The longer term agenda

What drove substitution of metals so far and what learnings can we define for the future?

7 November 2018

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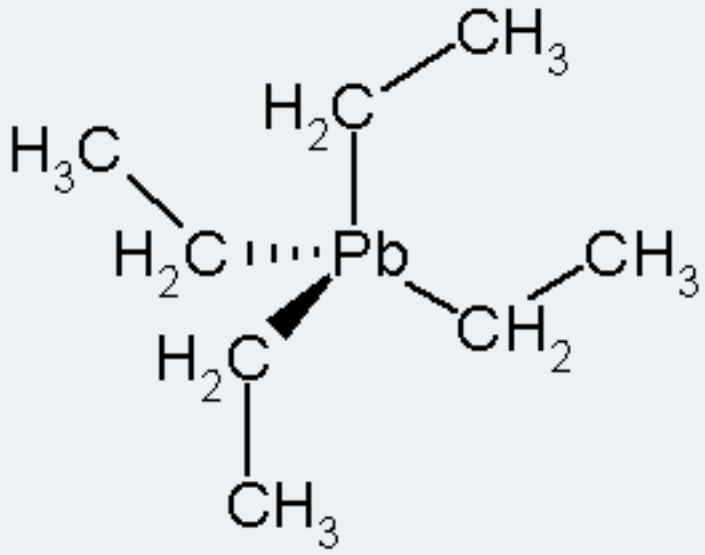
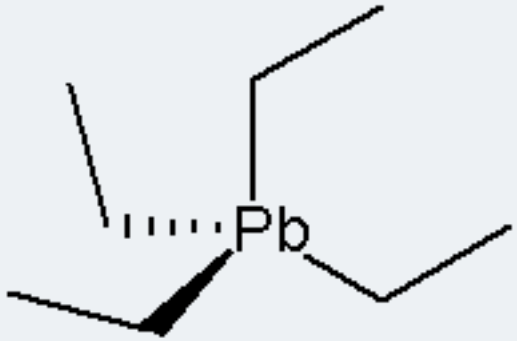
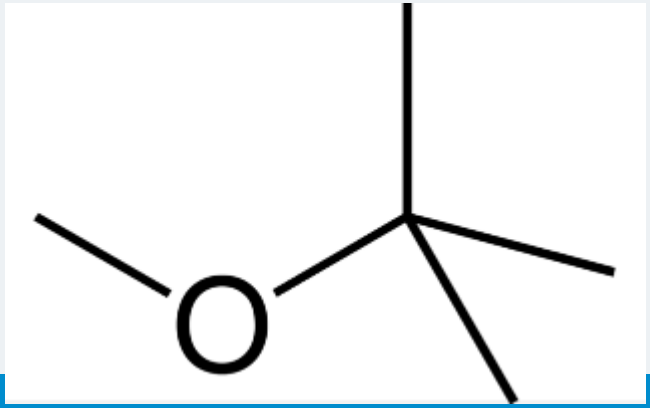
Can we learn from the past to help understanding the needs for the future?

What was (probably) the biggest & fastest substitution case in the EU with the largest impact?





Tetra-Ethyl-Lead (TEL) BY Methyl-terd-buthyl-ether (MTBE)



What was (probably) the biggest & fastest substitution case in the EU with the largest impact?

In the US in the eighties: *the mean blood lead level of persons aged 1 to 74 years dropped 78%, from 0.62 to 0.14 µmol/L (12.8 to 2.8 µg/dL).*

Conclusions —The results demonstrate a substantial decline in blood lead levels of the entire US population and within selected subgroups of the population. The major cause of the observed decline in blood lead levels is most likely the removal of 99.8% of lead from gasoline and the removal of lead from soldered cans.

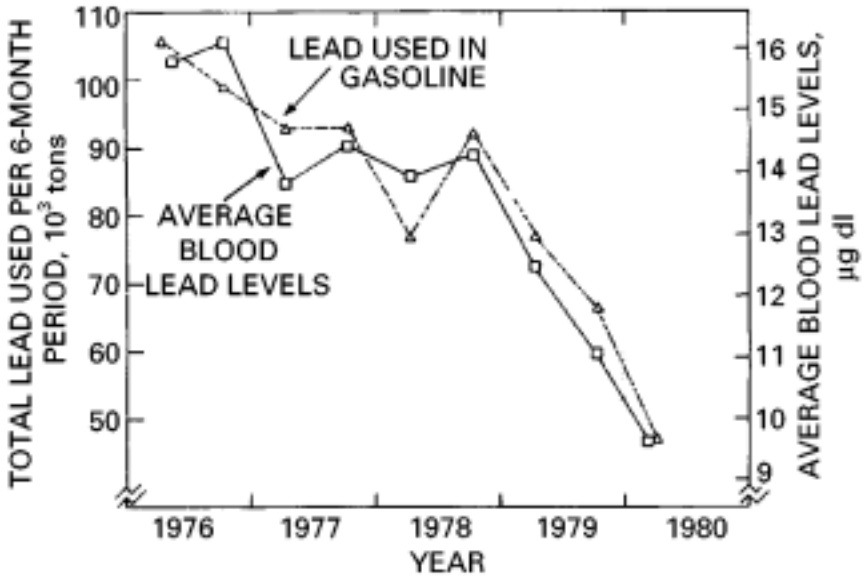


FIG. 2. Parallel decreases in blood lead values and the amounts of lead consumed in gasoline between 1976 and 1980. Source: USEPA/Environmental Criteria and Assessment Office (1986).

What was (probably) the biggest & fastest substitution case in the EU with the largest impact?

Chemical solution was available in the seventies

Substitution started in the US in ’73 in California in the EU in the mid ’eighties

Fiscal measures swopped the market in months

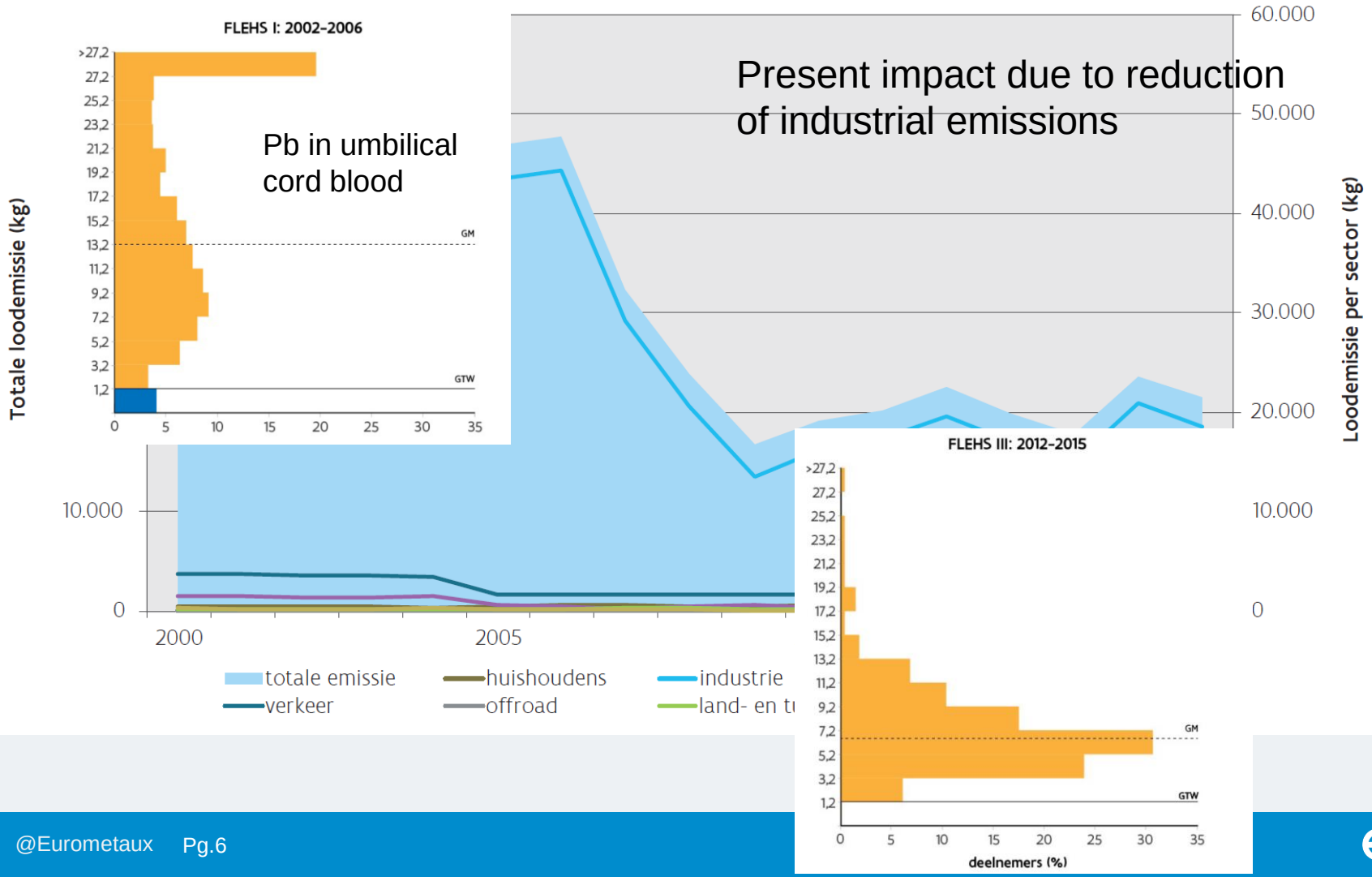
Attention in the EU was on boosting technical performance (Octane boosting)

No regulatory nor fiscal incentives in the EU until mid eighties

Technical performance constraints of some car engines

What was (probably) the biggest & fastest substitution case in the EU with the largest impact?

Figuur 9.2: Trend loodemissies tussen 2000 en 2016 (kg)



Replacement of NiCd batteries

NiCd rechargeable batteries were a revolution !

- But energy density is low 45Wh/kg.
- Capacity < 1000 mAh
- Memory effect
- Reliable

Replacement of NiCd batteries

- Ni-metal hydrate rechargeable batteries
  - Much higher density: 60 - > 120Wh/kg.
  - Capacity up to 2500mAh and more
  - Energy density is medium
  - Lower memory effect

- Li-ion rechargeable AA and AAA batteries
  - Density slightly better
  - Better charge/discharge
  - Higher voltage
  - Overheating may occur
  - …

Replacement of NiCd batteries

Technical performance relevant to use

Price

EU Battery Directive had only a limited role in the substitution story

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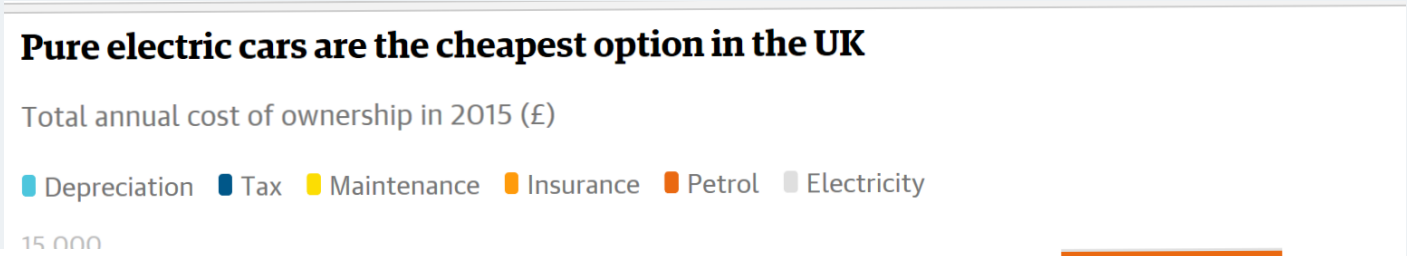
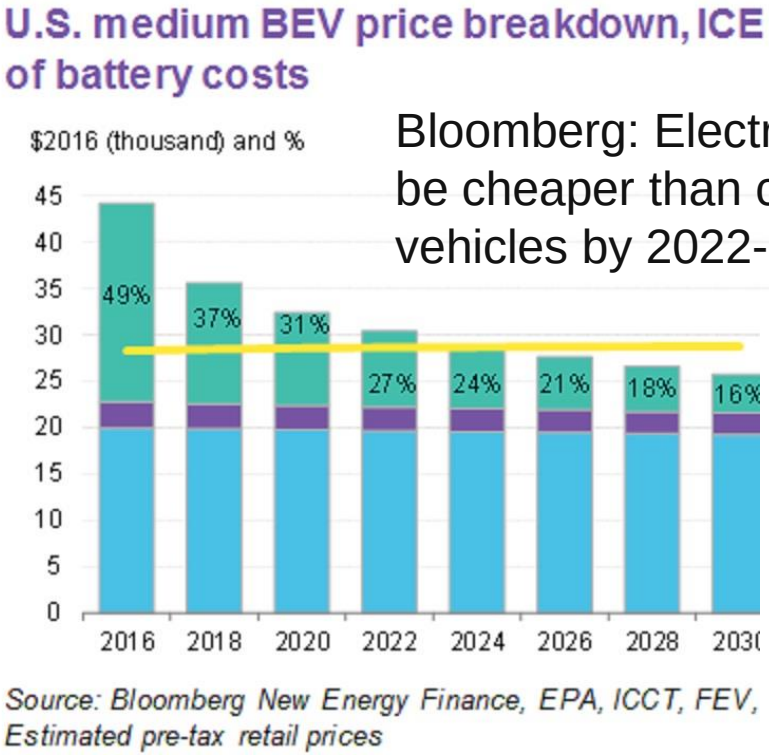
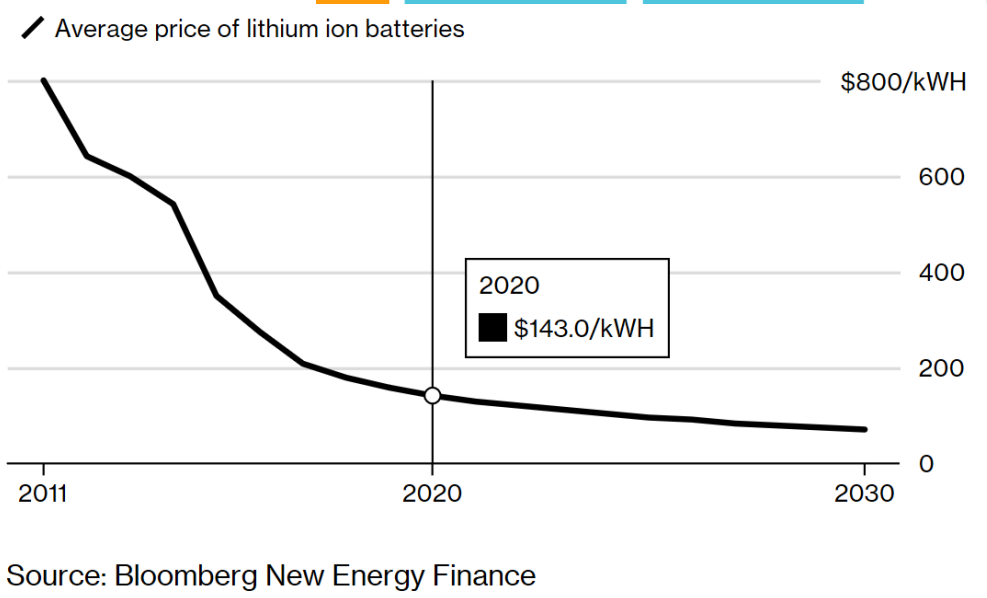
Can we learn from the past to help understanding the needs for the future?

Petrol versus Electric cars





Bloomberg: Electric cars 'will be cheaper than conventional vehicles by 2022-'24'



Petrol versus Electric cars

- Technical progress
- Price erosion of batteries/cars
- Tax incentives

- Autonomy fear
- Loading infrastructure
- Tax loss for governments

This case may be more than a price issue only (changing a habbit, fear, …)

Content

Can we learn from the past to help understanding the needs for the future?

Megatrends

Trends dixit PWC…

Demografic changes	Moving of the economic power	More people in the cities	Climate & prim. Mat shortage	Technology changes

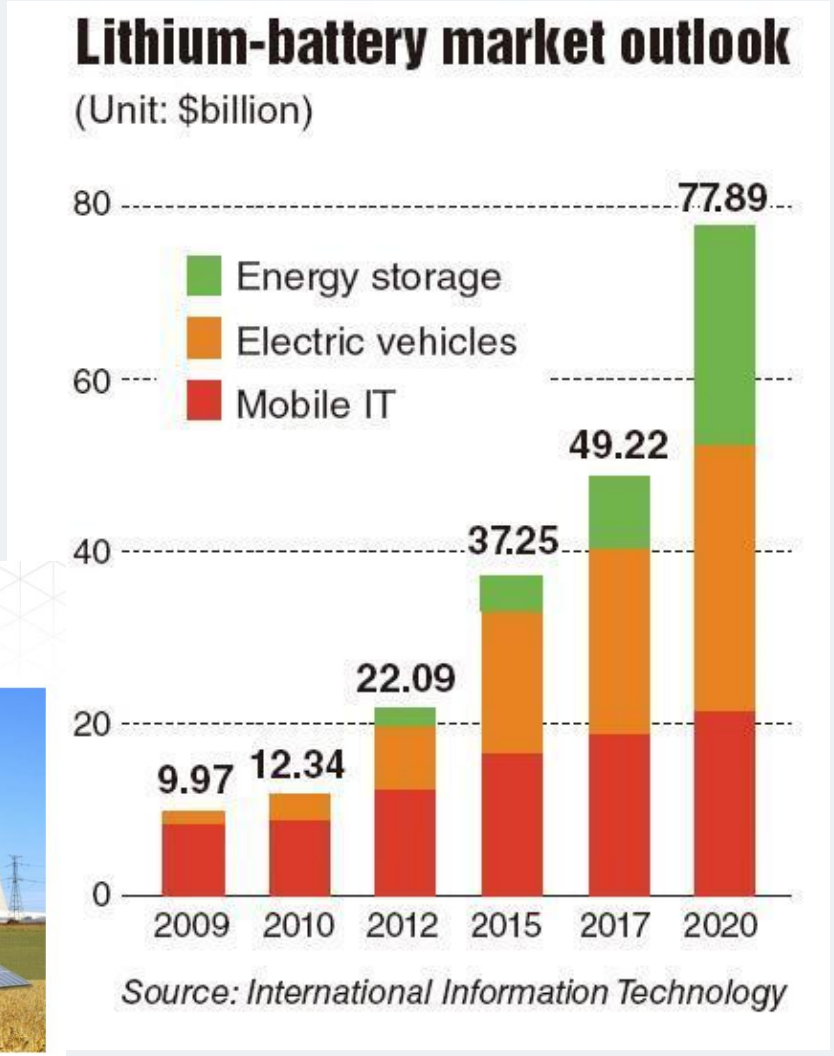
Main expected trends in respect to substitution (based on the past):

- Technological breakthroughs
- Economic breakthroughs
- Societal changes

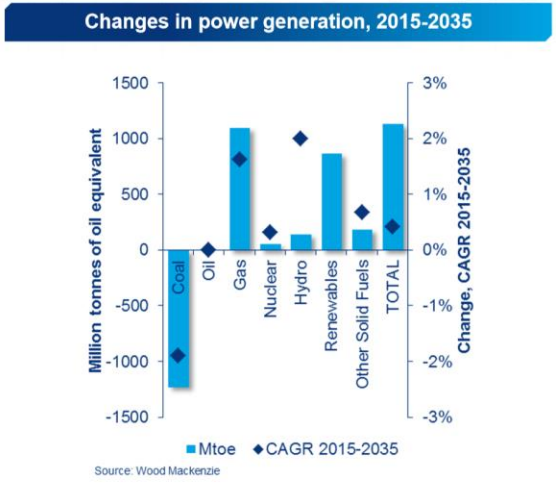
Expected trends and their consequences:

- Materials demand for Energy storage:
  - Huge increase in demand for new battery materials (metal oxide and salts)
  - What about other materials use (lead)?

DRIVERS: Technology, cost & availability



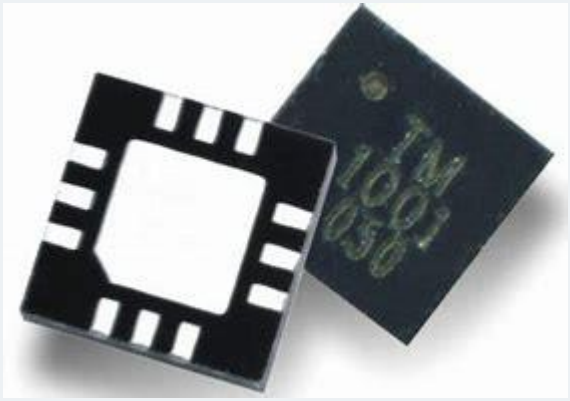
Power generation will change: less burning, more wind & sun



Expected trends and their consequences

Materials demand:

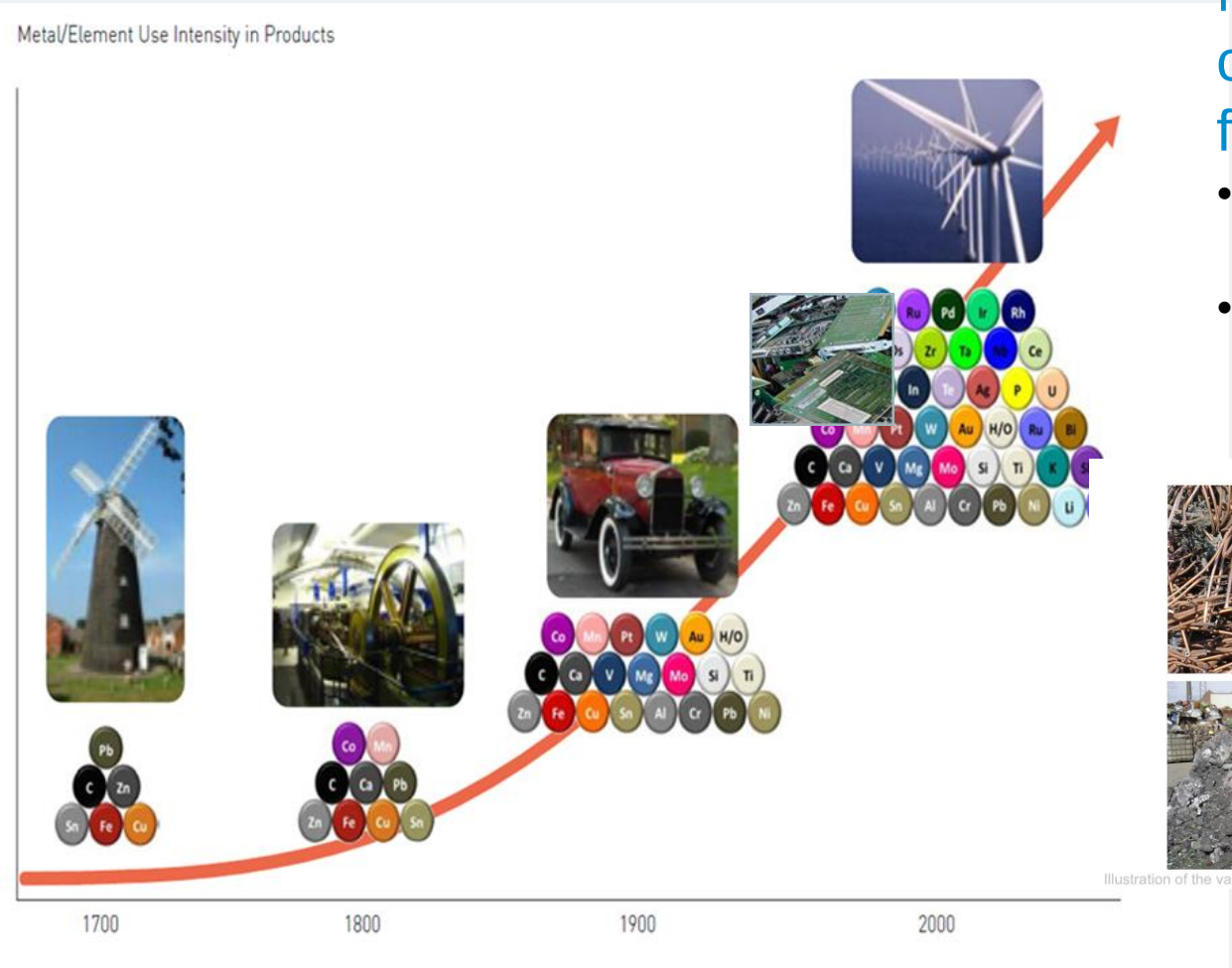
- Digitalisation, WIFI interconnectivity, remote control, solar energy,… expected increase in use of:
  - Gallium arsenide
  - Indium phosphide
  - …



Drivers: technical and cost

Expected trends and their consequences

RECYCLED materials offering:



Materials complexity offered for recycling will:

- rise for the coming decade
- Either from articles (Ni, Co, …) or from side streams in case demand decreases (Cd)

Illustration of the various scraps and secondary materials processed by European metal recyclers

Expected trends and their consequences

Complexity of **recycling materials offered,** for recovery/reuse/(safe disposal):

- On the rise for the coming decades
- Either from articles (Ni, Co, …) or from side streams in case demand decreases (Cd)

Illustration of the various scraps and secondary materials processed by European metal recyclers

Conclusions:

- **Large and effective substitutions** with a large impact on society were:
  - driven by innovation in substances/technologies
  - rather than regulatory action
- **Societal support** (tax incentives, changes in habbits, …) helped creating demand/leverage for substitution
- ***Important technology and economic breakthroughs*** will lead to large changes in material streams on potentially SVHC materials
- ***Those trends*** can be triggered fast but keep on for decades
- ***Material flows for inorganics*** are somewhat independent from the demand (eg as a material or a by or waste product)
- ***Restricted impurities/minor constituents*** will continue to increase in recycling processes…

THANK YOU

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