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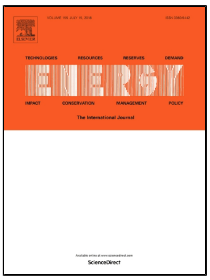

Global material requirements for the energy transition. An exergy flow analysis of decarbonization pathways.

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Global material requirements for the energy transition. An exergy flow analysis of decarbonization pathways.

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Abstract: Moving towards a low-carbon economy will imply a considerable increase in the deployment of green technologies, which will in turn increase the demand of certain raw materials. In this paper, the material requirements for 2050 scenarios are assessed in terms of exergy to analyze the impact in natural resources in each scenario and identify which technologies are going to demand more resources. Renewable energy technologies are more mineral intensive than current energy sources. Using the International Energy Agency scenarios, from 2025 to 2050, total raw material demand is going to increase by 30%, being the transport sector the one that experiences the highest increase. Aluminum, iron, copper and potassium are those elements that present a higher share of the material needs for green technologies. Besides, there are five elements that experience at least a six-fold increase in demand in that period: cobalt, lithium, magnesium, titanium and zinc. Comparing those results with Greenpeace's AE[R] scenario, which considers a 100% renewable supply by 2050, this increase is even higher. Therefore, avoiding the dependency on fossil fuels will imply to accept the dependency on raw materials.

Keywords: energy transition, energy scenarios, mineral requirements, green technologies, exergy, IEA

1. Introduction

The Paris agreement's central aim is to strengthen the global response to climate change, and in the 21st Conference of the Parties (COP21), it was agreed to hold the increase in global mean temperature from global warming to well below 2ºC above pre-industrial levels. Even more, it also has the ambitious goal to pursue efforts to limit the temperature increase even further to 1.5ºC [1]. Still, global temperature reached in 2015 1ºC above pre-industrial levels [2]. To stay below 2ºC, global greenhouse gases (GHG) emissions must be cut to at least 80% below 1990 levels [3], and to accomplish this goal, all sectors must contribute.

The need to mitigate emissions is now receiving significant attention and all the sectors, public energy stakeholders, non-governmental organizations (NGO's), private sector and regional and local entities are involved in this process. Yet this transition cannot happen suddenly and roadmaps need to be established to achieve stepwise a decarbonized system [4,5]. For instance, some recommendations and studies have already been made for decarbonizing Europe [6,7], Canada [8] or and China [9,10]. Different measures have been proposed to reach this emission reduction target, the most important