CleanEnergyGroup

DOE'S REGIONAL HYDROGEN HUBS:

CLIMATE SOLUTION, OR CLIMATE DISASTER?

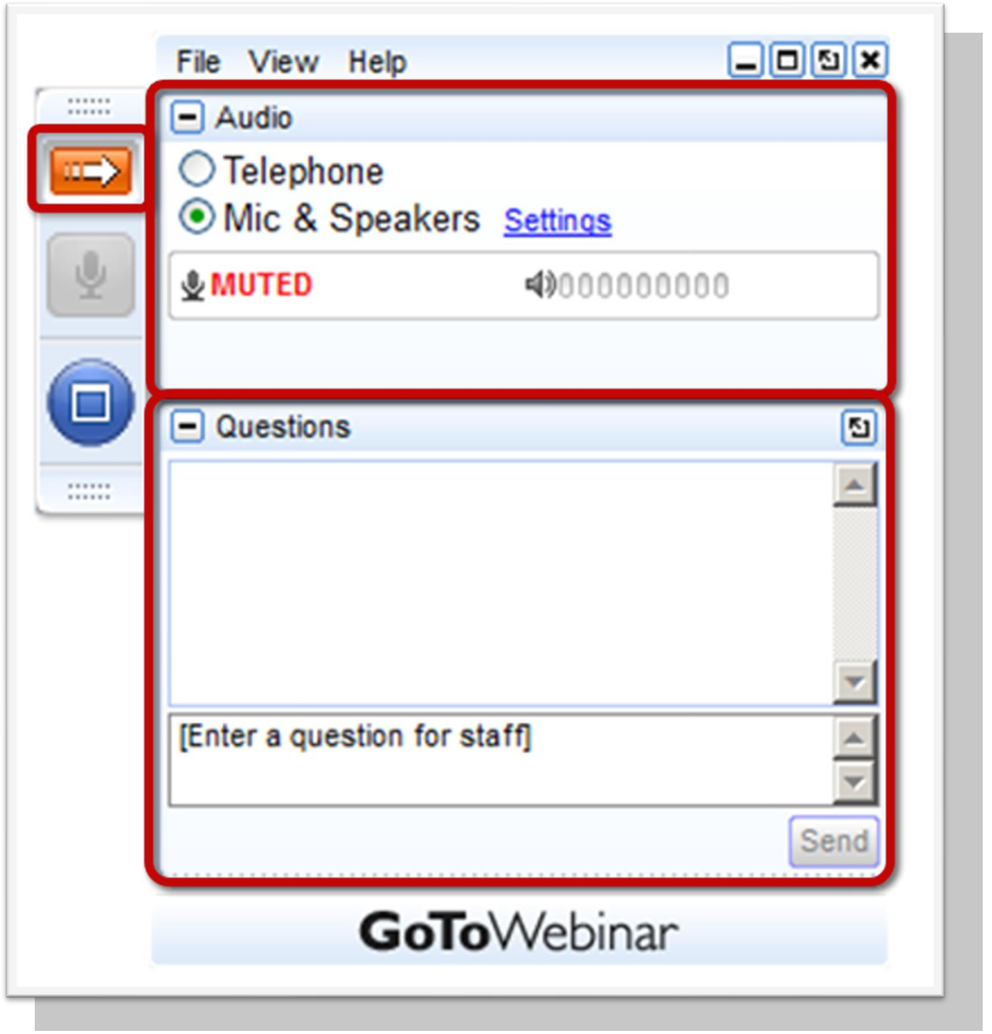
January 18, 2024

Webinar Logistics

Use the orange arrow to open and close your control panel

Submit questions and comments via the Questions panel

This webinar is being recorded. We will email you a webinar recording within 48 hours. This webinar will be posted on CEG's website at www.cleanegroup.org/webinars



Clean Energy Group

Affordable, reliable, clean energy for all.

Climate Resilience and Community Health

Distributed Energy Access and Equity

Energy Storage and Flexible Demand

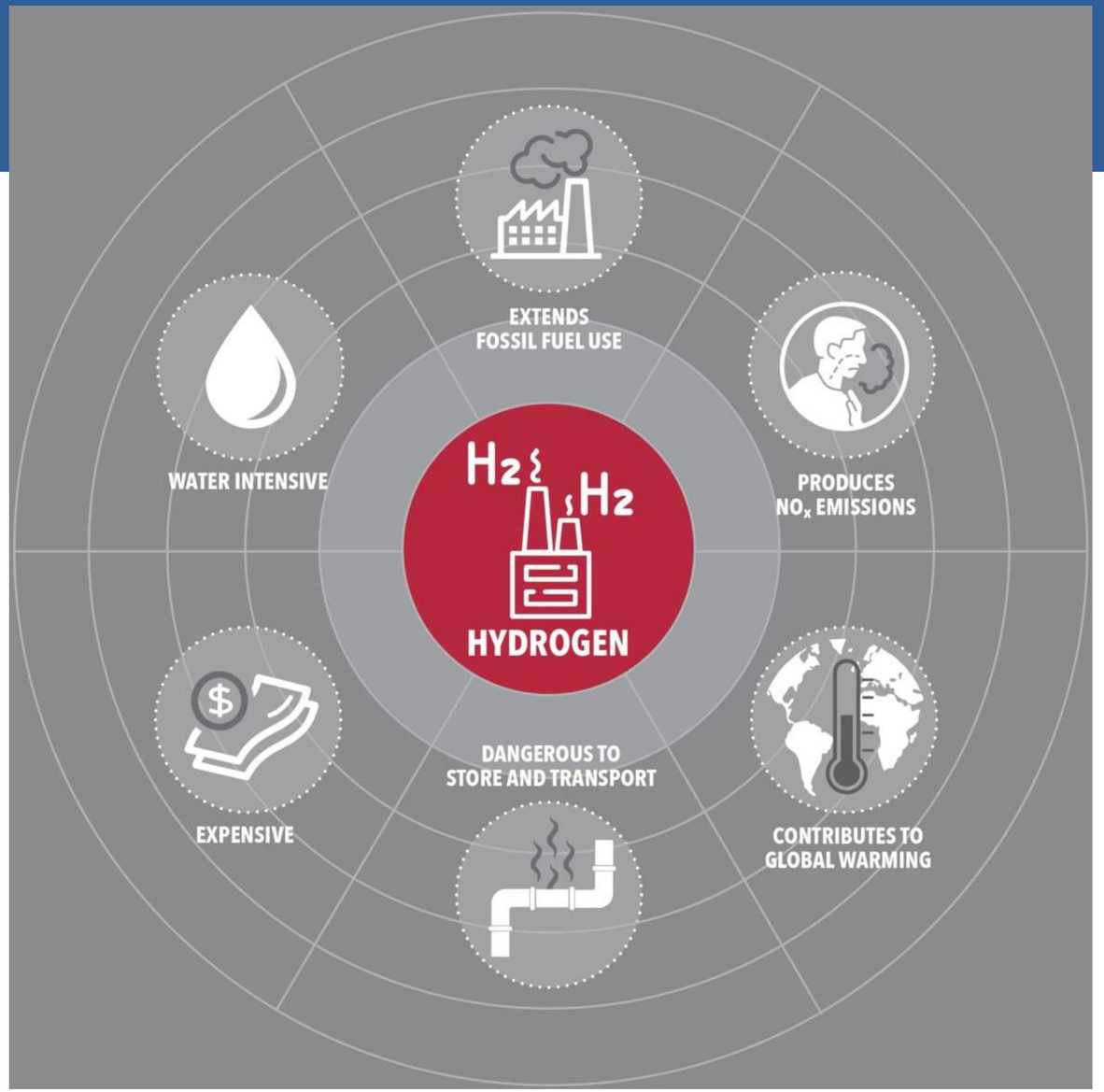
Fossil Fuel Replacement

www.cleanegroup.org

Clean Energy Group

Hydrogen Information & Public Education

Raising awareness of the health and environmental impacts of hydrogen production and use.



© Clean Energy Group

NEW YORK CITY ENVIRONMENTAL JUSTICE ALLIANCE

EARTHJUSTICE
BECAUSE THE EARTH NEEDS A GOOD LAWYER

NYLPI
JUSTICE THROUGH COMMUNITY POWER

THE POINT

UPROSE

www.cleanegroup.org/initiatives/hydrogen

Webinar Speakers

DOE'S Regional Hydrogen Hubs: Climate Solution, or Climate Disaster?

Abbe Ramanan

Project Director
Clean Energy Group

Amanda McKay

Policy Manager
Pipeline Safety Trust

David Schlissel

Director of Resource Planning Analysis
IEEFA

Anika Juhn

Data Visualization Analyst
IEEFA

CleanEnergyGroup

Pipeline Safety TRUST

Institute for Energy Economics and Financial Analysis
IEEFA.org

Thank You

Abbe Ramanan
Project Director
Clean Energy Group
Abbe@cleanegroup.org

Upcoming Webinars

Replacing NYC's Peaker Plants with Clean Alternatives: Progress, Barriers, and Pathways Forward
(February 6)

Solar Adopter Income and Demographic Trends: An Update from Berkeley Lab
(February 15)

Read more and register at www.cleanegroup.org/webinars

CleanEnergyGroup

www.cleanegroup.org | info@cleanegroup.org

JANUARY 26, 2024

Federal Hydrogen Incentives

Abbe Ramanan

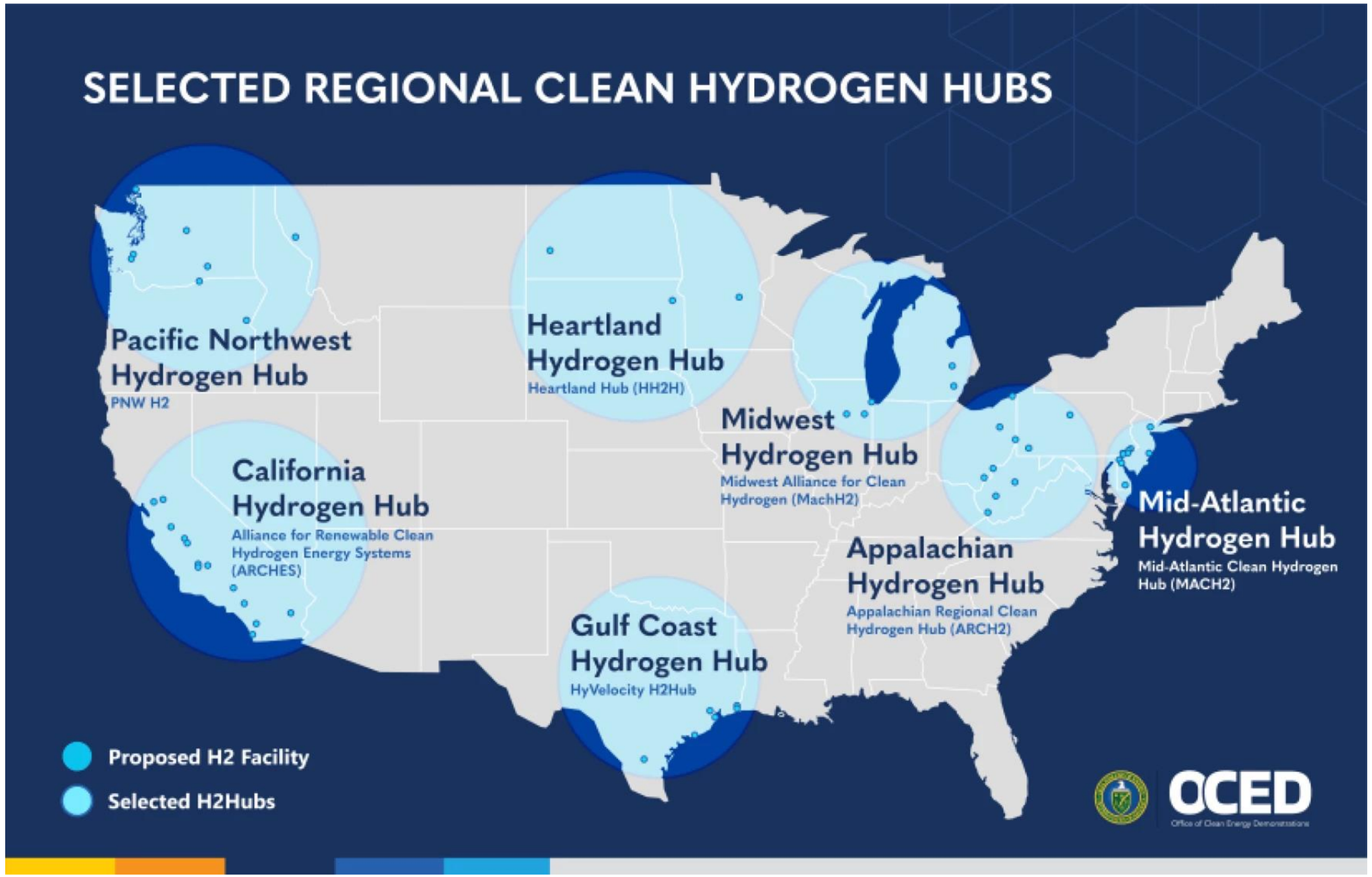
Project Director

Clean Energy Group

Abbe@cleanegroup.org

What are the Regional Clean Hydrogen Hubs (H2Hubs)?

- Seven regional hydrogen production Hubs, awarded $7 billion in funding in Oct. 2023.
- More that half of funding went to blue hydrogen hubs, which will produce hydrogen from fossil fuels.
- Award negotiations happening this winter, few details shared with the public.
- DOE has stated that Community Benefit Plans (CBPs) will be heavily weighted in the negotiation process but its unclear how CBPs will be created or evaluated.



Other Federal Hydrogen Incentives

- **45V Hydrogen Production Tax Credit**: 45V is a tiered incentive based on CO2-equivalent emissions. Carbon-free hydrogen is eligible for a $3.00/kgH2 credit over 10 years.
  - **Subsidies from 45V could exceed $70 billion over the next decade (BloombergNEF)**

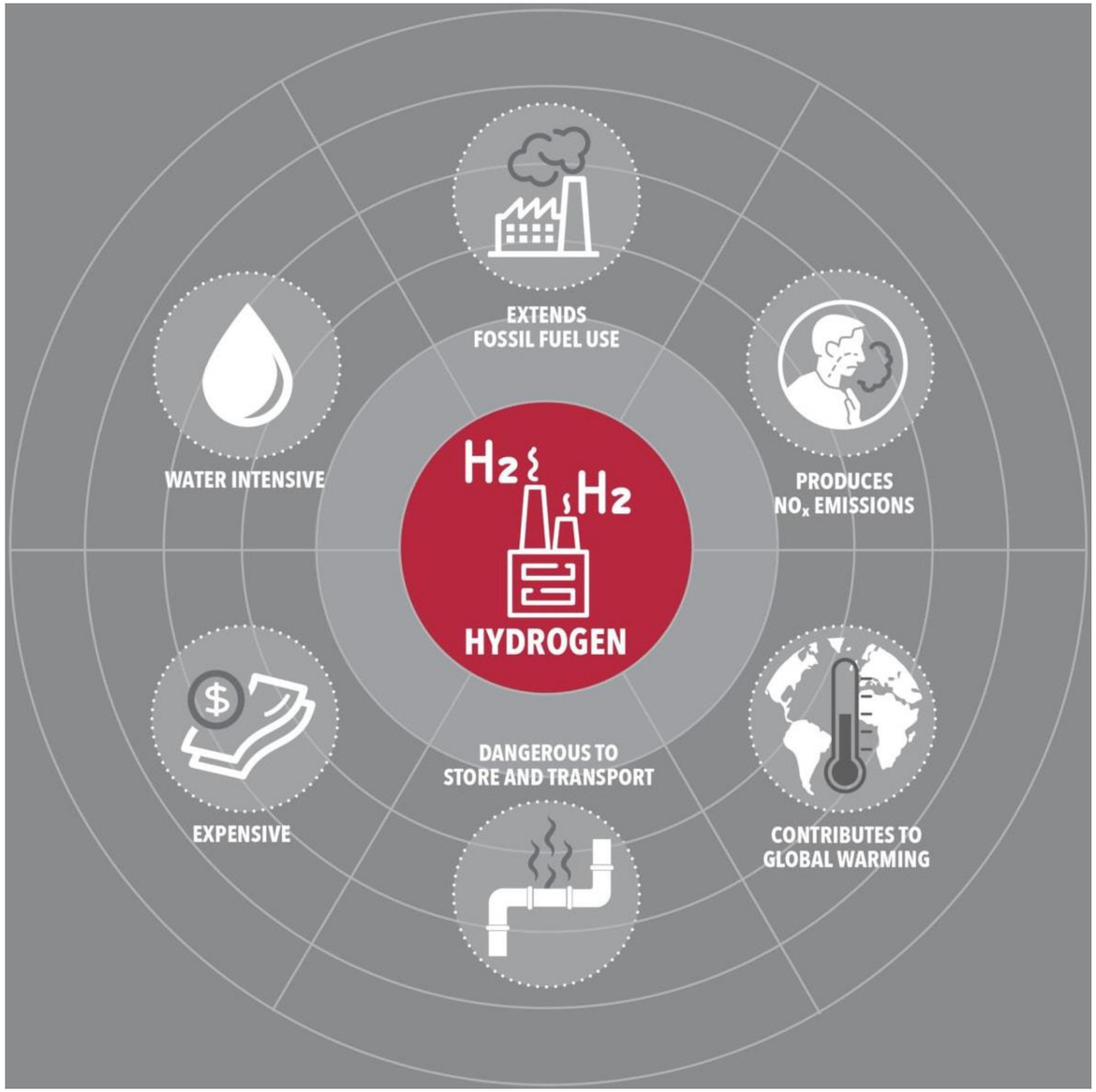
- **45Q Carbon Capture Production Tax Credit:** Tiered incentive per metric ton[3] of carbon that is captured and either sequestered or used in enhanced oil recovery (EOR). Sequestered carbon is eligible for up to $85/ton.

45V Clean Hydrogen Production Tax Credit Tiers

Emissions Intensity (kg of CO2e per kg of H2)	Maximum credit ($/kgH2, assuming prevailing wage and apprenticeship requirements are met)
0 - 0.45kg	$3.00
0.45 -1.5kg	$1.00
1.5 - 2.5kg	$0.75
2.5 - 4kg	$0.60

Other H2Hub Harms

- **Water Intensity:** Electrolysis powered by renewable energy is the only carbon-free way to make hydrogen. However, it uses significant amounts of water, up to 2 tons per 1 ton of hydrogen produced.
- **NOx Emissions:** When combusted, such as in a power plant, hydrogen produces six times as much of the harmful air pollutant nitrogen oxide as natural gas.



Engaging at the Federal Level

Hydrogen Hubs

DOE Hydrogen Hubs general email: Engage_H2Hubs@hq.doe.gov.

- Appalachian Hydrogen Hub (ARCH2): appalachianh2hub@hq.doe.gov
- California Hydrogen Hub (ARCHES): californiah2hub@hq.doe.gov
- Gulf Coast Hydrogen Hub (HyVelocity H2Hub): gulfcoasth2hub@hq.doe.gov
- Heartland Hydrogen Hub (HH2H): HeartlandH2Hub@hq.doe.gov
- Mid-Atlantic Hydrogen Hub (MACH2): midatlantich2hub@hq.doe.gov
- Midwest Hydrogen Hub (MachH2): MidwestH2Hub@hq.doe.gov
- Pacific Northwest Hydrogen Hub (PNWH2): PacificNWH2Hub@hq.doe.gov

45V Tax Credit

- Comments being accepted until February 26, 2024: https://www.federalregister.gov/documents/2023/12/26/2023-28359/section-45v-credit-for-production-of-clean-hydrogen-section-48a15-election-to-treat-clean-hydrogen

Pipeline Safety TRUST

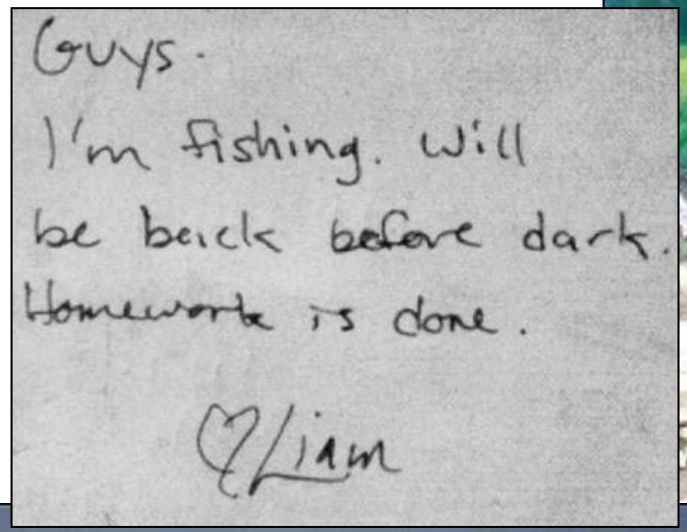
Credible.
Independent.
In the public interest.

Hydrogen Pipeline Safety

January 18, 2024

Amanda McKay, Policy Manager

Pipeline Safety Trust History



Pipeline Safety TRUST

PST: Hydrogen pipeline safety

- Strong incentives in 2021 Infrastructure Bill and 2022 IRA
- Report from University of California Riverside for CPUC that identifies risks and safety gaps
- American Gas Association includes a 20% blend of hydrogen in its Net Zero plan
- PST white paper

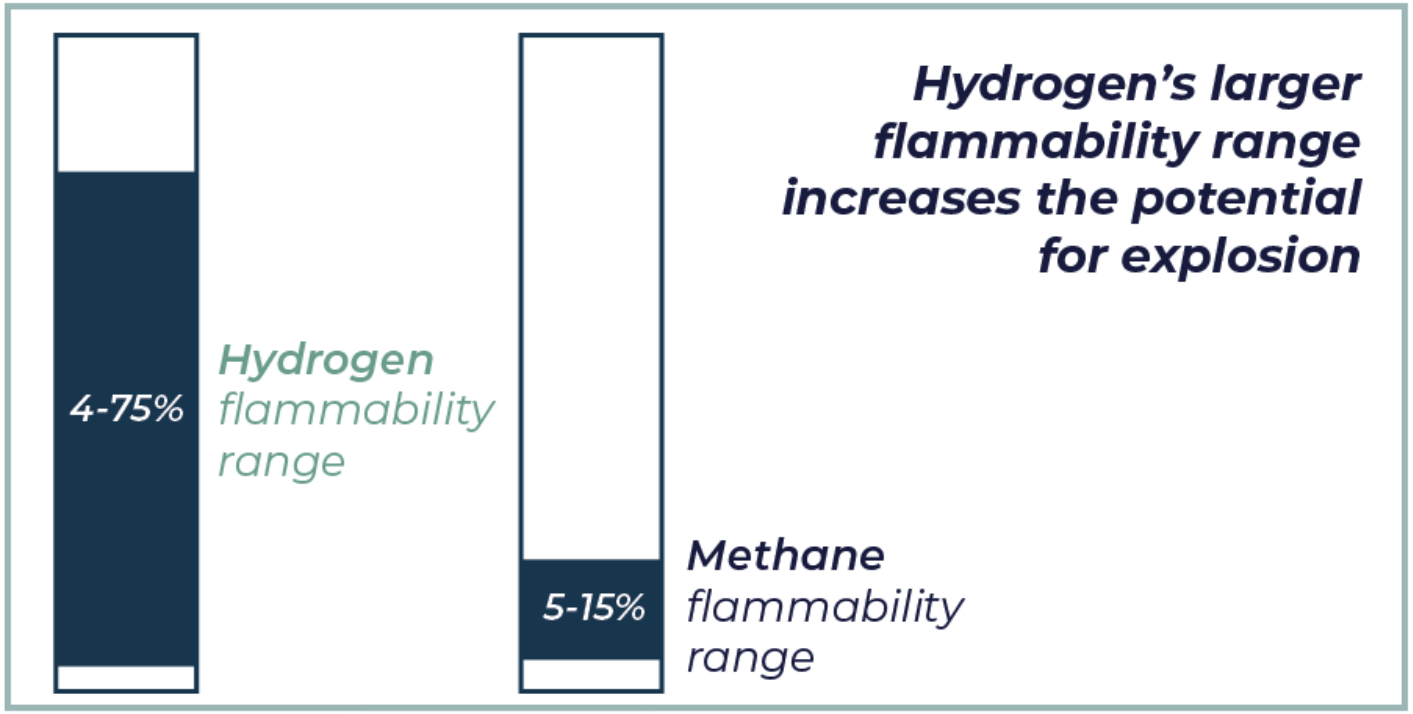
Pipeline Safety TRUST

Hydrogen: Current infrastructure

- 1,500 miles of hydrogen pipelines
- 85% of mileage with three operators
- Relatively rural and small diameter
- Falls under PHMSA natural gas regulations

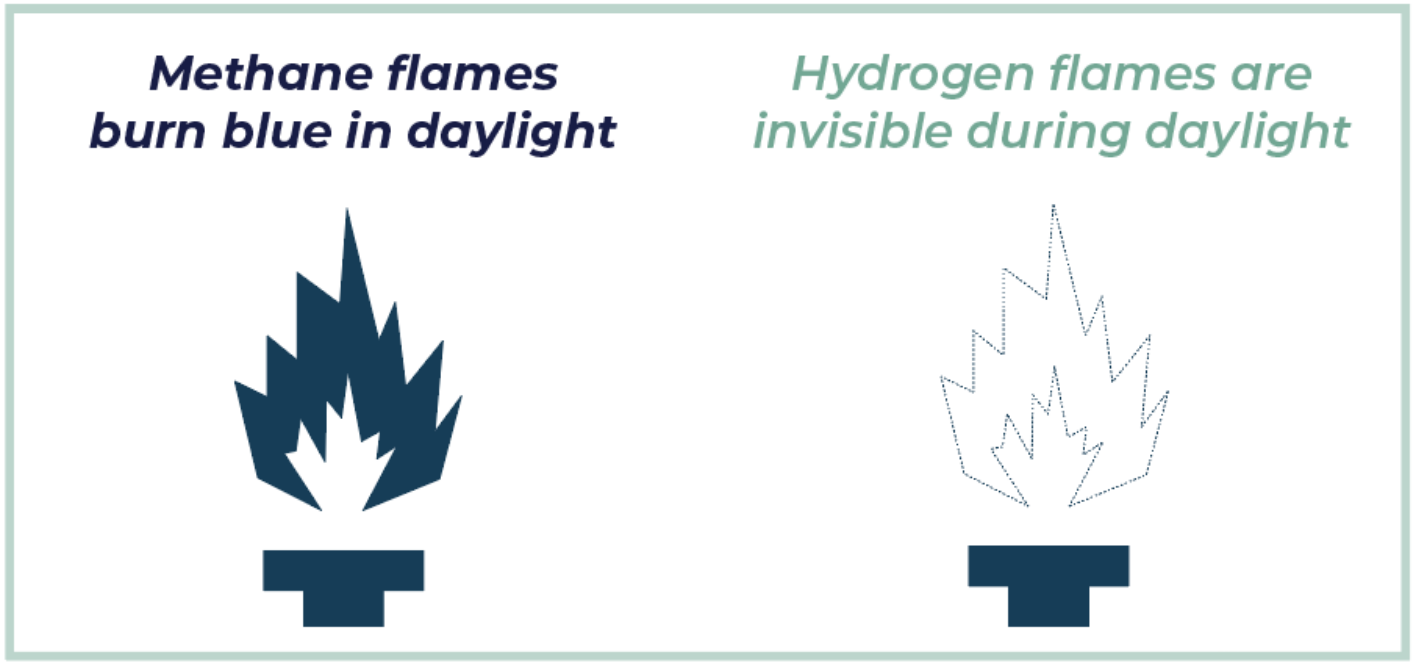
Pipeline Safety TRUST

Hydrogen: Riskier than methane



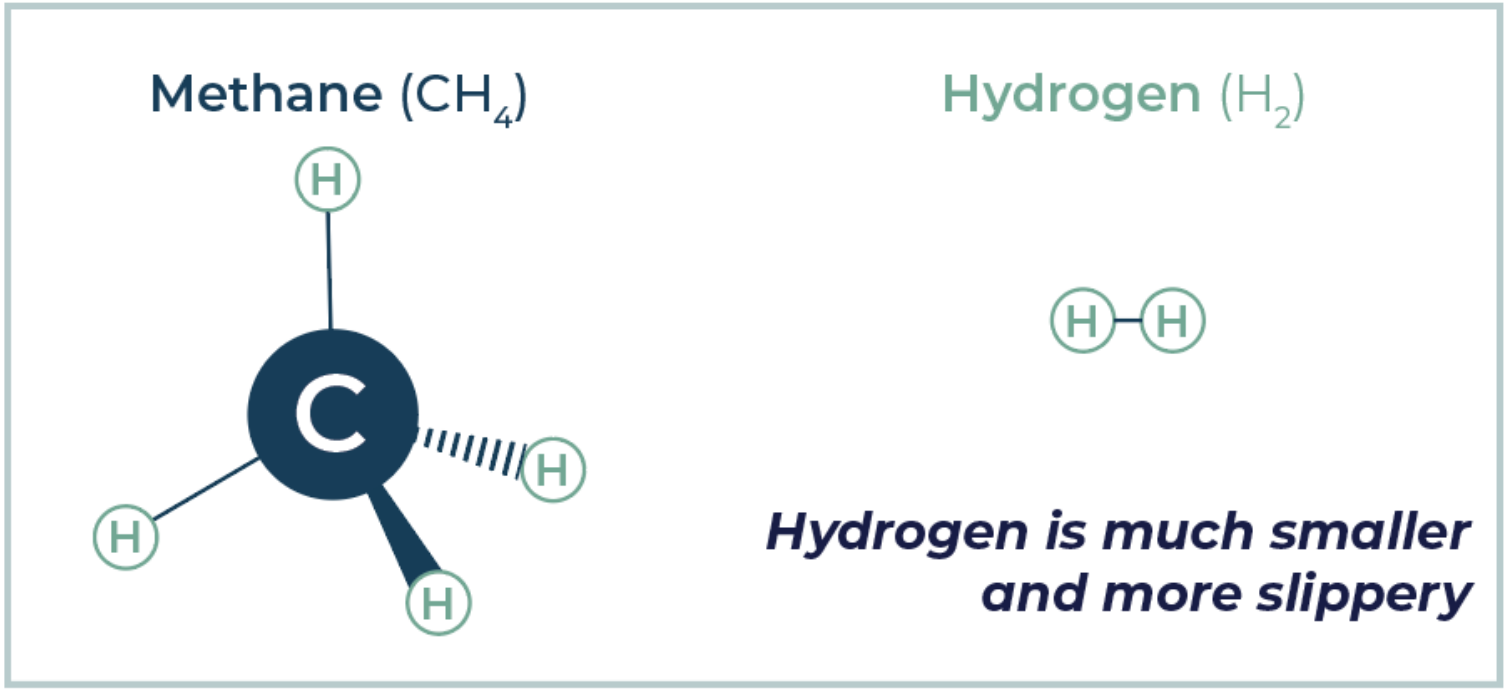
Pipeline Safety TRUST

Hydrogen: Riskier than methane



Pipeline Safety TRUST

Hydrogen: Riskier than methane



Pipeline Safety TRUST

Hydrogen: Riskier than methane

- H_2 can leak at higher rates than methane, given its small size and viscosity
- It can migrate underground and accumulate in basements or other confined spaces

Pipeline Safety TRUST

Hydrogen: Riskier than methane

- H_2 causes integrity issues in both steel and certain polyethylene leading to embrittlement and cracking
- We expect systems with hydrogen to fail at higher rates without further R&D to close knowledge gaps and extensive infrastructure overhauls

Pipeline Safety TRUST

Hydrogen: Riskier than methane

- All these factors lead to the fact that hydrogen pipelines can be more likely to explode than methane pipelines

Pipeline Safety TRUST

Hydrogen: Climate issues

- H_2 has lower energy density by volume than methane
- Not a 1-to-1 mitigation of greenhouse gas emissions
- For example, a 10% hydrogen blend would lead to an approximate 3% reduction in greenhouse gases (before accounting for leakage)

Pipeline Safety TRUST

Hydrogen: Climate issues

- Again, hydrogen can leak at higher rates than methane
- Important because H_2 is an indirect greenhouse gas with over 30 times the warming power of CO_2 in its first 20 years
- Leakage will erode climate benefits or could even contribute to warming

Pipeline Safety TRUST

Hydrogen: Knowledge gaps

- The knowledge gaps identified in the recent University of California Riverside Hydrogen Blending Report should be addressed and the results made public.
- The report, focused on hydrogen blending, identifies knowledge gaps with blending rates as low as 2% in areas such as inspection and maintenance and underground gas storage. Beyond 10%, the knowledge gaps extend to network management and compression. Further knowledge gaps exist for blending hydrogen up to 30% in distribution, safety, and end-use equipment. The amount of knowledge gaps beyond 50% blends becomes very significant.
- Further research should be pursued to assess hydrogen compatibility of steel transmission pipelines and their components.
- Further research should fully explore and confirm the heat release capability and combustion dynamics from pipelines containing hydrogen, both as leaks and ruptures.

Pipeline Safety TRUST

Hydrogen: Safety recommendations

- Gas utilities should not pursue hydrogen blending into their systems, and regulators should prohibit the blending of hydrogen in gas distribution systems that serve homes and commercial buildings and transmission pipelines that serve distribution systems.
- PHMSA should update reporting requirements to include documentation of any percentage of hydrogen blended into a transportation pipeline.
- Existing transmission pipelines that should not be candidates for hydrogen transportation should be clearly identified.
- PHMSA should require gas transmission pipelines converting to transport hydrogen, either blends or higher purity, to conduct spike hydrotests.
- Pipeline safety leakage survey regulations should be developed for pipelines transporting hydrogen.

Pipeline Safety TRUST

Hydrogen: Resources

- PST report summary
- PST full report
- University of California Riverside hydrogen blending report
- Study on hydrogen's indirect greenhouse gas effect

Pipeline Safety TRUST

Thank you!

Amanda McKay
Policy Manager
Pipeline Safety Trust

amanda@pstrust.org
360-543-5686 Ext. 106
www.pstrust.org

Pipeline Safety TRUST

Institute for Energy Economics and Financial Analysis

Blue Hydrogen: A Dirty and Shockingly Expensive Proposition

Anika Juhn

David Schlissel

January 18, 2024

Blue Hydrogen Is Not Clean or Low Carbon

Examining Blue Hydrogen Carbon Intensity

U.S. standard defines **clean hydrogen** as having a carbon intensity of **≤4.0 kilograms (kg) CO_2e emitted / kg H_2 produced**

We found **four key assumptions** in the DOE GREET model that result in an underestimation of the carbon intensity of blue hydrogen

Examining Blue Hydrogen Carbon Intensity

U.S. standard defines **clean hydrogen** as having a carbon intensity of **≤4.0 kilograms (kg) CO_2e emitted / kg H_2 produced**

We found **four key assumptions** in the DOE GREET model that result in an underestimation of the carbon intensity of blue hydrogen

1

Use of **100-year GWP** for methane and no GWP for hydrogen

= significant **understatement of warming impact** in the short term

Examining Blue Hydrogen Carbon Intensity

U.S. standard defines **clean hydrogen** as having a carbon intensity of **≤4.0 kilograms (kg) CO_2e emitted / kg H_2 produced**

We found **four key assumptions** in the DOE GREET model that result in an underestimation of the carbon intensity of blue hydrogen

1

Use of **100-year GWP** for methane and no GWP for hydrogen

= significant **understatement of warming impact** in the short term

2

Very low upstream **methane emissions rate of 0.9%**

= far **lower than recent scientific analyses** as well as satellite and air surveys of basins

Examining Blue Hydrogen Carbon Intensity

U.S. standard defines **clean hydrogen** as having a carbon intensity of **≤4.0 kilograms (kg) CO_2e emitted / kg H_2 produced**

We found **four key assumptions** in the DOE GREET model that result in an underestimation of the carbon intensity of blue hydrogen

1

Use of **100-year GWP** for methane and no GWP for hydrogen

= significant **understatement of warming impact** in the short term

2

Very low upstream **methane emissions rate of 0.9%**

= far **lower than recent scientific analyses** as well as satellite and air surveys of basins

3

Nearly complete **CO_2 capture** in the production process

= overly optimistic **carbon capture rates not proven** over long term at commercial scale

Examining Blue Hydrogen Carbon Intensity

U.S. standard defines **clean hydrogen** as having a carbon intensity of **≤4.0 kilograms (kg) CO_2e emitted / kg H_2 produced**

We found **four key assumptions** in the DOE GREET model that result in an underestimation of the carbon intensity of blue hydrogen

1. Use of **100-year GWP** for methane and no GWP for hydrogen

   = significant **understatement of warming impact** in the short term

2. Very low upstream **methane emissions rate of 0.9%**

   = far **lower than recent scientific analyses** as well as satellite and air surveys of basins

3. Nearly complete **CO_2 capture** in the production process

   = overly optimistic **carbon capture rates not proven** over long term at commercial scale

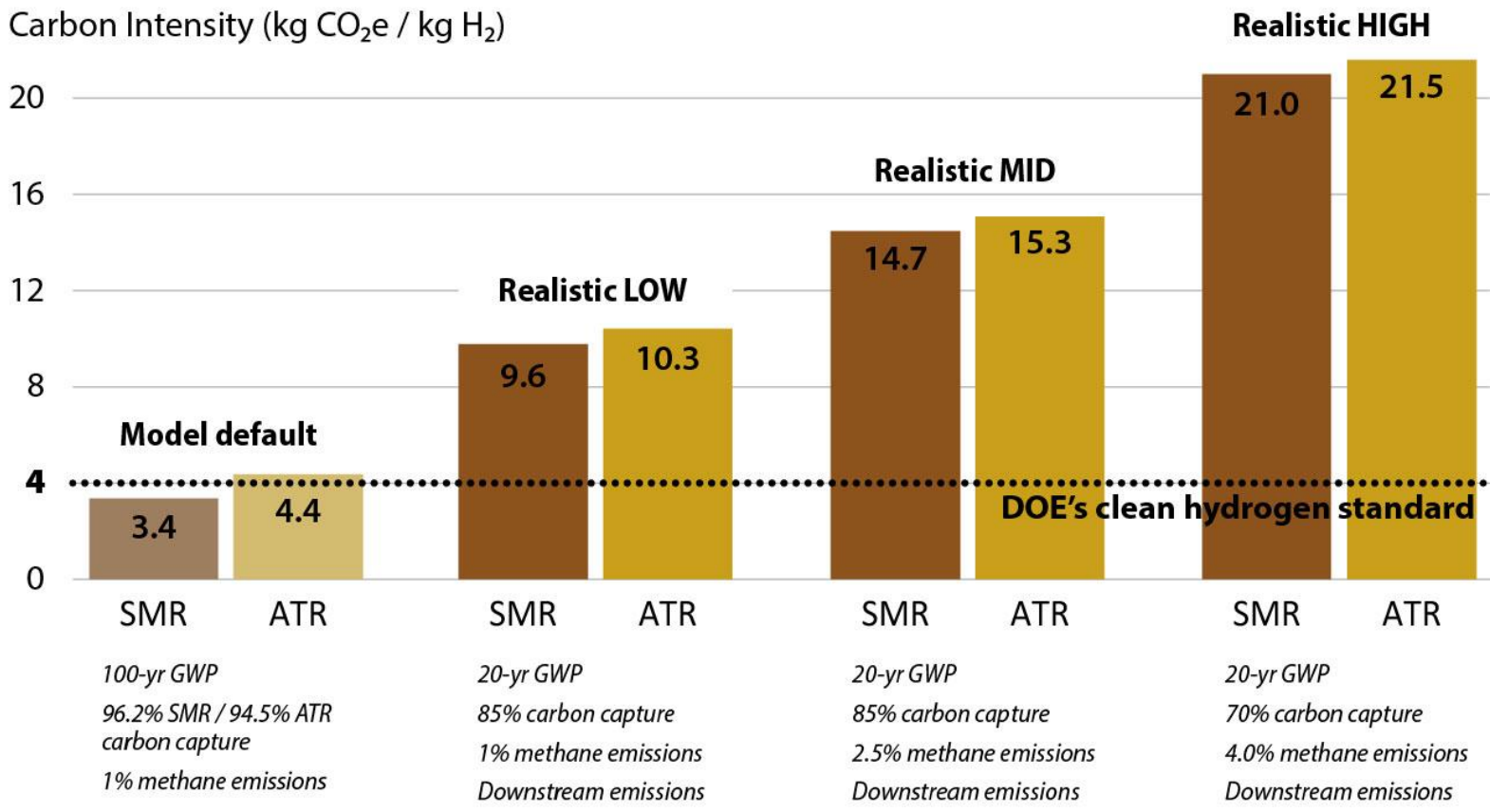
4. Exclusion of all downstream **hydrogen-related emissions**

   = omits significant **H_2 leakage** potential and energy required to **transport H_2**

IEEFA Estimates for Blue Hydrogen Carbon Intensity

Even accepting DOE GREET model optimistic assumptions, blue hydrogen barely meets the clean standard for SMR and fails to meet it with ATR.

With more realistic assumptions, including high CO_2 capture rates, the carbon intensity of blue hydrogen could be substantially higher than the clean standard.



Carbon Capture Is The Key to Blue Hydrogen Financial Viability

Multiple Sources of Funding for Blue Hydrogen

Hydrogen Hub Funding

- Funds are in the form of DOE grants that are issued to applicants after certain milestones and other criteria are met.
- Projects within hubs may also be receiving funds from other Federal programs.

45V Tax Credit

- 45V is based on kilograms of hydrogen produced and how "clean" the hydrogen is.
- No credit is issued under 45V for hydrogen that has a carbon intensity above 4.0 kg CO_2e / kg H_2, i.e. the clean standard.

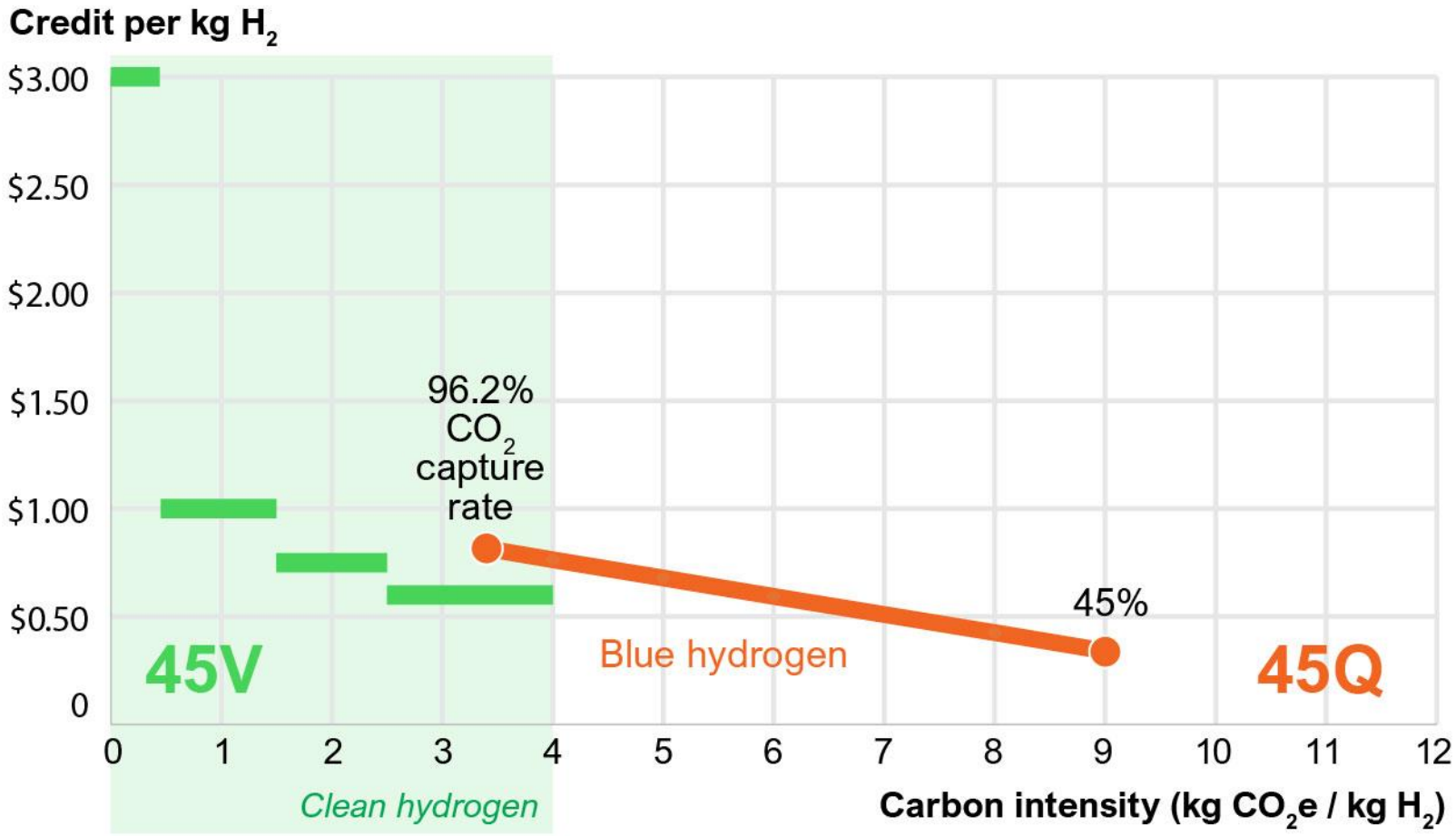
45Q Tax Credit

- 45Q targets carbon capture.
- $85 per tonne CO_2 captured and permanently stored and $65 for CO_2 used for enhanced oil recovery (EOR) or other purposes.
- Cannot be combined with 45V.
- Will be tens of billions of dollars in subsidies to hydrogen producers

45V Versus 45Q

45V incentivizes clean hydrogen production but this has little to no relevance for blue hydrogen

Blue hydrogen producers can reap generous credits via 45Q, even when CO_2 capture rates are much lower than promised and the hydrogen is far dirtier than the clean standard

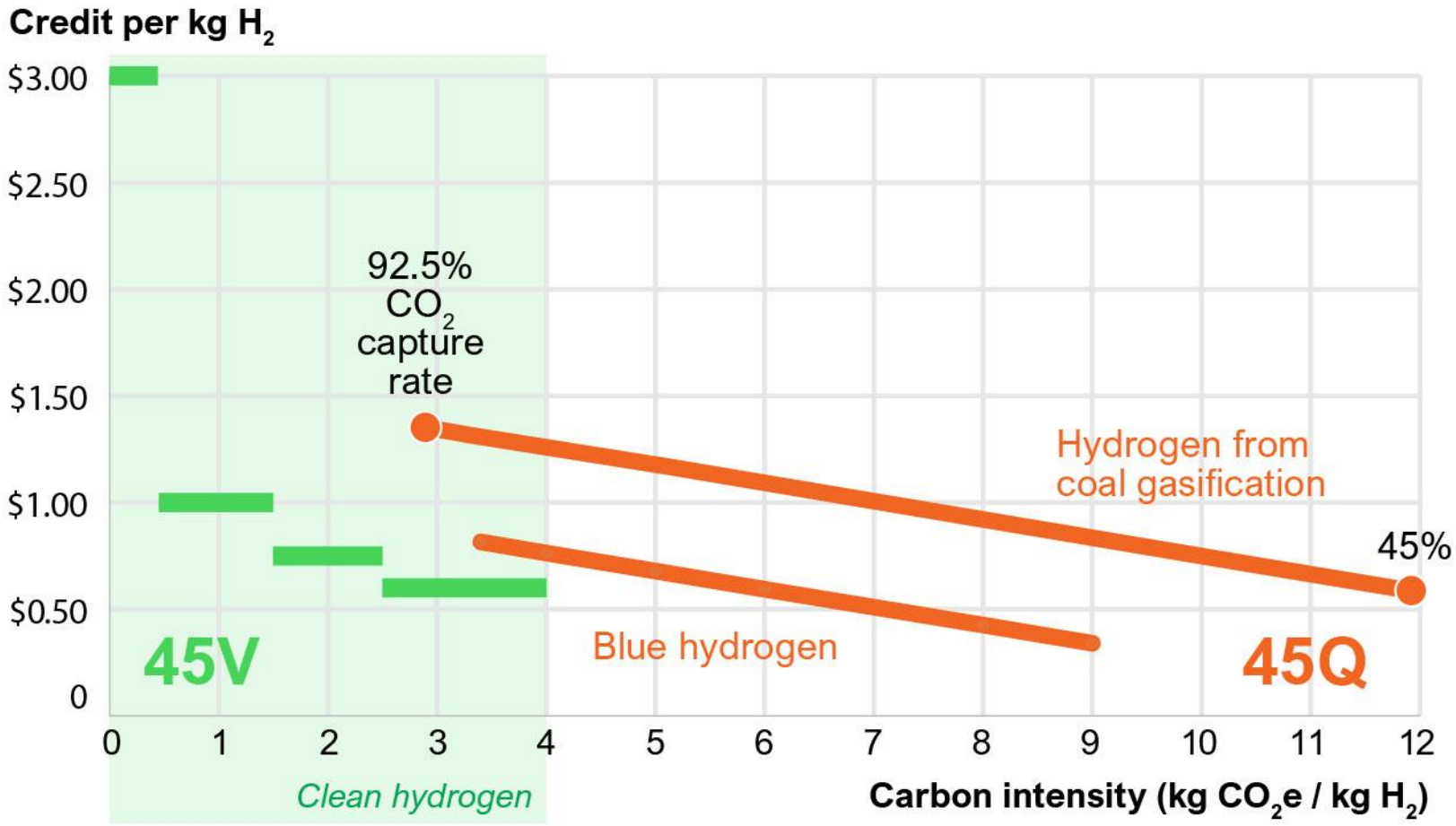


45V Versus 45Q

Coal gasification is a very CO_2-intensive production pathway

More CO_2 produced = more available to capture

At just 45% carbon capture, the carbon intensity is 3 times the clean standard and the project could harvest a credit per kg H_2 as large as if it was “clean”



How Much Money Is This in the Real World?

Air Products plant in Louisiana

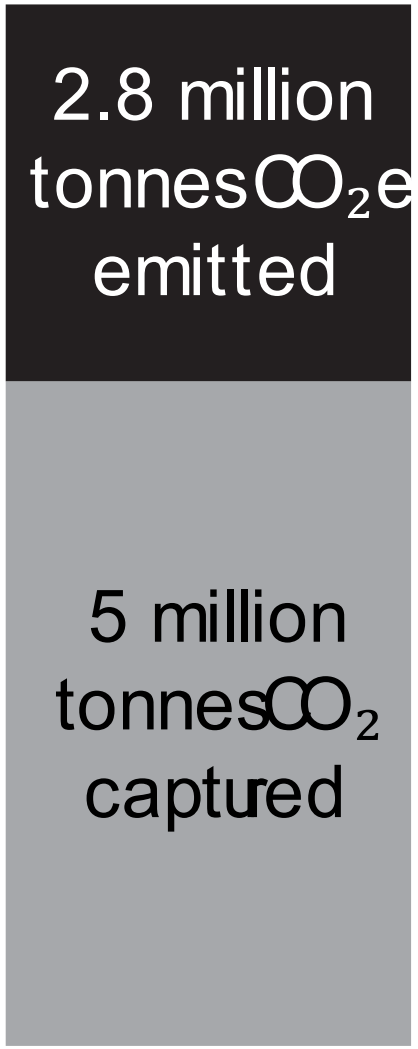
585,000 tonnes hydrogen per year (assuming 90% capacity factor)

Plans to capture 5 million tonnes CO_2 per year, a 90% capture rate at the production facility that represents just 64% of the CO_2e for the lifecycle

Overall carbon intensity of 4.8 kg CO_2e / kg H_2 = Does <u>not</u> qualify for 45V

45Q

$425 million per year



Even More Money?

ExxonMobil website states that current $85 per tonne 45Q credit should be initially increased to about $100 and eligibility extended from 12 years to 30.

A December 2023 letter, signed by over 50 unions, non-profits, and energy companies (including the Carbon Capture Coalition) asked Congress to approve changes to 45Q that would raise the credit for EOR/other uses to $85/tonne, equal to the credit for permanent geologic storage.

ENHANCE THE CCS PRODUCTION TAX CREDIT (45Q) FOR NON-EOR (ENHANCED OIL RECOVERY)

- Initially increase value to ~$100 per metric ton from current $85
- Extend eligibility period to 30 years from current 12 years
- Eliminate deadline for starting construction

ExxonMobil website accessed Jan 16, 2023

Conclusions

1. Using realistic assumptions for key lifecycle analysis parameters, blue hydrogen is not clean or low-carbon. It should not be promoted as a clean fuel.

2. Credits available under 45V do not provide a meaningful financial incentive to blue hydrogen producers to strive for high rates of carbon capture.

3. 45Q credits represent a huge reservoir of funding for blue hydrogen that will cost taxpayers tens of billions of dollars while contributing to global warming.

For More Information

- Contact us:
  - Anika Juhn at ajuhn@IEEFA.org
  - David Schlissel at dschlissel@IEEFA.org
- IEEFA reports available at www.ieefa.org/topic/hydrogen
- Sign up to get new research from IEEFA when it's available