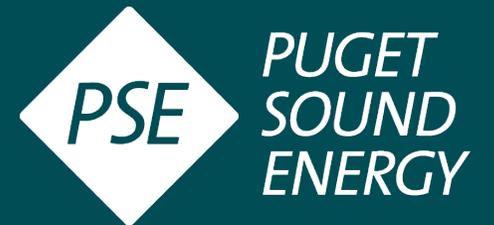


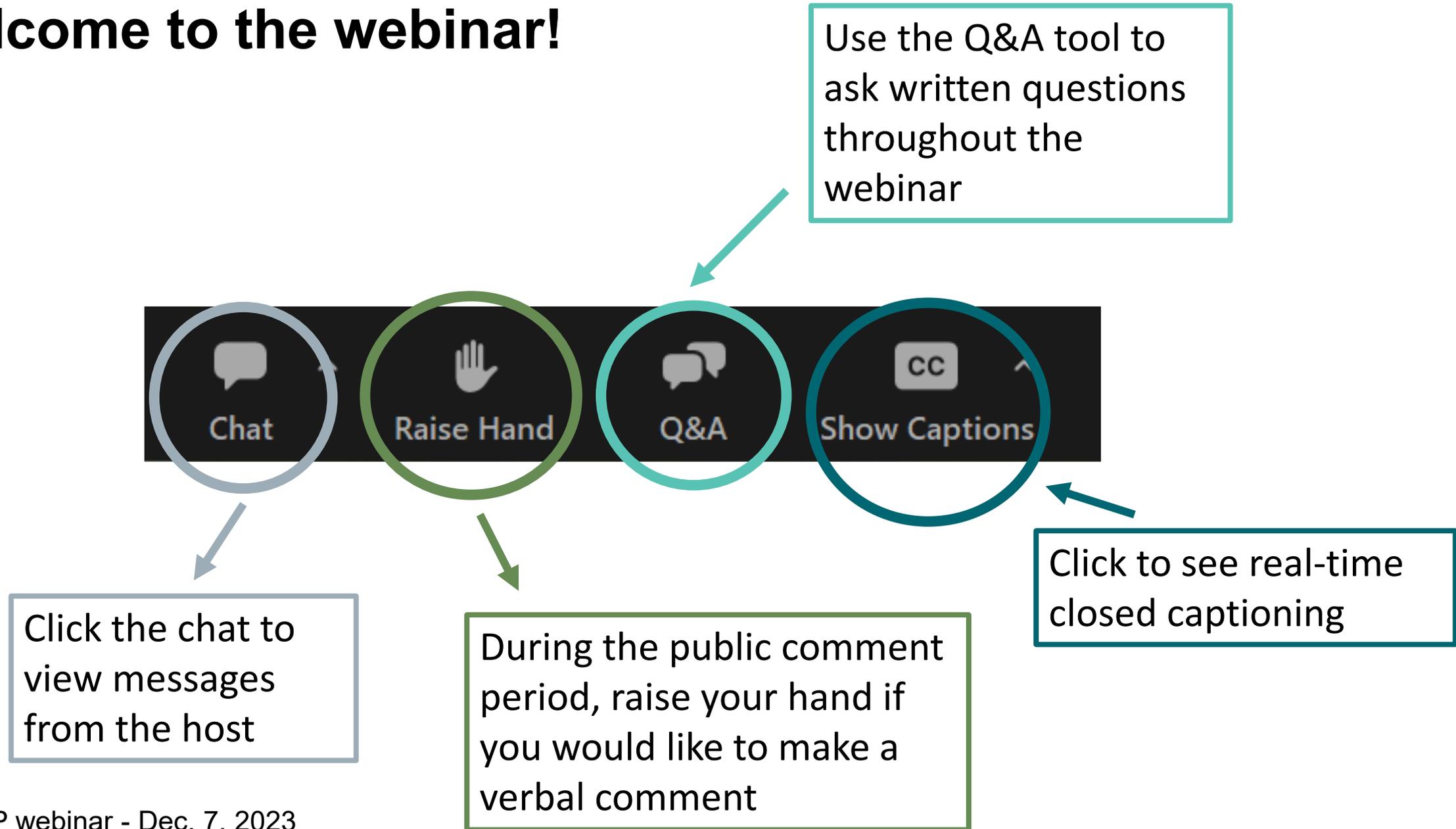
# Emerging resources: hydrogen

Public webinar

December 7, 2023



# Welcome to the webinar!



# Facilitator requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- Avoid use of acronyms and explain technical questions
- Use the Feedback Form for additional input to PSE
- Aim to focus on the webinar topic
- Public comments will occur after PSE's presentations

# Safety moment

## Winter holiday safety

- Never leave a burning candle unattended
- Don't overload circuits or "daisy chain" extension cords
- Plug space heaters directly into a wall outlet; do not use extension cords to power a space heater
- Never leave cooking or baking unattended
- Keep holiday plants like poinsettias away from pets and children

# Today's speakers

## **Sophie Glass**

Facilitator, Triangle Associates

## **Steve Schueneman**

Development Manager, Strategic Energy Initiatives

## **Niecie Weatherby**

Manager, Gas Systems Integrity

## **Jennifer Coulson**

Manager, Operations and Gas Analysis

# Today's objectives

- Learn about the basics of hydrogen: what it is, how it is used, and how we address safety concerns
- Learn how hydrogen can support PSE's clean energy goals
- How we incorporate hydrogen into the IRP
- Collect feedback related to the use of hydrogen

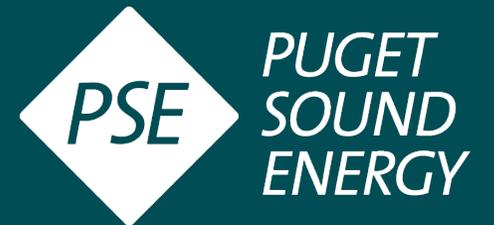
# Agenda

Time	Agenda Item	Presenter / Facilitator
4:00 p.m. – 4:05 p.m.	Introduction and agenda review	Sophie Glass, Triangle Associates
4:05 p.m. – 4:20 p.m.	Hydrogen basics & use within the utility industry	Steve Schueneman, PSE
4:20 p.m. – 4:35 p.m.	Meeting PSE's clean energy goals safely with hydrogen	Niecie Weatherby, PSE
4:35 p.m. – 4:50 p.m.	Hydrogen in the IRP	Jennifer Coulson, PSE
4:50 p.m. – 5:00 p.m.	Next steps and public comment opportunity	Sophie Glass, Triangle Associates
5:00 p.m.	Adjourn	All

# Hydrogen basics

Steve Schueneman, PSE

December 7, 2023





# Definitions

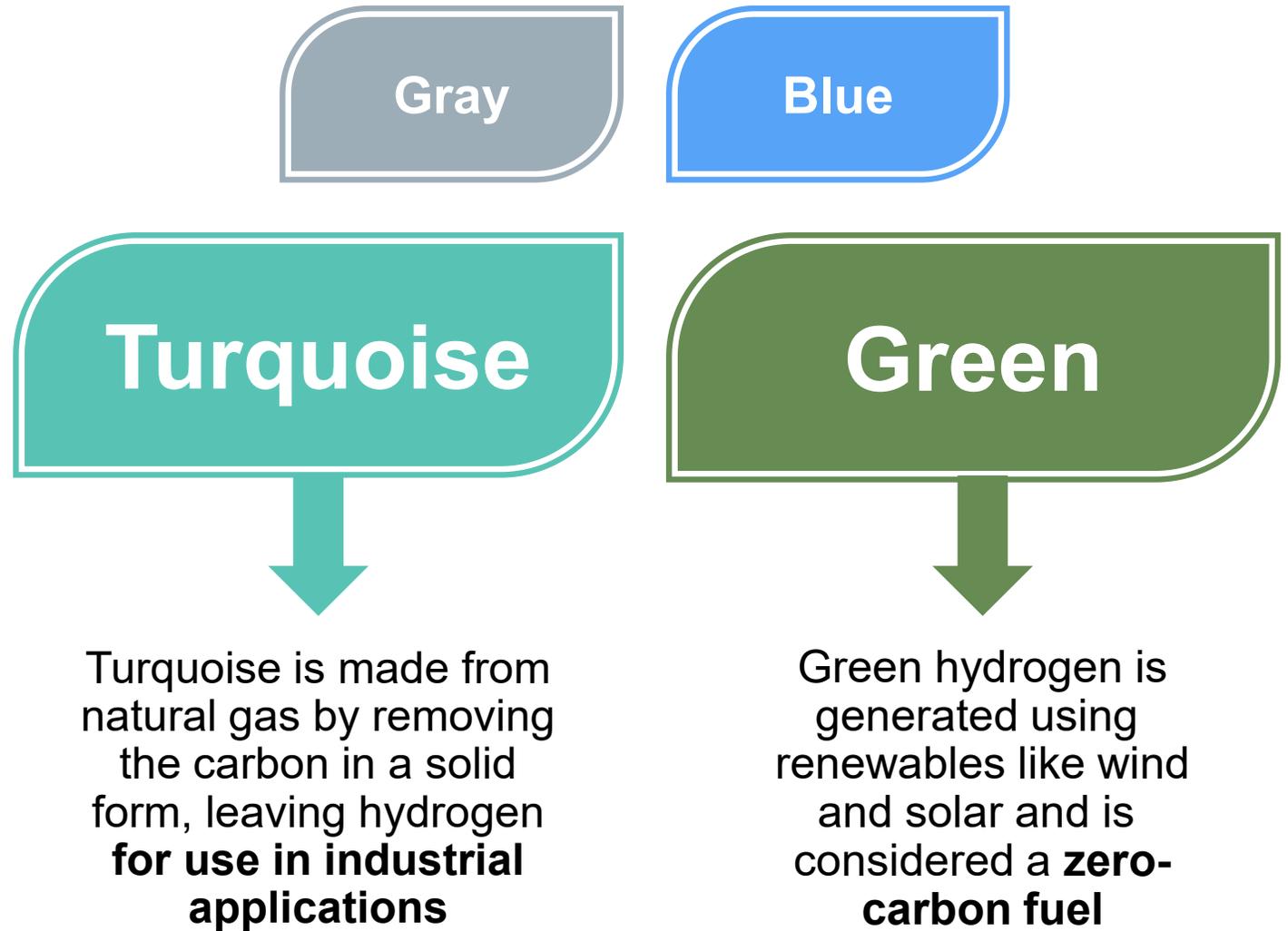
## RCW 19.405

- (32) "Renewable hydrogen" means hydrogen produced using renewable resources both as the source for the hydrogen and the source for the energy input into the production process.
- (34) "Renewable resource" means: (a) Water; (b) wind; (c) solar energy; (d) geothermal energy; (e) renewable natural gas; **(f) renewable hydrogen**; (g) wave, ocean, or tidal power; (h) biodiesel fuel that is not derived from crops raised on land cleared from old growth or first growth forests; or (i) biomass energy.

## Department of Energy

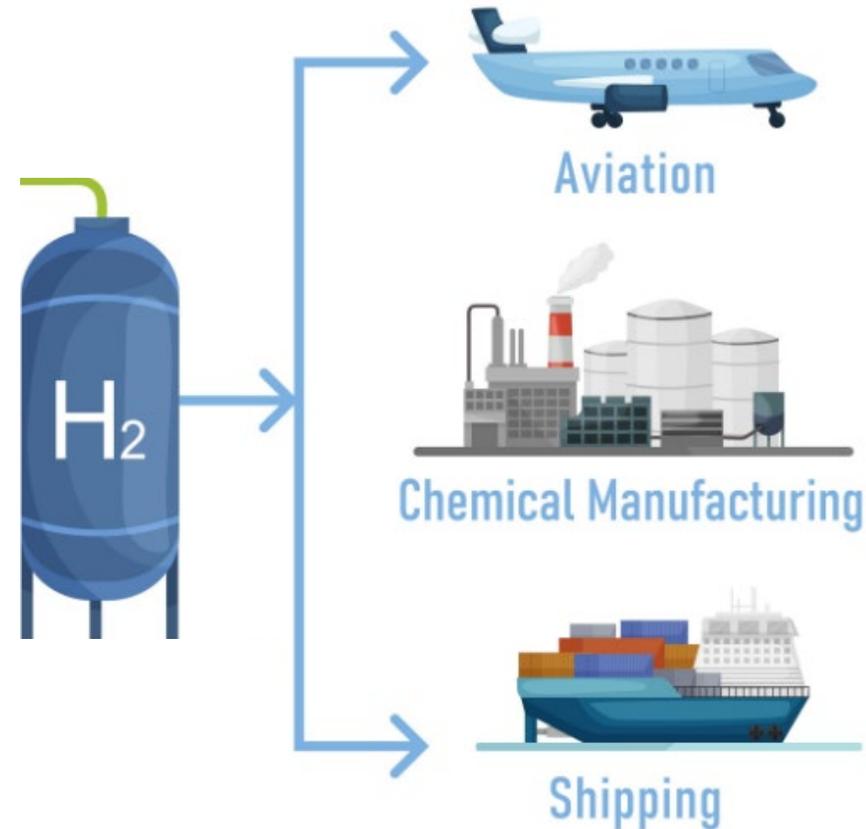
- "Clean hydrogen is defined as hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produced."

# Types of hydrogen fuel



# Hydrogen uses

- ◇ Hydrogen is already fueling personal and industrial vehicles around the world, but it could also reduce emissions in the most carbon-intensive industries.



# Hydrogen uses

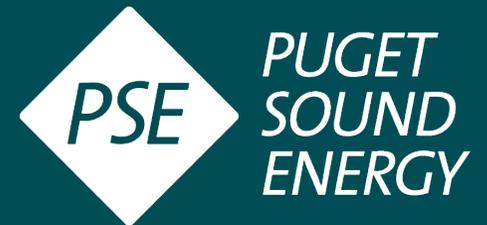


- ◆ Hydrogen has been used as a fuel source for decades – even by NASA in the 1950s
- ◆ Each year, the U.S. produces approximately 10 million tons of hydrogen to fuel:
  - ◆ Agriculture needs
  - ◆ Food production
  - ◆ Electronics manufacturing
  - ◆ Petroleum refining

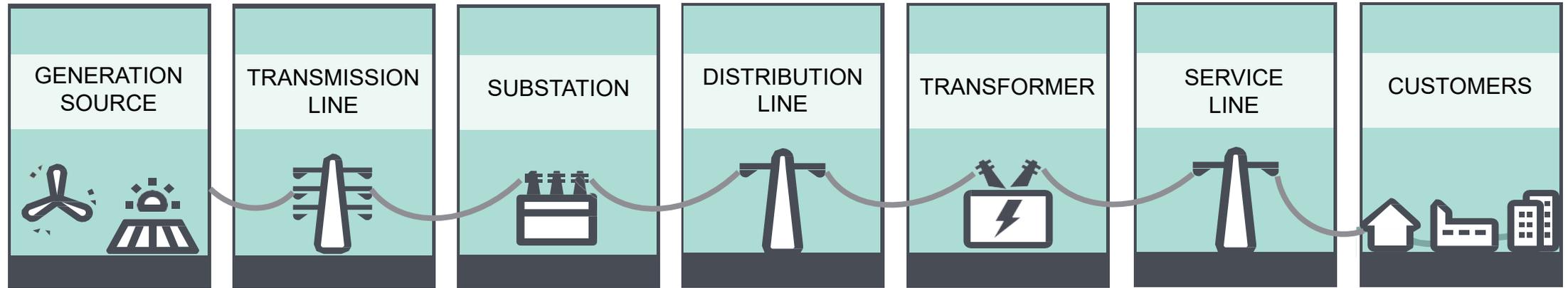
# Meeting PSE's clean energy goals with hydrogen

Niecie Weatherby, PSE

December 7, 2023



# How PSE could use hydrogen in the ELECTRIC system

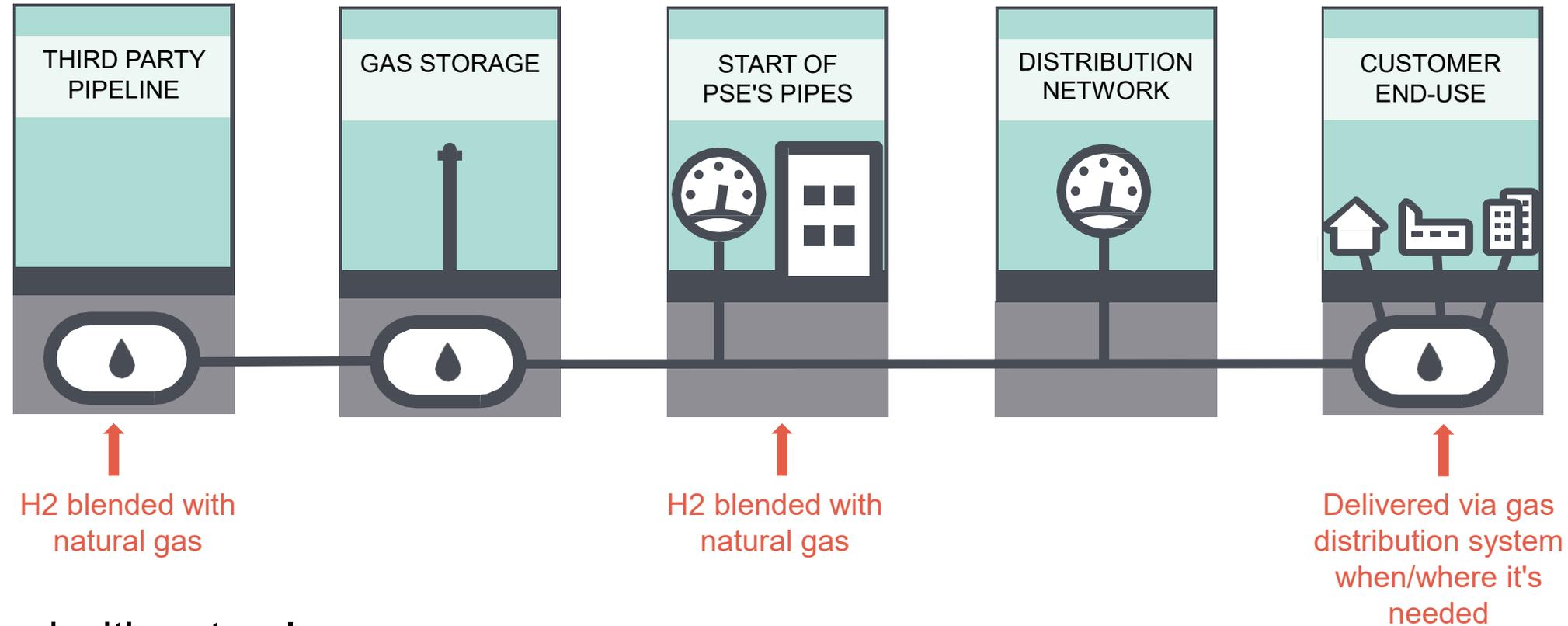


↑  
H2 created  
with renewables  
and stored

↑  
Added to the  
grid when  
needed

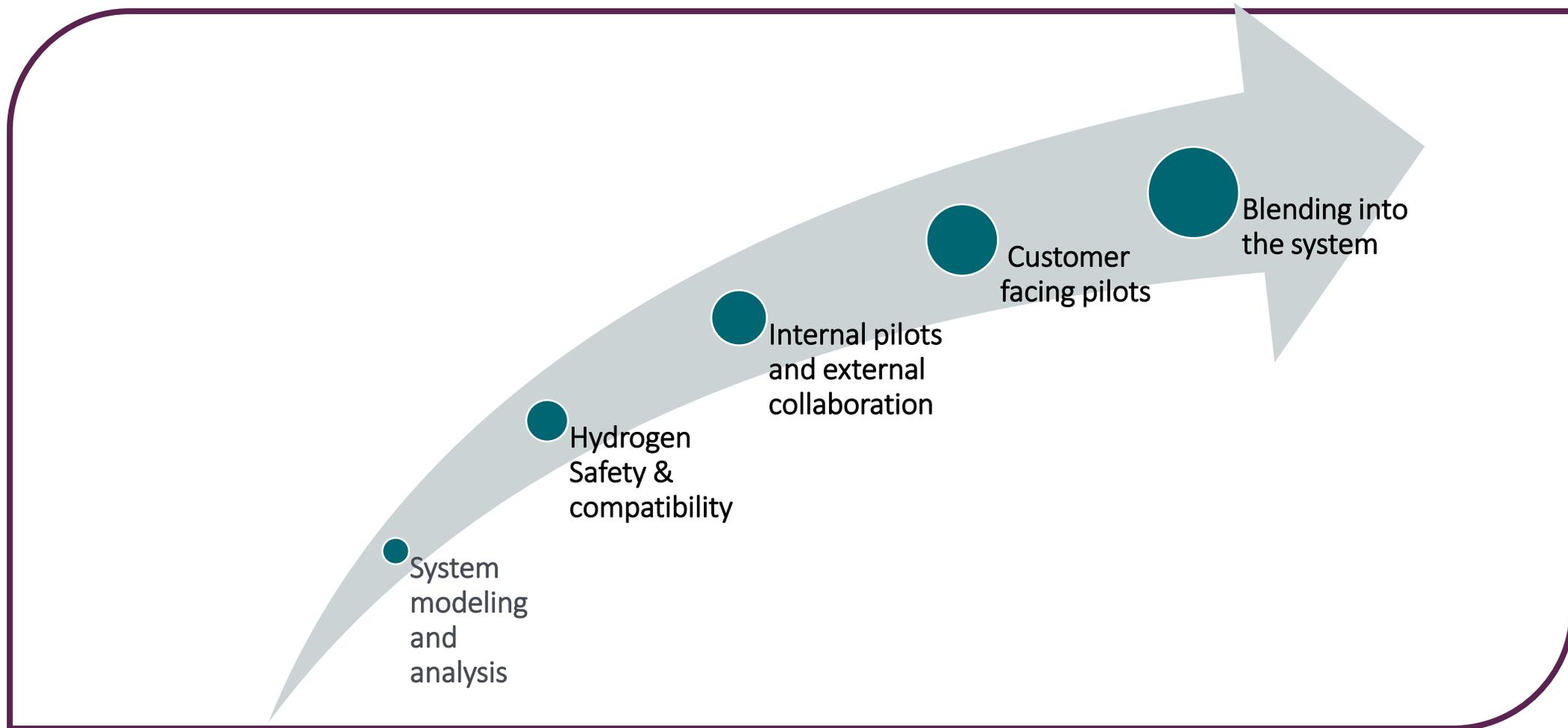
- ◆ Combust at a power plant, or use in a fuel cell, to generate electricity
- ◆ Use to supplement unpredictable renewables or as a “peaker” fuel during high demand

# How PSE could use hydrogen in the NATURAL GAS system



- ◆ Blend with natural gas to lower carbon content

# PSE's hydrogen injection strategy

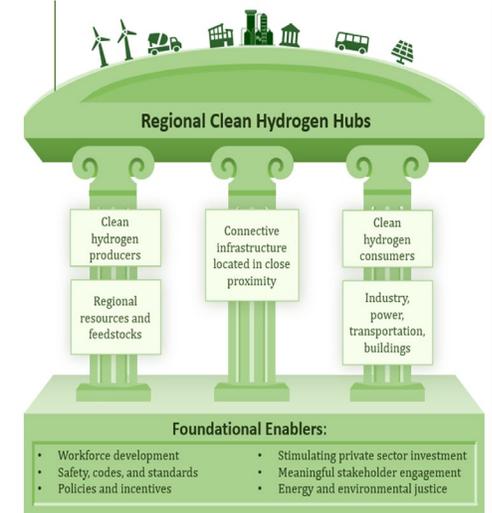


# Safety concerns about hydrogen blending

- **Leakage/flammability**
- **Material compatibility**
- **End use appliances**
- **Accumulation of hydrogen in confined spaces**

# PSE's hydrogen pilots and studies

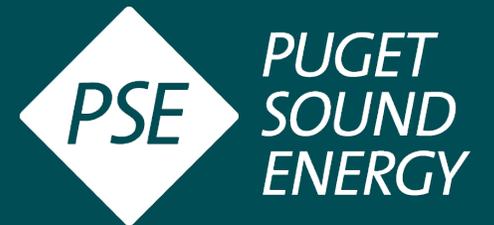
-  Pilot 1 – Customer Appliances: (completed)  
Gain first-hand experience with a hydrogen blend in a closed piping system. Test typical residential appliance performance.
-  Pilot 2 – Common Natural Gas Components: (completed)  
Test currently approved components compatibility with hydrogen in a small closed distribution system over 90 days for impacts.
-  Pilot 3 – Electrolyzer Operations: (in process)  
Gain familiarity with an electrolysis unit, and use green hydrogen for electric generator cooling. Learn blending requirements including measurement and safety equipment.
-  Pacific Northwest Hydrogen Hub: (in process)  
PSE is part of the consortium participating in the regional Hydrogen Hub. Currently in negotiations with DOE to determine final federal funding levels, scope and terms.



# Hydrogen in the IRP

Jennifer Coulson, PSE

December 7, 2023



# Clean Hydrogen in the 2025 IRP

## Inputs

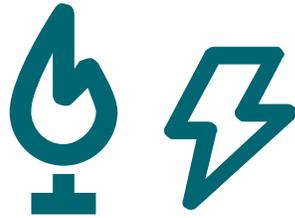


Est. Clean Hydrogen  
Volume & Price



+ Other renewable  
resources, capacity  
resources and energy  
efficiency potential

## Analysis

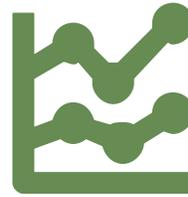


All resource  
alternatives are  
evaluated together  
within PSEs Gas &  
Electric Optimization  
models

### Some important things to consider:

- Hydrogen is not made available **within the models until 2030**
- **The Inflation Reduction Act provides an incentive** for leveraging the fuel, making it more cost effective within the 2030 timeframe. Over time, these incentives are likely to decrease/go away.

## Outputs



The outputs of both  
models are potential  
volumes of least  
cost resources to meet  
customer demands

## Out of Scope



If an IRP identifies a need for a resource within the next 3 yrs, the company is required to issue a request for proposal. Meaning the company goes to the market and asks if anyone can fill the need.



There is an extensive analysis that occurs to ensure the acquisition of a resource is right for our customers. Once that is complete, eventually that resource helps power your home/business.

# Feedback related to clean hydrogen

## 2023 Gas Utility IRP

- Explored the use of alternative fuels including clean hydrogen and renewable natural gas (RNG)
- Captured key characteristics of alternative fuels such as price and availability
- Committed to further refine the assumptions for alternative fuels in future IRP cycles
- Interested parties expressed concerns about cost, availability and feasibility of hydrogen

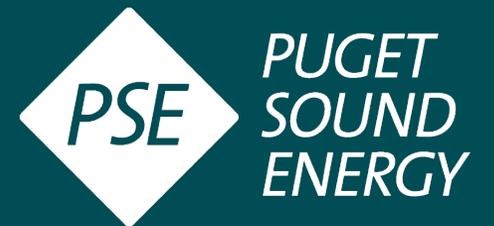
## 2023 Electric Progress Report

- Explored the use of alternative fuels including green hydrogen and biodiesel for peaking facilities
- Assumed clean hydrogen and natural gas blending in peaking facilities starting in 2030
- Committed to further refine the assumptions for alternative fuels in future IRP cycles
- Interested parties expressed concerns about cost, availability and feasibility of hydrogen

# Next steps

Sophie Glass, Triangle Associates

December 7, 2023



# Upcoming activities

Date	Activity
December 12, 2023	RPAG meeting
December 14, 2023	Feedback form for Emerging Resources: Hydrogen public webinar closes
December 15, 2023	Revised IRP workplan due to UTC

# Next steps

- During public comment and/or via the feedback form
  - Share questions about how hydrogen can support PSE's clean energy goals and current and future hydrogen pilots/studies
  - To what degree should PSE model blending hydrogen into the natural gas system as a way to decarbonize our gas system and bridge to electrification?
  - To what degree should PSE explore hydrogen for peak power production and distributed resource applications at this time?
- Observe future discussions with the RPAG as we develop specific assumptions and provide comments during the public comment period or via the feedback form

# Public comment opportunity

Please raise your “hand” if you would like to make a comment



**Thank you for joining us!**



# Appendix



# Meets a key utility need



- ◆ The electric grid must always be in balance to operate safely
- ◆ Sometimes, renewables produce too much energy – or not enough
- ◆ Excess renewable energy can be used to create clean hydrogen for later use
- ◆ This gives utilities a carbon-free, dispatchable energy supply, whenever it's needed, to keep the lights on 24/7.

# Customers benefit, too!

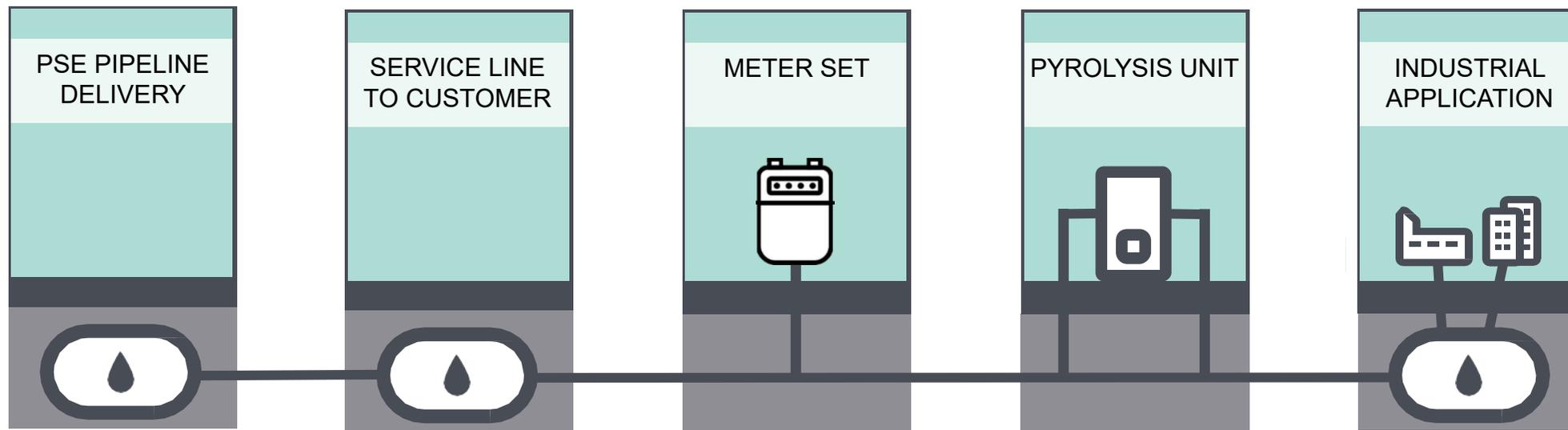


- ◆ This 24/7 supply helps ensure reliability for customers
- ◆ Plus, hydrogen can be stored for long periods of time, without losing any energy capacity
- ◆ This means a safe, clean, and continuous energy supply, particularly during times of peak demand (like winter nights), when customers need it most

# Hydrogen Blended Natural gas used around the world

- ◆ Utilities across North America, Asia and Europe have been using hydrogen to decarbonize.
- ◆ Singapore and Hong Kong have towns operating above 50% blend
- ◆ Dominion Energy, ATCO, Enbridge and others have been piloting 5-20% blends with customers
- ◆ Hawai'i Gas has had hydrogen present in their fuel blend for decades



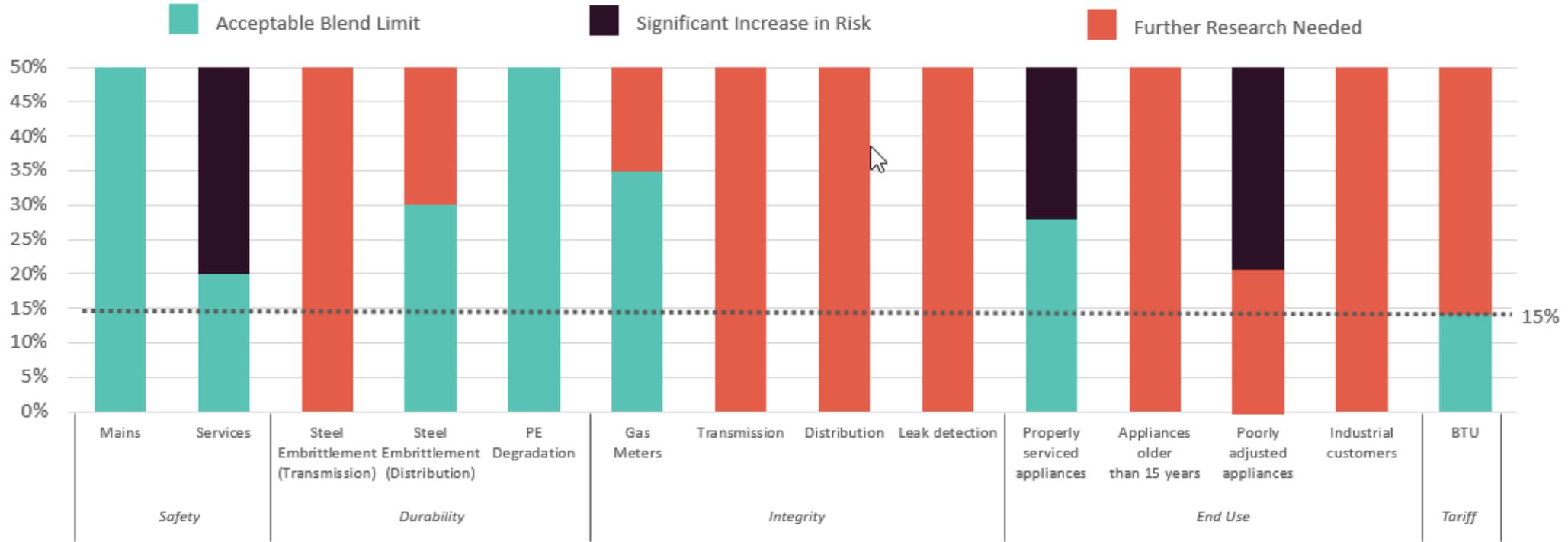


↑  
Clean Hydrogen is delivered, while the carbon is captured and repurposed

- ◆ Remove carbon at the point of use

## How PSE could use hydrogen for INDUSTRIAL decarbonization

# Hydrogen Blending Limits



## Potential Blending Limiting Factors

- Transmission and Distribution Integrity Management Programs should be re-evaluated end-to-end in greater detail.
- Industrial customers should be assessed on a case-by-case basis
- Each Transmission pipeline will be evaluated based on type of steel and pressure
- Assessing appliances older than 15 years and resolving poorly adjusted customer appliances

## Additional Considerations

- Increased probability of gas ignition in the event of a gas leak
- Greater tendency to leak through fittings; should assess facilities in confined spaces
- Likely increase in inspection frequencies
- Leak detection or monitoring devices; no available odorant for hydrogen
- Assess gas chromatography technology for monitoring hydrogen levels in the pipeline
- Reduced pipeline capacity
- Assess for potential contaminants in hydrogen gas

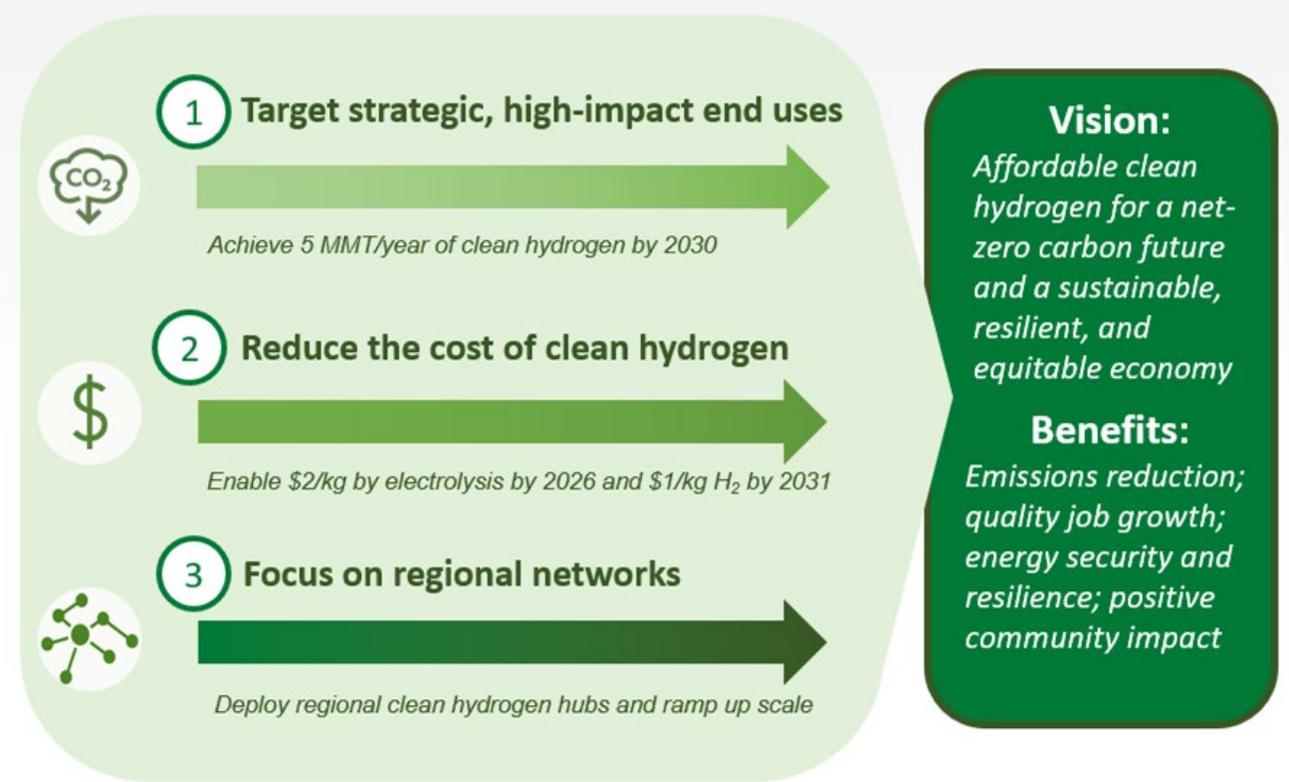


# Pacific Northwest Hydrogen Hub

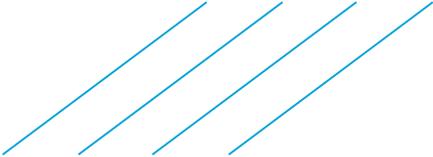
## Overview

November 2023

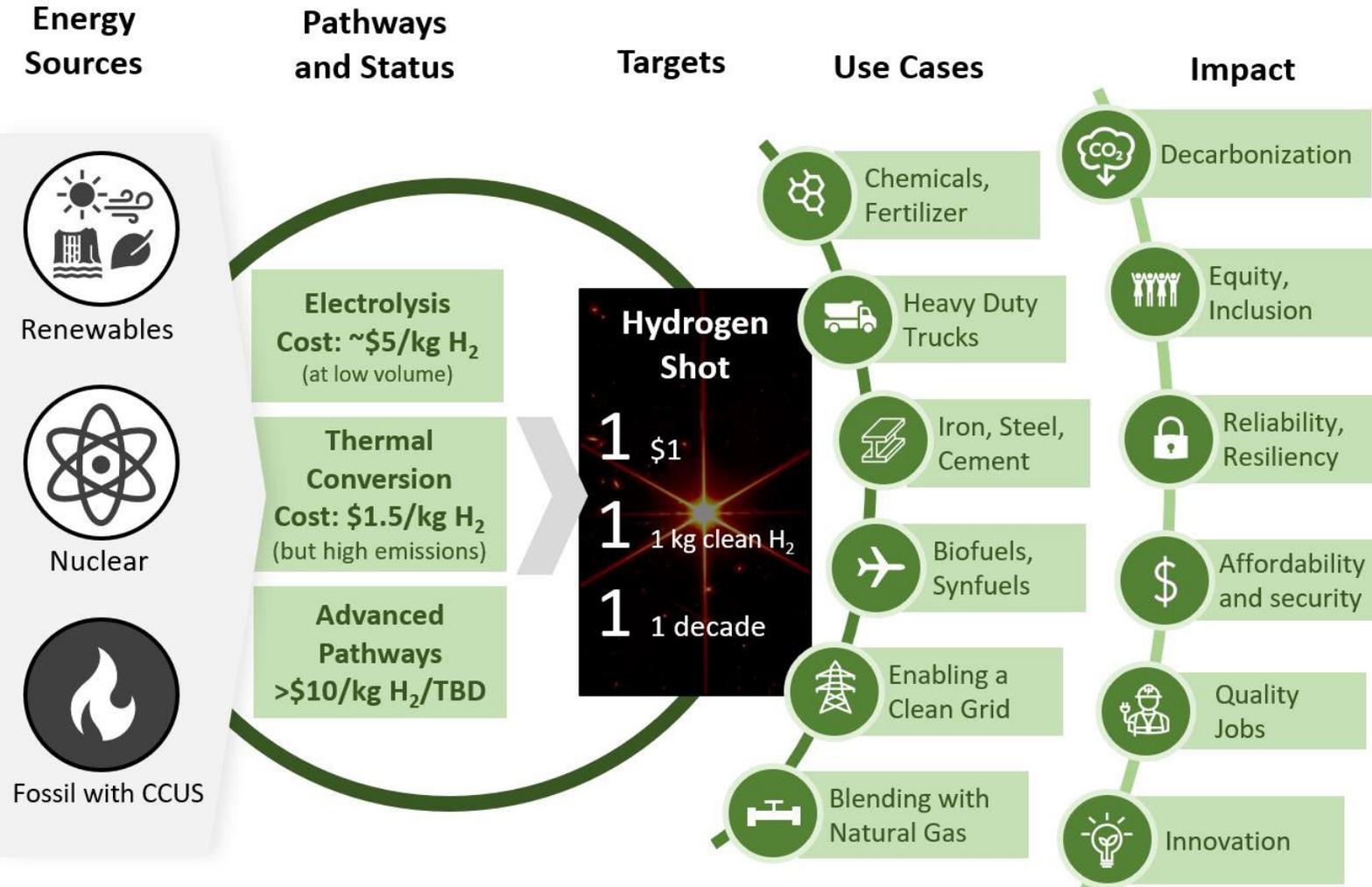
# National Strategies for Clean Hydrogen & DOE Hydrogen Program Mission and Context



This graphic was originally created and published by the U.S. Department of Energy.



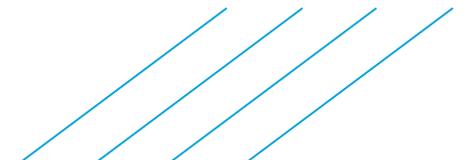
# DOE Hydrogen Targets



The seven Regional Clean Hydrogen Hubs selected for award negotiations are expected to leverage multiple production technologies, become integrated into a broad spectrum of technologies, and provide positive benefits across many communities.

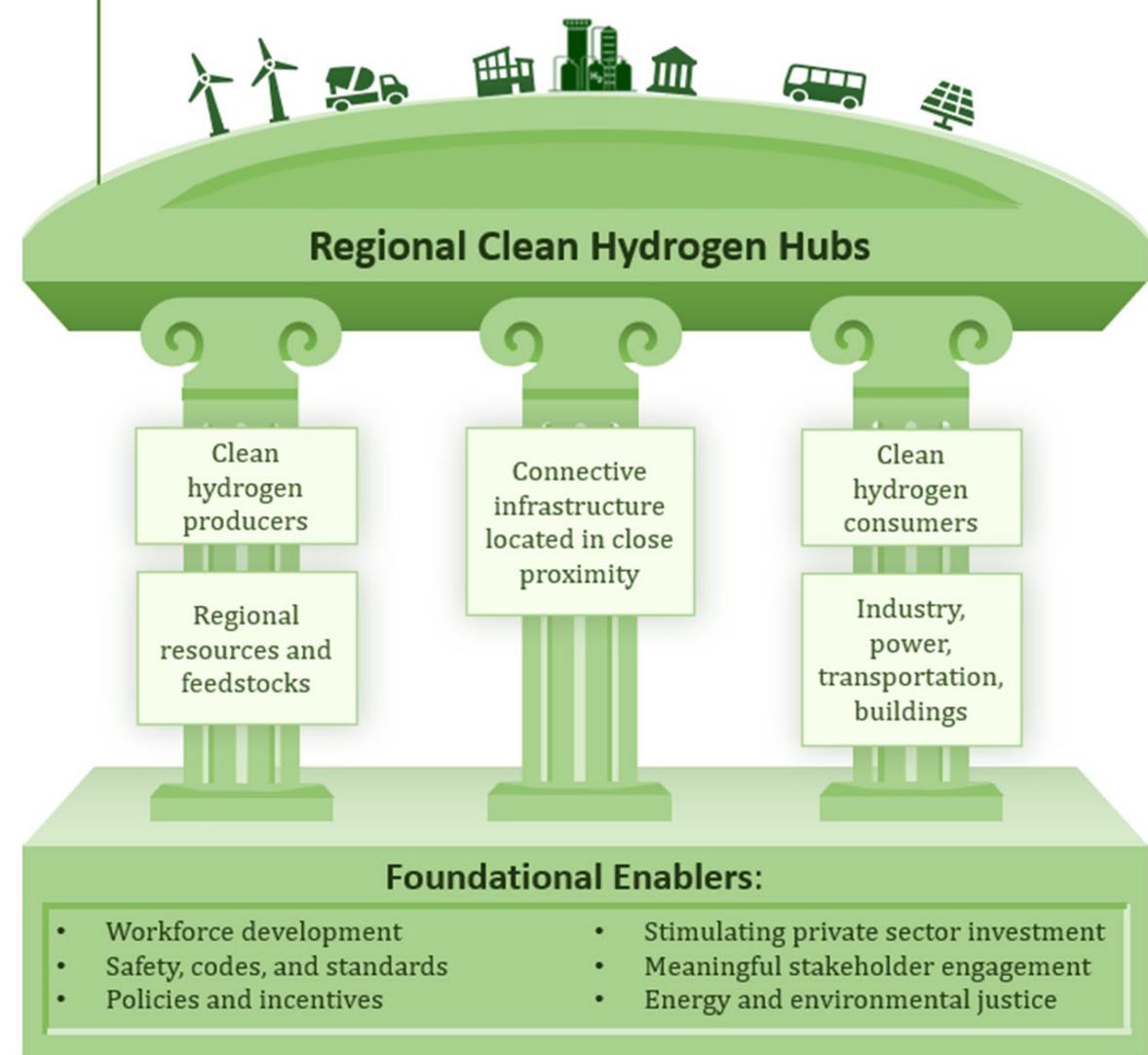
The Hydrogen Shot targets build on progress for a variety of pathways, enabling a range of use cases and impacts.

This [graphic](#) was originally created and published by the U.S. Department of Energy.

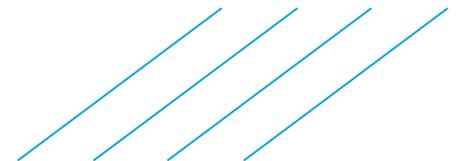


# Benefits for Hub Regions

- › Clean hydrogen produced and used at scale
- › Carbon emissions and pollution reduction
- › New sustainable jobs, including good-paying union jobs
- › Clear benefits for disadvantaged communities
- › Exemplary models for skills training, diversity, equity and inclusion
- › Domestic manufacturing
- › Sustained economic growth and scaled-up hydrogen use
- › Additional and sustained private sector investment



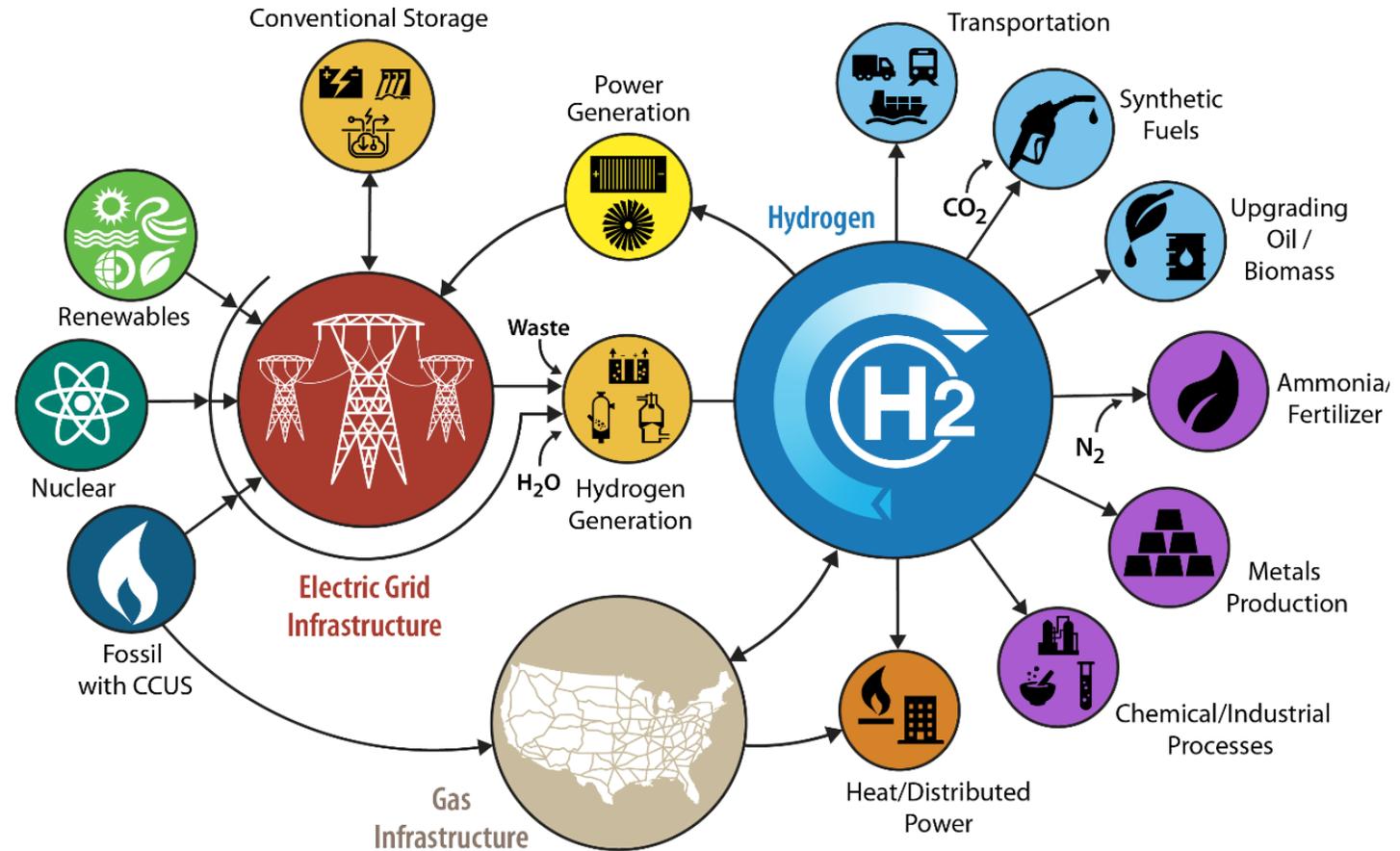
This [graphic](#) was originally created and published by the U.S. Department of Energy.



# Pacific Northwest Hydrogen Hub

Vast Coalition Collaborating to Make a Difference

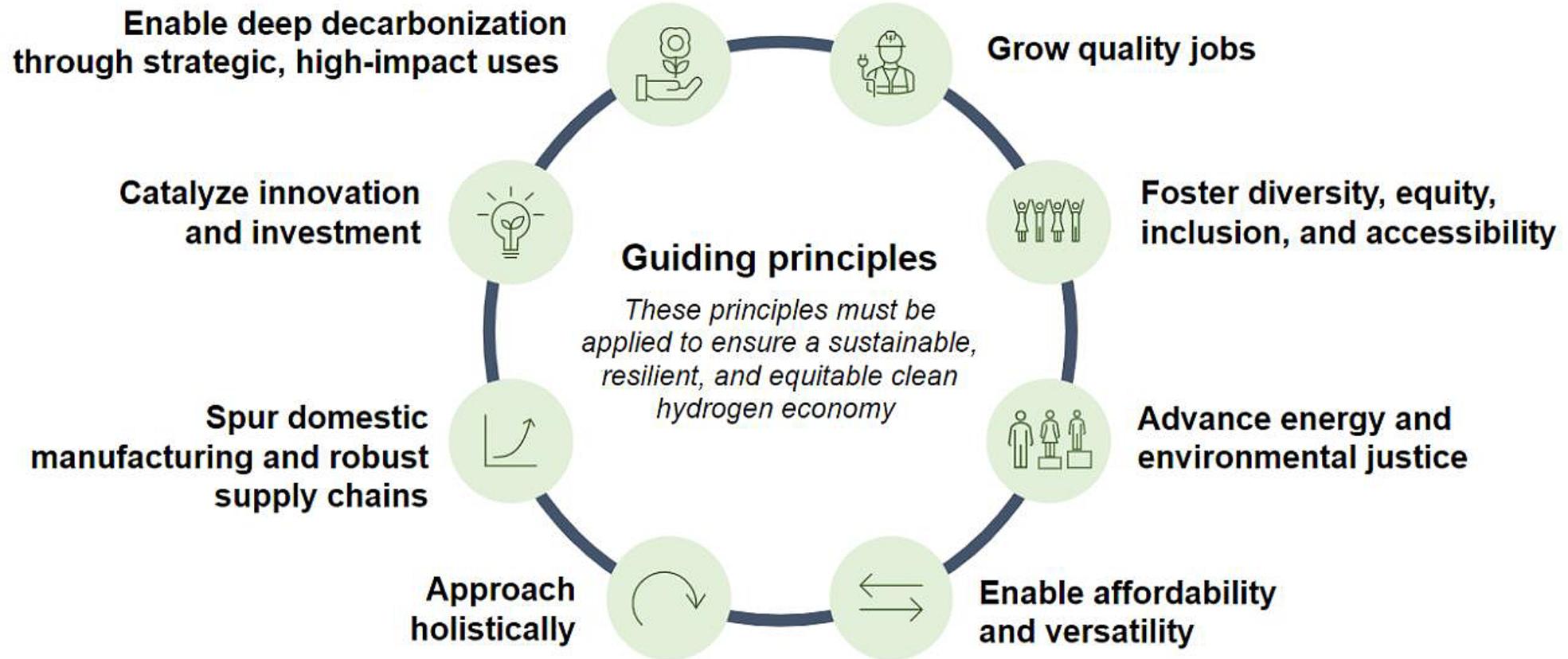
- › Energy Equity and Environmental Justice Plan
- › Workforce Development and Jobs Plan
- › Tribal Engagement
- › Community Engagement
- › Use of Mapping and Geospatial Tools & Data to Advance Equity
- › Domestic Clean Technology Manufacturing
- › Energy Emergency Management & Planning
- › Industry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



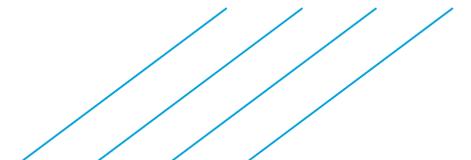
The U.S. Department of Energy's H2@Scale initiative to enable decarbonization across sectors using clean hydrogen.

# Pacific Northwest Hydrogen Hub

## Applying National Guiding Principles



This graphic was originally created and published by the U.S. Department of Energy.



# Pacific Northwest Hydrogen Hub

## Timeline

- › November 2022: PNWH<sub>2</sub> Hub submits concept paper to the U.S. Department of Energy (DOE) in response to the Regional Clean Hydrogen Hubs Program Funding Opportunity Announcement – **79 concept papers received**
- › December 2022: DOE “encourages” PNWH<sub>2</sub> Hub to submit a full application – **33 invited to submit full application**
- › April 2023: PNWH<sub>2</sub> Hub submits its full application to DOE
- › Summer 2023: DOE invites PNWH<sub>2</sub> Hub representatives to complete a pre-selection interview
- › Fall 2023: DOE OCED selects PNWH<sub>2</sub> Hub as one of seven for negotiation of award – **1 of 7 selected**
- › Fall 2023: Negotiations with DOE begin to determine final federal funding levels, scope and terms for each hub
- › Early 2024: Phase 1, detailed project planning, kicks off to refine projections submitted in the proposal and provide assurance to DOE that the overall hydrogen hub concept is technologically, financially, and legally viable, with buy-in from local stakeholders

