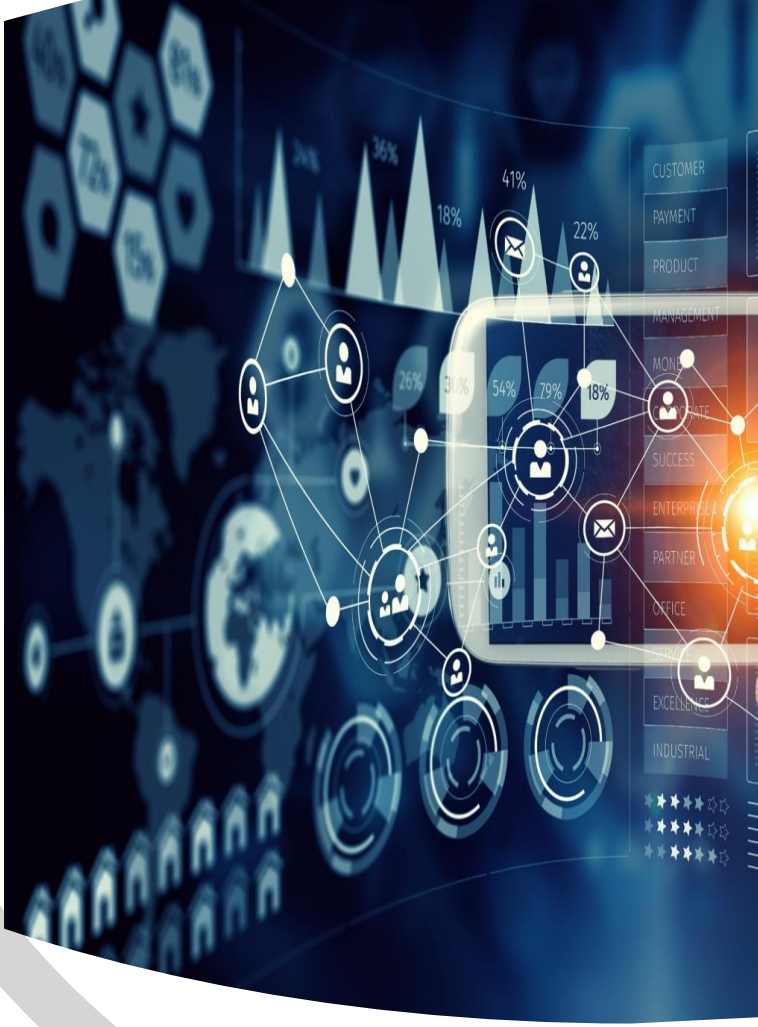


EIT RawMaterials
e-M@S
Ethics Module – Part II

Adolfo Villafiorita
ICT4G - Bruno Kessler Foundation

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

Linear Economy

Linear Economy

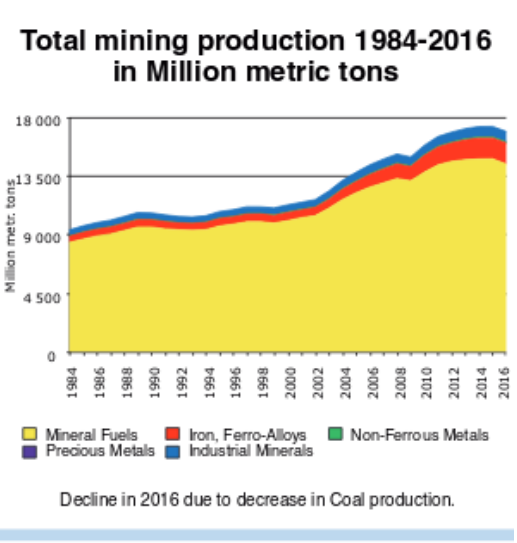
- No (longer) works!
  - Resource exhaustion (garbage piling on)
  - volumes, speed and acceleration make the issue more urgent

Today’s topic…

supply of raw materials for production

Some data

World mining production
2016 16.9 Billion metric tons
2000 11.3 Billion metric tons
1985 9.7 Billion metric tons



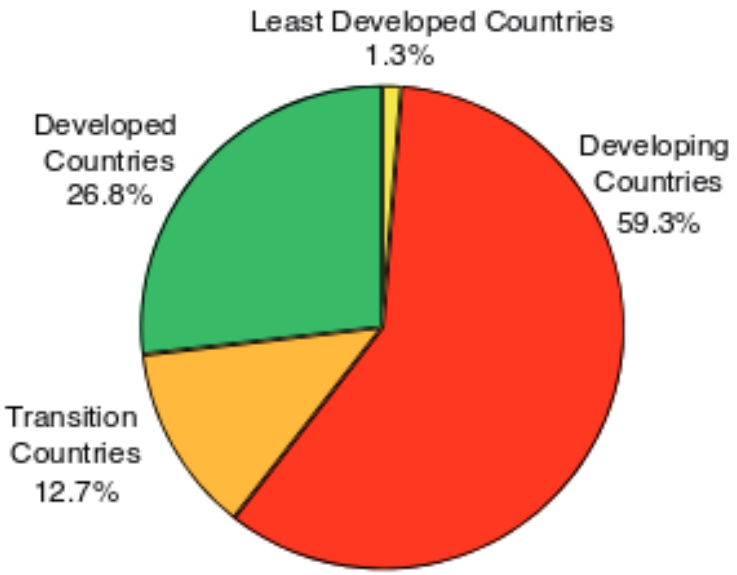
Lithium

Li_2O-ratio of brines to hard rock ore is around

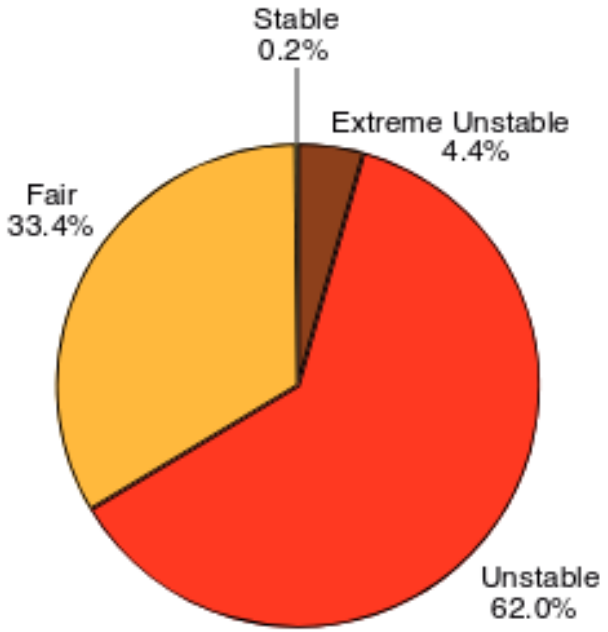
62.0 % to 38.0 %

http://www.wmc.org.pl/sites/default/files/WMD2018.pdf

More data



Developing countries share around 60 % of global production.



2/3 of global production is mined in politically unstable countries.

Impact and Consequences

- Long-term effects:
  - sustainability
  - climate change
- Short-term effects:
  - environmental impact
  - social impact

Material at Risk of Exhaustion

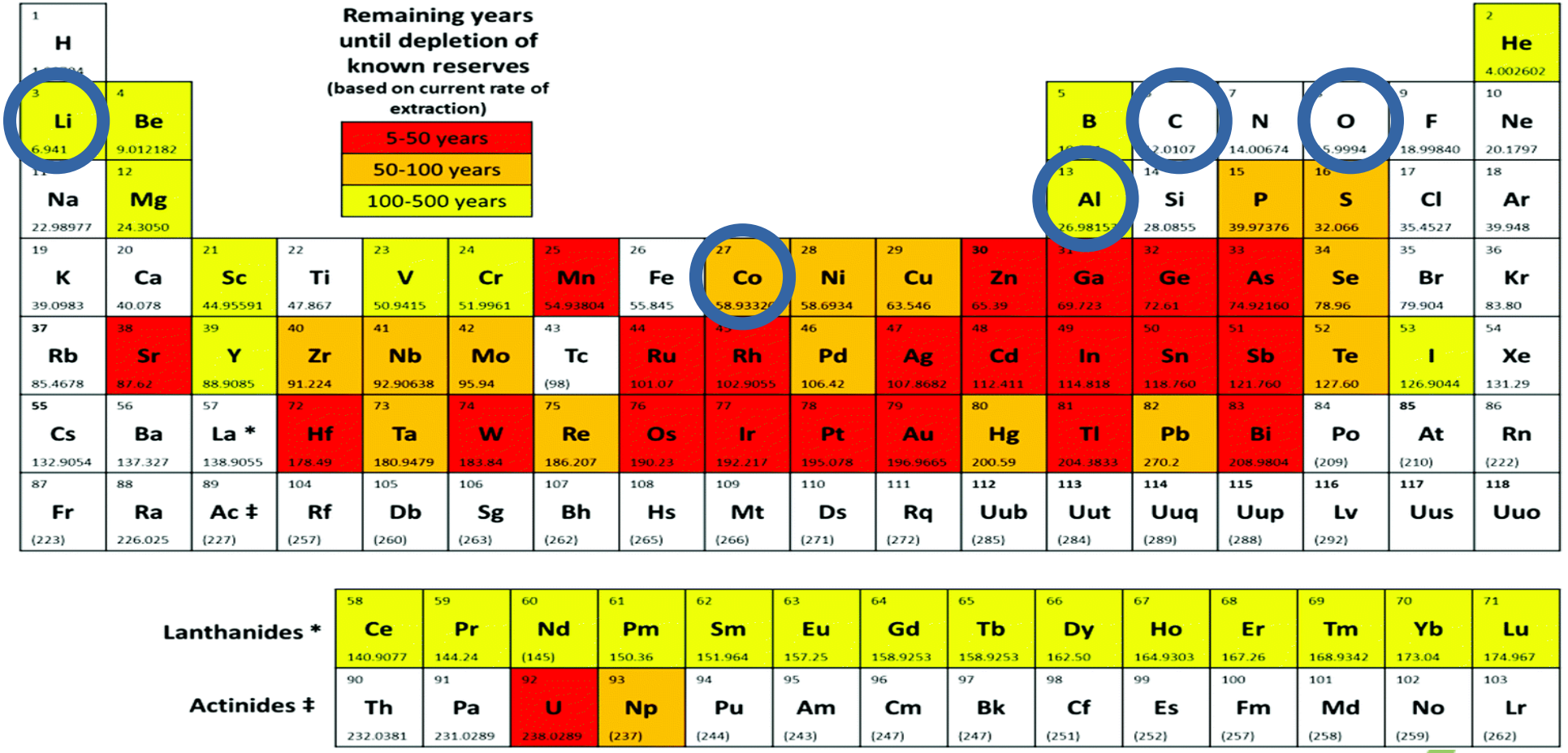
Remaining years until depletion of known reserves
(based on current rate of extraction)

- 5-50 years
- 50-100 years
- 100-500 years

1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.99840	10 Ne 20.1797
11 Na 22.98977	12 Mg 24.3050											13 Al 26.98153	14 Si 28.0855	15 P 39.97376	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.93804	26 Fe 55.845	27 Co 58.93320	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9085	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.760	51 Sb 121.760	52 Te 127.60	53 I 126.9044	54 Xe 131.29
55 Cs 132.9054	56 Ba 137.327	57 La * 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.9665	80 Hg 200.59	81 Tl 204.3833	82 Pb 270.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 Ac ‡ (227)	104 Rf (257)	105 Db (260)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (271)	111 Rq (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Lv (292)	117 Uus	118 Uuo

Lanthanides *	58 Ce 140.9077	59 Pr 144.24	60 Nd (145)	61 Pm 150.36	62 Sm 151.964	63 Eu 157.25	64 Gd 158.9253	65 Tb 158.9253	66 Dy 162.50	67 Ho 164.9303	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
Actinides ‡	90 Th 232.0381	91 Pa 231.0289	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Materials used in a Mobile Phone (Battery)



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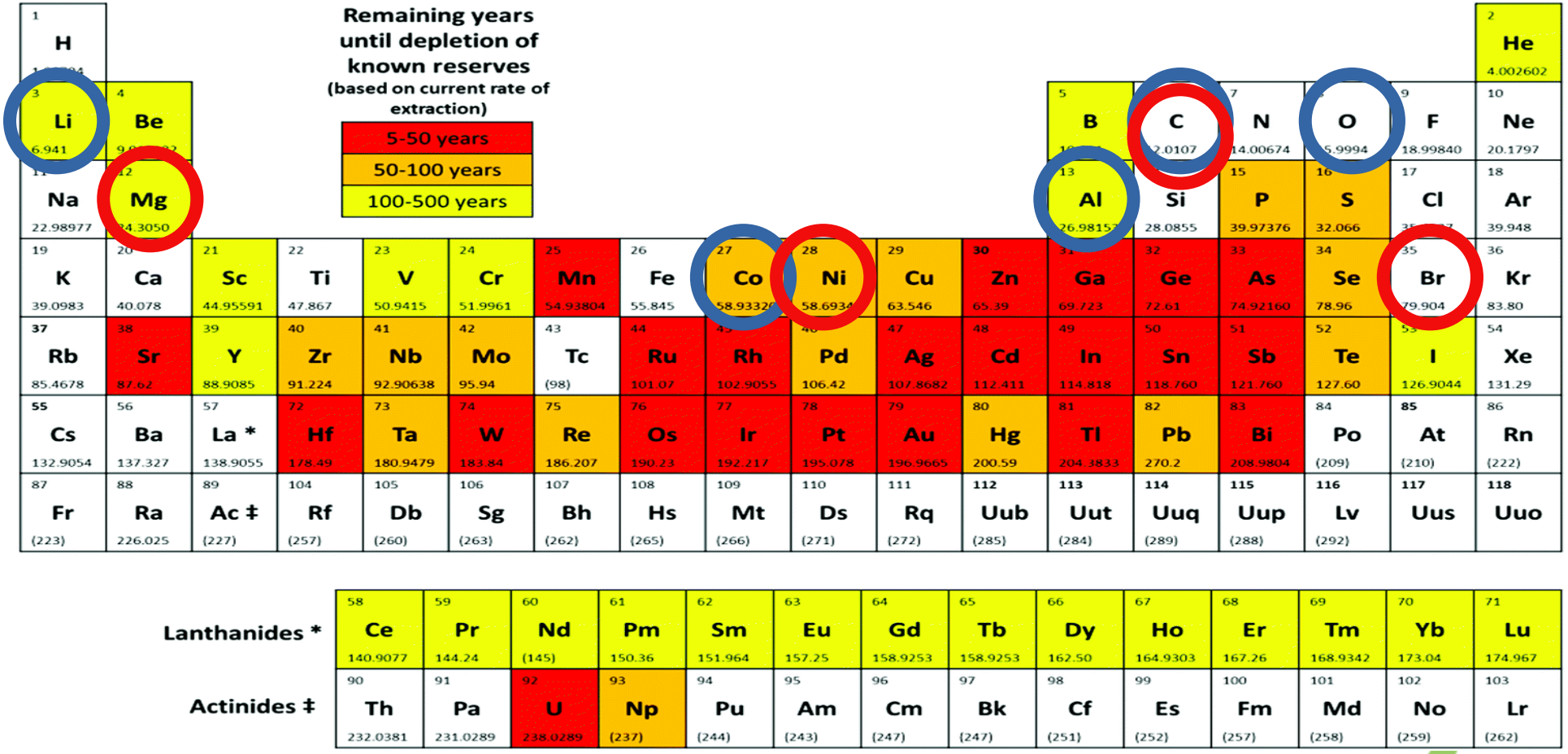
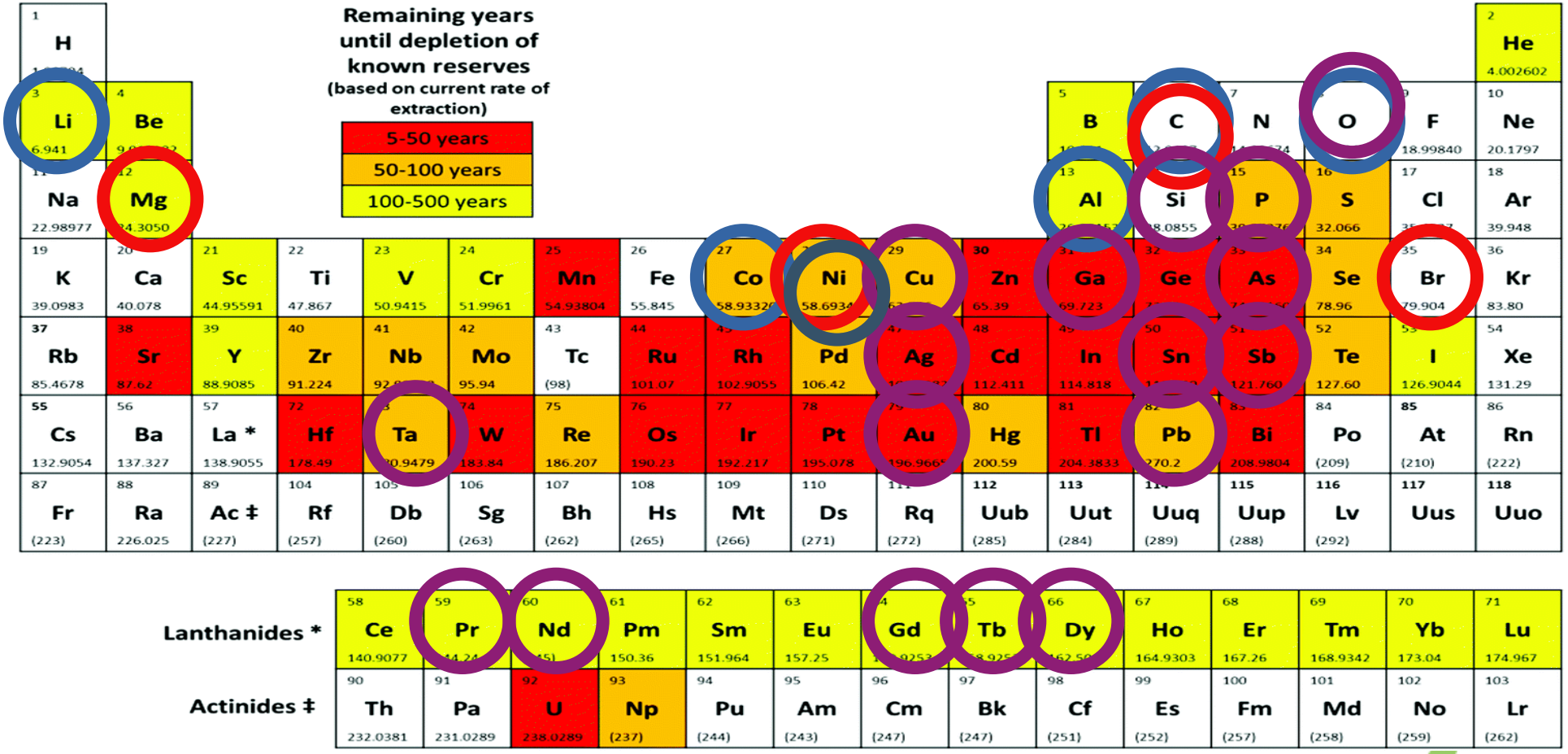
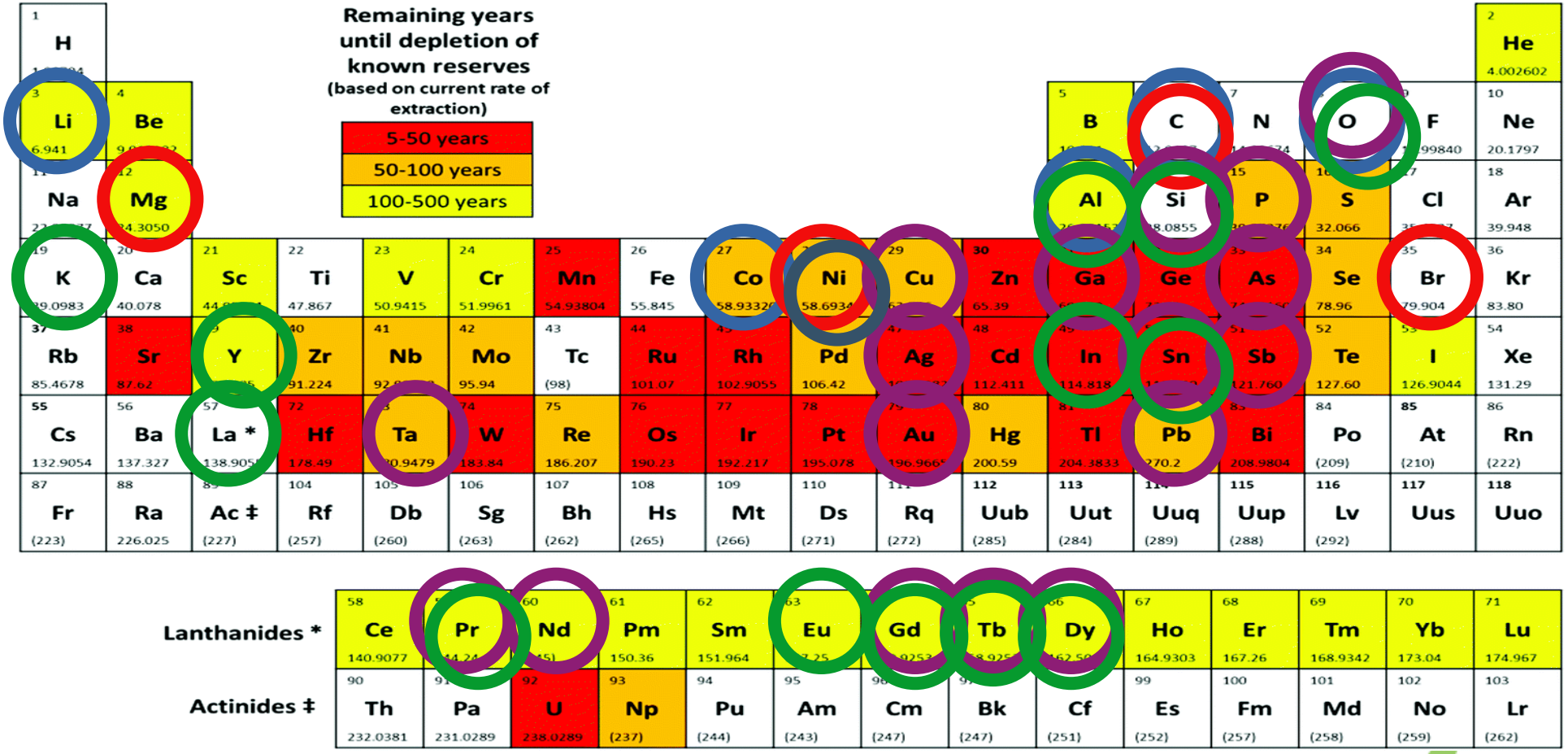
Materials used in a Mobile Phone (Shell)



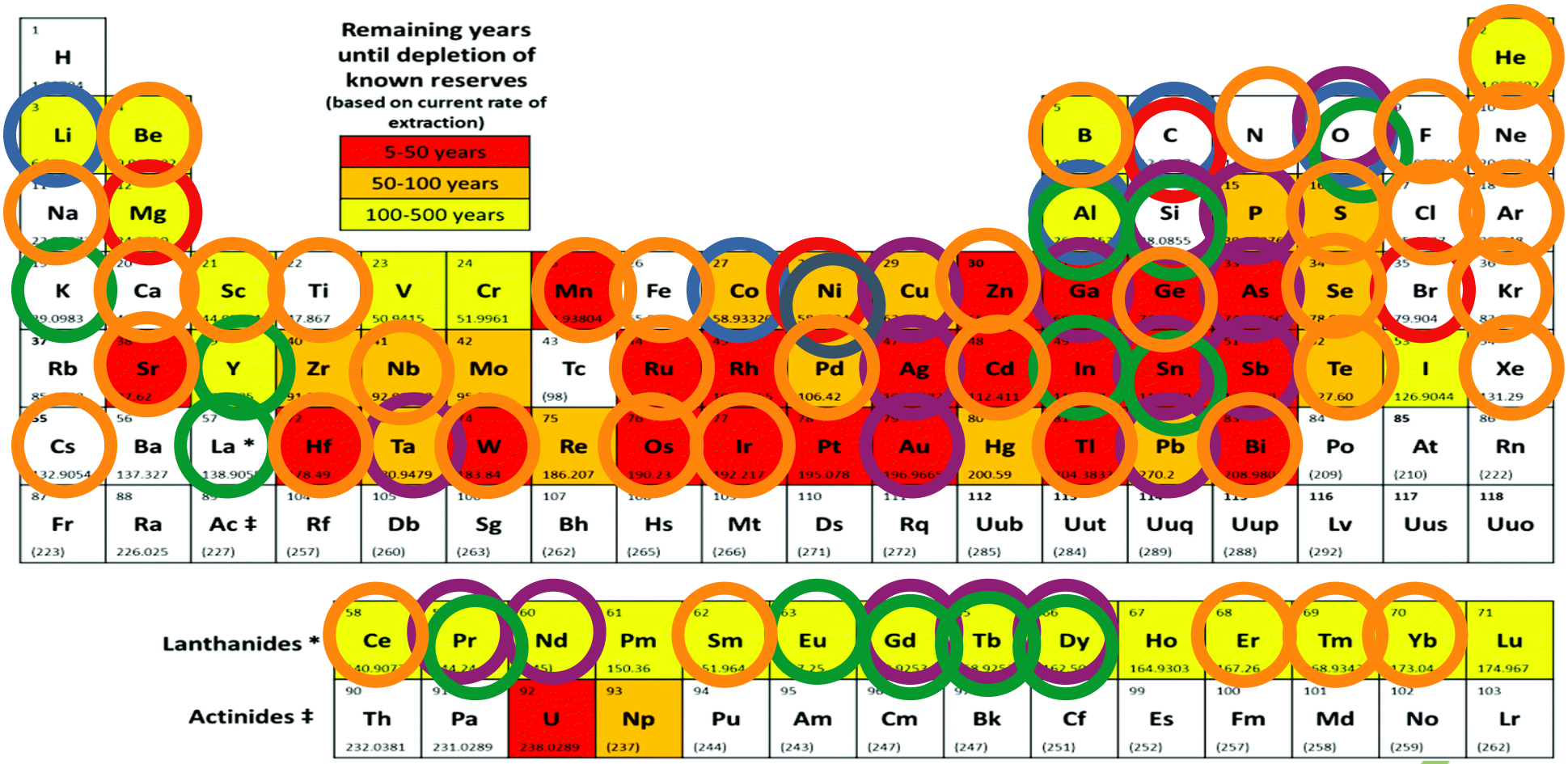
Materials used in a Mobile Phone (Electronics)



Materials used in a Mobile Phone (Screen)



Materials used for Electronics



https://www.pcworld.com/article/2013092/the-periodic-table-of-tech.html
https://www.compoundchem.com/2015/09/15/recycling-phone-elements/

Critical Materials

- Periodically, the United States and the European Union provide a list of critical materials according to two criteria: **economic importance and supply risks**
- 2011 → 14
  2014 → 20
  2017 → 27
  (https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en)

- Let’s try to see ourselves in a world

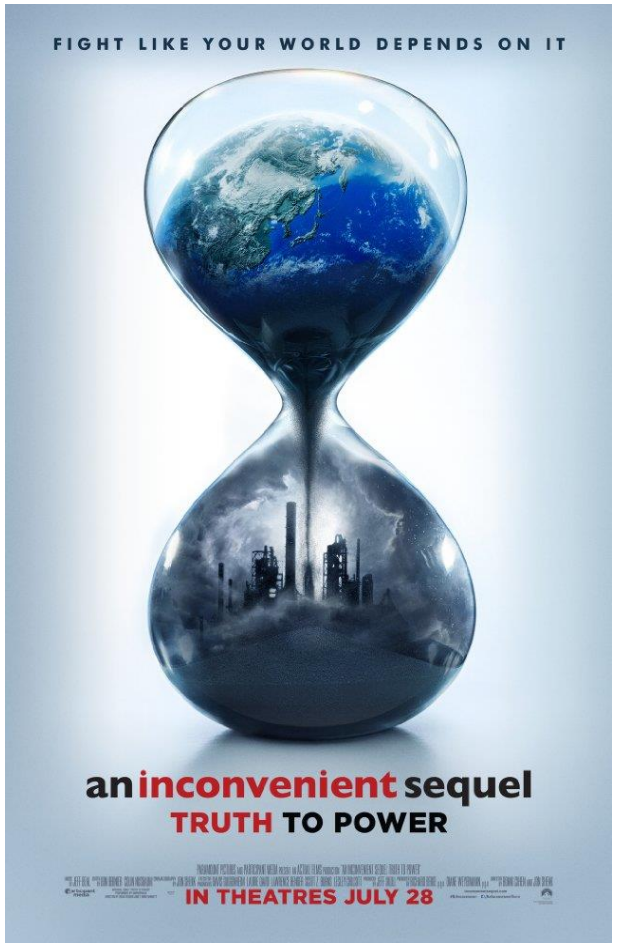
  ... without electronics

- Let’s try to see ourselves in a world in which the materials needed to assemble electronic circuits

  - .... were found only in China
    …. found only in... (a country of your choice)

- (90% of rare earths are extracted in China)

Climate change

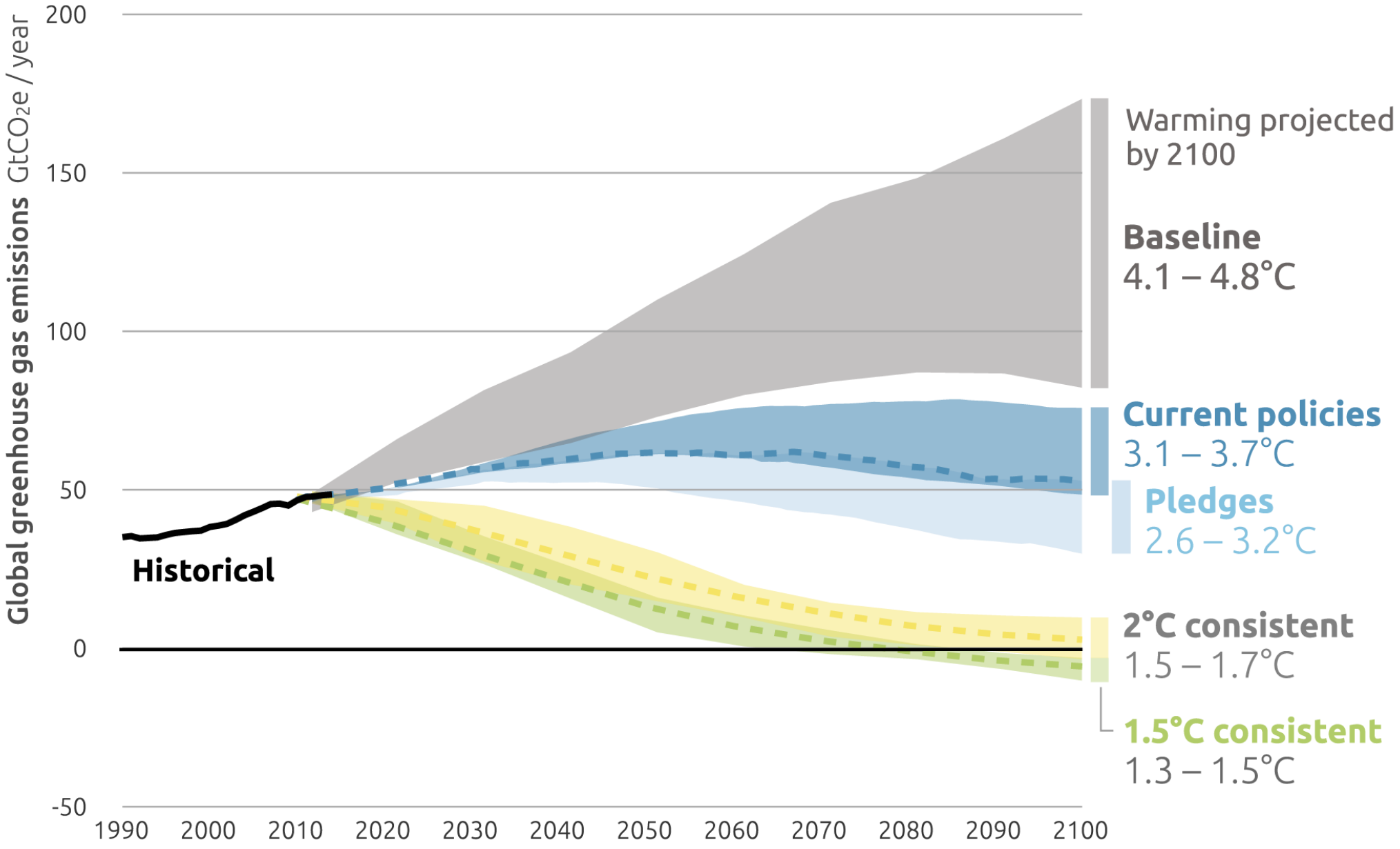


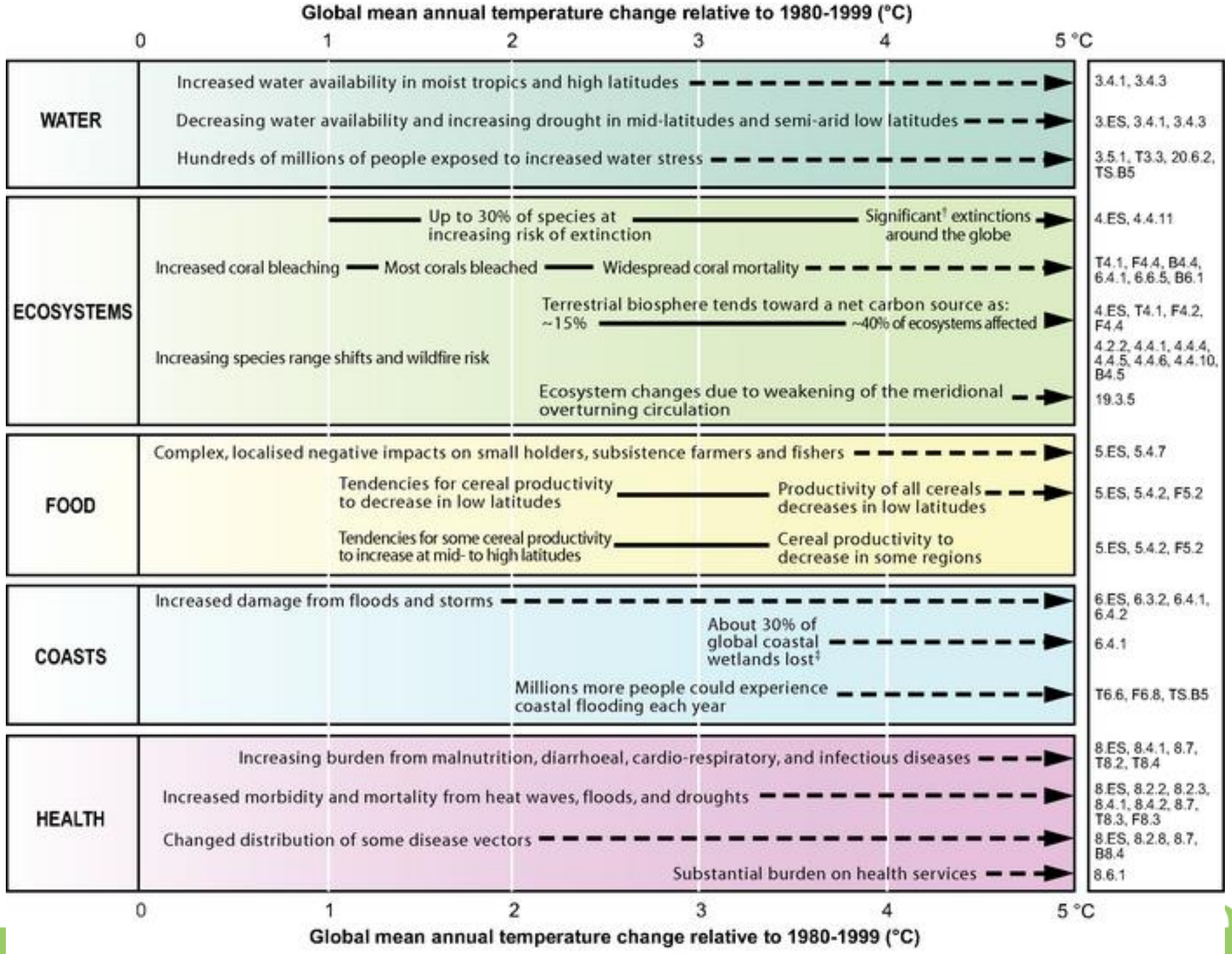
https://en.wikipedia.org/wiki/An_Inconvenient_Truth
https://www.imdb.com/title/tt6322922/videoplayer/vi1430763033?ref_=tt_pv_vi_aiv_1

2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies

Climate Action Tracker




Global mean annual temperature change relative to 1980-1999 (°C)
0
1
2
3
4
5 °C
WATER
Increased water availability in moist tropics and high latitudes
Decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes
Hundreds of millions of people exposed to increased water stress
3.4.1, 3.4.3
3.ES, 3.4.1, 3.4.3
3.5.1, T3.3, 20.6.2, TS.B5
ECOSYSTEMS
Up to 30% of species at increasing risk of extinction
Significant† extinctions around the globe
Increased coral bleaching
Most corals bleached
Widespread coral mortality
Terrestrial biosphere tends toward a net carbon source as: ~15%
~40% of ecosystems affected
Increasing species range shifts and wildfire risk
Ecosystem changes due to weakening of the meridional overturning circulation
4.ES, 4.4.11
T4.1, F4.4, B4.4, 6.4.1, 6.6.5, B6.1
4.ES, T4.1, F4.2, F4.4
4.2.2, 4.4.1, 4.4.4, 4.4.5, 4.4.6, 4.4.10, B4.5
19.3.5
FOOD
Complex, localised negative impacts on small holders, subsistence farmers and fishers
Tendencies for cereal productivity to decrease in low latitudes
Productivity of all cereals decreases in low latitudes
Tendencies for some cereal productivity to increase at mid- to high latitudes
Cereal productivity to decrease in some regions
5.ES, 5.4.7
5.ES, 5.4.2, F5.2
5.ES, 5.4.2, F5.2
COASTS
Increased damage from floods and storms
About 30% of global coastal wetlands lost‡
Millions more people could experience coastal flooding each year
6.ES, 6.3.2, 6.4.1, 6.4.2
6.4.1
T6.6, F6.8, TS.B5
HEALTH
Increasing burden from malnutrition, diarrhoeal, cardio-respiratory, and infectious diseases
Increased morbidity and mortality from heat waves, floods, and droughts
Changed distribution of some disease vectors
Substantial burden on health services
8.ES, 8.4.1, 8.7, T8.2, T8.4
8.ES, 8.2.2, 8.2.3, 8.4.1, 8.4.2, 8.7, T8.3, F8.3
8.ES, 8.2.8, 8.7, B8.4
8.6.1
0
1
2
3
4
5 °C
Global mean annual temperature change relative to 1980-1999 (°C)
† Significant is defined here as more than 40%.
‡ Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

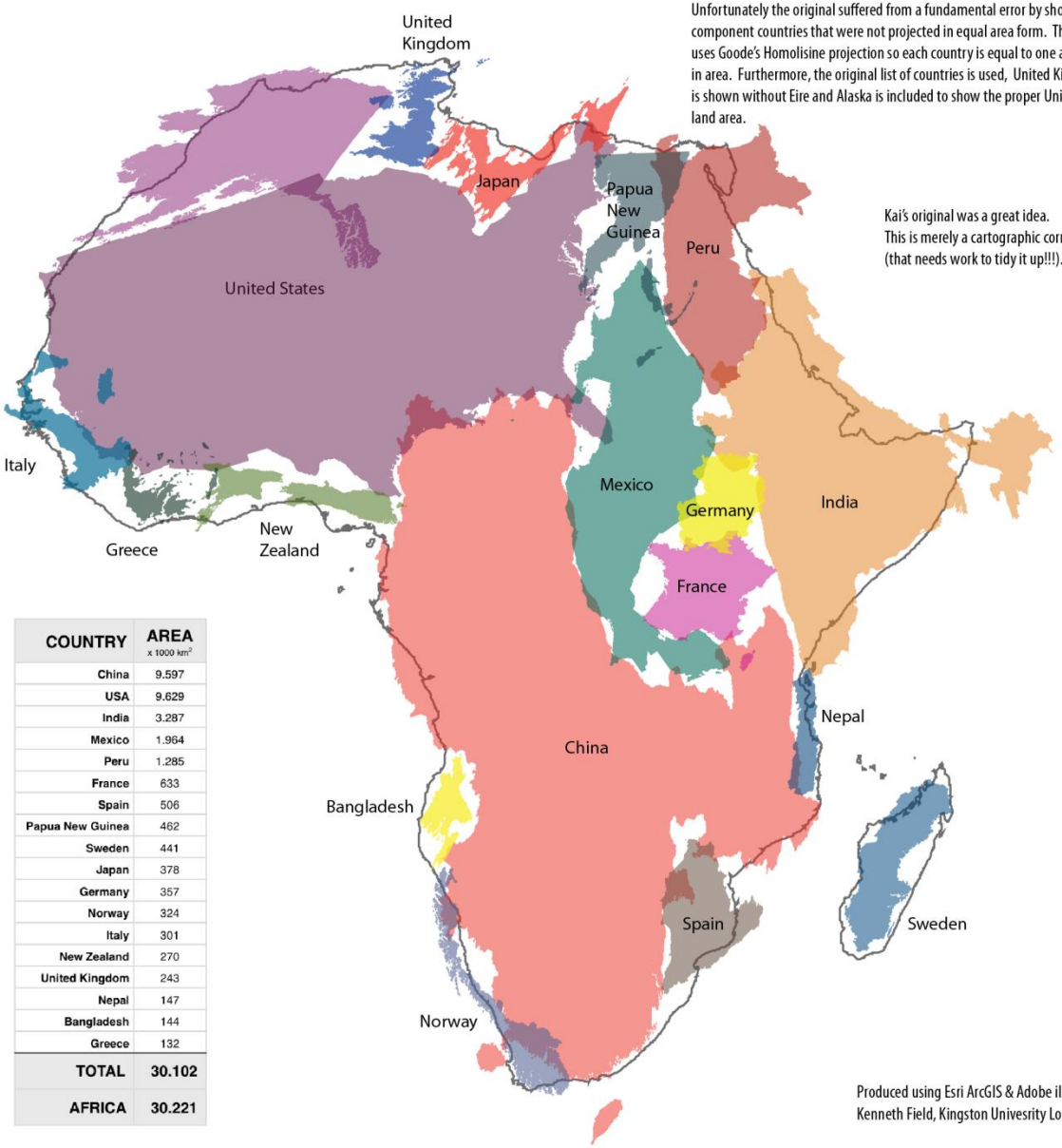
The **True Size** of **Africa**

Correcting the fight against immappancy

The original image by Kai Krause was designed to graphically illustrate the true size of the continent of Africa in relation to various countries mapped by land area. The intention was to counter *immappancy* - that is *insufficient geographical knowledge*.

Unfortunately the original suffered from a fundamental error by showing component countries that were not projected in equal area form. This map uses Goode's Homolisine projection so each country is equal to one another in area. Furthermore, the original list of countries is used, United Kingdom is shown without Eire and Alaska is included to show the proper United States land area.

Kai's original was a great idea.
This is merely a cartographic correction
(that needs work to tidy it up!!!).



COUNTRY	AREA x 1000 km²
China	9.597
USA	9.629
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	**30.102**
AFRICA	**30.221**

Produced using Esri ArcGIS & Adobe illustrator
Kenneth Field, Kingston Univesrity London


gp
Africa
Clothing & Textiles
Petroleum & Natural Gas
Crude Oil
Crude Oil & Petroleum Products
Phosphates
Iron Ore
Cotton
Uranium
Oil
Gold
Livestock
Coffee (in transit)
Fish
Peanut Products
Fish
Aluminum
Diamonds
Rubber
Cocoa Beans
Gold
Oil
Cotton
Cotton
Petroleum & Petroleum Products
Crude Oil
Timber
Crude Oil
Petroleum
Diamonds
Grains
Coffee
Livestock
Coffee
Tea
Diamonds
Gold
Crude Oil
Copper
Tobacco
Aluminum
Platinum
Diamonds
Diamonds
Gold
Soft Drink Concentrates
Clothing & Shoes
Coffee
Oil
Food / Drink
Metals / Minerals
Precious Metals / Minerals
Wood Products
Textile / Apparel
Machinery / Transportation
Electronics Related
Other
Source: CIA Factbook
Simran Khosla/ GlobalPost

- ... so, why is Africa an underdeveloped continent? (*)
-

(*) approximating a little

The resource curse?

- **Resource curse**: regions with an abundance of natural resources, particularly non-renewable resources, tend to have lower economic growth and worse development
- Reasons
  - Conflicts
  - Corruption
  - Increased volatility due to resource prices
  - Lack of diversification
  - ...

- Some “collateral” effects of production and mining...

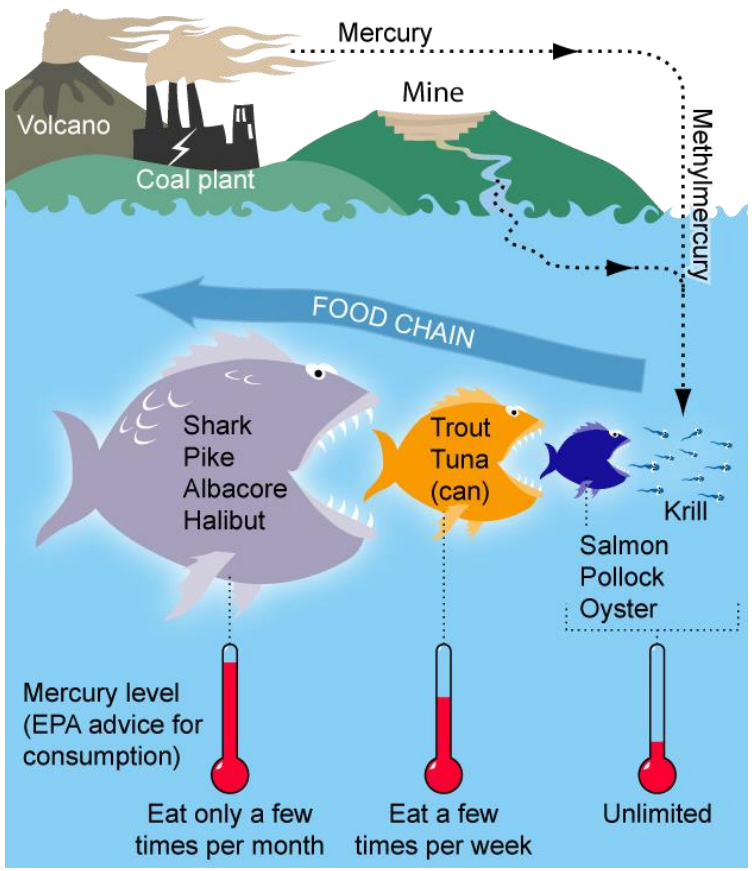
… immediately

- Each phase of a product's life cycle has **environmental** and **social** effects (positive or negative ... and, in many cases, some positive and other negative)
- What are those that concern mining, in your opinion?

Environmental impact

- Change of land use (sites, infrastructures,...)
- Pollution
  (mining waste by-products)
- Health

- **Local and global consequences**



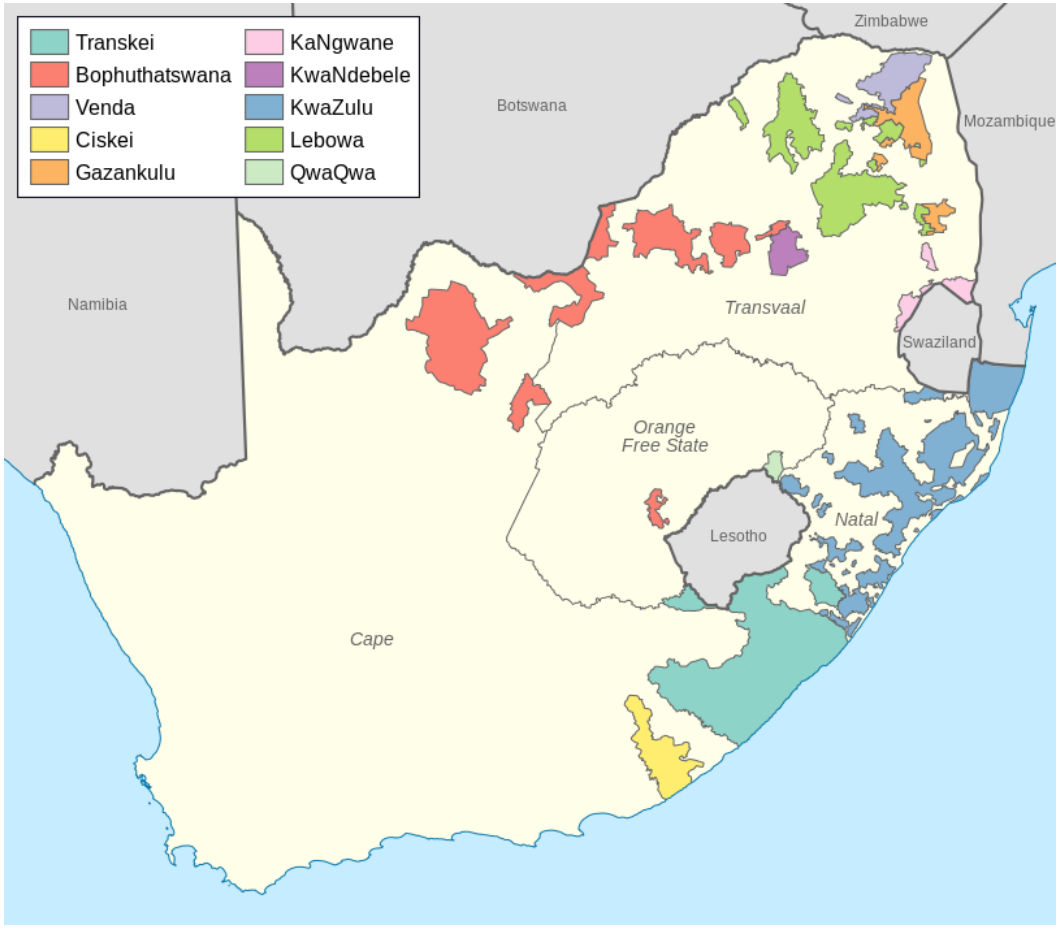
Social impact

- Displacement of individuals and groups to access resources

Apartheid

- “Separation” system in force in South Africa from the post-war to the nineties
- Petty apartheid and Grand apartheid

Grand Apartheid



By Htonl - Own work. Bantustan boundary data from the Directorate: Public State Land Support via Africa Open Data, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=25392438

Social impact

- **Working conditions**
- "**Craft**" mining: 10 to 25 percent of the world's cobalt production and about 17 to 40 percent of production in Congo
- Shenzen and processing with hazardous products (cleaning screens with toxic materials)

Social impact

- **Conflicts**

- complex supply chain

Social impact

- **Revenue distribution**
- Example: Cobalt
  - Kolwezi, Congo ($2-$3/day)
  - Musompo ($881/ton 16% cobalt rock)
    Zambia, Tanzania
  - Zhejiang Huayou Cobalt, China
  - $ 20,000 to $ 26,000 per ton
  - LG Chem
  - Tesla, Apple, Amazon, ...

https://www.google.it/maps/place/Kolwezi,+Repubblica+Democratica+del+Congo/@-0.8896887,23.9204147,3.59z/data=!4m5!3m4!1s0x1979e57971072e4f:0xa23ff3e3cd0d2277!8m2!3d-10.7275273!4d25.5088914

CSR

- **Corporate Social Responsibility**

What can we do?

- As consumers
- As citizens
- As politicians
- As entrepreneurs
- As communicators

Supported by:

eit RawMaterials

Connecting matters

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation