

PRESS RELEASE

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Future technologies are increasing raw material demand: A Fraunhofer study shows where action is needed

How will emerging technologies such as electric mobility, renewable energy and artificial intelligence impact raw material demand? This question is addressed in the new edition of the “Raw Materials for Future Technologies” study which was presented today. In it the Fraunhofer Institutes ISI and IZM analyze the future development of 34 technologies and 14 raw materials on behalf of the German Raw Materials Agency (DERA) at the Federal Institute for Geosciences and Natural Resources (BGR). Early action is required in order to avoid supply bottlenecks and enable a sustainable transformation.

Demand for certain raw materials could rise sharply in the coming years: Future technologies are enabling the transition to a climate-neutral and digitalized economy, but at the same time are leading to rising demand for mineral raw materials. In its fourth iteration, the “Raw Materials for Future Technologies” study continues to provide valuable insights and recommendations for policymakers, industry and researchers.

An analysis by Fraunhofer ISI and Fraunhofer IZM for the German Raw Materials Agency (DERA) shows that emerging technologies such as electric mobility, artificial intelligence and renewable energy could lead to significant shifts in global demand for raw materials.

The Fraunhofer researchers determined that by 2045, demand from the 34 future technologies studied could match or exceed current global production volumes for 12 metals.

Demand for iridium and lithium likely to rise in the future

Demand for iridium could see the sharpest increase, primarily due to water electrolysis technology. In this process, water is broken down into its components, oxygen and hydrogen, using electrical energy. When electricity from renewable energy sources is used, this method of hydrogen production is considered a key technology for the decarbonization of the chemical and steel industries.

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Lithium follows in second place. The analyses show that the demand for lithium for battery technologies, particularly for electric mobility, could increase fivefold by 2045. This corresponds to a demand for raw materials that is roughly four times higher than today's global production volume. Scandium ranks third, driven by high potential demand for stationary fuel cells. In one of the scenarios examined, demand for graphite used in high-performance lithium-ion batteries will also reach a level in 2045 that is significantly higher than global production in 2023.

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Wind power, heat pumps and data centers are driving up demand for raw materials

Other raw materials with the potential for a sharp rise in demand include the heavy rare earth elements dysprosium and terbium, which are needed for traction motors in electric vehicles, wind turbines, heat pumps and air conditioning systems.

Future demand for platinum could also be significantly higher than current total production. This is due to the potential demand for storage media in data centers. Digital technologies, including the further development of AI, are indirectly driving demand for platinum and ruthenium through the global expansion of data centers.

Given the expected growth in data, which, depending on how things develop, could increase a hundred to a thousand-fold, the demand for the raw materials needed to support this growth is rising significantly. This underscores the need for resilient, sustainable raw material strategies for digital technologies. "Digitalization is always a process of materialization, and 'the cloud' is a technology-based system that actually requires a great deal of raw materials—it's not some light, fluffy cloud," says Jana Rückschloss, a research associate at Fraunhofer IZM.

Conclusion: Transformation can only succeed through proactive policy action on raw materials

An analysis of future technologies through 2045 shows that the availability of raw materials will become a decisive factor in the success of the sustainable and digital transformation of the economy and society.

From the researchers' perspective, measures are needed to secure raw materials, such as diversifying and securing supply chains, increasing efficiency in the manufacture and use of products, expanding the circular economy through increased recycling, and developing new methods for substituting certain materials. Raw materials should be taken into account early on in the development of new technologies, for example in the selection of materials and design.

"Our analysis does not provide a forecast, but rather possible development paths," emphasizes Dr. Sabine Langkau, head of the Sustainability Innovations and Policy business unit at Fraunhofer ISI. "The study can be understood as an early-warning tool making it clear that: We need a strategic industrial and raw materials policy that takes

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a long-term view to secure the raw materials base for future technologies, so that we do not have to react to supply bottlenecks and price increases in the short term.”

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BACKGROUND/APPENDIX**Methodology of the study**

The study analyzed the impacts of 34 technologies for which exceptional growth in demand is expected by 2045. The future technologies examined span the fields of mobility, aerospace, digitalization, power and data networks, as well as energy technologies and decarbonization. All the technologies were analyzed using three scenarios, each covering a wide range of possible future developments:

- In the “Sustainable Transformation” scenario, ambitious climate and environmental protection goals are met.
- The “Rapid Growth in Prosperity” scenario examines the effects of a development focused on consumption and economic growth without efforts being made toward environmental and climate protection.
- Set against the backdrop of global tensions, the “Obstacles to Development” scenario explores the impact of regional rivalry and a lack of international cooperation.

The future demand for raw materials was determined for all technologies across the various scenarios. The Fraunhofer researchers then compared the demand projected for 2045 with raw material production in 2023.

Background information

The new study updates the findings from the 2009, 2016, and 2021 studies, which were also conducted using the same study design. The study is an important component of DERA’s raw materials monitoring program, which is mentioned in the German federal government’s 2010 Raw Materials Strategy and has been implemented ever since. The two Fraunhofer Institutes combine expertise in applied research and future studies and possess interdisciplinary knowledge spanning a wide range of technologies. A preliminary version of the study is available for download; a final version will follow in the coming weeks.

More on this topic

- [Download the preliminary version of the study \(in German\)](#)

About Fraunhofer ISI

The Fraunhofer Institute for Systems and Innovation Research ISI analyzes the origins and impacts of innovations. We research the short- and long-term developments of innovation processes and the impacts of new technologies and services on society. On this basis, we are able to provide our clients from business, politics and science with recommendations for action and perspectives for key decisions. Our expertise is founded on our scientific excellence as well as our interdisciplinary and systemic research approach.

About Fraunhofer IZM

The Fraunhofer Institute for Reliability and Microintegration IZM is one of the world's premier research institutions for electronics packaging. With its dedication to developing miniaturized, high-reliability electronics in cutting-edge lab facilities, the institute works to maintain the competitive edge of Germany and Europe.

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

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