

# Hydrogen Energy

## Technologies Offer Potential Benefits but Face Challenges to Widespread Use

Highlights of [GAO-26-107932](#), a report to congressional addressees

April 2026

### Why GAO did this study

Hydrogen is a versatile chemical with many potential uses, including vehicle fuel cells, aviation fuel, and power generation. For decades, interest in hydrogen energy technologies to augment or replace diesel, natural gas, and electricity has garnered billions of dollars in research and development. The U.S. could produce hydrogen in vast quantities from domestically abundant resources. However, hydrogen energy is generally more costly than alternatives and infrastructure is lacking, so whether it will replace incumbent technologies is unclear.

This report examines: (1) current and emerging technologies for hydrogen production, transport, storage, and use; (2) potential benefits and challenges to developing or using these technologies; and (3) possible policy options.

To conduct this technology assessment, GAO searched the relevant literature; reviewed documents and reports; interviewed stakeholders from government, industry, academia, and nonprofits; conducted site visits; attended a conference; and convened a 3-day meeting of 18 experts from government agencies, industry, academia, and federally funded research and development centers. GAO is identifying policy options in this report (see next page).

### What GAO found

Hydrogen energy technologies offer long-duration energy storage, increased transportation efficiencies, quiet operation, reduced air polluting emissions, and potentially broad availability. For example, hydrogen fuel cell power generation technologies could provide quiet, clean backup power to data centers and other large-scale operations during power outages. These generation technologies could increase overall electricity grid security by providing long-duration energy storage. Currently, hydrogen fuel cells provide about 0.03 percent of utility-scale electricity generation.

#### Current and potential hydrogen energy technologies



Source: Macrovector/stock.adobe.com (images). | GAO-26-107932

However, hydrogen energy technologies have not been widely adopted because of hydrogen’s relatively high cost and limited market. Additionally, GAO identified four technical challenges to widespread use:

- **Efficiency and safety.** Hydrogen’s physical characteristics make it particularly susceptible to efficiency losses, leakage, and emergency response risks.
- **Infrastructure.** Transport and storage infrastructure is generally lacking or confined to certain regions of the U.S., and existing natural gas pipeline infrastructure might not be suitable for hydrogen.
- **Geography.** Geographic constraints can increase transport and storage costs for hydrogen users.
- **Regulation and permitting.** Unclear federal jurisdiction and lack of standards can slow down projects.

Since the 1950s, the U.S. has made periodic investments in hydrogen as a potential power source and transportation fuel. Relevant past legislation cited goals such as energy security and resilience, market competitiveness, and prioritizing use of lower-emission energy technologies. GAO offers seven options that policymakers could consider to advance these goals and address challenges to hydrogen energy use. GAO formulated these options for five policy goals, identified through a review of historical congressional legislation related to hydrogen energy. See tables 1–5 in this report for additional policy options and details.

## Policy Goals and Policy Options for Hydrogen Energy Technologies

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### Policy goal: Energy security and resilience.

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#### Policy options (report p. 22)

- Identify energy system vulnerabilities and deploy solutions
- Identify and address infrastructure needs
- Develop or clarify regulations, standards, and oversight purview
- Support research and development (R&D)

#### Opportunities

- Could diversify the energy system and improve its resiliency.
- Could make hydrogen more readily available as a tool to build resilience by producing energy independent of existing electricity grid infrastructure.

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#### Considerations

- May reduce staff and financial resources for more cost effective or mature energy technologies that may provide similar benefits.
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### Policy goal: U.S. hydrogen market competitiveness.

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#### Policy options (report p. 23)

- Implement market-stimulating mechanisms
- Develop or clarify regulations, standards, and oversight purview
- Support R&D
- Evaluate hydrogen energy deployment and utility

#### Opportunities

- Could help bridge the gap between the higher cost of hydrogen and the price customers are willing to pay.

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#### Considerations

- There may not be sufficient or available transport and storage methods to support increased supply and demand.
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### Policy goal: Low-carbon energy transition.

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#### Policy options (report p. 25)

- Implement market-stimulating mechanisms
- Identify and address infrastructure needs
- Develop or clarify regulations, standards, and oversight purview
- Support R&D
- Evaluate hydrogen energy deployment and utility
- Support collaboration and consortia

#### Opportunities

- Could help bridge the gap between the higher cost of low carbon hydrogen and the price customers are willing to pay.
- Could reduce supply chain infrastructure limitations.
- Could help identify whether, where, and when to use specific technologies.

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#### Considerations

- May reduce staff and financial resources for other policy goals.
  - Resource- or time-intensive regulations or permitting requirements could hinder adoption of hydrogen energy technologies.
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### Policy goal: Prioritize technologies with near-term potential.

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#### Policy options (report p. 28)

- Implement market-stimulating mechanisms
- Support R&D
- Evaluate hydrogen energy deployment and utility

#### Opportunities

- Could streamline R&D for technologies on the cusp of commercialization

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#### Considerations

- The most mature technologies may not be competitive in global markets or may not have many utilization opportunities.
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### Policy goal: Research, development, and innovation.

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#### Policy options (report p. 29)

- Support R&D
- Evaluate hydrogen deployment and utility
- Support collaboration and consortia

#### Opportunities

- Could enable scientific and technological developments and advancements for hydrogen energy and the larger scientific community.

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#### Considerations

- There is no guarantee that additional R&D will result in technology deployment.
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