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Unobtainium? Critical Elements for New Energy Technologies

ROBERT JAFFE, MIT

I will report on a recently completed study jointly sponsored by the APS Panel on Public Affairs (POPA) and the Material Research Society (MRS). The twin pressures of increasing demand for energy and increasing concern about anthropogenic climate change have stimulated research into new sources of energy and novel ways to harvest, transmit, store, transform or conserve it. At the same time, advances in physics, chemistry, and material science have enabled researchers to identify chemical elements with properties that can be finely tuned to their specific needs and to employ them in new energy-related technologies. Elements like dysprosium, gallium, germanium, indium, lanthanum, neodymium, rhenium, or tellurium, which were once laboratory curiosities, now figure centrally when novel energy systems are discussed. Many of these elements are not at present mined, refined, or traded in large quantities. However new technologies can only impact our energy needs if they can be scaled from laboratory, to demonstration, to massive implementation. As a result, some previously unfamiliar elements will be needed in great quantities. We refer to these elements as energy-critical elements (ECEs). Although the technologies in which they are employed and their abundance in the Earth's crust vary greatly, ECEs have many features in common. The purpose of the POPA/MRS study was to evaluate constraints on availability of energy-critical elements and to make recommendations that can help avoid these obstructions.