Stimulating Substitution in the metals sector, a conceptual frame,

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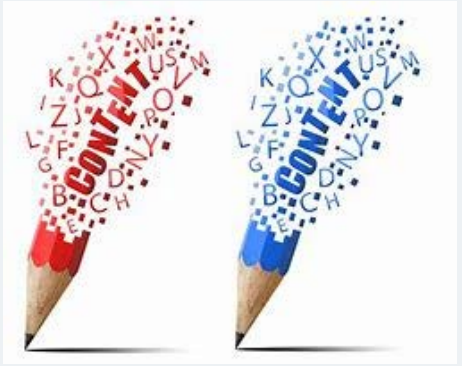
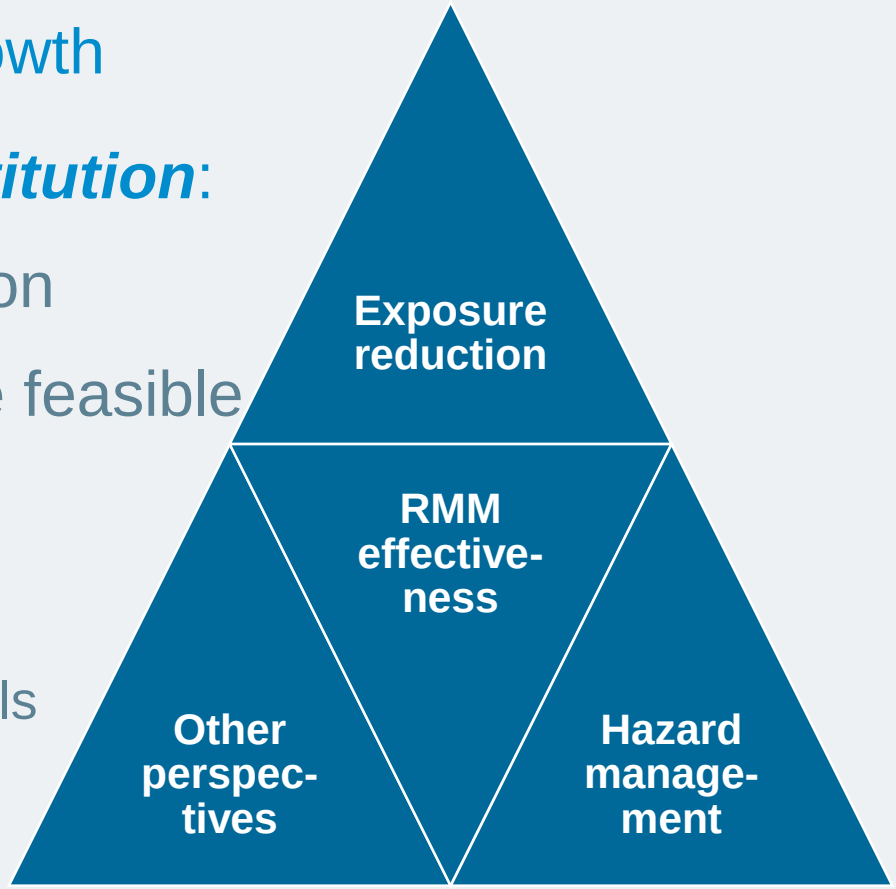
Workshop on Sustainable substitution

- Antwerp 7 Nov 2018
- Objectives:
  - How to stimulate attention for substitution in the metals business model
  - Recognising the broader perspective of sustainable growth of the EU metals sector
  - Recognising societal, political and economic trends

Concept

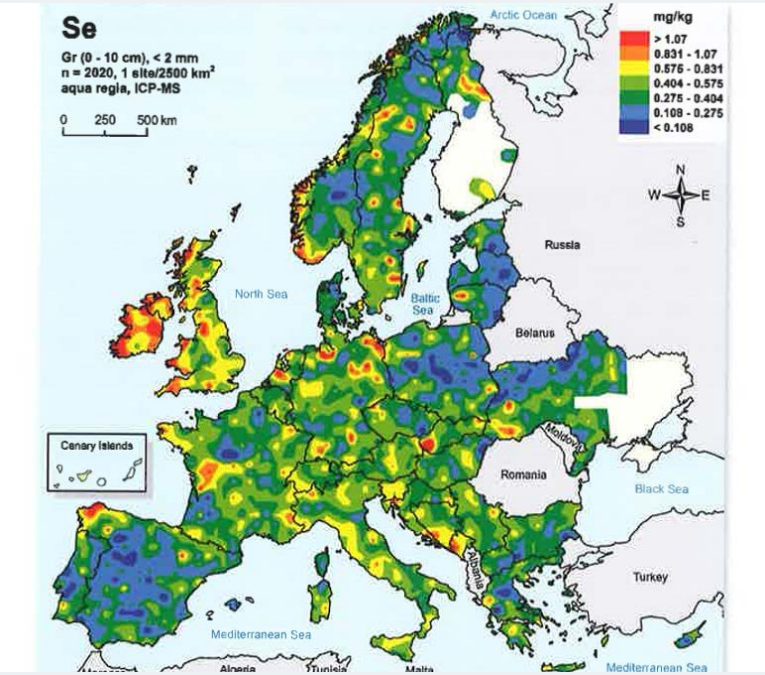


- Frame to ***stimulate Substitution*** for metals recognizing their properties and economic contributions to sustainable growth
- Concept of ***Sustainable Substitution***:
  - Maximize Exposure reduction
  - Hazard management where feasible
  - Assessing/considering :
    - EOL and recycling
    - Other EU EHS legislation/tools
    - Societal value and impact

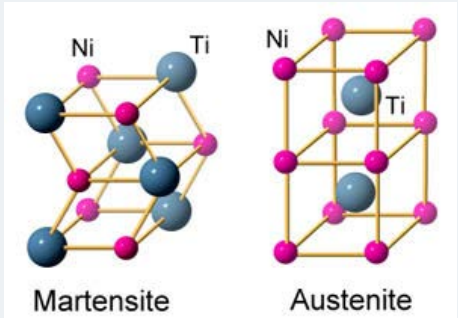


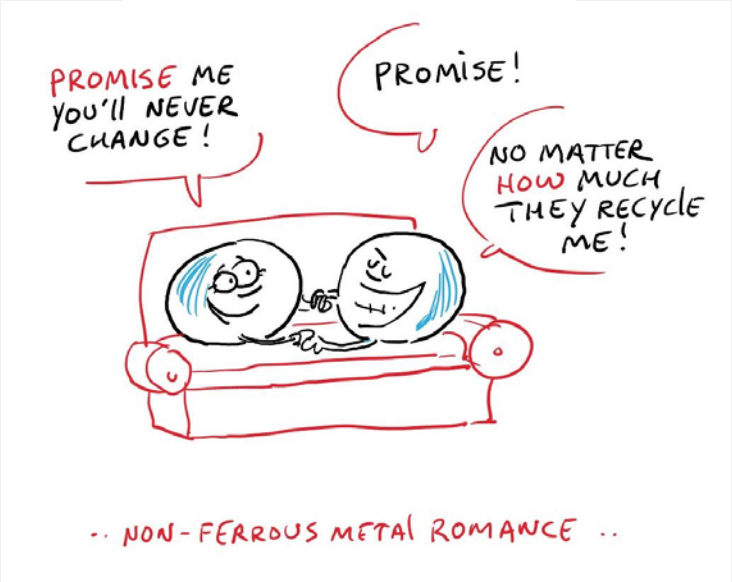
1. Metals' key properties

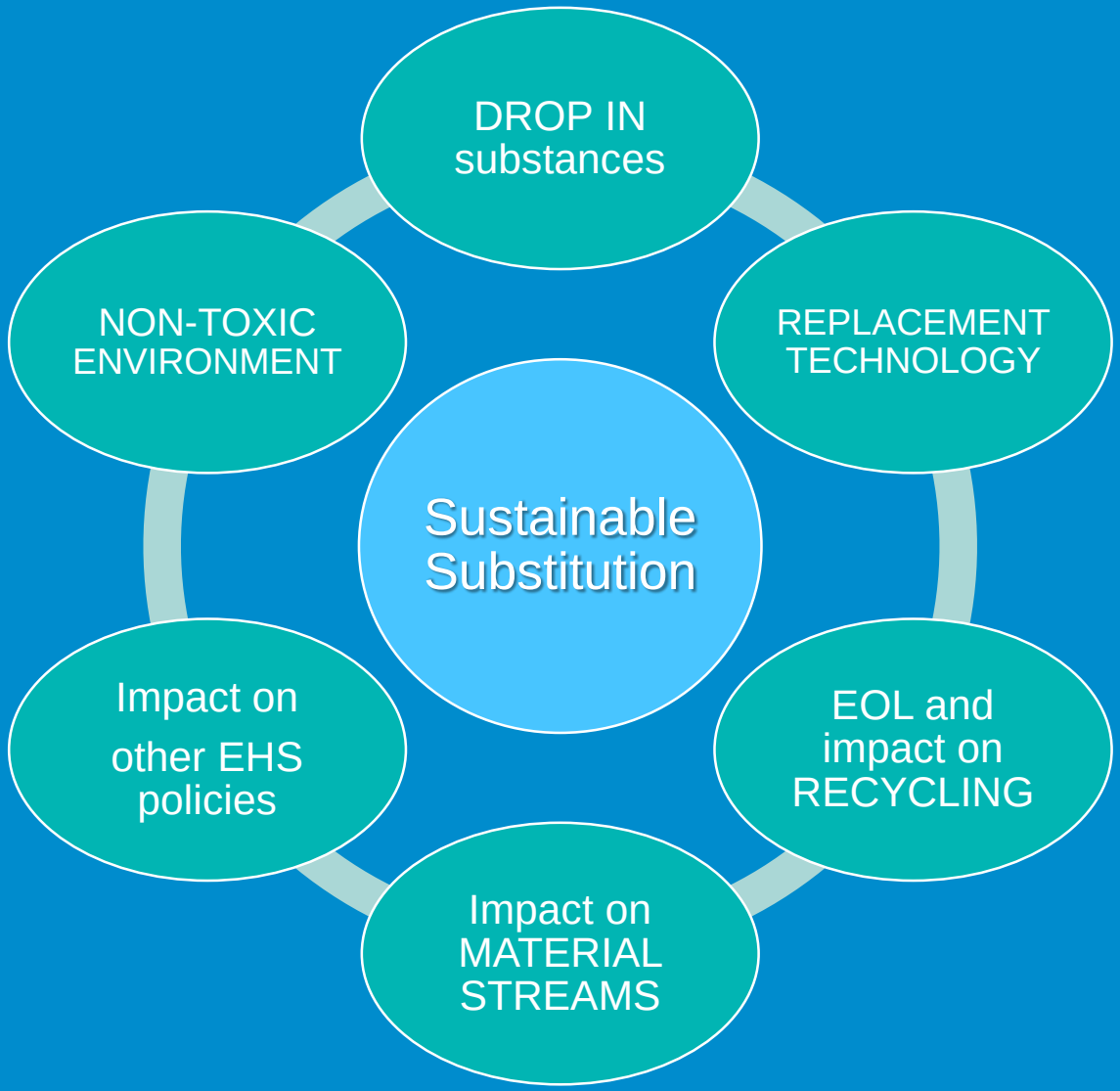
Metals are natural elements often occuring commonly (Zn-Cd, Pb-Ag, Cu-As, …)



Recycling does not alter the original metal properties



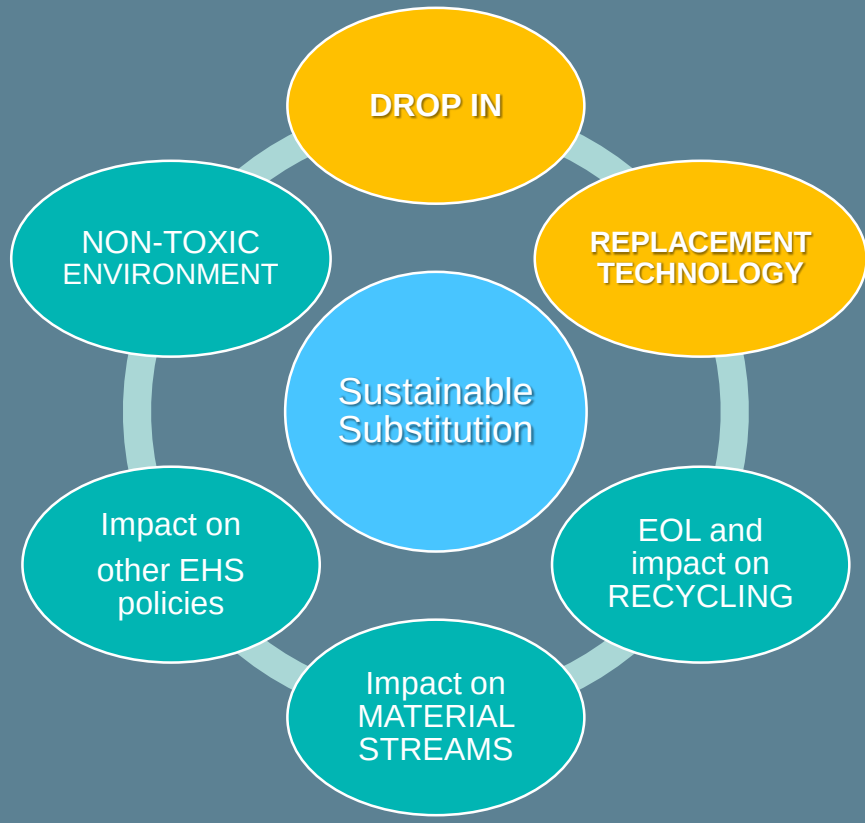




A Conceptual Frame for assessing/stimulating substitution for metals

Proposal for Frame for Sustainable Substitution assessment/promotion of metals

Promote Sustainable substitution by assessing in a **stepwise approach** if the replacement of a **Substance of Very High Concern** is **technically and economically feasible** from a **combined perspective** of Chemicals Management, Circular Economy, and other EU-Environmental and Health policy objectives; recognising **Societal Value and Impact.**



Check for DROP-in or REPLACEMENT Technology

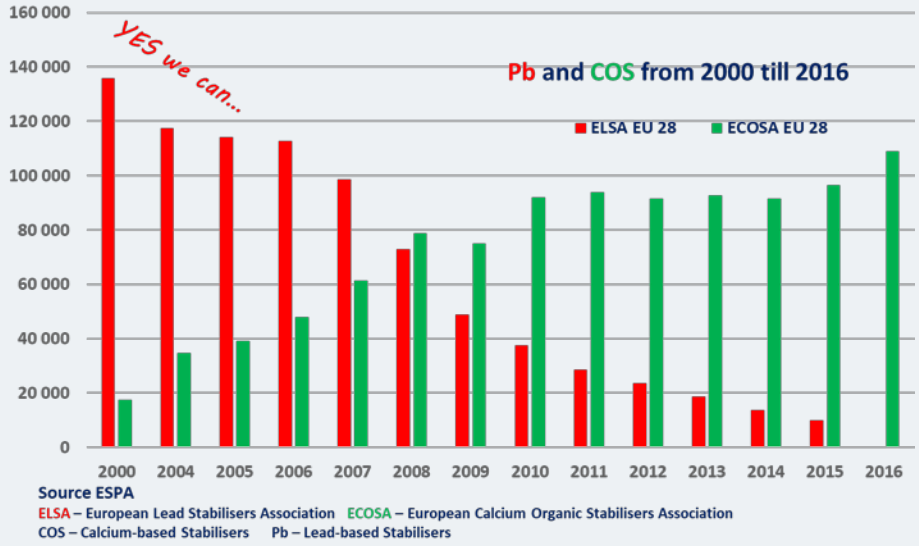
The Pb stabilisers case in PVC

Drop in's in the Metal sector: a difficult target due to specific properties

Pb-stabilisers in PVC

A voluntary commitment… but took time and was not an easy ride …

Complemented by an **EU restriction**



… and we did it!

vinyl plus

This is a success example of the European PVC industry voluntary commitment

vinyl plus COMMITTED TO SUSTAINABLE DEVELOPMENT

We can proudly say that we have achieved our goal to "replace Pb-based stabilisers in PVC applications in the EU-28, by the end of 2015".

This was inspected and confirmed by an external audit company.

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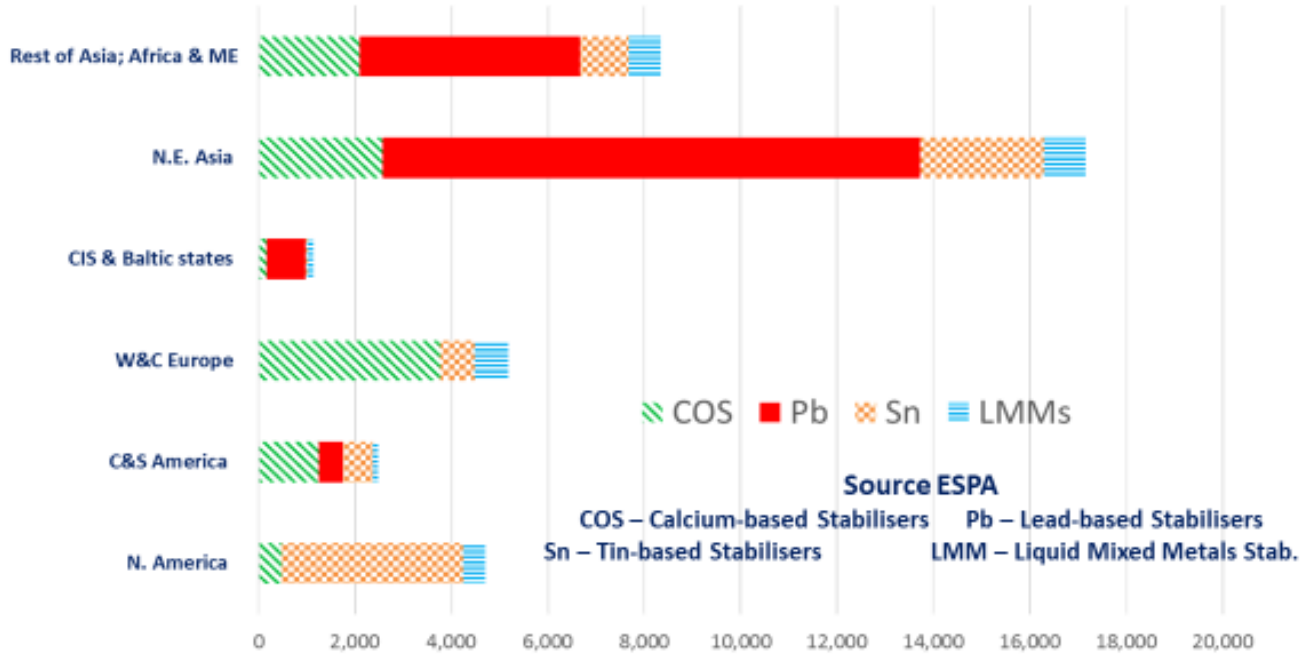
Drop in substitution on Pb stabilisers

The economic balance: the EU at the forefront but what is the impact of other jurisdictions / markets that are not moving?

But there is still a long road ahead for the global PVC industry

Figure II: how in the world PVC resin (expressed in K tonnes) is stabilised (2015)



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Ni catalyst

- On the search for an alternative… so far no holy grail found… due to the complexity of the properties and reactions to substitute for.

Market/Functionality Matrix
Ni Catalysts, info from ECMA members

Market	Refinery	Hydrogen	Fertilisers	Petro-chemicals	Fine chemicals	Oleoche-micals
Steam reforming/ Methanation	■	■	■	■		
Hydrotreating (HDS, HDN, HDO)	■	■				
Hydrocracking	■					
Hydrogenation	■					
Amination						
Sulfur trapping	■	■				

■ = nickel is being used

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Steam reforming

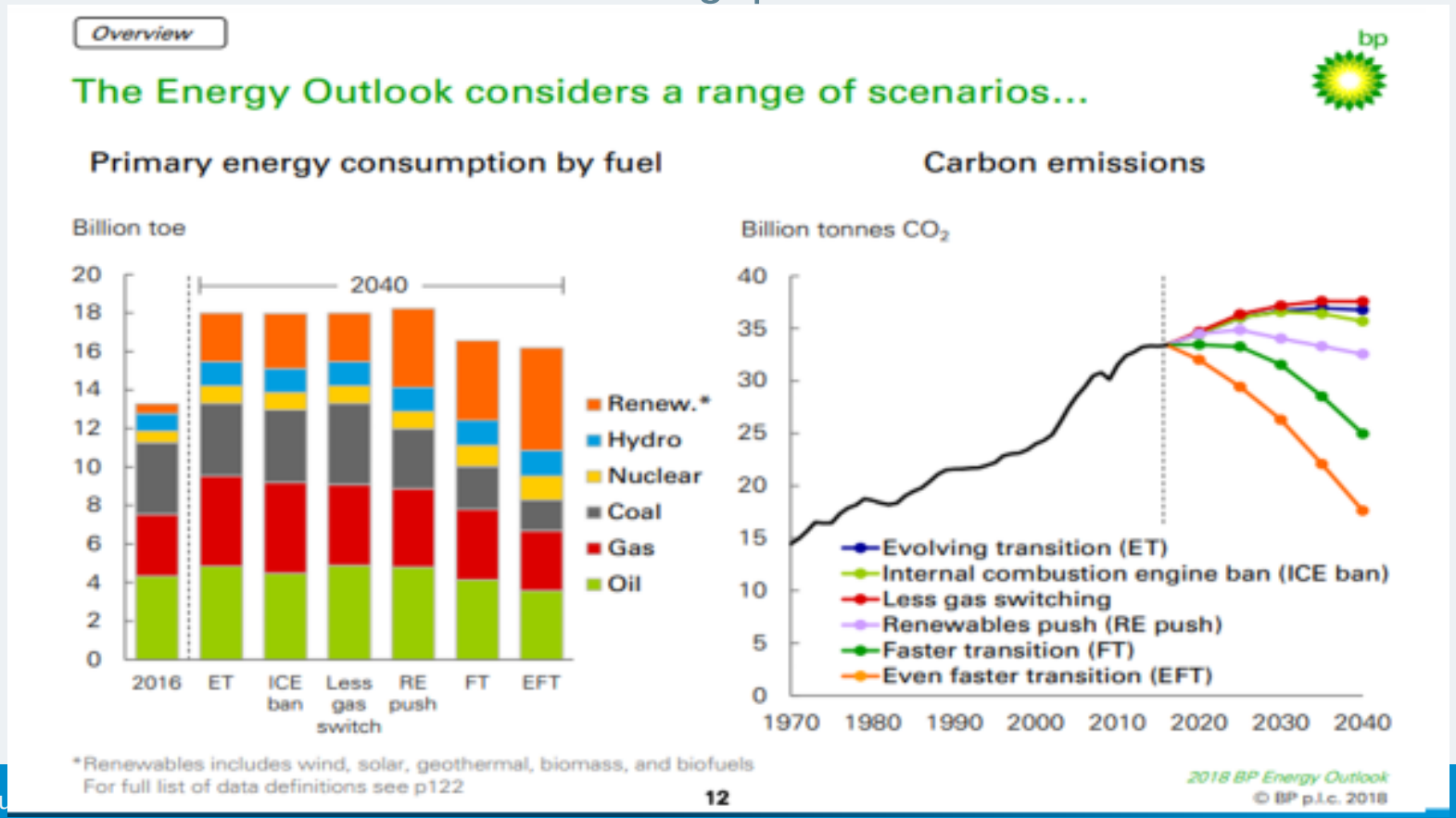
- Large scale production of hydrogen used in refineries, chemicals production, fertilizers, etc.
- Currently only Ni is used.
- Ru is an alternative (Rh, Ir, Pd, Pt, Co, identified but not proven)

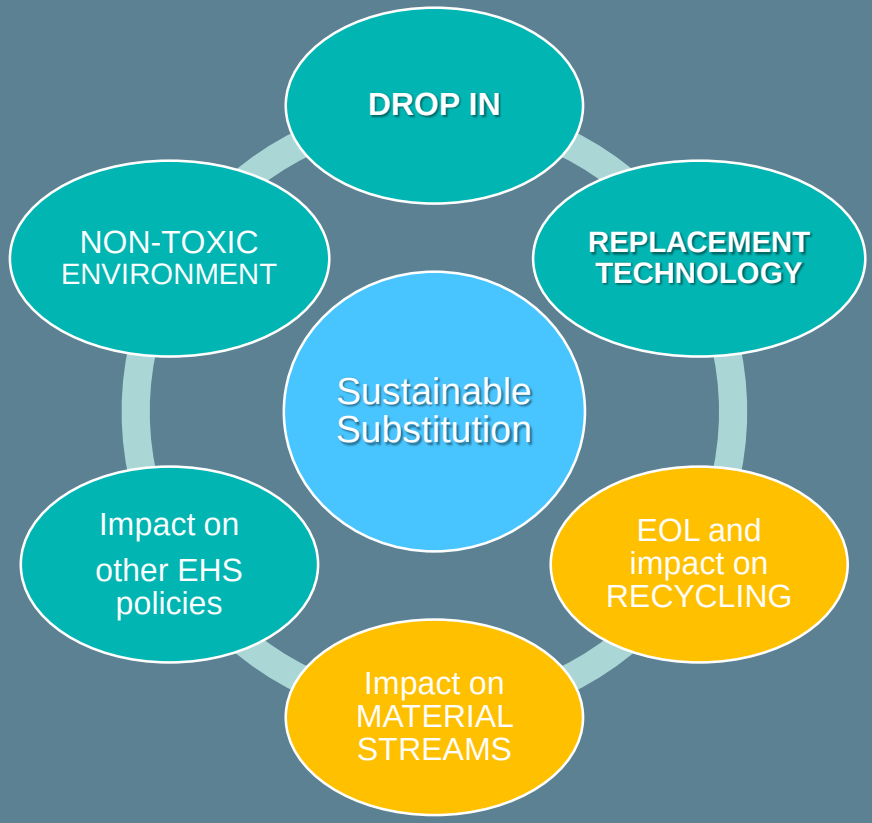
	Ni	Ru	Pgm	Co
Activity	1	>5	>1	<0.3
Selectivity	1	1	1	1

Ni catalyst replacement: the longer term view…

Would the reduction in fuel/diesel for mobility due to climate and fine dust reduction policies allow for reducing the need on Ni-catalysts of making its alternative (Ru) viable?

- Determined by the balance between “decrease for transport modes” and “increase for e.g. petrochemical uses”

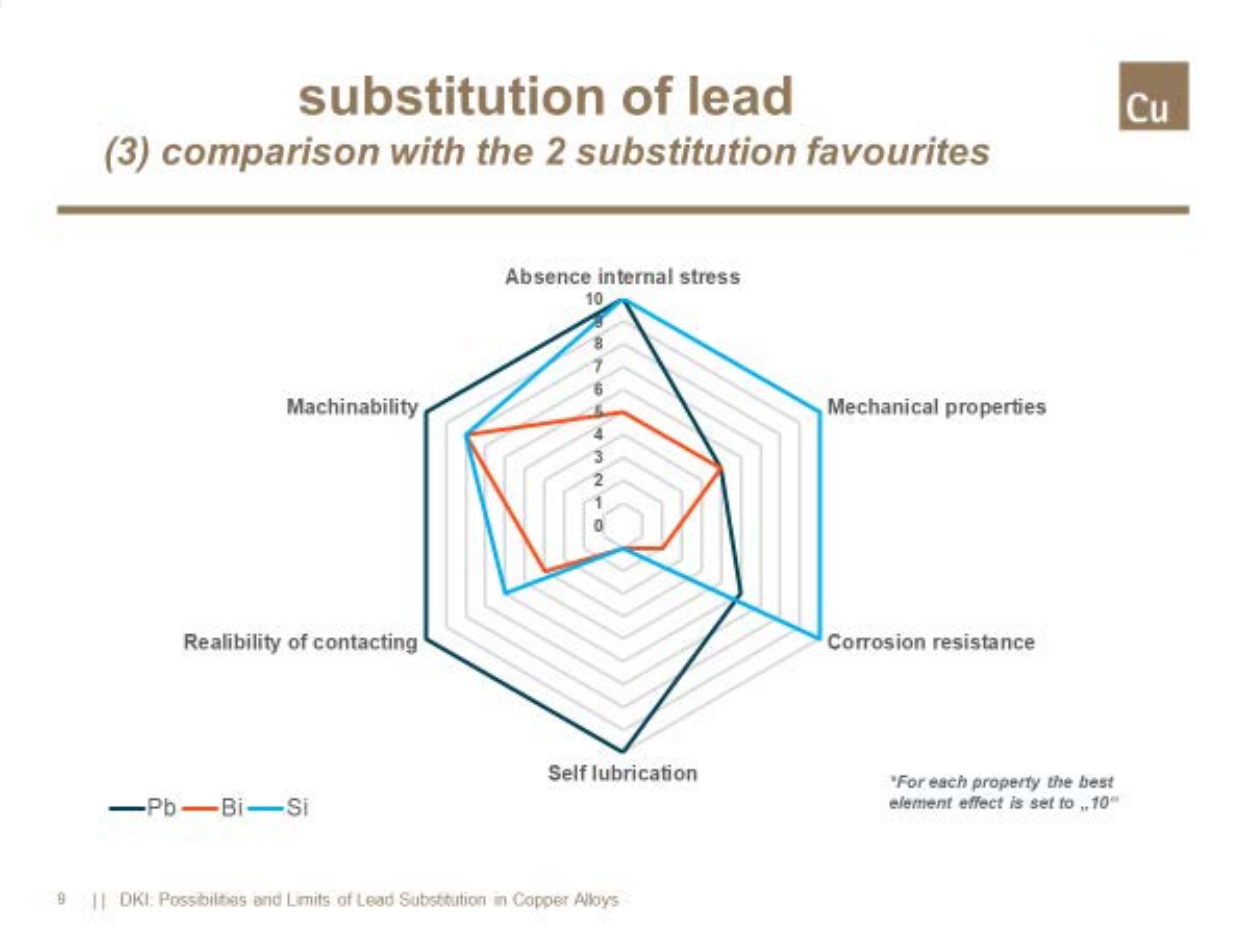




EOL, impact on Recycling and Material Streams

Can Pb in Cu be substituted ?

Pb fulfills many specific properties in Cu alloys… some being substitutable by Bi or Si



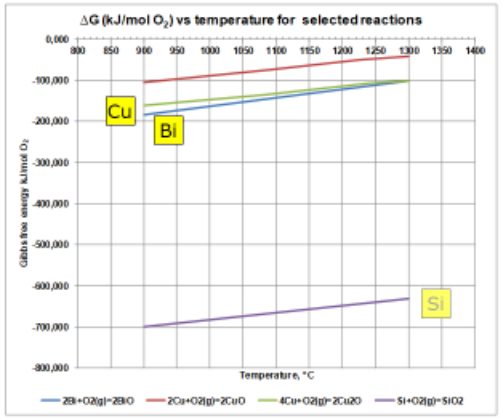
Can Pb in Cu be substituted by Bismuth?

YES… but

- The available volumes of Bi are too small, so price spike
- Needs more Pb ores (50-100 x more)
- Serious consequences on Recycling (e.g. Impossible to separate Bi from Cu)
- Nevertheless promoted in other jurisdictions…

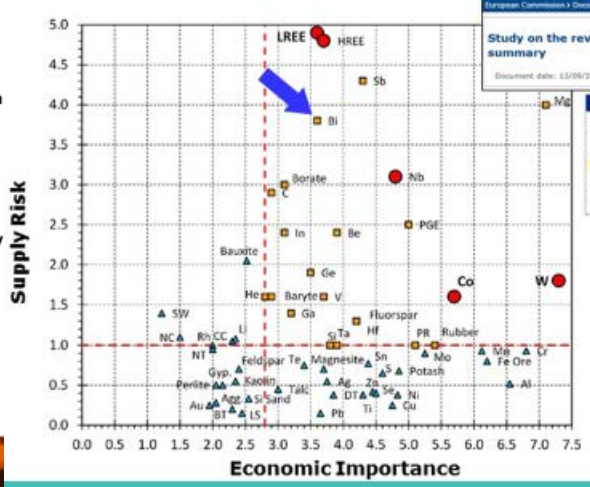
Technical feasibility during recycling

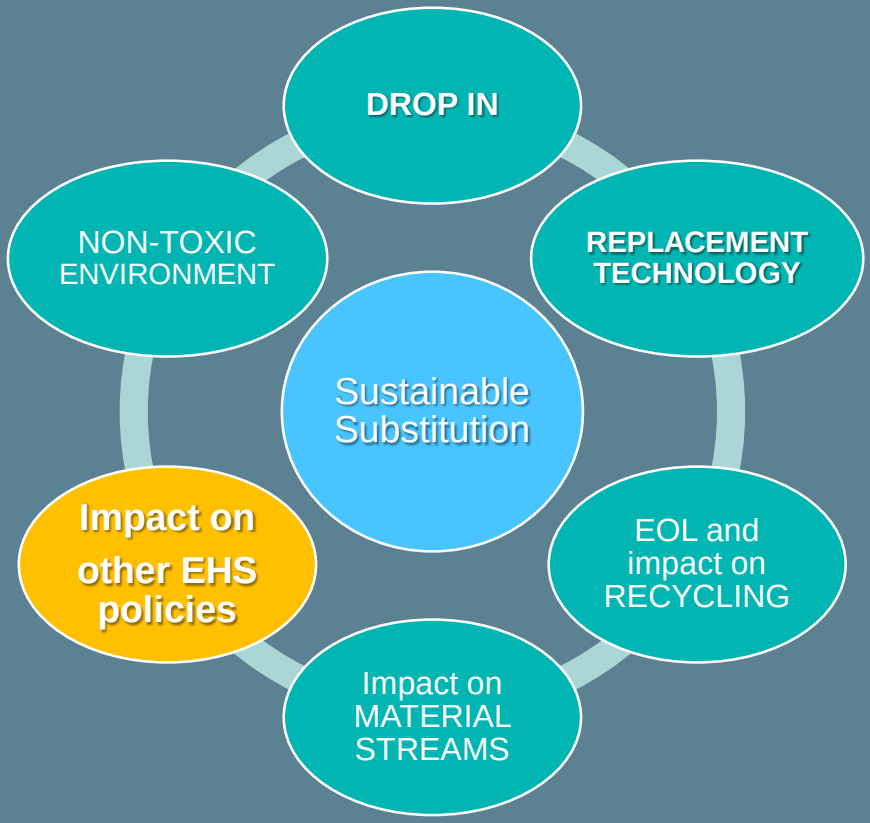
Refining of Copper - pyrometallurgy



- **Based on more/less selective reaction oxygen with "impurities" in liquid "copper", depending on**
  - Properties of "impurity"
  - Temperature
- **Graphical presentation in "free energy diagram : the more negative ΔG, the easier the oxidation of the element**
- **Conclusion :**
  - Bi : almost impossible to remove from copper
  - Si : easy to remove from copper

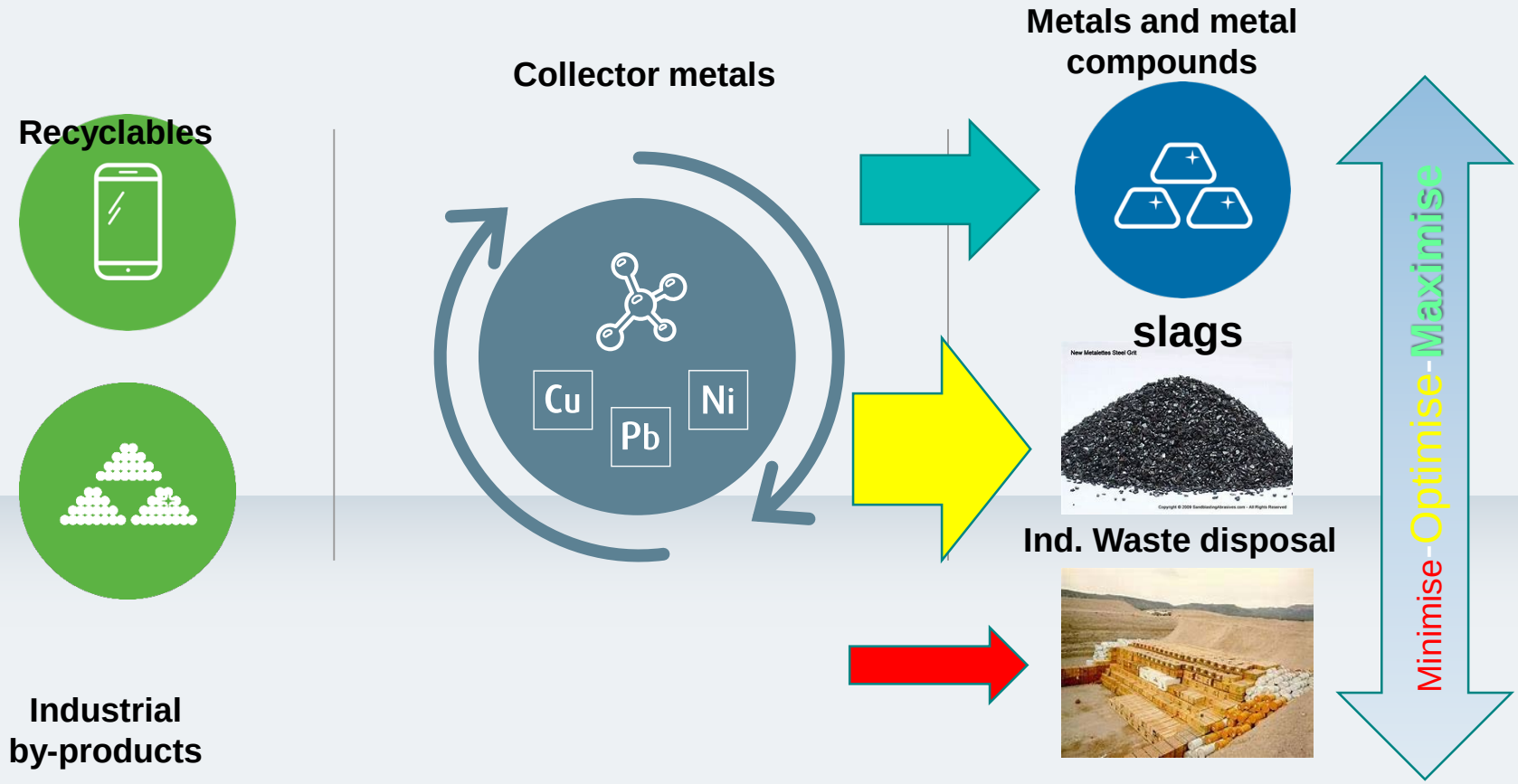
(Natural) availability





Impact on other EU policies

Circular economy: recycle and reuse safely



Economically and Technically feasible but requiring “enablers”

Substituting them causes a major problem for closing the loop in a safe way

The longer term potential

Substitution: can we learn from past successful cases to help understanding the needs/challenges for the future?

Good learnings exist: *Pb in petrol, battery materials, petrol versus electric cars…*

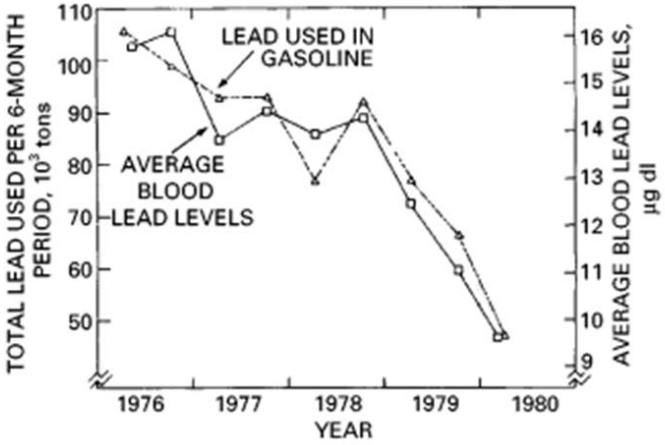
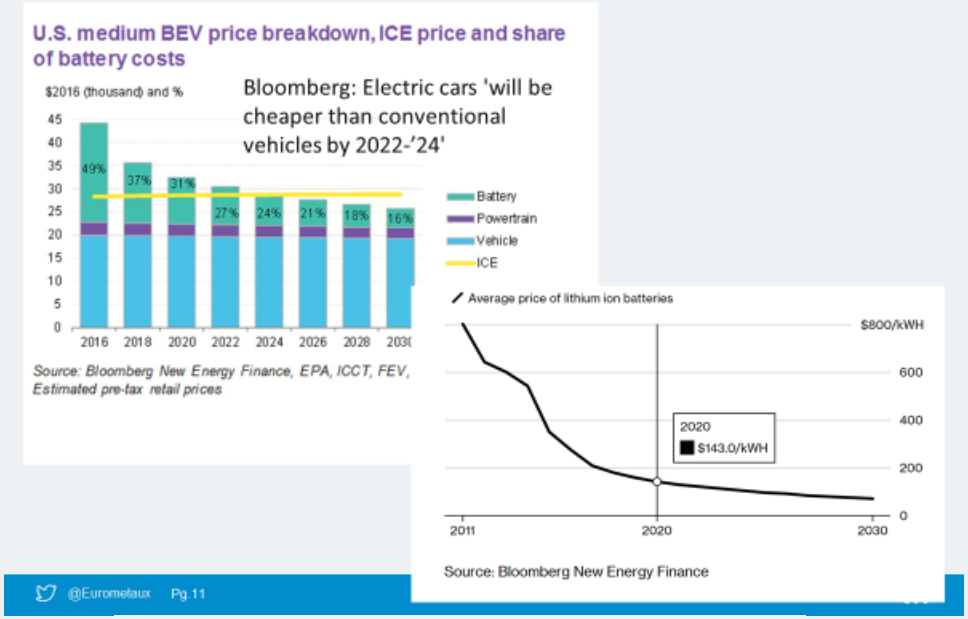


FIG. 2. Parallel decreases in blood lead values and the amounts of lead consumed in gasoline between 1976 and 1980. Source: USEPA/Environmental Criteria and Assessment Office (1986).

Petrol versus Electric cars



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

Petrol versus Electric cars

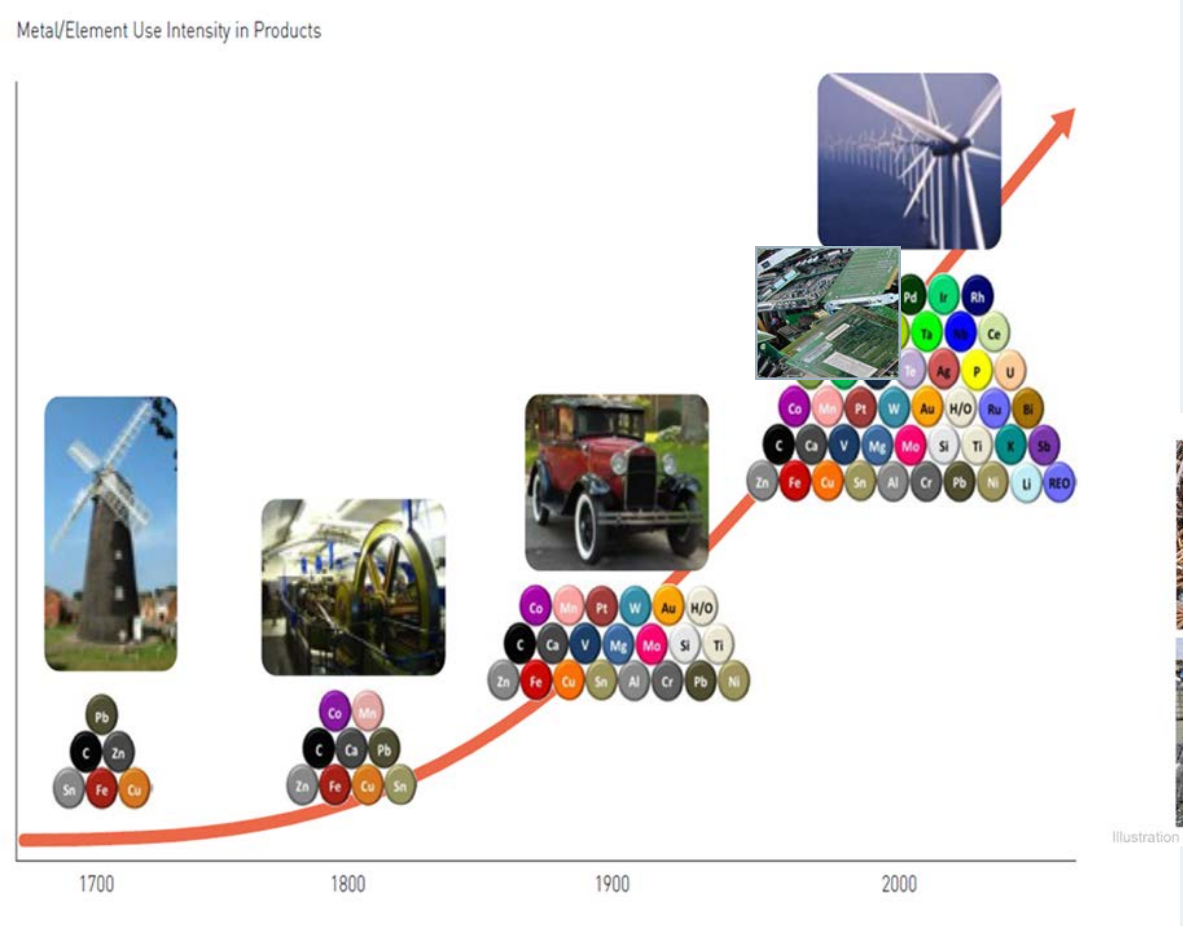
- Technical progress
- Price erosion of batteries/cars
- Tax incentives

- Autonomy fear
- Loading infrastructure
- Tax loss for governments

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

BUT…. SVHC materials will remain a(n increasing) part of recycling…

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)

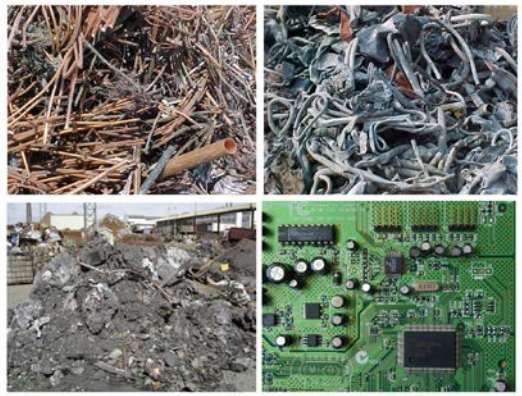
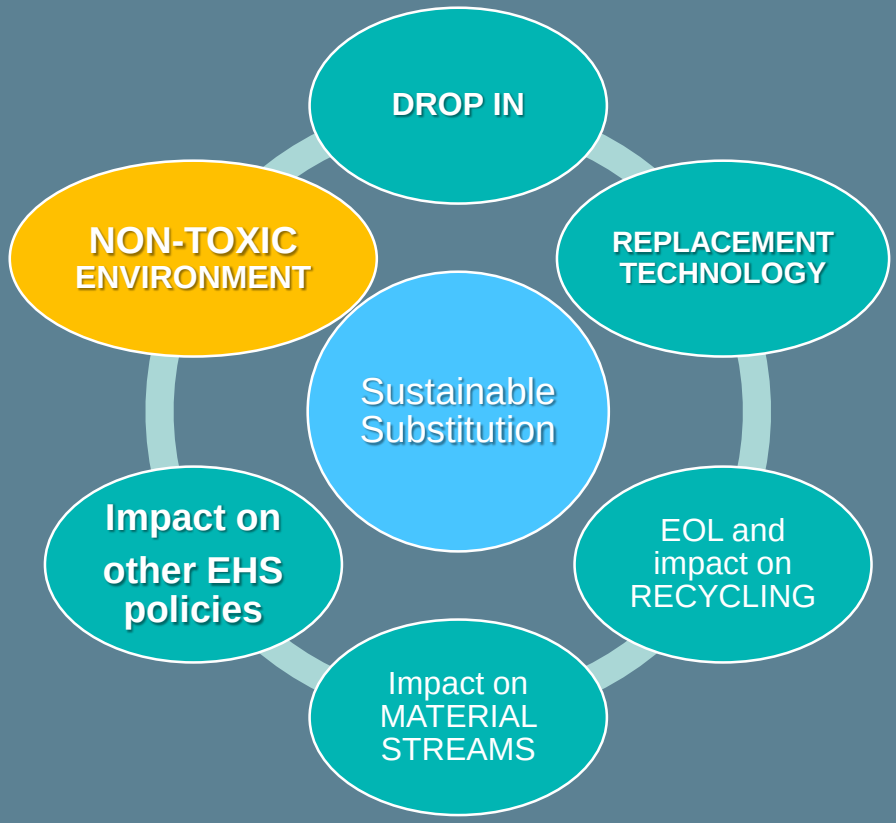


Illustration of the various scraps and secondary materials processed by European metal recyclers

Conclusions on the longer term:

- **Large & effective substitutions** with a large impact on society were:
  - driven by innovation in substances/technologies
  - rather than technical/regulatory action (except when tax regulations intervened)
- **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 while they may keep on for long
- ***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…



A Non-Toxic Environment…
or for metals & inorganics a *risk controlled Environment*

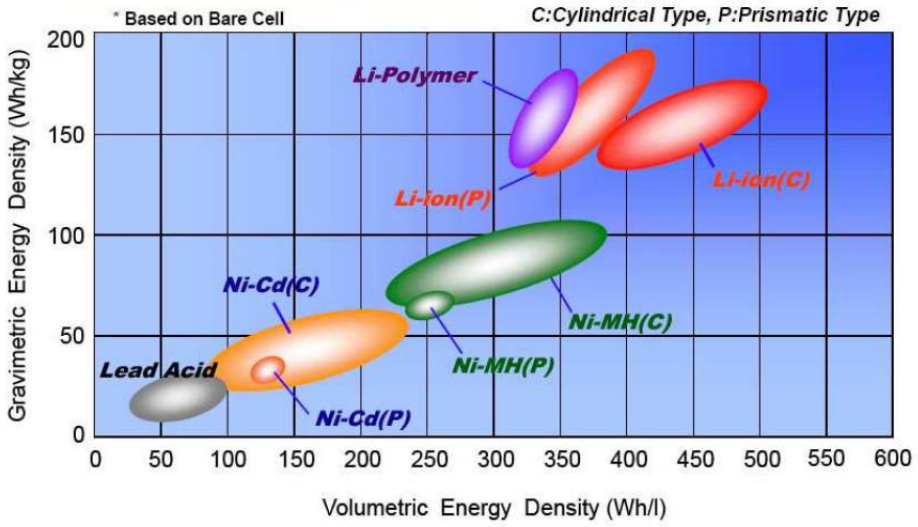
Some new societal uses will increase the need for some SVHCs….

Example of electric vehicle, battery technology

Different battery chemistries

umicore
Rechargeable Battery Materials

Li ion batteries have highest energy densities and are therefore used in electronics, automotive and energy storage systems



Some new societal uses will increase the need for some SVHCs….

Materials optimisation is in first instance driven by technical performance and cost considerations with attention for closing the materials loop.

Cathode material optimization

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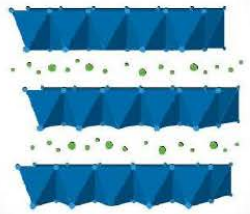
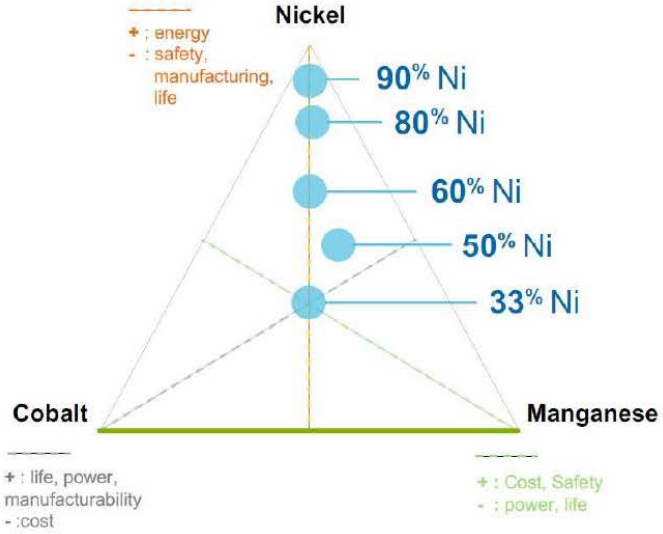
One big family of products



LCO, all grades of NMC, NCA: all layered materials sharing:

- crystal structure
- base manufacturing concepts

Exact properties depend, among others, on relative ratio metals in metal site

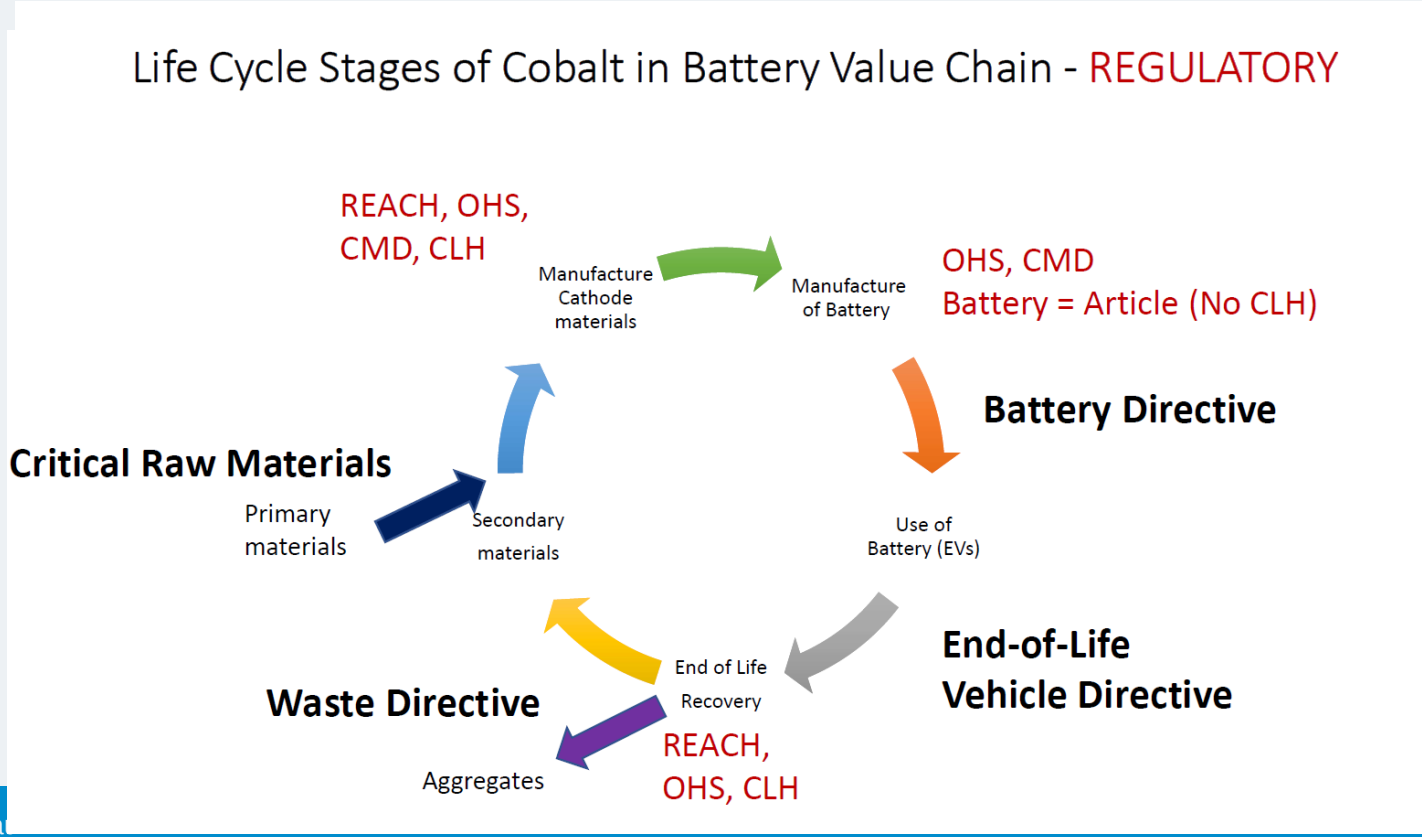


CAPITAL MARKETS DAY POWERING AHEAD

Umicore has the full spectrum of materials in portfolio

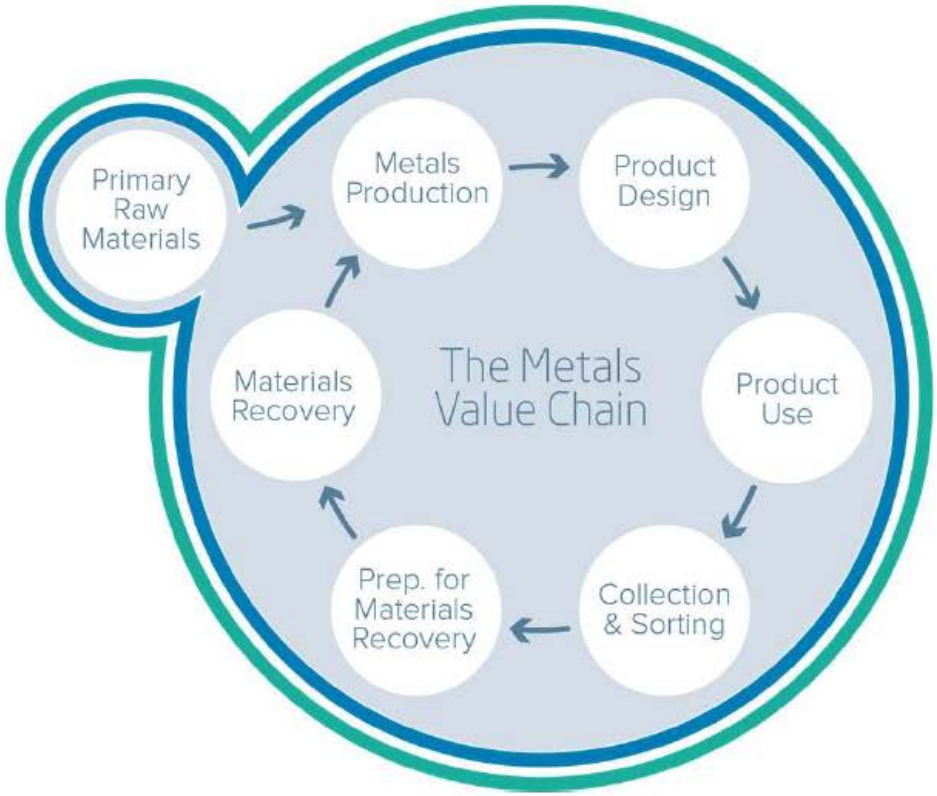
Some new societal uses will increase the need for some SVHCs….

Balancing **new economic needs for different EU-EHS policies** requires therefore ***comprehensive attention for exposure, hazard and materials flow management*** over the "product life cycle"… for every step…



Chemicals and Circular Economy: effectively closing the loop

CE and REACH goals are not incompatible but require a ***risk controlled environment***



CHEMICALS POLICY

Focus on handling materials safely

- Safe use
- Safe manufacturing
- Safe recycling
- Article legislation

CIRCULAR ECONOMY POLICY

Focus on keeping materials in the loop

- Industrial Symbiosis
- Ecodesign
- Waste management
- Secondary raw materials markets

Closing the loop through ***reuse or materials recycling*** improves substance performance!

Conclusions

Overall conclusions from the workshop

Stimulating sustainable substitution were ***relevant preventing regretable substitution*** for metals but how?

- Concept of (better) **INFORMED substitution**, some ideas:
  - Stop the “linear” thinking and allow for “more circular integrated thinking” (including optimizing recycling)
  - IND: anticipate and think in short-medium and longer term objectives in respect to the potential for substitution (eg exposure reduction, changes in materials selection or technologies, breakthrough changes)
  - IND: Better communication of RMM expectations and contributions in the supply chain
  - ALL: earlier and better prioritisation (During RMOa ???)
  - ALL: consider all these steps to define the best RMM which may be Authorisation, another option or combined options

THANK YOU

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