U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

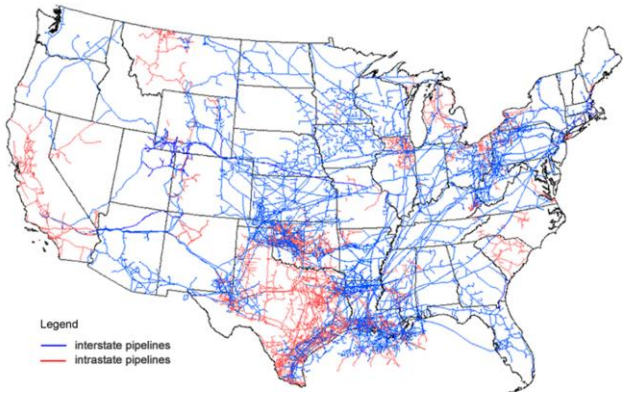
HyBlend: Opportunities for Hydrogen Blending in Natural Gas Pipelines

HyBlend
U.S. DEPARTMENT OF ENERGY

The HyBlend initiative aims to address technical barriers to blending hydrogen in natural gas pipelines. Key aspects of HyBlend include materials compatibility R&D, technoeconomic analysis, and environmental life cycle analysis that will inform the development of publicly accessible tools that characterize the opportunities, costs, and risks of blending.

BACKGROUND

The United States has an extensive network of approximately three million miles of natural gas pipelines and over 1,600 miles of dedicated hydrogen pipeline. Hydrogen produced through clean pathways can be injected into natural gas pipelines, and the resulting blends can be used to generate heat and power with lower emissions than using natural gas alone.



Natural gas pipeline networks in the continental US. Source: EIA

Blend limits depend on the design and condition of current pipeline materials (e.g., integrity, dimensions, materials of construction), design and condition of pipeline infrastructure equipment (e.g., compressor stations), and design and condition of applications that utilize natural gas (e.g., building appliances, turbines, and chemical processes, such as plastics production). Blend limits can vary greatly based on these variables but have ranged from <1% to 30% in recently announced demonstrations and deployments.

Natural gas transmission pipelines in the U.S. are currently commonly made of steel, and, prior to 1950, were built of cast iron. Lower pressure distribution piping is commonly made of plastic.[1] The HyBlend team will test pipeline materials in varying concentrations of hydrogen at pressures up to 100 bar to assess their susceptibility to hydrogen effects.

1. https://www.phmsa.dot.gov/technical-resources/pipeline/pipeline-materials

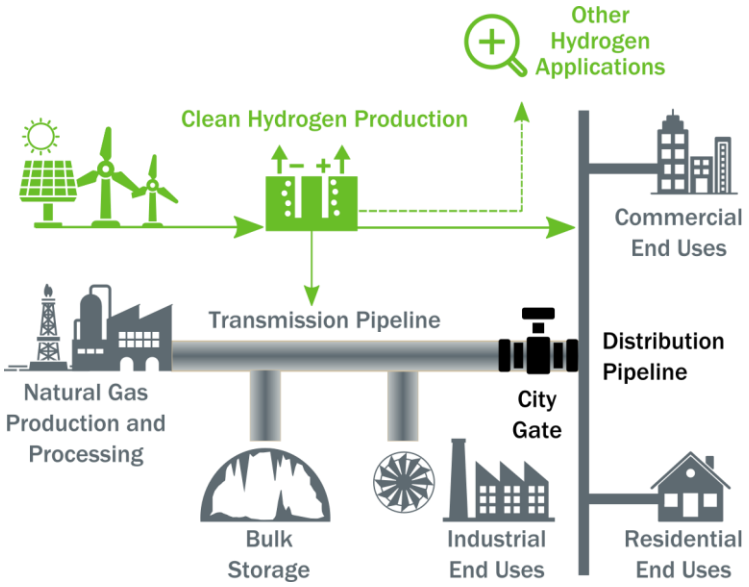
ORGANIZATION

EERE's Hydrogen and Fuel Cell Technologies Office (HFTO) launched the HyBlend collaboration in 2021. R&D projects within the collaboration are primarily being conducted by the National Laboratory team (shown below), led by the National Renewable Energy Laboratory (NREL), with the participation of over 20 partners in industry, nonprofits, and academia. HFTO will collaborate with the Office of Fossil Energy and Carbon Management (FECM), the Advanced Manufacturing Office (AMO), the Building Technologies Office (BTO), and other relevant offices and agencies on RD&D topics relevant to HyBlend.

NREL NATIONAL RENEWABLE ENERGY LABORATORY
Sandia National Laboratories
Pacific Northwest NATIONAL LABORATORY
Argonne NATIONAL LABORATORY
OAK RIDGE National Laboratory
NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

HyBlend by the Numbers

$15M R&D Portfolio
>20 partners
6 national labs
Duration of Current R&D Projects: 2021-2023



Supply chain and components of blending in natural gas networks

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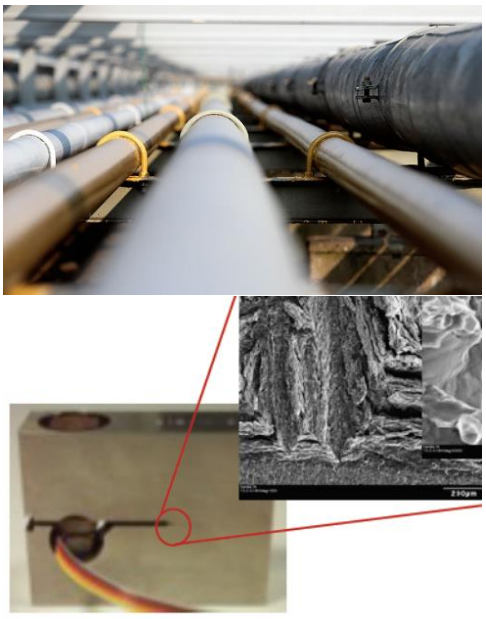
OBJECTIVES

Develop public tools that assess the risks of blending to a pipeline system, given the materials in use, age of the system, and blend concentration. The tools will be informed by systematic testing of metal and polymer materials used in pipelines, such as steel and polyethylene, with hydrogen blends.

Develop a tool that evaluates the opportunities and costs of blending and of synthetic natural gas. The tool will allow for user-defined scenarios of electricity price, pipeline materials, and decarbonization drivers.

Analyze life-cycle greenhouse gas and criteria pollutant emissions of blending relative to alternative pathways. This includes conventional natural gas and synthetic gas pathways, which will be incorporated into GREET®, a public-facing environmental life-cycle analysis model.



R&D will assess the impact of hydrogen on durability of pipeline materials, using unique high-pressure test facilities at the H-Mat labs.

BUDGET & TIMELINE

HyBlend currently comprises $15M in funding, including $11M of federal funding and $4M of cost share. R&D within the current portfolio is expected to last from 2021-2023.

Related R&D Activities

HyBlend is being conducted in coordination with other recent and ongoing DOE R&D activities. Significant examples include

H-Mat: National laboratory consortium co-led by SNL and PNNL, conducting cross-cutting R&D on the compatibility of metallic and polymer materials for hydrogen service. H-Mat labs have conducted significant prior R&D on materials for hydrogen pipelines, in collaboration with the National Institute of Standards and Technology. For more information, please see: https://h-mat.org/

Advanced Research on Integrated Energy Systems

ARIES: NREL's research platform designed to de-risk, optimize, and secure current energy systems and to provide insight into the design and operation of future energy systems. This spans hydrogen and fuel cell technologies, including electrolyzers and infrastructure components. For more information please see: https://www.nrel.gov/aries/

GREET: Model developed and annually updated by ANL to depict life cycle emissions of hundreds of fuel pathways. GREET has over 40,000 users worldwide. For more information, please see: https://greet.es.anl.gov/

PARTNERSHIPS

HyBlend partners include:

- American Air Liquide, Inc
- Chevron
- DNV GL
- Enbridge
- Electric Power Research Institute
- GTI
- Hawaii Gas
- National Grid
- New Jersey Natural Gas (NJNG)
- ONEGAS
- Operations Technology Development NFP (OTD)
- Pipeline Research Council International (PRCI)
- Sacramento Municipal Utility District (SMUD)
- Southern Company
- Southwest Research Institute
- Stony Brook University
- Tenaris

And many more!

Contacts

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