

On the road to 2050: The path to achieving a circular economy for mobility and renewable energy

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Climate change is one of the biggest crisis humanity is facing at this time. Two of the **largest emitters of greenhouse gas (GHG) emissions** are the **mobility** (14% of global GHG emissions in 2018) and **energy** (34%) sectors, requiring a major shift towards renewable energy and alternative fuel systems. However, this transition comes with its own set of challenges, in particular an increased resource intensity, its dependence on critical minerals and metals, as well as sustainability challenges in the technologies' supply chains. These challenges highlight the need for **more sustainable resource management** from mining to consumption to reuse and recycling, and progress towards a **clean and circular economy**. In this regard, **responsible sourcing (RS)** as an approach to address sustainability risks in mineral supply chains has gained interest; and RS considerations are expanding from a previous focus on primary raw materials to now also include secondary raw materials, as e.g., the EU's Circular Economy Action Plan.

The **RE-SOURCING** project, funded under the Horizon 2020 research and innovation programme by the European Union (EU), launched its **Global Stakeholder Platform for Responsible Sourcing in Mineral Value Chains** in 2019. The focus of the project is on three sectors critical for the clean energy transition: renewable energy, mobility, and electric and electronic equipment. RE-SOURCING will deliver three **sectoral roadmaps** as well as **good practice guidance** documents providing recommendations for all relevant actors on how to achieve RS and sustainable mineral value chains. For the development of the sectoral roadmaps, the "roadmapping" method has been deployed, which allows for the consultation and involvement of all relevant supply chain actors (policy makers, industry, CSOs, academia, and research institutions).

The **renewable energy** and **mobility sectors** focus on:

- **Technologies:** wind turbines, solar photovoltaic (PV), and lithium-ion batteries (LIBs)
- **Mineral Raw Materials:** copper, rare earth elements, silicon, cobalt, lithium, nickel, graphite

Shared Challenges and Recommendations

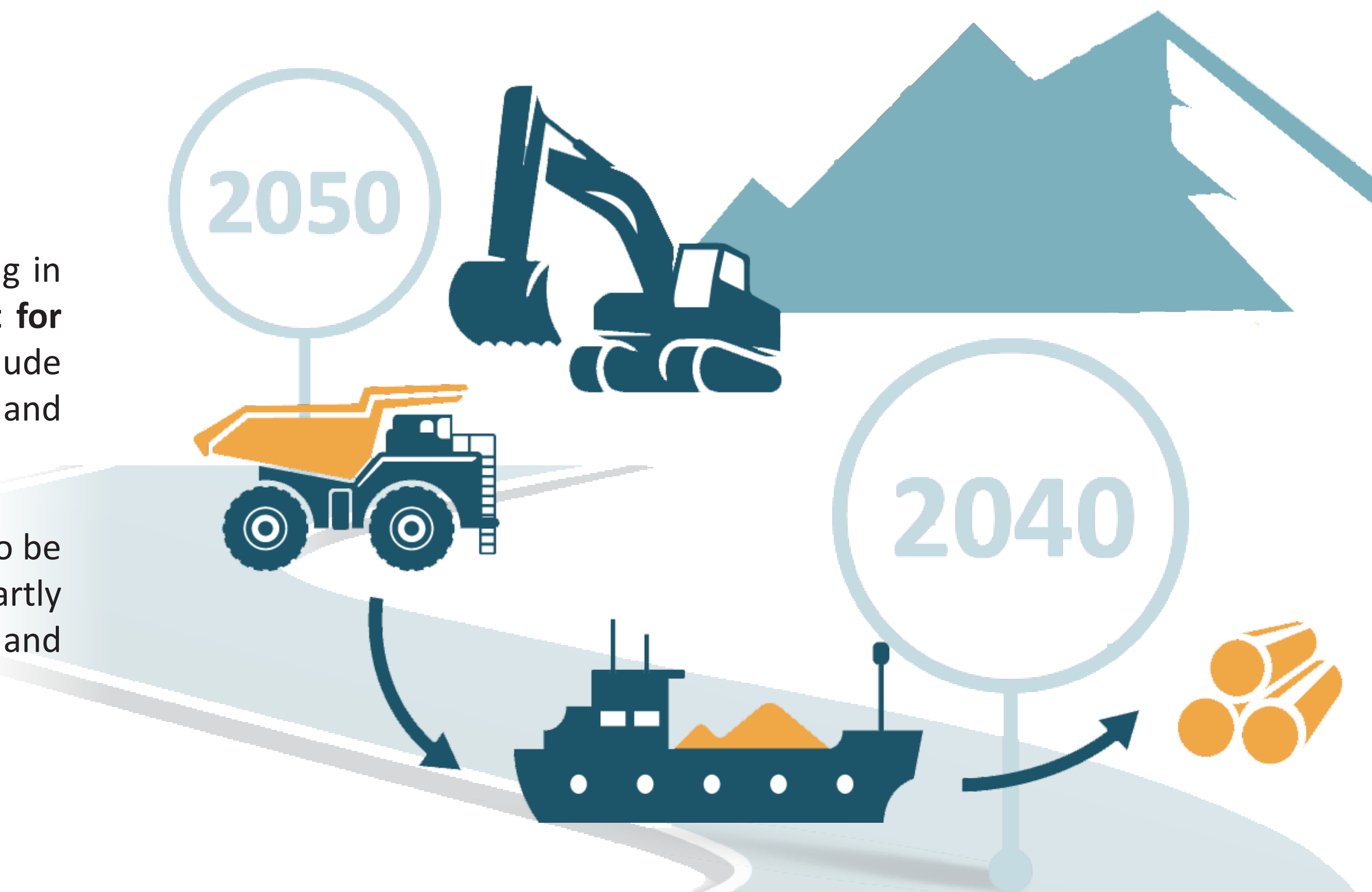
At the moment, the volumes of waste streams for all three technologies are relatively small, often resulting in **uneconomical recycling processes**. It is therefore important to realize an economy of scale and a **market for secondary raw materials**. Policies that can support the creation of a market for secondary raw materials include tradable recycling credit schemes and **circular economy and product reuse targets** accompanied by measuring and monitoring mechanisms.

The design of the products is often preventing an efficient disassembly or even repair and reuse. This needs to be a consideration from the very beginning of product development. The introduction of **eco-design policies** (partly already under development, see EU Ecolabel for solar PV) and **enhanced cooperation** between manufacturers and recyclers are crucial prerequisites.

Mobility Sector

Over the next 10 to 15 years, the return of LIBs from the electromobility sector to recycling is expected to increase to 0.7 Mt per year in the EU and then continue to grow exponentially. The **massive growth of the battery market** leads to high resource demand. Therefore, **recycling is crucial** to recover resources and manage the battery waste stream. However, battery recycling is associated with several challenges, including occupational health and safety considering the control of thermal runaway and the high fire load of an LIB. Also, in order to save weight, common designs for LIBs do not always provide for the possibility to disassemble cells or modules from packs, which would facilitate recycling.

With the focus on circular economy, the roadmap recommends the introduction of policies concerning **design for recycling** accompanied by a **battery passport** providing information about the life cycle of the LIB, **recycling targets**, **extended reuse/repurposing** as well as a significant increase in **resource efficiency** for batteries. Companies should not only implement these policies, but also create **circular business models**, using their knowledge about batteries to enable an **intensified use in a second and third life** before recovering as many resources as possible during recycling. The latter has to be conducted in a responsible way, following all three pillars of sustainability (environmental, social and governance standards). **CSOs** should support the transformation by **informing the public** about their duties and **challenging policy makers and industry** to always take the next step towards sustainability.



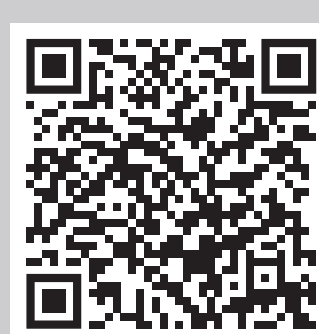
Renewable Energy Sector

Wind turbines and solar PV generally show a high recyclability of approximately 90%. However, to achieve this recovery rate **specialized infrastructure is required**. A recycling plant operated by Veolia in cooperation with PV Cycle and Syndicat des Énergies Renouvelables even achieved a record recovery rate of 94.7% in 2019. Additionally, we will have to deal with large amounts of unrecyclable wind turbine blades in the future. Industry, research and academia need to **foster collaboration** and explore **alternative materials and reuse options**. While some manufacturers have already set up their own recycling facilities in combination with **take-back schemes**, their efforts are often impeded by regulations prohibiting the import and export of waste. The RE-SOURCING project's Roadmap not only recommends the **revision of waste policies** (e.g., to foster (cross-)national material flows for efficient recycling), but also the introduction of **concrete recycling and reuse targets**.

2025



Roadmap
Mobility Sector



Roadmap
Renewable Energy Sector



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This is an extract of the RE-SOURCING project's roadmaps for the renewable energy and mobility sector. The roadmaps cover not only recycling, but also mining and manufacturing and include recommendations for all relevant stakeholder groups.

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