NETL - Penn State

University Coalition for Fossil Energy Research

Current Uses and Future Opportunities for US Industry in Rare Earth Elements and Critical Materials Technologies and Markets: Knowledge-Base Tool Development

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PBS NEWS HOUR

The U.S. is worried about shortages of critical minerals for electric vehicles, military tech

Nation Apr 13, 2021 5:14 PM EDT

When U.S. companies build military weapons systems, electric vehicle batteries, satellites and wind turbines, they rely heavily on a few dozen "critical minerals" – many of which are mined and refined **almost entirely by other countries**. Building a single F-35A fighter jet, for example, requires at least **920 pounds** of rare earth elements that come primarily from China.

That level of dependence on imports **worries the U.S. government**.

Deloitte. Insights

Trend 10: Meeting demand for green and critical minerals

The conversion to renewable energy and electrification are central to the world's clean energy future…

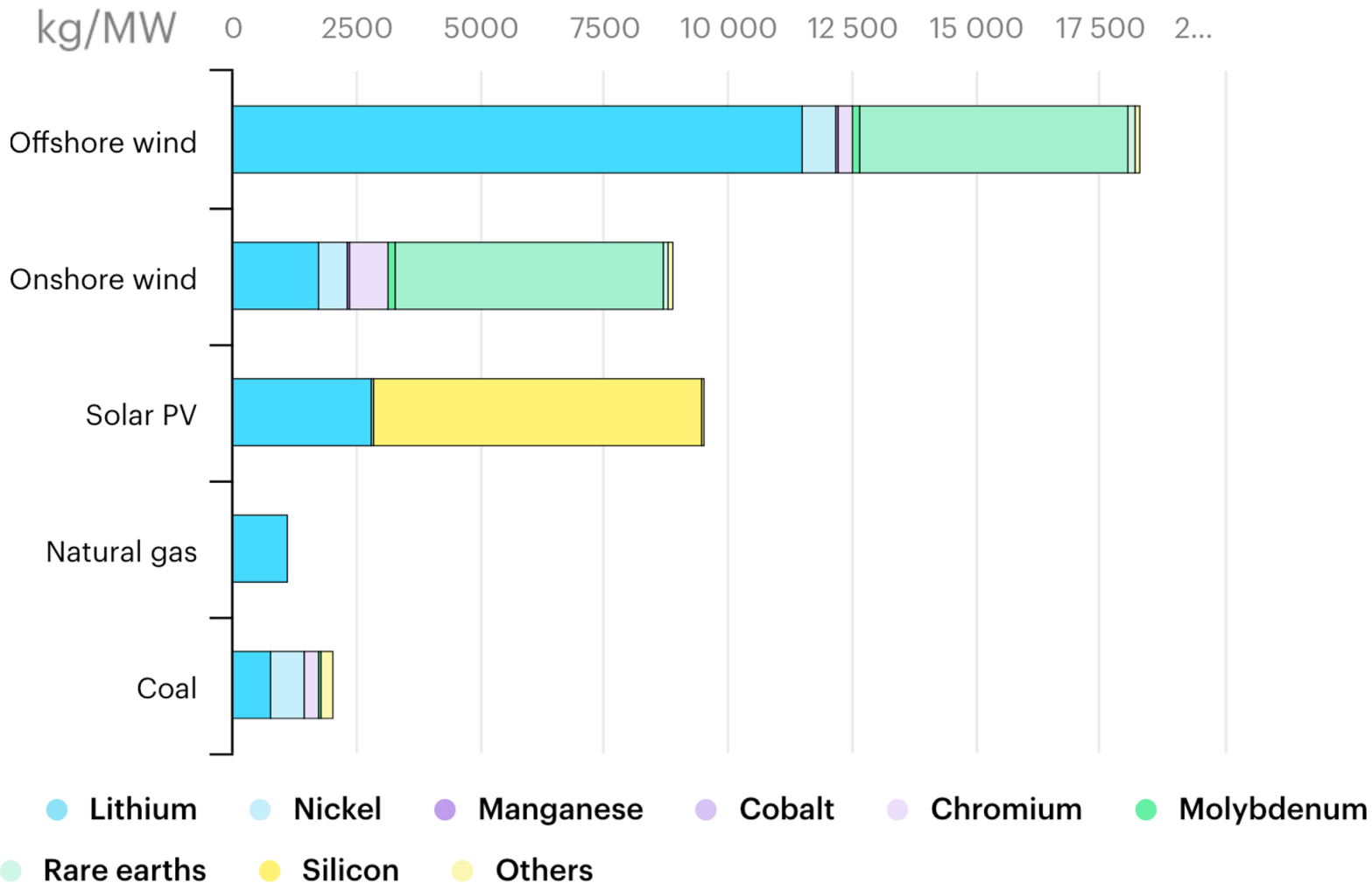
THE CONVERSATION

February 16, 2020 1.55pm EST

Critical minerals are vital for renewable energy.

As the world shifts away from fossil fuels, we will need to produce enormous numbers of wind turbines, solar panels, electric vehicles and batteries. Demand for the materials needed to build them will skyrocket.

Minerals in selected power generation technologies

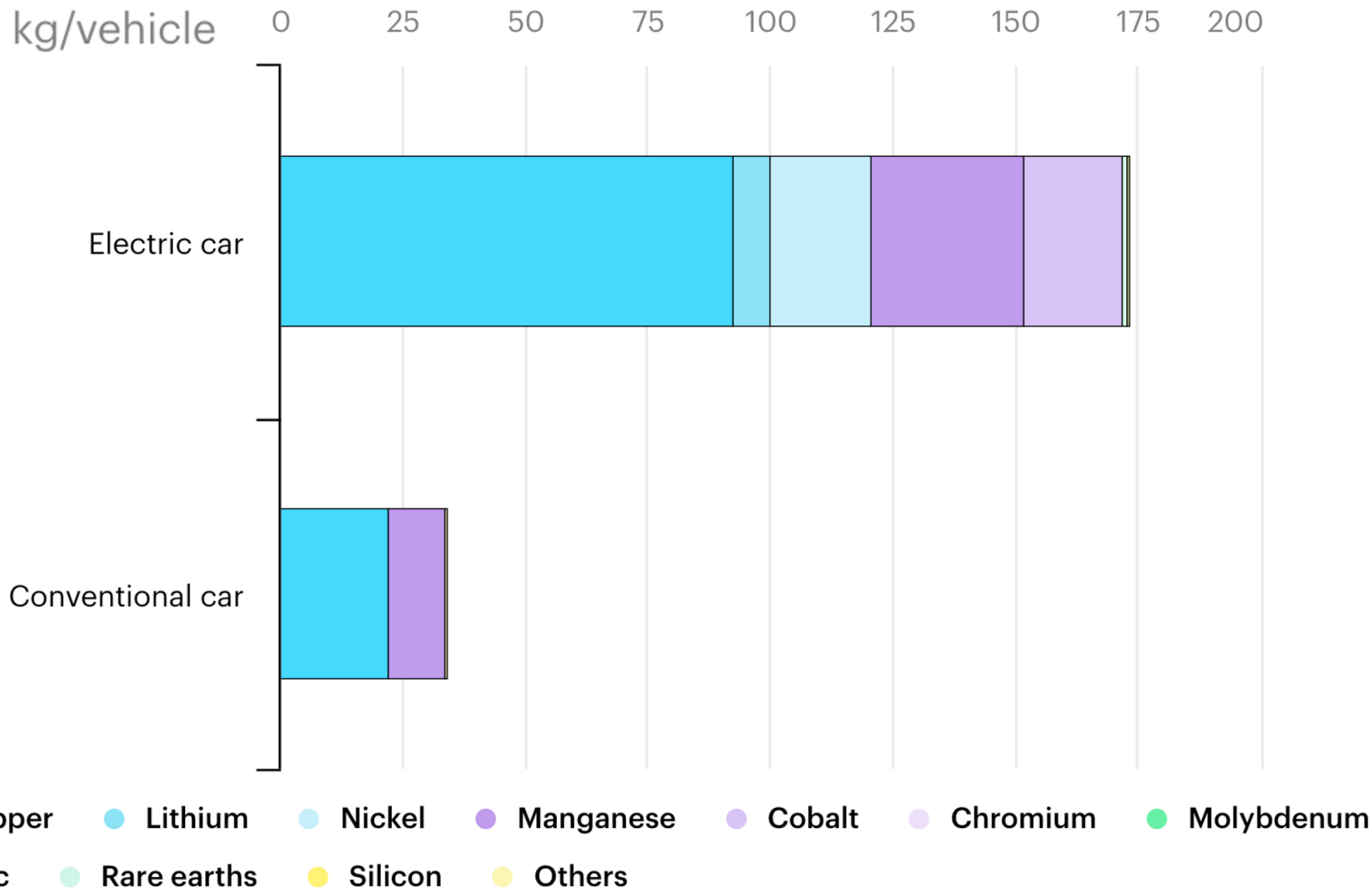


Electrification will Drive Selected Elemental Demand

Wind turbines—permanent magnets	**REE (Nd, Dy, Sm, Pr)**
Photo-voltaics (PV)	**In, Sb, Ga, Te, Ag, Cu, Se**
Electric cars—batteries	**REE (La, Ce, Nd, Pr), Li, Ni, Co, Mn, graphite**
Electric cars—magnets	**REE (Nd, Dy, Sm, Pr)**
Electric cars—fuel cells	**PGE, Sc**
Cars—light metals	Al, Mg, **Ti**

- For example, 27 percent of the cost of a Tesla Model 3 is its battery pack. Raw materials make up 79 percent of the EV battery cost, especially lithium, cobalt, nickel, and graphite.
- Around 73% of REEs are used in mature industries, including glass, ceramics and metallurgy. The remaining 27% are used in the production of neomagnets, which are essential components in electric vehicles (EVs).
- Dysprosium, along with the REE praseodymium, can also increase a magnet's coercivity, when alloyed with neodymium. For this reason, neomagnets for EVs tend to be composed of around 24% neodymium, 7.5% dysprosium and 6% praseodymium.

Minerals used in selected transport technologies

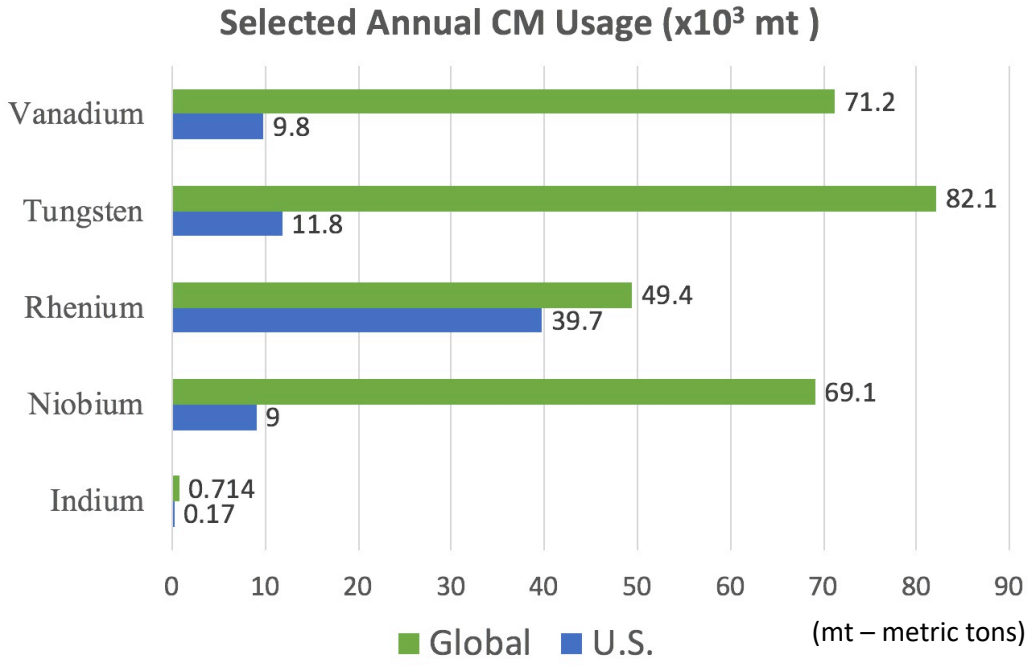


Project Tasks

Identify the industrial opportunity for utilization of REE and REE-containing materials within the U.S. if a domestic supply of high purity REEs were to be available, and where could it be utilized to ensure that the REEs remain within the U.S.

- Current work with Materials Flow through Industry tool and database to enhance REE data with flow through industry/products

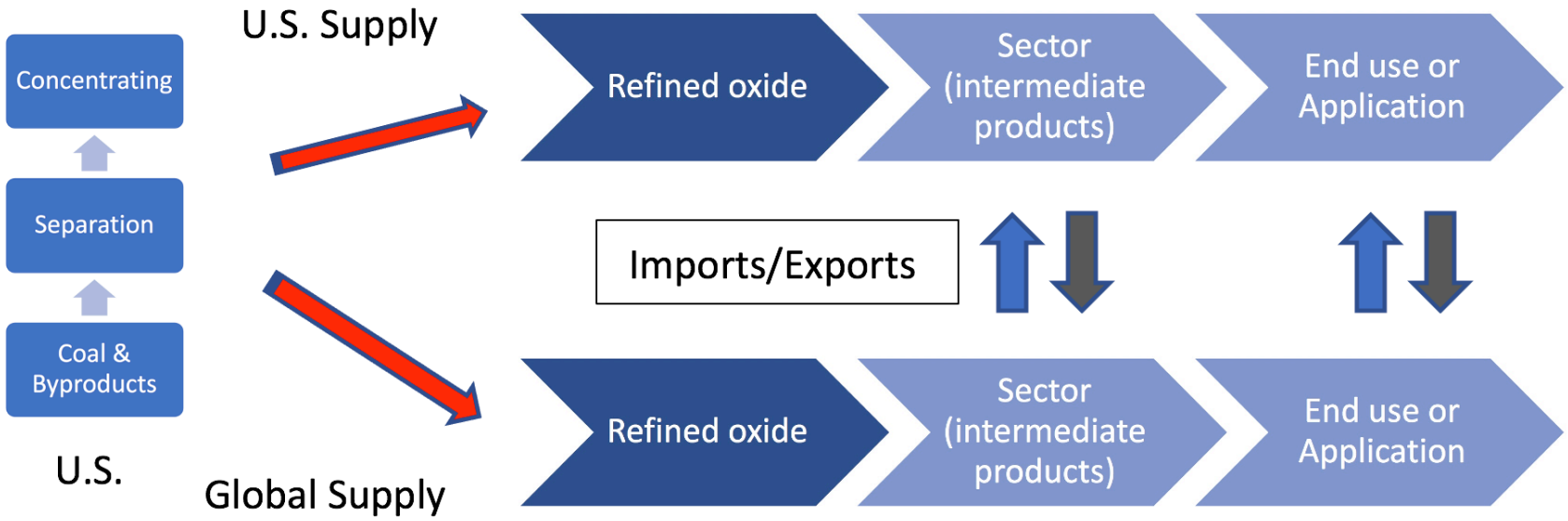
Identify current industries and specific companies that utilize rare earths within the U.S. Determine what volume of REEs would be necessary to supply these facilities and where these supply opportunities are located.



Project Tasks

If a domestic supply of high purity CMs were to be available within the U.S.,

- Identify the industrial opportunity for utilization of CM and CM-containing materials
- future U.S. infrastructure needs for domestic production.



Collaborations

- Wish to network with researchers in the NETL REE and CM research space
  - West Virginia University, *Paul Ziemkiewicz*
  - Physical Sciences, Inc.
  - University of North Dakota, *Michael Mann*
  - University of Kentucky, *Dorin Preda & Rick Honaker*
- Current platforms for dissemination of cultivated data
  - Tool/database formatting
- Access existing NETL resources
  - Embedded demand database
  - Other data/models identifying REE concentrations in products

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Questions, Comments, Feedback

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