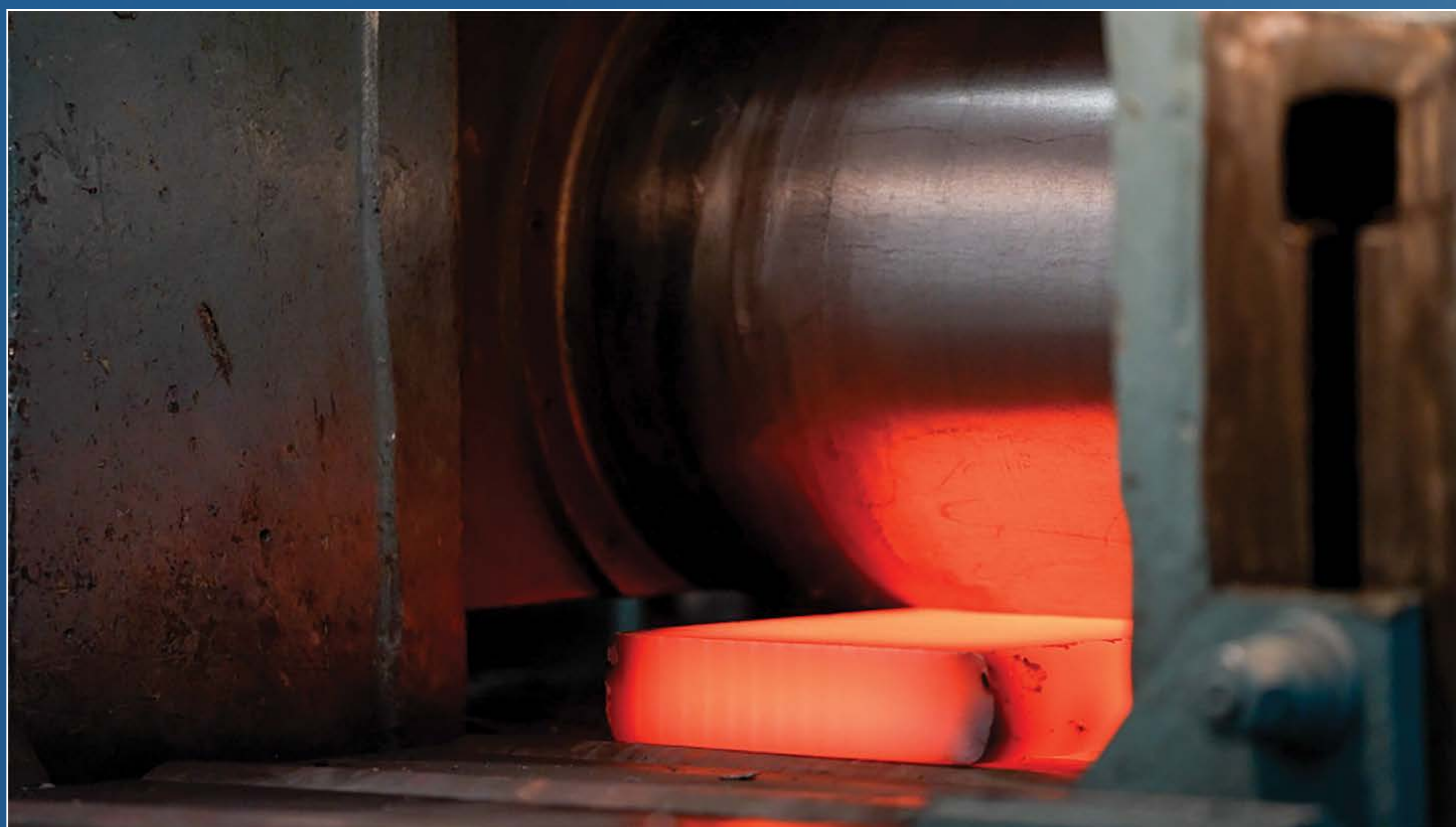


# NETL PRODUCES A MORE ROBUST PIPELINE STEEL BY ALLOYING WITH SMALL AMOUNTS OF THE RARE EARTH ELEMENT, CERIUM

*The addition of cerium results in a tougher steel alloy to make pipelines for transporting hydrogen supplies and captured carbon dioxide. It also increases demand for cerium, which will stimulate additional production of critical minerals.*



The abundance of cerium presents an excellent opportunity for the renewed consideration of these rare earths as promising and inexpensive alloy additions in steelmaking.

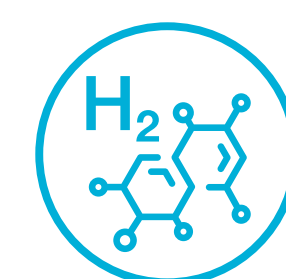
Cerium added to pipeline material reacts with oxygen and sulfur impurities and produces a steel less susceptible to cracking. Moreover, cerium is currently a major unused byproduct of the extraction of more valuable rare earths. Incorporating even small amounts of cerium into the high production volume steel components would significantly increase its demand. Additionally, adding a small amount of cerium improves the mechanical response of the steel, making it tougher and more resistant to failure, and enhancing the reliability of components manufactured from the steel.

- Improvement in steel toughness is important for new pipelines for carbon dioxide and hydrogen transport where running ductile fracture is a major concern.
- Developing high-volume applications for cerium can improve the economics of domestic production of rare earths by making the cerium byproduct more valuable.

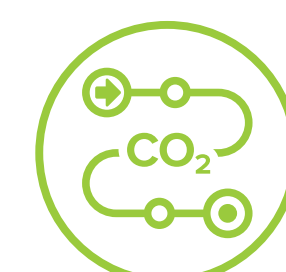
## RESEARCH PRIORITIES



DOMESTIC CRITICAL MINERALS PRODUCTION



HYDROGEN WITH CARBON MANAGEMENT



CARBON STORAGE AND TRANSPORT

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