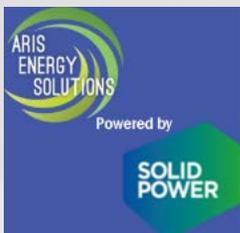


Fuel Cells and Hydrogen in America

Moving Forward

Our Members



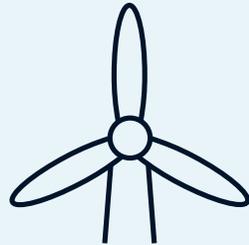
Nebraska Public Power District
Always there when you need us



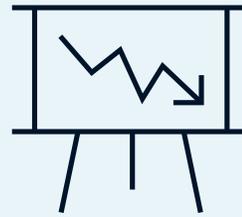
Benefits of Hydrogen



Economic growth
and employment



Resiliency and
reliability

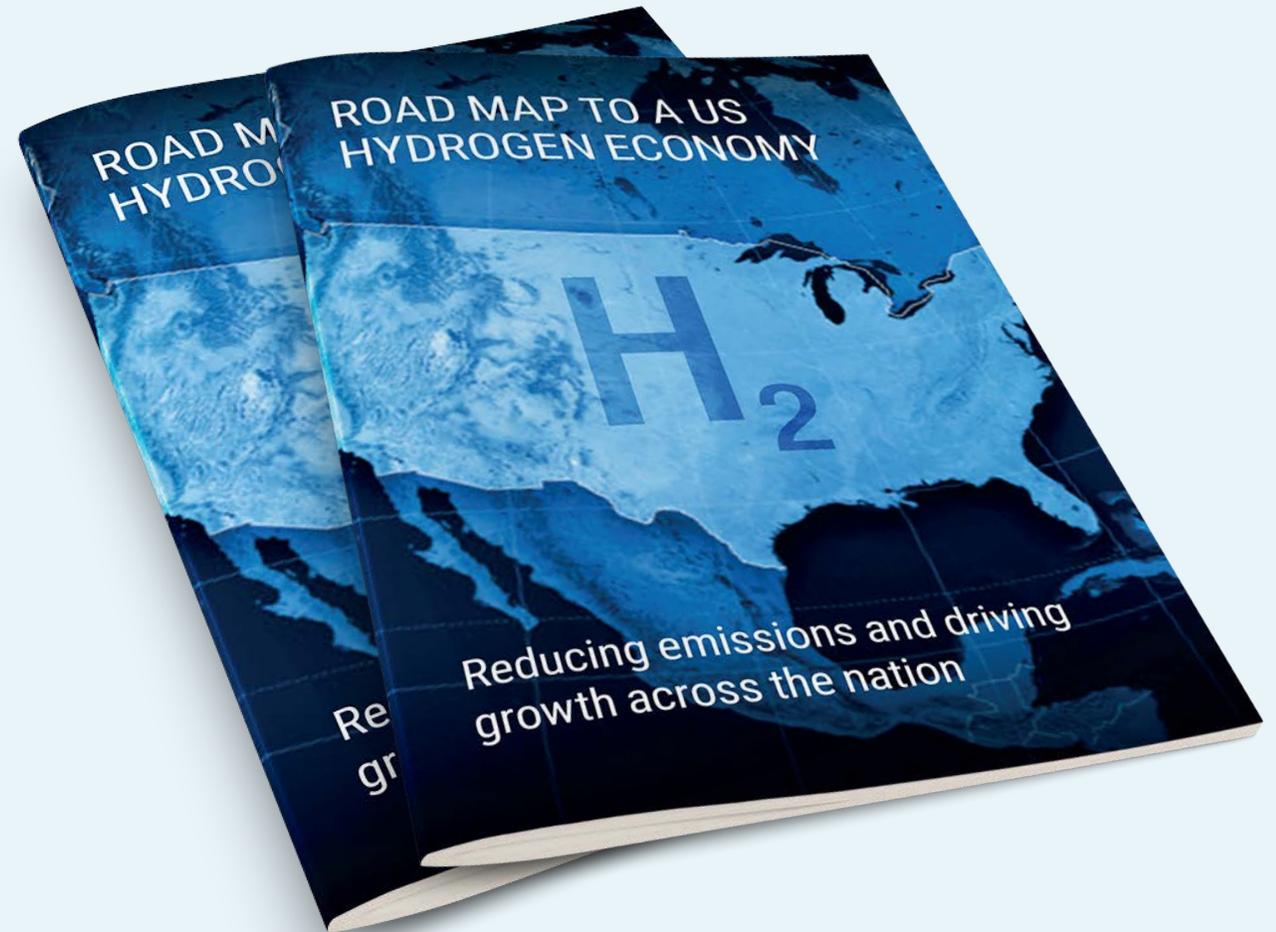


Reduction in local
air pollutants



Reduction in
greenhouse gases

The US industry road map lays out a 10-year plan to develop a hydrogen economy



Today

2022

2025

2030

Immediate next steps

Early scale-up

Diversification

Broad rollout

5 Uses of Hydrogen

Power generation and grid balancing

Centralized power (including storage) and distributed power (off-grid, backup power)
Hydrogen as an energy carrier and storage medium



Transportation fuel
(including material handlings, light- and heavy- duty vehicles, captive fleets, rail)

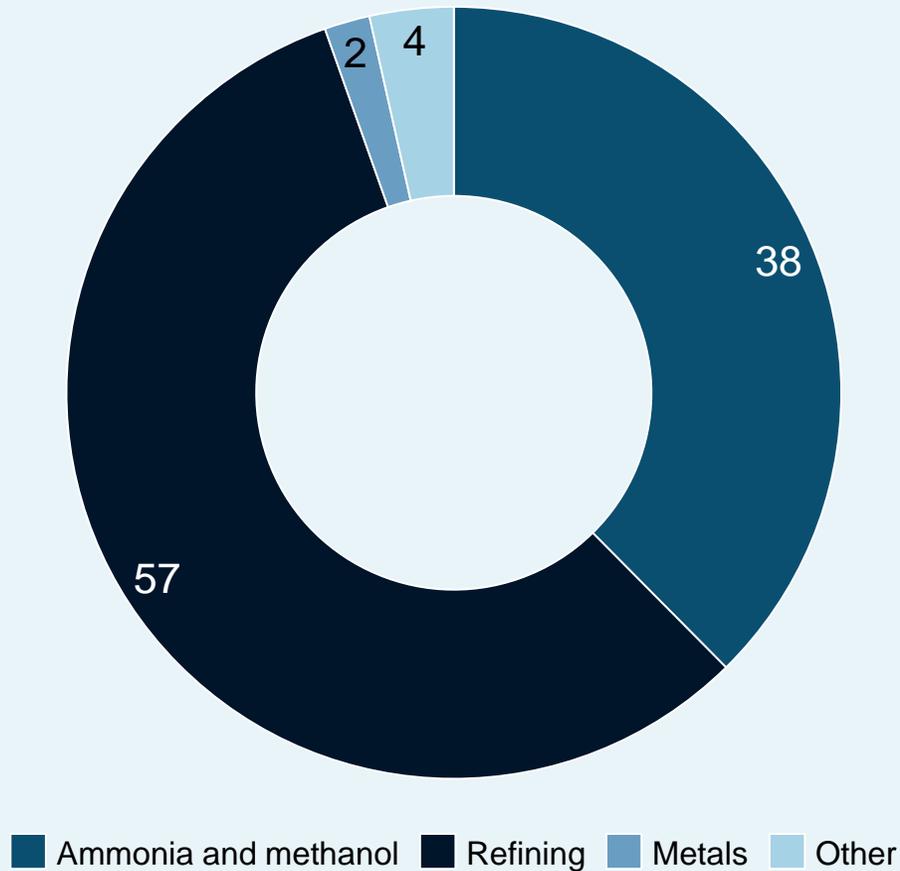
Fuel for residential and commercial buildings
(including blending into the gas grid, combined heat and power)

Fuel for industry

Feedstock for industry (ammonia, methanol, refineries, steel) and long-distance transport (aviation, marine)

US Hydrogen Market Today

Current consumption in the US H₂ market
Percent



11.4 m metric tons

of H₂ is currently consumed annually in the US market

~\$17.6 bn

total value of the H₂ market in the US today¹

77%

steam methane reforming H₂

23%

by-product H₂ from refining

1. Assuming realized price of \$2/kg for hydrogen produced from steam methane reforming (SMR)

“Low-carbon hydrogen”



Hydrogen produced from low carbon production pathways

Transition to ‘low-carbon hydrogen’

Water electrolysis using low-carbon electricity (e.g., nuclear, solar, wind)

Reformer-based hydrogen with carbon capture and storage (CCS) or renewable natural gas (RNG) feedstock

Direct gasification of waste including municipal and agricultural

By-product hydrogen recovered from other industrial processes

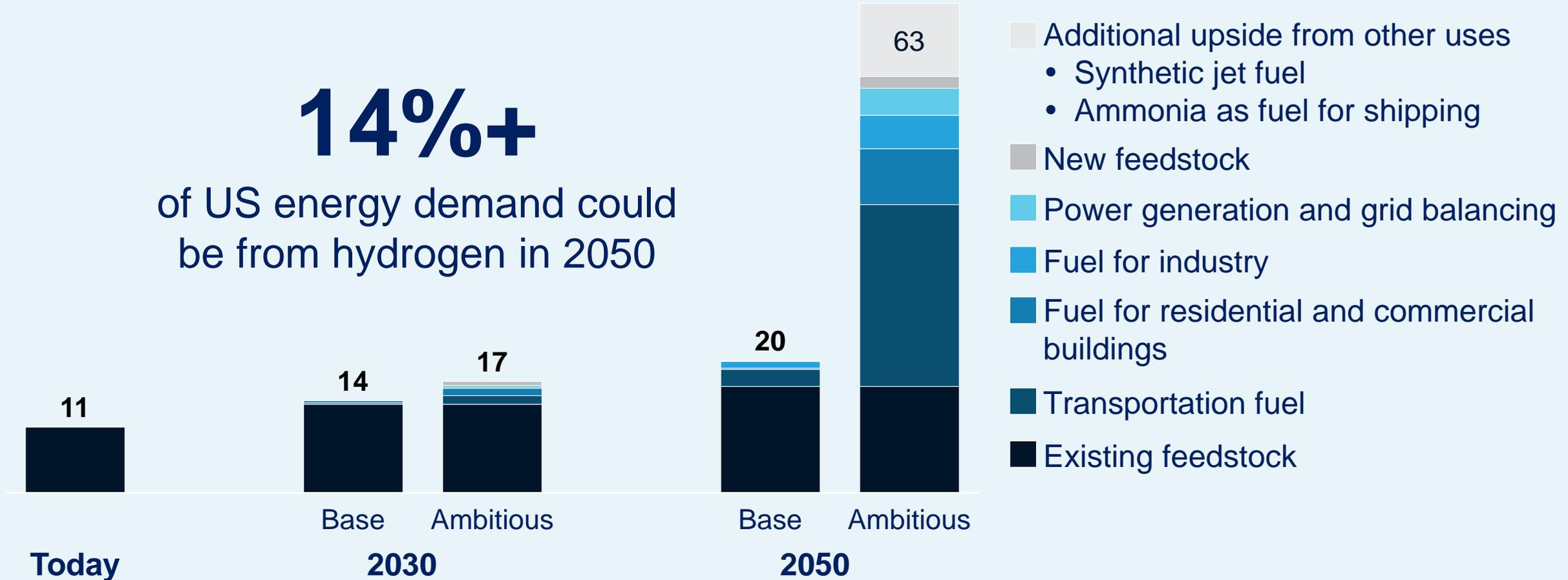
This effort has adopted a **pathway agnostic** approach

The road map lays out a high-growth pathway for hydrogen

Million metric tons per year

14%+

of US energy demand could be from hydrogen in 2050



1. Demand excluding feedstock, based on IEA final energy demand for the US
 2. Assuming that 20% of jet fuel demand would be met from synthetic fuel and 20% of marine bunker fuel from ammonia
 Note: Some numbers may not add up due to rounding

The roadmap describes 4 phases over the next decade to develop hydrogen across applications

2020-2022

Immediate next steps



2023-2025

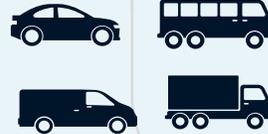
Early scale-up



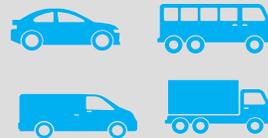
Distributed power
(e.g., data centers)

2026-2030

Diversification



Vehicles



2031 and beyond

Broad roll out



Pure H2 heating



Steel



Low/ medium industry heat



Low-carbon fuel²



Blended H2 heating



High-grade industry heat

Pilots and engineering analysis

R&D investment and pilots



■ Mature market ■ Under development (e.g., pilots) or early commercialization

Scaling up Economic Opportunities: Investments and Jobs

Annual investment



\$1bn

2022

Early scale-up

\$2bn

2025

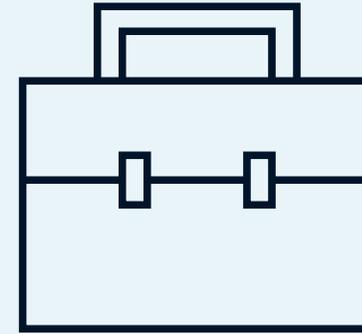
Diversification

\$8bn

2030

Broad rollout

New jobs¹



+50,000

2022

Early scale-up

+100,000

2025

Diversification

+500,000

2030

Broad rollout

1. Includes direct, indirect, and resulting jobs

The US economy would benefit through emissions reduction, growth, jobs, & use of domestic energy resources

Hydrogen in the US could ...



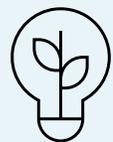
... Strengthen the US economy

~\$750 bn

in revenue

3.4m

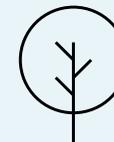
jobs



... Create a highly competitive source of domestically produced low-emission energy

~100%

domestically produced



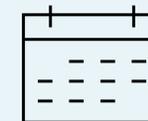
... Provide significant environmental benefits and improve air quality

-16%

CO₂

-36%

NO_x



In 2050

Note: Final energy demand excluding feedstock; share of abated CO₂ emissions relative to US emissions in 2050 as forecasted in the IEA Reference Technology Scenario; for NO_x, for tailpipe emissions only, based on EPA current NO_x emissions

Thank you.

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