Natural Resource Security: Geostrategic Context

ISOA Europe Industry Days, April 2025

ecospherics℠
Securing the Future

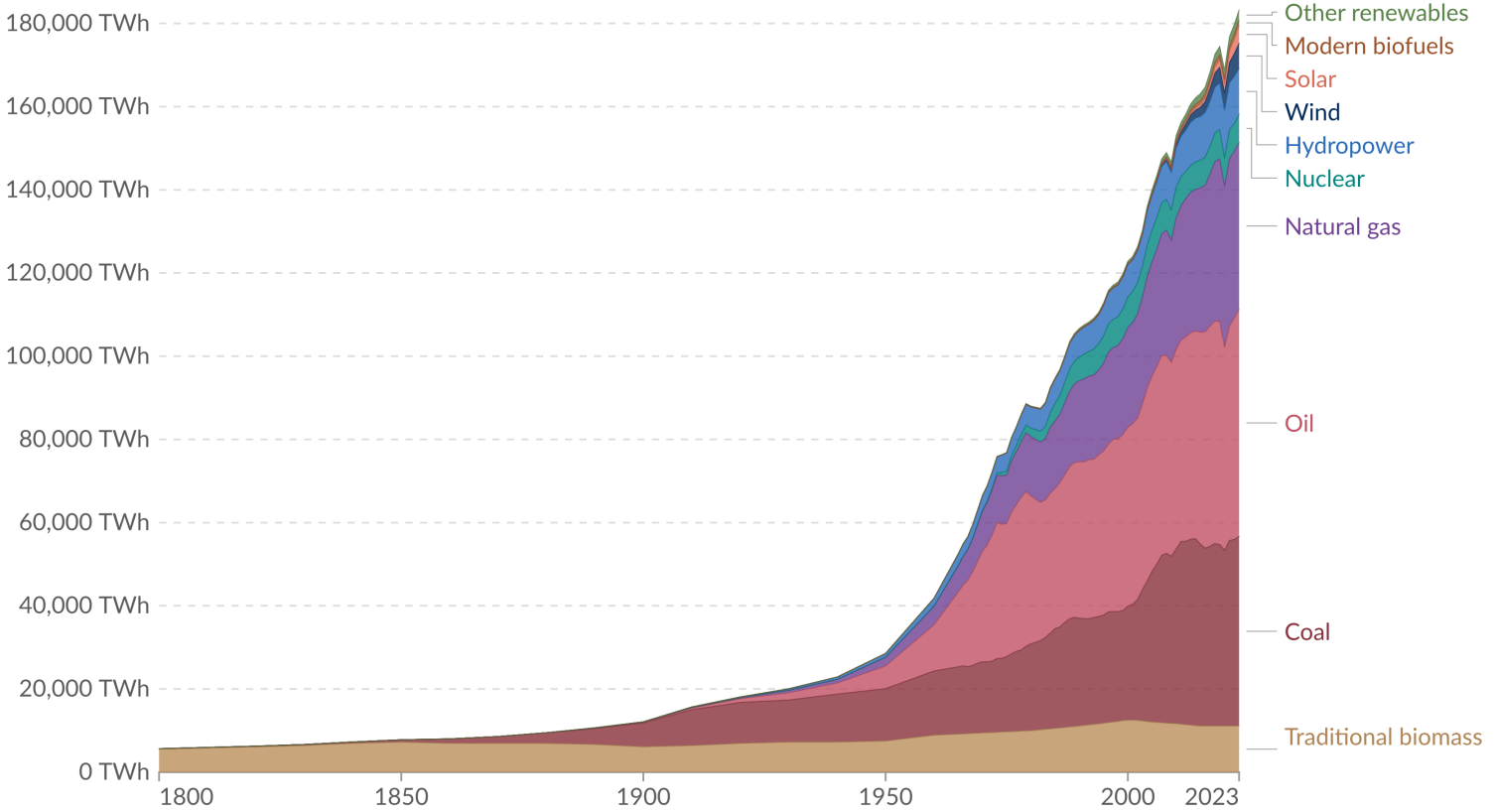
Global Energy Demand

Fossil fuels continue to hover around 80% of all primary energy consumption worldwide

Global primary energy consumption by source

Primary energy[1] is based on the substitution method[2] and measured in terawatt-hours[3].

Our World in Data

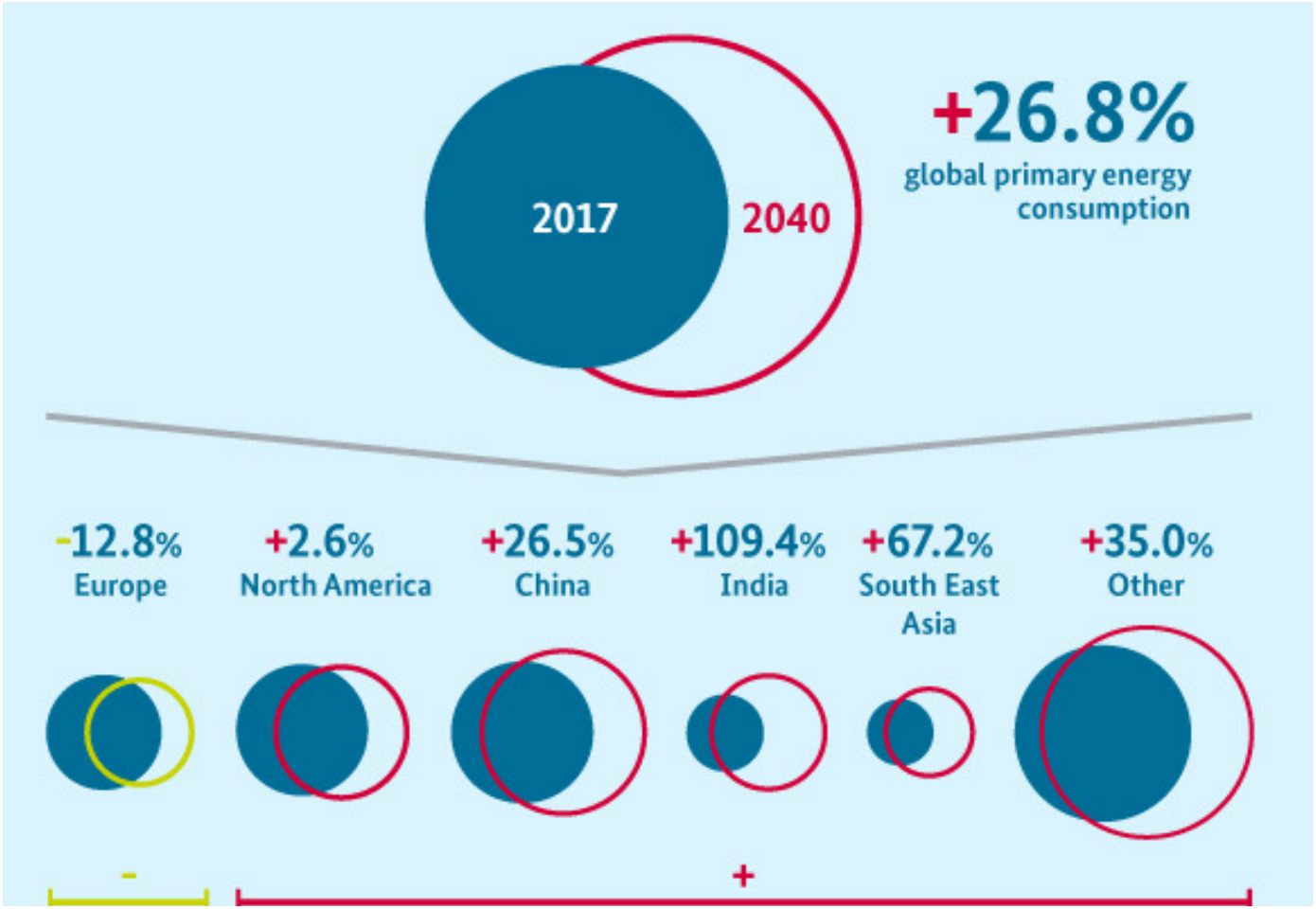


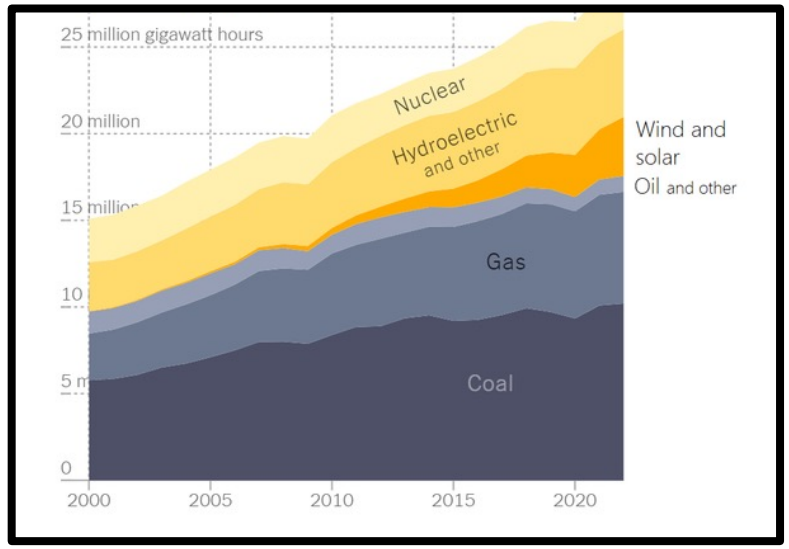
Data source: Energy Institute - Statistical Review of World Energy (2024); Smil (2017)

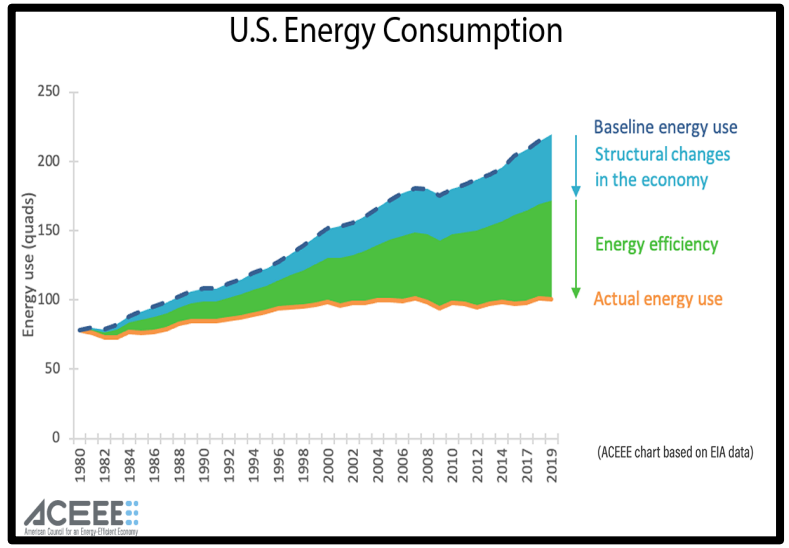
OurWorldinData.org/energy | CC BY

Note: In the absence of more recent data, traditional biomass is assumed constant since 2015.

Forecast for Significant Demand Growth (?)





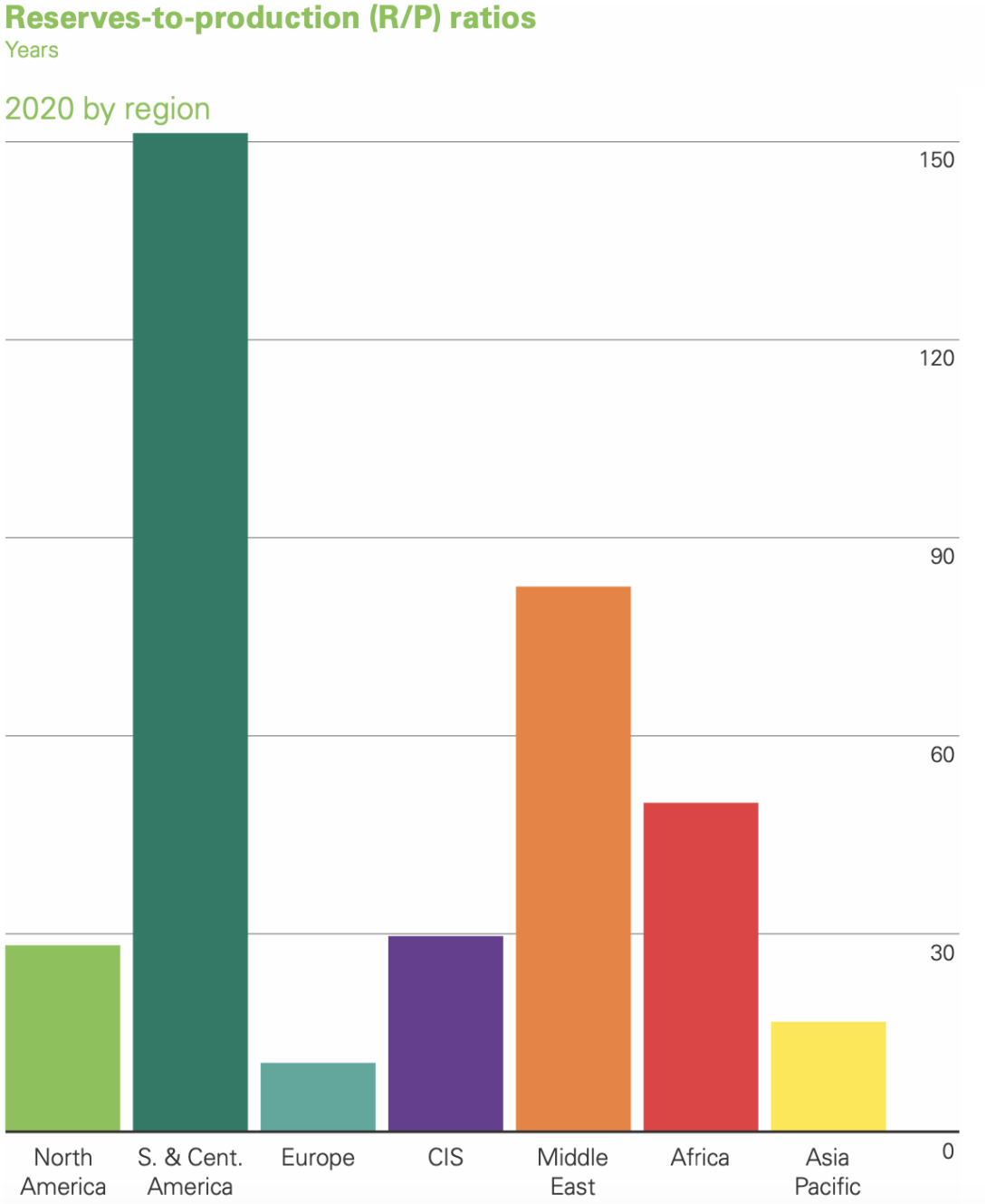


Bundesministerium
für Wirtschaft
und Klimaschutz

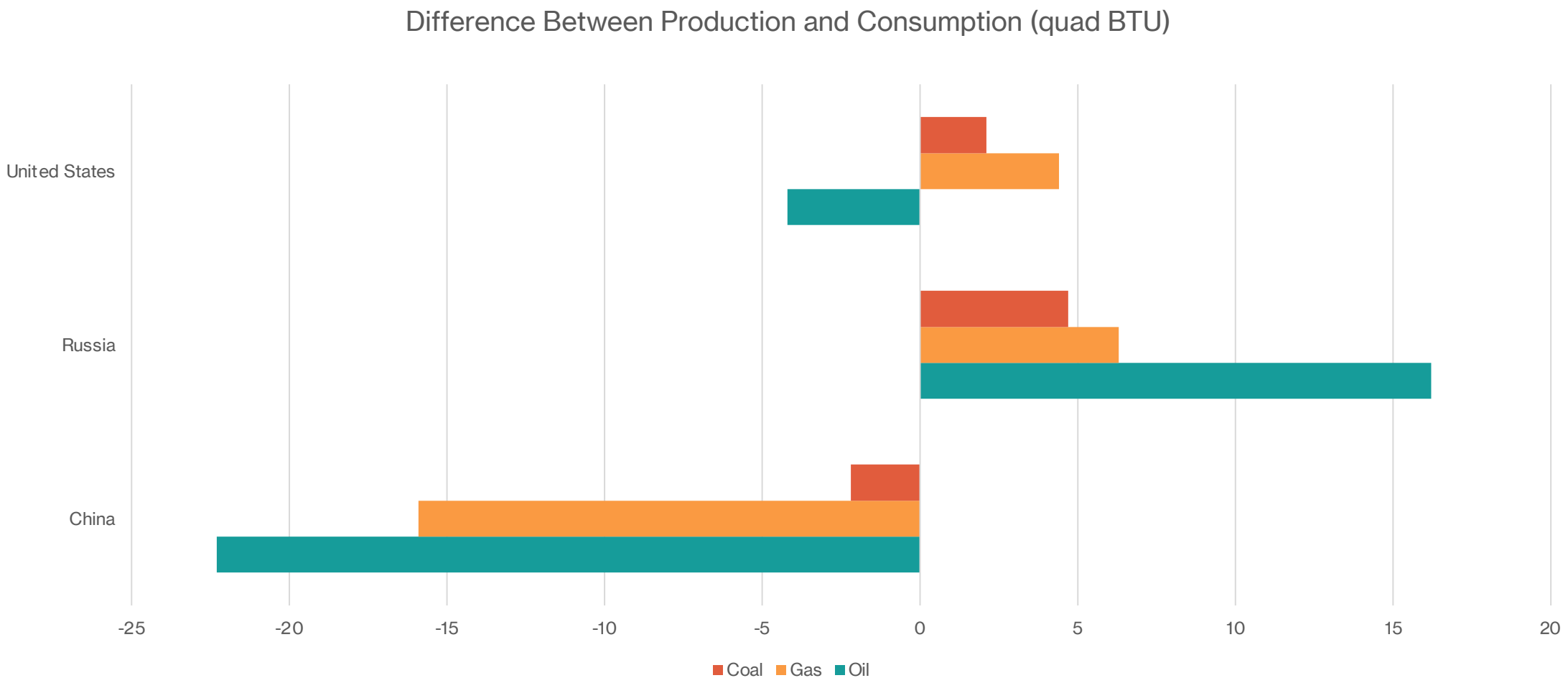
Global Oil Production

The top 10 oil[1] producers and share of total world oil production[2] in 2022[3]

Country	Million barrels per day	Share of world total
United States	20.30	21%
Saudi Arabia	12.44	13%
Russia	10.13	10%
Canada	5.83	6%
Iraq	4.61	5%
China	4.45	5%
United Arab Emirates	4.23	4%
Iran	3.67	4%
Brazil	3.17	3%
Kuwait	3.01	3%
Total top 10	71.83	74%
World total	97.70	



Fossil Fuels and Strategic Competition

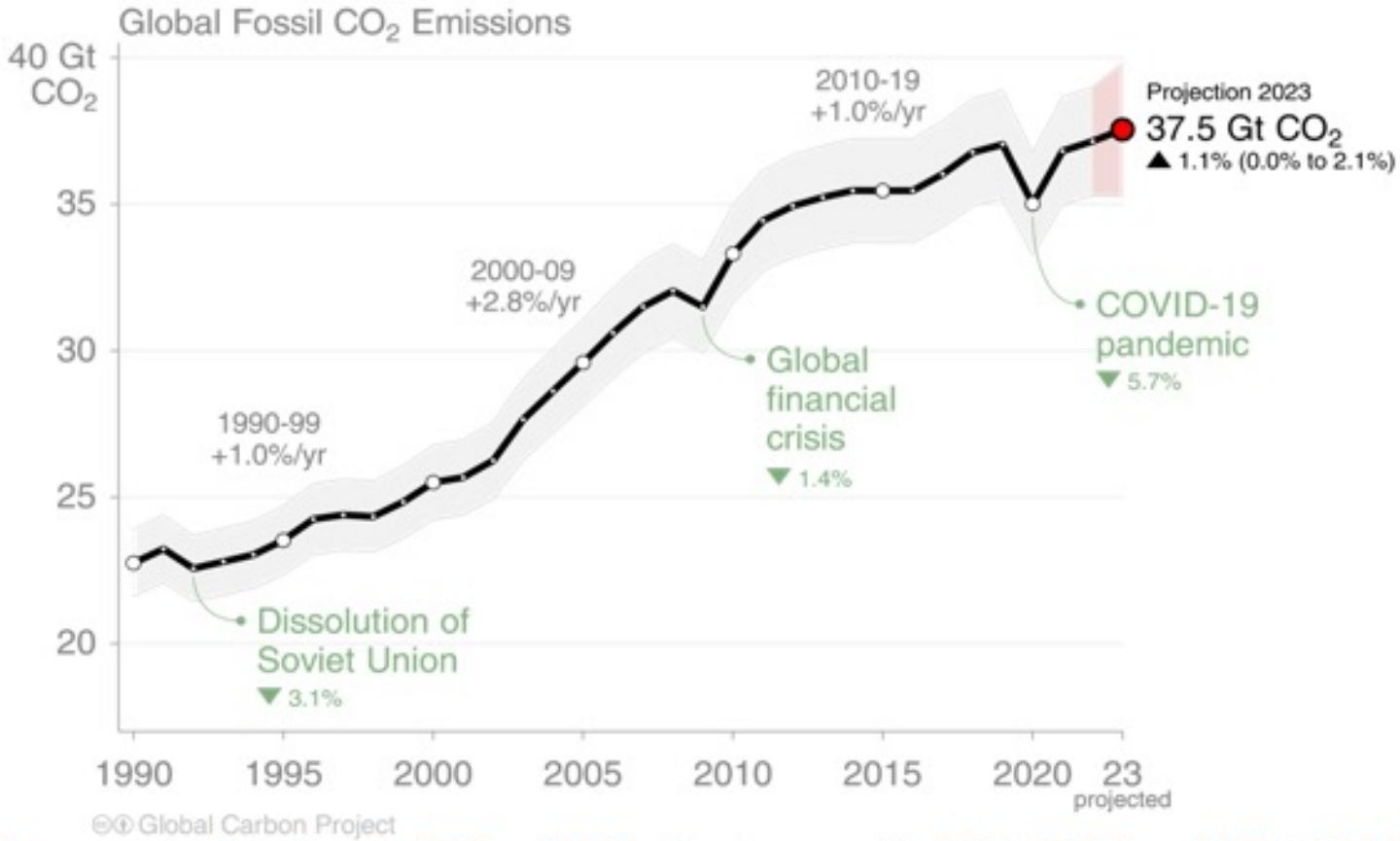


Global Fossil CO_2 Emissions

The Flip Side of Fossil Fuel Dominance

Global fossil CO_2 emissions: 37.1 ± 2 $GtCO_2$ in 2022, 63% over 1990

Projection for 2023: 37.5 ± 2 $GtCO_2$, 1.1% [0.0% to +2.1%] higher than 2022



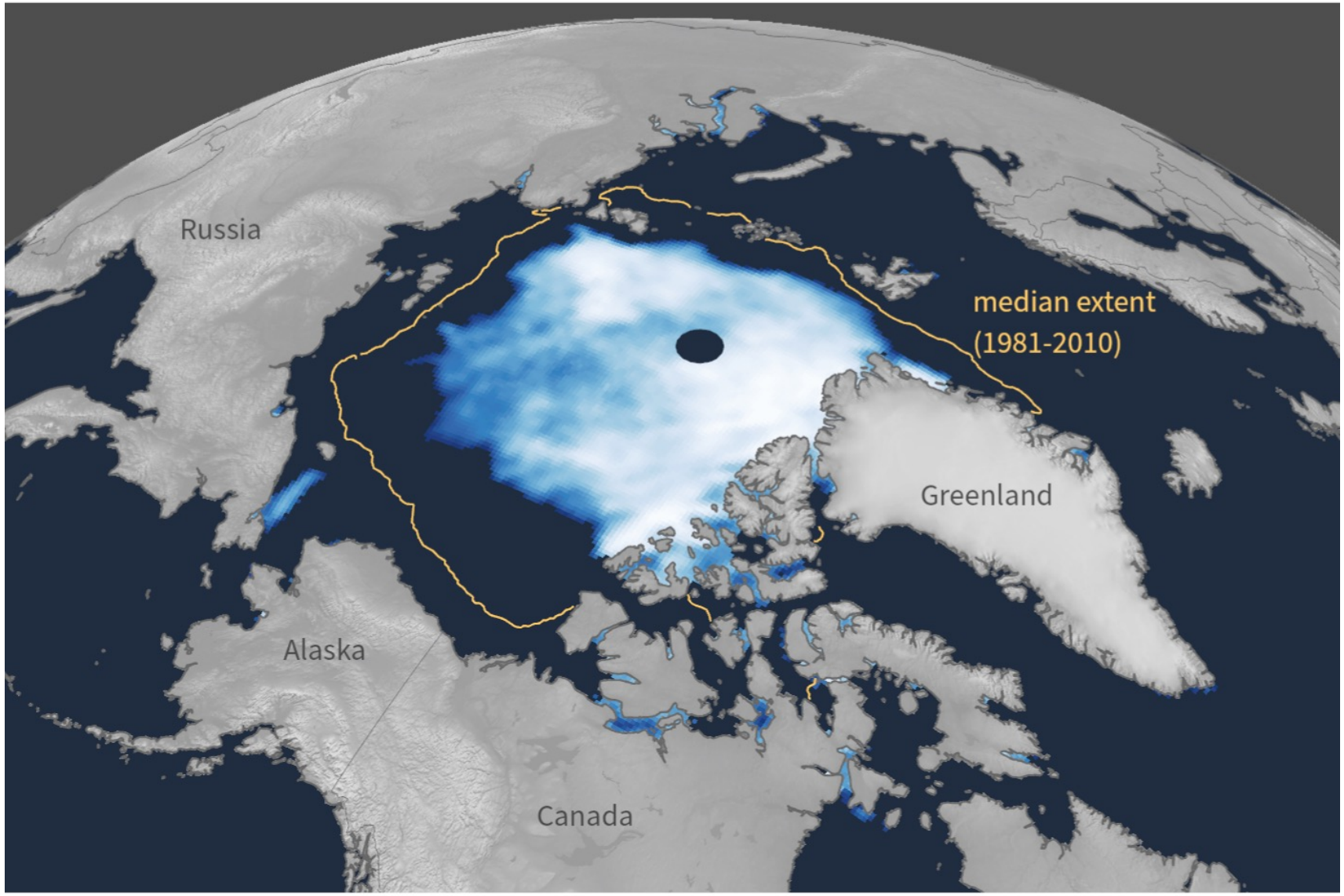
Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

When including cement carbonation, the 2022 and 2023 estimates amount to 36.4 ± 2 $GtCO_2$ and 36.8 ± 2 $GtCO_2$ respectively

The 2023 projection is based on preliminary data and modelling.

Source: Friedlingstein et al 2023; Global Carbon Project 2023

2024 Arctic sea ice summer minimum



September 11, 2024

Sea ice concentration (percent)

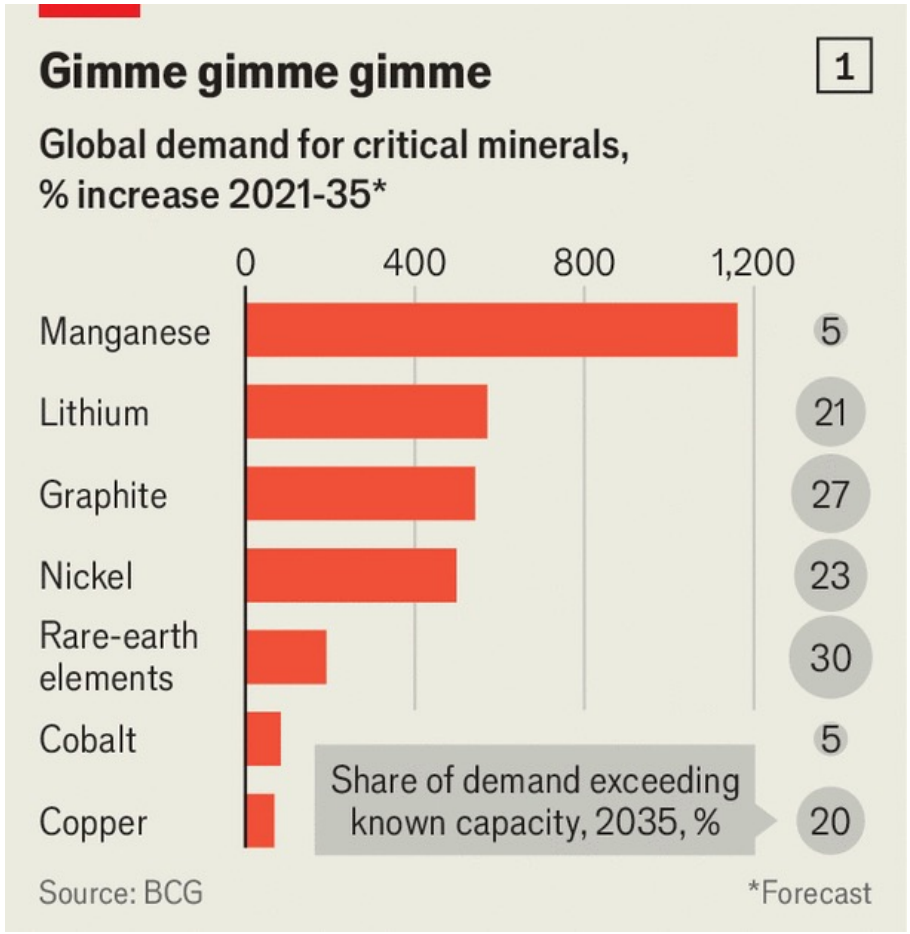
15 100

NOAA Climate.gov
Data: NSIDC

- New global trade routes
- New access to considerable resources
- All NATO nations on the littoral – except for Russia
- Icebreaker gap (48?)

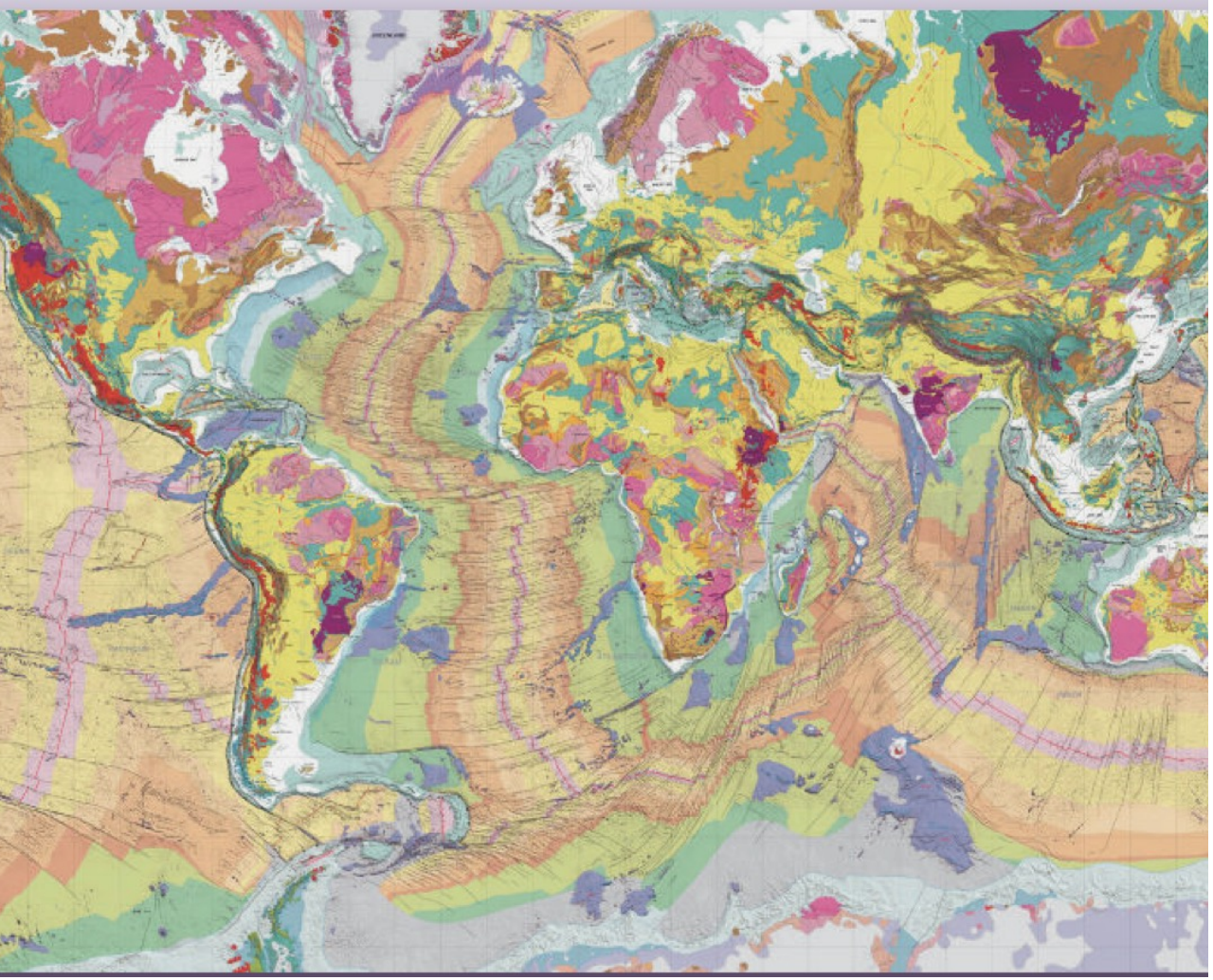
"Changes in Arctic sea ice cover have wide-ranging impacts. The sea ice affects local ecosystems, regional and global weather patterns, and the circulation of the oceans"

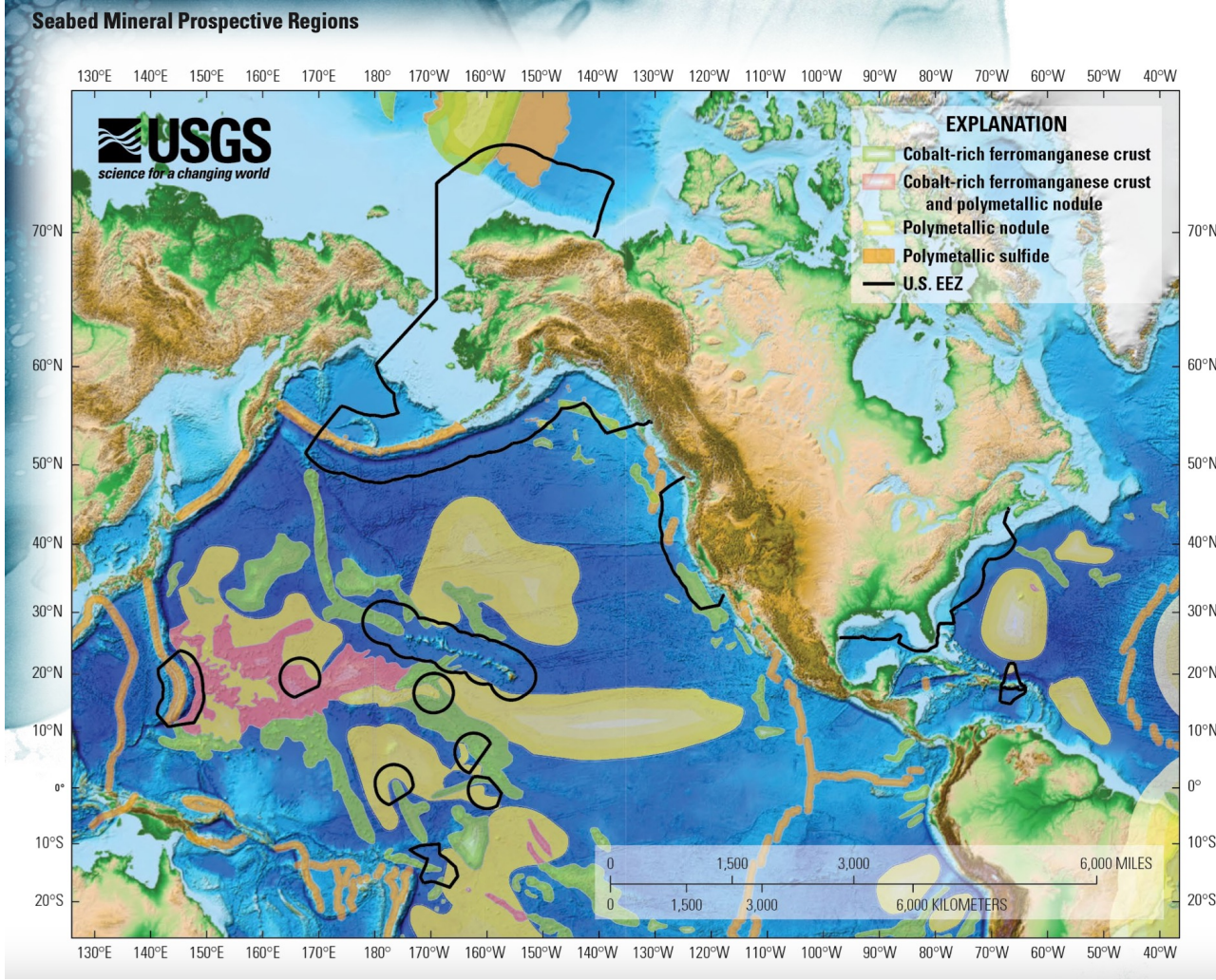
Minerals Demand Growth



Major Critical Minerals End Uses

Defense	Electronics	Medical	Energy	Infrastructure
Platforms	Smartphones	MRIs	Batteries	Roads
Munitions	Computers	Prosthetics	Solar	Bridges
Equipment	TVs	Pacemakers	Geothermal	Buildings
Space	Semi conductors	X-Rays	Wind	Power grids
Robotics		Hearing aids	Oil refining	Vehicles



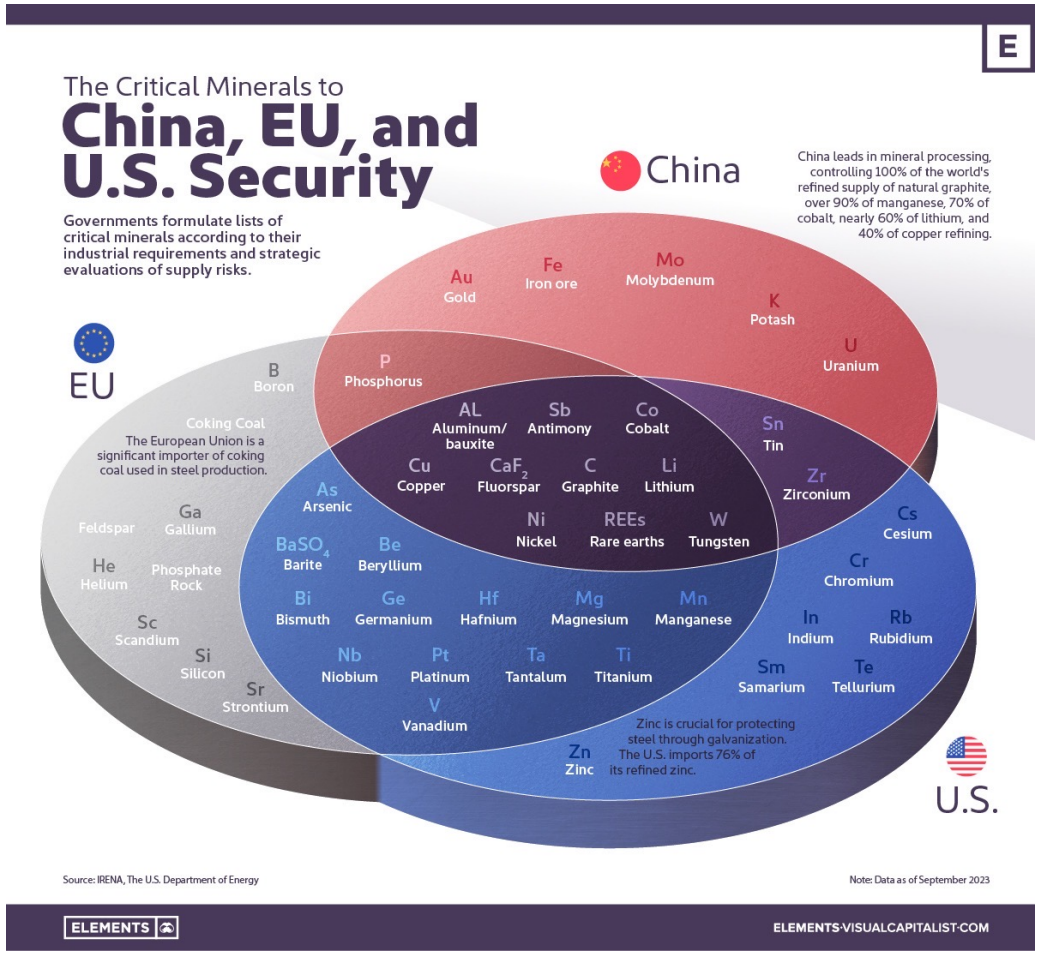


https://ccgm.org/en/

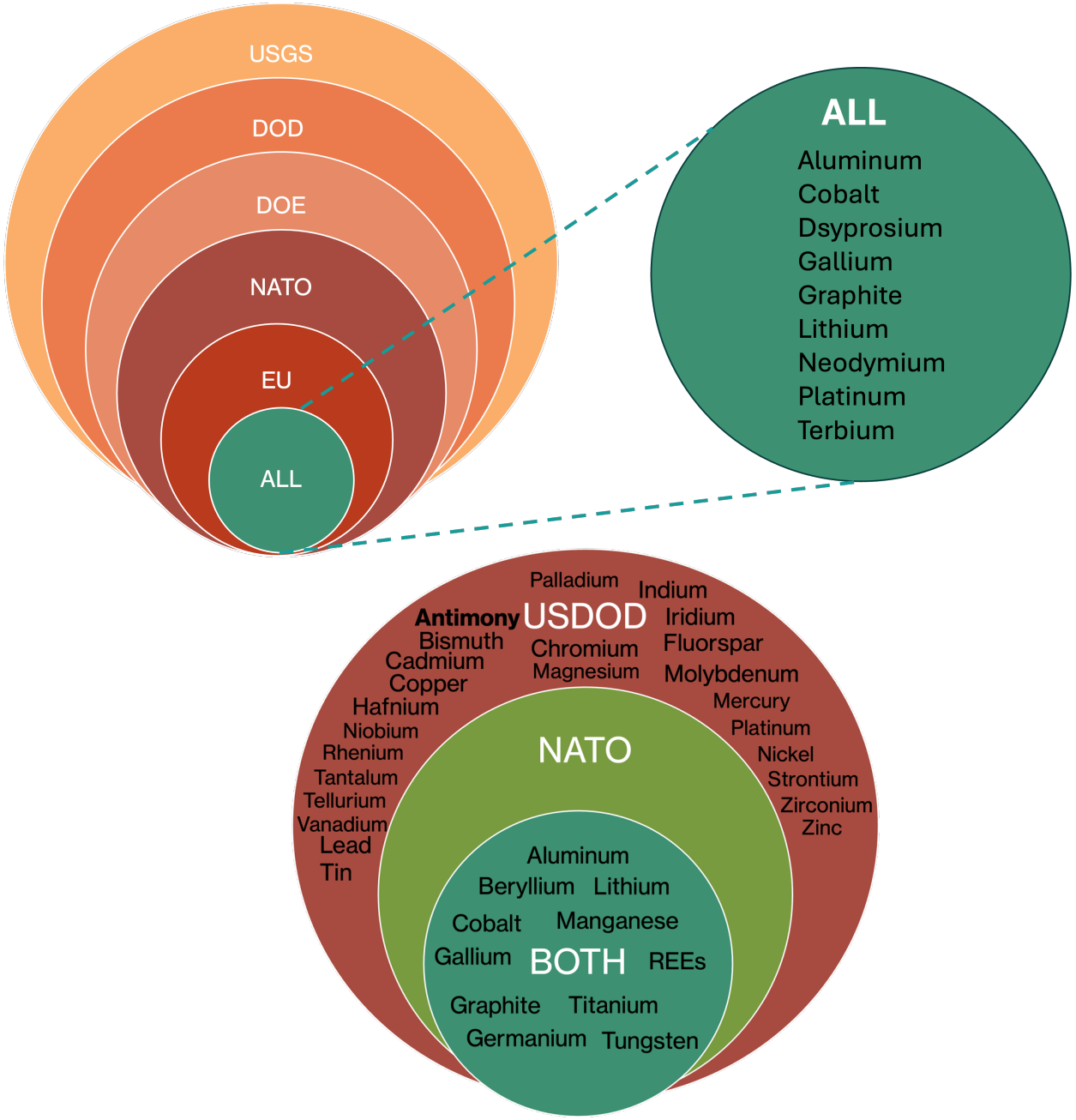
Underground Truths

Critical Minerals

Variety in how criticality is measured



https://deepseamining.ac/article/38#gsc.tab=0



	Top Global Reserves of Convergent Critical Minerals	Share (Percent)	Top Global Refiners of Convergent Critical Minerals	Share (Percent)
Aluminum	Australia India	41 21	China India	58 6
Antimony*	Tajikistan China	41 32	China Tajikistan	47 17
Cobalt	DRC* Indonesia	43 11	China Finland	78 8
Copper*	Tanzania* Chile	50 12	China Chile	43 8
Fluorspar	Mexico China	24 24	China Mexico	62 20
Graphite	Mozambique Tanzania	32 11	China Mozambique	67 10
Lithium	Bolivia Australia	50 12	Australia Chile	47 30
Nickel	Indonesia Canada	21 14	Indonesia China	37 27
Rare Earth Elements	China USA	60 13	China Malaysia	87 12

Data from https://rmis.jrc.ec.europa.eu/rmp/

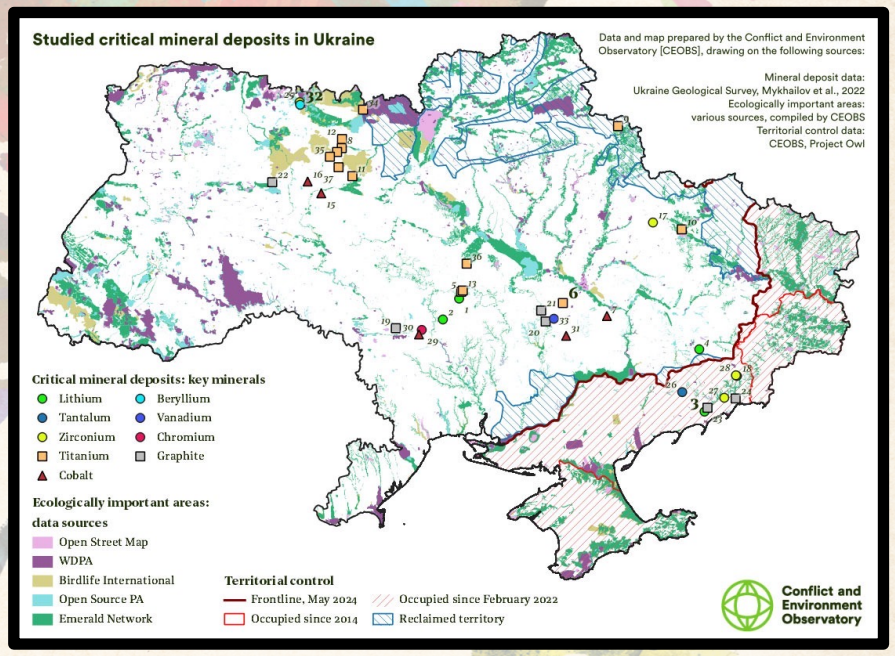
Critical Mineral Superpowers

Critical Mineral Superpowers

- Australia
- Brazil
- Canada
- Chile
- China
- DRC
- Indonesia
- Mexico
- Peru
- Russia
- South Africa
- USA

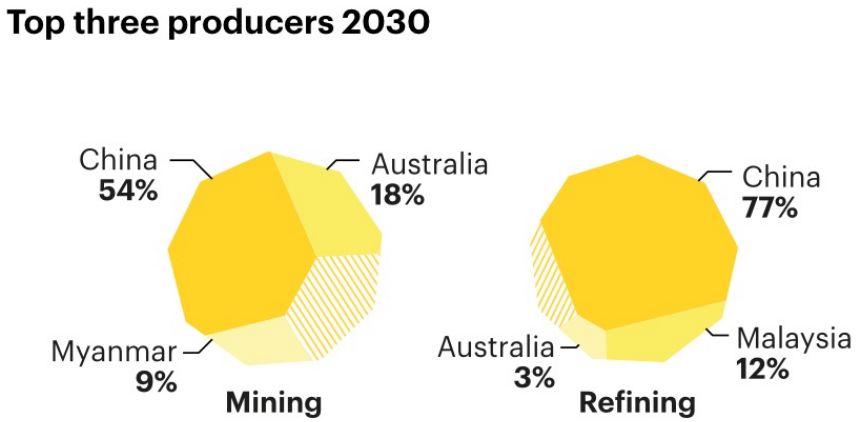
Potential or Regional

- Argentina
- Bolivia
- Greenland
- Iran
- Kazakhstan
- Poland
- Seabed
- Sweden
- Ukraine
- USA
- Zambia
- Zimbabwe

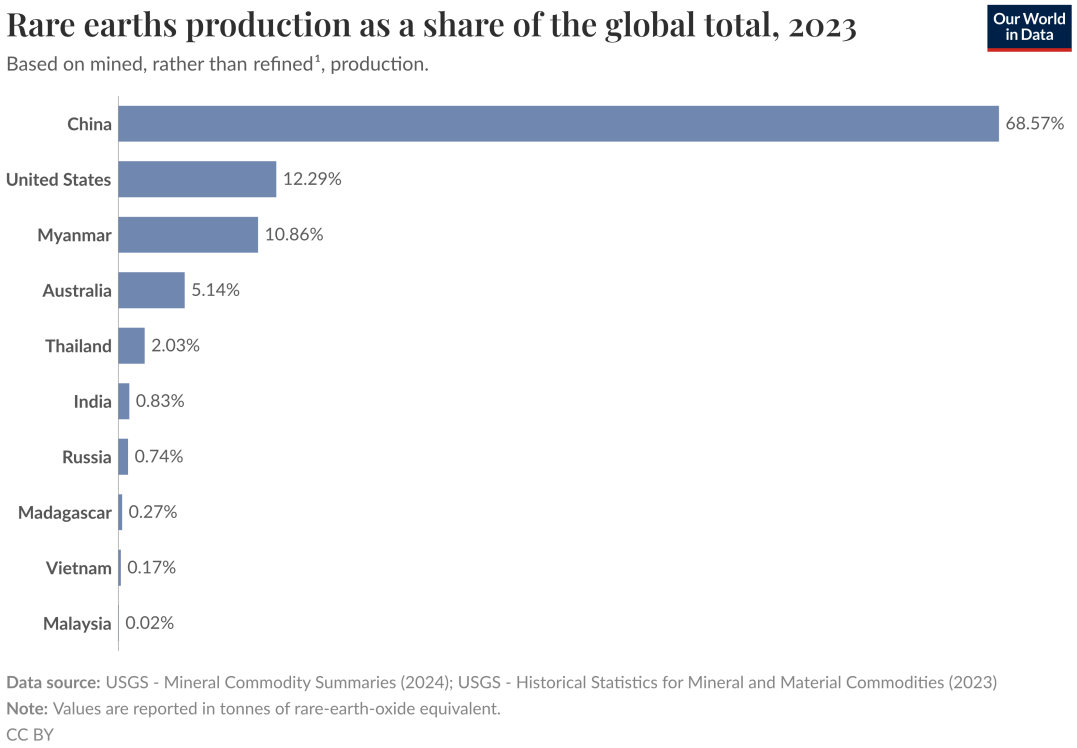


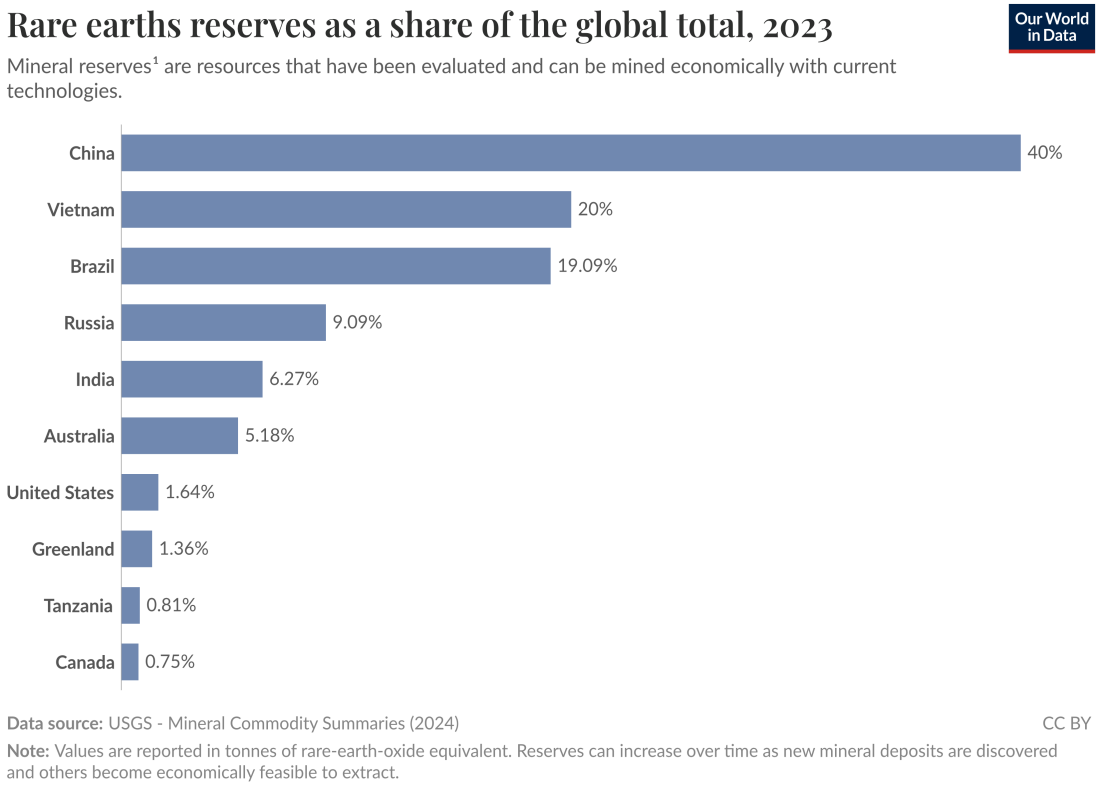
https://ceobs.org/the-environmental-risks-from-a-critical-minerals-rush-in-ukraine/

Snapshot: Rare Earth Elements



https://www.iea.org/reports/rare-earth-elements#dashboard





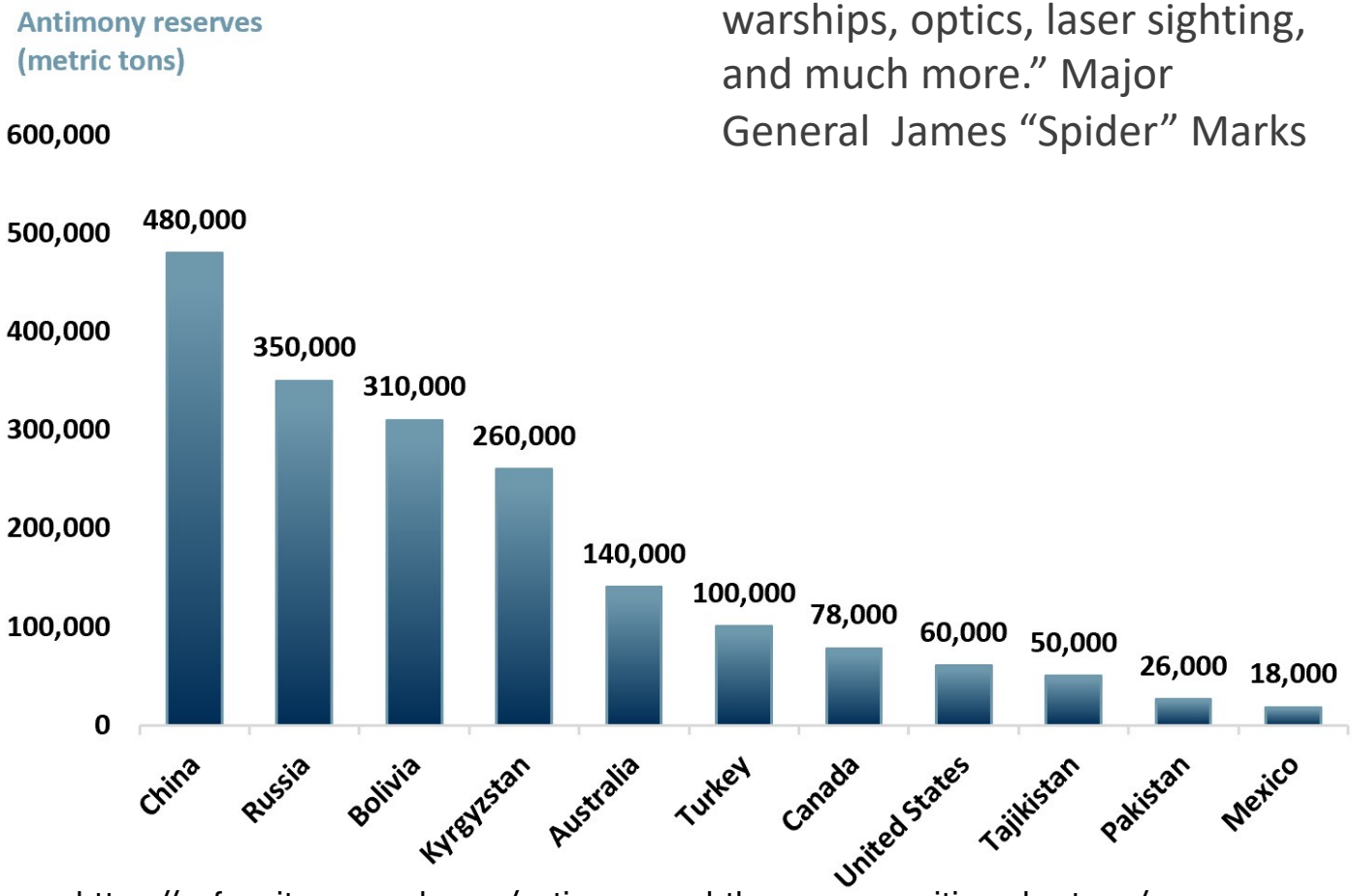
Snapshot: Antimony

51
Sb
Antimony
121.76

- Automotive batteries (lead-acid)
- Ceramics and glass
- Flame retardants (flameproof fabrics)
- Automotive brake pads (additive to adjust co-efficient of friction)
- Cable sheathing

Uses according to US Department of Defense website

"Antimony is a key ingredient in communication equipment, night vision goggles, explosives, ammunition, nuclear weapons, submarines, warships, optics, laser sighting, and much more." Major General James "Spider" Marks



https://acfequityresearch.com/antimony-and-the-us-ammunition-shortage/

Dirty Business, Instability & Innovation

https://www.euronews.com/green/2022/02/01/south-america-s-lithium-fields-reveal-the-dark-side-of-our-electric-future

https://www.fpri.org/article/2022/03/chinas-rare-earth-metals-consolidation-and-market-power/

https://www.nytimes.com/2023/01/23/books/review/cobalt-red-siddharth-kara.html

https://meduza.io/en/feature/2025/03/17/a-costly-gamble

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