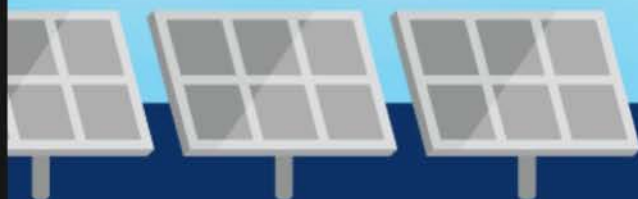




# Minerals Required for Green Energy Technologies



<b>Al</b> Bauxite & Aluminum	<b>Ge</b> Germanium	<b>Ni</b> Nickel	<b>Te</b> Tellurium
<b>Cd</b> Cadmium	<b>In</b> Indium	<b>Se</b> Selenium	<b>Sn</b> Tin
<b>Cu</b> Copper	<b>Fe</b> Iron	<b>Si</b> Silicon	<b>Zn</b> Zinc
<b>Ga</b> Gallium	<b>Pb</b> Lead	<b>Ag</b> Silver	

<b>Al</b> Bauxite & Aluminum	<b>Fe</b> Iron	<b>Mo</b> Molybdenum
<b>Cr</b> Chromium	<b>Pb</b> Lead	<b>* Rare Earths</b>
<b>Co</b> Cobalt	<b>Mn</b> Manganese	<b>Zn</b> Zinc
<b>Cu</b> Copper		

<b>Al</b> Bauxite & Aluminum	<b>C</b> Graphite	<b>Li</b> Lithium	<b>* Rare Earths</b>
<b>Co</b> Cobalt	<b>Fe</b> Iron	<b>Mn</b> Manganese	<b>Si</b> Silicon
<b>Cu</b> Copper	<b>Pb</b> Lead	<b>Ni</b> Nickel	<b>Ti</b> Titanium

\* The "Rare Earths" designation refers to 17 different elements, including dysprosium and neodymium (critical for wind technologies and energy storage), as well as praseodymium (critical for electric vehicles and energy storage).

**SOLAR TECHNOLOGY**

**WIND TECHNOLOGY**

**ELECTRIC VEHICLES  
& ENERGY STORAGE**

Image:Reuters



A lanthanum mine Nancheng County, Jiangxi

Image: National Geographic

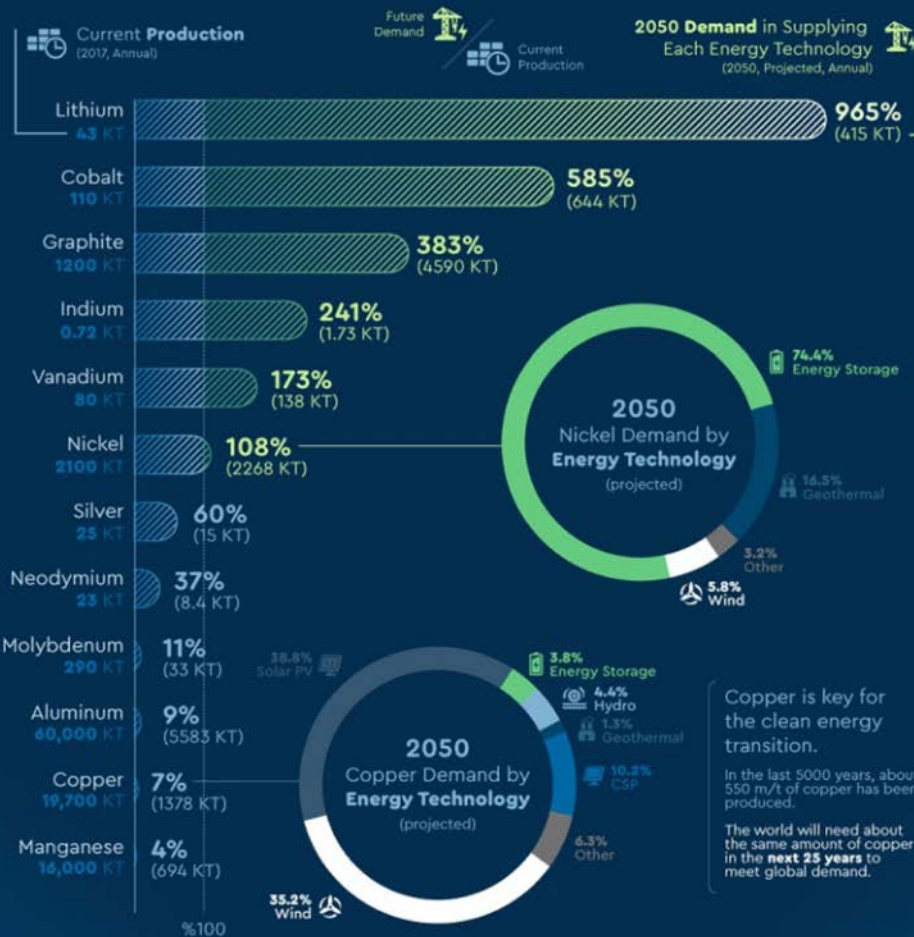


Lithium mining in Bolivia



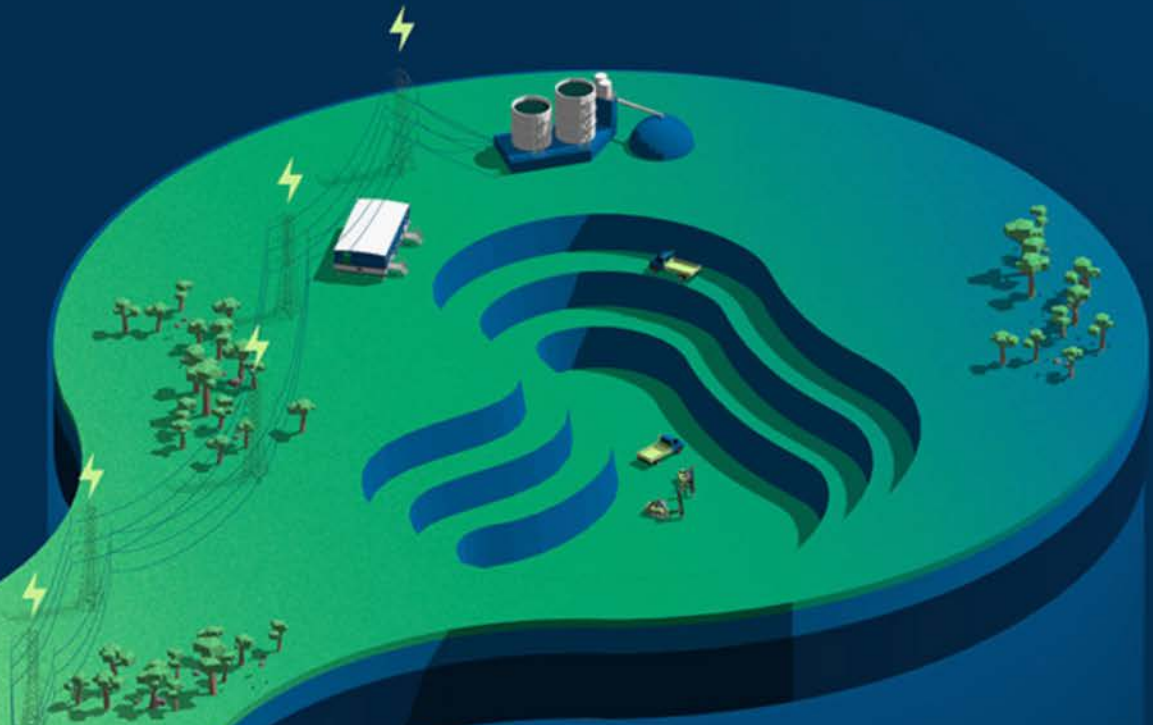
## Growing Demand

By 2050, low-carbon technologies will demand a higher percentage of the world's mineral production. To meet this demand, sustainable and reliable production will need to keep up.



Source: World Bank 2019

However, while mining is crucial to the clean energy transition, it also accounts for **up to 11% of global energy use.**

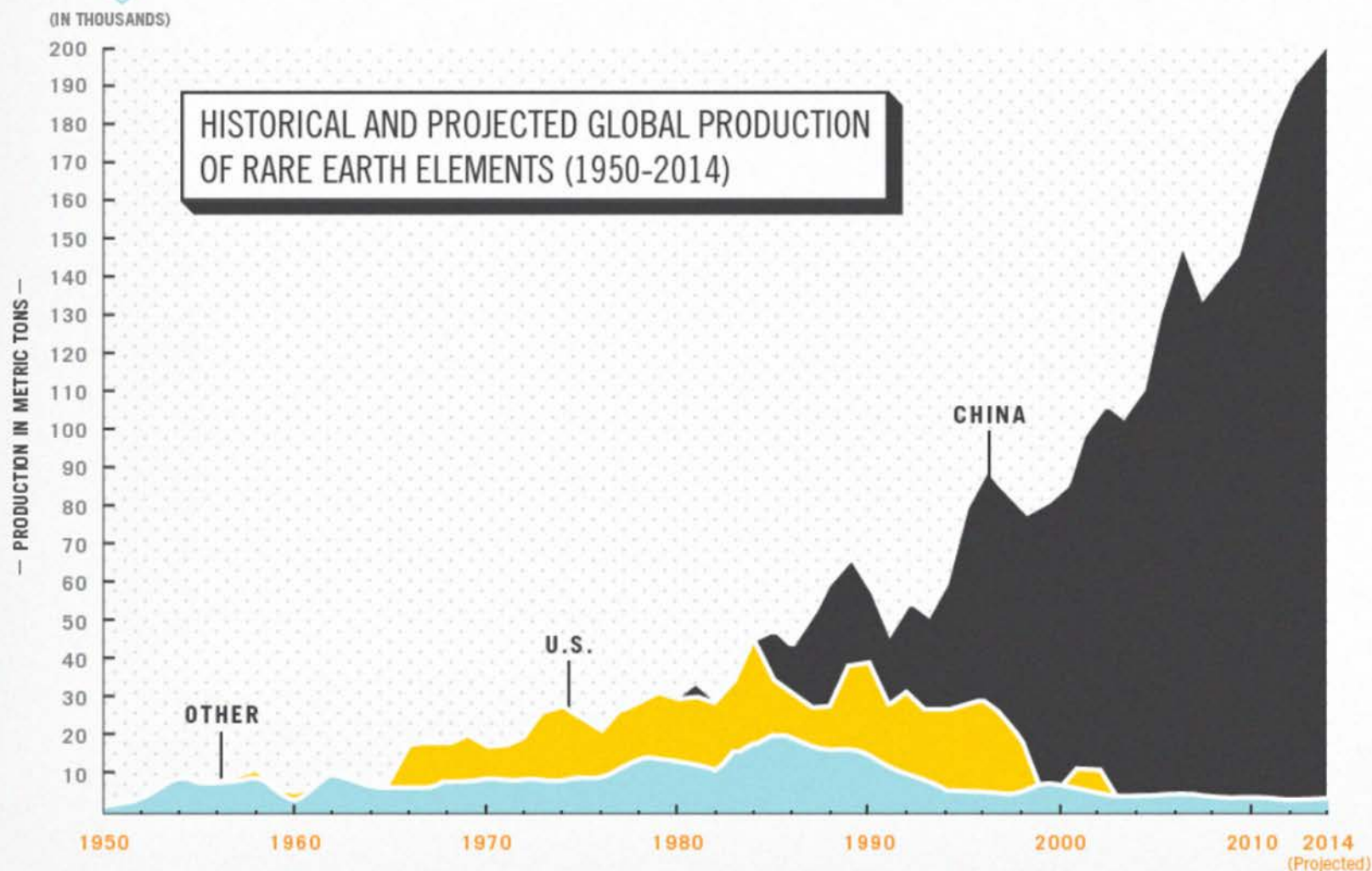


To benefit from the increase in mineral demand, developing countries and emerging economies must adopt mining practices that minimize carbon and material footprints.

These countries will need **good governance, knowledge, capacity** and **strategy** to do so.

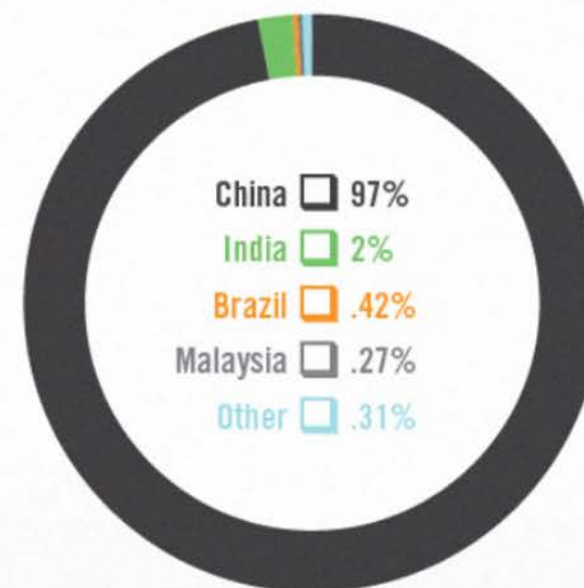


## TOP SUPPLIERS IN THE WORLD: THEN AND NOW



Together, just 4 countries mine the majority of the world's supply of rare earth elements. China, which produced 130,000 metric tons in 2010, dwarfs all other production yields by claiming 97% of the share.

### SHARE OF GLOBAL RARE EARTH ELEMENT PRODUCTION



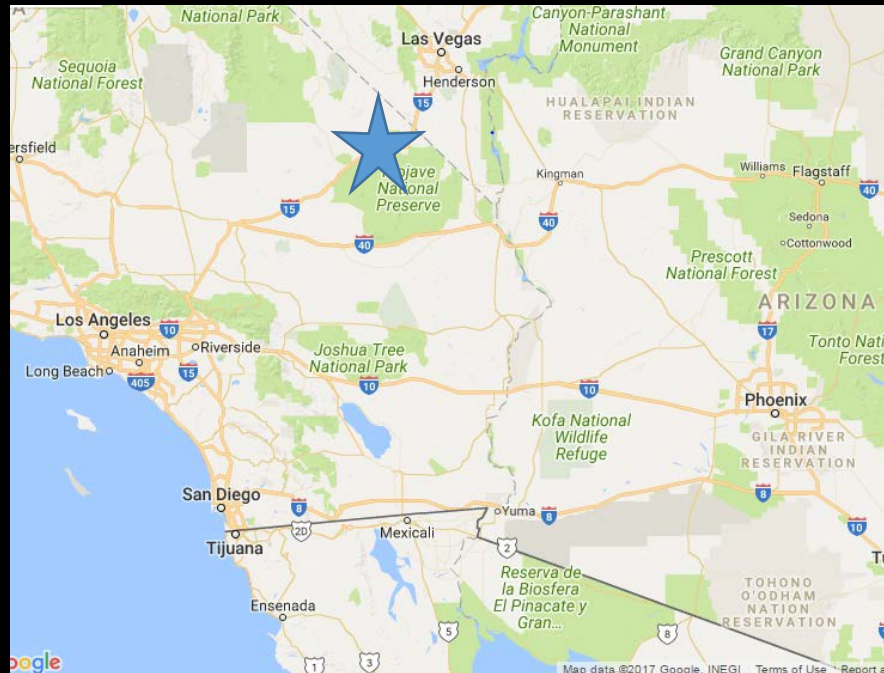
An illustration depicting the intersection of green technology and resource extraction. In the background, several wind turbines stand in a field. In the foreground, a worker in a hard hat and safety vest is climbing a ladder to maintain one of the turbines. To the right, a semi-trailer truck is parked with its back open, revealing a load of large metal pipes. The truck has a recycling symbol on its side. In the lower right, another worker in a hard hat is standing near a tree stump, holding a chainsaw. The overall scene suggests the need for sustainable and responsible sourcing of metals for green technology.

How can we sustainably and responsibly  
source green technology metals  
to address climate change?

1)Repatriate

2) Recycle

3) Repair



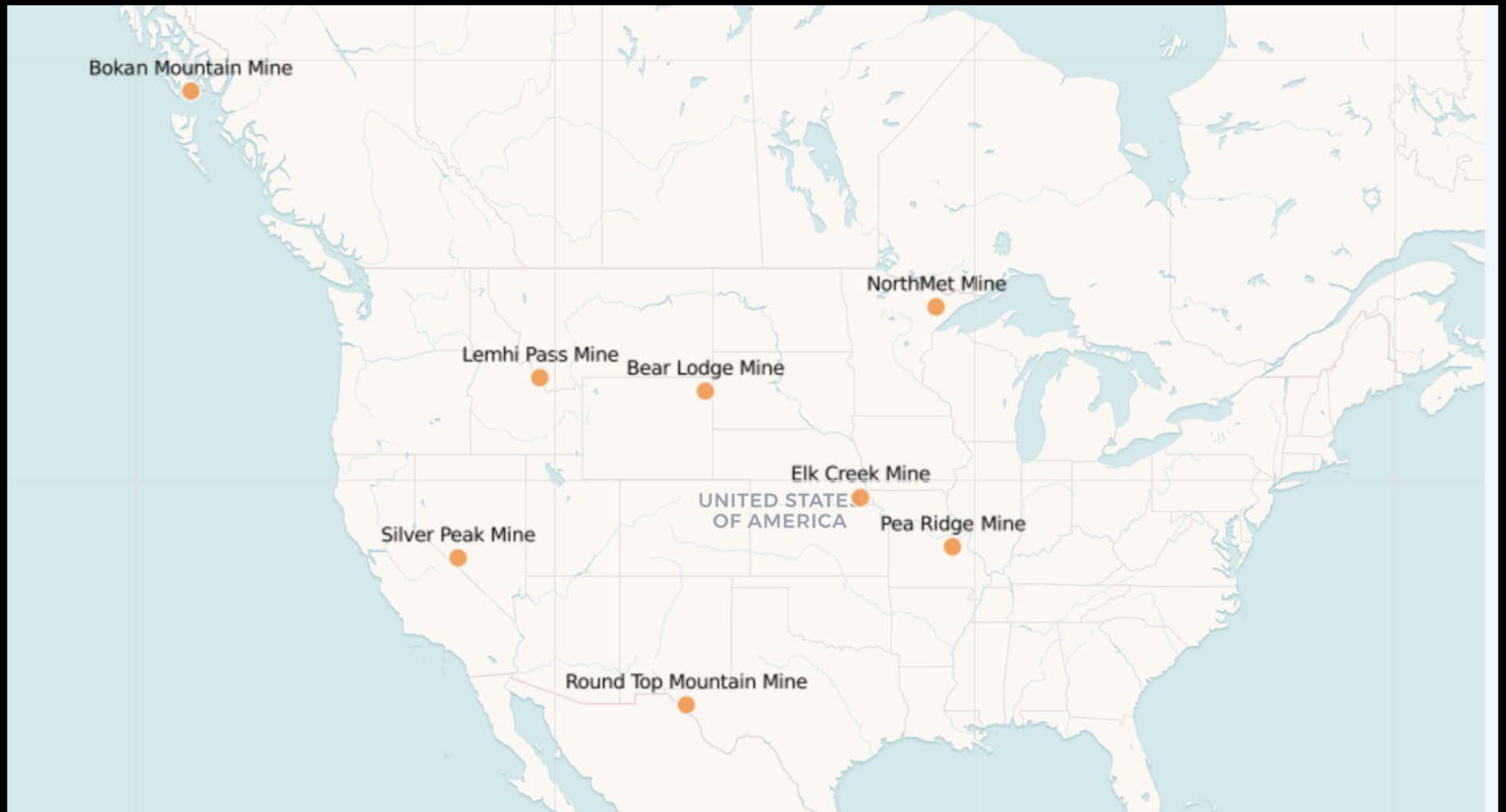
## A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:



**Sec. 3. Policy.** It shall be the policy of the Federal Government to reduce the Nation's vulnerability to disruptions in the supply of critical minerals, which constitutes a strategic vulnerability for the security and prosperity of the United States. The United States will further this policy for the benefit of the American people and in a safe and environmentally responsible manner, by:

- (a) identifying new sources of critical minerals;
- (b) increasing activity at all levels of the supply chain, including exploration, mining, concentration, separation, alloying, recycling, and reprocessing critical minerals;
- (c) ensuring that our miners and producers have electronic access to the most advanced topographic, geologic, and geophysical data within U.S. territory to the extent permitted by law and subject to appropriate limitations for purposes of privacy and security, including appropriate limitations to protect critical infrastructure data such as those related to national security areas; and
- (d) streamlining leasing and permitting processes to expedite exploration, production, processing, reprocessing, recycling, and domestic refining of critical minerals.





ucore®  
RARE METALS



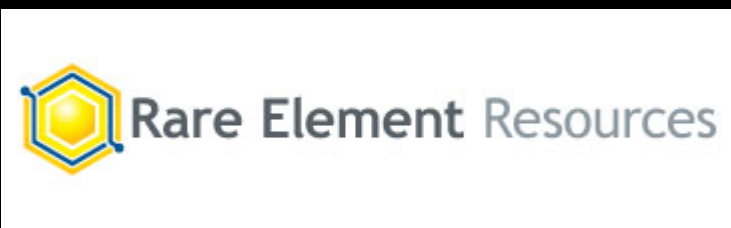
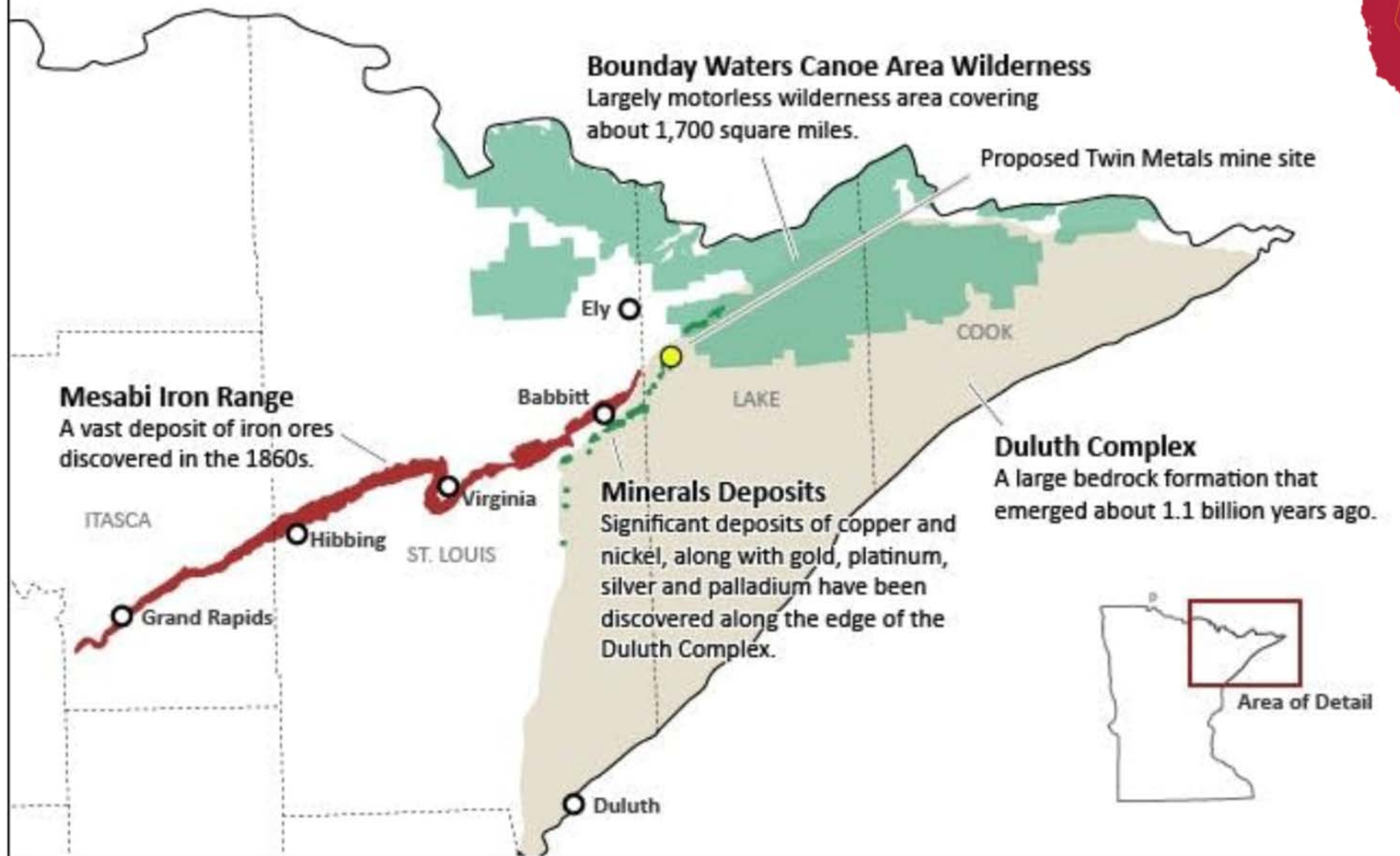


Image: National Geographic



# Minerals deposits in Northern Minnesota





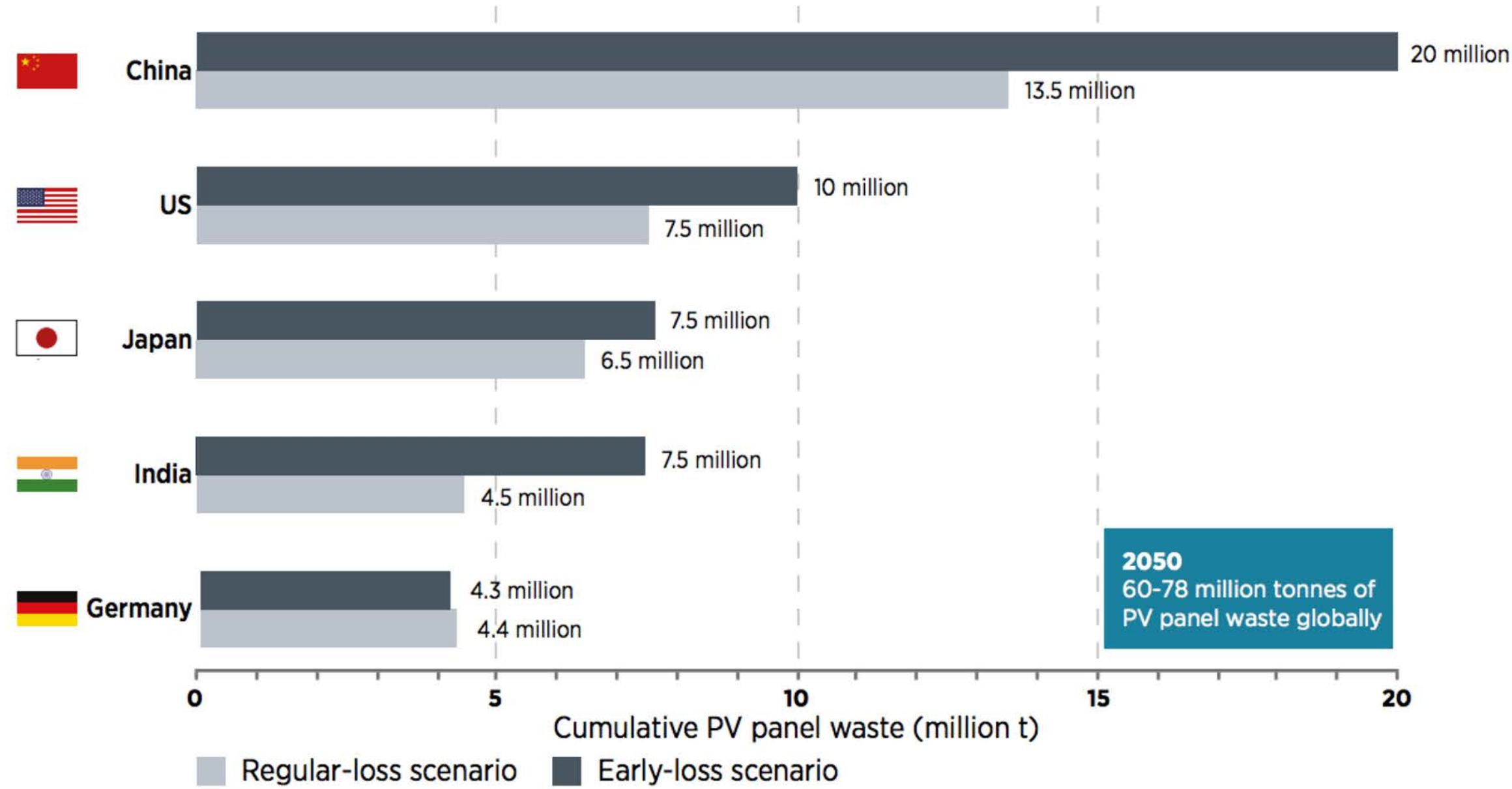
	Location	Metals	Developer	Level of Controversy*	Status
<a href="#"><u>Bear Lodge Mine</u></a>	Crook County, Wyoming	Dysprosium, Europium, Neodymium	Rare Element Resources, Ltd.	High	Stalled
<a href="#"><u>Bokan Mtn. Mine</u></a>	Prince of Wales Island, Alaska	Dysprosium, Terbium, Yttrium	Ucore Rare Metals Inc.	Moderate	Construction Underway
<a href="#"><u>Elk Creek Mine</u></a>	Johnson County, Nebraska	Niobium, Scandium, Titanium	NioCorp Developments	High	Permitting Underway
<a href="#"><u>Lemhi Pass Mine</u></a>	Lemhi Pass, Idaho	Neodymium, Thorium	US Rare Earths Inc	Moderate	Stalled
<a href="#"><u>NorthMet Mine</u></a>	Saint Louis County, Minnesota	Copper and Nickel	PolyMet	High	Permitting Underway
<a href="#"><u>Pea Ridge Mine</u></a>	Washington County, Missouri	Cerium, Dysprosium, Lanathium, Thorium, Yttrium	MFC Industrial Ltd. / Alberici Constructors	Moderate	Stalled
<a href="#"><u>Round Top Mtn. Mine</u></a>	Hudspeth County, Texas	Beryllium, Dysprosium, Thorium, Uranium, Yttrium	Texas Mineral Resources Corporation	High	Stalled
<a href="#"><u>Silver Peak Mine</u></a>	Esmeralda County, Nevada	Lithium Carbonate	Albemarle Corporation	Low	Complete

[www.macalester.edu/miningfutures](http://www.macalester.edu/miningfutures)

# RECYCLING

~95% semiconductor material for thin-film PV panels can be recycled

Cumulative waste volumes of top five countries for of end-of-life PV panels in 2050



Climate Changed

## Turbines Tossed Into Dump Stirs Debate on Wind's Dirty Downside

By [Chris Martin](#)

31 July 2019, 16:02 GMT-5 Updated on 1 August 2019, 05:00 GMT-5

Photographer: Daniel Acker/BP



1,000 blades  
entering  
the Casper  
Regional  
Landfill in  
Wyoming

RIGHT TO REPAIR

## Advocacy

[HOW TO HELP](#)[LEGISLATION](#)[STANDARDS](#)[POLICY OBJECTIVES](#)[ACHIEVEMENTS](#)[FIX THE DMCA](#)[THE ENVIRONMENT](#)[LEGAL UPDATES](#)[IOT SECURITY](#)

## Stand up for your Right to Repair!

State Legislators have the power to protect you from unfair and deceptive policies that make it difficult, expensive, or impossible for you to repair the things you own.

Right to Repair or Fair Repair Bills are being prepared for 2019 in many states. All it takes in most places is for one person to start the ball rolling.

Write, Call, or Meet with your state legislators and make Right to Repair happen.



# Right-to-repair bill appears headed for first time to floor of Minnesota House

The bill has been a long-sought goal of a consortium of independent repair shops, environmentalists, the Minnesota Farmers Union and others.

MARCH 24, 2019 — 3:41PM

Star Tribune



MONICA HUBKA

Technician Alonzo Nelson repaired a flat-screen TV panel for resale at Tech Dump's used-electronics retail business in St. Paul.



IN A  
DISPOSABLE  
SOCIETY  
TO REPAIR  
IS  
TO REBEL

SAY YES!  
TO REPAIR  
#RightToRepair

YES  
REPAIR

YES  
REPAIR

Germair 1.1  
Wouterij 1.4  
Flagey  
Drive St-Hubert 8.5  
St-Hubertsdreef  
Jourdan



“Metals are gifts from the stars that were generated over billions of years; we should treat them with the awe and respect they deserve and devise ways to recycle them over and over. Only then will sustainability become a reality”

Source: Gradel et al. 2011