

# Sustainable metals for a sustainable society

## KU Leuven Institute for Sustainable Metals & Minerals (SIM<sup>2</sup>)

On November 26, 2019, the KU Leuven Academic Council formally recognised SIM<sup>2</sup> as one of the first ‘KU Leuven Institutes’. SIM<sup>2</sup>, the ‘KU Leuven Institute for Sustainable Metals and Minerals’, wants to contribute to the environmentally friendly production and recycling of metals, minerals and engineered materials. SIM<sup>2</sup>’s mission statement is fully in line with the ambitions of the European Commission to become climate neutral by 2050 and to avoid replacing Europe’s reliance on fossil fuels with a reliance on non-energy raw materials.

PETER TOM JONES

### KU LEUVEN INSTITUTES

In 2018, Rector Luc Sels launched the KU Leuven Strategic Plan, which included the desire to establish some flagship ‘KU Leuven Institutes’. Those bodies would foster interdisciplinary research with a crucial societal relevance, focusing on topics that remain important in the long term.

**Sels:** ‘For the University, the Leuven Institutes are a way to highlight certain focal points in research – a strategic instrument, in other words. For the outside world, they are a recognisable contact point for a specific area of research. And for the individual researcher, they are a form of recognition, a signpost towards organisational security, and a kind of intellectual home base – alongside the faculties and departments (...).’

In 2019, the Academic Council agreed upon a format and application procedure and opened a formal call. As such, five Institutes have come to fruition: LBI (KU Leuven Brain Institute), LKI (KU Leuven Cancer Institute), Leuven.AI (KU Leuven Institute for Artificial Intelligence), LECTIO (KU Leuven Institute for the Study of the Transmission of Texts, Ideas and Images in Antiquity, the Middle Ages and the Renaissance) and SIM<sup>2</sup>, the KU Leuven Institute for Sustainable Metals and Minerals.

### METAL AND MINERALS FOR CLIMATE ACTION

In December 2019, prior to the COVID-19 outbreak, the European Commission launched its ambitious European Green Deal, a road-map towards a climate-neutral, resource-efficient and competitive European economy. Energy, buildings, industry and mobility were highlighted as the four (interrelated) economic sectors that require system-wide transitions.

However, as recently pointed out by the World Bank in its *Minerals for Climate Action report*, the transition towards a climate-neutral economy will be very metal and mineral intensive. Cleantech solutions such as lithium-ion batteries, rare-earth-based electric motors and

direct-drive wind turbines have a substantial material footprint. To meet the EU’s (pre COVID-19) climate targets in 2050, the EU would need, just for electric vehicle batteries and energy storage, almost 60 times more lithium and 15 times more cobalt in 2050, compared to the current supply to the whole EU economy. Similarly, demand for rare earths used in permanent magnets for e-mobility and wind generators would increase tenfold by 2050.

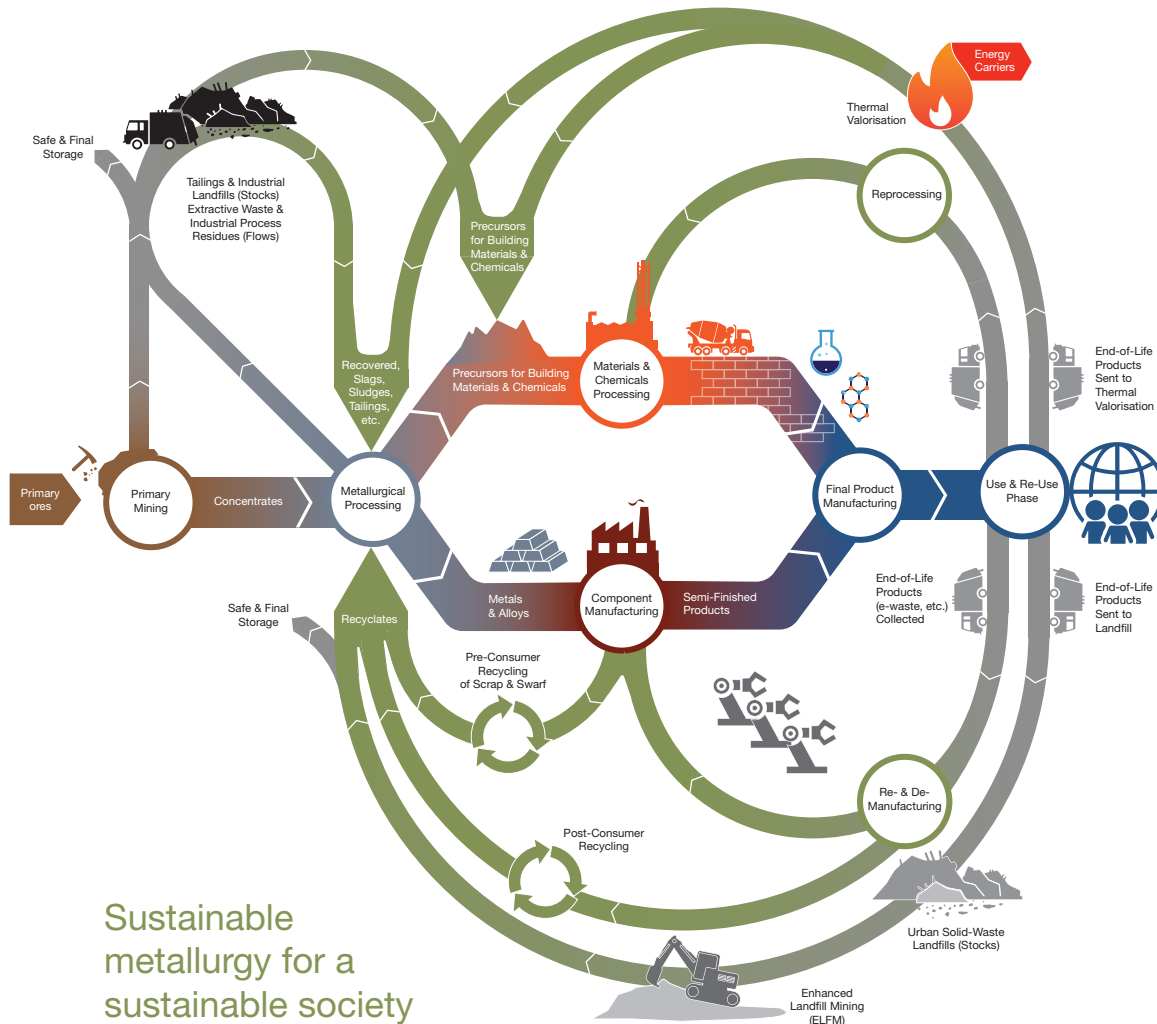
### CRITICAL RAW MATERIALS RESILIENCE

As highlighted in the updated EC’s Critical Raw Materials list, Europe finds itself in a highly vulnerable position because the supply of key materials such as lithium, cobalt and rare earths is dominated by a limited number of non-EU countries. This supply risk is now compounded by the COVID-19 crisis. Beyond the devastating health impact, COVID-19 is having very substantial impacts on raw material supply chains globally. Raw materials cannot be taken for granted. Europe urgently needs more ‘Critical Raw Materials Resilience’ to avoid replacing Europe’s reliance on fossil fuels with a reliance on non-energy raw materials. Hence, securing a diverse, sustainable and uninterrupted supply of (critical) raw materials to the EU is a vital, strategic, long-term issue for Europe.

### SIM<sup>2</sup> TO THE RESCUE

This grand societal challenge lies at the heart of the KU Leuven Institute for Sustainable Metals and Minerals or, in brief, SIM<sup>2</sup>. Designing new, efficient and sustainable processes for the exploration, extraction, recovery, recycling, and refining of metals and minerals, is the core of what SIM<sup>2</sup> does. With respect to clean energy and mobility, SIM<sup>2</sup> develops new eco-friendly processes to produce and ultra-refine battery raw materials such as lithium, cobalt and nickel salts, which are essential ingredients for the best-performing lithium-ion batteries.

Likewise, SIM<sup>2</sup> is a key actor in the upcycling of diverse industrial process residues, such as non-ferrous slags, into (almost)



- Research Line 1**  
Geological exploration and advanced resource characterisation
- Research Line 2**  
Remanufacturing and demanufacturing
- Research Line 3**  
Sustainable metallurgical processes
- Research Line 4**  
Upcycling processes for primary and secondary resources
- Research Line 5**  
Sustainability assessment and policy research
- Research Line 6**  
Process intensification and digitalisation

## Sustainable metallurgy for a sustainable society

climate-neutral building materials. In terms of sustainable industry, SIM<sup>2</sup> participates in the international efforts to decarbonise the production of steel and other metals through a combination of electrification and novel reducing agents such as hydrogen.

### SIM<sup>2</sup>'S TAKE ON THE CIRCULAR ECONOMY

In order to provide the metals and minerals that are needed to implement the European Green Deal, SIM<sup>2</sup> has developed its own, thermodynamically-based view on the Circular Economy (Figure 1). This scheme goes far beyond the often-simplistic Circular Economy drawings that can be found on the worldwide web.

SIM<sup>2</sup>'s model tries to close as many metals and minerals loops as possible: it is vital to recycle, reprocess and remanufacture as many materials as possible. However, we also have to realise there is a need for 'responsible' primary mining. Critical metals such as cobalt, neodymium and lithium are not yet present in sufficient amounts in the technosphere. This implies that even a (purely hypothetical) 100% recycling rate will not be enough to satisfy the demand for these metals.

Still, SIM<sup>2</sup> acknowledges that many mining activities in the world are associated with dirty environmental practices, atrocious labour violations and widespread corruption. To support the transition to responsible mining, SIM<sup>2</sup> critically assesses the potential health and environmental impacts of mining processes, and pro-actively engages with external stakeholders, including civil society groups and local communities that may be affected by mining activities.

Also firmly integrated in SIM<sup>2</sup>'s model, is the 'inconvenient truth of the circular economy', i.e. due to laws of thermodynamics material losses inevitably occur during the processing of metals and minerals. Finally, SIM<sup>2</sup> is not blind for our historic legacy: a comprehensive

Circular Economy view should not just deal with the waste flows of the present but should also find an answer for the waste stocks of the past (cf. Europe's 500 000 landfills). Hence, SIM<sup>2</sup> has been an ambassador for the Enhanced Landfill Mining agenda.

### SIM<sup>2</sup> IN THE FUTURE

Given the gargantuan challenges that need to be tackled in the 21st Century – post-COVID-19 – it is clear that SIM<sup>2</sup> will have a busy agenda. The formal recognition as a KU Leuven Institute will act as a catalyst for SIM<sup>2</sup> to collaborate even more intensively with its partners to jointly 'take the (climate/raw materials) bull by the horns'.

More info? SIM<sup>2</sup> website: <https://kuleuven.sim2.be/>

### SIM<sup>2</sup> IN NUMBERS

Early 2020, SIM<sup>2</sup> reached out to other KU Leuven colleagues to join the new Institute. A fine-tuned governance and membership model was set up. Currently, SIM<sup>2</sup> comprises more than 240 KU Leuven members, including approximately 30 professors and senior research managers, 50 postdocs and research experts, 160 Phd students and several project managers. The membership is truly interdisciplinary as its members originate from diverse faculties and departments. Research & Innovation is organised along six Research Lines (see Figure 1) and three interdisciplinary Task Forces (Battery raw materials & recycling; Low-carbon cement/building materials; Monitoring & digitalisation of the CE). SIM<sup>2</sup> remains open to new KU Leuven colleagues.