



Circularity for Educators

04. Materials

Critical Raw Materials

Dr. David Peck

*Associate Professor, chair of Climate Design and Sustainability
Department of Architectural Engineering + Technology (AE+T)*

Hello! Have you asked yourself; “What are critical materials and what do they have to do with circularity?” In this video I will introduce what a critical material is and show circular options to help address the challenge. We will explore what a critical material is from a European perspective. The Netherlands, like most EU countries does not do its own costly and complex critical materials assessments but relies on the European Union to do it.

For the EU, a Critical Raw Material is one with high risk of supply disruption and, at the same time, with high economic importance. As you can see it is all about supply risk and economic importance. A key aspect of risk is around supply and demand. It is when supply is unable to meet demand. Economic importance relates to industrial sectors, who need materials, including construction, which create value and jobs. Please note terms such as scarcity or running out, are not used. Sometimes the popular press and society uses such expressions, but they cannot be defined scientifically and are not relevant.

So, what factors go into creating a picture of supply risks and economic importance for any given material? You can see there are many factors, shown here in the two blue boxes. Factors such as market concentration of supply from particular countries, World Governance index,

import reliance, trade agreements, recycling, and substitution are all important and complex assessments.

Now, let us look at this two-axis graph in more detail. In this graph you see the vertical axis shows the supply risk, and the horizontal axis the economic importance. There are red dotted lines which represent the determined threshold lines, a material that crosses both lines is a critical material. All essential materials are plotted onto the graph based on the factors under economic importance and supply risk. The more a material is in the top right of the graph, the more critical it is. Critical materials are in red, non-critical in blue. Most are elements from the periodic table of elements, some are minerals, a few are natural materials. Some elements are clumped together as families of elements such as the LREE, HREE and PGM. These are the Light and Heavy Rare Earths and the Platinum Group Metals.

There are the critical materials listed for the European Union. There are 30, but three are families of materials. Some materials are unfamiliar to many people, but they are essential in the built environment and all technologies essential for modern society. So, let us look a bit deeper in some of the factors.

This world map highlights the percentage of supply dependence of selected critical materials from



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certain countries. The higher the percentage, the more import dependent the EU is from that country. Look at China for example. There are geo-political tensions and trade tensions with China on-going. Human rights in China remains a concern for the EU. Look at the Democratic Republic of Congo, or DRC, in Africa. A country in conflict or post conflict, with human rights challenges. Note how few materials come from within the EU or from countries with whom the EU has close friendly relationships.

So, you might say, perhaps we can move away from this primary mining dependence by circular recycling? Here we see the end-of-life recycling rates. For a variety of complex reasons the recycling remains a big challenge for many critical materials. Many you can see are simply not recycled at all.

This image shows the industrial sectors which use critical materials. Construction is shown at the end column. If you also consider that buildings contain textiles, electronics, renewable energy and digital, then you see the built environment, especially a circular, low carbon-built environment, is highly critical material dependent.

So, what can circular strategies do to help? The answer is a lot. *We must slow down the rate of critical material use by Product Life Extension or PLE strategies.* Remanufacturing for example is an excellent strategy for transitioning to a Circular built environment. Once we have products and components looping we can enhance the recycling and raise the low figures of recycled critical materials. As we transition to a low carbon, digital circular economy, our use of critical materials rises. Circular strategies in turn can help us manage that rise.