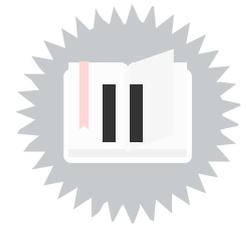


# Consumption of abiotic resources

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- Main threads of the course : Metals and Oil
- Metals
  - Brief global history
  - Contemporary trends
- Oil :
  - Brief global history
  - Contemporary trends
- Sociotechnical perspective (Tutorial work)

## 1. Main threads of the course

### 1.1. The mineral resource example: Metals

- Why metals? On the 118 known atoms, most of them are metals :<sup>[3]</sup>
  - 85 metals
  - 6 metalloids
  - 17 non metals
  - 10 non determined
- General properties :
  - electrical & thermal conductors
  - mechanical ductility
- Geological forms: oxides (common) > sulfides (less common) > natives (uncommon)

### 1.2. The energetical resource example: Oil

- Currently, most used source in main primary energy consumption :
  - Oil (33,1%)
  - Coal (27%)
  - Natural gas (24,2%)<sup>[6]</sup>
- Regroup varied forms of derived fuels (petrol, shale oil) and secondary resources
- General properties: gives a lot of secondary resources when refined, good energy density, easy and convenient to transport and to use as energy vector in varied contexts

## 2. Metals

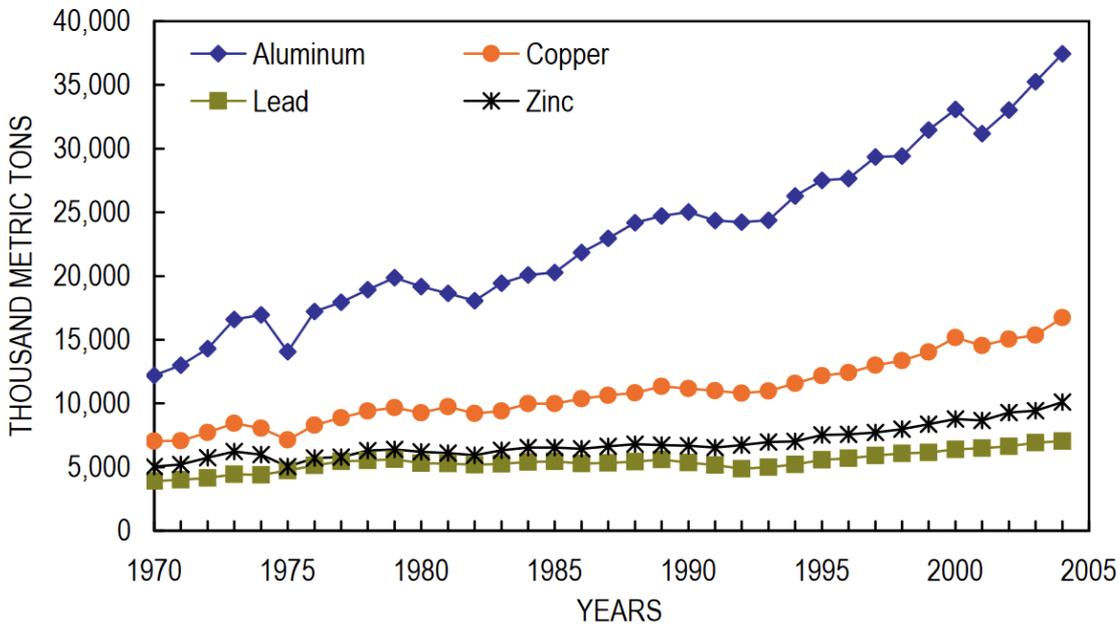
### 2.1. Metals global history

A very brief summary <sup>[3]</sup>

- Contrary to first intuition: native metals were the first to be used. Although uncommon (often mixed) they were easily recognizable:
  - Copper (at least 8000 BC, and melted since 4000 BC), Gold and Silver (4000 BC)
  - Alloys starting in 2500 BC with Bronze (Tin & Copper)
  - Furnaces since at least 1000 BC let reduce oxides (notably, Iron oxide) and develop experiments on alloys (Steel = Iron + Carbon)
  - Lead, Antimony, Mercury used pure or in alloys during Antiquity
- This tiny number of metals has constituted the main uses until the XIXth century and structured economical and geopolitical relationships between populations
  - Besides native platinum in Peru, other metals like Nickel, Zinc, Cobalt have been identified by chemistry and metallurgy (beginning of XVIIIth). And then: Manganese, Molybdenum, Tungsten, Titanium (end of the XVIIIth).
  - Electrolysis in XIXth allows to separate most elements in pure form, but weak rate of use until the XXth century.

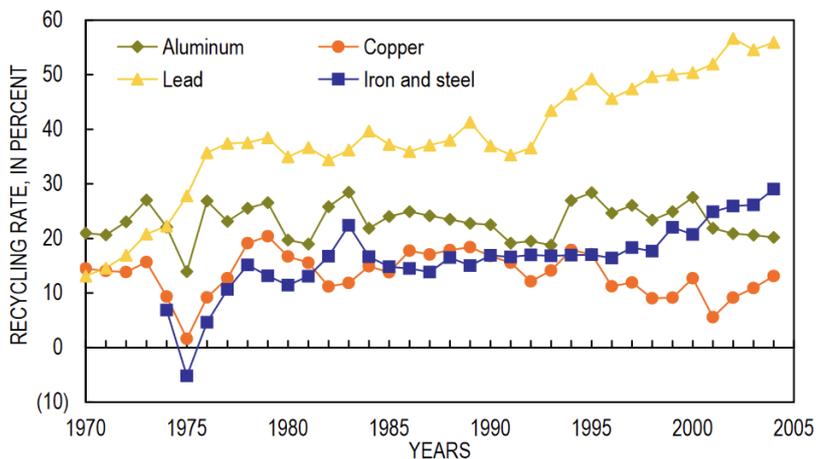
### 2.2. Contemporary trends

a) Continuous growth in use of base metals



**Figure 3.** Global aluminum, copper, lead, and zinc consumption.

- Heterogeneous rise of world consumption for base metals: by a factor from **1,5** (Lead) to **3** (Aluminium)

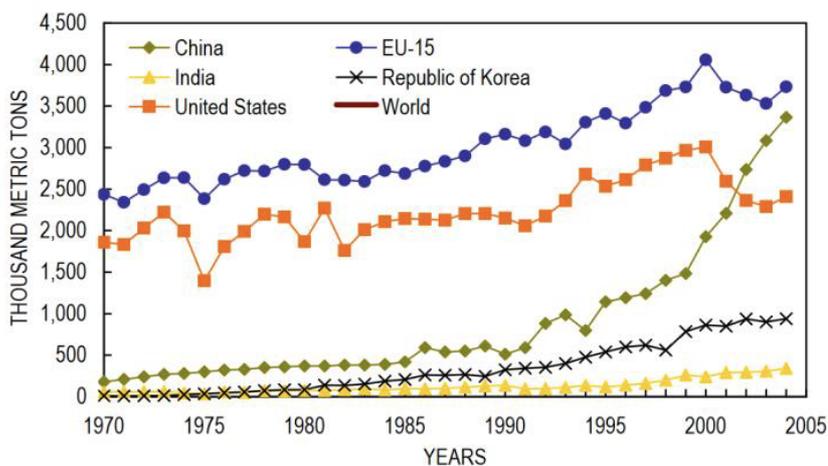


**Figure 24.** Graph illustrating calculated world metals recycling rates.

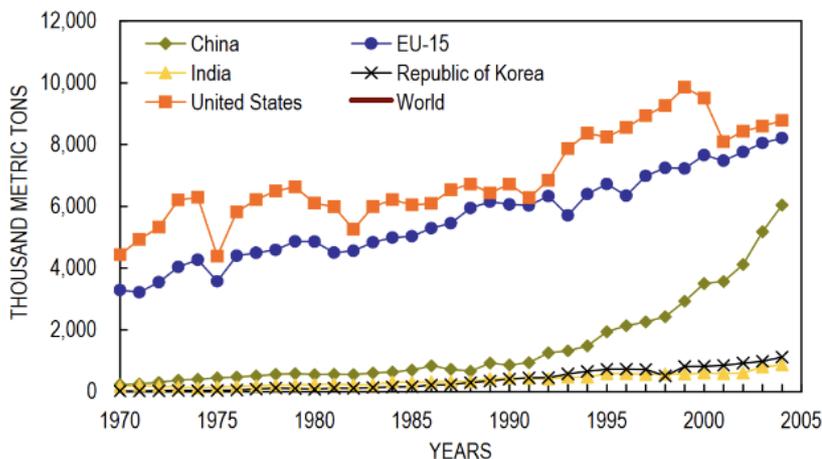
- Recycling rates not progressing as much

[7] ROGISH, D.G., and MATOS, G.R., 2008, The global flows of metals and minerals: USGS Open-File Report 2008-1355

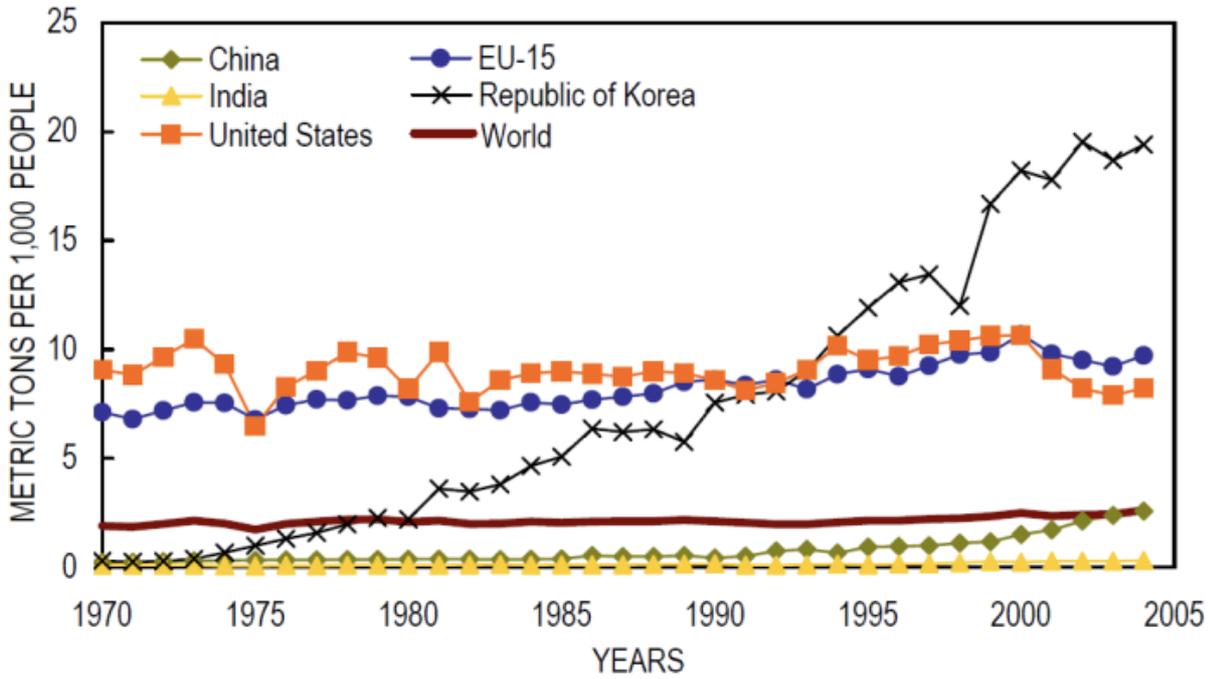
b) Countries high disparities



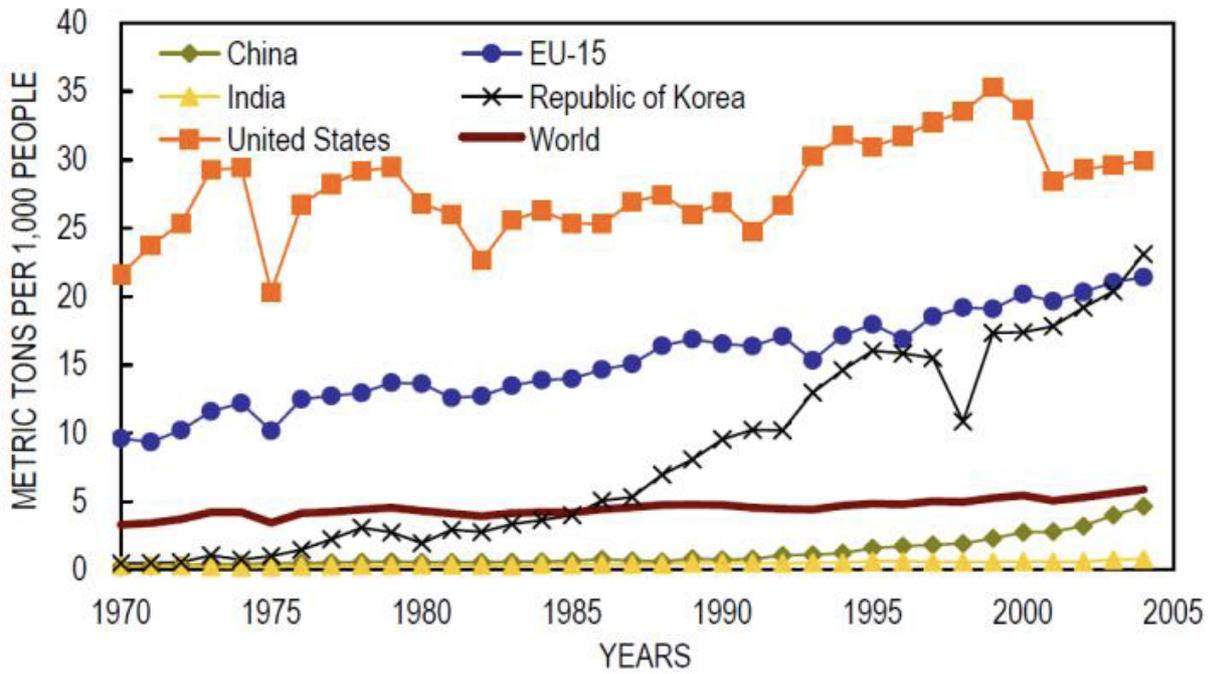
**Figure 11.** Copper consumption by country.



**Figure 12.** Aluminum consumption by country.

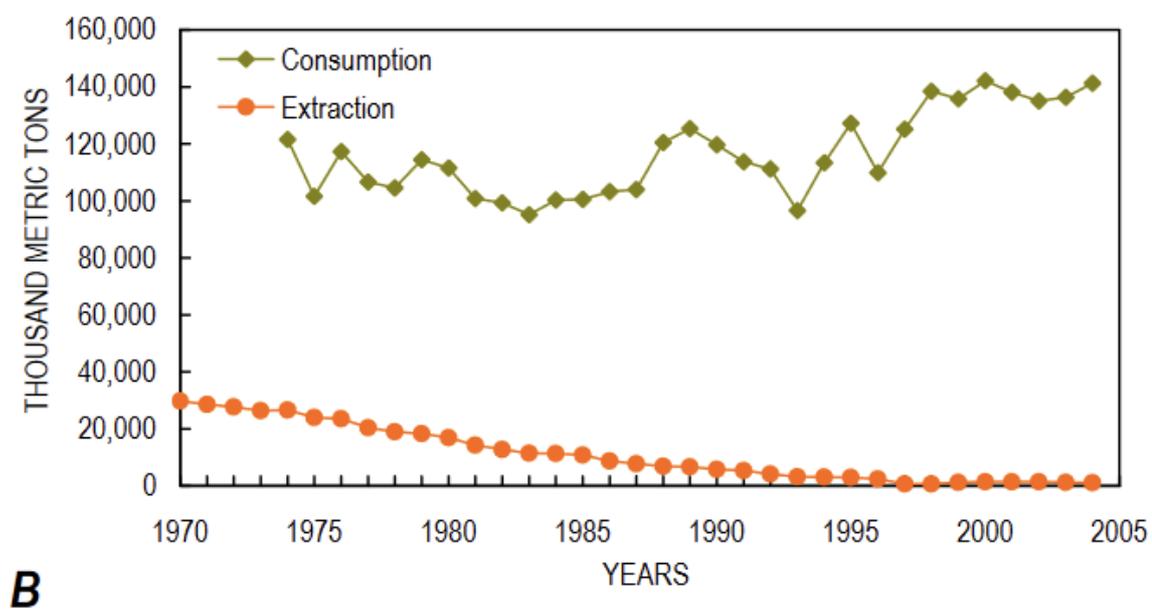
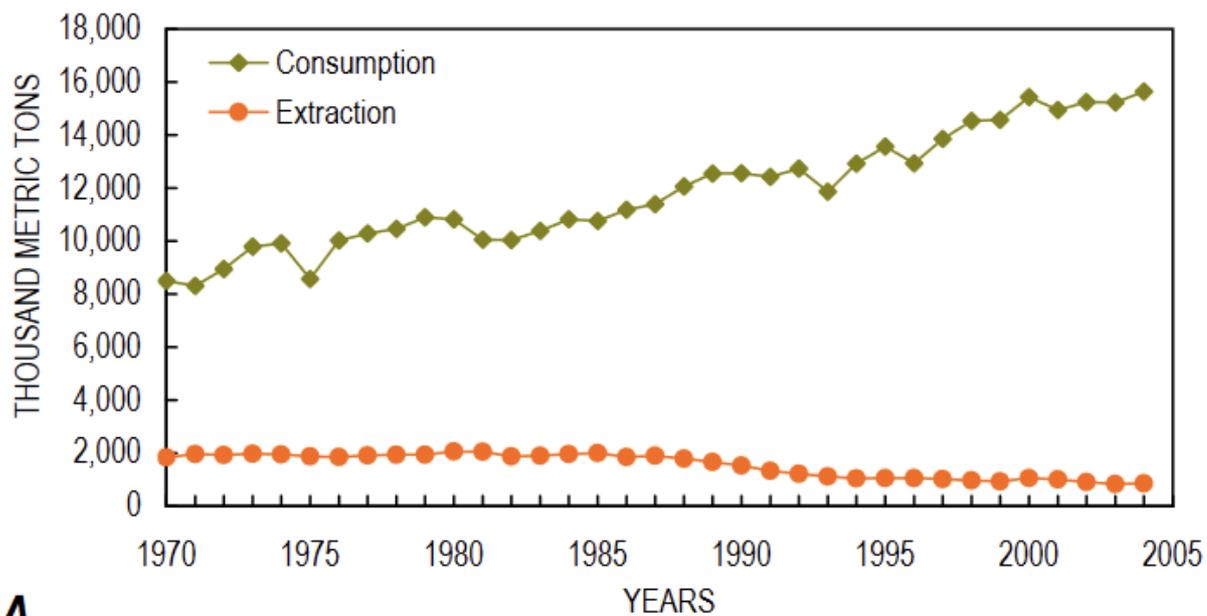


**Figure 15.** Copper consumption per capita by country.

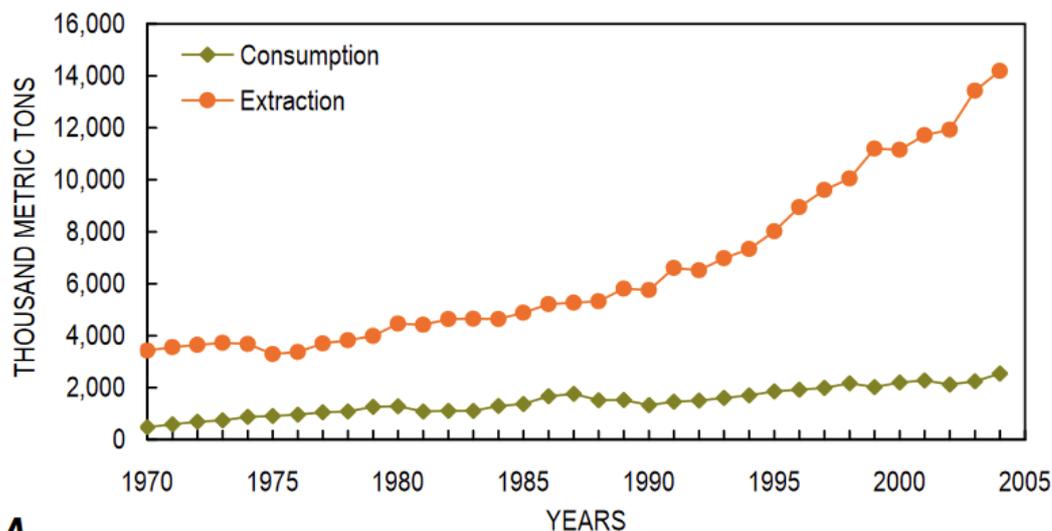


**Figure 16.** Aluminum consumption per capita by country.

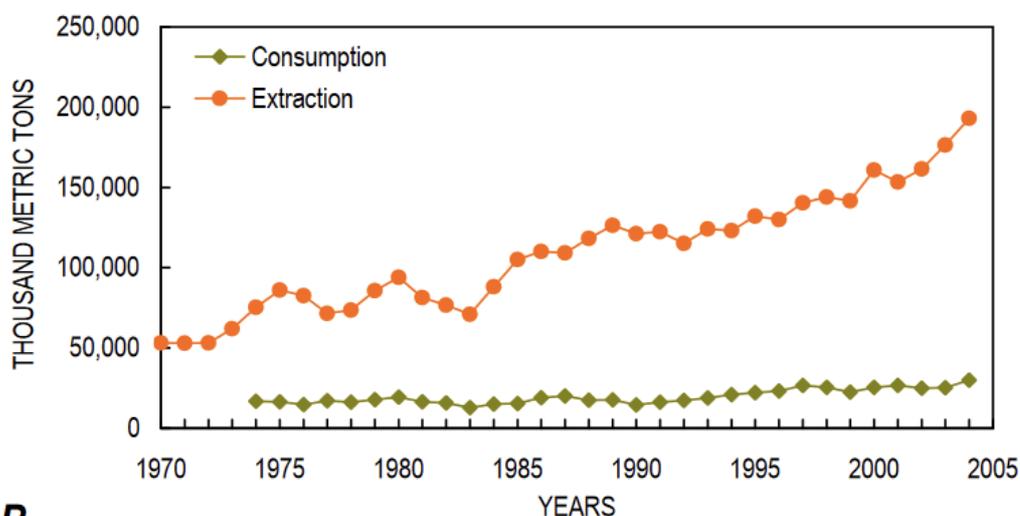
## c) Global Extraction/Consumption pattern



**Figure 18.** Consumption and extraction in the European Union group of 15 countries (EU-15). A, Base metals. B, Iron and steel.



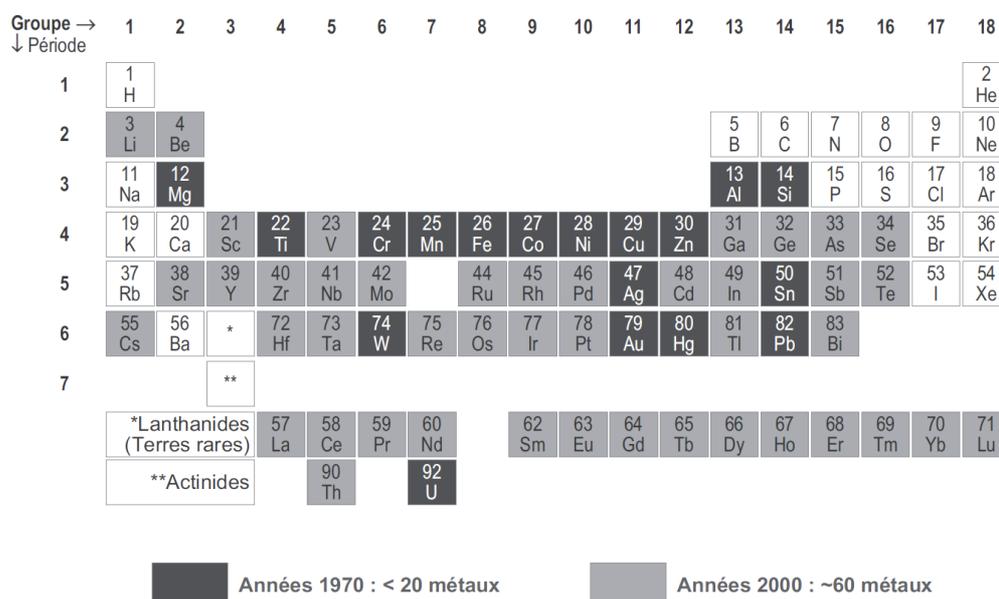
**A**



**B**

**Figure 20.** Consumption and extraction in South America. A, Base metals. B, Iron and steel.

d) Growing variety of metals for expanding specific uses



## 2.3. Medias

<https://pod.utt.fr/video/3944-ev14-abiotic-resources-2-metals/>

## 3. Oil

### 3.1. Oil global history

#### A very brief summary <sup>[8]</sup>

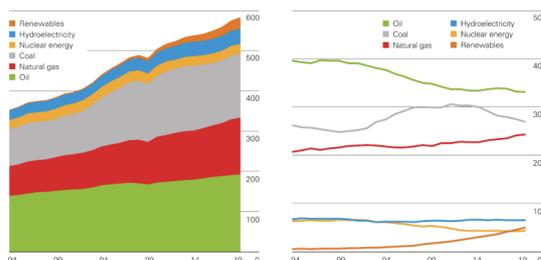
- Oil has been used for a long time in varied forms
  - Used as fuel as back as 400 BC in China
  - Used for lighting or in the asphalt form for construction as back as 2000 BC in Babylon
  - Crude oil already distilled by Persian chemist in 9th century to obtain tar, used for streets' paving
  - Distillation arrive in Europe in 12th century through Islamic Spain
- The mid19th –early20th turning point <sup>[9]</sup>
  - First industrial oil well and oil refinery around 1850
  - Consumption stayed low (5% of world energy in 1910), as oil as not that interesting at first, compared to wind or animals for transport, solar& coal were largely dominant for thermal power, etc.
  - Complex and crossing technical but mostly political phenomena let oil grew in varied uses, to represent more than60% of world energy as soon as 1970

[8] Petroleum, 2020. *Wikipedia*[online].

[9] BONNEUIL, C., FRESSOZ, J-B, 2016. *The Shock of the Anthropocene. The Earth, History and Us.*

### 3.2. Contemporary trends

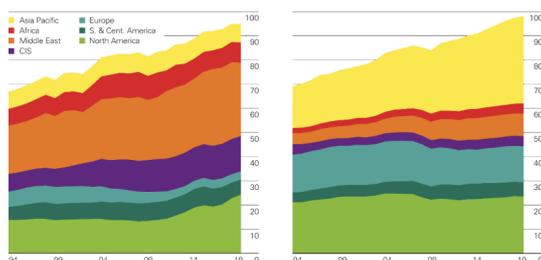
#### a) No primary energy transition



- Oil's share in primary energy is steadily decreasing for more than30 years, but:
  - Oil is still the dominant energy vector
  - In absolute quantity, it is not declining at all, as for all energy vectors!

Extracted from <sup>[6]</sup>

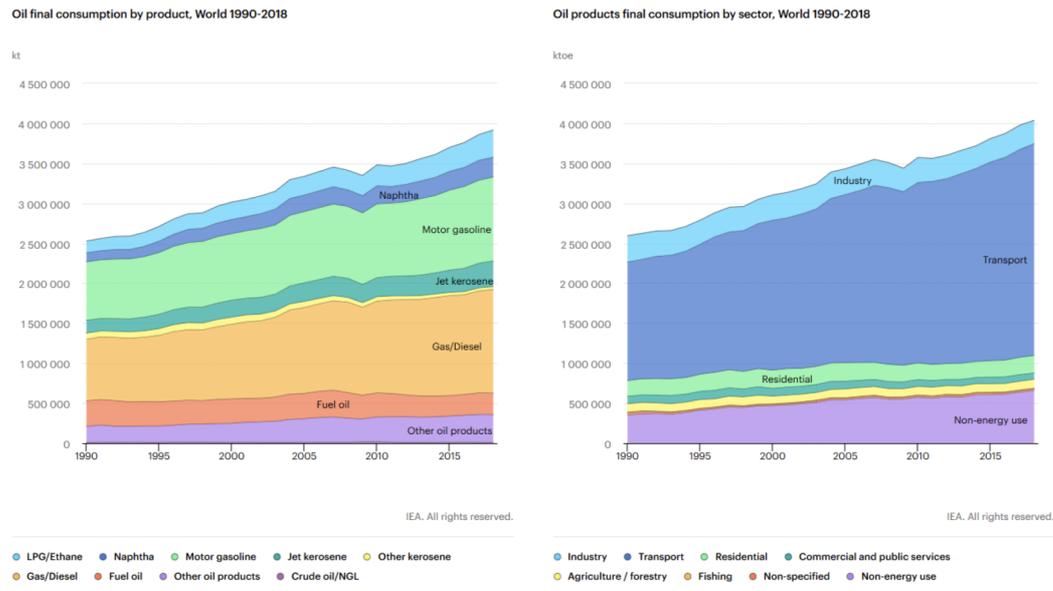
#### b) Three main profiles



- High ratio of Production/Consumption
- Low ratio of Production/Consumption
- Ratio of Production/Consumption near 1

Extracted from <sup>[6]</sup>

### c) Consistency of uses



### 3.3. Medias

<https://pod.utt.fr/video/3945-ev14-abiotic-resources-3-oil/>