



UKOPA 2022 Technical Seminar

- **H₂ pipelines & blending work in North America and implications for the UK**

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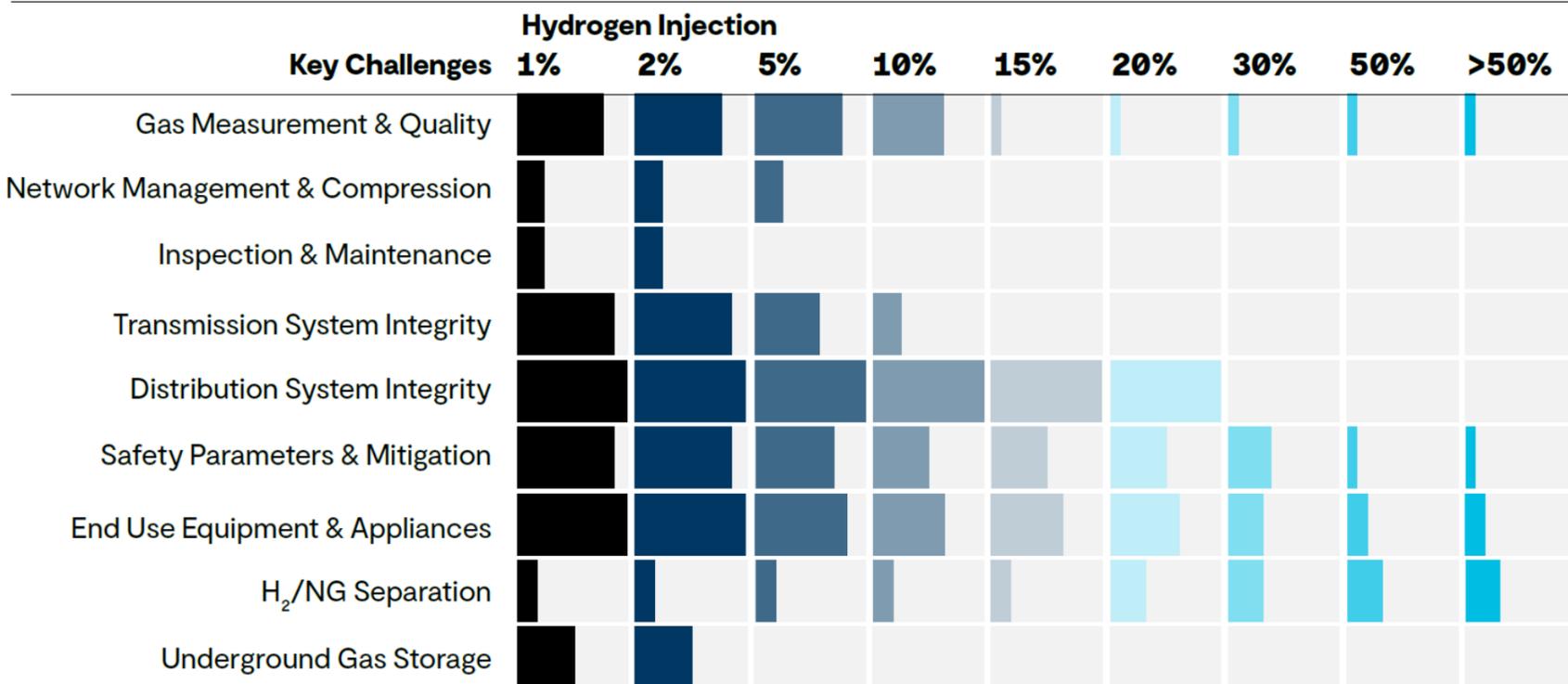


Global State-of-the-Art Analysis on Hydrogen Blending

2020



2022



High-level summary of knowledge on different levels of blending in the grid

30+ Organizations

100+ Projects

300+ Reference Documents

- Technical state-of-the-art & gap analysis
- Regulations & policies
- Education toolkit
- Customer Eng.
- Roadmap
- StoryMap



GHD's Involvement in Canada H2 Codes & Standards

- Stakeholder in the development of **Canada Hydrogen Strategy** (Dec 2020).
- Participating in the **Codes & Standards Working Group** under NRCan – one of the working groups launched following the national Hydrogen Strategy.
- Providing expertise to the **Standards Council of Canada** for their work assessing the international standardization landscape for hydrogen.
- **Supporting gas utilities and industries** defining pilot & demonstration projects to gather data & serve as proof for the development of H2 blending standards.
- Note: Recent **funding opportunity** has funds dedicated towards developing or **standardizing codes and standards** for hydrogen projects (\$3M).



Canada



Energy Innovation Program (EIP)



Clean Fuels &
Industrial Fuel Switching



Small Scale Hydrogen Blending Community

GHD is working with a major natural gas distribution company on various hydrogen blending opportunities.

Development of a small-scale “hydrogen community”

- Test and validate blending percentages on various NG appliances and piping systems.
- Building “12 sheds” to house appliances
→ Gives the look and feel of a real community
- Involve community, local fire marshal and permitting agencies upfront in program development process.
- Start off with a small-scale hydrogen supply (cylinders) system - grow into other supply options.
- Verify results prior to a full-scale project.



An advanced R&D lab was developed to test existing and future appliances and standards at various fuel mixtures (up to 100% H₂) in a collaborative research environment.



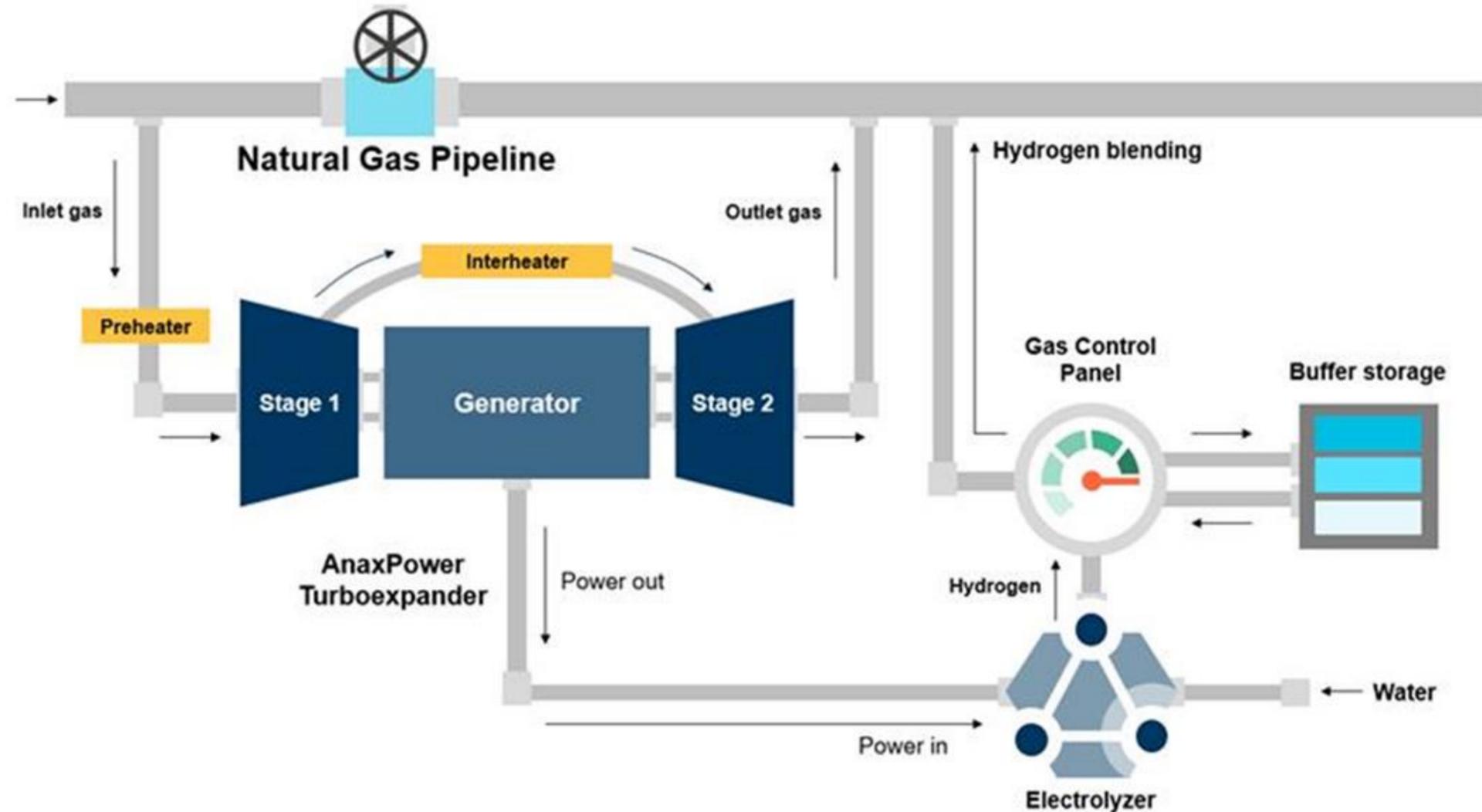
Turboexpanders to Power H2 Blending

GHD and Anax Power have developed a technology that utilizes the potential energy available across typical natural gas regulating stations to produce:

- 100% renewable power (500kW per unit).
- 100% renewable hydrogen (250 kg) via onsite electrolysis
- Hydrogen that is blended back into pipeline onsite.
- A practical, feasible, lower cost decarbonization option.

Estimated opportunity in the US:

- 5 GW of renewable power
- 800,000 tons of hydrogen per year
- Represent 11% of the total hydrogen required for a 10% blend of the entire natural gas consumption



GHD is working with a major natural gas utility to implement a full-scale demonstration in 2022



US DOE Hydrogen Hubs

Infrastructure Investment Job Act (IIJA)

aka

Bipartisan Infrastructure Law (BIL)



US DOE

\$8B over 5 years

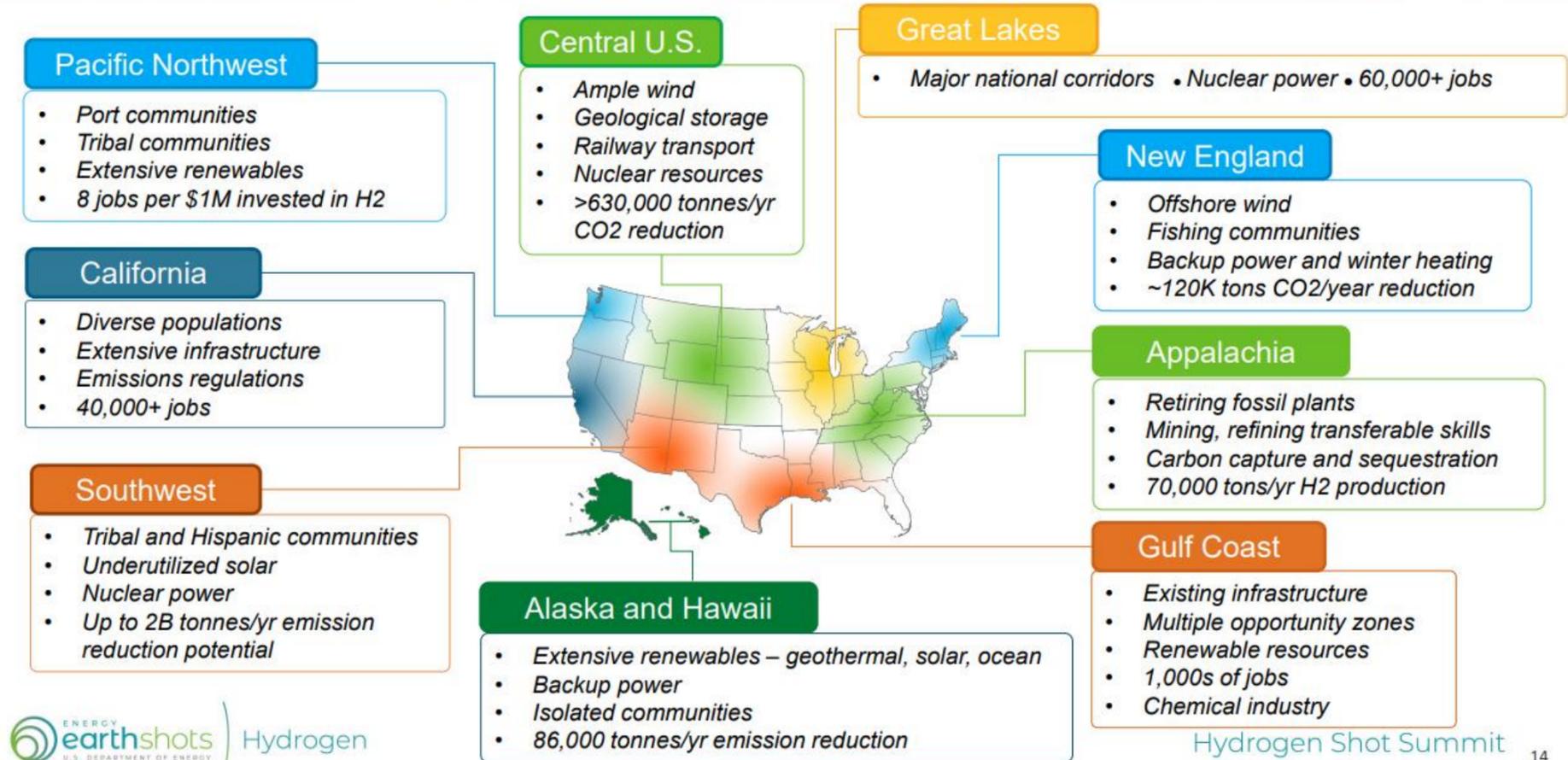
4+ regional clean hydrogen hubs

Requirements:

- Geographic diversity
- Feedstock diversity
- End uses diversity

- Cost share 50% of total project costs
- JEDI *Justice, Equity, Diversity, Inclusion*

RFI Findings: Regional clusters and geographic factors



Hydrogen-to-Infinity Landmark Pilot Project

Pacific Gas & Electric

2022 – Ongoing

Pilot project for hydrogen blending in natural gas transmission pipelines.



GHD is providing technical, preliminary engineering & design, stakeholder engagement, regulatory, and funding application services to the landmark end-to-end demonstration facility.

The dedicated facility will allow for a controlled and safe study of hydrogen injection, storage, and combustion of different hydrogen blends in a variety of end uses. NCPA's Lodi Energy Center power plant is located adjacent to H₂[∞] and will accept a hydrogen-natural gas blend for electric generation in the Siemens Energy 5000F4 Gas Turbine.

H₂[∞] will include a new 130-acre facility located in Lodi, California that will serve as a demonstration facility, laboratory, and training and education centre for hydrogen blending in high-pressure natural gas systems that incorporates production, pipeline operations and integrity, storage, and end-use combustion.



California Hydrogen Hubs: NorCal H2 Hub



H2 on the Move

— Hydrogen Framework and H2Hub Updates —



NOTE:
Elements outside of the Lodi facilities are part of Future Hub Expansion.

The Green Hydrogen Coalition's HyDeal Los Angeles vision:

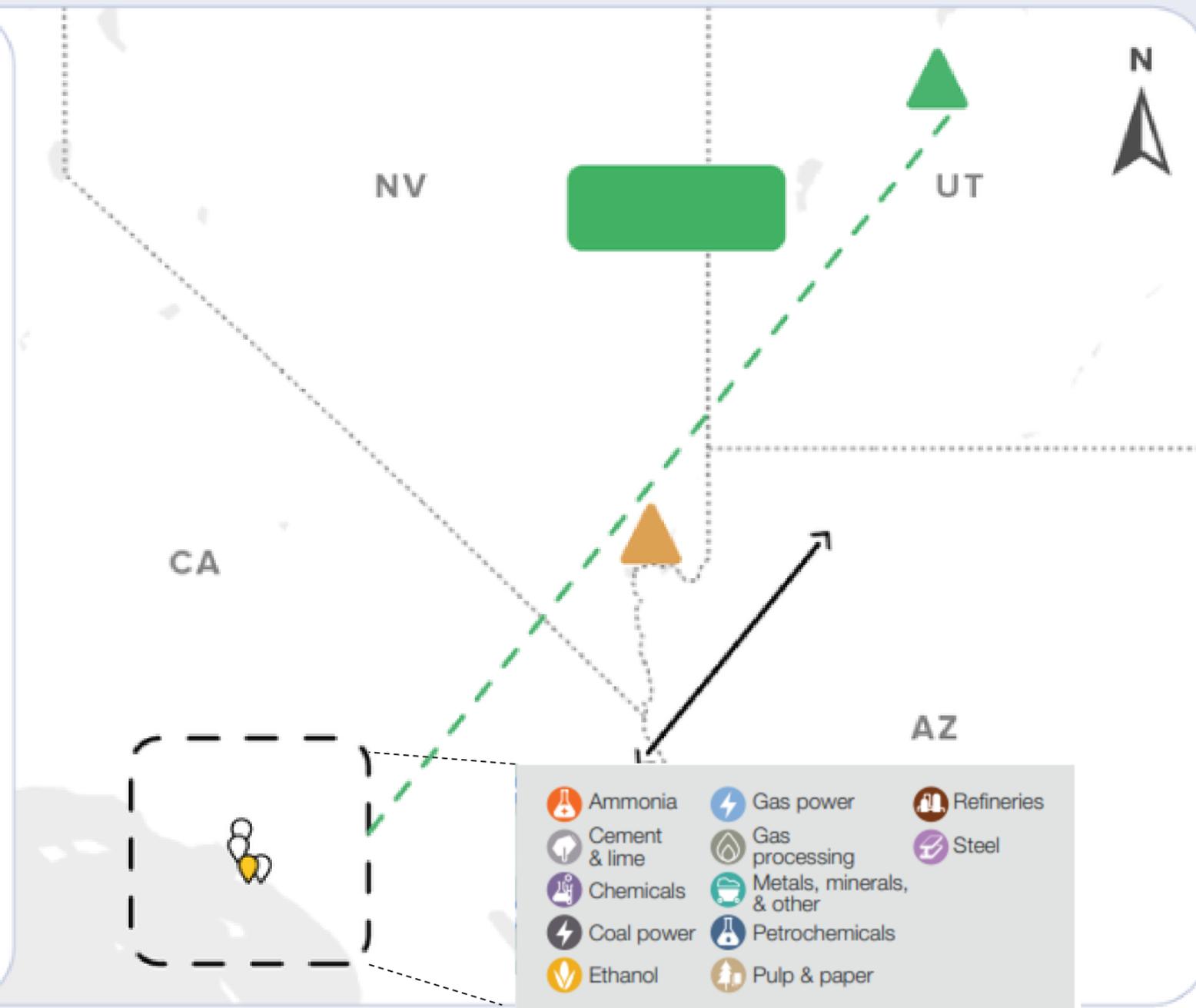
- Achieve \$1.50/kilogram delivered green hydrogen in the LA Basin by 2030
- Make LA home to the first scaled green hydrogen ecosystem in North America
- Become a model for rapid acceleration for other cities around the continent

The HyDeal LA hub connects multi-sectoral off-takers and low-cost renewable electrolytic production and storage, spanning four U.S. states¹

Legend

- Qualified and not-qualified refineries
- Qualified power plant
- Known storage sites – Salt cavity
- Possible storage sites
- H2 off-takers area
- Flow direction need
- TSOs potential routes (greenfield) – High-level design

Note: Electrolytic green hydrogen can be produced in Southern California and along the pipeline route.



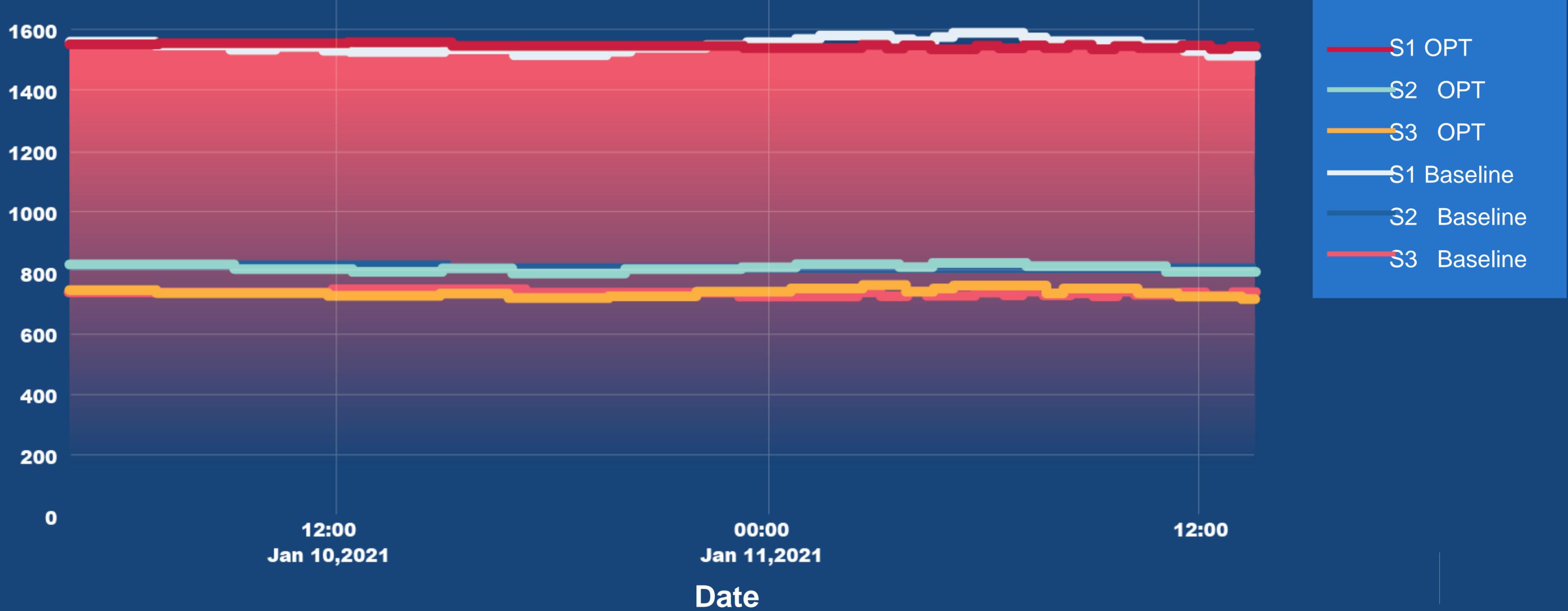
- Hydrogen pilot project to enable the proposed conversion of **43-kilometres of Parmelia Gas Pipeline** in Western Australia into Australia's first 100 per cent hydrogen-ready transmission pipeline.
- The \$3 million project will fund three phases, including: research and testing of the material for embrittlement in the laboratory, development of safe operating guidelines, and full-scale testing on-site.
- GHD providing technical assurance in the PGP conversion.
- GHD undertook the feasibility for a High Pressure long distance transmission pipeline (confidential client)



Verification of Pipeline Optimization

The benefit of realizing a digital twin (or virtualized pipeline model) is that it can be used to predict how the actual system would operate under different conditions. Parameters can be adjusted to maximize system operation based on defined criteria, and the results of multiple simulations analyzed to achieve optimum system performance.

Optimized vs Baseline





Hydrogen Blending – What's Next?

- Continued widespread interest in hydrogen blending → 100% H2
- Upcoming large funding opportunities
 - CEC Targeted H2 Blending grant
 - IIJA DOE \$8B for H2 hubs!
- Progressing from studies to actual pilot & demonstration projects
- Lot of testing already on distribution side
 - Growing interest in blending in transmission lines



GFO-21-507 - Targeted Hydrogen Blending in Existing Gas Network for Decarbonization

**Available funding \$5.6M
Program 2022-2025**

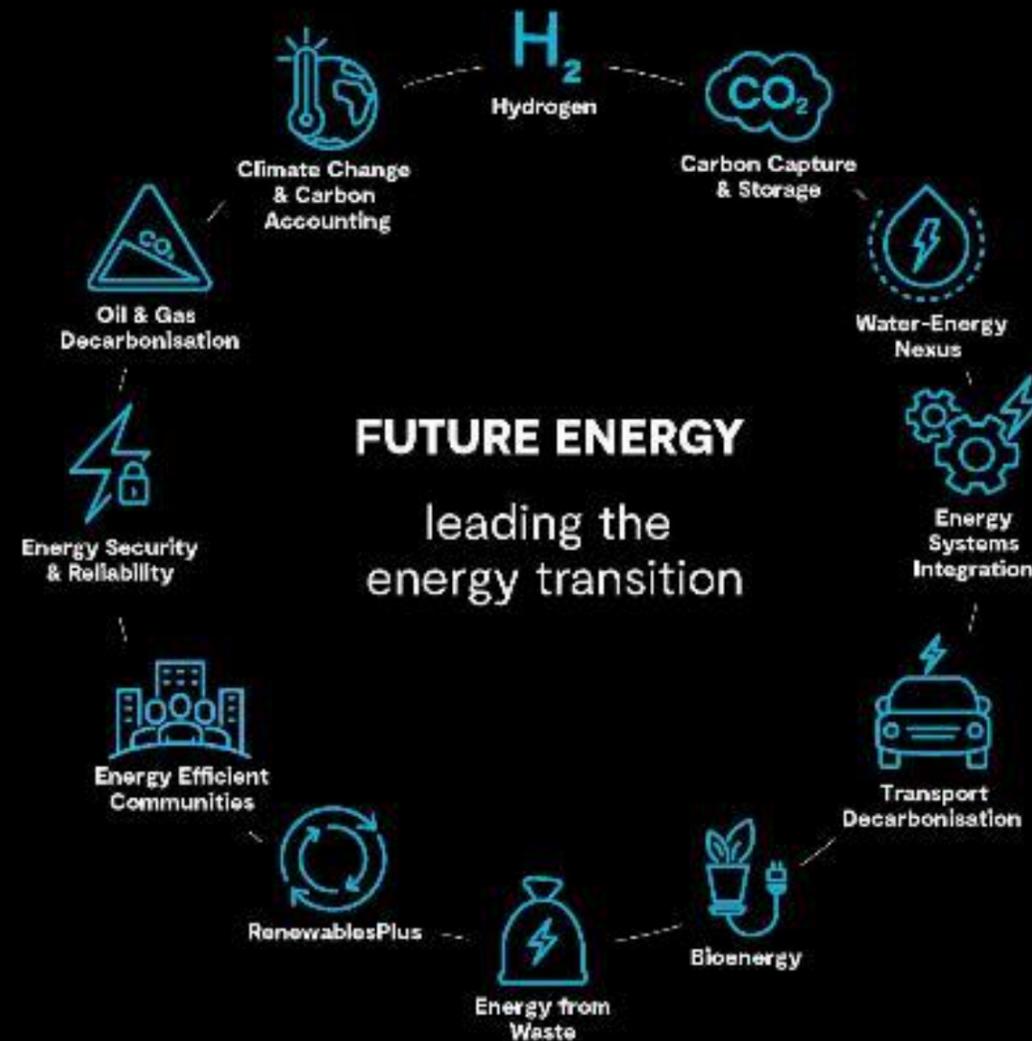


Infrastructure Investment Job Act

**9 US regional clean hydrogen clusters identified
\$8B to support for at least 4 clean H2 hubs**



Thank you



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Read GHD's Hydrogen Blending Whitepaper:
<https://www.ghd.com/en/expertise/the-rise-of-a-green-h2-economy.aspx>

