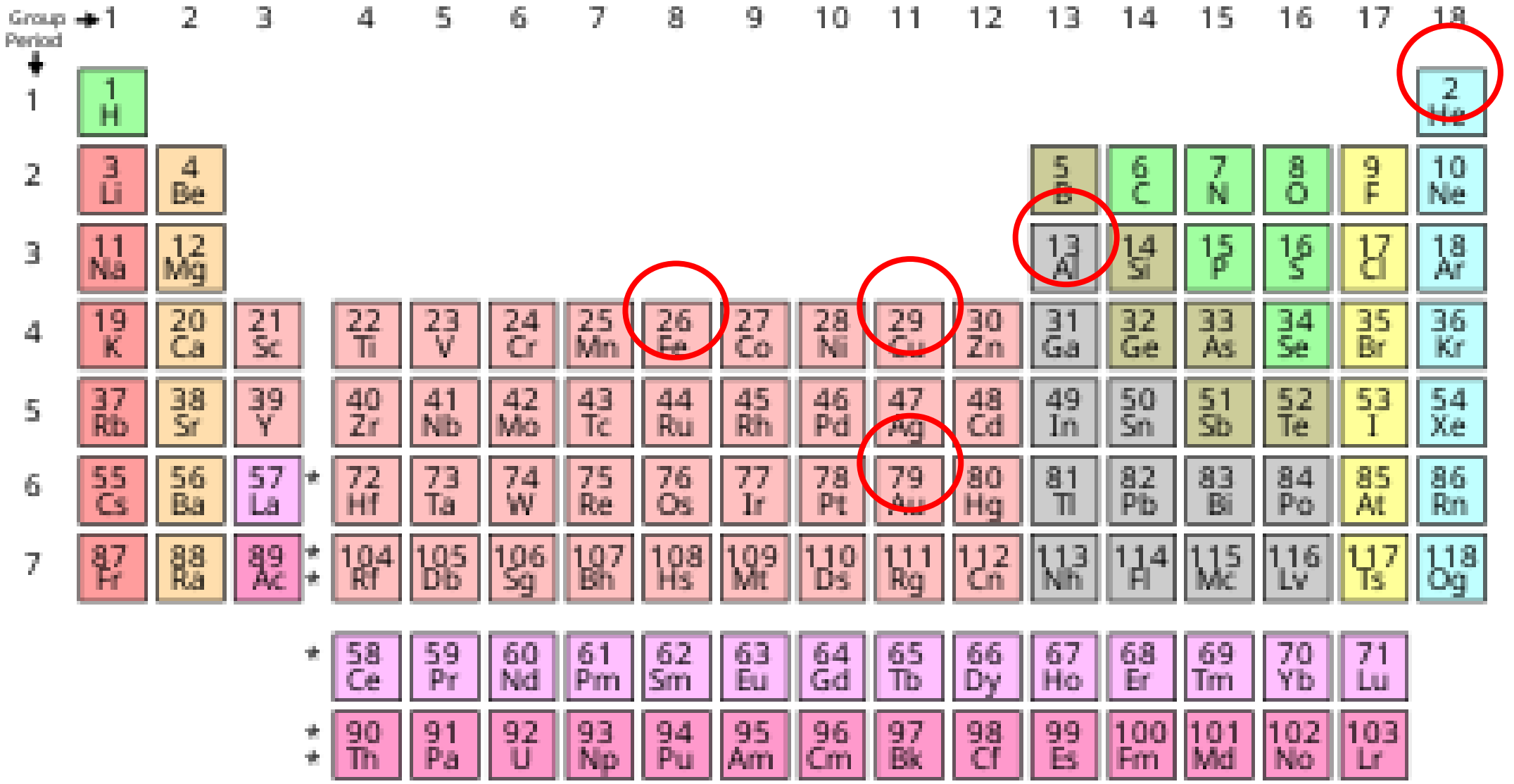
Review the Periodic Table.
What are the element symbols of Helium, Aluminum, Iron, Copper, and Gold?



Geology, Mineral resources and Environments in our society

Ch Mineral resources and Economics

1. We review the resource distribution in the world.

2. How do the resources contribute to economics?
   We see a case of USA.

3. What is future trends of developing mineral resources?

- An example of resource distribution; Australia produces Iron ore over 30 percent in the world.

- Mineral resources contribute economics through digging, processing, smelting, and manufacturing.

- New industry will use new minerals (elements).

1 Mineral resource production

Let's know top three producing countries in **Iron** and **Nickel** ores.

- Top five iron ore producing countries (2023), by USGS (2024).

Australia – 960 million tons, Brazil – 440 million tons, China – 280 million tons, India – 270 million tons, Russia – 88 million tons

- Top five nickel ore producing countries (2023), by USGS (2024).

Indonesia – 1,800,000 tons, Philippines – 400,000 tons, Russia – 200,000 tons, New Caledonia – 230,000 tons, Australia – 160,000 tons

Other example; Rare Earth Elements

- Rare earth metal (element) production was on the rise in 2023, jumping to 350,000 tons worldwide from 240,000 tons in 2021.

China – 240,000 t, USA – 43,000 t, Myanmar – 38,000 t, Australia – 18,000 t, Thailand – 7,100 t, India – 2,900 t, Russia – 2,600 t, Madagascar – 960 t, Vietnam – 600 t, Brazil – 80 t

Ten top countries for Rare Earth Production (USGS, 2024)

2 The role of minerals in the US economy in 2023

Mineral raw materials　Digging

↓

Mineral materials processed, and Processing and Smelting

↓

Industries that consume materials　(3.84trillion US$)

↓

Products　Producing new value,

For example, PC contributes to Information industries.

⇓

Gross Domestic Product (GDP)　(27.456 trillion　US$)

3 Trend of resources Trends in Mineral resource consumption

First stage in industrialization is characterized by the construction of infrastructures (housing, transport, communication, use of energy)

--Consumptions of structural raw materials

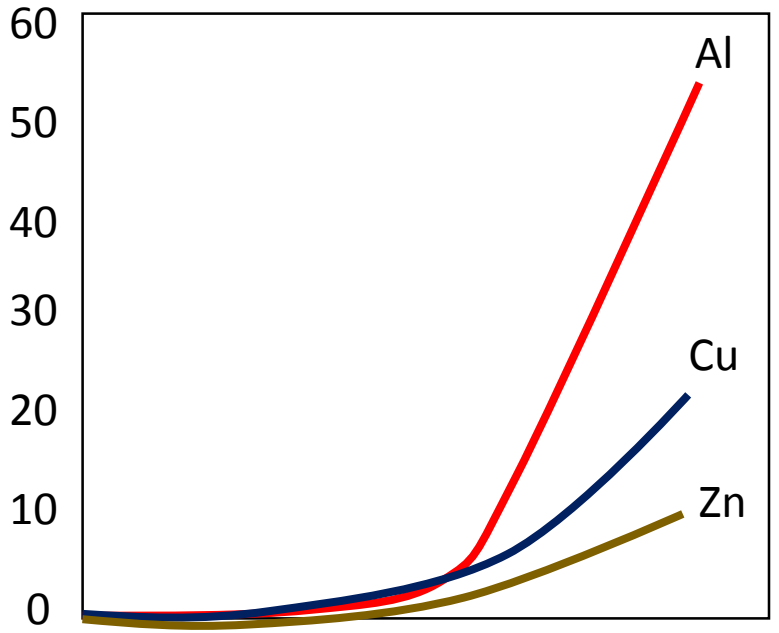
After a period of increased consumption, consumption of structural raw materials stabilizes when GDP per capita reaches high around USD20,000.

More data in figure

Al: 63 Mt, Cu 20 Mt, Zn 13 Mt (at 2019)

Al: 68 Mt, Cu 21 Mt, Zn 13 Mt (at 2021)

Al: 70 Mt, Cu 22 Mt, Zn 12 Mt (at 2023)



Simplified Fig. 1 (C) in Vidal et al. (2017)

Rate Al: 5%/year, Cu: 3%/year

Let's consider the relation between Population and Energy consumption

See a diagram on population and energy consumption, for example,

(ex 1)

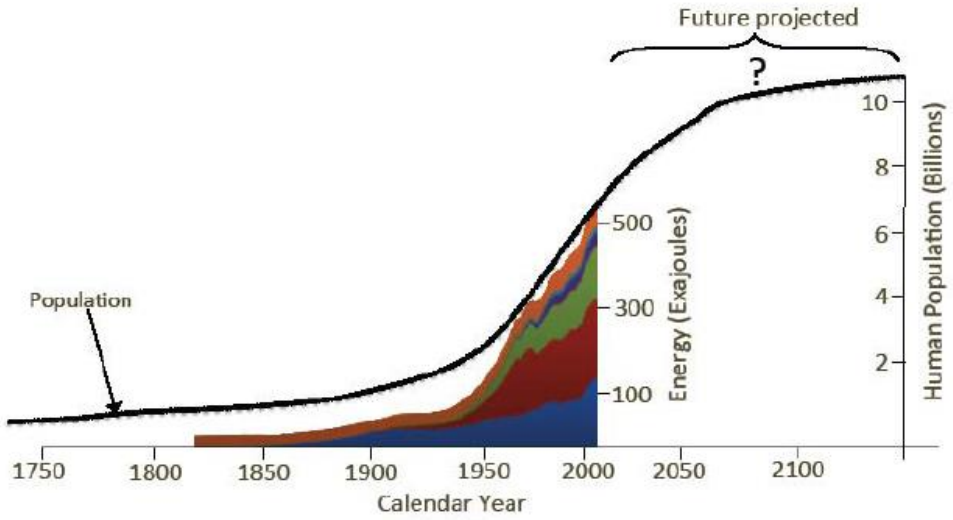
Produced energy and the pattern of human population growth from 1750. | Download Scientific Diagram (researchgate.net)

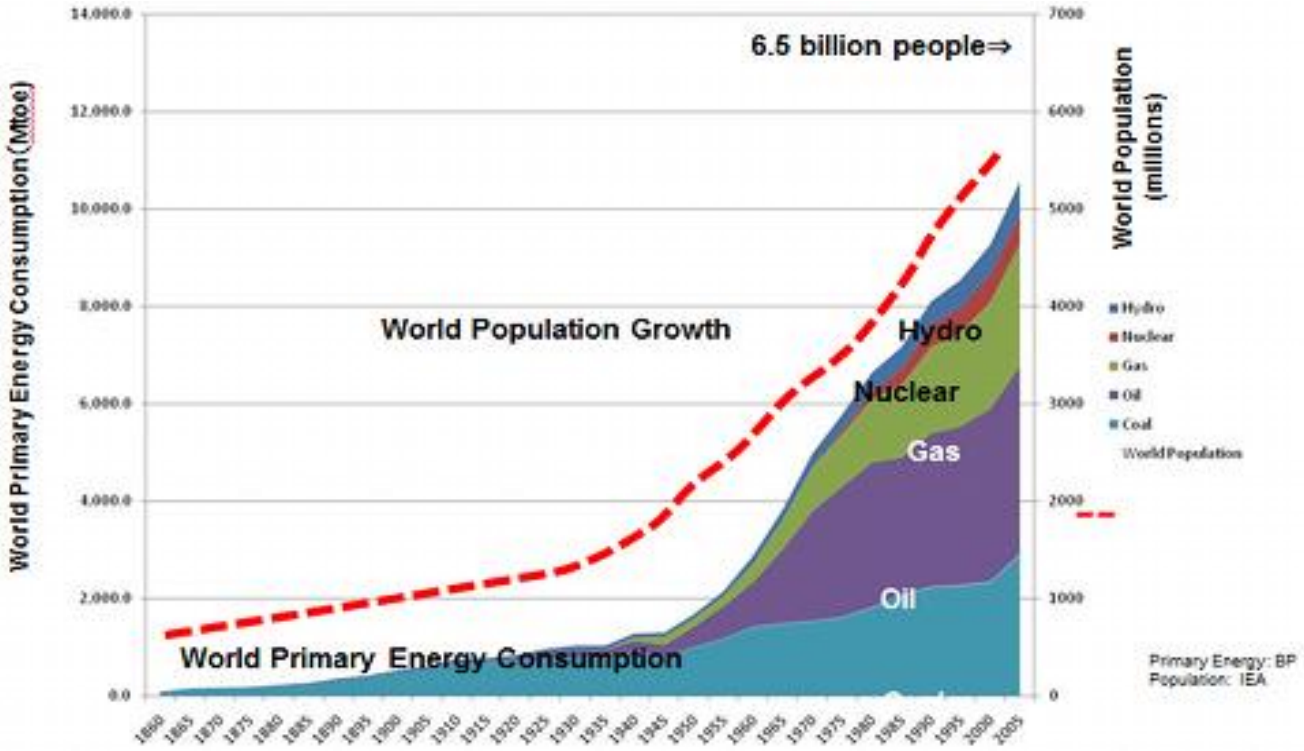
(ex 2)

Digital Grid – The Digital Grid Consortium

Question

When and why do the general trends of energy consumption change?





- When; Around just after the Second World War
- Why; Developing and extending of using oil (and gas)
- In addition, the industry evolution (1750–1800) is the key epoch.

Low-carbon energy infrastructures, new industries, require more raw materials. The technological tools need new resources.

- Large amounts of structural mineral resources
- High-tech metals, for example, Sb and Co,
- REEs in the super-magnets of wind turbines,
- Ga, In, Se and Te in photovoltaic thin films,
- Li in batteries of hybrid or electric vehicles,
- Platinum-group (PGMs) in cells

Video

・Video：Iron manufacture (Pohang Iron Foundry) (POSCO) 6min 43sec

https://www.youtube.com/watch?v=DwiIzb9KNfQ

・Video：Wind power（NHK）1min 22sec

http://www2.nhk.or.jp/school/movie/clip.cgi?das_id=D0005300797_00000

Supplement:
I introduce General Interest Publication.

Gold

By Kirkemo, Newman, and Shley

Series “USGS general interest publications”, 1997

Gold (usgs.gov)