



The operating implications of distributing Hydrogen/Natural Gas mixtures and other new fuels

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DOT/PHMSA Pipeline R&D Forum

Overview

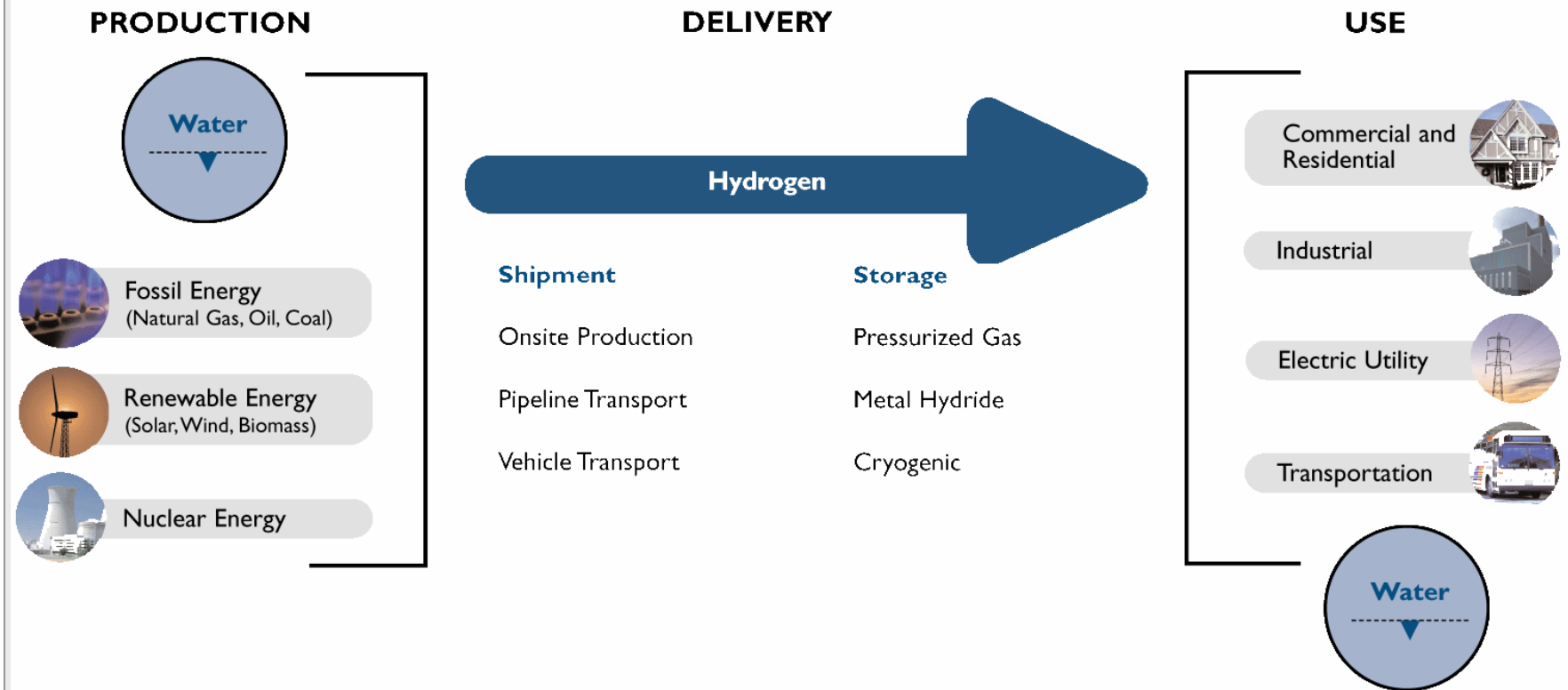
- > Many projects exist to examine delivering Hydrogen, some by using existing pipelines
- > One approach involves mixing hydrogen and natural gas and distributing in the existing pipeline network
- > Newer methane sources are also being considered, such as biogas, landfill gas and LNG
- > Pipeline quality standards are targeted to traditional natural gas sources



Overview

- > There are currently approximately 700 miles of hydrogen pipelines operated in the USA
- > Natural Gas transmission lines total approximately 300,000 miles (non-gathering)
- > The natural gas industry distributes energy through approximately 1,100,000 miles of mains
- > Issues with Distribution from new fuels are unique and different from Transmission

THE HYDROGEN ENERGY SYSTEM



Background- Manufactured Gas

<u>Component % volume</u>	<u>USA</u>	<u>UK</u>
CO ₂	2.4	2.5
O ₂	0.8	1.0
C ₃ H ₆ (aggregate)	3.0	3.0
CO	7.4	14.0
H ₂	48.0	47.0
CH ₄	27.1	23.5
N ₂	11.3	9.0
Specific Gravity	0.42	0.48
Calorific Value	btu/ft ³	480
	MJ/m ³	17.9



Background - properties

Characteristic	Hydrogen	Natural Gas
Calorific Value (MJ/m ³)	13	39
Diffusion coefficient (cm ² /sec)	0.61	0.16
Density, gas (kg/ m ³)	0.0838	0.651
Flame velocity (laminar) cm/s	265	34
Flammability range % air	4 - 75	5 - 15
Energy required for ignition (MJ)	0.02	0.29

Background – properties of mixtures

		Hydrogen/natural gas blends		
		0/100%	5/95	10/90
Calorific value	btu/ft ³	1030	995	960
	MJ/m ³	38.37	37.07	35.77
Specific Gravity		0.6	0.570	0.550
Relative energy		1.0	0.966	0.932
Volume req. to equivalent natural gas energy		1.0	1.035	1.073



Distribution System Design

- > Sizing of Network Components
 - Increased volumes
 - > Mains
 - > Services
 - > Meters
- > Regulator/Meter Stations
 - Sizing

Distribution Operating Issues

- > Materials
 - Leakage
 - > Permeation
 - > Threads and fittings
- > General Hydrogen Safety



Operating Practices

- > Odorization
- > Leak Survey
- > Leak Investigation
- > Safety Procedures



Operating Practices

- > Other procedures
 - Measuring Heating Value
 - Purging
 - Squeeze off
 - Vacuum Excavation
 - Billing Customers
 - Gas Contracts
- > Jurisdictional Regulations



Pipeline Quality Standards

> FGT Recent Gas Quality Tariff Provisions

- HV 1025 – 1110 Btu/scf
- Wobbe Number 1340 - 1396
- Hydrocarbons C1 85% or greater
 - > C2, 10% or less, C3, 2.75% or less
 - > C4, 1.2% or less, C5+ 0.12% or less
- CO₂ and N₂ 3% or less, no more than 1% CO₂
- O₂ 0.25% or less
- H₂S less than 0.25grains per ccf
- Total sulfur, less than 2 grains per ccf
- Water vapor less than 7 lbs per mmcf



New Fuels

- > Current pipeline gas quality standards may not be adequate
 - Mercury
 - Heavy metals
 - Microbial content (potentially leading to MIC corrosion)
 - Particulate sizes
 - Ammonia
- > We need to know what the new fuels may do to the pipeline system, and how they impact end users

Standards Review

Some areas identified in a recent (pure Hydrogen) project:

- Operator Qualification
- Class Location parameters
- Pipeline integrity management parameters
- Odorization issues
- Conversion of service
- Pipe materials
- Joining
- Emergency Plans
- Leak survey/instrumentation
- Purging/abandonment



Summary

- > If existing pipeline networks can be safely used without significant modification, adopting new fuels as viable energy sources will be more widely accepted.
- > Physical characteristics' differences will require some changes in practices and procedures.
- > Distribution pipeline operators must be confident their facilities can operated safely and cost effectively when delivering the mixtures discussed.
- > We need to understand the new fuels better
- > There must be a new view of pipeline quality standards



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