Energy Sources for Electric Generation.

Until fusion is perfected for commercial use, there are only a few sources of energy available to produce electricity or steam. Natural gas, coal and petroleum produce about 60% of our electricity. Non-GHG producing sources, nuclear and renewables, produce about 40% of our electricity.

Energy Sources of Electric Generation 2020

- **Natural Gas:** about 40% of U.S. electricity generation in 2020.
- **Nuclear:** about 20% of U.S. electricity generation in 2020.
- **Coal:** the third-largest energy source for U.S. electricity generation in 2020 about 19%.
- **Petroleum:** less than 1% of U.S. electricity generation in 2020.
- **Renewables:** the source of about 20% of total U.S. electricity generation in 2020.

wind: 8.4%
 hydroelectric: 7.3%
 solar: 2.3%
 biomass: 1.4%
 geothermal: 0.5%

Source: EIA.gov

WHAT ABOUT HYDROGEN? See next pages...

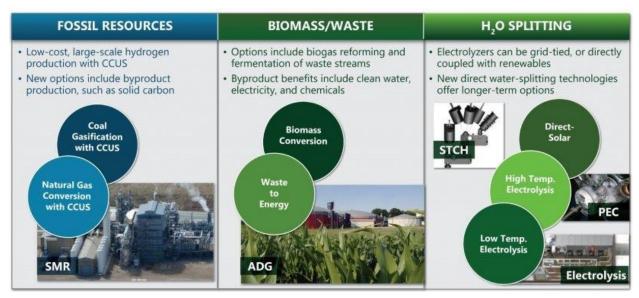
Petroleum is a minor source for electrical generation although it is the primary energy source for the transportation sector.

Non-GHG producing sources, nuclear and renewables, produce about 40% of our electricity. Nuclear waste is a problem yet to be solved although Europeans and others are doing a better job than the US in reusing/recycling their waste thereby reducing their disposal volumes. Renewables contributions are growing and continue to be supported by federal incentives and technological advances.

Hydrogen is a growing source of vehicle power. Other industrial applications are emerging. Nuclear fusion is a great answer, but not now.

From...energy.gov, Hydrogen and Fuel Cell Technologies Office

Hydrogen Production Pathways



CCUS: carbon capture, utilization, and storage; SMR: steam methane reforming; ADG: anaerobic digester gas; STCH: solar thermochemical hydrogen.

PEC: photoelectrochemical

The U.S. Department of Energy (DOE) is focused on developing technologies that can produce hydrogen at \$2/kg by 2025 and \$1/kg by 2030 via net-zero-carbon pathways. This is in direct support of the <u>Hydrogen Energy Earthshot</u> goal of reducing the cost of clean hydrogen by 80% to \$1 per 1 kilogram in 1 decade ("1 1 1"). To reach these goals, the program looks at a wide portfolio of <u>processes</u> over a range of time frames.

Currently, most hydrogen in the United States is produced by large-scale <u>natural gas</u> <u>reforming</u> without carbon capture and storage. This established technology has been shown to be able to reach the cost targets; however, the goal is to reach the cost target via low-carbon pathways. To produce hydrogen economically and via net-zero-carbon pathways, DOE supports the research and development of a wide range of technologies.

In the near- and mid-term, <u>electrolysis pathways</u> (where electricity is used to split water into hydrogen and oxygen) are anticipated to begin reaching the cost targets.

In the mid- to long-term, innovative approaches, such as those using <u>waste streams</u> and others based on <u>solar energy</u>, are expected to become viable.

LINK: https://www.energy.gov/eere/fuelcells/hydrogen-production-pathways

From...CANARY MEDIA...

The biggest green hydrogen hub in the US could be coming soon to Mississippi.

Hy Stor Energy wants to use renewables to produce hydrogen in the oil and gas industry's heartland.

LINK: https://www.canarymedia.com/articles/hydrogen/the-biggest-green-hydrogen-hub-in-the-us-could-be-coming-soon-to-mississippi

19 October 2021

From CT.org: Hydrogen is an important part of America's comprehensive energy program.



(Fabian Sommer/Picture Alliance via Getty Images)



The United States could see its biggest green hydrogen hub by far up and running in Mississippi by 2025 — if a team of former natural-gas storage developers and a major Canadian energy infrastructure developer can pull off their plans.

On Tuesday, Hy Stor Energy announced that it intends to build a green hydrogen production and storage complex that could match the large size of such projects being constructed in Europe. By 2025, the first phase of the project could be making 110,000 metric tons of green hydrogen per year and storing more than 70,000 metric tons of it in underground salt caverns.

Read the rest of the story at: https://www.canarymedia.com/articles/hydrogen/the-biggest-green

hydrogen-hub-in-the-us-could-be-coming-soon-to-Mississippi Subscribe

Hydrogen Brings New Hope to an Old Industry Titan.

Thyssenkrupp planning minority IPO of electrolyzer business that can be repurposed to serve production of potential wonder fuel.

By Rochelle Toplensky Jan. 13, 2022 1:11 pm ET

Spinning trendy green assets out of venerable industrial companies at high valuations is a strategy that often sounds better in theory than in practice. But Thyssenkrupp 's promising hydrogen business could be an exception.

On Thursday, the German company best known for steel production gave investors a closer look at a 66%-owned joint venture long buried within its conglomerate structure: Uhde Chlorine Engineers, now rebranded as Thyssenkrupp Nucera. The unit has long been making chlorine electrolyzers, which generate hydrogen as a byproduct. A product redesign means its existing facilities can now crank out one gigawatt annually of green-hydrogen electrolyzers at competitive costs to be installed and serviced by its existing network.

LINK: https://www.wsj.com/articles/hydrogen-brings-new-hope-to-an-old-industry-titan-11642097502?mod=hp_minor_pos20