



Pacific Northwest Hydrogen Hub

PNW Environmental Stakeholder Briefing

March 13, 2024



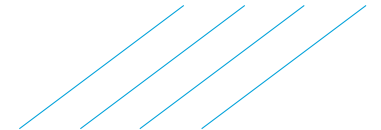
Agenda

I. Greeting & introductions (5 min)

II. Presentation (40 min)

- › Setting the scene – hydrogen hub award announcement
- › Hydrogen “101”
- › Hydrogen policy context: Washington
- › Hydrogen policy context: Oregon
- › PNWH2 hub overview
- › Environmental and EJ considerations
- › Siting & Permitting

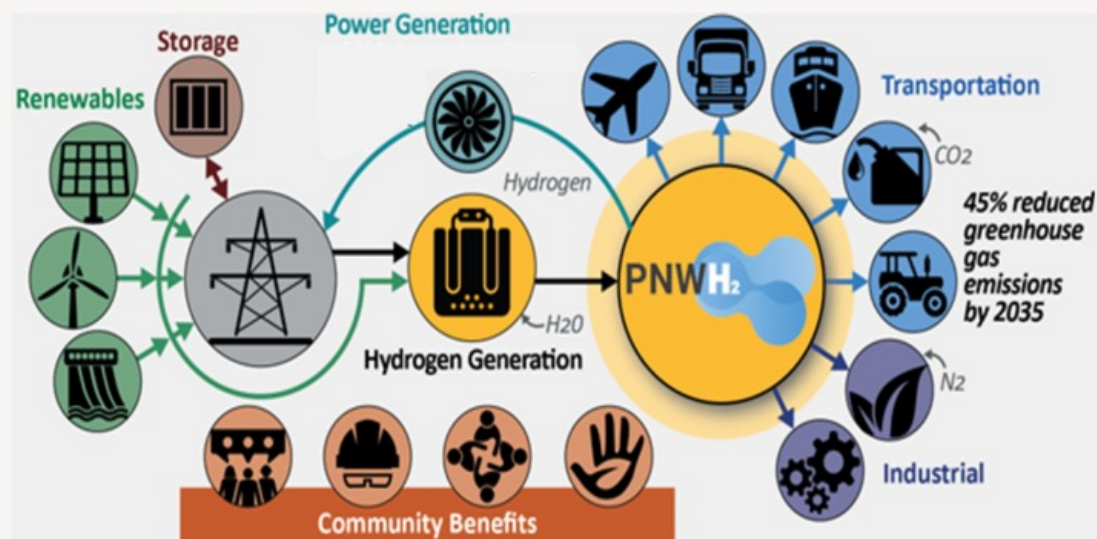
III. Q&A (45 min)



Pacific Northwest Hydrogen Hub

Decarbonizing hard to abate sectors using clean hydrogen in the PNW

- › Energy Equity and Environmental Justice Plan
- › Workforce Development and Jobs Plan
- › Tribal Nation Engagement
- › Community Engagement
- › Use of Mapping and Geospatial Tools & Data to Advance Equity
- › Domestic Clean Technology Manufacturing
- › Energy Emergency Management & Planning
- › Industry Cluster Development



Clean hydrogen will be made and used in the PNW





Hydrogen 101

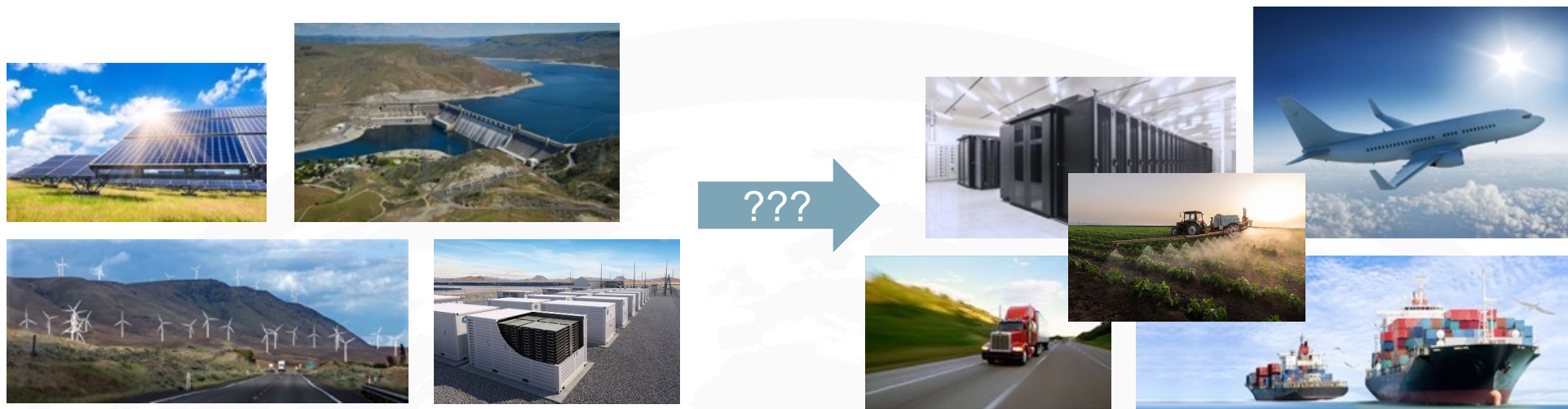
March 13, 2024

Aaron Feaver PhD
Executive Director

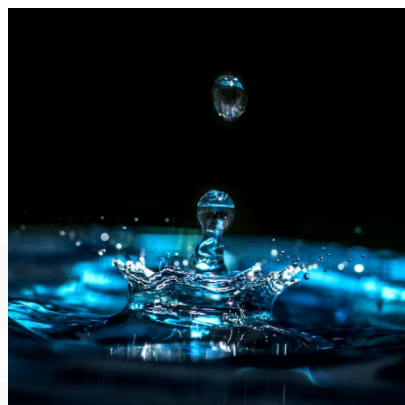
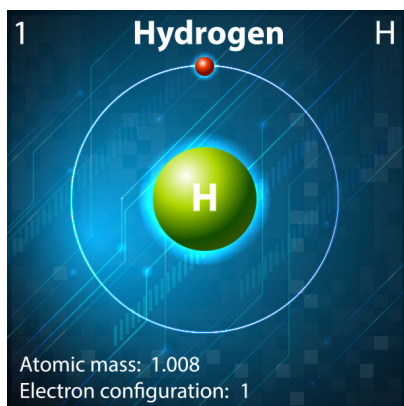
JCDREAM.ORG

Problem: Electrification can't do it all

- There is a need for fuels derived from renewable energy to support GHG reduction in high power demand applications.
- Washington State transportation OEMs and the tech companies are building assets that will be in place for decades but need to be decarbonized
- Washington State utilities produce low carbon electricity at some of the lowest costs on the planet



Renewable hydrogen: a crucial molecule

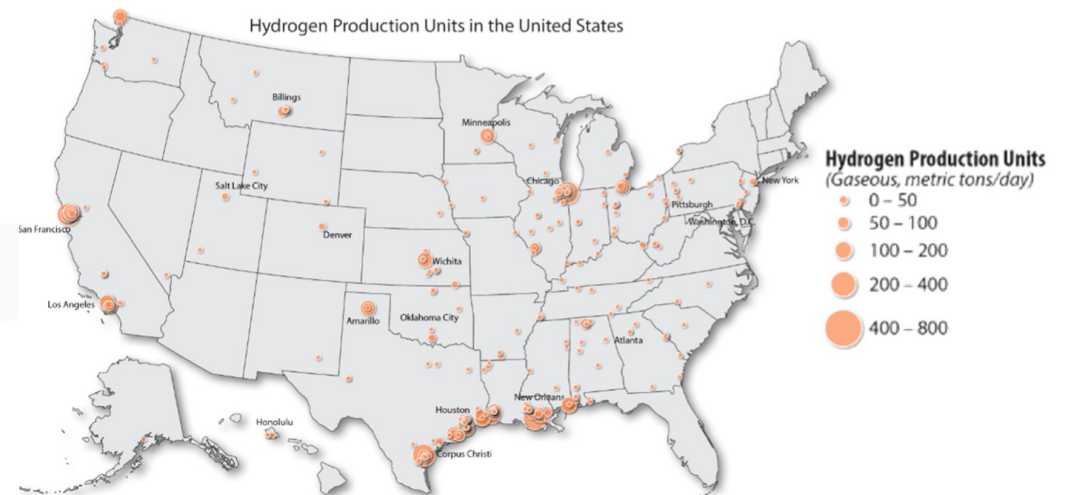


- Hydrogen is the lightest and most abundant element in the universe
- On Earth, hydrogen is found in the greatest quantities in water
- Hydrogen is an energy carrier. Compared to other fuels, it has the highest energy content by weight but lower energy content by volume

How much hydrogen?

- The U.S. produces 10 million metric tons per year
- Conventionally, H₂ is produced from natural gas and used in refineries, chemicals and fertilizer production

Clean hydrogen is an important component of the net-zero future. Production of 50 million metric tons/year by 2050 will help achieve a 10% GHG emissions reduction



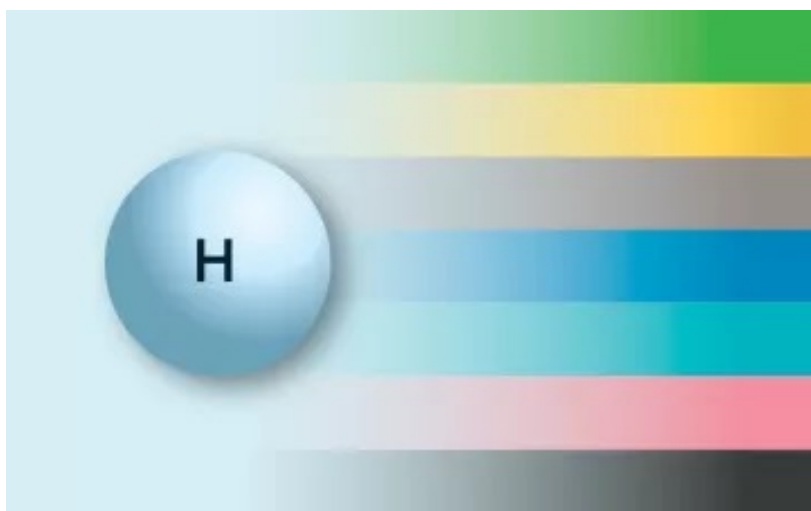
Source: National Renewable Energy Laboratory

How much hydrogen?

- PNWH2 Hub will potentially produce 400 metric tons of H₂ per day
(146,000 tons per year)
- Used for a variety of applications to replace diesel, natural gas, and gasoline
- In diesel-energy-equivalent terms, this could replace up to 400,000 gallons of diesel each day



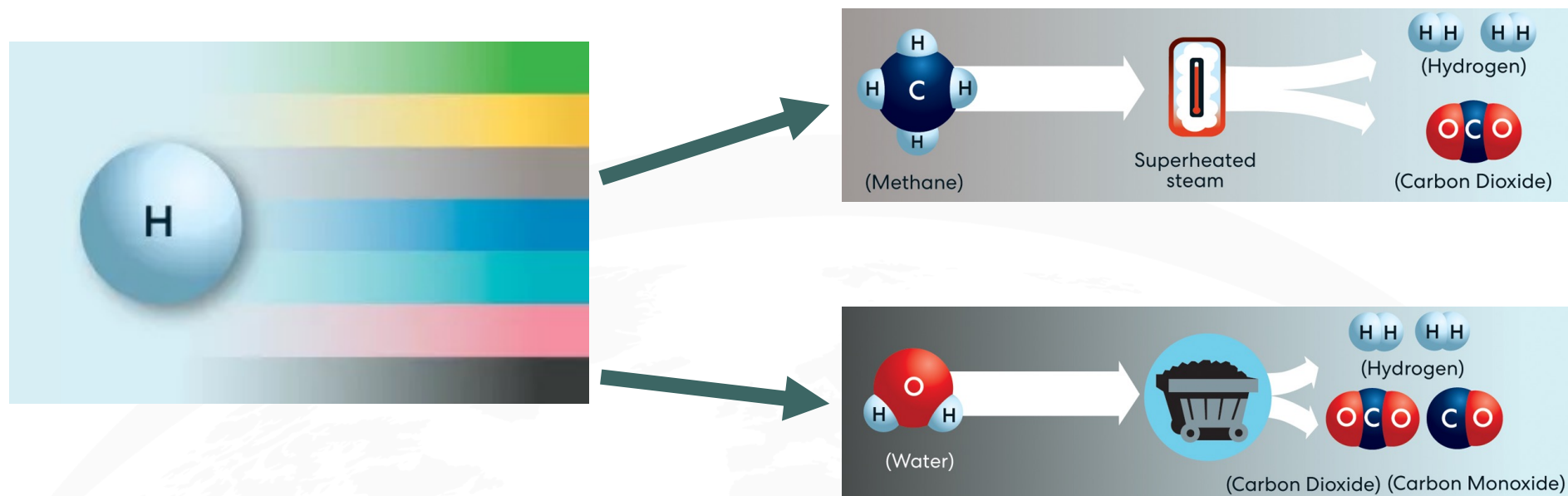
Hydrogen comes in many colors



*If you want
“Clean” H₂,
Follow the
Carbon!*

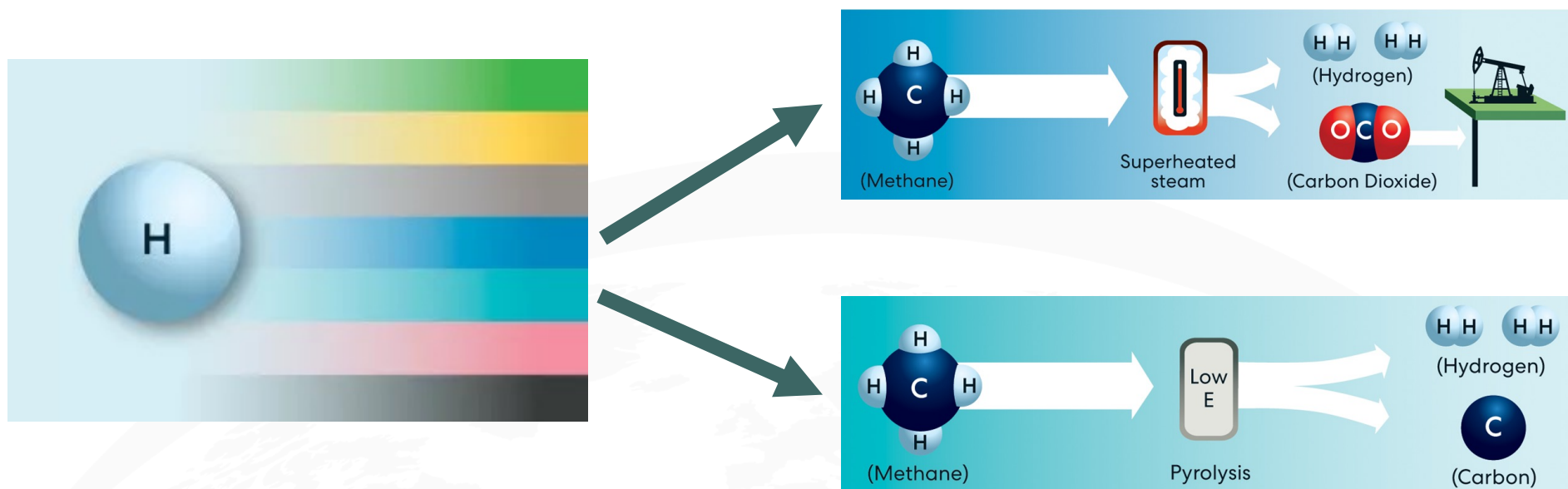
Graphic credit: Sierra Club

Hydrogen comes in many colors



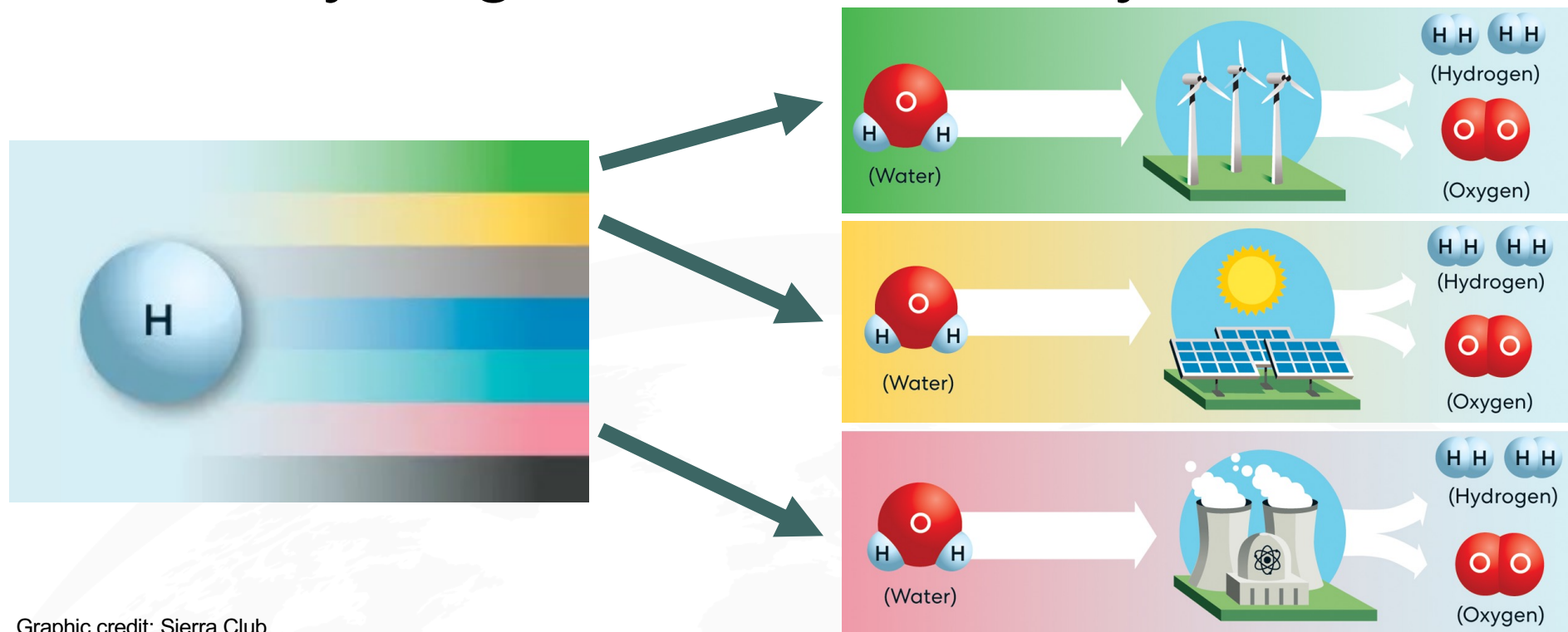
Graphic credit: Sierra Club

Hydrogen comes in many colors



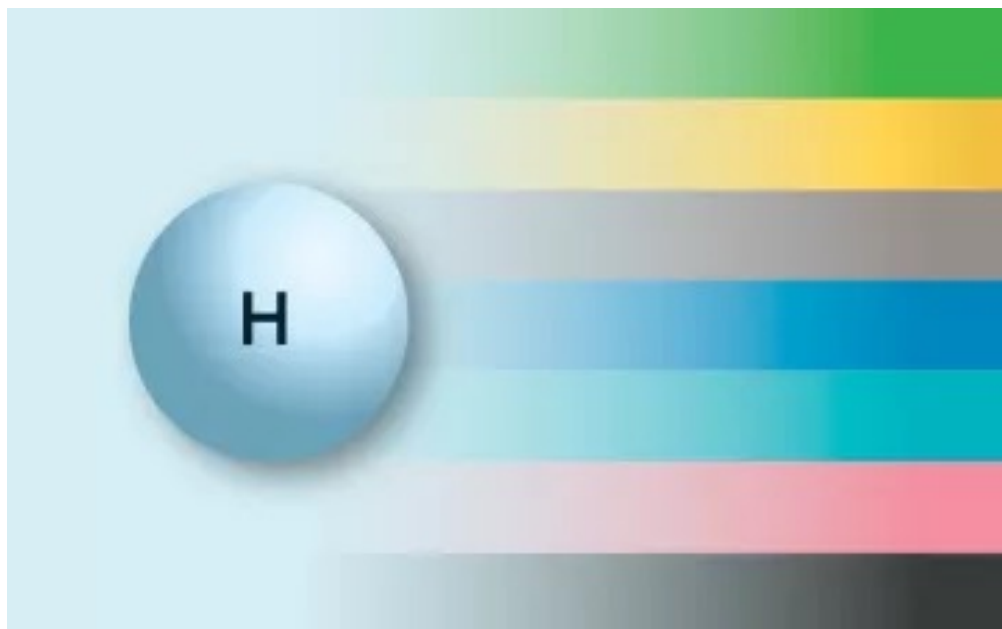
Graphic credit: Sierra Club

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Hydrogen comes in many colors



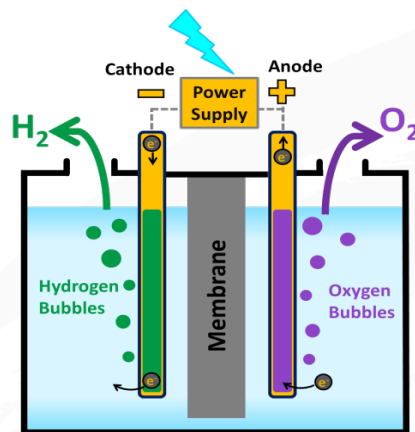
Graphic credit: Sierra Club

*If you want
“Clean” H₂,
Follow the
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Electrolyzers and Fuel Cells 101

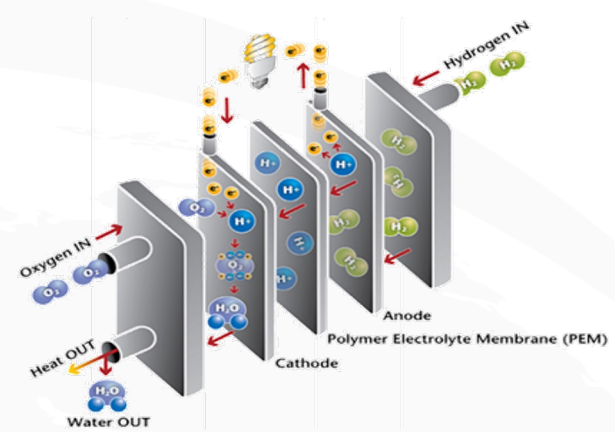
Electrolyzers: Make Hydrogen

- Electricity and Water IN
- Hydrogen and Oxygen OUT
- Makes hydrogen using electricity



Fuel Cells: Can Use Hydrogen

- Hydrogen and Oxygen IN
- Electricity and Water OUT
- Makes electricity using hydrogen



Hydrogen Safety

Challenges

- Hydrogen is not toxic, but it is a fuel, flammable and potentially explosive
- Hydrogen flame is invisible in daylight
- Unique challenge – hydrogen embrittles metal and tends to leak due to molecule size



Solutions

- Hydrogen is stored **outside**
- Hydrogen storage, transportation, and use require the selection of **appropriate materials, ventilation and leak detection systems** to ensure safety
- Workers handling hydrogen and first responders **will be trained** accordingly

National labs and companies worldwide are developing hydrogen safety standards, new materials, and leak-detecting solutions





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Hydrogen modeling and policy context in Washington

PNWH2 environmental webinar

Stephanie Celt, Senior Energy Policy Specialist

MARCH 13, 2024



Washington State
Department of
Commerce

Washington policy context

Clean electricity

- Existing clean grid
- 100% clean electricity standard by 2045

GHG reduction

- Cap and invest program covering ~75% of emissions
- Clean Fuel Standard
- Next zero GHG emissions by 2050

Equity and workforce laws and incentives

- HEAL Act
- Labor standards tax incentives for clean energy

Green hydrogen policy

- Office of Renewable Fuels
- Authorities and incentives for public utilities, transit agencies
- Siting and permitting improvements including for H2

State funding

- H2Hubs planning and match
- Clean Energy Fund H2 projects
- Innovation Clusters - CHARGE

Green hydrogen legislative report

“Green Electrolytic Hydrogen and Renewable Fuels: Recommendations for Deployment in Washington” published January 2024.

Guiding questions:

- What levels of green electrolytic hydrogen does Washington need to most efficiently decarbonize?
- How much electricity and water are needed?
- What are the best sources of new renewables?
- How should the state approach siting and permitting?
- What are the best approaches to environmental justice?

Scenario modeling to account for important variables

- H2Hub award
- Final 45V rules

Core Case

What does Washington use hydrogen for?

- Initially hydrogen consumption is in petroleum refining and bulk chemicals
- Usage grows over time and transitions to high-value applications, including:

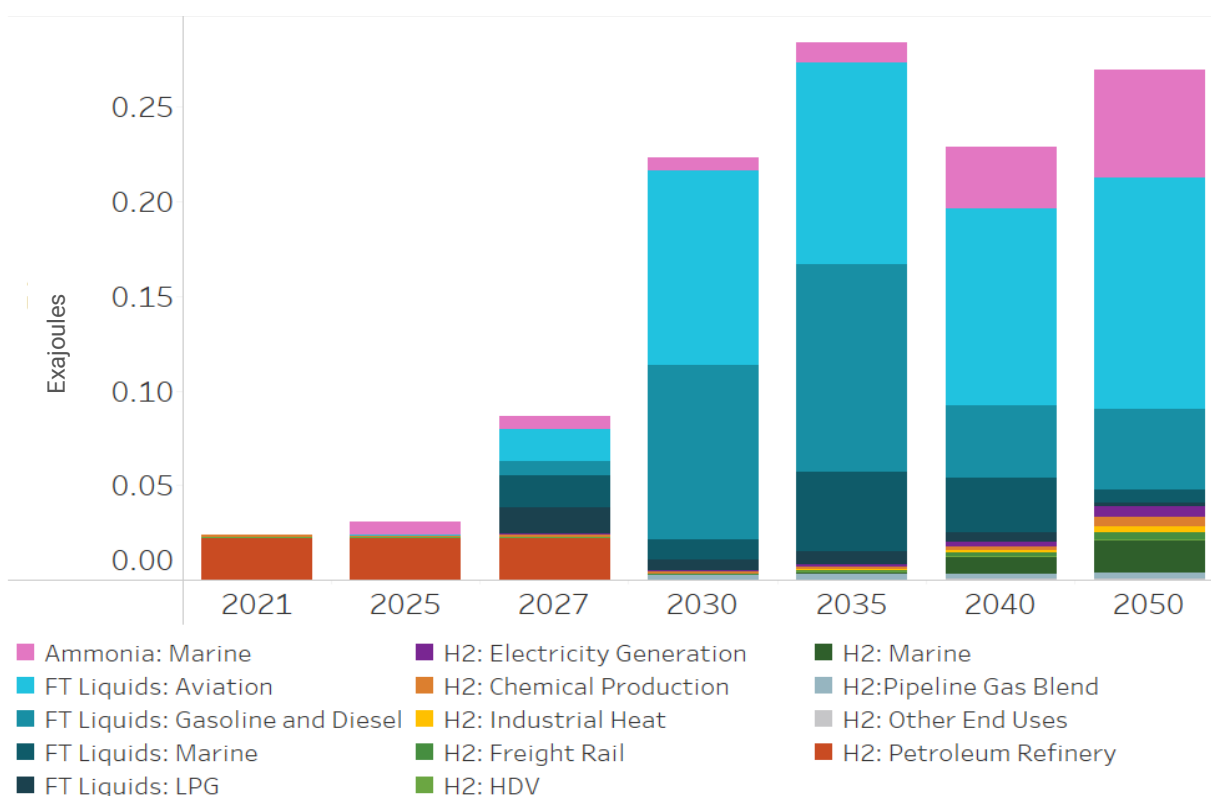
Displacing fossil liquid fuels with hydrogen-derived products via Fischer-Tropsch and Haber-Bosch

Marine usage directly in fuel cells, and in the form of ammonia as a drop-in fuel

Increased bulk chemicals demand

Industrial heat, such as in iron and steel

- WA TES forecasts negligible amount of light- and medium-duty on-road fuel cell vehicle sales



Top line findings

| Finding | Notes |
|--|---|
| Washington will have strong demand for green hydrogen as part of a net zero economy | <ul style="list-style-type: none">• Earliest opportunity to scale in the US• 25% of total energy demand by 2050 |
| We anticipate direct use of hydrogen as a gas, as well as production of hydrogen-derived fuels | <ul style="list-style-type: none">• Examples: SAF, green ammonia• Fuel cells as well as combustion uses |
| We need to scale up production of hydrogen and renewable fuels rapidly through new electrolysis in Washington | <ul style="list-style-type: none">• Current electrolytic hydrogen production ~0• 200,000 MT per year of H2 by 2030• 700,000 MT per year by 2035 |
| New renewable electricity and transmission capacity are critical | <ul style="list-style-type: none">• 0.8GW by 2030, 3.5GW by 2035 – as part of overall renewable electricity growth for WA |
| We must develop demand in key end-use sectors | <ul style="list-style-type: none">• This helps ensure hydrogen and renewable power are used efficiently |
| Opportunities to create environmental justice and workforce benefits for Washington communities | <ul style="list-style-type: none">• Center inclusive practices and equitable benefits. |



Washington State
Department of
Commerce

www.commerce.wa.gov



Thank you!

Oregon Department of **ENERGY**

Pacific NW Regional Clean Hydrogen Hub Environmental Briefing

Michael Freels, Sr. Policy
Analyst
March 13, 2024





OREGON DEPARTMENT OF ENERGY

Leading Oregon to a safe, equitable, clean, and sustainable energy future.

Our Mission

The Oregon Department of Energy helps Oregonians make informed decisions and maintain a resilient and affordable energy system. We advance solutions to shape an equitable clean energy transition, protect the environment and public health, and responsibly balance energy needs and impacts for current and future generations.

What We Do

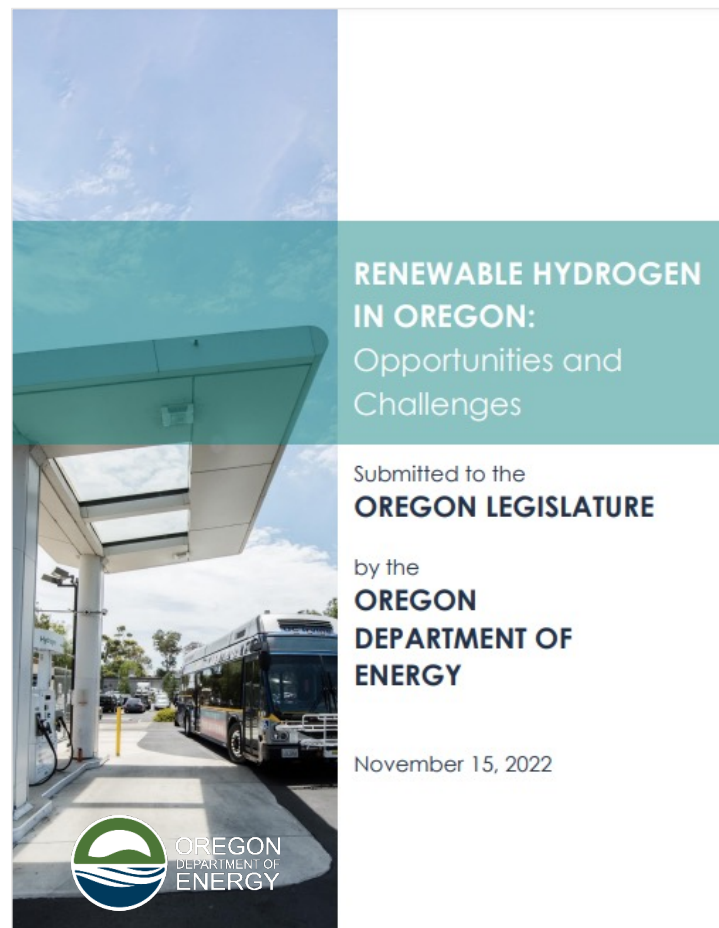
On behalf of Oregonians across the state, the Oregon Department of Energy achieves its mission by providing:

- A Central Repository of Energy Data, Information, and Analysis
- A Venue for Problem-Solving Oregon's Energy Challenges
- Energy Education and Technical Assistance
- Regulation and Oversight
- Energy Programs and Activities

2022 ODOE Renewable Hydrogen Report

Benefits:

- RH2 can be swapped in for fossil-based hydrogen with no retrofits
- Support hard-to-electrify sectors
- Strengthen grid resilience
- Serve as long-duration energy storage or backup generator fuel

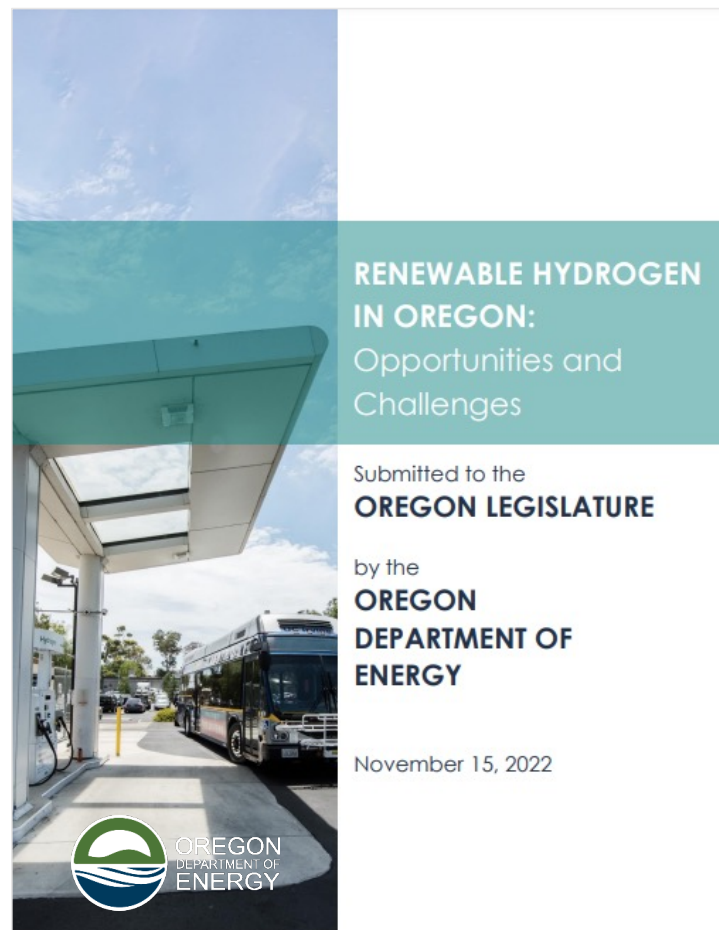


tinyurl.com/ODOE-RH2-Study

2022 ODOE Renewable Hydrogen Report

Barriers:

- Cost
- Chicken-and-egg market challenges
- Lack of infrastructure
- Update safety regulations
- Water consumption



tinyurl.com/ODOE-RH2-Study

HB 2530: Renewable Hydrogen

- Defines renewable hydrogen and green electrolytic hydrogen.
- Directs ODOE to seek and apply for federal funds to support renewable hydrogen in the state.
- Directs ODOE to provide education and increase awareness of renewable hydrogen.



HB 3630: Comprehensive State Energy Strategy

Directs ODOE to develop a state energy strategy identifying pathways to achieve Oregon's energy policy objectives

- Must be informed by stakeholder perspectives
- Must draw from existing resource plans, energy-related studies, and analyses

State energy strategy must account for a variety of factors, such as:

- Costs, efficiencies, feasibility, and availability of energy resources and technologies
- Economic and employment impacts
- Energy burden, affordability, environmental justice, and community impacts and benefits
- Land use and natural resource impacts and considerations
- Energy resilience, security, and market implications

Pacific Northwest Hydrogen Hub

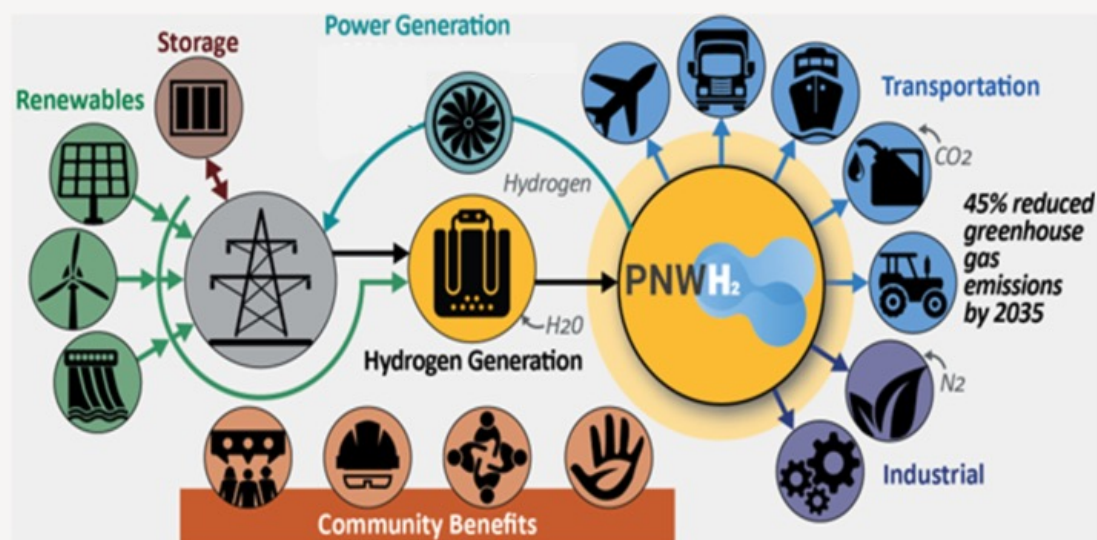
An Overview



Pacific Northwest Hydrogen Hub

Decarbonizing hard to abate sectors using clean hydrogen in the PNW

- › Energy Equity and Environmental Justice Plan
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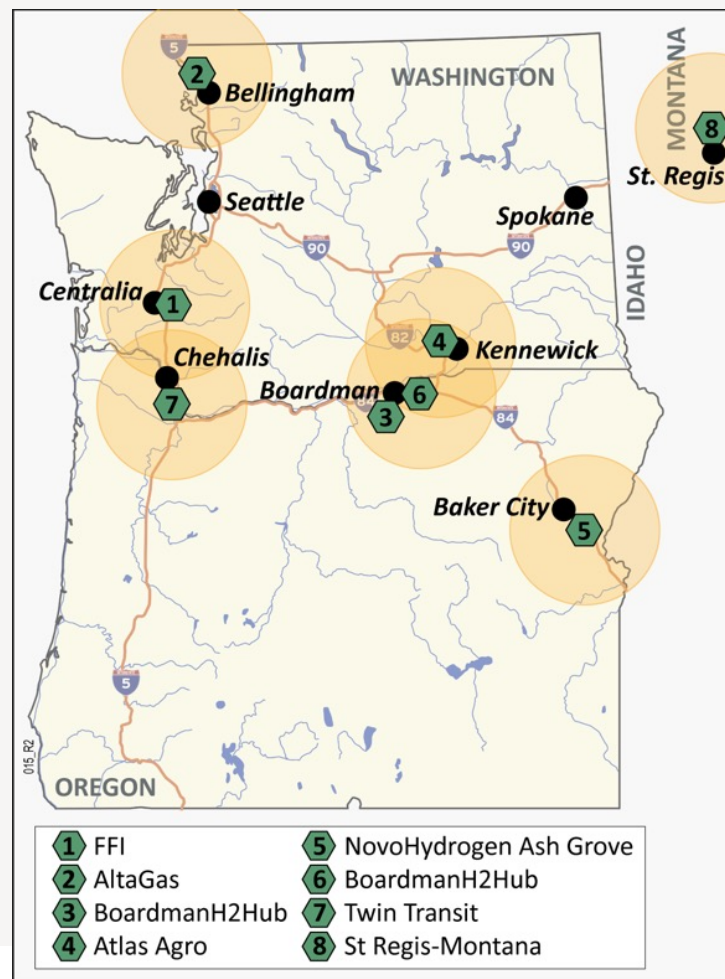


Clean hydrogen will be made and used in the PNW



Potential Project Locations

100% “green” electrolytic hydrogen



<https://pnwh2.com/pnwh2-hub>

Potential Project Locations & H₂ Uses

Heavy Duty Trucking



Clean Power & Energy Storage



Public Transit

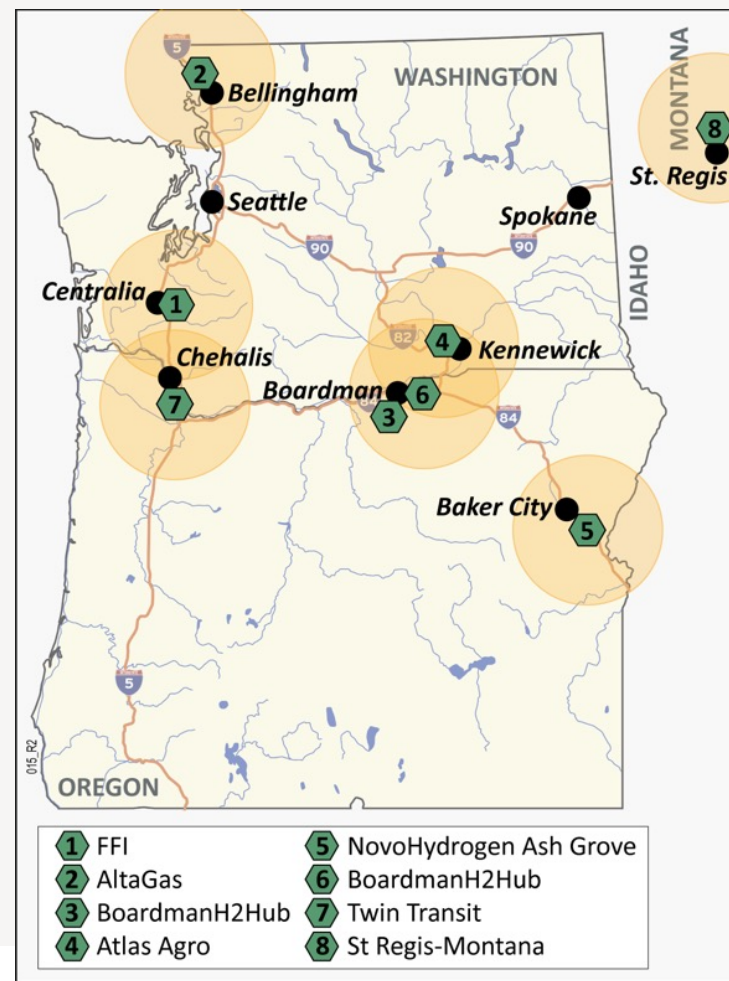


<https://www.hfcbuscouncil.com/about>

Agriculture



<https://agr.wa.gov/washington-agriculture/maps>

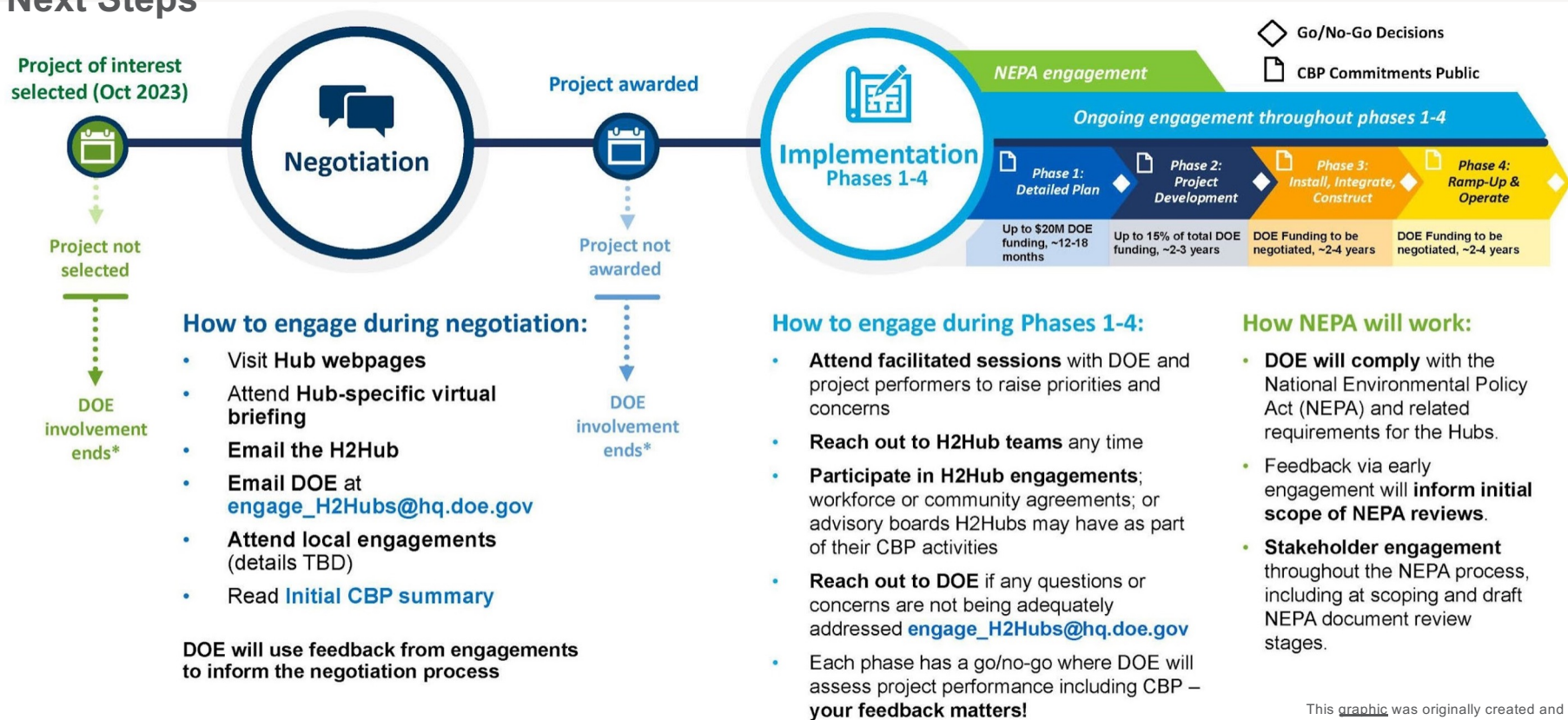


<https://pnwh2.com/pnwh2-hub>



Pacific Northwest Hydrogen Hub

Next Steps



This graphic was originally created and published by the U.S. Department of Energy's Office of Clean Energy Demonstrations.



Hydrogen: Future of Clean Energy or a False Solution?

Hydrogen holds a lot of promise, but it must be done right.

- Must be Green and must not jeopardize our clean energy goals
- Must be used for hard to electrify sectors of the economy, must not expand the life of fossil fuels
- Must be produced, stored and use within close proximity
- Must not increase air pollution, where possible best used in fuel cells and where not must be controlled.

Hydrogen Hope: Hard to Electrify Sectors

- First replace current fossil fuel hydrogen already in use mainly fertilizer and oil refinery processing. Then,
- Industrial applications
 - High heat processes (steel, aluminum, concrete)
 - Chemical feedstock (methanol, ammonia)
- Transportation: shipping, long-distance road transport and aviation
- Long-duration storage: to a lesser extent hydrogen may serve as a storage medium to enable the shift to renewable energy.

Hydrogen Hype: Replacing Natural/Fossil Gas

The fossil fuel industry is campaigning to keep their dirty business alive through H₂

- Buildings and Power Plants
- Light-Medium Duty Cars and Trucks
- Burning releases more than just water, when not used in a fuel cell H₂ has increased Nox emissions compared to methane

Siting & Permitting

PNWH2 NEPA

NEPA will proceed in phases and will be at the direction/coordination with DOE.

Action: Federal funding issuance by DOE

Lead NEPA agency DOE

Federal dollars trigger NEPA

Alternative Analysis – Project Siting

NEPA determination CATEX, EA, EIS

Community/Stakeholder Engagement

Final NEPA Document FONSI and/or ROD

Negotiations - ECS



Phase I - EIV



Phase 2 - NEPA



**Phase 3 and 4
Construction/NEPA
Supplements as
necessary**

Siting and permitting in WA

Report recommendation: **Promote expedited and equitable siting and permitting practices for hydrogen and renewable electricity systems**

- Work with WA Ecology to develop an effective and equitable Programmatic Environmental Impact Statement (PEIS) for green H2
- Develop a process to evaluate preferred geographic locations for H2 infrastructure.
- Promote local/on-site H2 and renewable fuel production where appropriate.
- Site and permit renewable electricity and transmission infrastructure.

Current updates and opportunities

- WA Ecology PEIS for H2 – scoping beginning now (will be completed June 2025)
- DOE funding opportunity for siting and permitting outreach and education – Commerce, Ecology, PNNL collaborating (due March 2025).

Oregon Energy Facility Siting and Permitting

Energy Facility Siting Council

- Oversee the review of certain energy facilities to ensure energy supply while protecting communities and the environment.
- Proposed energy facilities must undergo a thorough review and meet the Council's siting standards to receive a site certificate
- Opportunities to participate in the process
 - Public Information Meetings
 - Public Comment Periods
 - Council Meetings



Thank you!

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