HYDROGEN ENERGY & FUEL CELLS

CRITICAL TO THE CLEAN ENERGY SOLUTION

The U.S. economy and energy sector are at a crossroads as we face tough challenges around how to meet the climate challenge and reduce emissions from difficult-to-decarbonize sectors, manage our domestic resources, build resiliency, and maintain U.S. competitiveness. **Across the board, hydrogen energy is a critical part of the clean energy solution to these challenges.**

50 years ago, hydrogen energy put a man on the moon. The Apollo 11 mission used a hydrogen-powered fuel cell system to produce its electricity and water, and liquid hydrogen fuel to propel the rockets. The United States has historically been a leader in hydrogen energy and fuel cell technologies. **Reinvesting in research, development, and deploying hydrogen energy can deliver a new hydrogen economy with broad-based economic and climate benefits.**

VISION FOR A HYDROGEN ECONOMY

Hydrogen is already providing fuel, feedstock, and power to wide-ranging sectors of the U.S. economy and by 2050, it could account for up to **14% of U.S. energy demand**. Hydrogen deployment at this scale yields substantial economic, climate, and geopolitical benefits, including:

- **A stronger economy.** By 2030, the U.S. hydrogen industry could generate an estimated $140 billion per year in revenue and support 700,000 jobs across the hydrogen value chain. By 2050, benefits could reach **$750 billion per year and 3.4 million jobs**.
- **A lower-emissions future.** Hydrogen fuel promotes decarbonization and eliminates tailpipe emissions, mitigating climate impacts and improving overall air quality. By 2050, an aggressive-roll out of hydrogen could reduce **carbon emissions by 16%** and cut **NO_x and tailpipe emissions by 36%.**
- **U.S. energy leadership.** As countries around the world increasingly look to hydrogen as a clean energy pathway, the U.S. is uniquely well-positioned to take a leadership role. By leveraging abundant resources and a robust industrial sector, the U.S. hydrogen industry can spur American energy innovation and promote economic competitiveness.
- **Increased energy security.** Hydrogen utilizes 100% domestic energy resources, offers more reliable backup and offsite power options, and supports renewable energy deployment. By reducing energy dependence and enhancing resiliency, hydrogen represents a clear driver of U.S. energy security.

BY 2050, HYDROGEN CAN...

- Meet 14% of energy demand
- Generate $750B per year
- Support 3.4 million jobs
- Reduce carbon emissions by 16%
- Reduce NO_x emissions by 36%

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MULTI-SECTOR APPLICATIONS

Hydrogen is a unique energy carrier with applications across five sectors:

Transportation: The transport sector accounts for a third of U.S. carbon emissions and directly impacts local air quality. Fuel cell vehicles (FCVs) provide a zero-emissions solution for light-, medium-, and heavy-duty vehicles.

Industrial Fuel: The industrial sector is one of the largest consumers of energy in the U.S. Low-carbon hydrogen can provide decarbonized heat in industrial processes that are difficult to electrify.

Feedstock for Industry & Transport: Low-carbon hydrogen offers a key emissions reduction opportunity in ammonia and methanol production. It can also support difficult-to-decarbonize sectors like steel production, aviation, and shipping.

Buildings: More than half of U.S. homes rely on natural gas and liquid petroleum gas for heating. Replacing a share of natural gas with low-carbon hydrogen would reduce GHG emissions associated with heating — without requiring new infrastructure.

Power Sector: Hydrogen could play an important role in decarbonizing the power system by supporting the deployment of variable renewable energy sources. It can also improve distributed generation by providing clean, noiseless, and odorless backup and off-grid power.

ROADMAP TO A HYDROGEN ECONOMY

2020 – 2022 Immediate Steps

Dependable and technology-neutral decarbonization goals are set. Public incentives and standards bridge barriers to initial market launch, helping bring mature hydrogen solutions to market, increase awareness, and pilot use in other applications.

2023 – 2025 Early Scale-up

Development of large-scale hydrogen production reduces costs and spurs scale-up. Clear regulatory guidelines are set to coordinate markets and attract investment. Direct policy support evolves into scalable market-based mechanisms.

2026 – 2030 Diversification

Hydrogen production is diversified beyond early adopter segments and states. Infrastructure build-out and R&D unlock new markets, and the hydrogen industry begins to scale up and offer competitive solutions.

2031 & Beyond Broad Rollout

Hydrogen is deployed at scale in the U.S. Most applications achieve cost parity with fossil fuel alternatives, and public support can be phased out. Significant GHG reduction in difficult-to-decarbonize sectors is achieved.

PATH FORWARD

Hydrogen offers a promising future of clean energy, economic growth, and geopolitical strength. Policymakers, industry leaders, and investors can support this ambitious roadmap by:

- **Setting the north star.** Set dependable, technology-neutral decarbonization goals.
- **Kickstarting markets with needed incentives and support.** Create public incentives to bridge barriers to initial market launch, and support infrastructure development.
- **Making systemic changes to pave the way for a hydrogen economy.** Update and harmonize technical codes, safety standards, and energy regulations. Support R&D and workforce development programs.

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Data and assumptions discussed in this fact sheet are based on McKinsey & Co.'s Roadmap to a U.S. Hydrogen Economy report and other sources. For more information, please visit https://www.fchea.org/hydrogenbonds