

# Critical Materials Innovation Hub: 10 Years of Innovation, Influence, & Impact



CMI Hub Annual Meeting hosted by Ames National Laboratory. Photo from CMI Hub

The U.S. Department of Energy's (DOE's) Critical Materials Strategy led to the establishment of a national resource for innovative technology development: the Critical Materials Innovation Hub (CMI Hub). Formerly known as the Critical Materials Institute, the CMI Hub has created a lasting innovation ecosystem operating under a shared mission since its inception in 2013.

**Mission:** The CMI Hub is a DOE Energy Innovation Hub led by Ames National Laboratory that seeks to accelerate innovative, scientific, and technological solutions to develop resilient and secure supply chains for rare earth metals and other materials critical to the success of clean energy technologies.

## By the Numbers



12 R&D 100 Awards



202 Invention Disclosures



50 U.S. Patents



20 Technologies Licensed



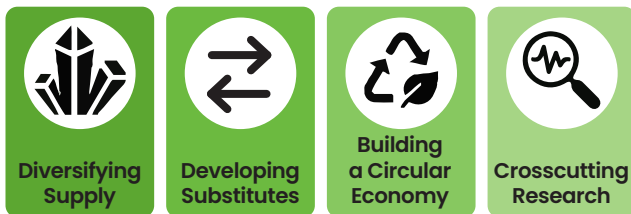
635 Peer-Reviewed Publications



\$80+ Million in Additional Government Awards

## A Decade of Research & Development

The CMI Hub conducts research in four focus areas: enhancing and diversifying supply, developing substitutes, building a circular economy, and crosscutting research.



### Education and Workforce Development

Inspiring and empowering people is a key component of the Hub. More than 400 students and postdoctoral scholars have or are currently participating in the CMI Hub. Alumni have gone on to careers in government, industry, DOE national laboratories, and universities, as the leaders, technical experts, and skilled professionals needed to assure critical materials supply chains in the United States.

## CASE STUDY: FROM LAB RESEARCH TO LICENSED TECHNOLOGY

CMI Hub researchers at Oak Ridge National Laboratory (ORNL) developed membrane solvent extraction, an energy-efficient, cost-effective, and environmentally friendly process to recover rare earth metals. They generated aqueous solutions containing multiple metal ions by dissolving end-of-life products and scrap, which then passed through patented membrane modules that contain bundles of hollow fibers in which only certain metal ions can pass through. The technology won a 2020 Federal Laboratory Consortium Technology Transfer Award and has been licensed by CMI Hub partner Momentum Technologies for recovery of rare earth and battery critical materials. ORNL and Momentum Technologies received follow-on funding through the Bipartisan Infrastructure Law to commercialize the process.



Syed Islam and Ramesh Bhawe, ORNL, with purified critical materials recovered by membrane solvent extraction

## Patent Analysis Highlights

CMI Hub-funded research patents have influenced subsequent technological developments both within and beyond critical materials across a range of technologies. These patents:

- **Influence other patents.** 14 CMI Hub-funded patents have influenced more than five patent families on critical materials technologies, including metals recycling, lithium recovery, and advanced aluminum alloys.
- **Influence both private industry and academic institutions.** There are 68 patent families across industry and academia linked via citations to earlier CMI-funded patents.
- **Fill a research gap not addressed extensively by leading companies.** The CMI Hub is focused on lithium and rare earth element recovery as well as aluminum alloys containing critical materials. This stands out from the leading companies, which are focused on recycling metals and patents directed toward ferrous alloys containing critical materials.

## Citation Analysis Highlights

The CMI Hub's publications are highly cited and impactful, unearthing trends and patterns and exploring the structure of research in a particular field. These publications:

- **Were cited 51% more than expected.** This suggests that CMI Hub has more impact on the scientific community than the average physical sciences author.
- **Show widespread thought leadership and influence.** The top 10 sources in which CMI Hub articles are published include the most well-respected and well-known industry standard journals.
- **Demonstrate the evolution of research over time and reflect the hub's ability to adapt to dynamic market conditions.** Nine out of 10 keywords with the highest growth were cited in CMI Hub publications after 2018, showing the Hub's focus on pivoting to the most promising areas.

### Publication Stats



Illustration from Nexight

Source	Number of CMI Publications
The Journal of The Minerals, Metals & Materials Society (TMS)	19
<i>Physical Review B</i>	17
Journal of Magnetism and Magnetic Materials	16
Resources, Conservation and Recycling	14
ACS Sustainable Chemistry and Engineering	12
Environmental Science and Technology	11
Minerals, Metals and Materials Series	11
Inorganic Chemistry	10
Journal of Applied Physics	10
Journal of Materials Chemistry C	10

## Onto the Next Five Years

As critical materials research needs continue to grow and evolve, the CMI Hub has been agile and adaptive to market conditions, accelerating discovery and path to market while also contributing greatly to the scientific community through its frequently cited publications

and influential patents. In the 10 years of the CMI Hub's existence, securing America's critical material supply chains has become even more vital to the clean energy economy, and the Hub is mission-focused on addressing the critical materials challenges of today and tomorrow.

### Dive Deeper Into the CMI Hub

10-Year Cumulative Report: <https://www.osti.gov/biblio/2338076/>

Patent Analysis: <https://www.osti.gov/biblio/2367359>

Citation Analysis: <https://www.osti.gov/biblio/2375399/>



<https://bit.ly/4cxBG0U>

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DOE/EE-2935 • September 2024