Developing Minnesota’s Hydrogen Economy with Community Engagement

Workshop and Q&A

March 28, 2023

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THEORY OF CHANGE

It's about finding transformative solutions, *together*.

Photo courtesy of Great Plains Institute

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Webinar Best Practices

- Please keep yourself muted until the end of a presentation
- Please use the chat to introduce yourself, ask questions, or make comments
- Please turn your camera on if you are able and feel comfortable doing so
- Share air space--please leave room for others to engage as well

Photo courtesy of Great Plains Institute

Agenda and Speaker Overview

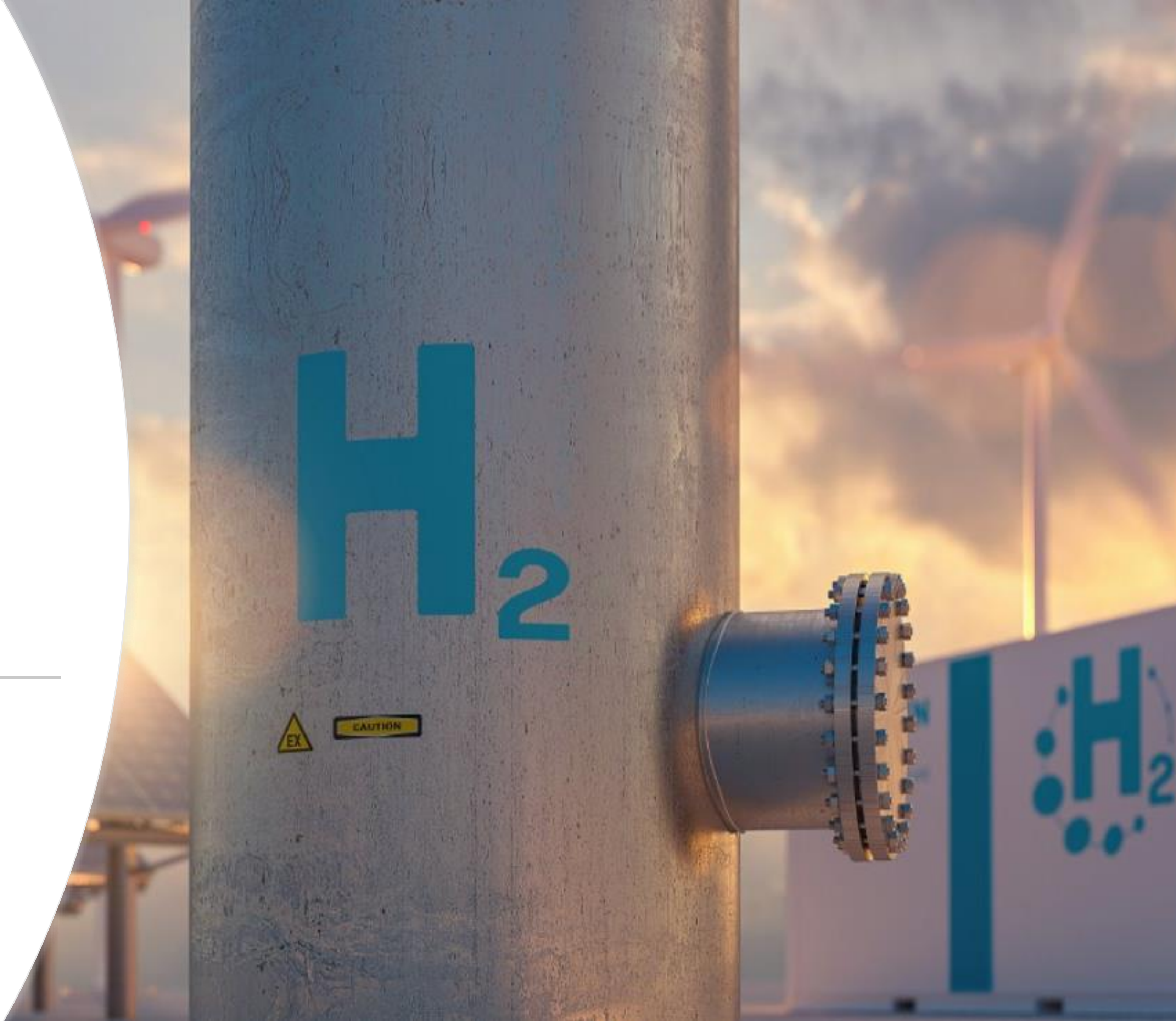
Topic	Speaker
Welcome	Sasha Bergman, Assistant Chief of Staff for Policy, Administration, and Federal Affairs, Governor's Office
Introductions	Michelle Gransee, Deputy Commissioner, MN Department of Commerce Pete Wyckoff, Assistant Commissioner for Federal and State Energy Initiatives, MN Department of Commerce
Hydrogen Production Pathways & Q&A	Facilitated by GPI
End Uses for Hydrogen & Q&A	Facilitated by GPI
Opportunities in Minnesota & Q&A	Facilitated by GPI
H2 Hubs Community Benefits Plans	Facilitated by GPI

Welcome

Sasha Bergman, Assistant Chief of Staff for Policy, Administration, and Federal Affairs, Governor’s Office

Source: iStock/ Zhaojiankang

Production Pathways



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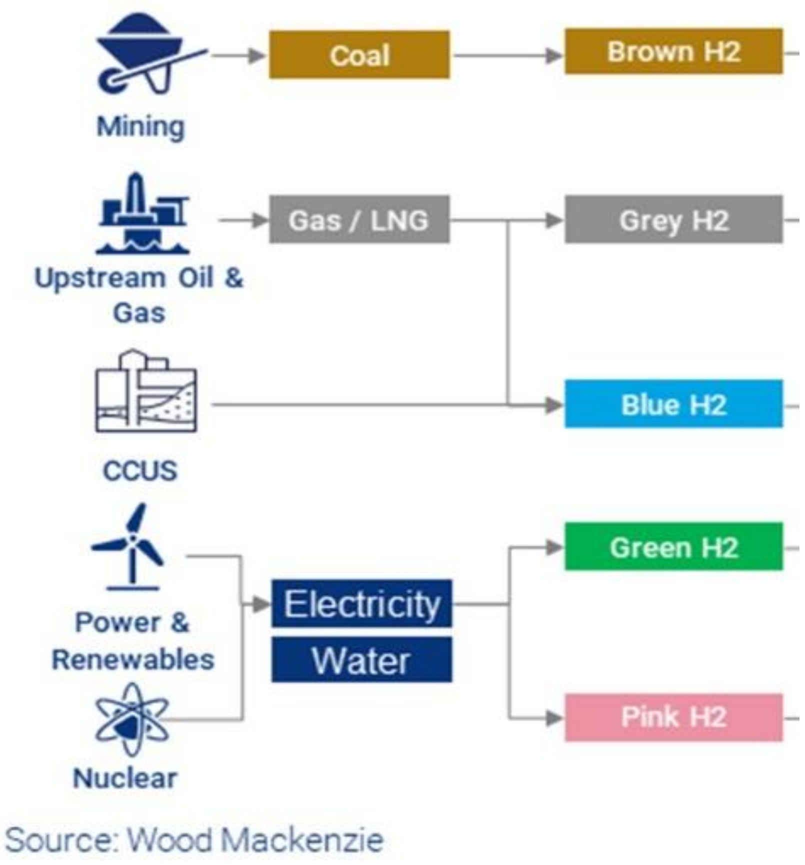
From a Hydrogen Rainbow

Towards a Clean Hydrogen Carbon Threshold



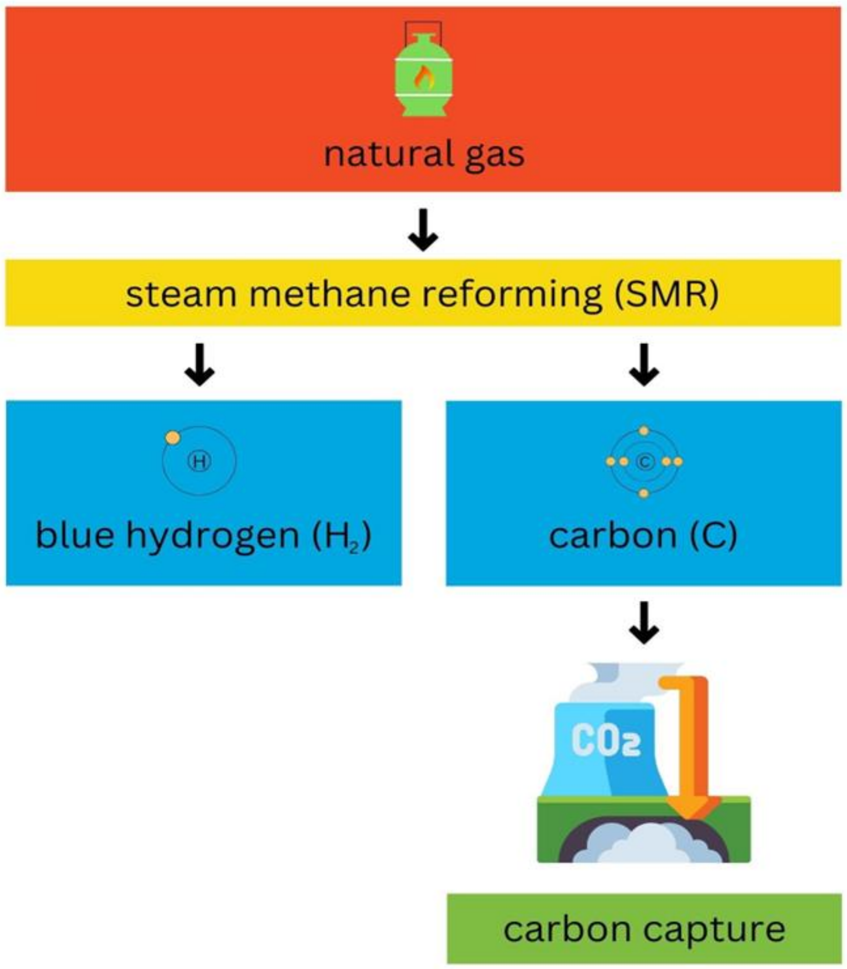
Life Cycle Emission (kg CO2e/kg H2)	PTC Value $/kg H2
4-2.5	0.60
2.5-1.5	0.75
1.5-0.45	1.00
0.45-0	3.00

"Decoding the hydrogen rainbow". Used with permission from Wood Mackenzie. https://www.woodmac.com/news/opinion/decoding-the-hydrogen-rainbow/

Carbon intensity thresholds and their corresponding production tax credit value. Source: Great Plains Institute

Blue Hydrogen

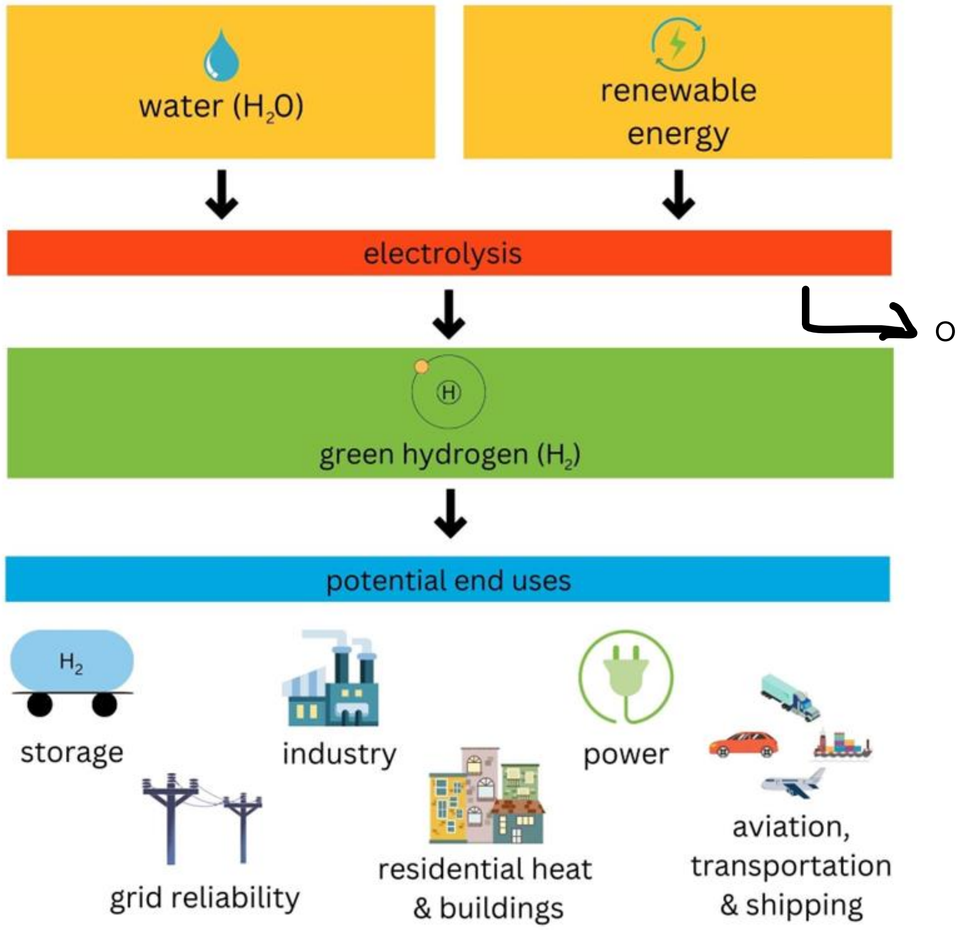
Uses the same production pathway as grey hydrogen. However, it is considered a form of clean hydrogen so long as it results in 4kg CO2e per 1kg H2 produced, or less.



Source: Graphic designed by Sydne Tursky, Great Plains Institute

Green Hydrogen

Results in zero carbon emissions. In this case, the feedstock is water, and renewable energy drives electrolysis



Source: Graphic designed by Sydne Tursky, Great Plains Institute

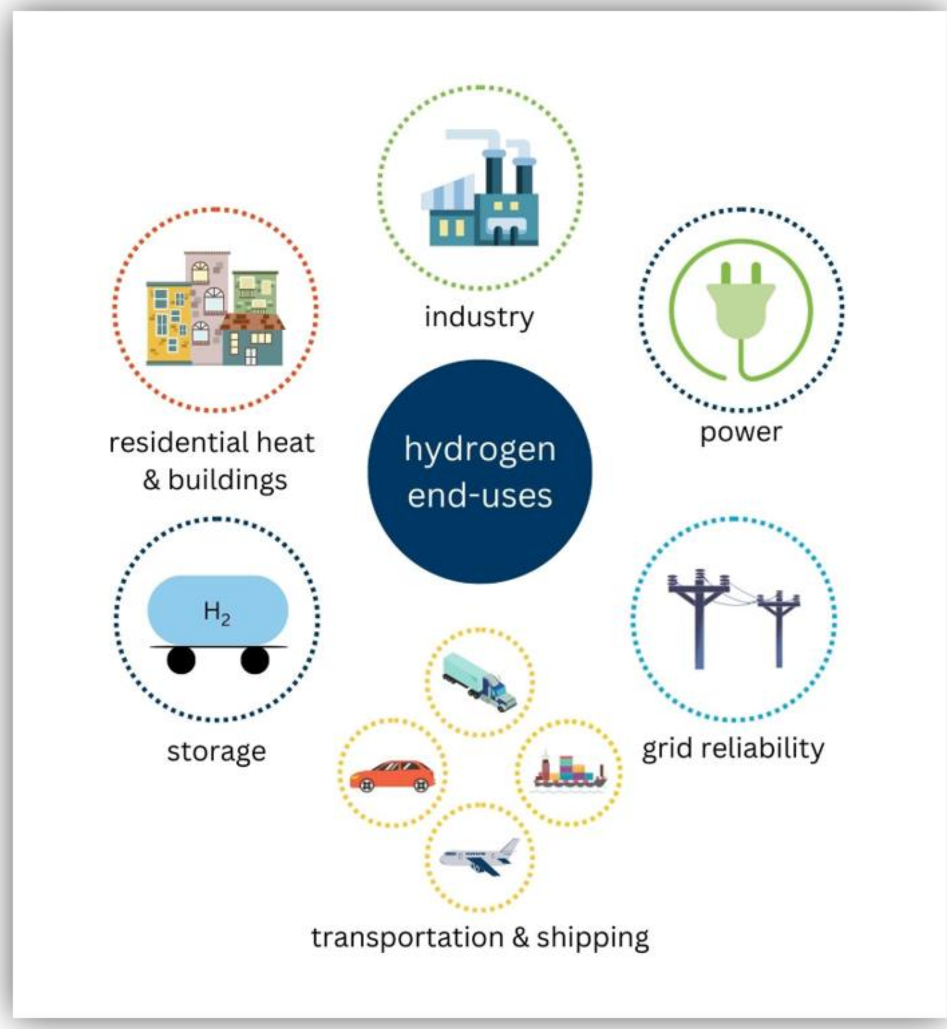
End Uses for Hydrogen

Source: iStock/RainStar

Potential Hydrogen End Uses

Hydrogen is already in use in some of these applications, but there are new opportunities that could open as electrification meets its limits.

This includes marine and aviation sectors, where hydrogen would need to be further transformed into a drop-in synthetic fuel such as ammonia and e-methanol.



Source: Graphic designed by Sydne Tursky, Great Plains Institute

End uses with the greatest emissions reduction potential?

Hydrogen Storage

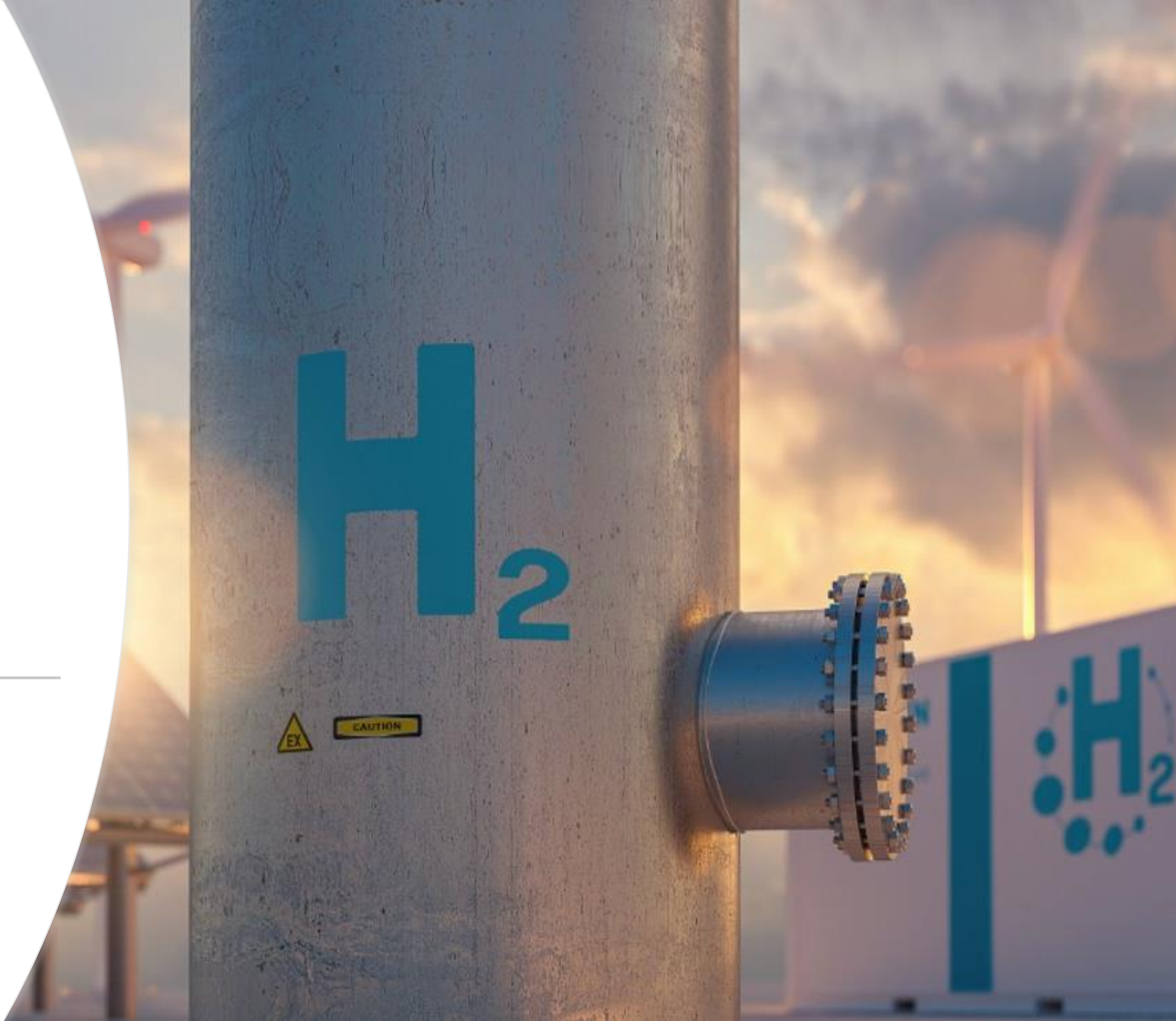


Photo courtesy of Great Plains Institute

Opportunities in Minnesota

Source: iStock/audioundwerbung

How Could the Hydrogen Economy Impact Minnesotans?

Workforce development opportunities across multiple sectors that include:

- R&D
- Manufacturing
- Engineering
- O&M
- Project management
- Communications
- Policy and regulatory affairs
- Construction and trade

Visit the DOE's Hydrogen and Fuel Cells Career Map

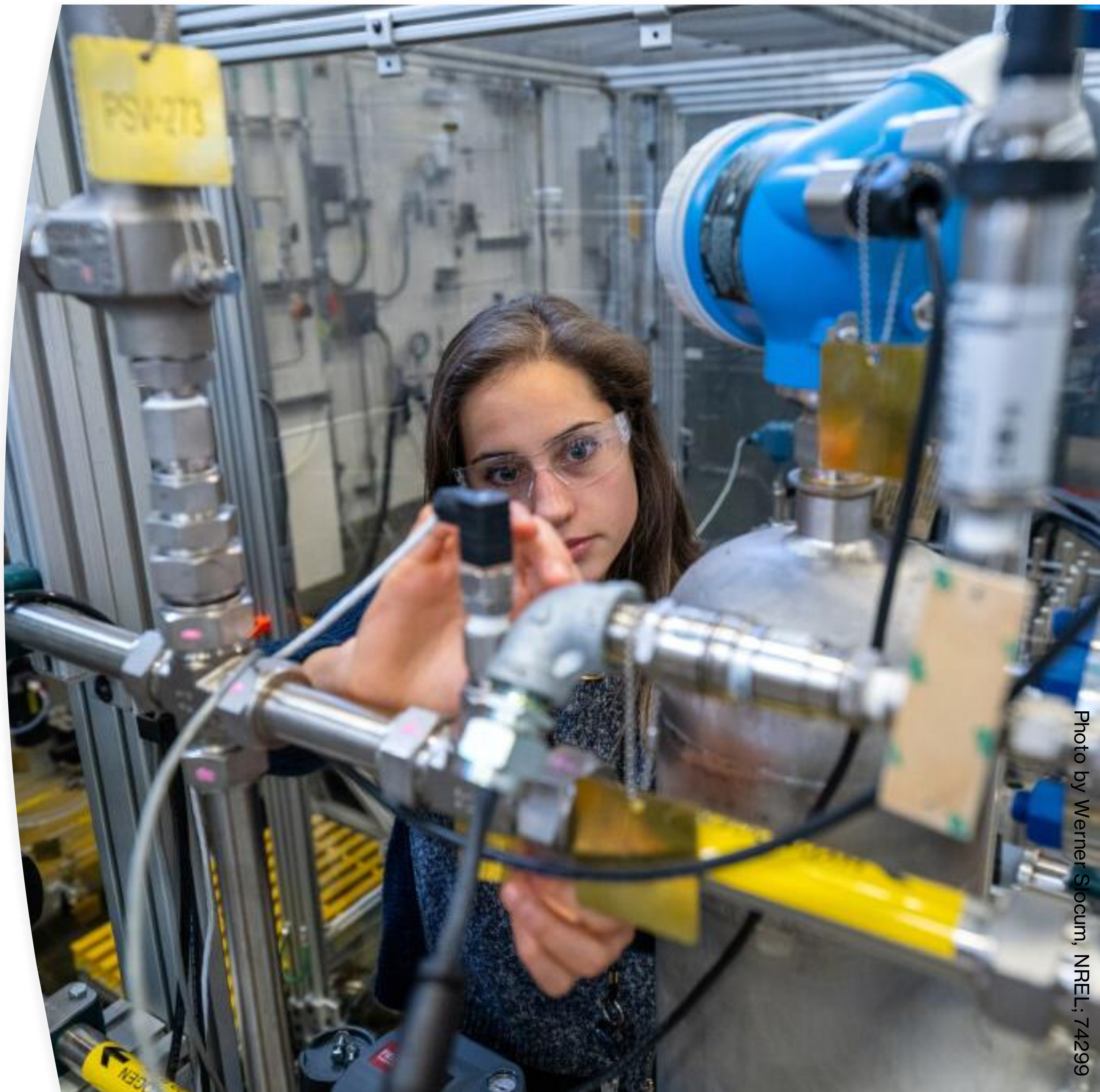


Photo by Werner Slocum, NREL; 74299

US Hydrogen Production and Potential Opportunity Applications

Ammonia fertilizer use and hydrogen production

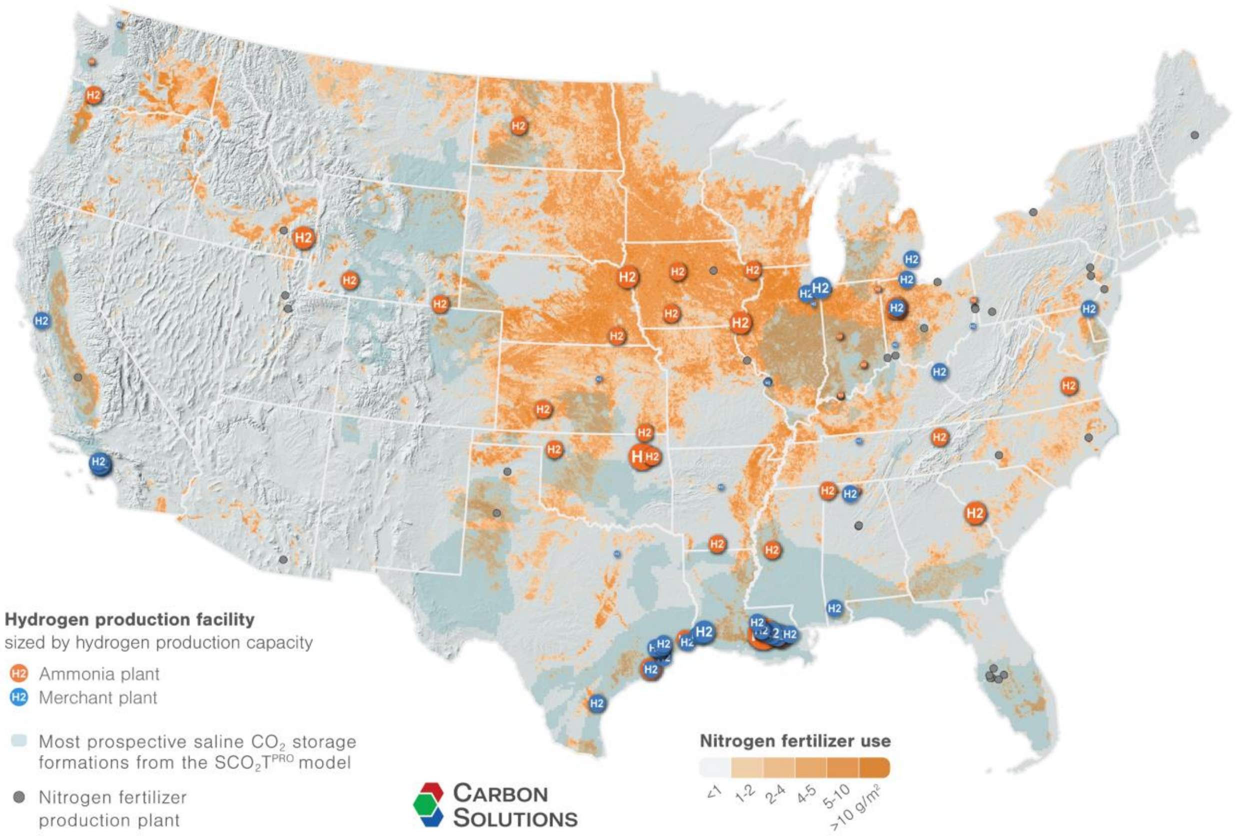


Figure authored by Elizabeth Abramson, Carbon Solutions, March 20, 2023. Source: Carbon Solutions LLC 2023; World Resources Institute 2023; Carbon Solutions LLC SCO2TPRO model 2023; Cao et al. 2017. Note, offshore saline geologic formations are not shown on this map.

Current Nitrogen fertilizer use approx. 10 g/m2 in MN.
Nitrogen fertilizer accounts for approximately 78% of the fossil energy footprint from corn production.

H2 Hub Proposals

Heartland Hub	**Midwest Alliance for Clean Hydrogen**
• MN, MT, ND, WI • MOU • Focus: Converting heavy-duty trucking fuel and other long-distance transportation from diesel to hydrogen and producing carbon-neutral fertilizer from clean hydrogen. • Fossil fuels + CCS	• Midwest public and private entities • Announcement • Focus: transportation, agricultural sector, process heat (steel sector) • Renewables + nuclear

Midwestern Hydrogen Coalition

- MOU between IL, IN, KY, MI, MN, OH, & WI
- Collaboration among Midwest states to coordinate the development of a regional clean hydrogen ecosystem

Community Benefits Plan

- Four core interdependent policy priorities
- What does a successful implementation strategy look like?

Source: Graphic designed by Rachel Percy, Great Plains Institute

Thank You

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