

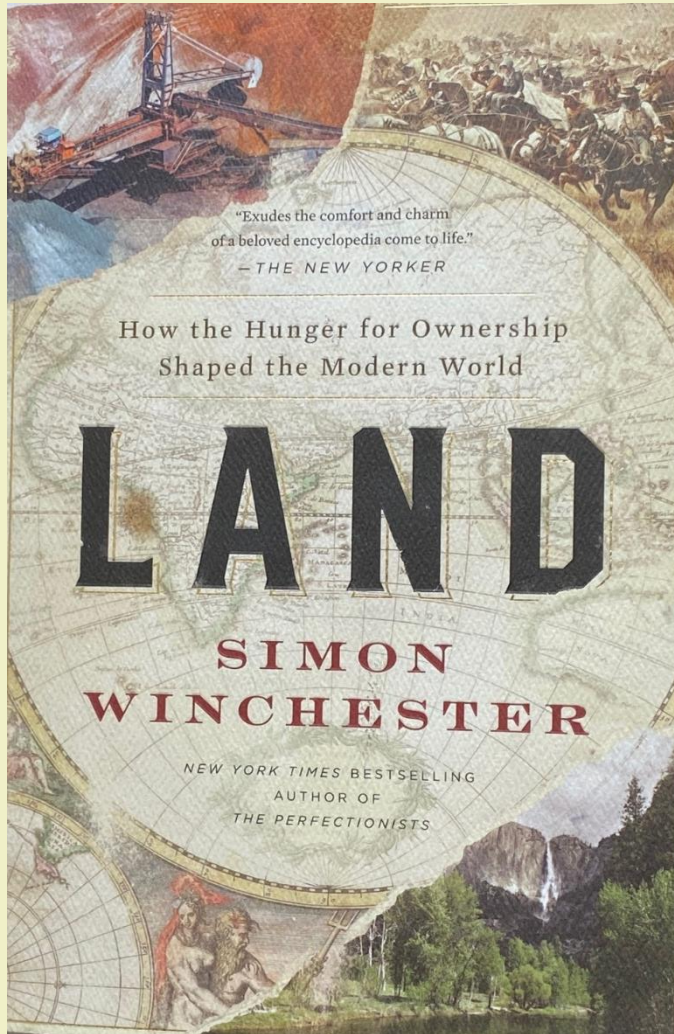
Resources in a world of change and uncertainty

John Thompson
PetraScience Consultants
University of Bristol

A word cloud of mining and sustainability terms arranged in a circular pattern. The terms are as follows:

- Climate change
- Energy transition
- Renewable energy
- Electrification
- Increasing mineral demand
- Critical metals
- supply chains
- Net Zero – emissions, biodiversity loss....
- Skills shortage
- Sustainable prosperity
- Rehabilitation
- Just transition
- Indigenous rights
- Social justice
- Communities
- Geopolitics
- Impact-benefit
- Water security
- Circular economy
- Recycling
- Full-value mining
- Selective/precision mining
- ASM – informal mining

Human development and impact



Land and ownership

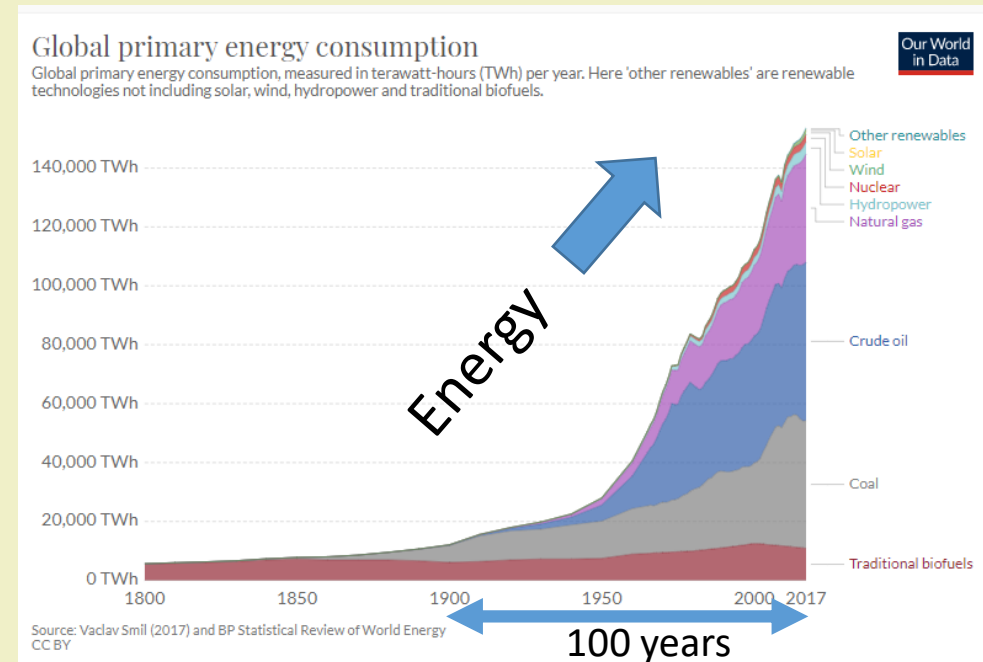
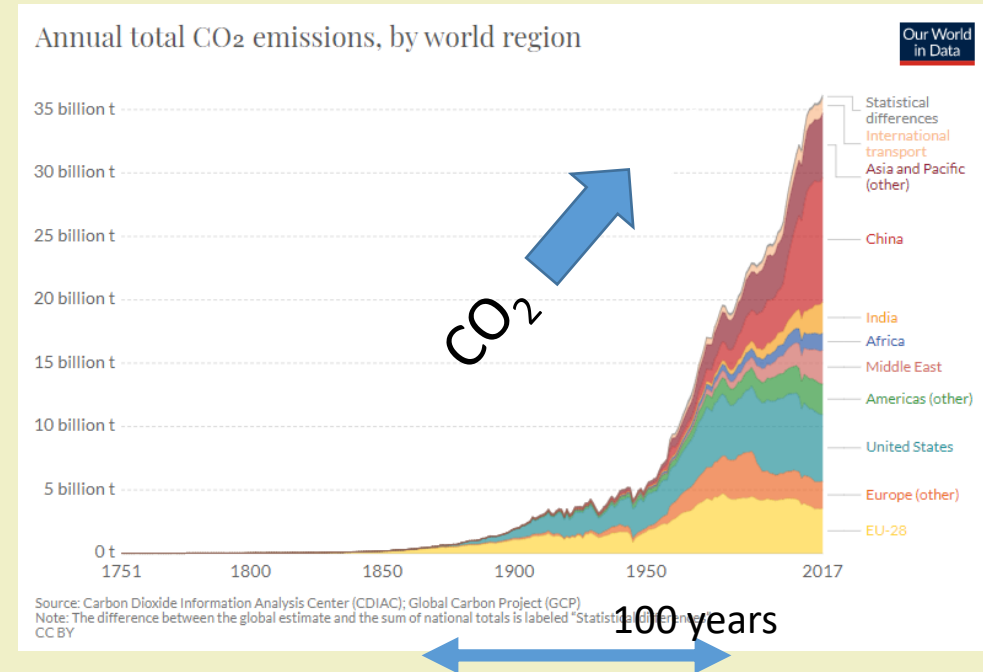
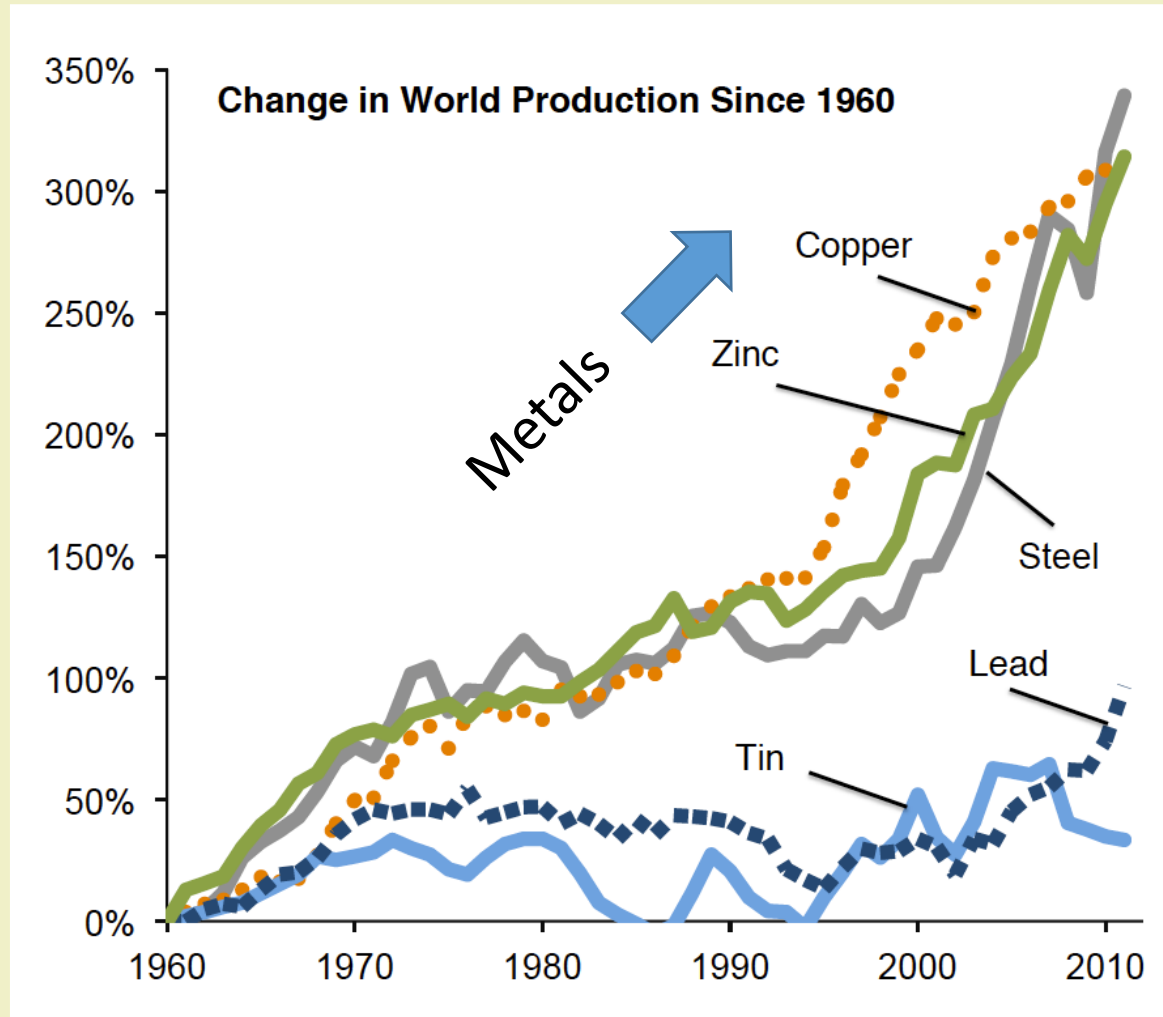
The first person who, having enclosed a plot of land, took it into his head to say this is mine, and found people simple enough to believe him, was the true founder of civil society. What crimes, wars, murders, what miseries and horrors would the human race have been spared, had someone pulled up the stakes or filled in the ditch and cried out to his fellow men: "Do not listen to this imposter. You are lost if you forget that the fruits of the earth belong to all and the earth to no one!"

—JEAN-JACQUES ROUSSEAU,
Discourse on Inequality (1755)



Anthropocene – ‘unconformity’

Exponential growth

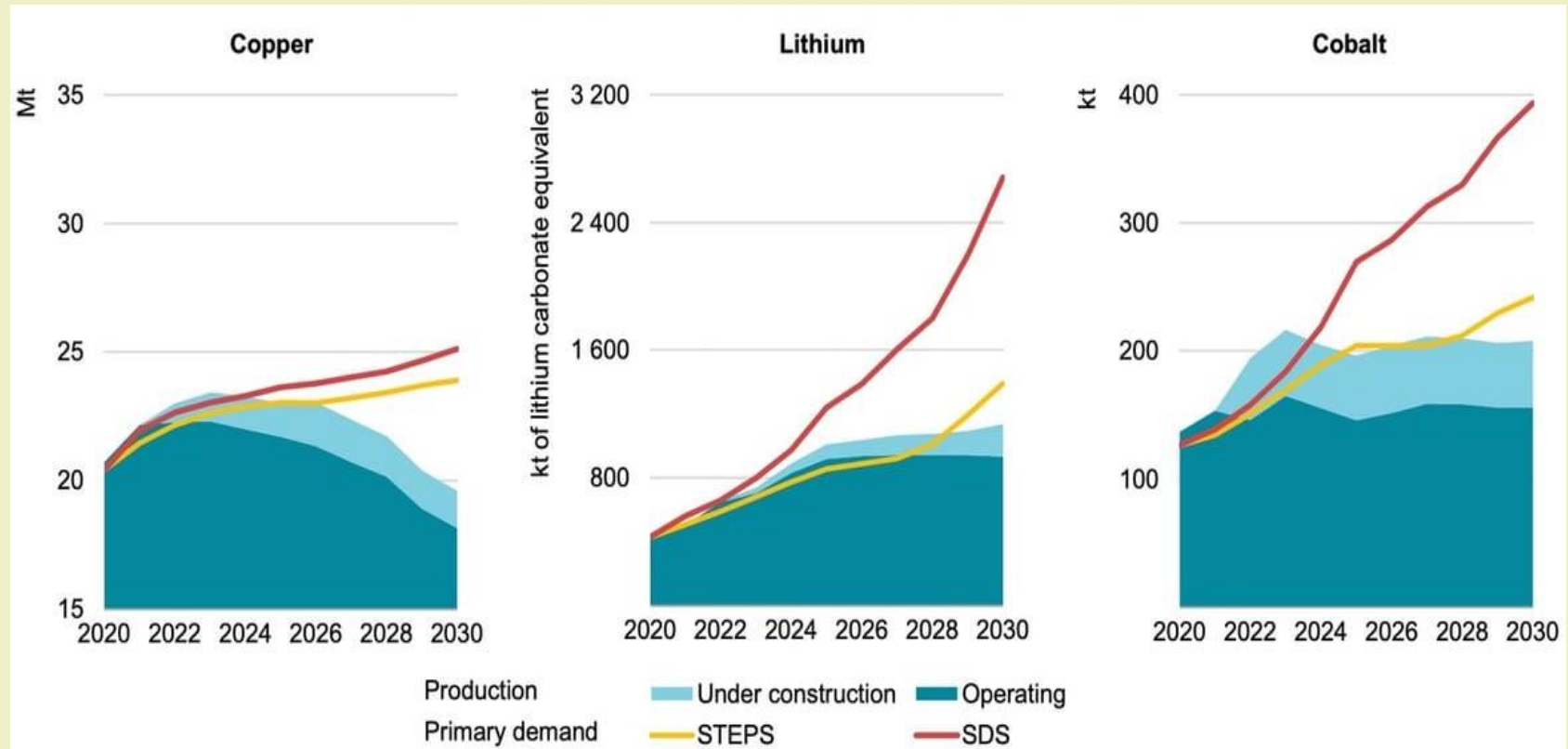


Predicting demand – supply constraints

- New demand
 - Energy transition
- New supply
 - Expansions
 - New technology
 - New discoveries

Supply gaps...?

IEA 2021: Mine production and demand scenarios




STEPS – Stated Policies Scenarios; SDS – Sustainable Development Scenarios

Mining euphoria

Copper

- Increasing by 40% in 20 years (IEA-2021)



CERAWEEK[®]
by IHS Markit

Can a Mismatch of Supply and Demand of Copper Upend the Energy Transition Timelines?

Dan Vergin, Carlos Pascual, Mohsen Bonakdarpour
10 March 2022
7:15 AM – 8:30 AM
The Grove Restaurant, Vista room

NOTE: Space will be available through 10:00 AM for additional conversations

CERA: Cambridge Energy Research Associates

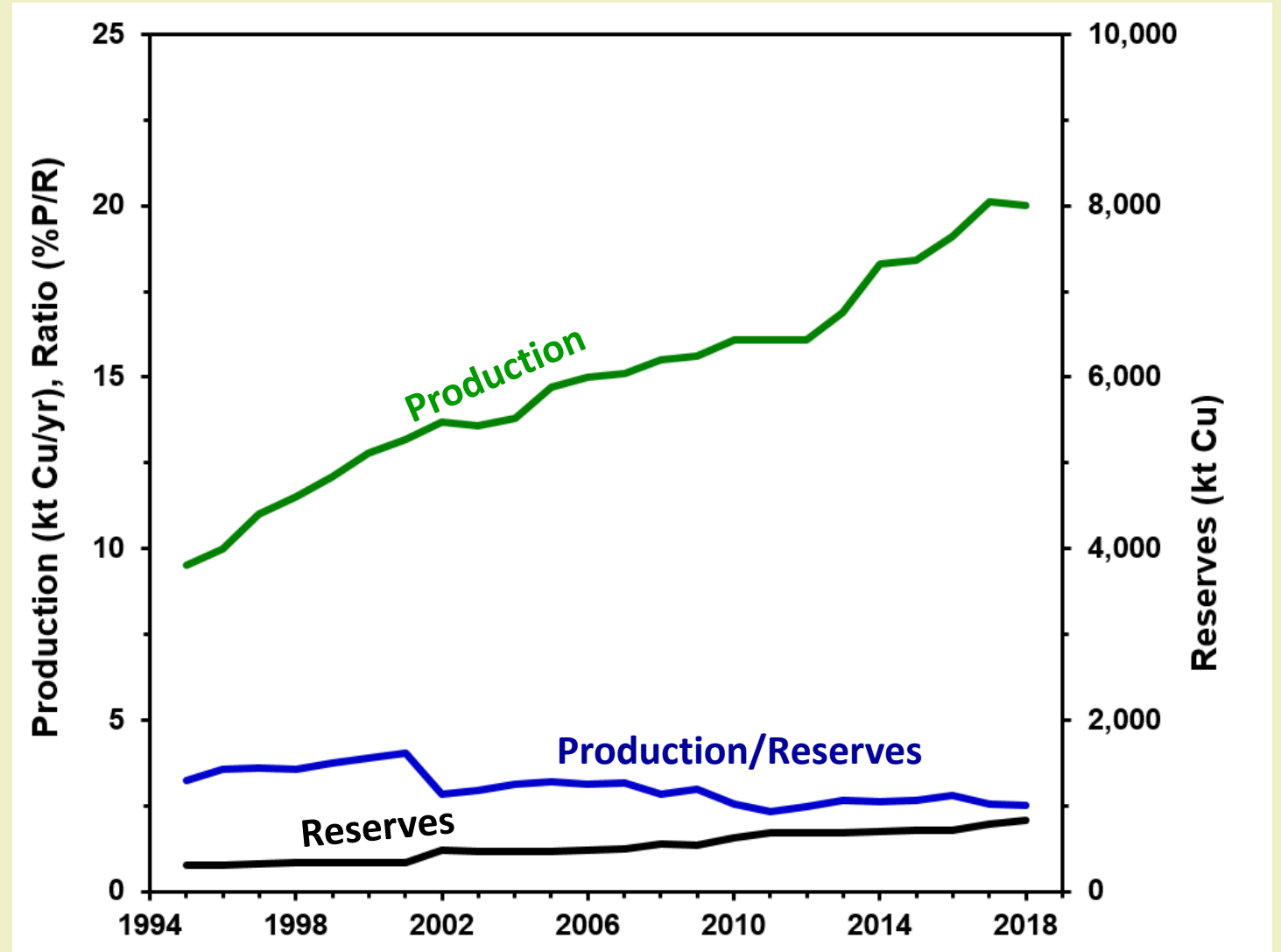
Metal demand/supply – reality check

Copper reserves

- Reserves always increase
- Predicted 'gaps' – in the future
- We are good at 'discovery'!

Production challenges – ESG

- Communities
- Energy – GHG
- Water
- Waste
- Land – access, competition
- Biodiversity
- Transparency.....

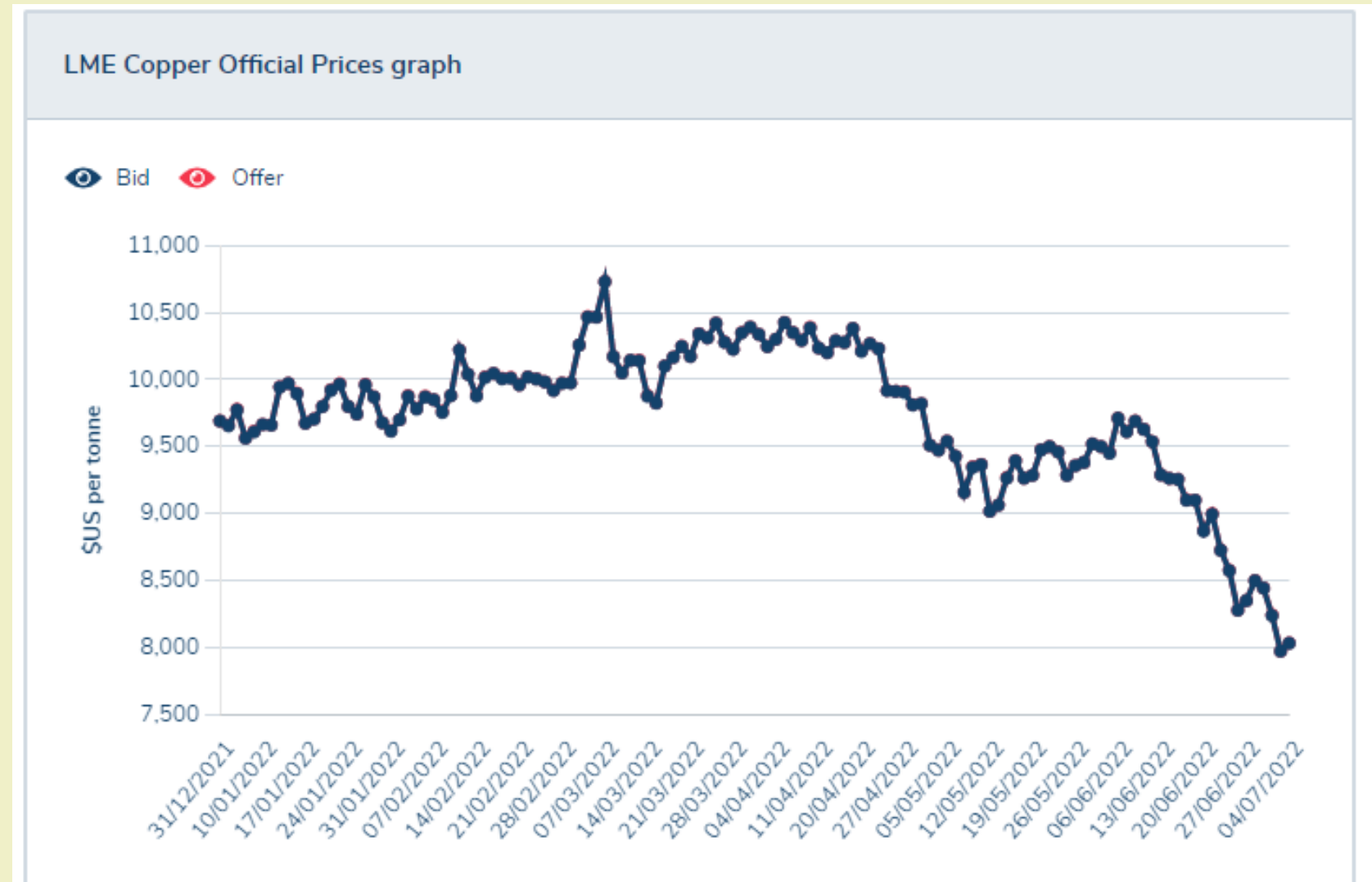


Adapted from Jowitt et al., 2020; USGS data

Complexity and volatility

Metal prices

- Copper price –
12 Months 2021-2022
- China, Russia-Ukraine
- Impact on demand?



Predicting the future

Predictions – variable timelines

- Climate change
- Globalization – failed globalization
- Populist politics
- The pandemic
- mRNA vaccines
- Digital transformation – automation, AI...
- Russia-Ukraine

Limited predictions

- Growth of China
- Peak oil
- Global financial crisis
- Social media
- Competitive electric cars
- Technology companies
- Shared economy
- Space companies

Three scenarios

- Follow the trends
- The end of mining
- Materials business



Follow the trends

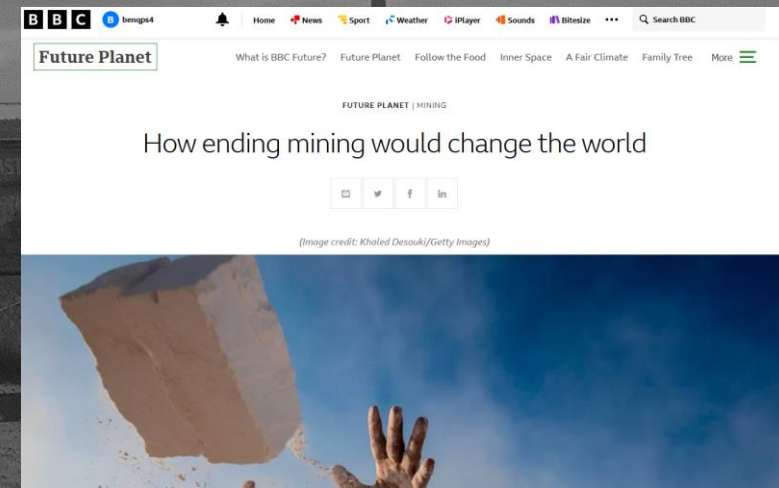
- Energy transition – more demand, more mining
- Supply chain disruption – more mines in more countries
- ESG – community opposition
- Climate change pressure
- Populism, nationalism, expediency – volatility



The end of mining

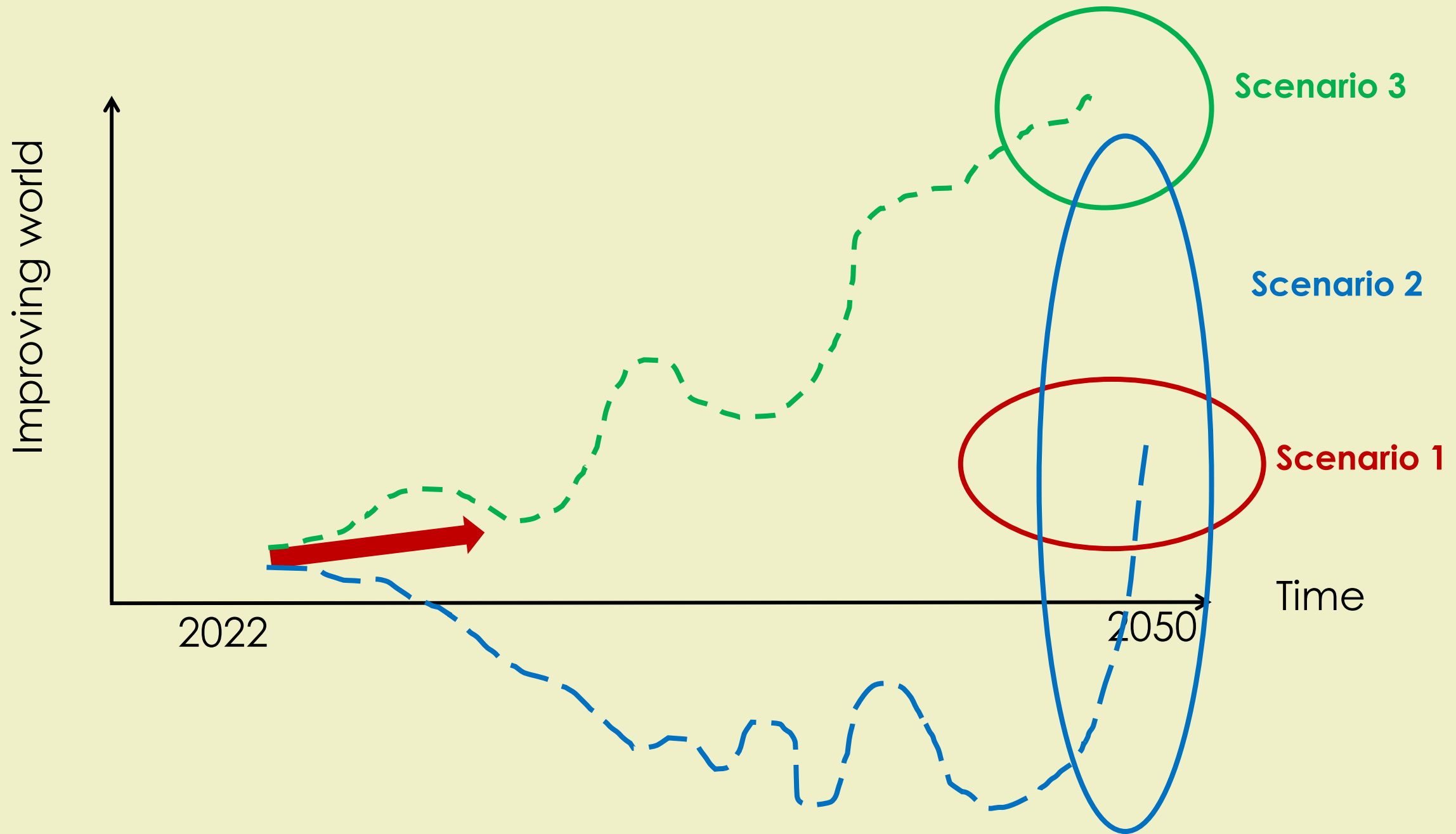
- Weeks – employees, people, disruption
- Months – massive economic damage, infrastructure and technology degradation, inequality, migration, war
- Years – pending survival... some countries start to adjust

<https://www.bbc.com/future/article/20220413-how-ending-mining-would-change-the-world>



A materials business

- Material design for recycling – circular economy
- Material sources – recycle streams, re-mined waste, crustal fluids, in-situ recovery, mines
- Mines – partnerships with communities, zero/net zero emissions, energy, water, waste, biodiversity loss; sustainable development for partners
- Secure sources/supply chains through valued partnerships
- Rehabilitation – redesign and reclamation



Scenario planing

- Following the trends – not sufficient
- No mining and global disruption – prepare for ‘Black Swans’ and chaos
- The ‘ideal’ case – what will it take

What do we need to do now?