

Minerals for the green agenda, implications, stalemates and alternatives

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Abstract: The green agenda aims to preserve the environment and climate, reduce CO₂ emissions and replace fossil fuels with renewable energy. It relies on electric vehicles, storage, solar and wind power plants. It requires an order of magnitude higher amount of critical minerals, poorly represented in the earth's crust, with problematic recycling, with extraction requiring considerable amounts of energy, fossil fuels and causing unacceptable damage to people and nature in countries that supply raw materials. The increase in the global average temperature demonstrates that the overall effects of decarbonization have been insufficient. The time frame of profit-oriented planning is too short and cannot respect the dynamics of the energy sector. Together with market uncertainty, regulations and incentives did not encourage investors to take all the steps we had hoped for. The long-term needs and availability of key minerals are considered together with an overview of the financial and environmental conditions offered to the population in the countries where mining is carried out. Growing popular resistance to cheap and environmentally damaging mining and increasing demand for critical minerals may call into question the sustainability of current practices. The development of new technologies must be geared towards solutions that use abundant minerals in the Earth's crust, while long-term sustainability requires that fair conditions be offered to the population of countries that supply critical minerals.

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Graphical Abstract:

Coltan mine in Rubaya, Democratic Republic of Congo

(taken from Wikipedia, https://en.wikipedia.org/wiki/Rubaya_mines)



Keywords: Critical minerals, low-carbon technologies, green agenda, mining, solar, wind power plants, battery powered electrical vehicles, sustainability.

Introduction

The global average surface air temperature during the first nine months of 2024 [1] exceeded pre-industrial levels by 1.54 °C. At the same time, global annual energy consumption from fossil fuels is growing several times faster than the combined growth of energy from solar and wind power plants [2], while CO₂ emissions have reached a historic maximum. These disturbing data speak of insufficient and/or inadequate measures being taken to mitigate climate change. The largest global emitters of CO₂ are the energy and transportation [3], which brought electric vehicles, solar power plants, wind farms and grid storage in the backbone of low-carbon technologies [4]. While phasing out fossil fuels is quite slow, the backbone solutions listed require much greater consumption of critical raw materials [5], [6], geochemically scarce minerals that are present in the earth's crust in an amount considerably less than 0.01%. Already existing crisis in the supply of essential minerals is aggravated by the decline in the ore grade, which increases the energy intensity, and by the neglect of socio-environmental aspects [7]. The latter increases the resistance of the local population to companies that practice cheap mining at the expense of the environment, with harmful effects on the living world and public health. An unfavorable series of events and circumstances further increases China's already large dominance in the