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Mind the E-Waste: A Case for Switzerland

As demand for critical minerals rises, an increase in recycling capacities can mitigate potential supply shortages. Switzerland has a strong track record in e-waste recycling, which it should capitalize on with a bigger emphasis on critical minerals.

By Julian Kamasa

The decarbonization of large economies in many parts of the world is a huge commodity transition. While demand for commodities such as oil, gas, or coal is expected to shrink, the reverse will be true for minerals that are key for renewable energy sources and the electrification of transport. Urban mining can play a crucial role here, as it can help to mitigate supply shortages and be part of the overall transition from linear to circular economies. This is because urban mining is the extraction of raw materials from used electronics, bringing these minerals back to the supply chain and, thereby, enabling the circular use of raw materials. In Switzerland, the recycling rate of electronic waste (e-waste) is above 90 per cent, making the country a global leader in this field. This creates an opportunity for the country to recycle so far unrecycled minerals that might be in short supply in the future as demand for them rises rapidly.

Why Minerals are Strategic

In its "Critical Minerals Market Review" from July 2023, the International Energy Agency (IEA) projects that already in an "Announced Pledges Scenario," demand for minerals like Lithium, Copper, Nickel, Cobalt, or Neodymium may at least double by 2030 and triple by 2050. In a "Net Zero by 2050 Scenario," demand for these minerals may more than triple by 2030.[1] Whether the supply side can keep up with this demand is not a given. For this reason, these minerals have a high economic significance and are considered "critical" or "strategic" by powerful actors such as the US, the EU, and China. The latter has a very dominant position across the supply chain for many critical minerals, but the country is also vulnerable. China dominates the refinement of most critical minerals, but it is also completely dependent on imports of these raw ma-

Key Points

- In their ambitions to reduce dependencies on authoritarian states, European countries should increase circularity of strategic raw materials.
- Urban mining can play an important role in these ambitions, and Switzerland should capitalize on its recycling capacities and put a stronger emphasis on strategic raw materials.
- Capacity and know-how in this area are what Switzerland can bring to the table in exchange for benefits that the EU or the US can offer in terms of the long-term goal of minimizing dependencies.

An employee walks next to isolated copper cables at the Metallum Group metal recycling company in Regensdorf, Switzerland, October 25, 2017. *Moritz Hager / Reuters*

terials from countries like Australia (Lithium), Chile (Lithium, Copper), the DR Congo (Cobalt), or Indonesia (Nickel). China's dominance of the supply chain for most critical minerals is, however, a main reason why the US and the EU classify certain minerals as "critical." China's export control regime introduced in early July 2023 on Gallium and Germanium, both important for chipmaking, shows that Beijing is able and willing to counter US export restrictions on advanced chips.[2] China could apply export controls to a wide range of other minerals in case of a larger geopolitical confrontation, which is why both the US and the EU are emphasizing a strategy of diversification of supply.

The EU Commission's proposal from March 2023, known as the European Critical Raw Materials Act (ECRMA) is about minimizing dependencies on single suppliers of so-called "strategic raw materials." One element of this de-risking approach is enhanced circularity. The goal is that by 2030, 15 per cent of the EU's annual demand for strategic raw materials is met by recycled metals. Currently, these recycling input rates (RIRs) are above the target-level for four (Copper, Tungsten, Cobalt, Nickel) out of the 16 strategic raw materials. Nine of those are well below the target level, with RIRs at zero to three per cent (see graph on p. 3). Getting to this goal is strategically important for two reasons. First, greater circularity reduces political dependencies and can help to avoid coercion. Second, mining raw materials can have huge environmental cost, especially in places where environmental standards are low. Getting these already mined raw materials back into the supply chain means a better ecological footprint, and it could also help to overcome potential supply shortages due to rising demand. This is where urban mining comes into play.

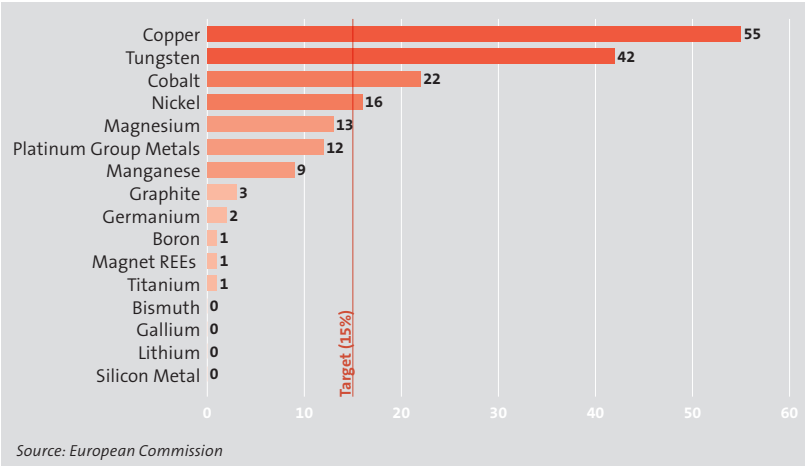
Urban Mining

Cities are dense in population and are typically places where a lot of offices are located. This means that huge amounts of consumer electronics are used and also disposed in urban regions. The approach of urban mining treats these consumer electronics as commodities from which, at the end of their life cycle, potential raw materials can be extracted. The term mining is, therefore, not related to drilling and extraction of raw materials from the earth. Rather, urban mining is part of the general transformation from linear economies, where goods are produced, used, and thrown away, to circular economies, where goods are produced, recycled, and used again. Traditionally, the idea of a circular economy was closely linked to sustainability and environmental policies and not to security policy. However, dependency on Russian gas has shown many European countries what kind of security implications the reliance on unreliable suppliers can have. Of course, gas cannot be recycled, but a wide range of the strategic raw materials for which the EU is massively dependent on China could be re-used. Therefore, increased efforts for intensified urban mining can reduce supply risks and coercion from authoritarian states.

There are, however, limits to urban mining. Given that demand is about to skyrocket in the coming decades, the most important supply source will not be the urban mine. The IEA estimates that only about 12 per cent of global supply of minerals for batteries could be met by recycled raw materials in 2040. This is due to the expected massive increase in demand, which is simply bigger than the quantity of raw materials that can be found in today's consumer goods. That means that even under perfect circumstances, the urban mine will not replace the traditional mine anytime soon. However, it can reduce the need for new mines by more than 12 per cent, which is a lot given the large demand increase. When larger quantities of green technologies reach the end of their life cycle, the RIRs can be expected to increase. Wind turbines and solar panels can be in use for 30 years, and electric vehicles typically come with an eight-year battery warranty. Thus, large amounts of raw materials for recycling will be available 10-30 years after the large-scale rollout of green technologies, so most likely after 2050.

A Case for Switzerland

Switzerland has already practiced urban mining for 25 years and is considered one of the global e-waste champions. In 1998, the so called "Ordinance on the Return, Taking Back and Disposal of Electrical and Electronic Equipment" (ORDEE) entered into force. The ORDEE foresees



Recycling input rates (RIRs) for strategic raw materials in the EU 2023.

that consumers pay a so-called "advance recycling fee" on domestically bought electronics. The amount is dependent on the type of device and its weight. Consumers can bring back used electronics free of charge and manufacturers, importers, and retailers must take care of the disposal and recycling by regulation. The advance recycling fee paid by consumers finances the recycling procedure. This may explain why over 90 per cent of electronics are recycled in Switzerland. This rate is above the recycling rates in the EU, which on average were at 45 per cent in 2020. Only one country, Bulgaria, reached the level of Switzerland, while big and advanced economies such as France and Germany ranked below the EU average.[3] Apart from Bulgaria, only Croatia and Finland were above the EU target of 65 per cent. That is well below the Swiss rate of 90 per cent. This means that EU countries could benefit from the Swiss approach towards electronic waste.

As a landlocked country that is short on natural resources and emphasizes open markets, Switzerland is highly dependent on stable and secure supply chains. Its most important trading partners are the US and the EU. Both are very ambitious in diversifying the China-dominated supply chain for a wide range of strategic raw materials. In order to indirectly, or even directly, benefit from these efforts, Switzerland needs to bring something to the table. Here, urban mining of precious metals from used electronics seems to be a good opportunity for Switzerland. It has excellent preconditions to be an attractive partner for Brussels and Washington. The country is highly innovative, it is host to many leading European universities, there is a vibrant and competitive biotech and chemicals industry, and it possesses technical know-how in e-waste recycling dating back at least 25 years.

Options for Switzerland

Many of the strategic raw materials with a recycling rate of zero per cent come in very small amounts and are, therefore, very hard to extract from electronic devices. This is the case for rare earth metals. Others, such as silicon metals, are not ready for recycling because the product (in this case solar panels) is relatively new and has not reached the end of its life cycle. This means that Switzerland has some homework to do in order to be able to extract these metals from its urban mines.

First, the focus on strategic raw materials needs to start now and not in ten years, when solar panels, wind turbines or electric vehicles have reached the end of their life cycles. Switzerland has recognized this development and updated the ORDEE. This new version entered into force in January 2022 and makes explicit mention of strategic raw materials such as Neodymium, Gallium, or Germanium which must be recycled if procedures and facilities allow.[4] The Association of the ICT and Online Industry (SWICO) has received some funding to find ways of Neodymium recycling. The company Solenthaler Recycling AG has used these funds to test the feasibility of extracting Cobalt and Neodymium from small

Further Reading

Alessandra Hool / Luis Tercero / Patrick Wäger, **"Kritische Rohstoffe: ein Thema für die Schweiz der Zukunft,"** in: *swissfuture* 02 (Bern: swissfuture, 2022), p. 7–17.
Explains why the topic of critical raw materials is important for Switzerland and what policy options are at disposal for the country. (German)

Circle Economy, ***The Circularity Gap Report Switzerland,*** March 2023.
Explores the potential for more circularity in Switzerland, including the role of critical minerals.

European Commission, ***Study on the Critical Raw Materials for the EU,*** 2023. Shows an in-depth criticality assessment of raw materials and their recycling input rates.

International Energy Agency, ***Critical Minerals Data Explorer,*** iea.org, July 2023. Provides an interactive tool using three different scenarios for demand projections of 37 critical minerals.

electronic devices with lithium-ion battery systems. An approach to recycle both raw materials from these devices has proven to be possible for implementation. Switzerland is, however, not the only country in Europe with progress in this area. In Estonia and in Germany, approaches to use microorganisms for the recycling of rare earth elements are in advanced stages.[5]

Second, international science cooperation for breakthroughs in critical minerals recycling is key. The current status of a non-associated third country regarding the participation in the EU's science program Horizon Europe is a potential limitation for both Switzerland and the EU. Science cooperation, which is the aim of Horizon Europe, could yield promising results that would enable urban mining of more critical minerals than is currently done. That the EU can leverage on inputs and know-how from Switzerland is visible in a recent policy proposal from the EU Commission, the End-of-Life Vehicles Directive. The Swiss Laboratory for Materials Science and Technology (EMPA) has conducted substantial research for many years to find ways to recycle electronic devices from vehicles. This approach from the EMPA also became part of the updated ORDEE making Switzerland a first mover for the recycling of electronic devices that are built in cars. Consequently, the Joint Research Centre of the EU Commission invited the EMPA team to write a report with a German and Swedish institute. The report's recommendations are taken up in the Commission's policy proposal for more circularity in the automotive industry.[6] This shows how valuable inputs from Switzerland can prove to be for the EU, especially for the aims set out in the ECRMA.

Third, Switzerland is a front-runner for urban mining of e-waste as far as the technical level is concerned, but the promotion of its achievements requires more political marketing. The ORDEE was adopted in Switzerland 16 years before the EU implemented a similar legal framework by 2014. The country has a well-established ecosystem of associations such as SWICO, which takes care of e-waste recycling from an industrial point of view, while EMPA is very active in finding new approaches to optimize urban mining from a research side. On a political level, these success stories deserve greater emphasis. At the level of foreign policy in particular, it would make sense to emphasize what Switzerland can bring to the table. With more strategic and clear communication, Brussels and Washington may realize that Switzerland could be a very important partner for intensified urban mining of critical minerals extracted from e-waste. At the same time, it would be essential for Switzerland to follow policy developments relating to critical minerals in the EU and the US closely. This will allow policymakers to define what role the country could play in these policy ambitions. Switzerland's strength has always been to find niche areas and to be an indispensable partner for other countries in this area. Urban mining of e-waste could be an opportunity for Switzerland because the country can leverage on excellent preconditions. With a closer focus on promoting these achievements on a political level and a wider focus on urban mining of critical minerals that are not yet recycled, Switzerland could play an important role in Western efforts to make supply chains for strategic raw materials more resilient.

In summary, there will be a growing need to improve the recycling rate of critical minerals in order to reduce potential supply risks. The US, the EU, and China are putting increased efforts into the development of recycling capabilities. Switzerland is in a position in which it already has a high recycling rate for e-waste. This presents an opportunity for the country to do more in this regard by intensifying its urban mining capacities, with a particular focus on critical minerals, while promoting its achievements on a political level.

Selected sources

1. International Energy Agency, *Critical Minerals Market Review 2023*, July 2023.
2. Sophie-Charlotte Fischer / Michiel Foulon / Julian Kamasa, *US-China Interdependence: Implications for Switzerland* (Zurich: CSS/ETH, 2023).
3. European Commission, *Total collection rate for waste electrical and electronic equipment, 2020,* ec.europa.eu, April 2023.
4. Federal Council, *Ordinance on the Return, Taking Back and Disposal of Electrical and Electronic Equipment,* 01.01.2022. (German)
5. Ian Mundell, "The Ecosystem: Weighing the attractions of recycling rare earth magnets," Science Business, 11.07.2023.
6. EMPA, *New EU policy measures based on Empa research: Boosting circular economy in the automotive sector,* empa.ch, 20.07.2023.

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