Hydrogen Blending

In the Natural Gas Industry

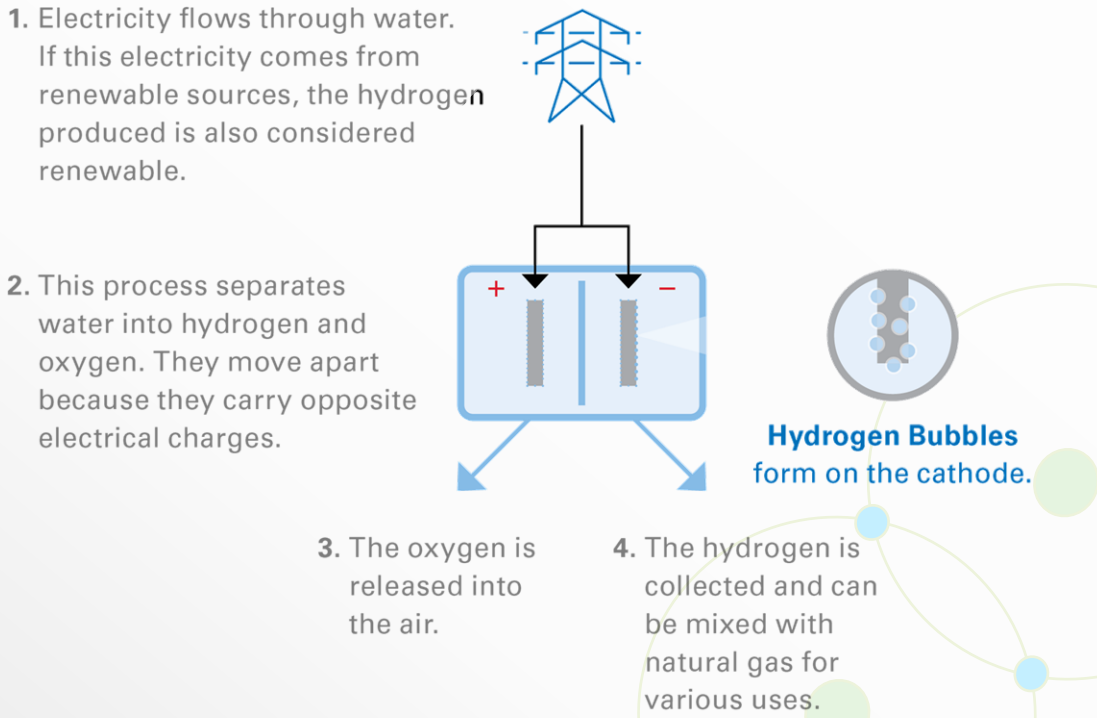
Alyssa Wahlin, PE

Why Hydrogen?

- Hydrogen is an energy carrier, much like natural gas
- The hydrogen molecule has no carbon
- When burned, the emissions do not have green house gases
- Can be considered renewable

Producing Hydrogen

- Steam Methane Reforming (SMR)
  - Most common production method today
- Electrolyzer
  - Alkaline
  - Proton Exchange Membrane (PEM)
  - Can be considered renewable
- Pyrolysis
  - Solid carbon is a byproduct



Natural Gas and Hydrogen

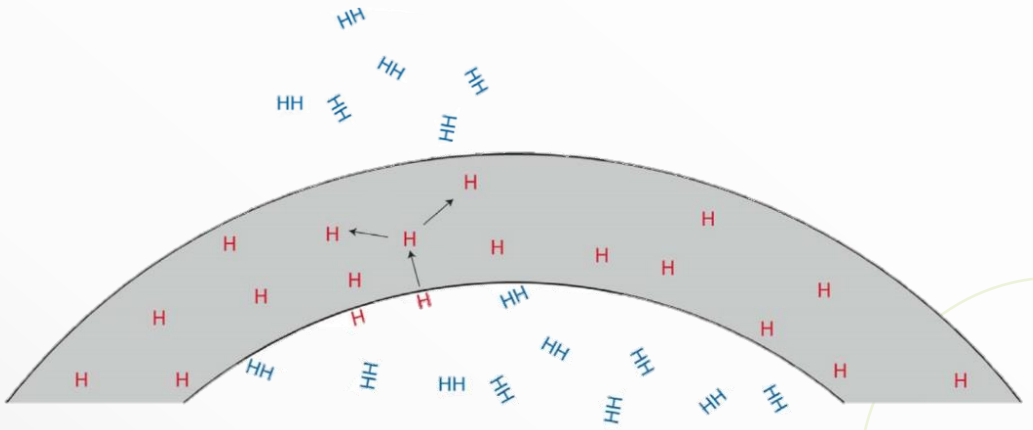
	Natural Gas (Methane)	Hydrogen
Heating Value	950 Btu/scf	325 Btu/scf
Flammability Range	5-15%	4-75%
Max Flame Speed	0.44 m/s	3.25 m/s
Molecular Weight	16.04 g/mol	2.02 g/mol
Density	~1.8 times lighter than air	~14 times lighter than air

Hydrogen Research

- A Note:
  - There is a lot going on related to hydrogen and hydrogen blending right now
  - Not all the reports for the research are publicly available
  - Most discussed here is within North America, but lot is going on globally as well.

Material compatibility

- Embrittlement
  - Higher risk with high tensile strength steel (X70 and higher)
  - Higher risk with high pressures
  - Research ongoing to better determine limits
- In-service welding
  - Early research indicates additional guidelines can limit risk



Hydrogen Embrittlement | Hydrogen Tools (h2tools.org)

Material compatibility

- Plastic Pipe
  - Less overall research focused here
  - No known material incompatibilities with hydrogen
  - Hydrogen more likely to seep through, but at still negligible amounts

End-Use Applications

- Most end-use research on residential applications
- At low blends:
  - No major change to gas combustion properties
  - Low risk of flashback
  - No change to NO_x emissions
- Minimal research so far with commercial/industrial

Leak Susceptibility

- Research is showing hydrogen will not leak out of gas tight fittings
  - Testing included blends up to 40% Hydrogen
- Hydrogen does not preferentially leak

Leak Survey

- For lower blends:
  - Hydrogen does not seem to affect methane specific survey instruments
  - Minimal change in overall gas properties, including flammability range

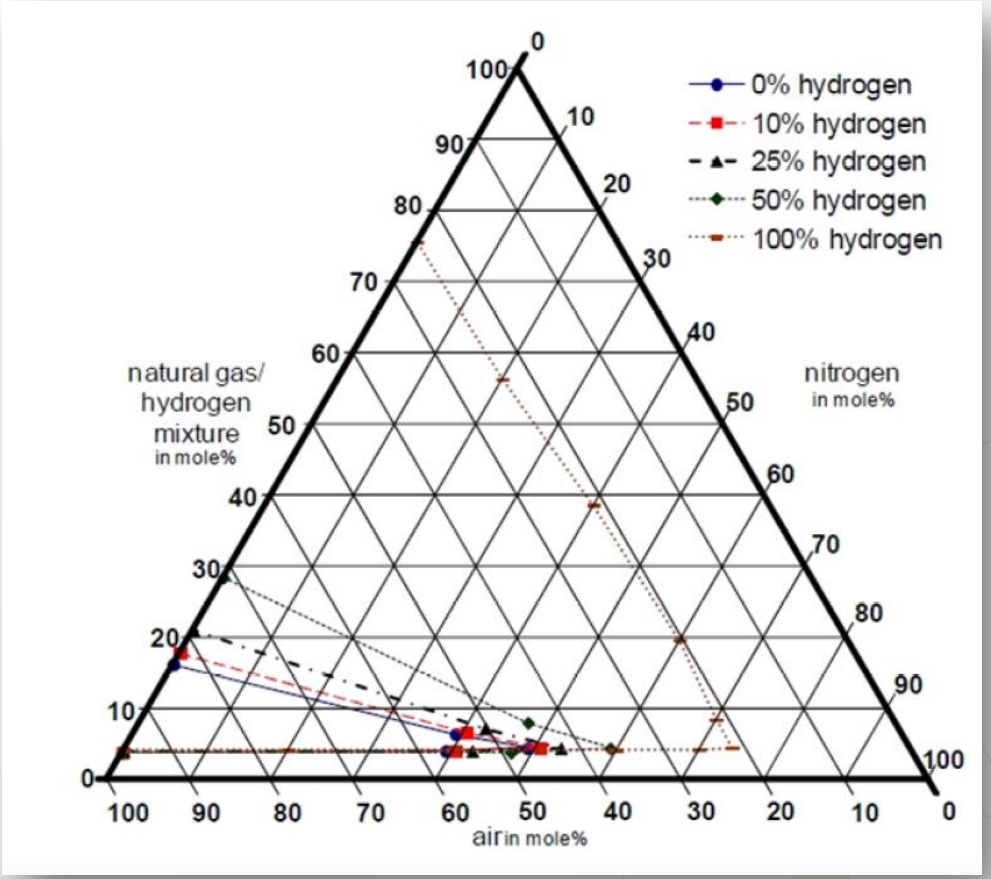


Figure 16: Ignition limits of methane, hydrogen and natural gas / hydrogen blends with air [15]

20211124-D2.2_CombustionTheory_final.pdf (thyga-project.eu)

Leak Survey

- CO Detectors
  - Known cross-sensitivity with hydrogen
  - Research is starting to explore other sensor types

North American Blending Pilots

- ATCO
- CenterPoint Energy
- Dominion Energy
- Enbridge
- Hawaii Gas
- National Grid
- New Jersey Resources
- New Mexico Gas
- NiSource
- Northwest Natural
- PG&E
- Puget Sound Energy
- SoCal Gas
- Southwest Gas
- Xcel Energy
- And others!

Dominion Energy Utah Pilot

- Efforts were focused on confirming existing research and gaining operational experience with blends up to 5% hydrogen

Dominion Energy Utah Pilot

- Testing fell into different categories:
  - Appliance safety
  - Gas Quality
  - NO_x Emissions
  - Leak Survey
  - Materials

Current Status

- Hydrogen research and blending pilots are continuing to build
- Recently announced Hydrogen Hubs expected to help build clean H2 industry

Future

- Hydrogen could be produced during high renewable electric production periods and then blended with natural gas
- Europe is starting to research and pilot 100% Hydrogen

Thank you!

- Hydrogen Blending in Delta Utah | Dominion Energy
- HYREADY (dnv.com)
- In-service welding of methane/hydrogen mixture pipelines (dnv.com)
- NREL Technical Report (NREL/TP-5600-51995) "Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues"
- NYSEARCH - Natural Gas RD&D
- Home - Operations Technology Development (OTD)
- THyGA | Testing Hydrogen admixture for Gas Applications (thyga-project.eu)

- Contact Information:
  - Alyssa Wahlin
  - Alyssa.Wahlin@DominionEnergy.com

Links to Individual Company Efforts

- ATCO: Fort Saskatchewan Hydrogen Blending Project (atco.com)
- CenterPoint Energy: CenterPoint Energy launches green hydrogen project in Minnesota (prnewswire.com)
- Dominion Energy Utah: Hydrogen Blending in Delta Utah | Dominion Energy
- Enbridge: Clean hydrogen enters the Markham energy mix - Enbridge Inc.
- Hawaii Gas: https://www.hawaiigas.com/clean-energy/decarbonization
- National Grid: One of US' first green hydrogen blending projects launches | National Grid Group
- New Jersey Resources: NJR_HydrogenProject_Factsheet_01d1.pdf (njrsustainability.com)
- New Mexico Gas: FOR IMMEDIATE RELEASE (nmgco.com)
- NiSource: Future of Energy - NiSource
- Northwest Natural: Hydrogen - NW Natural
- PG&E: Hydrogen to Infinity (pge.com)
- Puget Sound Energy: PSE | Hydrogen pilot
- SoCal Gas: H2 Blending | SoCalGas
- Xcel Energy: Hydrogen-Natural Gas Blending Demonstration Project (xcelenergyadamsdemo.com)