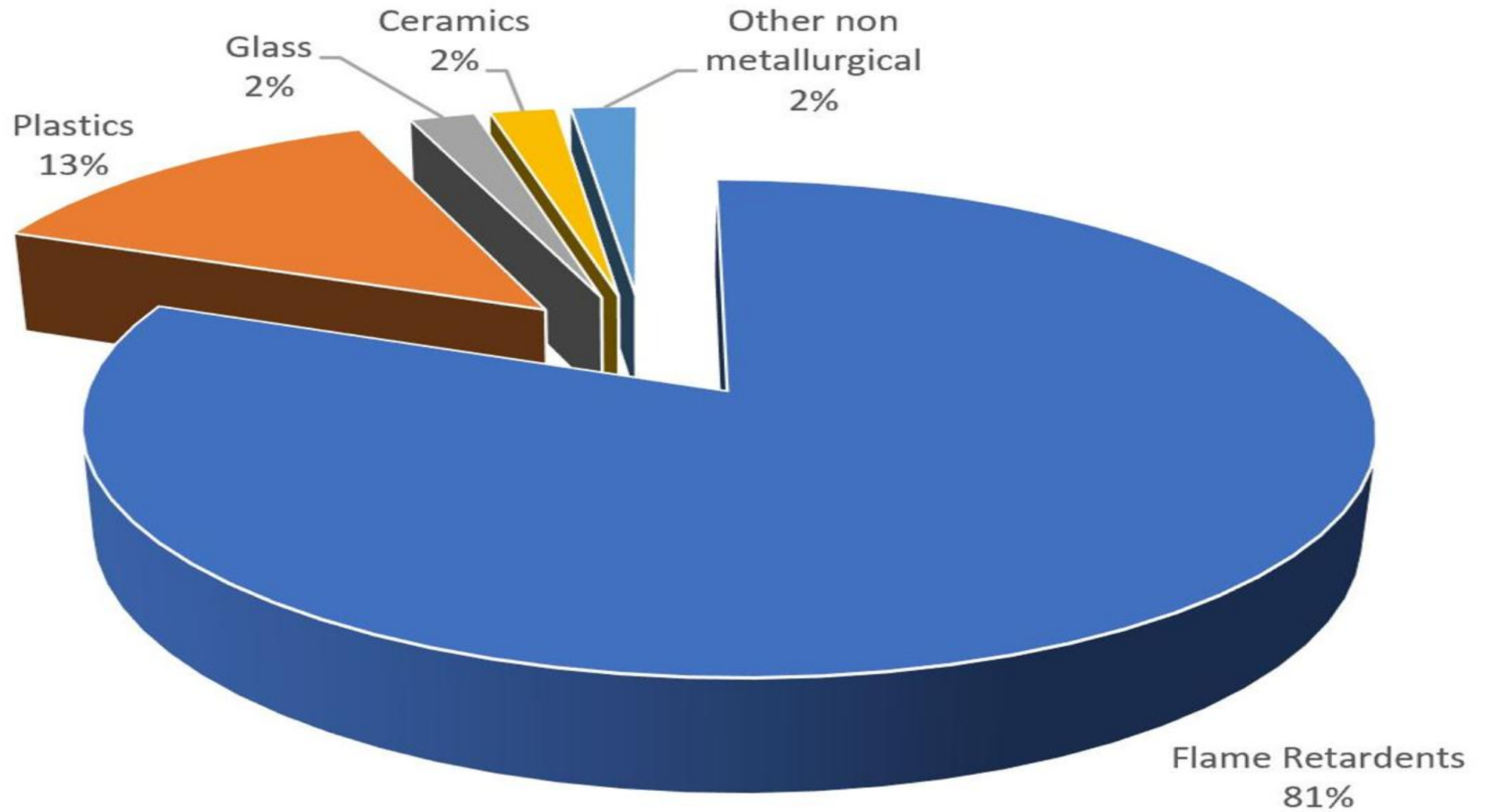
Use of Antimony ...

U.S. Flame Retardant Market, By End-Use, 2014-2024 (in BN USD)



Attribute	Details
Base Year	2016
Historic Analysis	2014 & 2015
Forecast	2017 to 2024
Complete Free Customization*	Equivalent to 50 analyst hours

Uses of Antimony ...

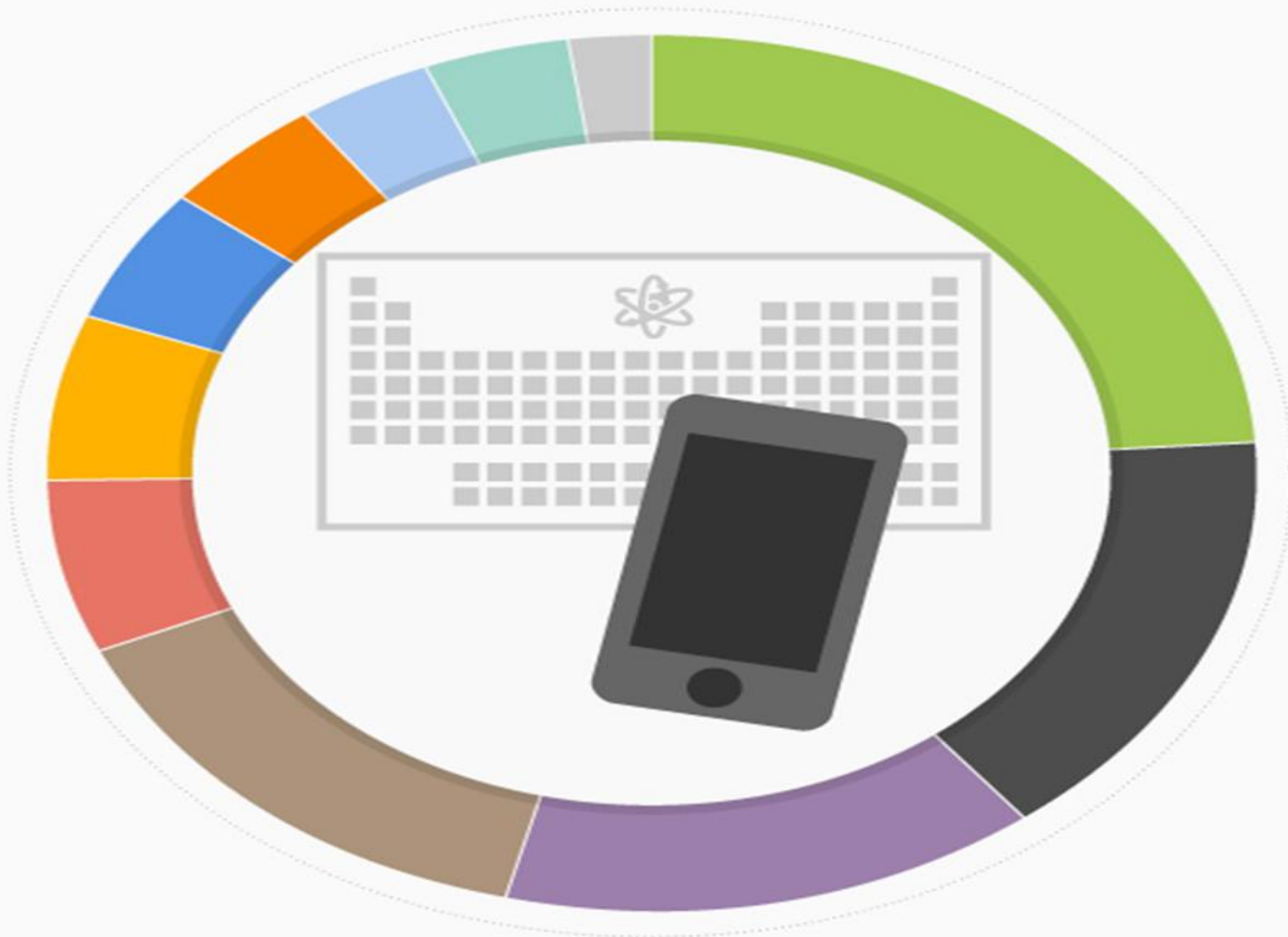


Materials used in iPhone ...

129 Grams: The Materials That Make Up The iPhone

Materials used in iPhone 6, 16GB model

- 31.1 g Aluminium
- 19.9 g Carbon
- 18.7 g Oxygen
- 18.6 g Iron
- 8.1 g Silicon
- 7.8 g Copper
- 6.6 g Cobalt
- 5.5 g Hydrogen
- 4.9 g Chrome
- 4.9 g Others
- 2.7 g Nickel
- 129.0 g Total



Total value
of elements
\$1.03

Uses of Antimony ...

Antimony – uses



Lead acid battery +
micro-capacitors



Solar panel



Touchscreens and semi-
conductors



TSXV: ADT • FSE: A7V



Ammunition



Ceramics and glass

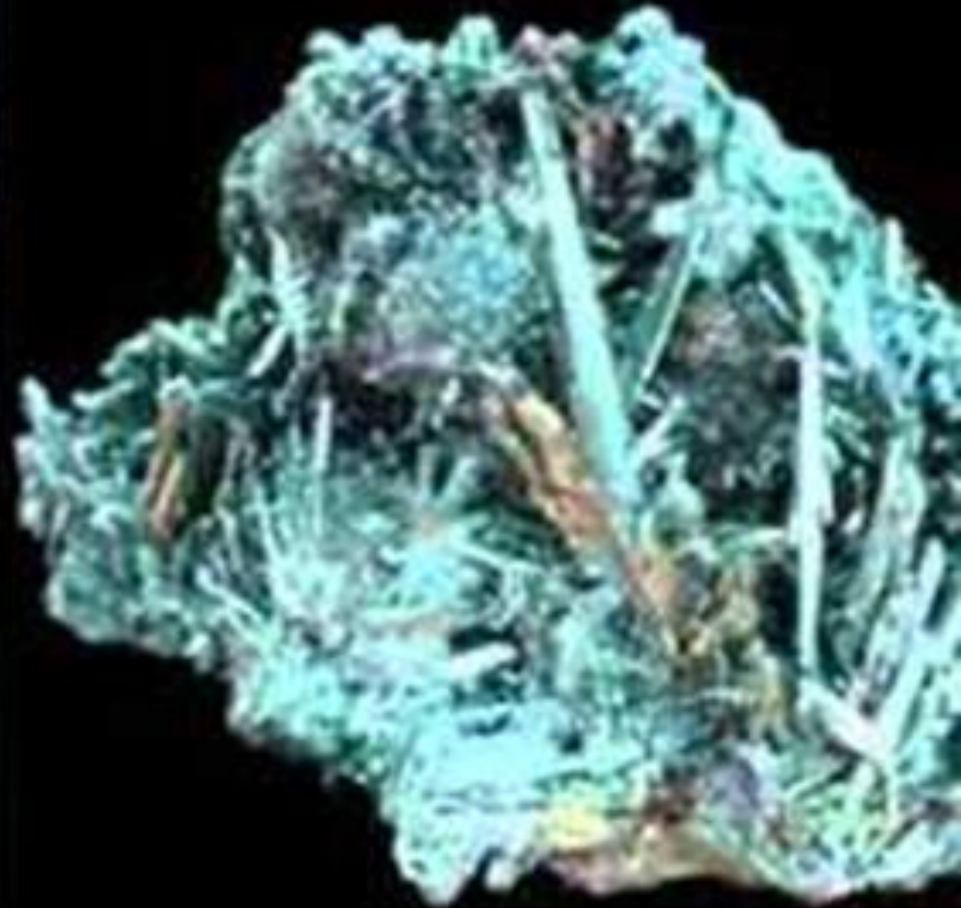
Uses of Antimony ...

- Used to increase the hardness and strength of lead
- Batteries
- Small arms and tracer bullets
- Cable sheathing
- Glass
- Pottery
- Paint
- A form of Antimony called hydrated potassium antimonyltartate, is used in medicine



Uses of Antimony ...

- FLAME PROOFING
- PAINTS
- CERAMICS
- BATTERIES
- MEDICINE
- EYE LINER
- BULLETS

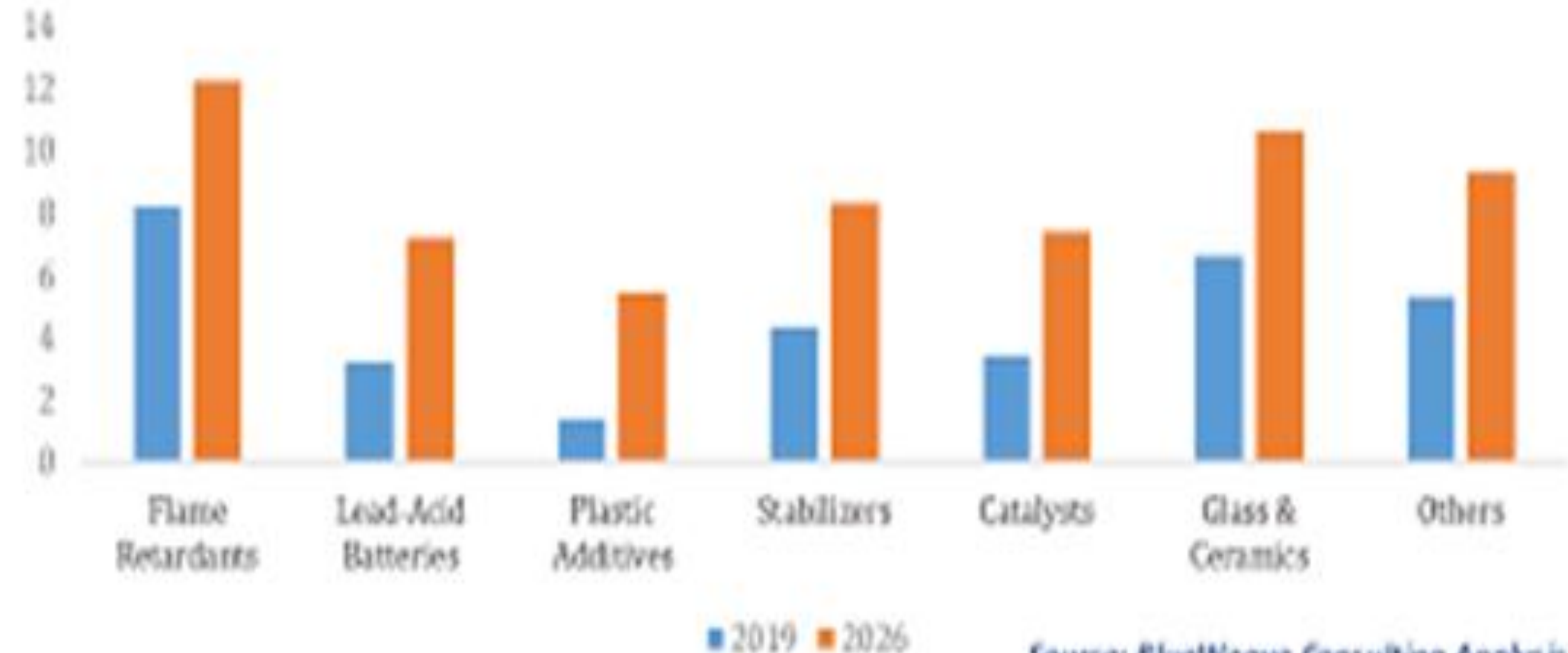


Copyright © 2008 Theodor

- Infrared detectors
- Hardening lead
- Batteries
- Small arms bullets
- Flame retardant

Uses of Antimony ...

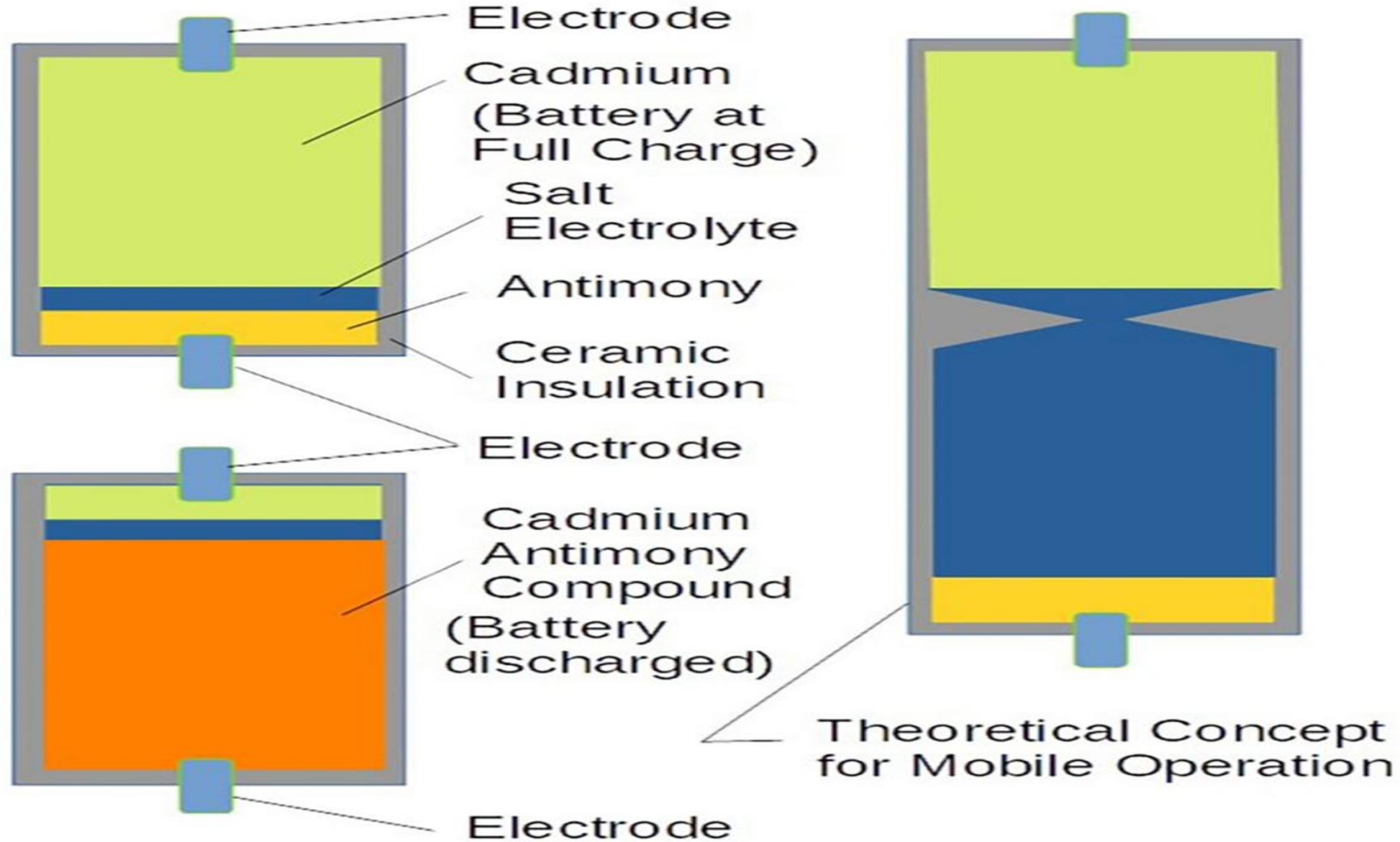
Global Antimony Market By Application



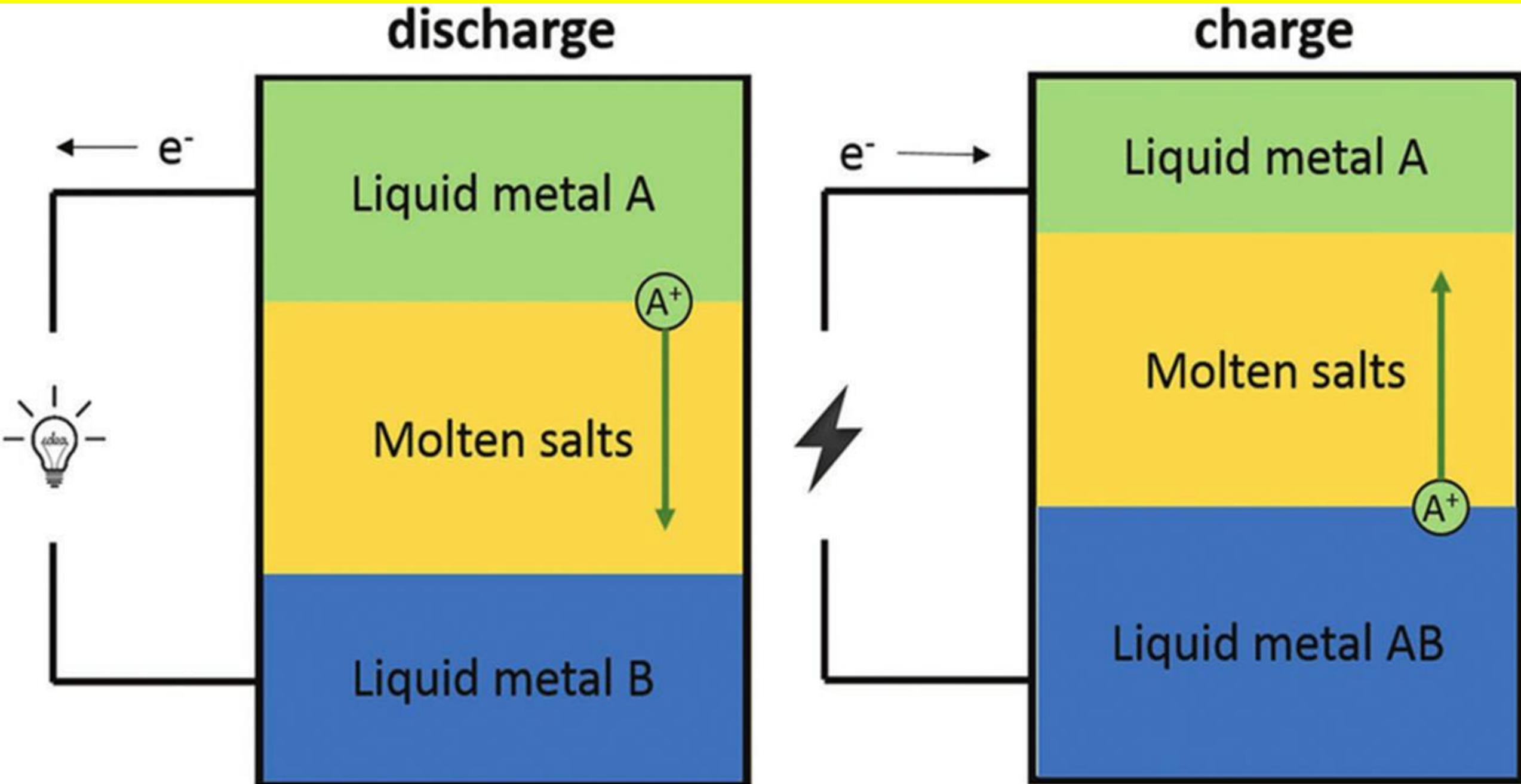
Source: BlueWeave Consulting Analysis

Antimony in Batteries ...

High Temperature Liquid Metal Battery



Antimony in Batteries ...



Uses of Antimony ...

- Antimony is used in the electronics industry to make some semiconductor devices, such as infrared detectors and diodes.
- It is alloyed with lead or other metals to improve their hardness and strength. A lead-antimony alloy is used in batteries. Other uses of antimony alloys include type metal (in printing presses), bullets and cable sheathing.
- Antimony compounds are used to make flame-retardant materials, paints, enamels, glass and pottery.



ANTIMONY IN LIQUID METAL BATTERIES

Mass storage devices mesh with energy grids to provide off-peak storage of electricity

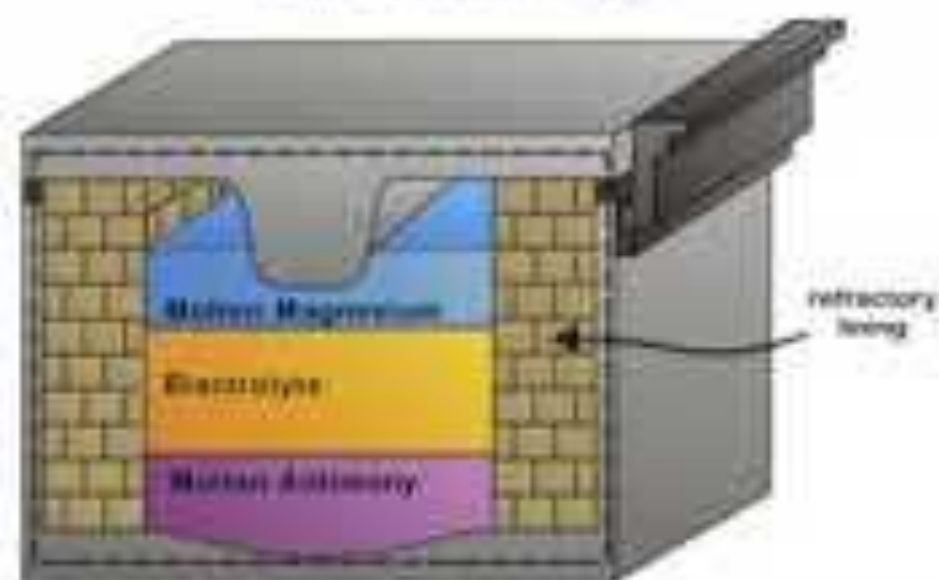
"Antimony is key to liquid metal battery storage solutions needed for a low carbon energy grid."

Hallgarten and Company, Antimony Molten Salt Batteries, the New Metal in Mass Storage, Jan. 2021

- "Grid" connection no longer needed
- Stored indefinitely
- Provides full power in an instant, on demand
- Antimony reduces cost and complexity
- Stored indefinitely



Ambri
Batteries for clean energy



6) Medical Uses of Antimony in the past ...



ANTIMONY

It was narrated from 'Abdullah Ibn 'Abbas, may Allah be pleased with him, that the Messenger of Allah, blessings and peace of Allah be upon him, said: "The best of your Kohl is antimony; it makes the hair grow and makes the vision clear." (Ibn Majah, Al-Tabarani, Al-Hakim; saheeh)

*read complete article about Antimony (Kohl, Surma)
in the description of the post...*



Medical Benefits of Antimony ...

Benefits

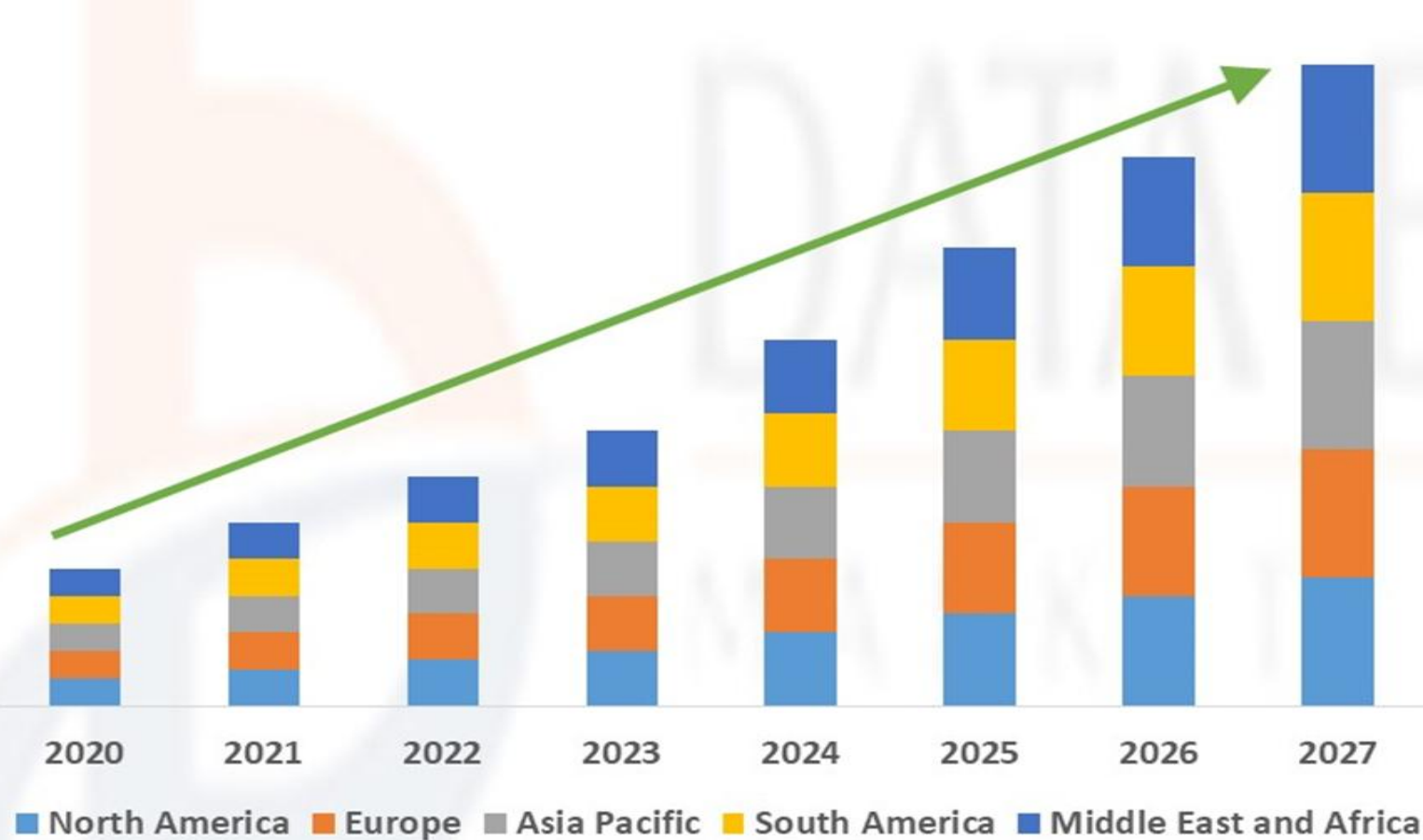
1. Beneficial to the eye & strengthens the eye nerve.
2. Dissolves in excess flesh around ulcers & closes the wound; cleansing the area around them.
3. Relieves headaches when blended with pure watery (not thick) honey.



7) Demand of Antimony Metal

Future Demand of Antimony ...

Global Antimony Market is Expected to Account for USD 3248.37 Million by 2027



Global Antimony Market,
By Regions, 2020 to 2027



DATA BRIDGE MARKET
RESEARCH

8) Supply of Antimony Metal

Metal Producers ...

Leading metal producers and their percentage of world production				
Elements	Largest producer	Second largest producer	Thirld largest producer	Application
Aluminium (Al)	Australia 31 %	China 18 %	Brazil 14 %	Vehicle bodies, consumer goods
Antimony (Sb)	China 84 %	South Africa 2.6 %	Bolivia 2.2 %	Flame retardants, electronic components, consumer goods
Arsenic (As)	China 47 %	Chile 21 %	Morocco 13 %	Semi-conductors, solar cells, optical components
Cadmium (Cd)	China 23 %	Korea 12 %	Kazakhstan 11 %	Accumulators, pigments, solar cells
Chromium (Cr)	South Africa 42 %	India 17 %	Kazakhstan 16 %	Stainless and heat-resisting steels
Cobalt (Co)	Democratic Republic of the Congo 40 %	Australia 10 %	China 10 %	Wear- and heat-resisting steels
Copper (Cu)	Chile 34 %	Peru 8 %	USA 8 %	Electric cable, electric motors, building industry
Gallium (Ga)	China	Germany	Kazakhstan	LEDs, solar cells
Germanium (Ge)	China 71 %	Russia 4 %	USA 3 %	Smartphones, solar cells
Gold (Au)	China 13 %	Australia 9 %	USA 9 %	Investment, jewellery, electrical industry
Indium (In)	China 50 %	Korea 14 %	Japan 10 %	Displays, alloys, photovoltaics
Iron (Fe)	China 39 %	Brazil 17 %	Australia 16 %	Steel, industrial magnets
Lead (Pb)	China 43 %	Australia 13 %	USA 10 %	Radiation shielding, batteries, metal working
Lithium (Li)	Chile 41 %	Australia 24 %	China 13 %	Accumulators, aviation- and space technology
Manganese (Mn)	China 25 %	Australia 17 %	South Africa 14 %	Stainless steel, LEDs
Molybdenum (Mo)	China 39 %	USA 25 %	Chile 16 %	Steel
Nickel (Ni)	Russland 19 %	Indonesia 13 %	Canada 13 %	Corrosion protection, corrosion-proof steels
Niobium (Nb)	Brazil 92 %	Canada 7 %	–	Stainless steels, jewellery
Palladium (Pd)	Russia 41 %	South Africa 41 %	USA 6 %	Catalysts (chemical industry), jewellery
Platinum (Pt)	South Africa 79 %	Russia 11 %	Zimbabwe 3 %	Catalytic converters, jewellery, metal coatings
Rare earth metals	China 97 %	India 2 %	Brazil 1 %	Permanent magnets, accumulators, LEDs
Selenium (Se)	Japan 50 %	Belgium 13 %	Canada 10 %	Semi-conductor and steel production, fertilizers
Silver (Ag)	Peru 18 %	China 14 %	Mexico 12 %	Investment, jewellery, chemical industry (catalysts)
Tellurium (Te)	Chile	USA	Peru	Stainless steels, semi-conductors, photo diodes
Tin (Sn)	China 37 %	Indonesia 33 %	Peru 12 %	Component of bronze, LEDs, displays
Vanadium (V)	China 37 %	South Africa 35 %	Russia 26 %	Steel alloys, cladding for nuclear fuel rods
Zinc (Zn)	China 25 %	Peru 13 %	Australia 12 %	Corrosion protection, batteries, construction industry

Antimony Producers ...

Antimony Producers (2010)

(tonnes per year)

Capacity

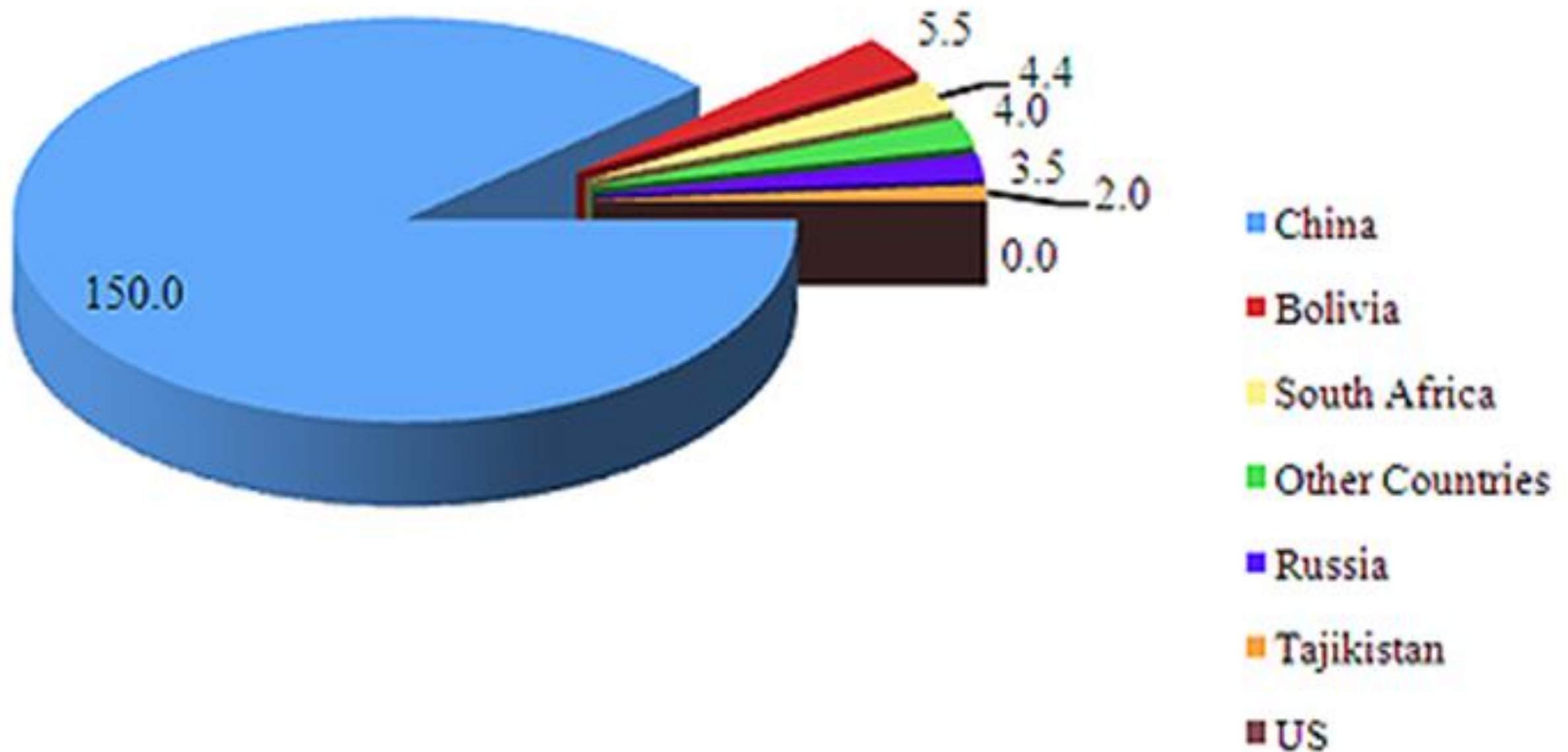
China	Hsikwangshan Twinkling Star	55,000
China	Hunan Chenzhou Mining	20,000
China	China Tin Group	20,000
China	Shenyang Huacheng Antimony	15,000
Russia	GeoProMining	6,500
Canada	Beaver Brook	6,000
Myanmar	various	6,000
South Africa	Consolidated Murchison	6,000
Tajikistan	Unzob	5,500
Bolivia	various	5,460
Australia	Mandalay Resources	2,750
Turkey	Cengiz & Özdemir Antimuan Madenleri	2,400
Kazakhstan	Kazzinc	1,000
Thailand	unknown	600
Kyrgyzstan	Kadamdzhai	500
Laos	SRS	500
Mexico	US Antimony	70

Production of Antimony ...

ANTIMONY PRODUCTION 2011



Production of Antimony ...

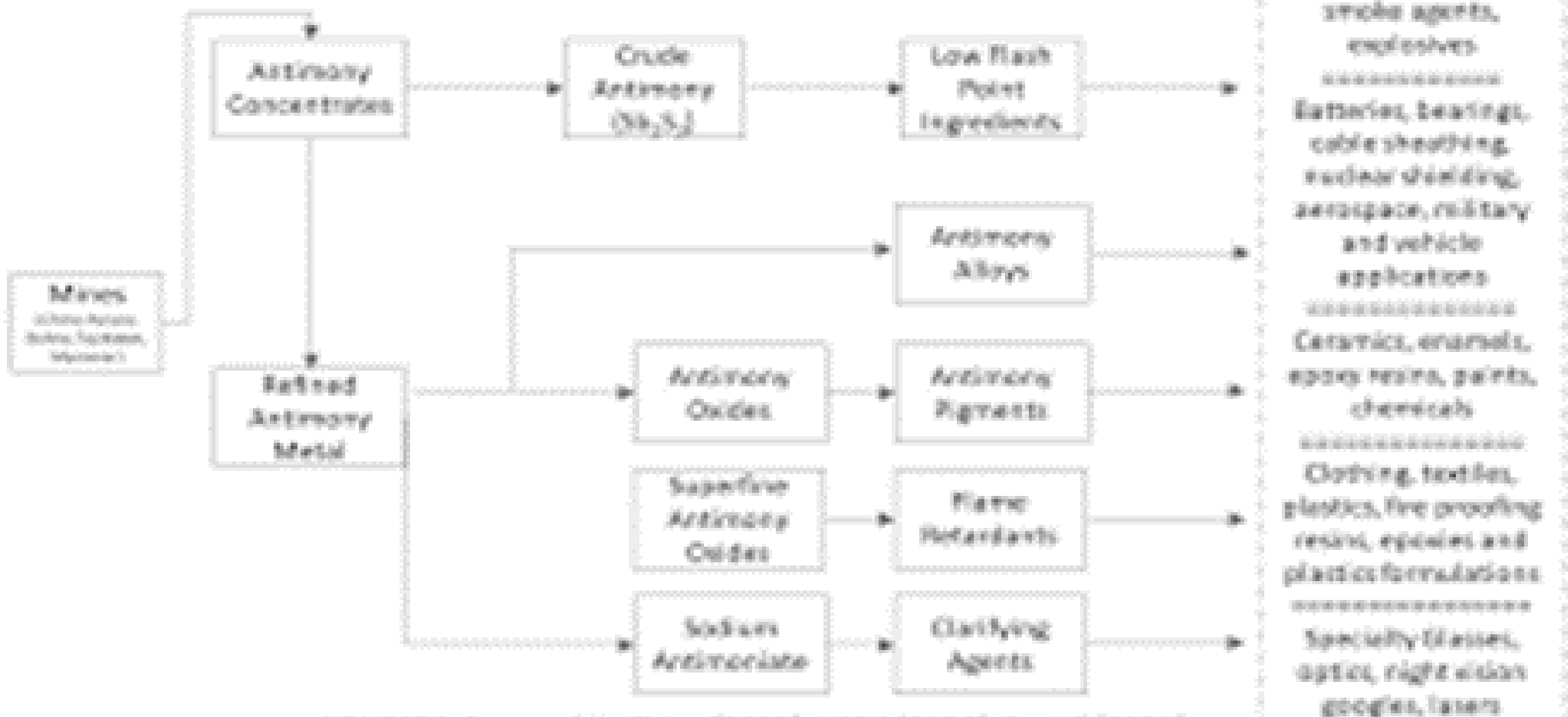


Supply of Antimony

- Chinese production decreasing : 166,000 t (2008), down to 150,000 t (2010) - 50% from one company est. 5 years of reserves
- Crustal abundance 200ppb, less than many so called rare earth elements
- Estimated 13 yrs of global reserves left
- Export duties and quantitative limits imposed by China, Argentina, Pakistan, Indonesia and Vietnam – and strategic stockpiling in US for defence purposes
- Additional Chinese capacity purchased - Beaver Brook, Canada and Anchor, Australia

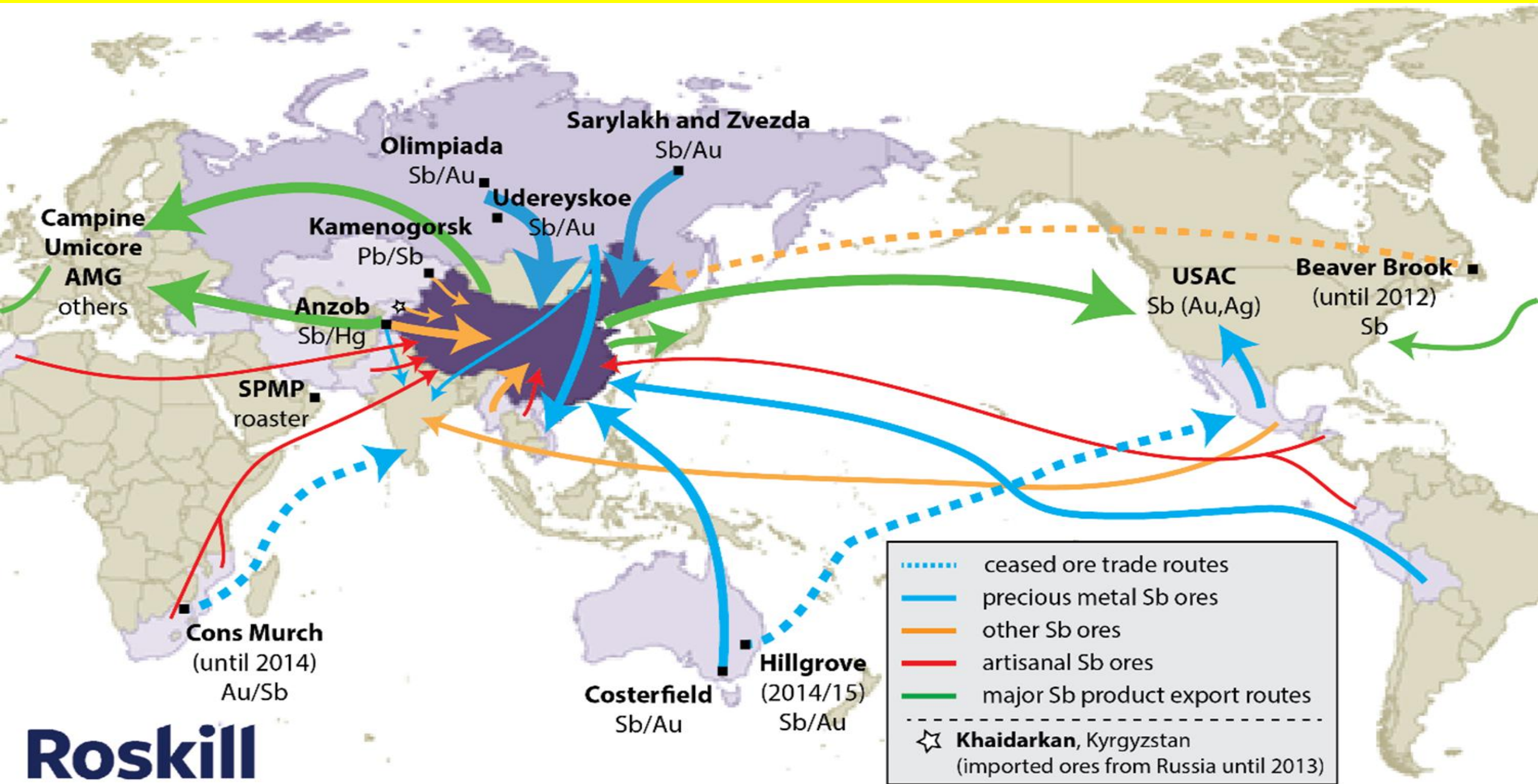
Supply Chain of Antimony ...

INDUSTRIAL SUPPLY CHAIN FOR ANTIMONY



SOURCES: Research in China (2018); USGS (2018); Roskill (2018)

Supply of Antimony ...



The Global Supply

China dominates the production and processing of antimony, leaving the U.S. at the mercy of its economic rival.



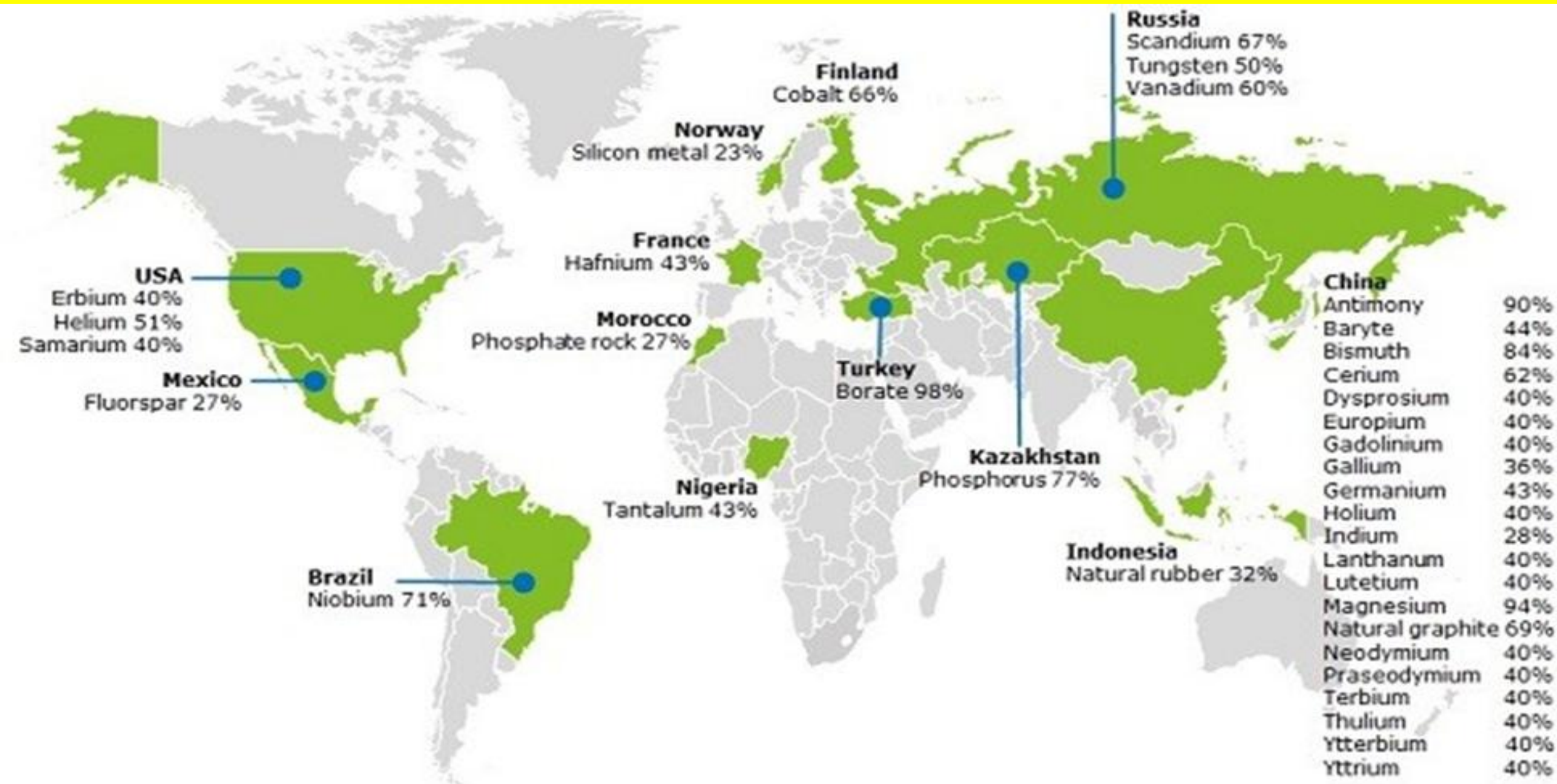
		Production in 2020 (tons)	Reserves (tons)
1	China	80,000	480,000
2	Russia	30,000	350,000
3	Tajikistan	28,000	50,000
4	Bolivia	3,000	310,000
5	Turkey	2,000	100,000
6	Australia	2,000	140,000
7	United States	-	60,000

(Source: US Geological Survey, 2021)

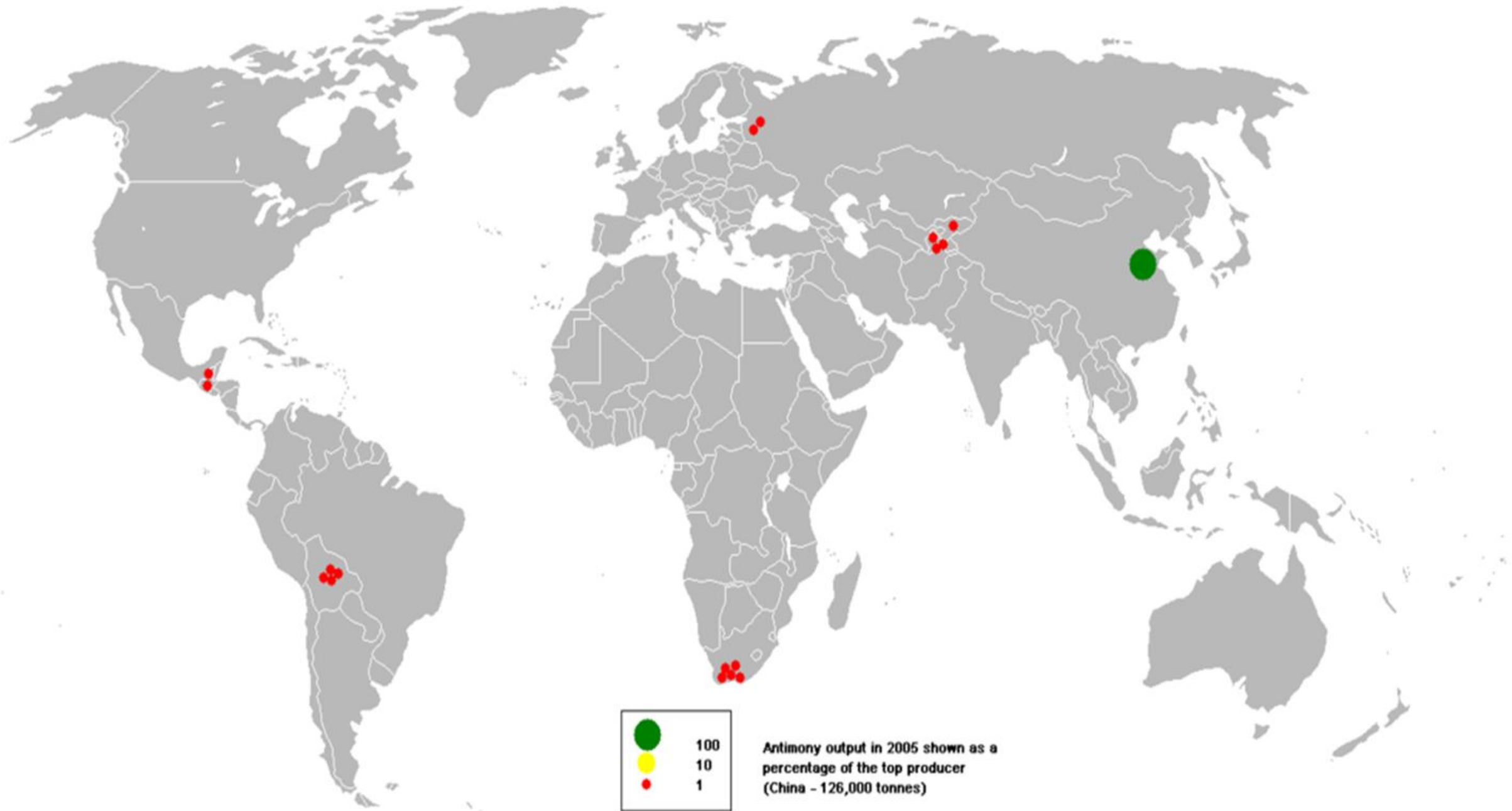
Russia is the second largest

To maintain market control, China has
been buying antimony deposits from

Antimony ...

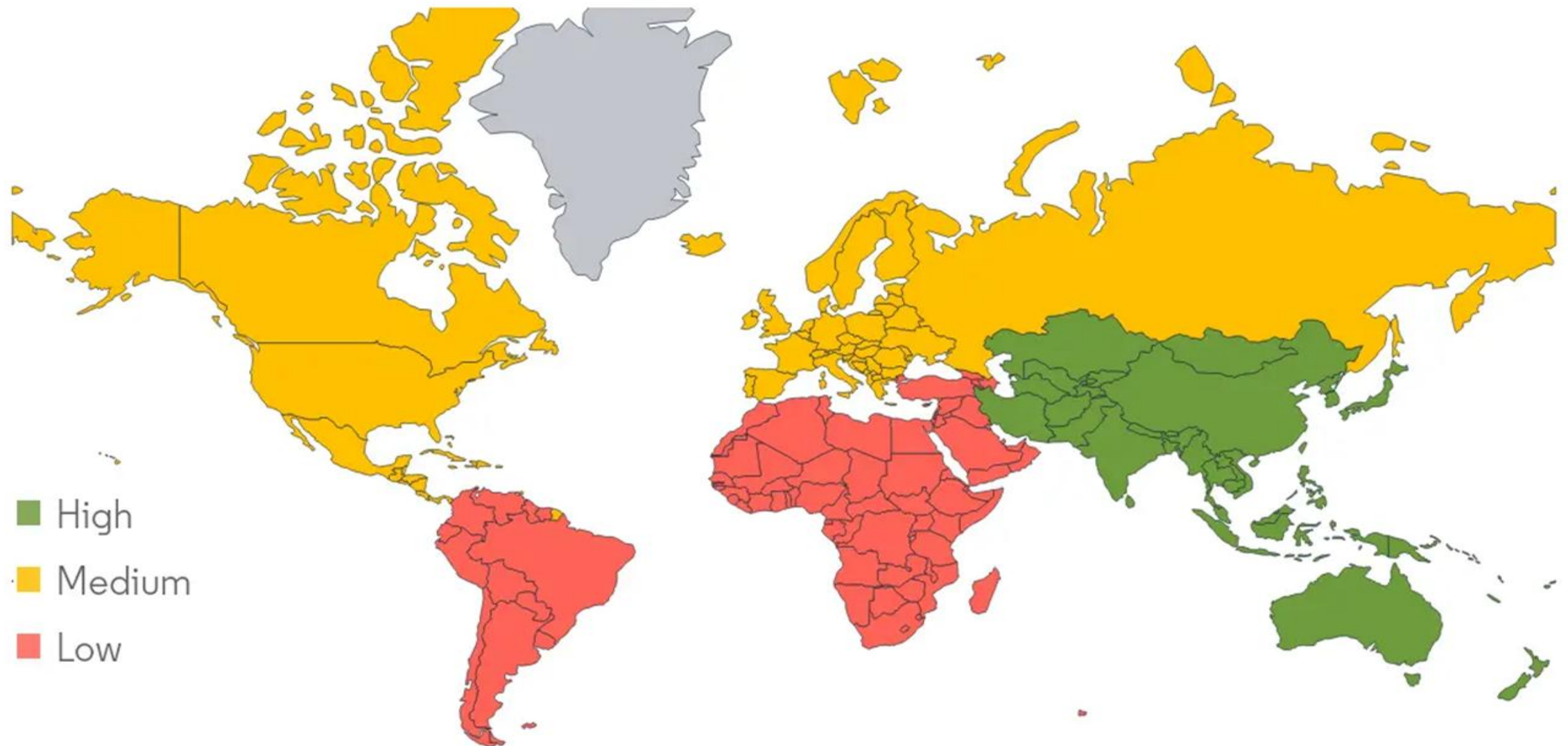


Antimony Producers ...



Antimony Producers ...

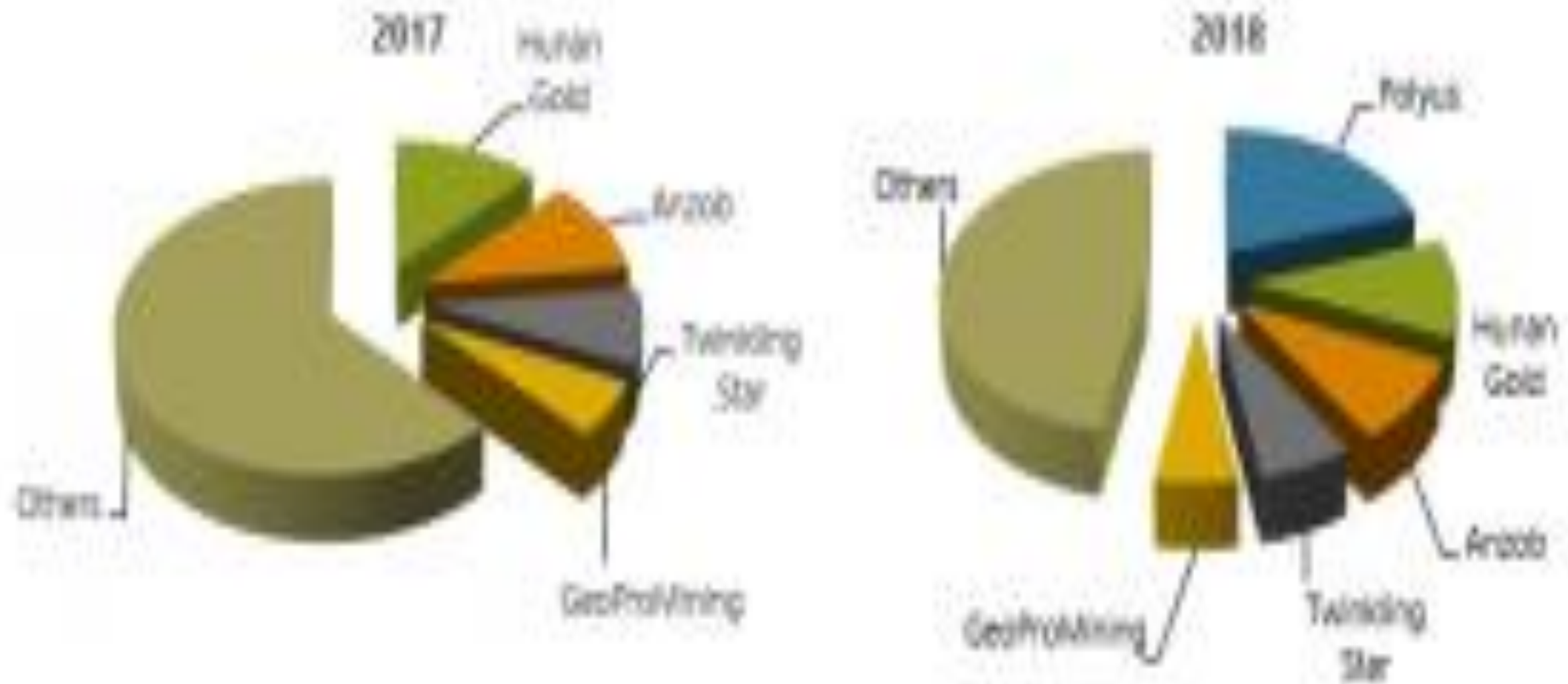
Antimony Market - CAGR by Region, 2020-2025



Source : Mordor Intelligence



World Leading Mine Producers (Companies) of Antimony ...



Supply of Antimony ...

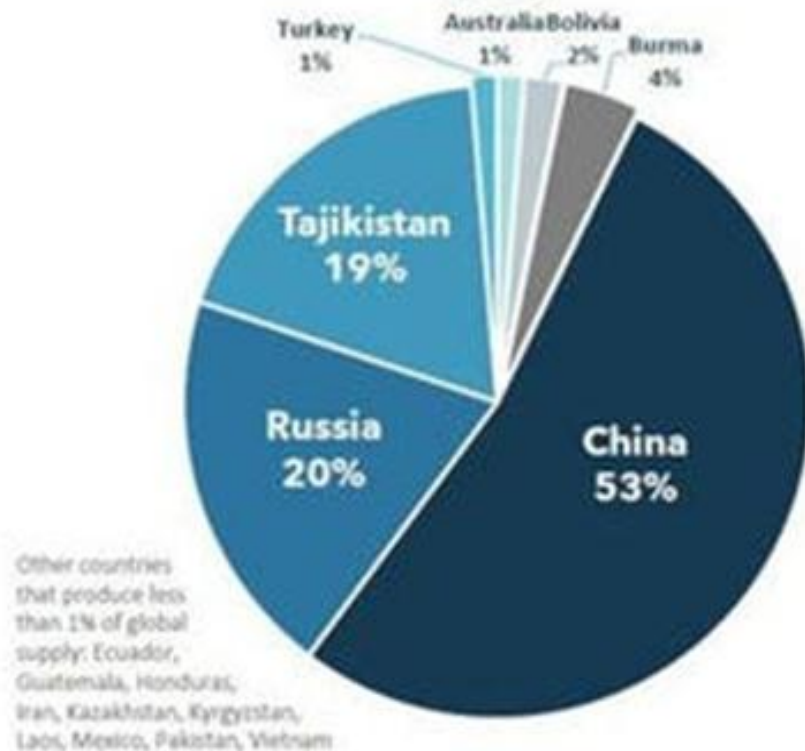
- Antimony is not an abundant element but is found in small quantities in over 100 mineral species. It is most often found as antimony(III) sulfide. It is extracted by roasting the antimony(III) sulfide to the oxide, and then reducing with carbon. Antimony can also be found as the native metal.
- China produces 88% of the world's antimony. Other producers are Bolivia, Russia and Tajikistan.



CRITICAL MINERAL ANTIMONY SUPPLY

"Critical Minerals" are metals and non-metals essential to economic and national security and are vulnerable to supply chain disruptions

World Antimony 2020 Production
(USGS)



- Antimony is one of 35 federally listed critical minerals
- China & Russia dominate the world antimony supply (>70%)
- U.S. has no domestic antimony production
- Necessary for energy, defense and technology

Supply of Antimony ...

But there’s a finite supply, and with China currently dominating [antimony production](#) and processing, the U.S. could be at the mercy of its economic rival.

In 2020, there was no domestically mined production of antimony in America—meaning the U.S. relied on other countries, primarily China, for its antimony supply.

In the past, China has imposed restrictions on the exports of antimony-based products to the U.S., which reduced availability and increased prices. Because of this, antimony was identified as one of the [35 minerals](#) that are critical to U.S. national security.

Country	Production in 2020 (tons)	Reserves (tons)
China	80,000	480,000
Russia	30,000	350,000
Tajikistan	28,000	50,000
Bolivia	3,000	310,000
Turkey	2,000	100,000
Australia	2,000	140,000
United States	---	60,000

Supply of Antimony ...

USA Supply

To decrease foreign dependence, the U.S. could tap into domestic resources of antimony and build up its local supply chain.

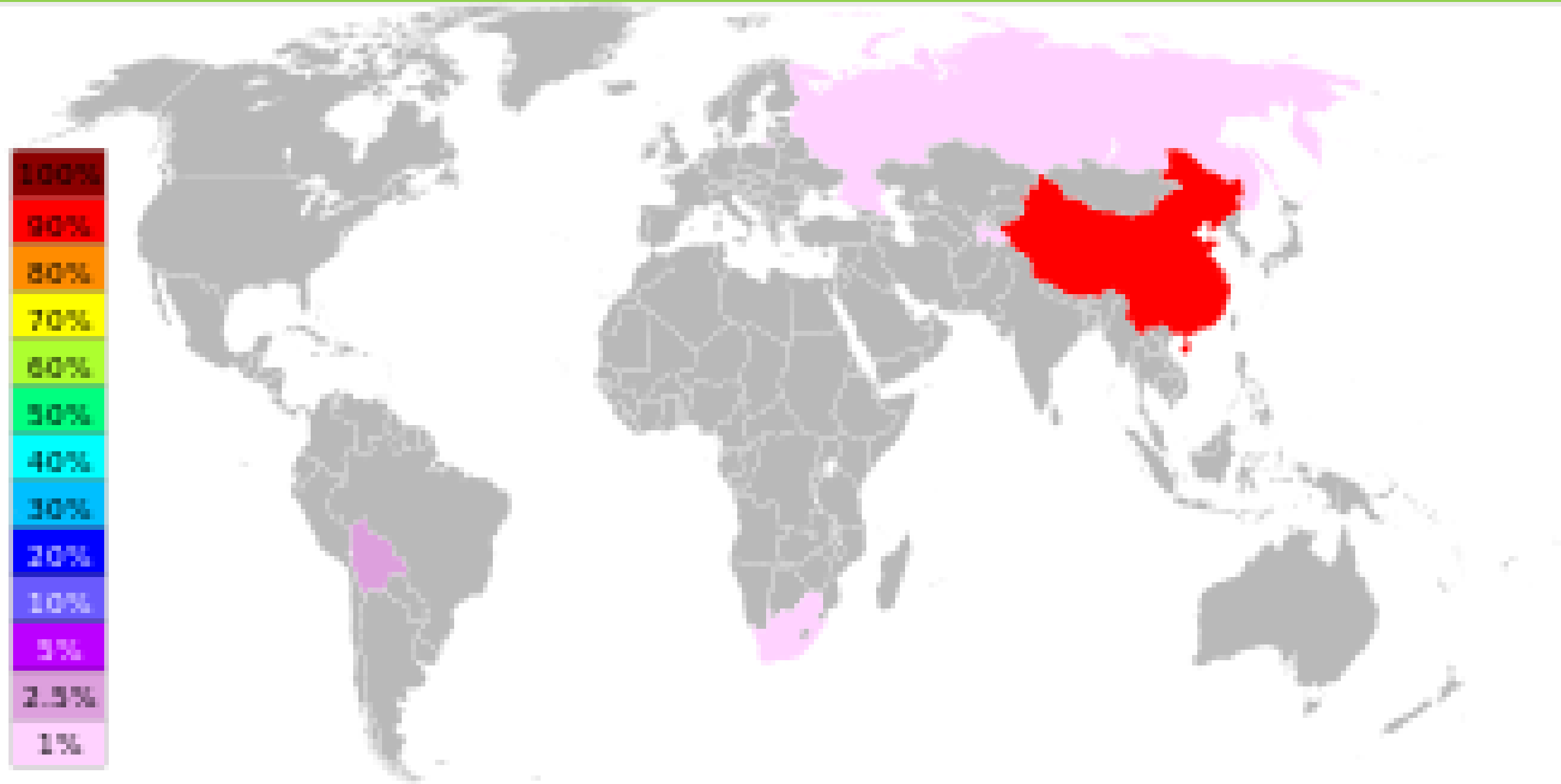
The only major antimony deposit in North America is located in the **Stibnite-Yellow Pine Mining District** of central Idaho. This site is the largest reserve in the nation and is expected to supply roughly [35%](#) of U.S. antimony demand on average for the first six years of production.

Domestic production would not only allow the U.S. to reduce its import reliance, but it would also create jobs, providing economic support for the local community.

In the near future, antimony demand could soar as a result of its critical role in clean energy storage—and domestic production via the **Stibnite-Yellow Pine Mining district** could play a key role in meeting this rising demand.

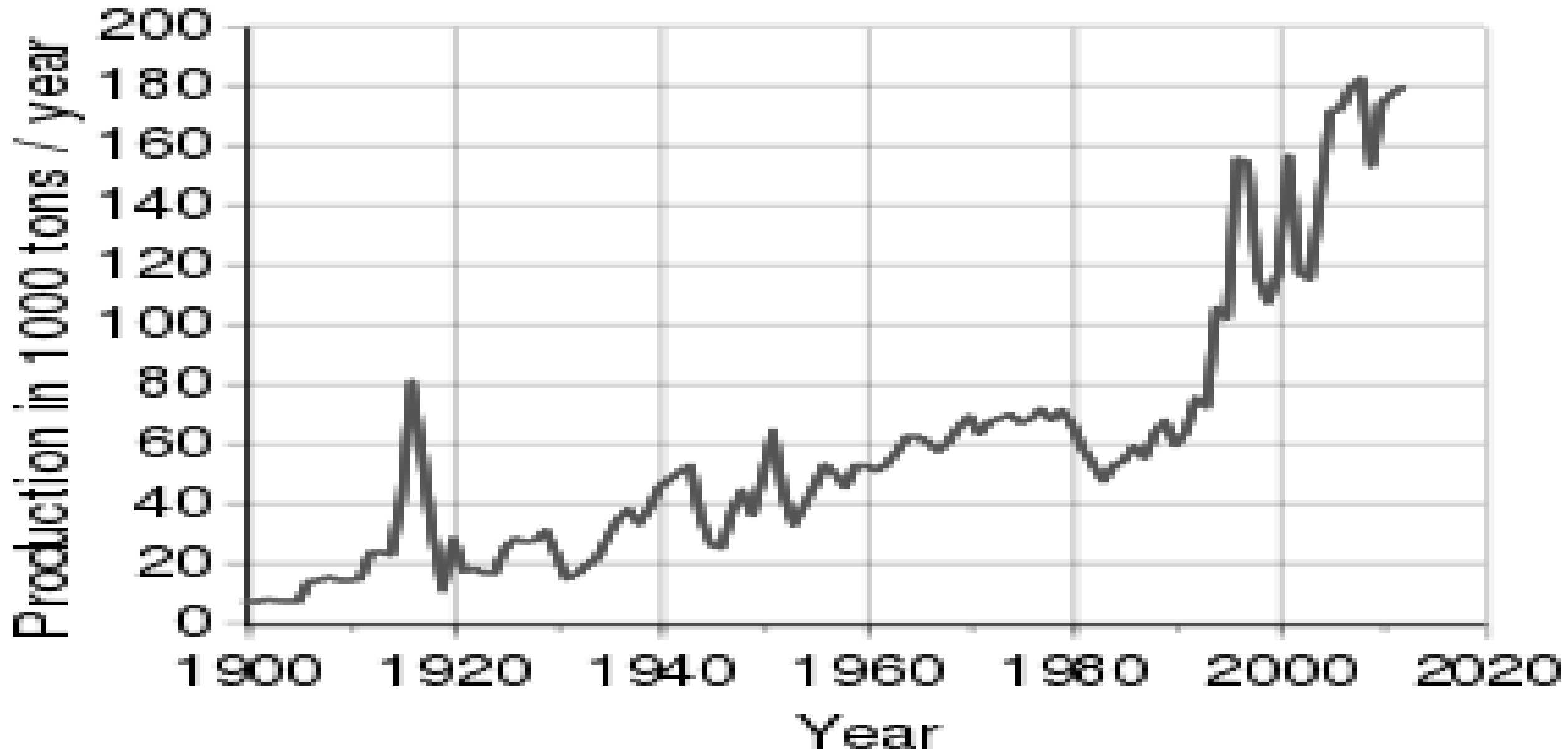
Supply of Antimony ...

World antimony output in 2010



Supply of Antimony ...

Historic world antimony output



Supply of Antimony ...

Top producers and production volumes

The [British Geological Survey](#) (BGS) reported that in 2005 China was the top producer of antimony with approximately 84% of the world share, followed at a distance by South Africa, Bolivia and Tajikistan. [Xikuangshan Mine](#) in [Hunan](#) province has the largest deposits in China with an estimated deposit of 2.1 million metric tons.

In 2016, according to the [US Geological Survey](#), China accounted for 76.9% of total antimony production, followed in second place by Russia with 6.9% and Tajikistan with 6.2%.

Supply of Antimony ...		
Antimony production in 2016		
Country	Tonnes	% of total
<u>China</u>	100,000	76.9
<u>Russia</u>	9,000	6.9
<u>Tajikistan</u>	8,000	6.2
<u>Bolivia</u>	4,000	3.1
<u>Australia</u>	3,500	2.7
Top 5	124,500	95.8
Total world	130,000	100.0

Supply of Antimony ...

Antimony production in 2016 ^[12]		
Country	Tonnes	% of total
 China	100,000	76.9
 Russia	9,000	6.9
 Tajikistan	8,000	6.2
 Bolivia	4,000	3.1
 Australia	3,500	2.7
<i>Top 5</i>	124,500	95.8
Total world	130,000	100.0

Supply of Antimony ...

Largest antimony producers in 2010.^[48]

Country	Company	Capacity (tonnes per year)
 China	Hsikwangshan Twinkling Star	55,000
 China	China Tin Group	20,000
 China	Hunan Chenzhou Mining	20,000
 China	Shenyang Huachang Antimony	15,000
 Russia	GeoProMining	6,500
 Canada	Beaver Brook	6,000
 South Africa	Consolidated Murchison	6,000
 Myanmar	various	6,000
 Tajikistan	Unzob	5,500
 Bolivia	various	5,460
 Australia	Mandalay Resources	2,750
 Turkey	Cengiz & Özdemir Antimuan Madenleri	2,400
 Kazakhstan	Kazzinc	1,000
 Thailand	unknown	600
 Kyrgyzstan	Kadamdzhai	500
 Laos	SRS	500
 Mexico	US Antimony	70

Supply of Antimony ...

Largest antimony producers in 2010.^[48]

Country	Company	Capacity (tonnes per year)
<u>China</u>	Hsikwangshan Twinkling Star	55,000
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<u>Canada</u>	Beaver Brook	6,000
<u>South Africa</u>	Consolidated Murchison	6,000
<u>Myanmar</u>	various	6,000
<u>Tajikistan</u>	Unzob	5,500
<u>Bolivia</u>	various	5,460
<u>Australia</u>	Mandalay Resources	2,750
<u>Turkey</u>	Cengiz & Özdemir Antimuan Madenleri	2,400
<u>Kazakhstan</u>	Kazzinc	1,000
<u>Thailand</u>	unknown	600
<u>Kyrgyzstan</u>	Kadamdzhai	500
<u>Laos</u>	SRS	500
<u>Mexico</u>	US Antimony	70

Supply of Antimony ...

World antimony reserves in 2015^[48]

Country	Reserves (tonnes of antimony content)	% of total
 People's Republic of China	950,000	47.81
 Russia	350,000	17.61
 Bolivia	310,000	15.60
 Australia	140,000	7.05
 United States	60,000	3.02
 Tajikistan	50,000	2.52
 South Africa	27,000	1.36
Other countries	100,000	5.03
Total world	1,987,000	100.0

Supply of Antimony ...		
World antimony reserves in 2015 ^[48]		
Country	Reserves (tonnes of antimony content)	% of total
<u>People's Republic of China</u>	950,000	47.81
<u>Russia</u>	350,000	17.61
<u>Bolivia</u>	310,000	15.60
<u>Australia</u>	140,000	7.05
<u>United States</u>	60,000	3.02
<u>Tajikistan</u>	50,000	2.52
<u>South Africa</u>	27,000	1.36
Other countries	100,000	5.03
Total world	1,987,000	100.0

Supply of Antimony ...

Supply risk and critical mineral rankings^{[[edit](#)]}

Antimony has consistently been ranked high in European and US [risk lists concerning criticality of the element](#) indicating the relative risk to the supply of chemical elements or element groups required to maintain the current economy and lifestyle.

With most of the antimony imported into Europe and the US coming from China, Chinese production is critical to supply. As China is revising and increasing environmental control standards, antimony production is becoming increasingly restricted.^{[[citation needed](#)]} Additionally Chinese export quotas for antimony have been decreasing in the past years. These two factors increase supply risk for both Europe and US.

Europe^{[[edit](#)]}

According to the BGS Risk List 2015, antimony is ranked second highest (after rare earth elements) on the relative supply risk index.^{[[53\]](#)} This indicates that it has currently the second highest supply risk for chemical elements or element groups which are of economic value to the British economy and lifestyle. Furthermore, antimony was identified as one of 20 critical raw materials for the EU in a report published in 2014 (which revised the initial report published in 2011). As seen in Figure xxx antimony maintains high supply risk relative to its economic importance. 92% of the antimony is imported from China, which is a significantly high concentration of production.^{[[54\]](#)}

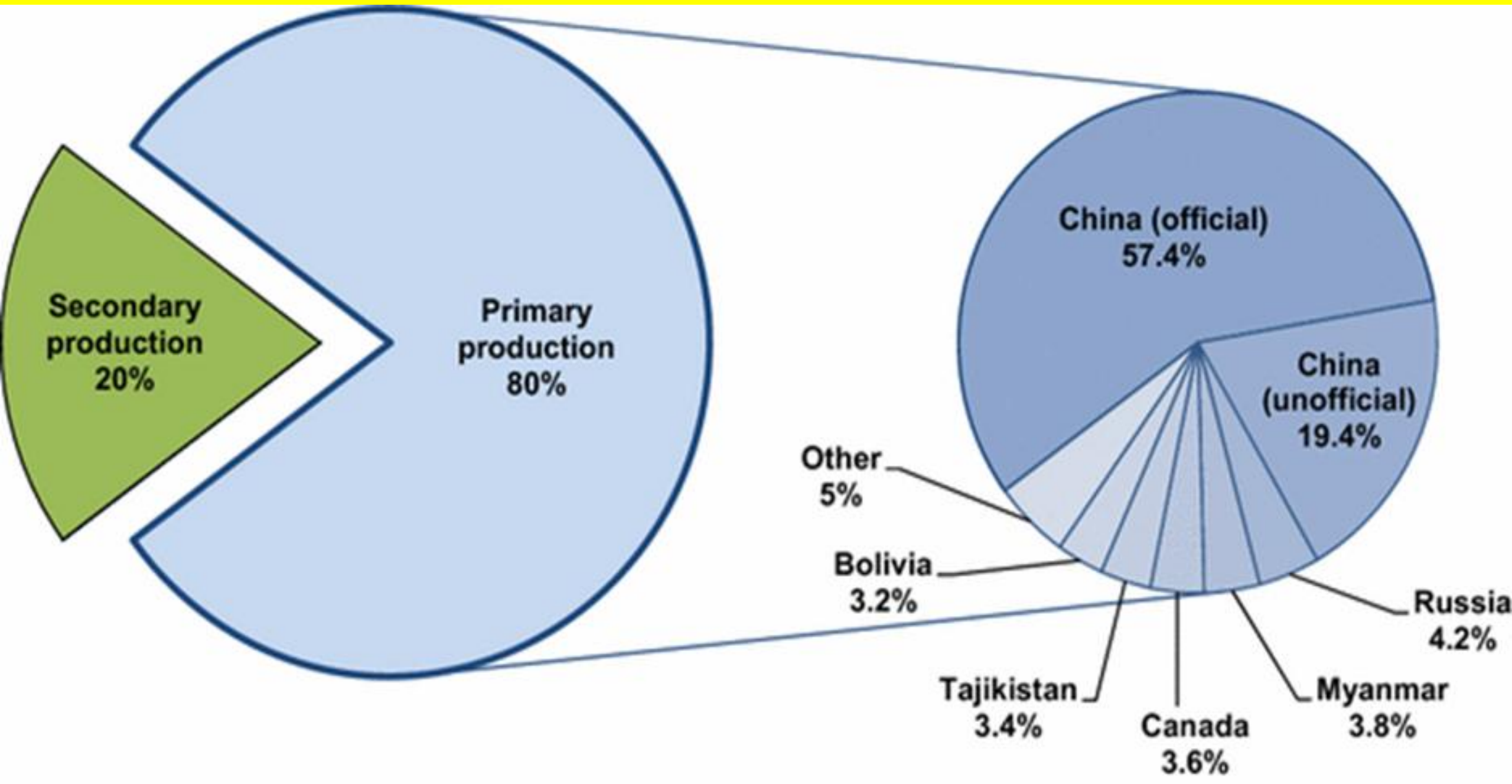
U.S.^{[[edit](#)]}

Much analysis has been conducted in the U.S. toward defining which metals should be called strategic or critical to the nation's security. Exact definitions do not exist, and views as to what constitutes a strategic or critical mineral to U.S. security diverge.^{[[55\]](#)}

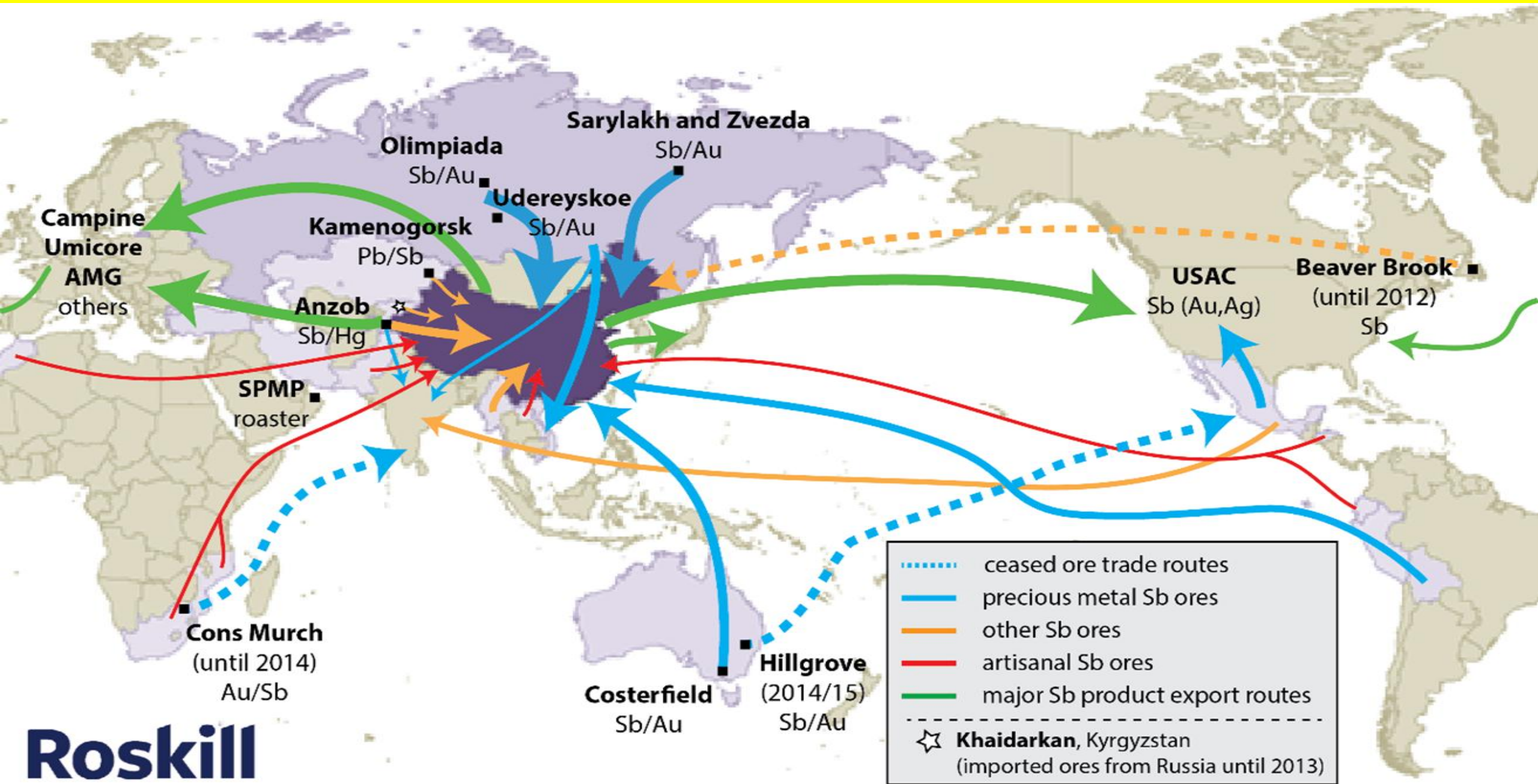
In 2015, no antimony was mined in the U.S., the metal is imported. In the period 2011–2014, 68% of America's antimony came from China, 14% from India, 4% from Mexico, and 14% from other sources. There are no publicly known government stockpiles in place currently.^{[[citation needed](#)]}

The U.S. "Subcommittee on Critical and Strategic Mineral Supply Chains" has screened 78 mineral resources from 1996 to 2008. It found that a small subset of minerals including antimony has fallen into the category of potentially critical minerals consistently. In the future, a second assessment will be made of the found subset of minerals to identify which should be defined of significant risk and critical to U.S. interests.^{[[56\]](#)}

Supply of Antimony ...

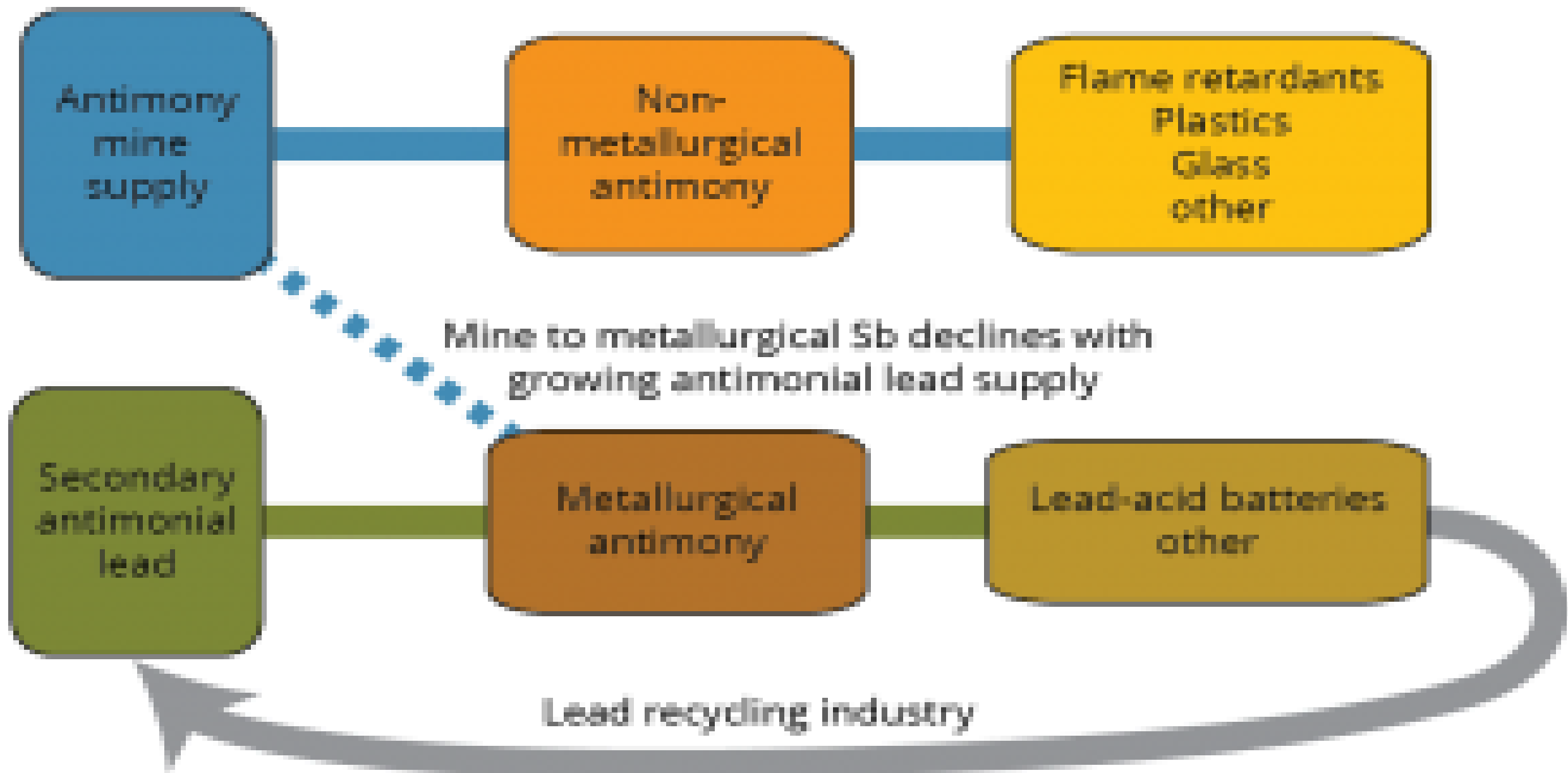


Antimony ...



9) Process of Antimony

Process of Antimony ...



Antimony ...

Development of a
mechanical presorting
technology

①

Closing 3 loops using dissolution under
superheated conditions by separation of :

②

- (1) the polymer
- (2) the bromine
- (3) the antimony trioxide

System optimizing for
sustainability and
economic viability

⑤

PL^{♻️}ST2b
CLEAN^{♻️}ED

③

Process integration
and scale-up

④

Performance
testing of process
and products



10) Evaluation or Value of Antimony

GLOBAL ANTIMONY PRICES

	29/05/2019	02/01/2019	% change to midpoint
Antimony MB free market \$ per tonne in-warehouse Rotterdam max 100 ppm Bi	6,600-6,850	7,900-8,100	▼ 15.9
Antimony Metal MMTA Standard Grade II \$ per tonne in-warehouse Rotterdam	6,500-6,700	7,700-7,900	▼ 15.4
Antimony Metal MB Chinese free market MMTA Standard Grade II delivered duty-paid yuan per tonne	38,000-39,000	49,000-49,500	▼ 21.8

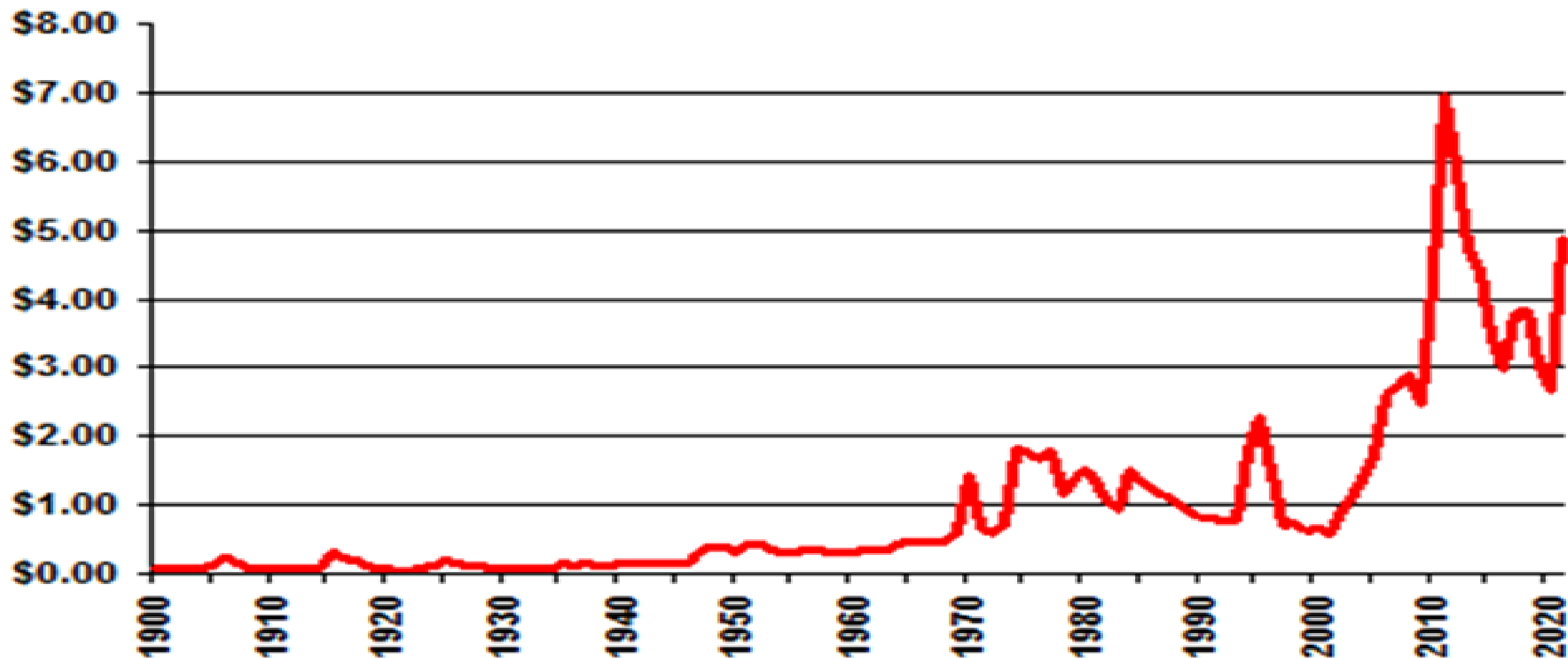
Source: Fastmarkets

Prices of Antimony ...

Antimony USD \$/lb

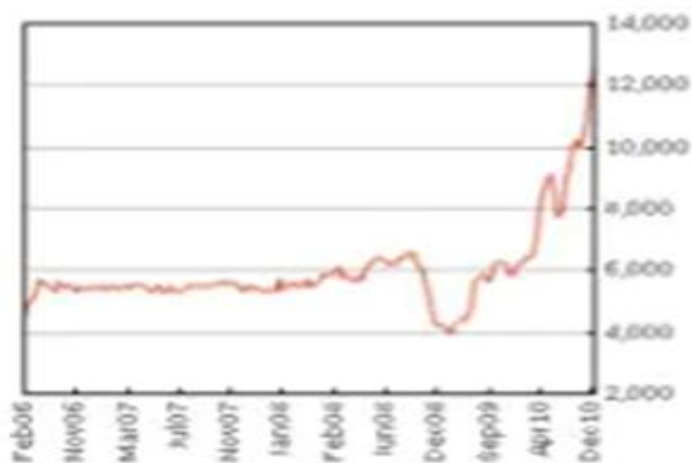
Annual Average

\$4.86



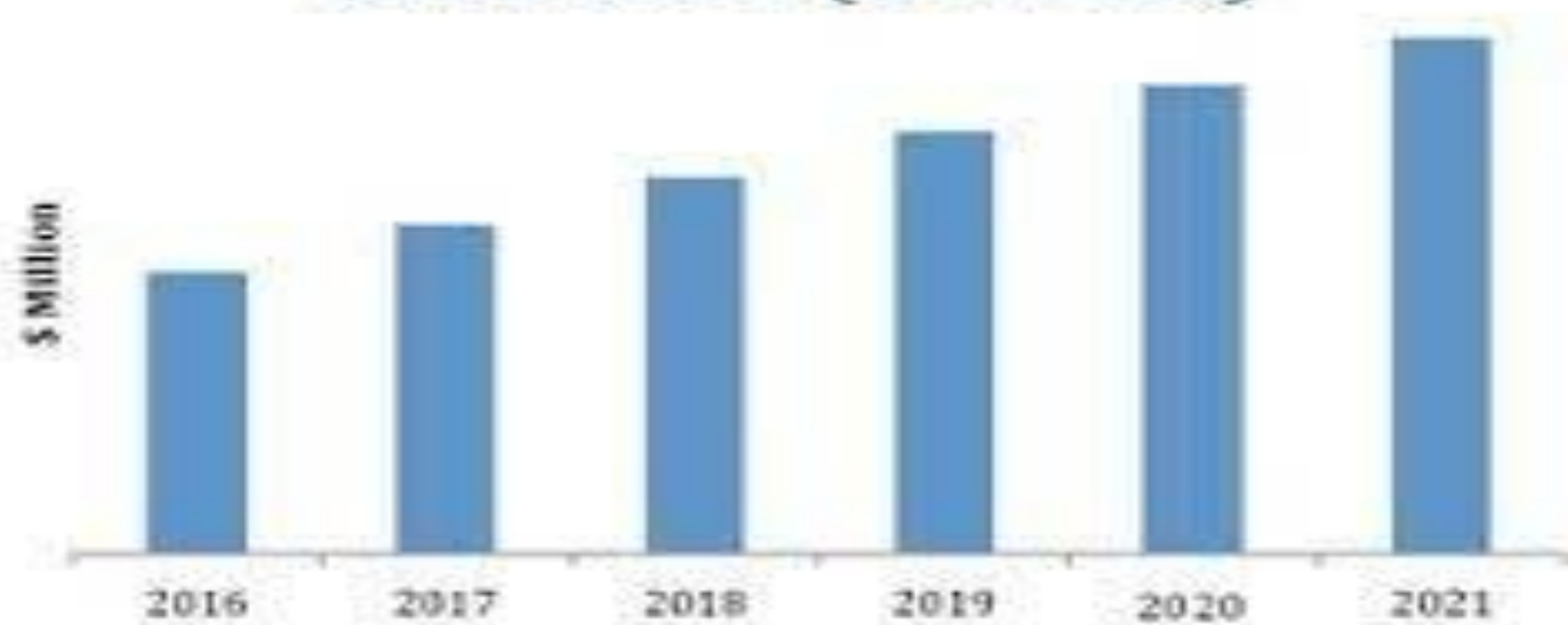
The Antimony Business

- Antimony prices have recently climbed higher to over \$14,000/MT.
- The price of antimony generally rose during 2010. It started the year at about \$1.93 per pound and finished December at about \$5.54 per pound.
- Chinese government is not allowing any new antimony mining permits until at least June 2011 due to rapidly depleting resources.
- Chinese companies have been buying additional antimony mining capacity abroad.



Evolution of Sb price
sources: Bloomberg & MinorMetals

Antimony Market Analysis, By Revenue, 2016-2021 (\$ Million)



Source: IndustryARC Analysis and Expert Insights

Thank You

Sources

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- 2) Wikipedia
- 3) References at Slides

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