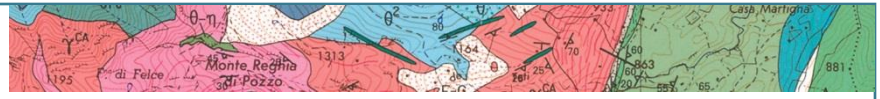

Why does the European Union need to produce primary minerals?

The complementary role of policies and technologies

2. FREIBERGER RESSOURCENTECHNOLOGIE-SYMPOSIUM
April 17th, 2013

Dr. Patrice Christmann
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Why does the European Union need to produce primary minerals?

- **Why do minerals matter to the European Union**
- **A changing (changed ?) world**
- **The respective role of policies and technologies**
  - Thoughts for a European Union in a global world

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WHY DO MINERALS AND METALS MATTER TO THE EUROPEAN UNION?

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Some reasons to worry …

- **Despite its important, and still largely untapped, geological potential the EU produces little of what it consumes, this makes it highly dependent on imports from beyond its borders**
- **NIMBYsm is a widespread EU problem;**
- **There is potentially overreliance on the virtues of a free market economy to ascertain the growing (!) diversity of raw material supplies needed by the EU economy**

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EU DEPENDENCE ON MINERAL RAW MATERIALS IMPORTS (EXAMPLES)

Antimony	100%	Vanadium	100%
Beryllium	100%	Tin	100%
Boron	100%	Phosphates	92%
Manganese	100%	Rhenium	90%
Cobalt	100%	Nickel	86%
Molybdenum	100%	Iron ore	83%
Niobium	100%	Bauxite	80%
Platinoids	100%	Zinc	80%
Rare Earths	100%	Tungsten	76%
Tantalum	100%	Lead	76%
Titanium	100%	Copper	74%
Germanium	100%	Chromite	53%

Numbers on red background indicate raw materials of which China is the first global mine producer - Data sources (data for 2009) : USGS, BGS, BRGM, PGI, WMD

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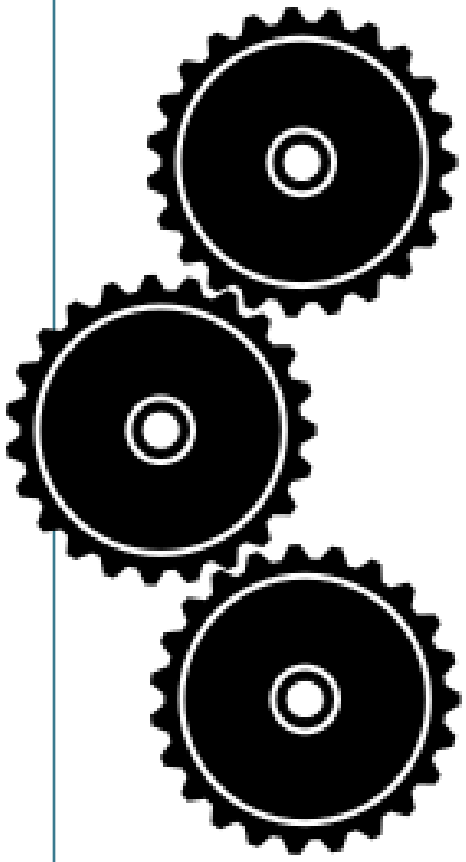
Direction de la Stratégie



KNOW YOUR SUPPLY CHAIN:
Primary and secondary mineral raw materials are vital inputs to many complex, frequently poorly documented and understood supply chains.

Just in time and zero stock: still valid mantras of a competitive economy?

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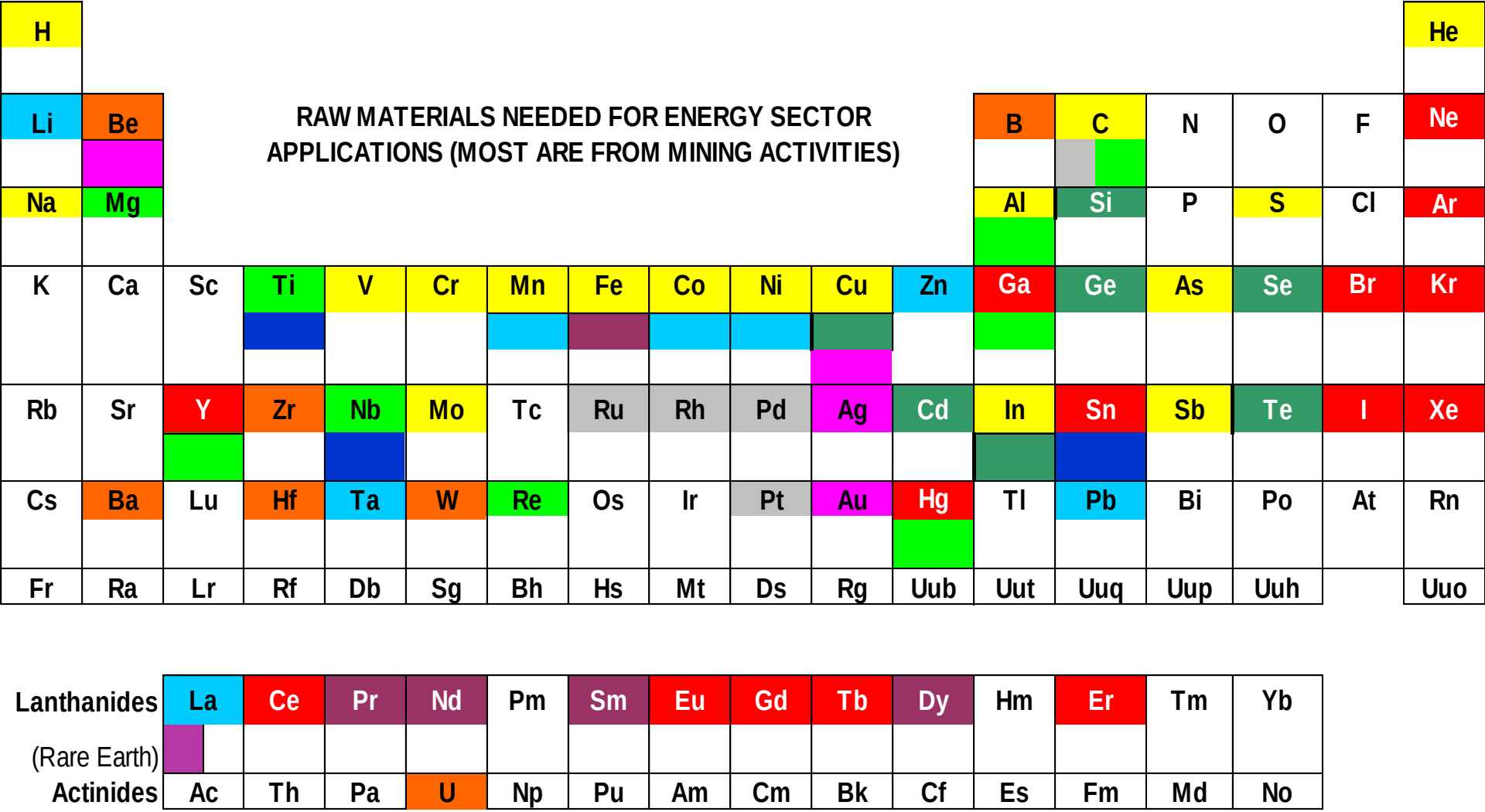
RAW MATERIALS NEEDED FOR ENERGY SECTOR APPLICATIONS (MOST ARE FROM MINING ACTIVITIES)



Energy storage

Connectivity

Energy saving

Catalysis (fuel cells)

Electricity generation and storage

Elements specific to nuclear electricity generation

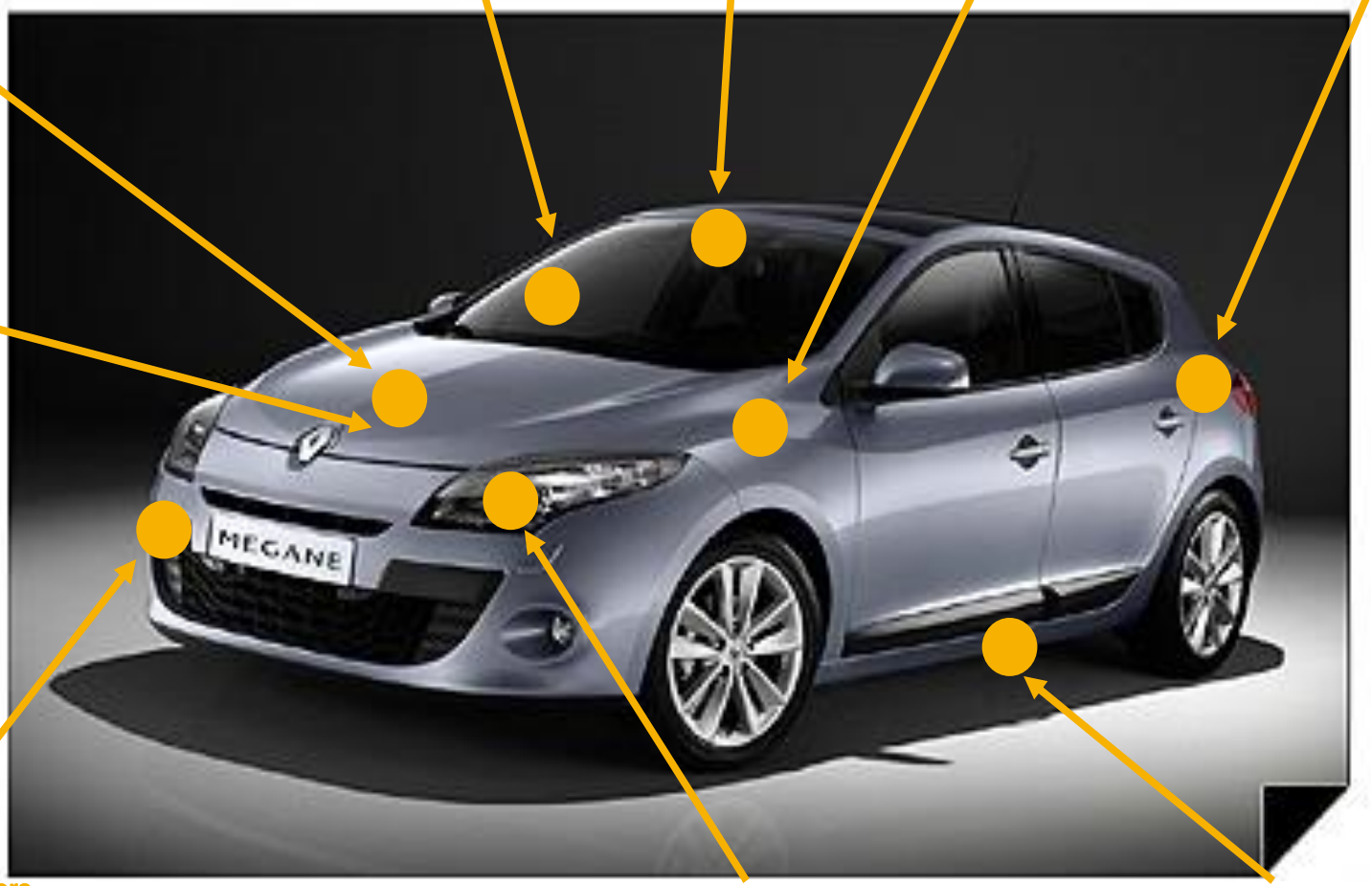
Photovoltaics

Permanent magnets for windmills and electrical/ hybrid cars

Lighting

Supraconductors

REE use in car manufacturing (By permission of Renault cars)



Engine Sensors

-Yttrium (ceramics)

Ductile cast iron

Cerium,

Lanthanum

+25 Electric Motors Throughout vehicle

-Neodymium Magnets

-Dysprosium

UV cut Glass

-Cerium

Glass and Mirrors polishing powder

-Cerium

Car body primers and anti-corrosive coatings

-Yttrium

Rare Earth phosphors and filters are used in automotive headlights to reduce glare

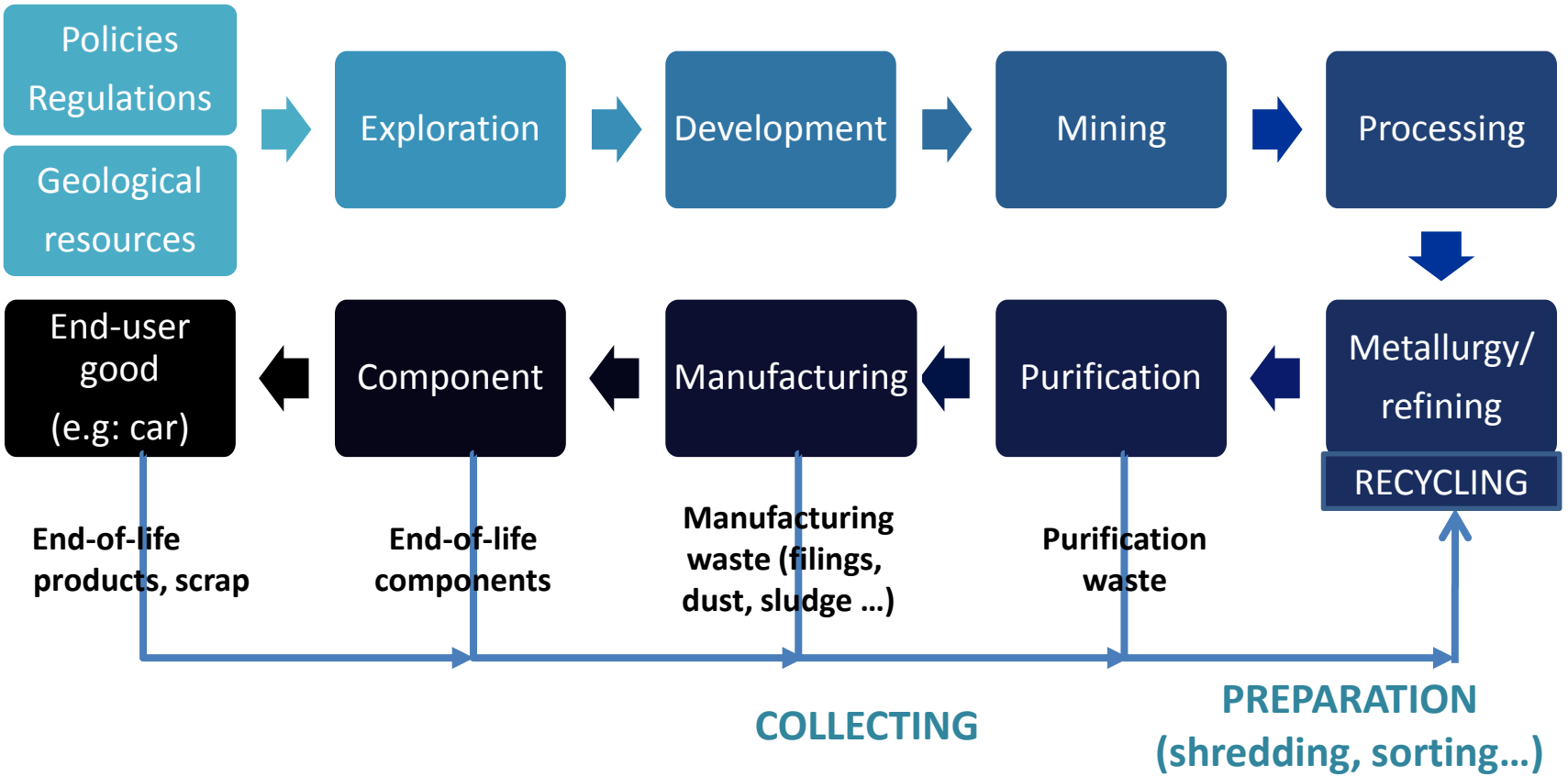
-Neodymium

Catalytic Converter

-Cerium

-Lanthanum

Criticality can hit one or several elements of a supply chain



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Many recent criticality assessment look at the geographic distibution of mine production as a key. Alas, there are more issues around …

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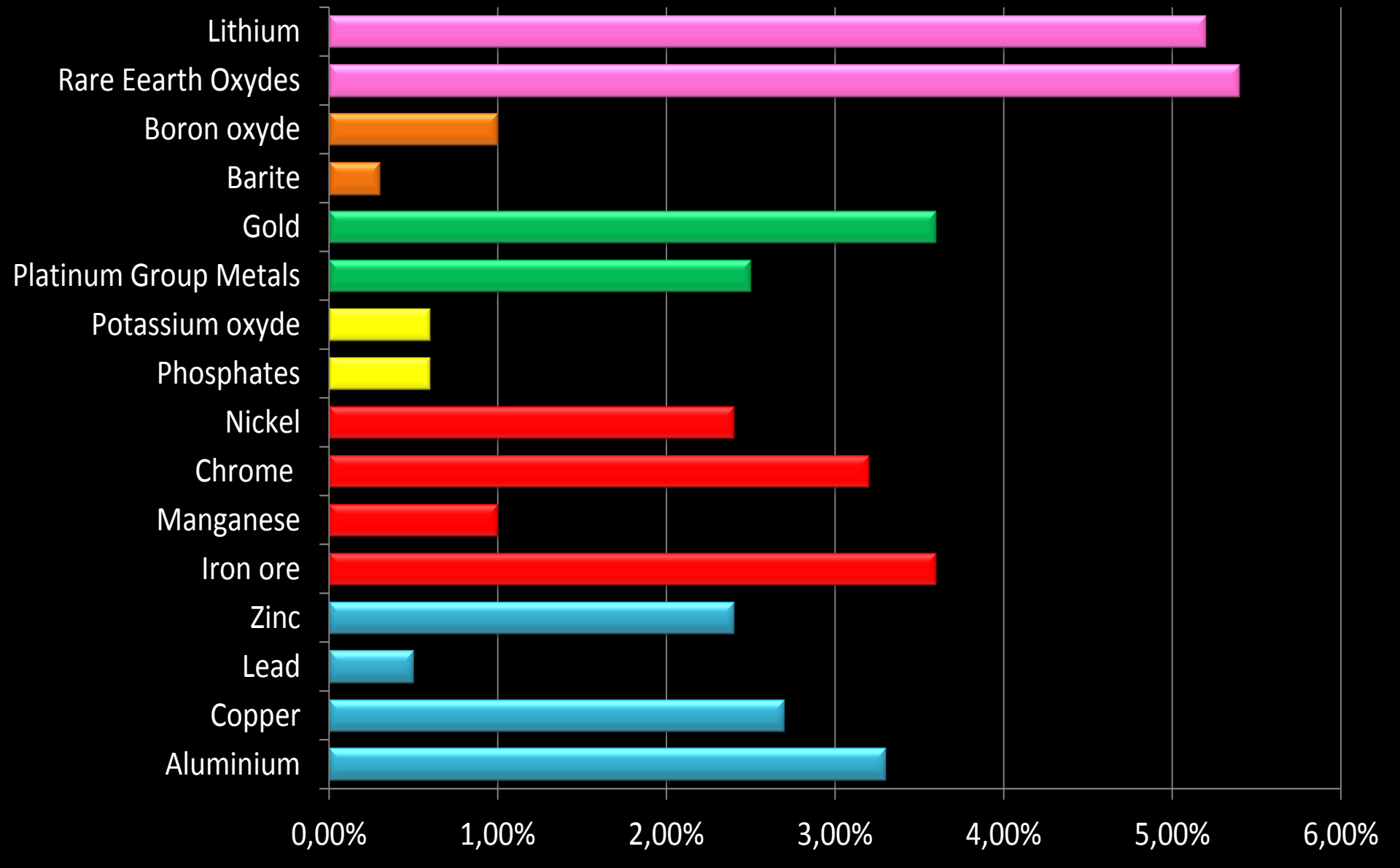
Compound Annual Growth Rate over 30 years (1981-2010) of the production of a selection of minerals and metals -

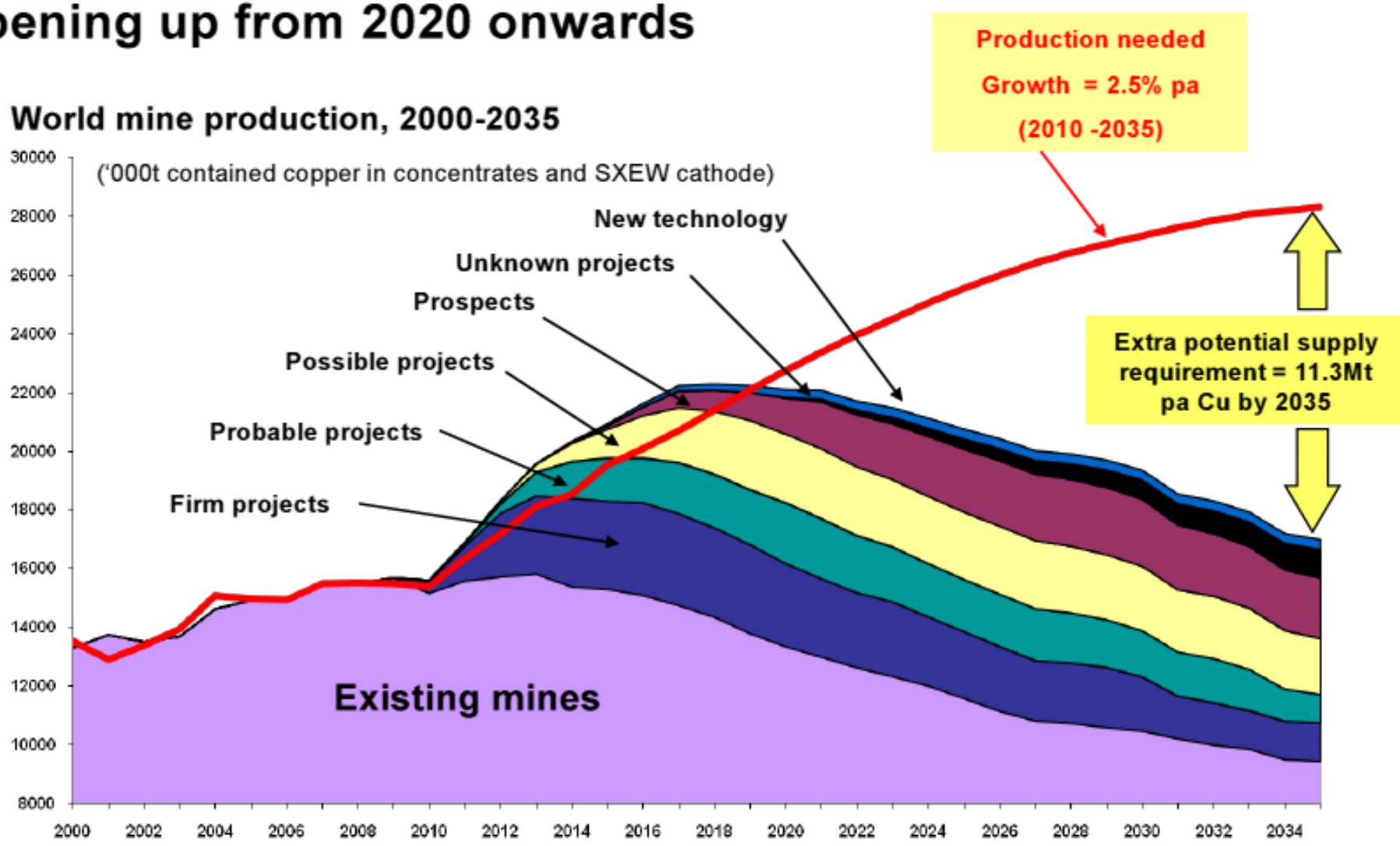
Data source: USGS Data Series 140



CRU | ANALYSIS

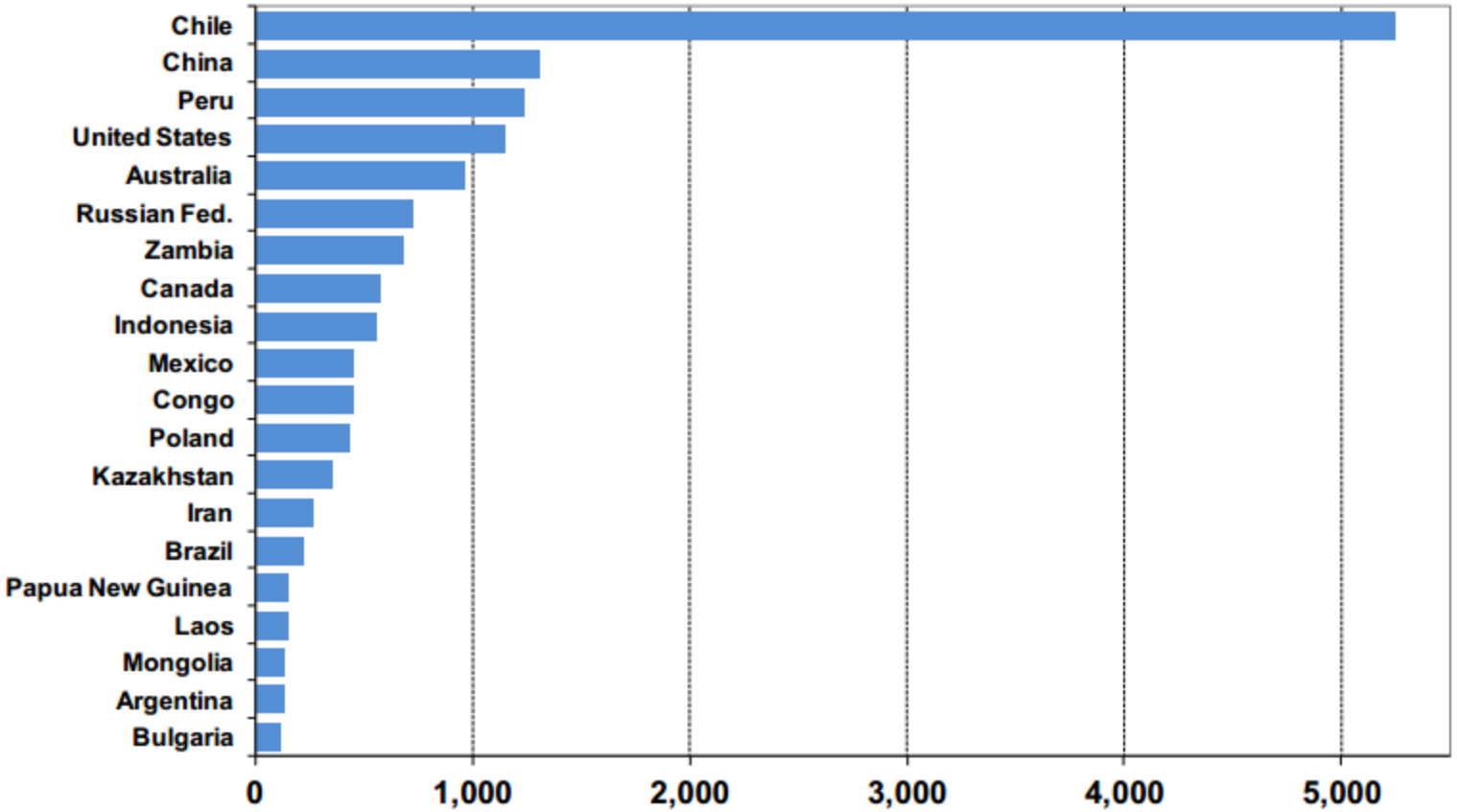
Source: CRU R. Schodde - Copper market outlook 2011

Substantial potential supply gap will start opening up from 2020 onwards



Copper Mine Production by Country: Top 20 Countries in 2011p

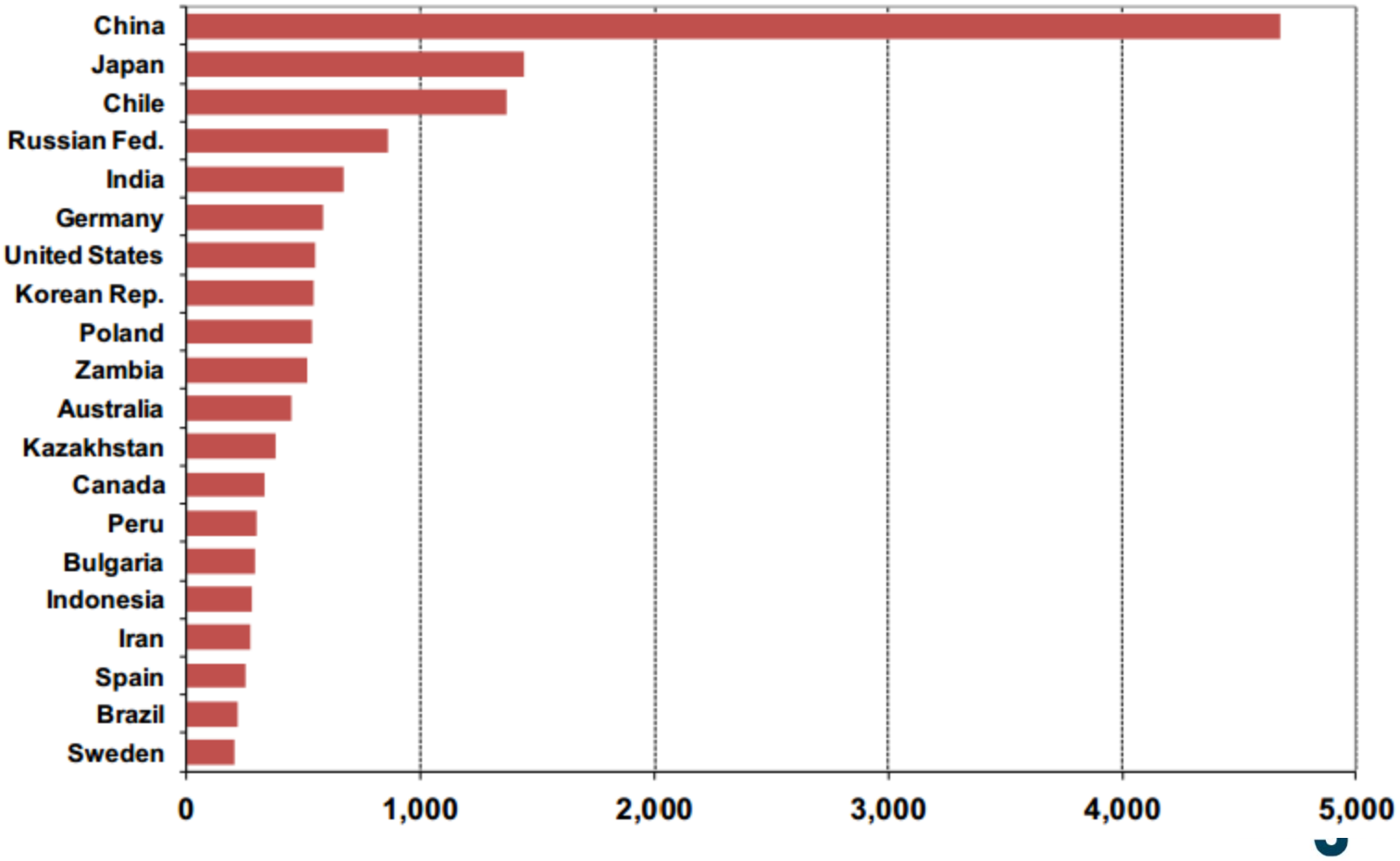
(Thousand metric tonnes)
Source: ICSG



Copper Smelter Production by Country: Top 20 Countries in 2011p

Thousand metric tonnes

Source: ICSG



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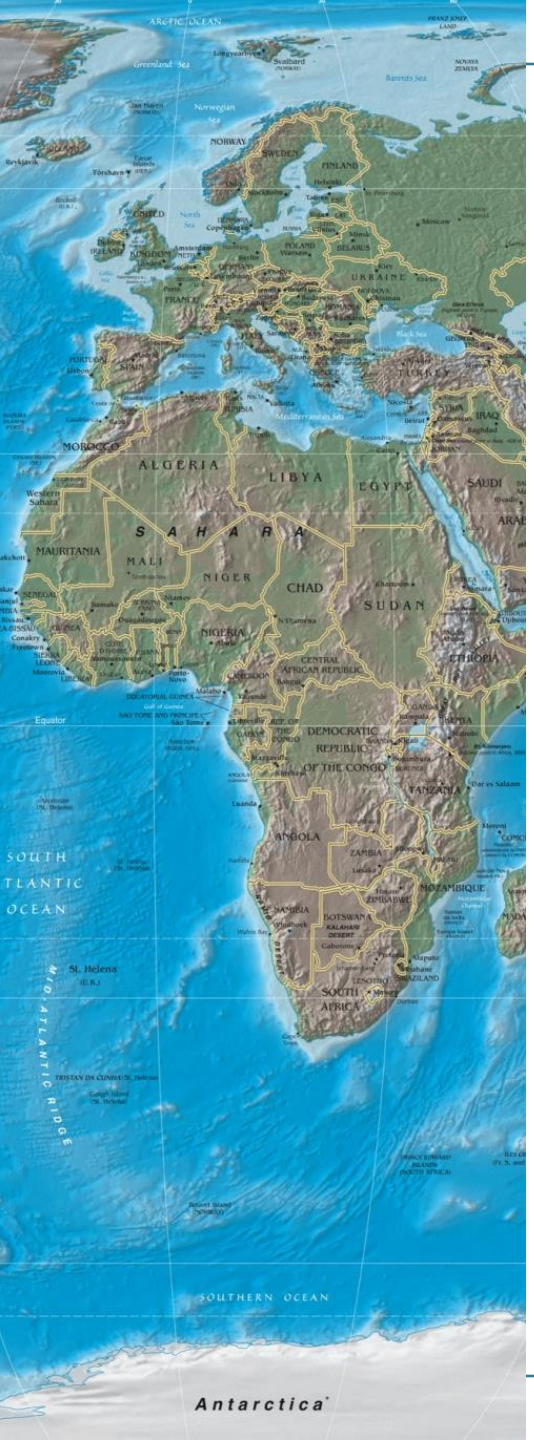

A CHANGING (CHANGED ?) WORLD

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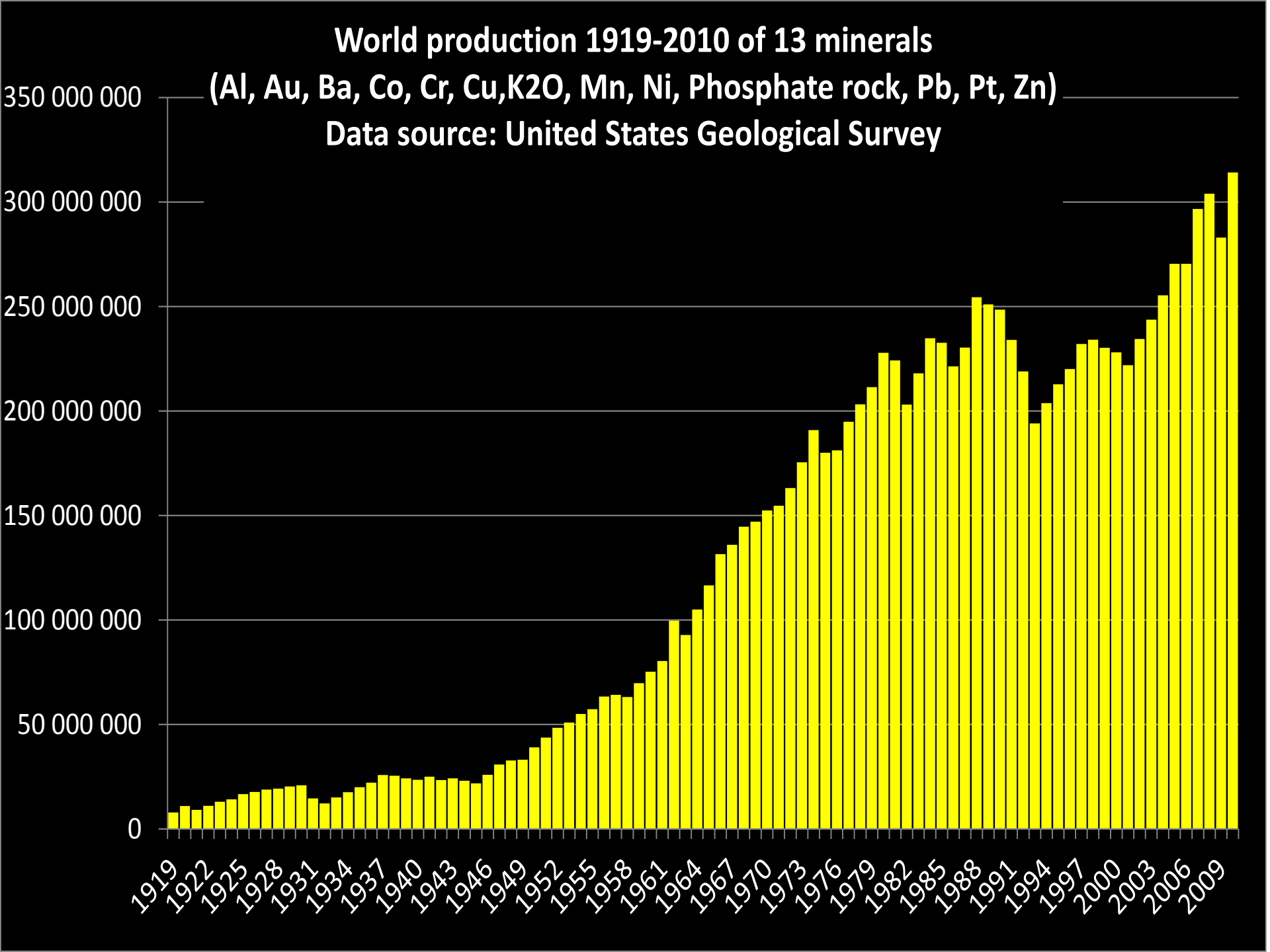
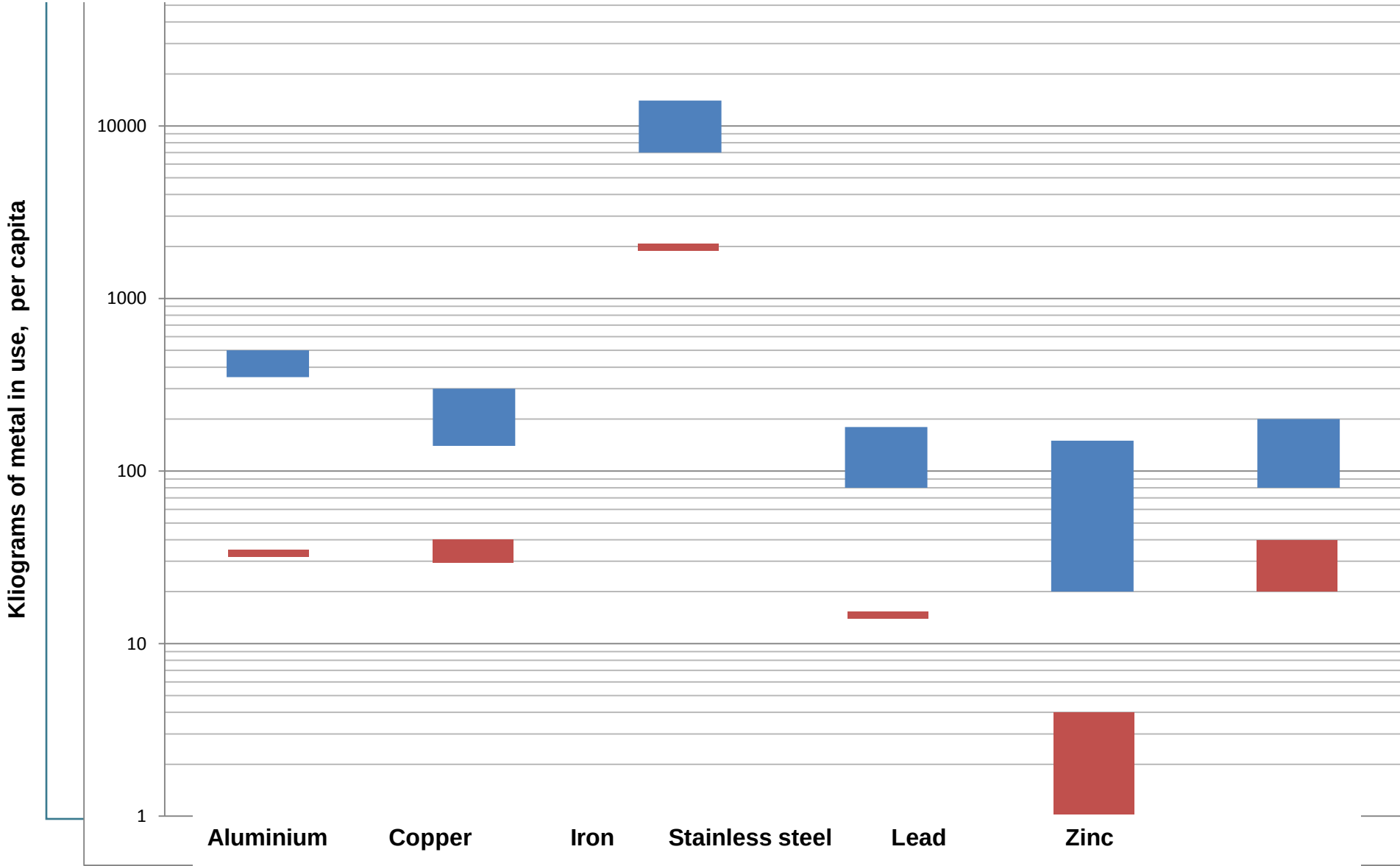

World production 1919-2010 of 13 minerals
(Al, Au, Ba, Co, Cr, Cu,K2O, Mn, Ni, Phosphate rock, Pb, Pt, Zn)
Data source: United States Geological Survey
350 000 000
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
0
1919
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009

Estimate of the per capita « metal in use » stock (in kg, 2005) of some of the most widely used metals , in blue: more advanced countries (860 M persons, in brown: least developed countries (5600 M persons)

Derived from: UNEP International Resource Panel, ‘Metal stocks in society ‘ report



“For to win one hundred victories in one hundred battles is not the acme of skill. To subdue the enemy without fighting is the acme of skill.”

Sun Tzu, approx. 2500 years ago

« The Middle East has oil, China has rare metals »

Deng Xiao Ping, 1992

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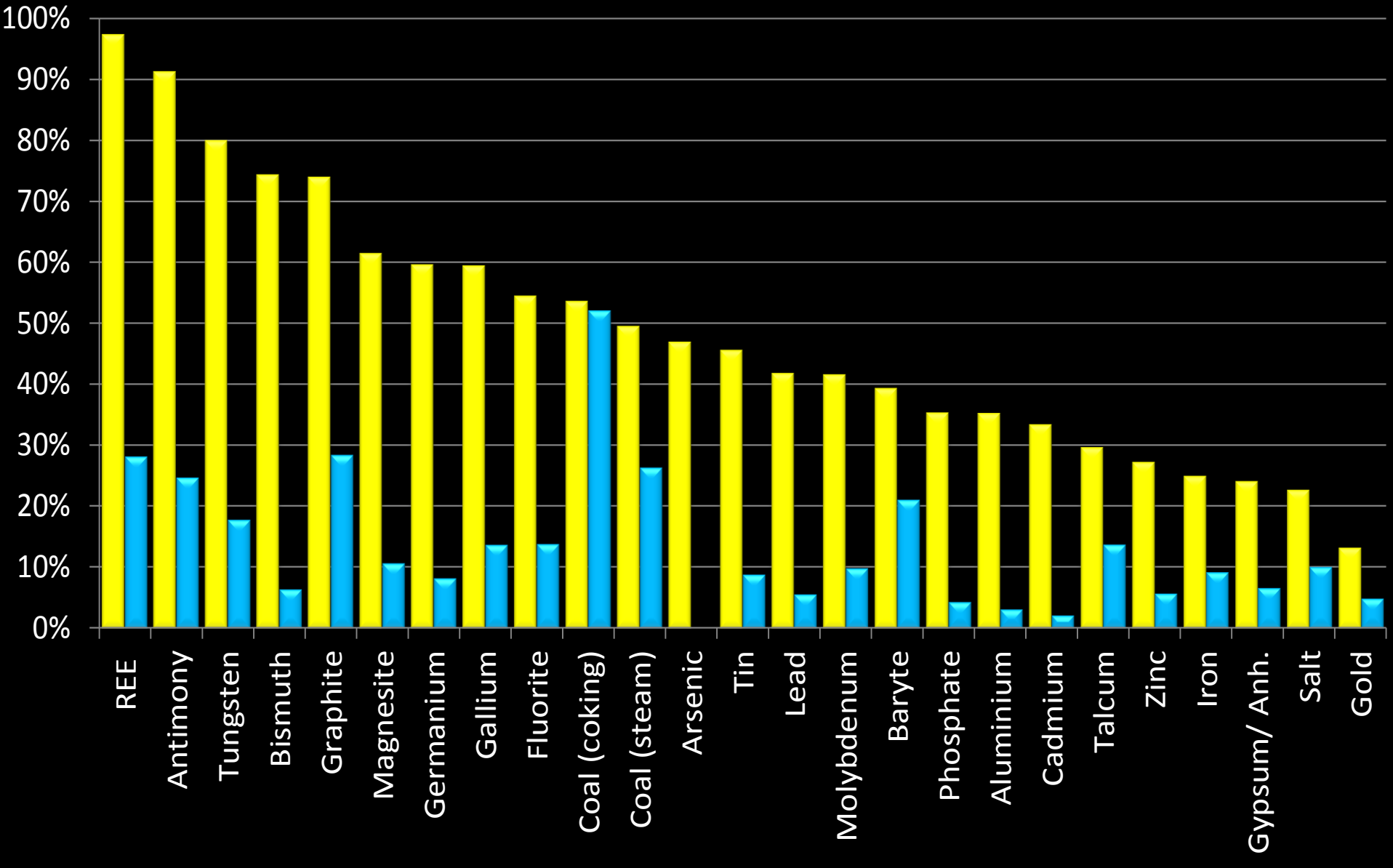
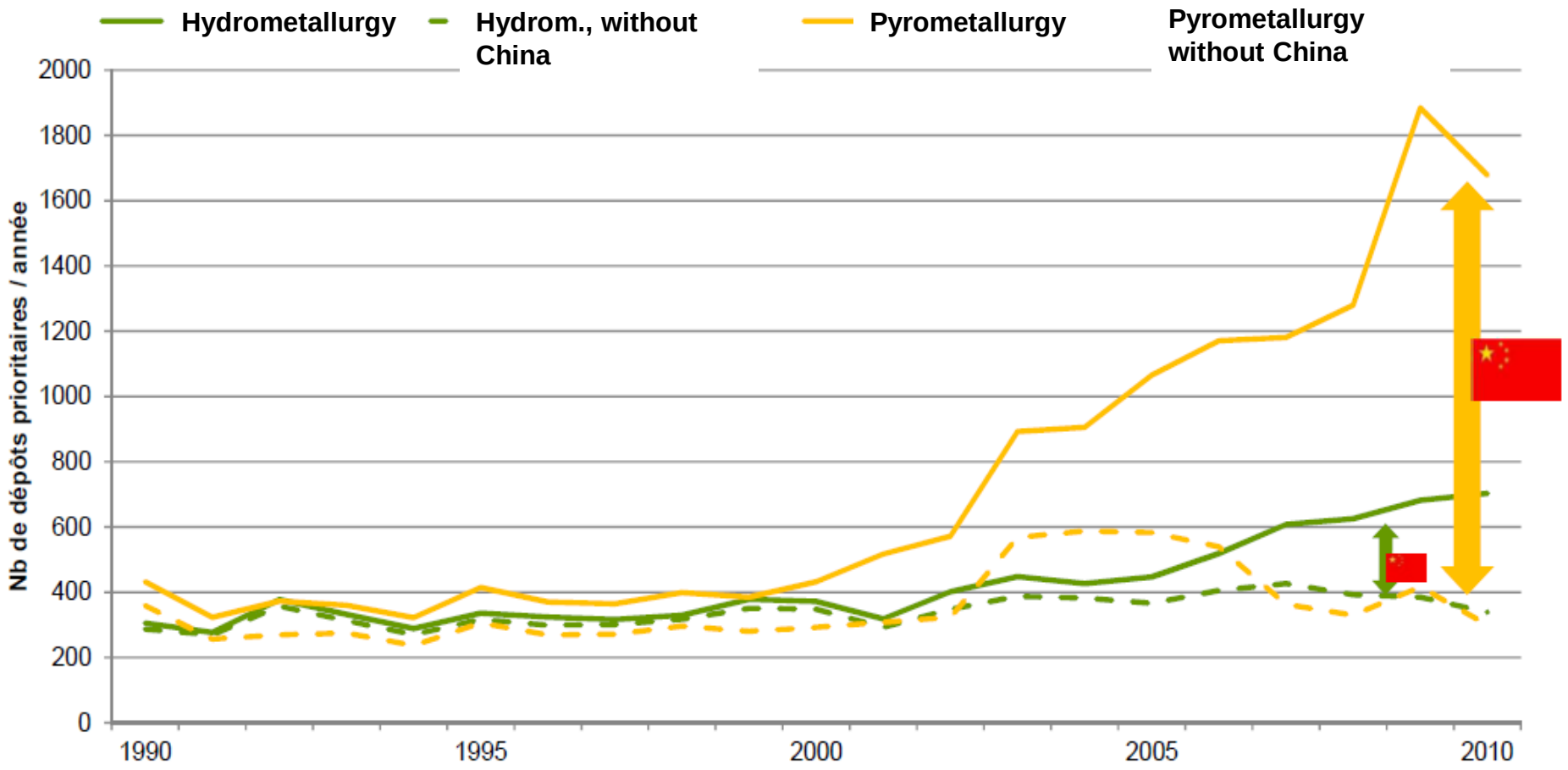
China's share of the global production for minerals and metals of which it was the first producer in 2010 - Yellow bars: 2010, blue bars: 1986

Data source: World Mining Data



Changes over time in patent submissions in the pyro- and hydrometallurgical domains, with and without submissions from Chinese actors –
Source: French Atomic Energy Commission, internal study (with permission)
Priority applications 1990-2010



THE RESPECTIVE ROLE OF POLICIES AND TECHNOLOGIES (WE NEED BOTH)

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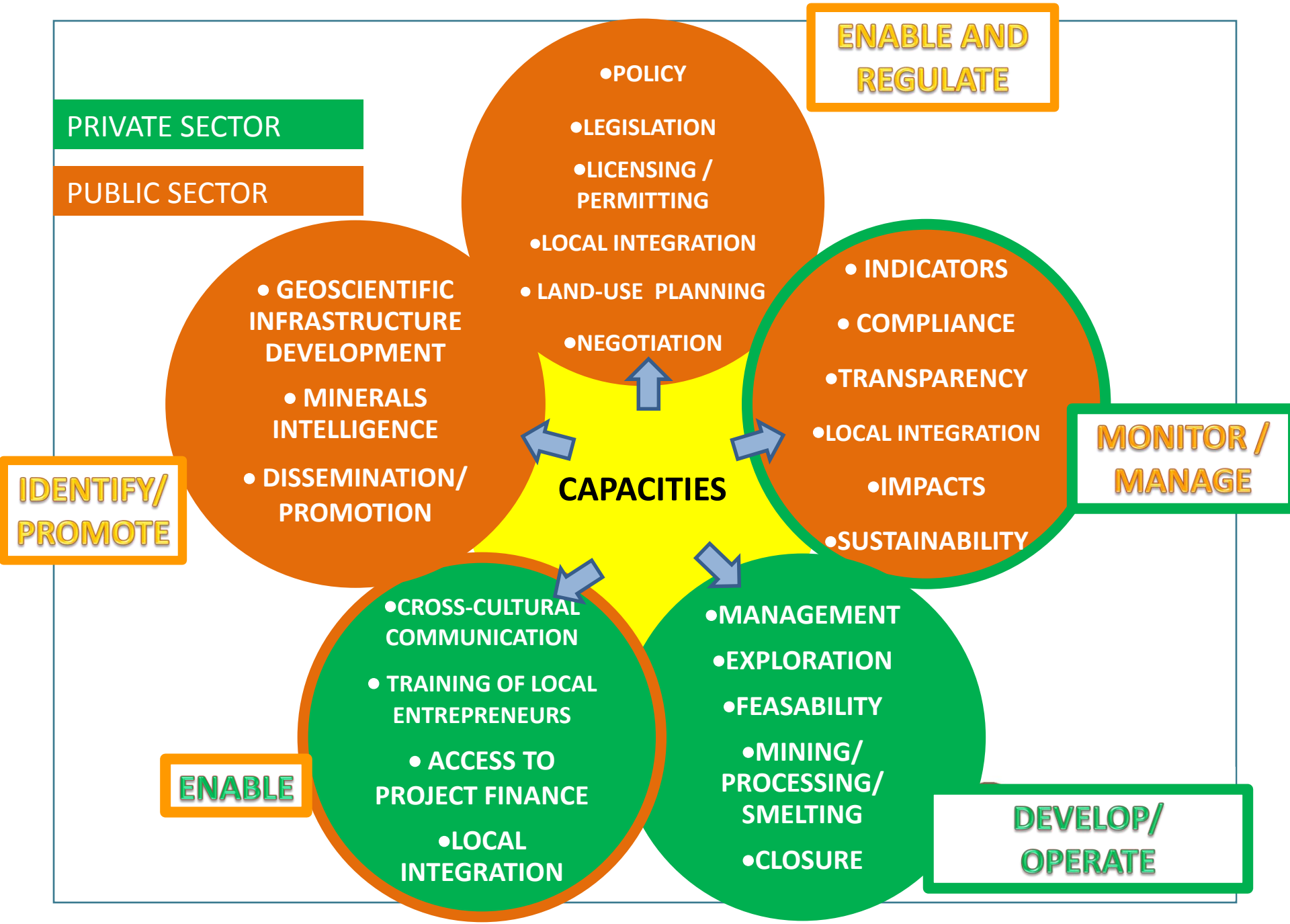
PRIVATE SECTOR
PUBLIC SECTOR
ENABLE AND REGULATE
•POLICY
•LEGISLATION
•LICENSING / PERMITTING
•LOCAL INTEGRATION
• LAND-USE PLANNING
•NEGOTIATION
IDENTIFY/ PROMOTE
• GEOSCIENTIFIC INFRASTRUCTURE DEVELOPMENT
• MINERALS INTELLIGENCE
• DISSEMINATION/ PROMOTION
CAPACITIES
MONITOR / MANAGE
• INDICATORS
• COMPLIANCE
•TRANSPARENCY
•LOCAL INTEGRATION
•IMPACTS
•SUSTAINABILITY
ENABLE
•CROSS-CULTURAL COMMUNICATION
• TRAINING OF LOCAL ENTREPRENEURS
• ACCESS TO PROJECT FINANCE
•LOCAL INTEGRATION
DEVELOP/ OPERATE
•MANAGEMENT
•EXPLORATION
•FEASABILITY
•MINING/ PROCESSING/ SMELTING
•CLOSURE

The complementarity between policies and technologies is well recognised in the EU 2014-2020 Research and Innovation Framework Programme and its related Europan Innovation Partnership on Raw Materials, built around 5 strategic goals?

- **Technology-focused policy areas**
  - WP1 - Exploration, extraction, processing, recycling …
  - WP2 - Substitution, alternative functionalities and materials
- **Non Technology policy areas**
  - WP3 - Improving Europe's raw materials regulatory framework conditions, knowledge base and infrastructure
  - WP4 - Improving Europe's recycling regulatory framework conditions and excellence
- **WP5 - International cooperation**
  - Promoting appropriate international cooperation

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Questions to us Europeans in a global world

- **Will China, Brasil and other mineral rich countries continue, ad for how long, to export low—added value mineral raw materials (concentrates,metals) to the world?**
- **How solid is Europe's metallurgical industry, a critical component of primary and secondary (recycling) metals supply chains?**
- **Is Europe decoupling its growth from its environmental footprint or are our policies shifting environmental burdens to outside countries?**
- **How to effectively decouple growth from its negative impacts at global scale?**
- **How could be corporate commitment to enhanced transparency and to sustainable performance be known to customers and rewarded by the market?**
- **Is there a future for mining in Europe?**

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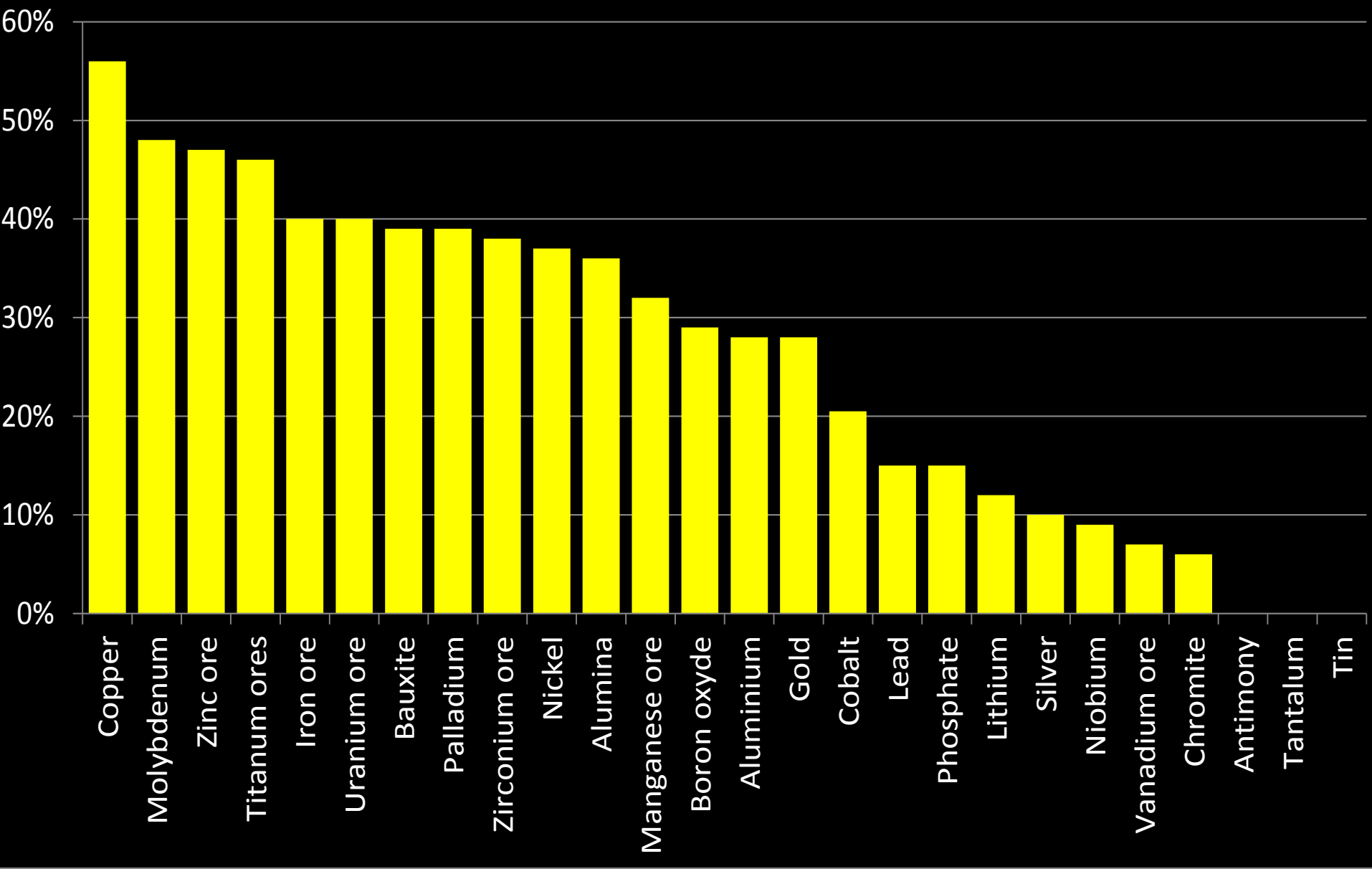
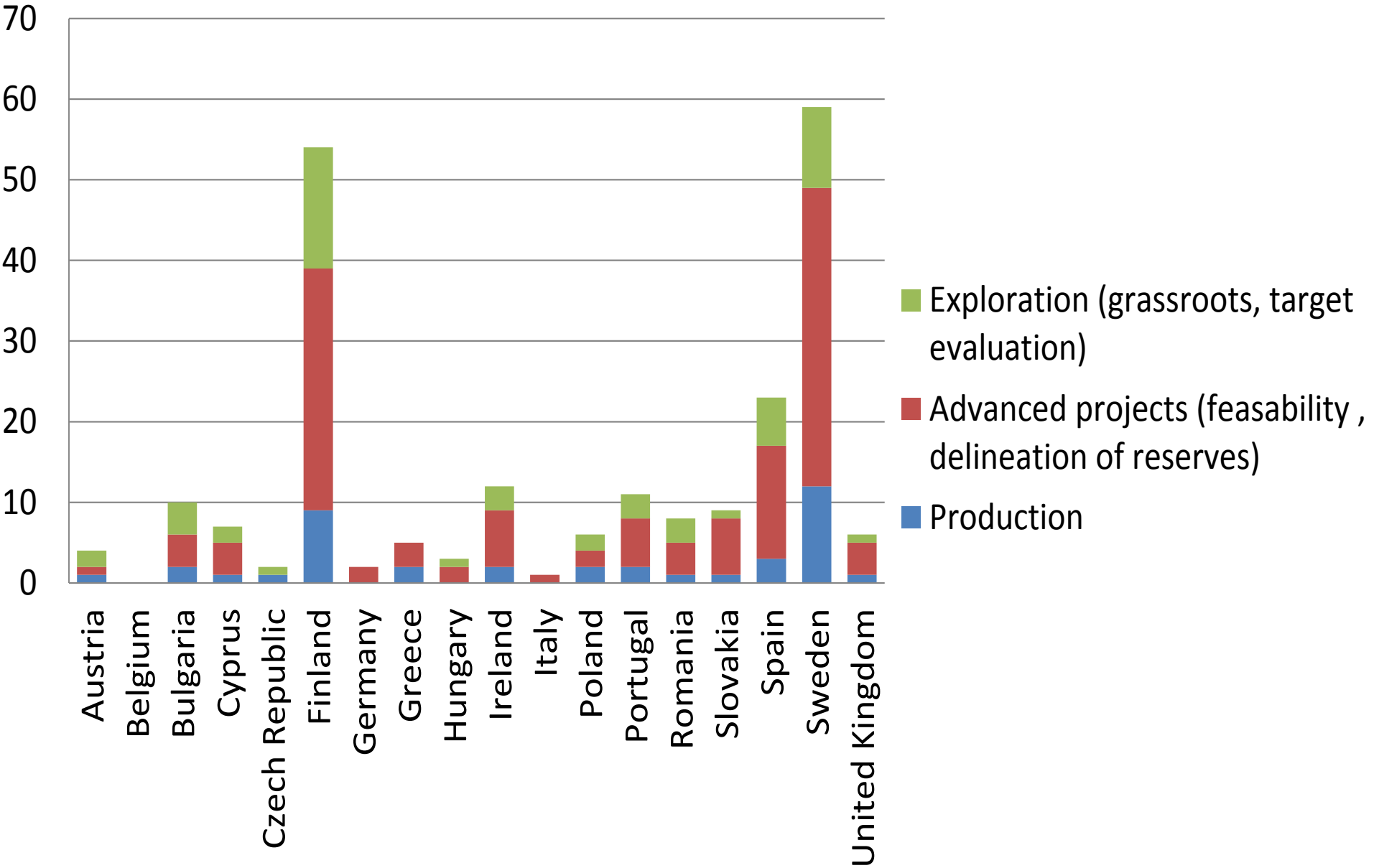
% of world mine or metals production 2009 by Global Reporting Initiative Reporters

Data sources: Raw Materials Data, Global Reporting Initiative - Compiled by P. Christmann, BRGM



Estimate of the number of active metallic resources projects in EU Member States

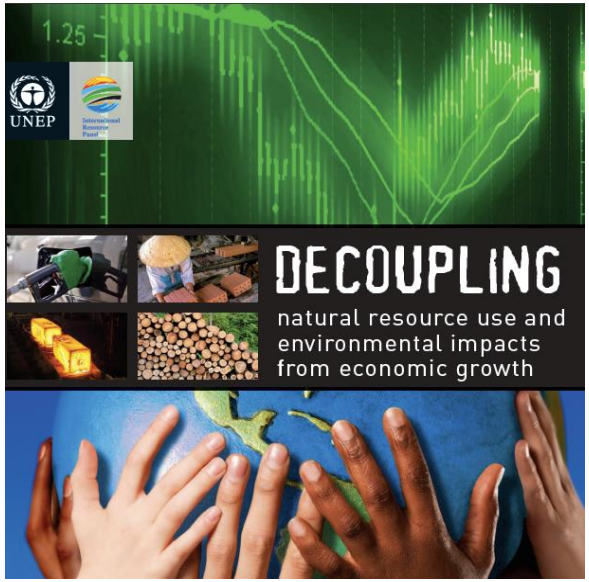
Derived from MineSearch data - situation: October 2012

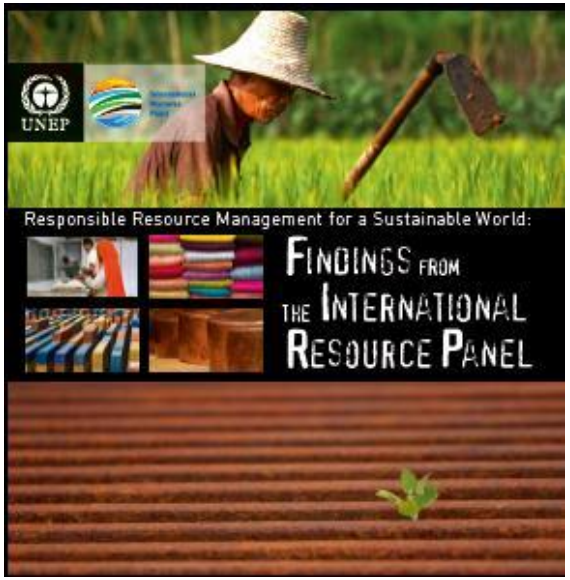


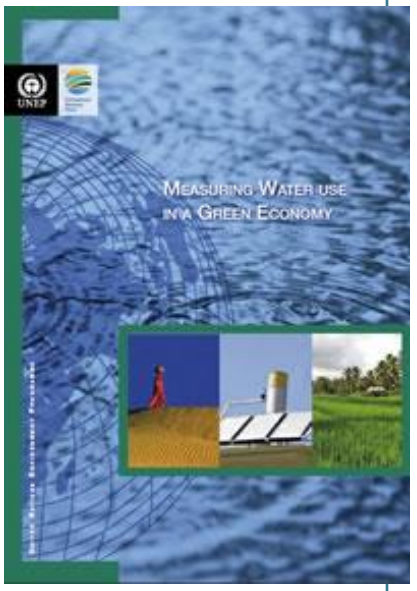
International Panel for Sustainable Resource Management

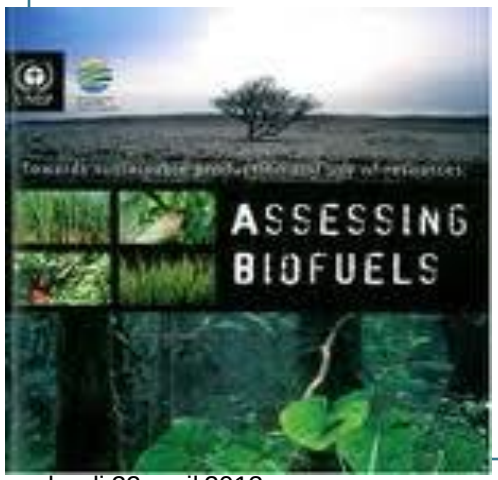
UNEP

unep.org/resourcepanel









GLÜCK AUF!
… UND HERZLICHEN DANK FÜR DIE EINLADUNG

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