

A photograph of a wind turbine on a body of water, with several other turbines visible in the background under a blue sky with light clouds.

MAKING SENSE OF HYDROGEN'S “45V” TAX CREDIT

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ENERGY
INNOVATION 
POLICY & TECHNOLOGY LLC



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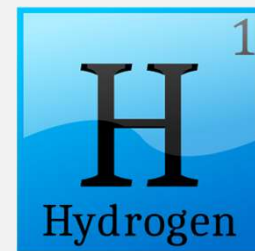
Agenda

- Context
- Production
- Use
- Recap

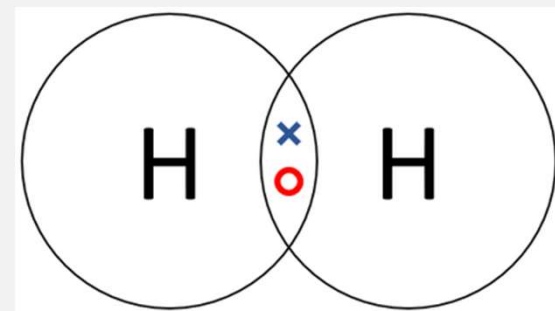


Context: What is Hydrogen?

- Hydrogen (H_2) is:
 - A gaseous molecule
 - that *can* be produced without greenhouse gas emissions and
 - that *can* be used in place of fossil fuels
- Hydrogen's value (beyond its existing uses) comes from its ability to decarbonize “hard to abate” sectors – this promise drives its policy support and buyer interest



https://en.wikiversity.org/wiki/The_periodic_table/Hydrogen



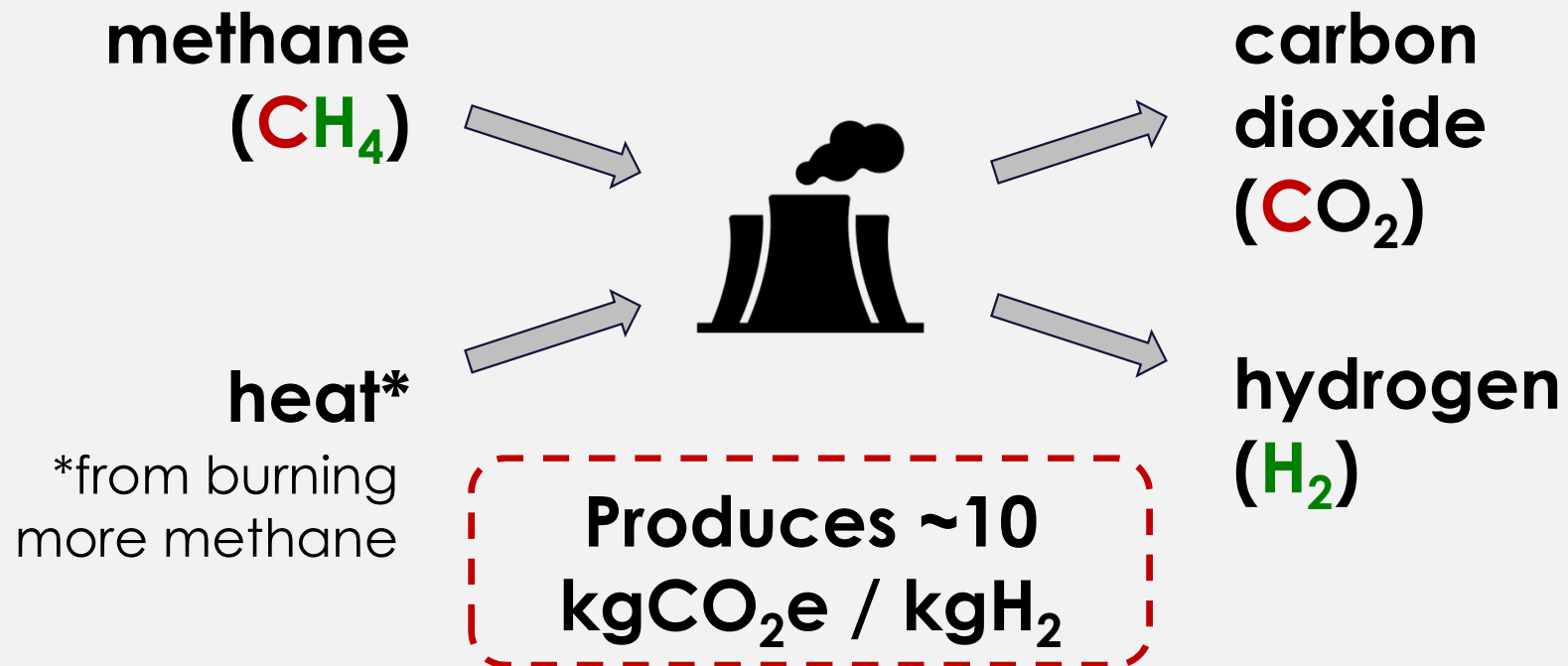
<https://keystagewiki.com/index.php/Hydrogen>



Key Resources



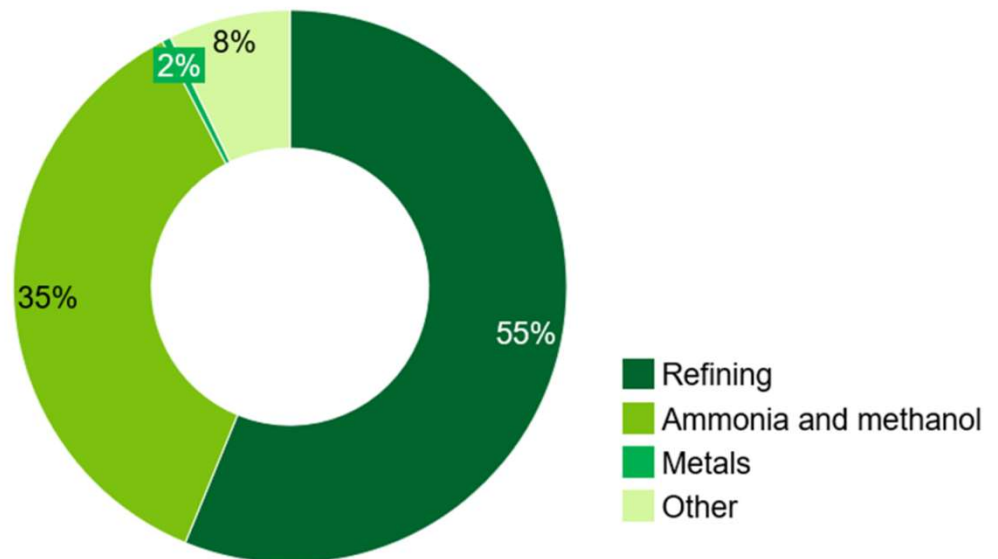
Context: Fossil-Based Hydrogen Production



Context: Today's Hydrogen End-Uses

- The U.S. produces 10 million metric tons (MMT) of hydrogen annually
- This is responsible for ~1.5% of all U.S. climate pollution
- The vast majority is used to refine oil or make chemicals (e.g., inputs to fertilizer)

Hydrogen consumption in the U.S. by end use, 2021



<https://www.hydrogen.energy.gov/pdfs/us-national-clean-hydrogen-strategy-roadmap.pdf>

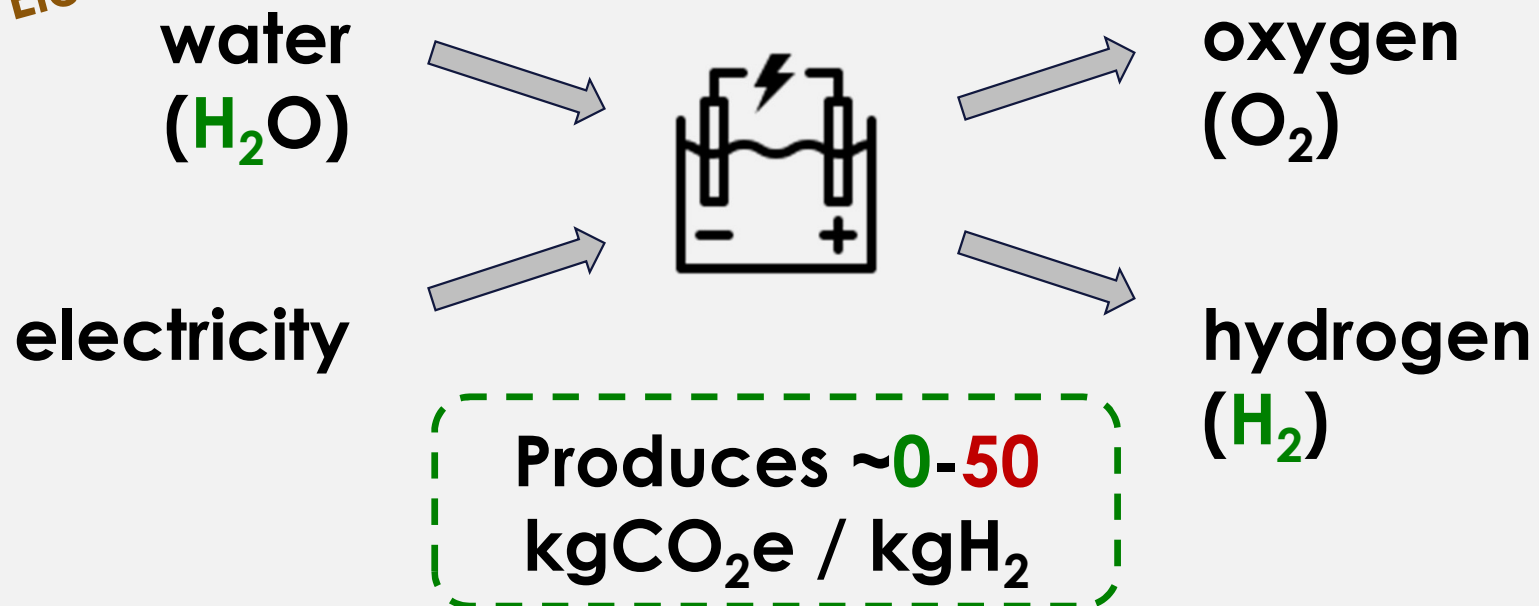


Key Resources



Context: Low-Carbon Hydrogen Production

Example: Electrolysis



Key Resources



Context: Ways to Use Hydrogen

Chemical Feedstock



- Used to make or alter other compounds
- Often no substitute – generally cannot be electrified

Combustion



- Burned to produce heat
- Inefficient process
- Can emit harmful air pollution (NO_x)

Fuel Cell



- Used to generate electricity
- Very efficient and clean process but often beat by electrification

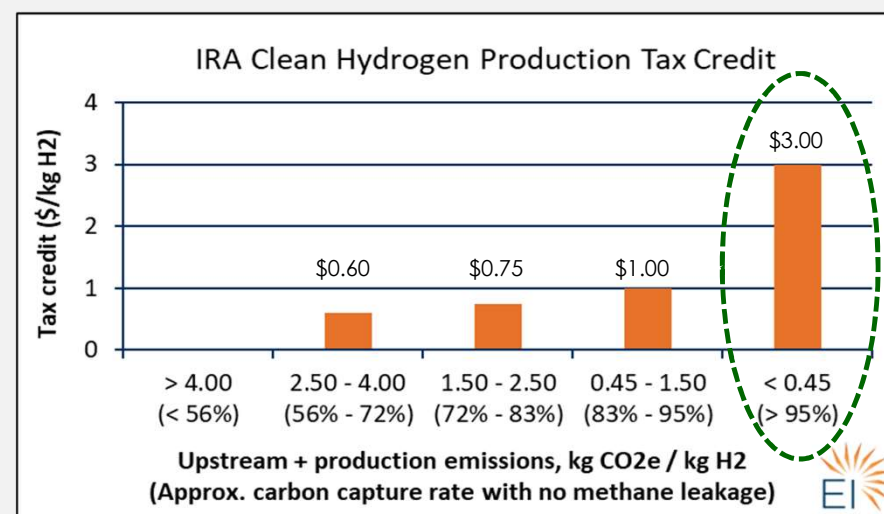


Key Resources



Production: Inflation Reduction Act Section 45V

- The 45V Clean Hydrogen Production Tax Credit value is based on lifecycle production emissions and is worth up to **\$3/kgH₂** (equiv. to ~\$60/MWh)
- Lifecycle GHGs are calculated via GREET's new 45VH2 Module
- U.S. Treasury published draft rules in Dec. 2023 (aligning with EU) but has not yet issued final rules



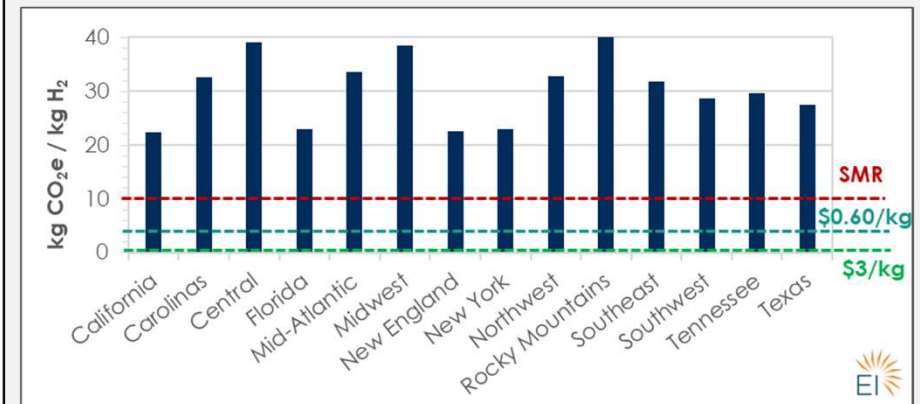
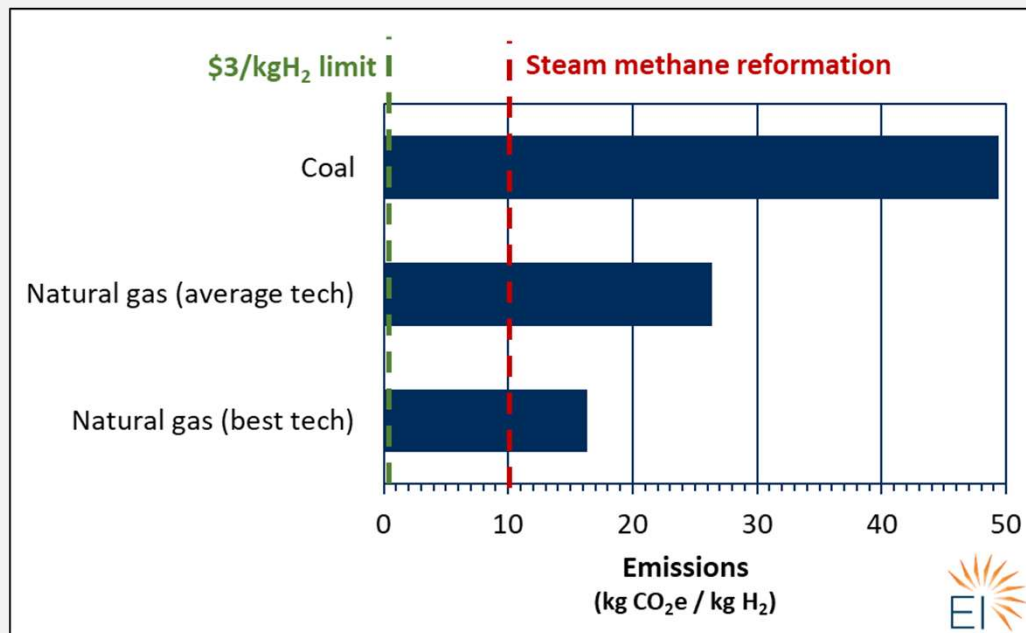
The credit values shown above depend on meeting prevailing wage and apprenticeship requirements; otherwise, divide values by 5.



Key Resources



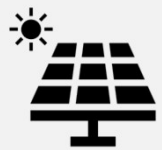
Production: Emissions Impact of Grid Electrolysis



Key Resources



Production: “Three Pillars” of Clean Electrolysis



Incrementality

Use new sources of clean electricity



Deliverability

Use local, deliverable sources of clean electricity



Time-matching

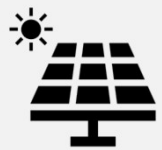
Ensure electrolyzer runs at same time of clean electricity generation



Key Resources



Production: Treasury's Draft Implementation



Incrementality

Electrolyzers must use clean energy built within 36 months of when electrolyzers begin commercial operations



Deliverability

Electrolyzers must use clean energy that exists within the same Department of Energy Transmission Needs Study region



Time-matching

All electrolyzers must hourly match their use of clean energy beginning in 2028 (with no grandfathering of old projects)



Key Resources



Production: Three Pillars' Benefits for H₂ Industry

Keys Enabled by 3 Pillars



Flexible Production



Confident Off-takers



Supportive Public

Risk Reduction Impact

Allows for profitable production after credit cliff

Ensures H₂ market grows rather than drying up

Reduces chance of policy support being revoked



Key Resources



Production: Flexible Production Key (1)



BTM Nuclear Example

Electrolyzer: gets \$80/MWh revenue
(\$1/kg sale price + \$3/kg 45V credit)

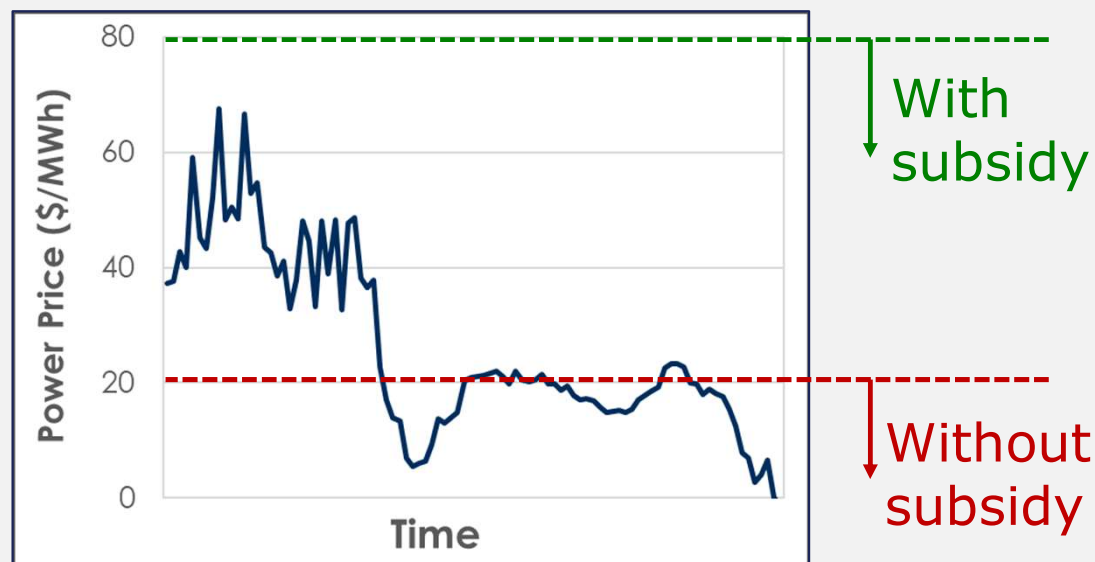
Nuke: needs \$45/MWh

Profit during 45V: \$35/MWh

Shortfall after 45V: \$25/MWh

Marginal H₂ production cost
of \$1/kg requires **<\$20/MWh**

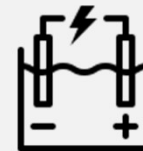
Grid-Connected Example



Key Resources



Production: Flexible Production Key (2)



Very low or negative
power prices
(competitively-priced H₂)

Excess renewables

Electrolyzer online



Higher power prices
(couldn't sell H₂)

Fossil power online

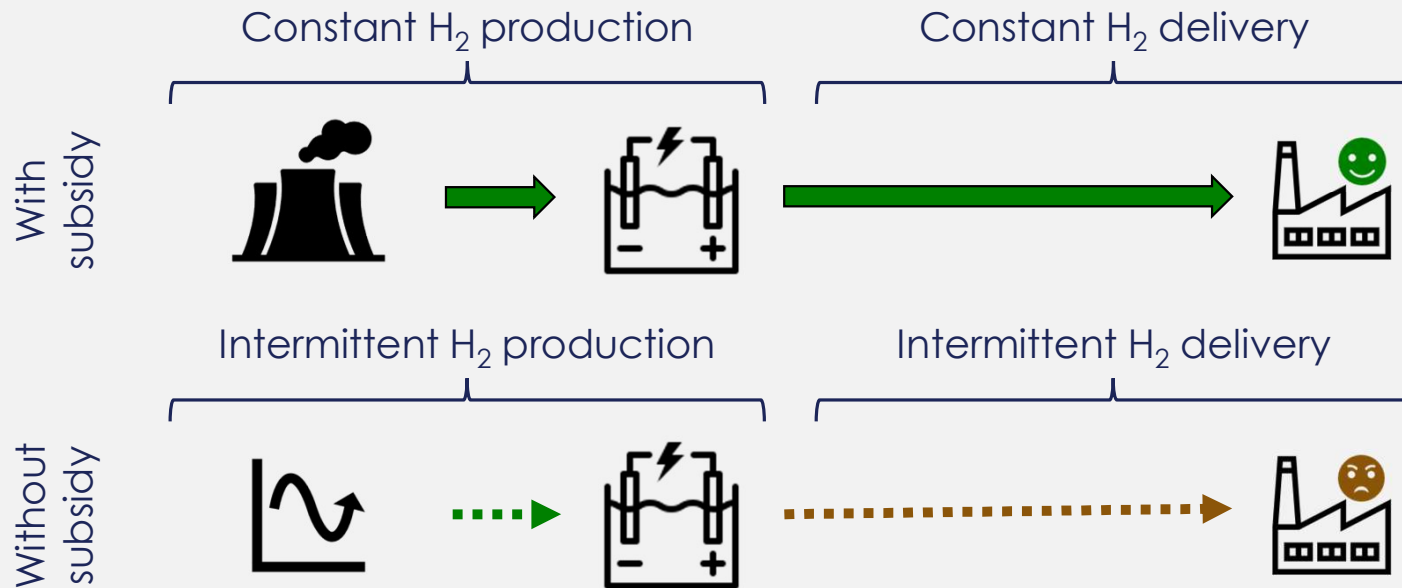
Electrolyzer offline



Key Resources



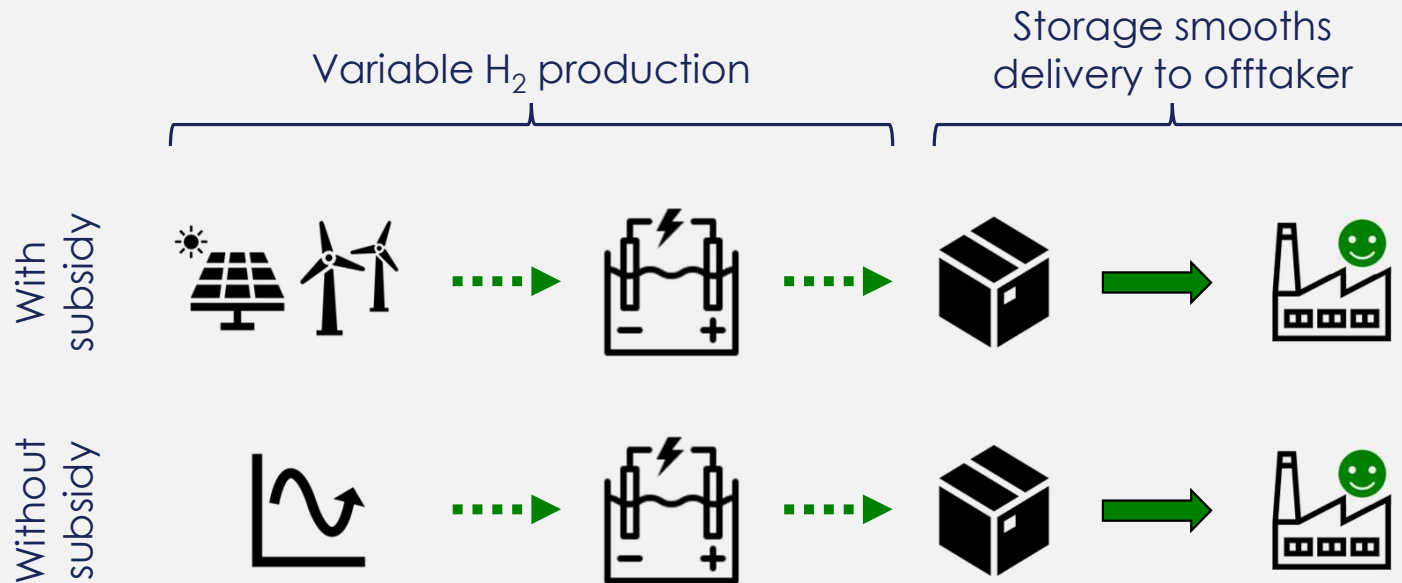
Production: Confident Off-takers Key (1)



Key Resources



Production: Confident Off-takers Key (2)



Key Resources



Context

Production

Use

Recap

Production: Industry Support for Three Pillars

Acciona & Nordex Green Hydrogen
Avantus
EDP Renewables
Electric Hydrogen
Fervo Energy
Firstlight Power
First Solar
GridStor
Leeward Renewable Energy
Nucor
Synergetic

<https://s3.documentcloud.org/documents/23854072/hourly-matching-industry-letter-final.pdf>



<https://www.airproducts.com/energy-transition/air-products-response-to-45v>

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<https://www.taxnotes.com/research/federal/other-documents/irs-tax-correspondence/group-urges-hourly-matching-implementation-for-hydrogen-credit/7h1c6>



<https://greenh2catapult.com/2023/11/06/joint-letter-on-45v-implementation/>

Hy Stor Energy LP
Air Products
ACCIONA & Nordex Green Hydrogen
CWP Global
Fervo Energy
Synergetic
Strata Clean Energy - P2X
Rondo Energy

<https://hystorenergy.com/wp-content/uploads/2024/03/45V-NPRM-Industry-Support-Letter-March-1-2024.pdf>



Key Resources



Context

Production

Use

Recap

Hydrogen's competitive prospects for decarbonization by end-use sector

EXCELLENT



Refining



Ammonia

GOOD



Primary Steel



Aviation (Long-Haul)



Marine Shipping (Long-Haul)



Petrochemicals

UNCERTAIN



Seasonal Electricity Storage



Aviation (Short-Haul)

POOR



Heavy-Duty Vehicles



Industrial Process Heat



Marine Shipping (Short-Haul)

TERRIBLE



Day-to-Day Power Generation



Light-Duty Vehicles



Buildings

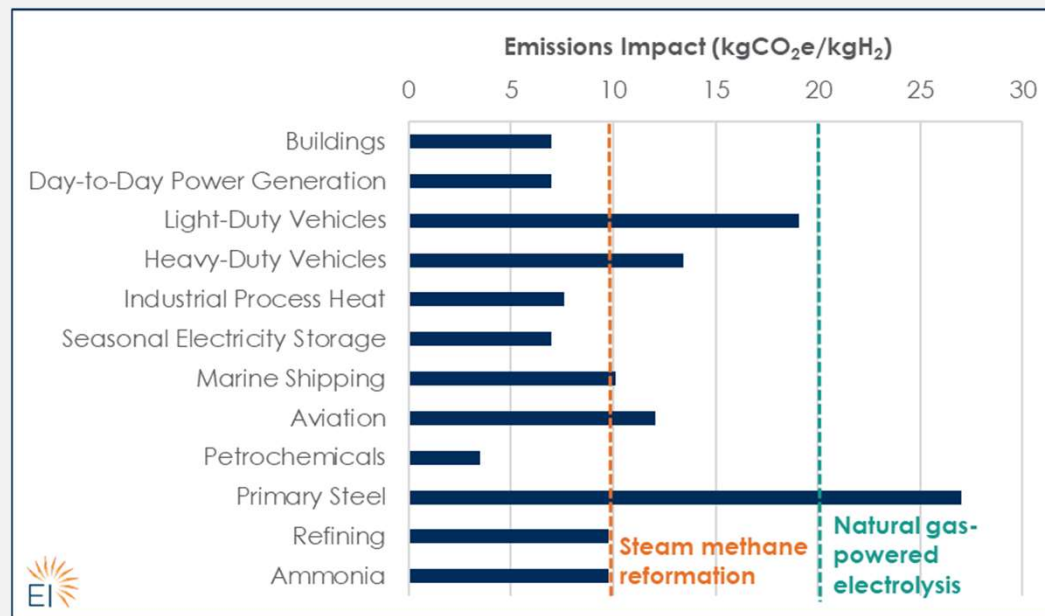
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Use: Net Climate Pollution Impact



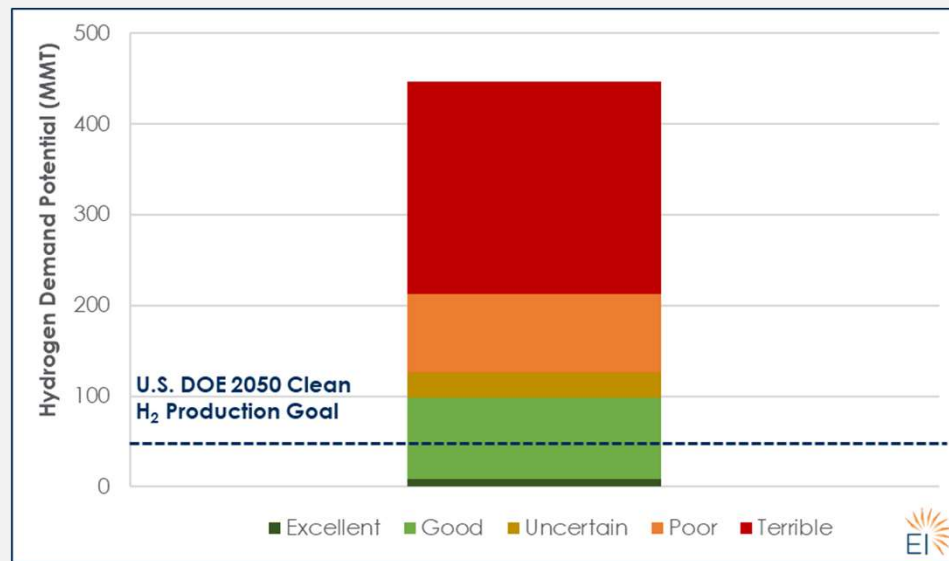
<https://energyinnovation.org/publication/hydrogen-policies-narrow-path-delusions-and-solutions/>



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Use: U.S. Hydrogen Demand Potential



<https://energyinnovation.org/publication/hydrogen-policys-narrow-path-delusions-and-solutions/>



Key Resources



Recap

- Hydrogen is a means to an end (decarbonization) and should not be viewed as an end in itself
- The “three pillars” enable truly clean hydrogen production that will:
 - (1) have lasting market value (incl. access to EU buyers); and
 - (2) allow for a low-cost, reliable product after subsidies expire
- 45V is rich-enough to make hydrogen *look* attractive in arenas where it will not be able to compete with alternatives once on a level playing field -- but, there is massive market potential in sectors where hydrogen should be competitive long term



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