

CGA Energy Nexus & Annual Technical Conference 2024

Fuelling the Future

Hydrogen: Small Molecule with a Large Potential

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Agenda

1. Hydrogen Introduction
2. The Good and Bad of Hydrogen
3. A Roadmap for Hydrogen Blending



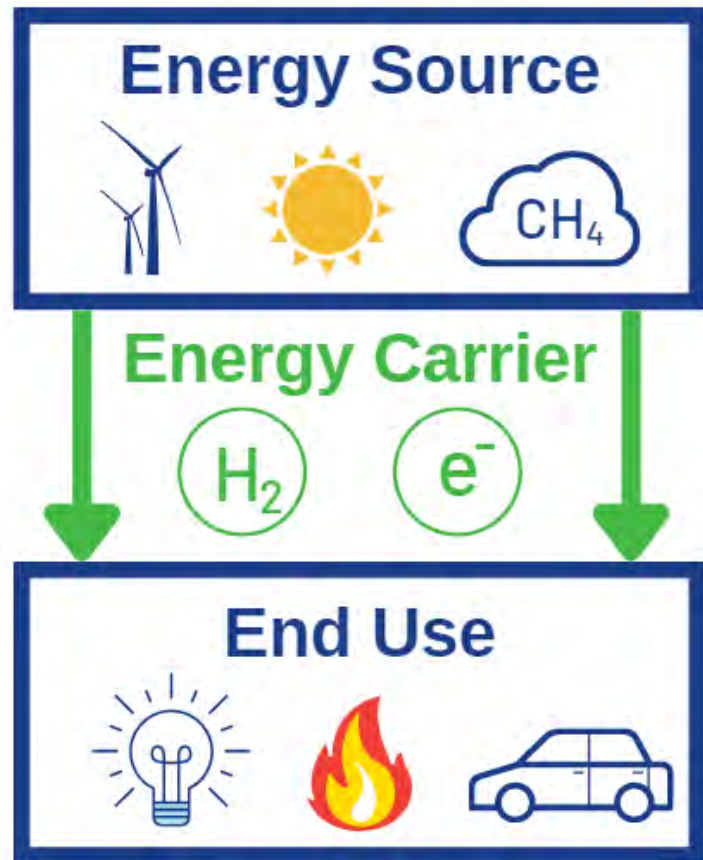


Hydrogen Intro




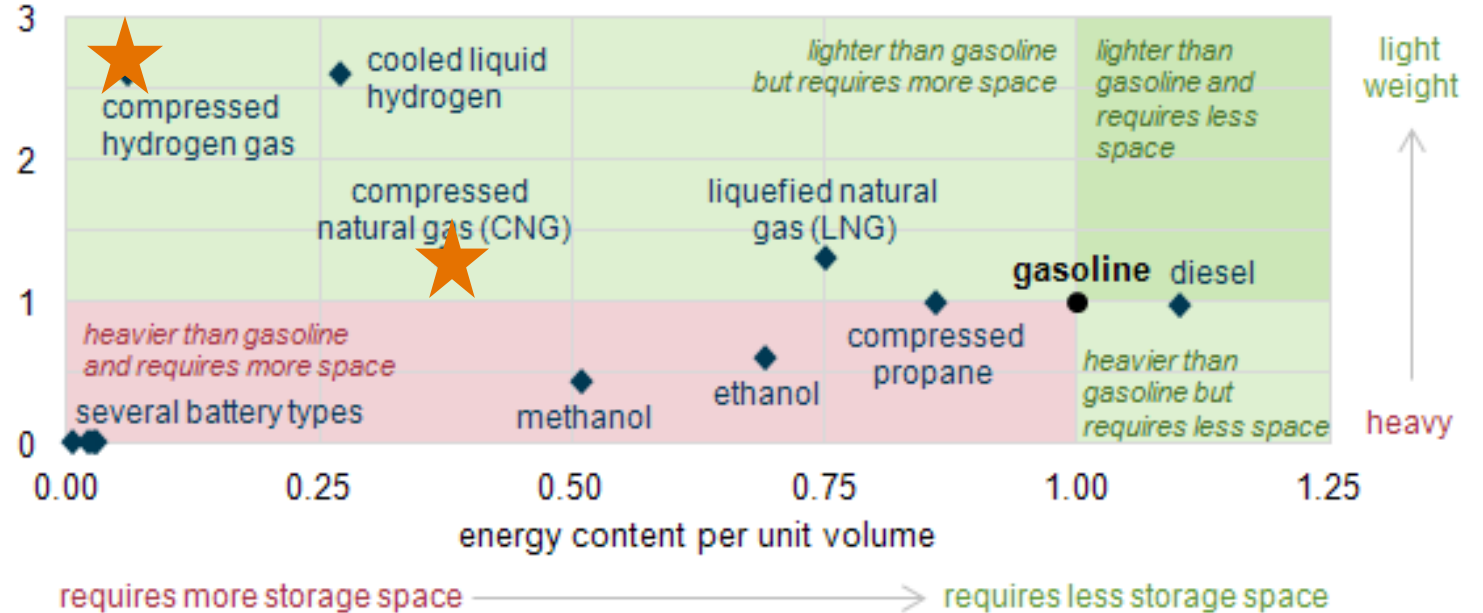
The most abundant element in the universe, but rarely exists in its pure form.

Hydrogen Intro



Hydrogen is an **energy carrier**

Energy density comparison of several transportation fuels (indexed to gasoline = 1) 



High energy and light weight but requires large storage space

Hydrogen and Natural Gas Comparison

| | Natural Gas | Hydrogen | 20% H ₂ Blend |
|---|-------------|----------|--------------------------|
| Lower Explosive Limit (vol %) | 4.4% | 4% | 4.4% |
| Higher Explosive Limit (vol %) | 15% | 75% | 18% |
| Lower Heating Value (MJ/m ³) | 35.8 | 10.8 | 30.8 |
| Higher Heating Value (MJ/m ³) | 39.8 | 12.7 | 34.4 |
| Wobbe Index (Btu/scf) | 1215 | 1039 | 1150 |

Hydrogen Market Overview



Production

- Steam Methane Reforming
- Partial oxidation of oil
- Coal gasification
- Water Electrolysis
- By-product



Transport

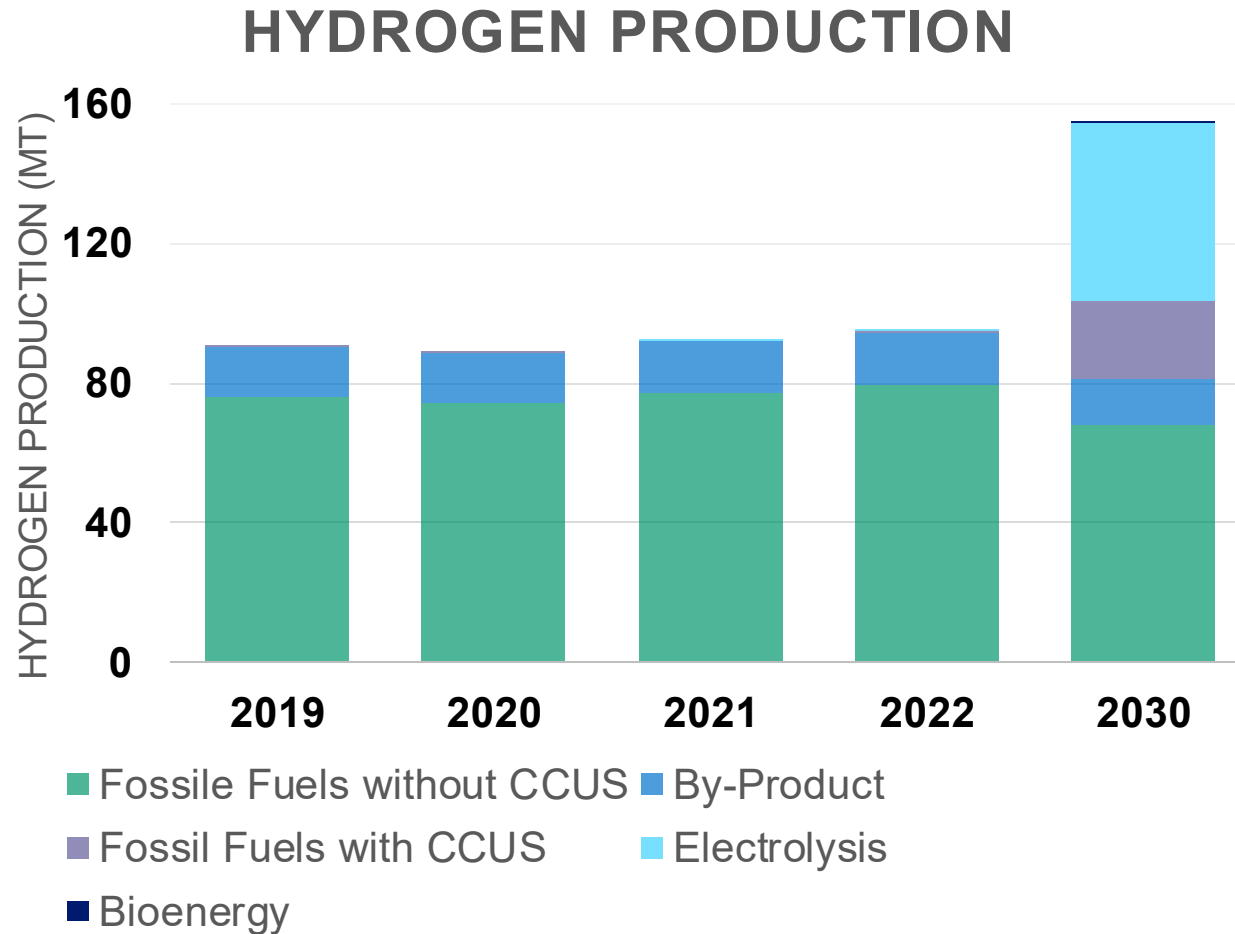
- Captive: produced onsite
- Market: shipped to usage location



End-Use

- Refining (33%)
- Ammonia production (27%)
- Methanol (10%)
- Steel (3.5%)
- Other (heating) (22%)
- Other (3.5%)

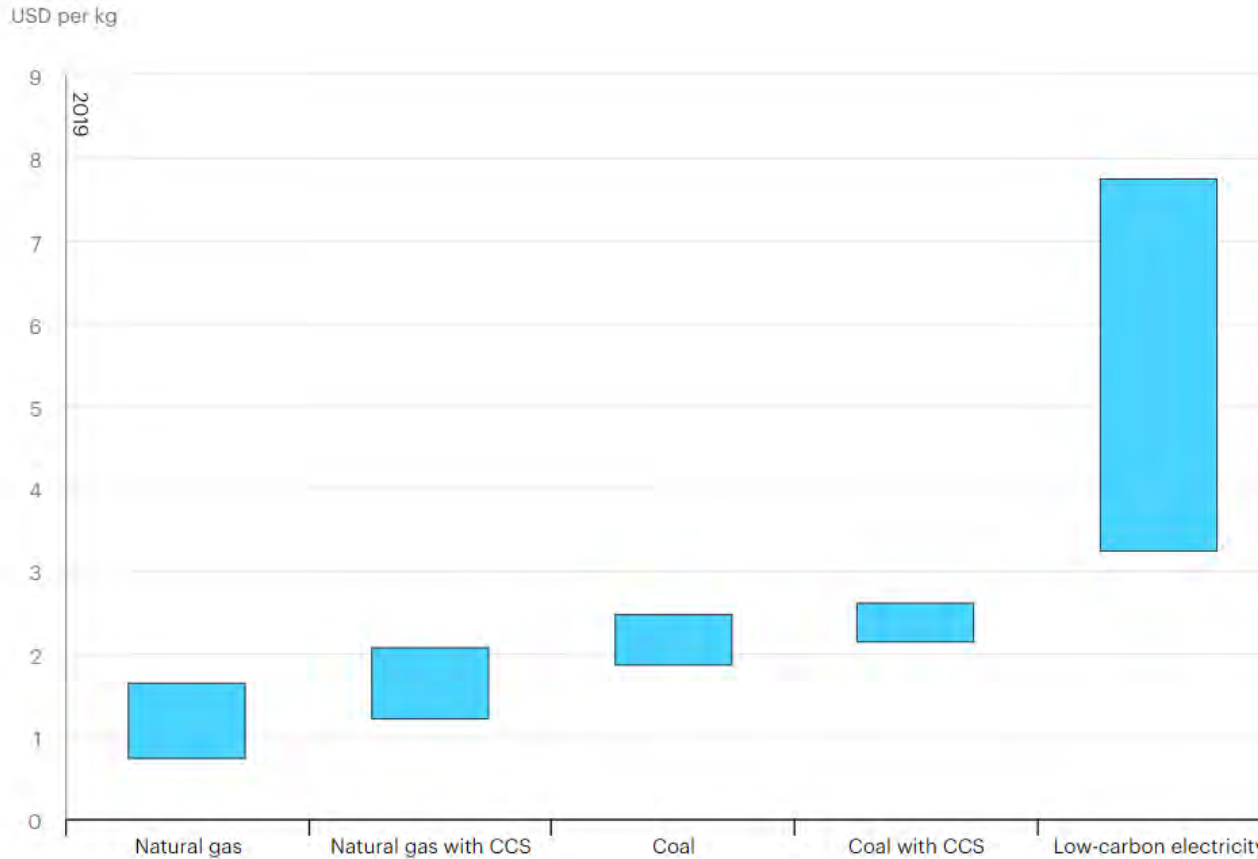
Hydrogen Production



- Hydrogen production expected to almost double in next decade
- **Steam methane reforming** is cheapest and most prevalent production method
- **Electrolysis** expected to grow to largest production method due to demand for green hydrogen

Hydrogen – Cost of Energy

Cost of Energy Production



- Green hydrogen technology expected to be cost comparative by 2030
- DOE hydrogen target cost of **\$2/kg to produce**

Hydrogen Blending – projects across the globe

- South Korea studying feasibility of 20% hydrogen
- US released funding \$8B in funding for 7 hydrogen hubs



- UK ceased operation of their first hydrogen village
- EU blending limits changed to 2%

Canada's Hydrogen Progress – At a Glance



Production

- **3,450 tonnes-H2** per year low carbon H2 deployed
- **80 projects announced**, under consideration or under development
- **5+ Mt H2 / year** announced or under development




End-Use

- 7 truck and bus, 4 train trails underway
- **22 codes and standards** developed
- **8 operating hydrogen refueling** stations, 21 announced
- **3600** Ontario households and **2100** Alberta customers **served by Natural gas blends**

#1 largest clean hydrogen production facility

#2 CO2 storage capacity

\$100B announced project investment

The background of the image is a dark blue-grey color, populated with numerous 3D molecular models. These models consist of dark blue spheres of varying sizes connected by thin, dark grey rods. The spheres have a glossy, reflective surface, with highlights and shadows that give them a three-dimensional appearance. The molecules are scattered across the frame, with some appearing larger and more prominent than others, creating a sense of depth and scientific atmosphere.

The Good and Bad of Hydrogen

The Good Side of Hydrogen

Lower GHG
Emissions



Energy Storage
for Renewables



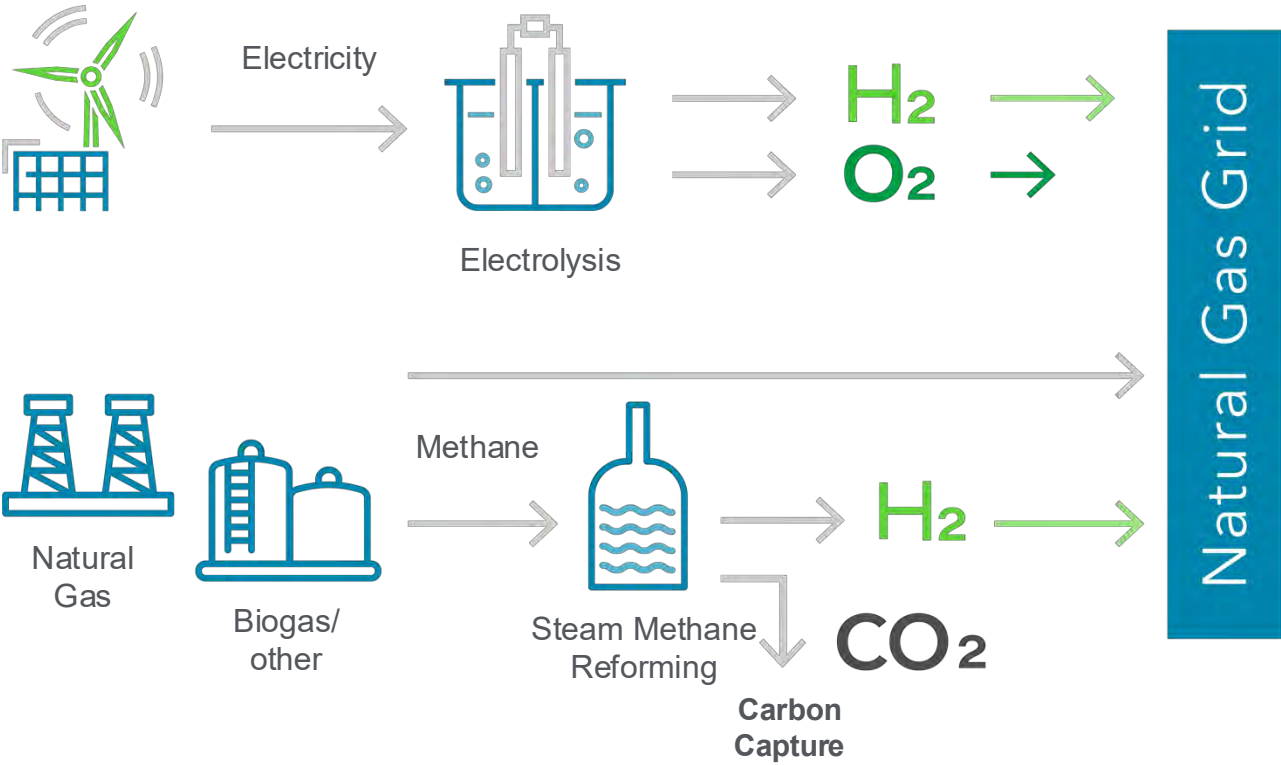
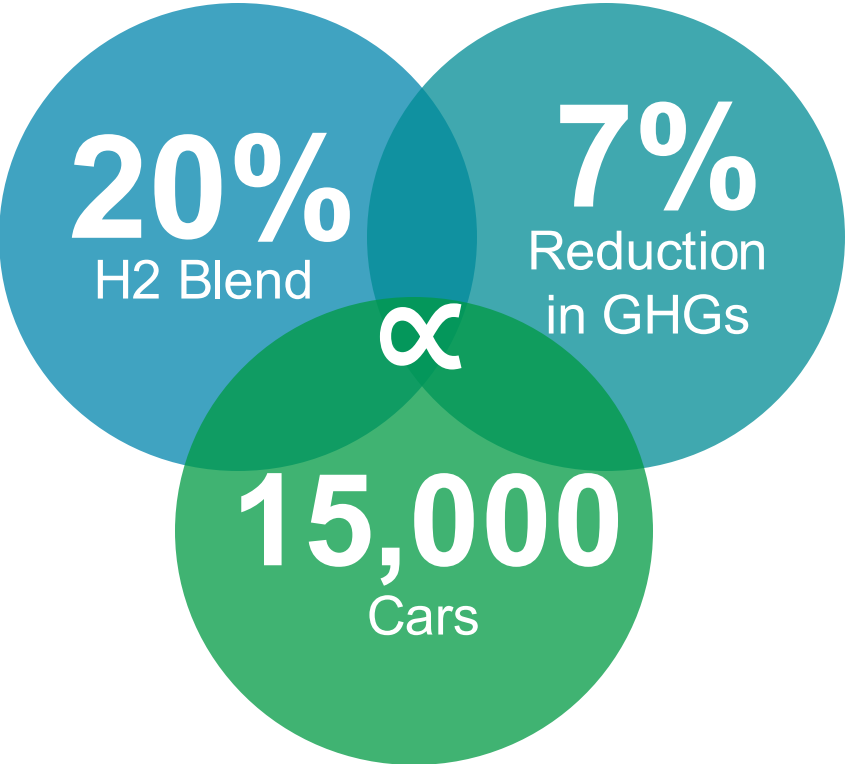
Use Existing
Infrastructure



Leverage Industry
Knowledge

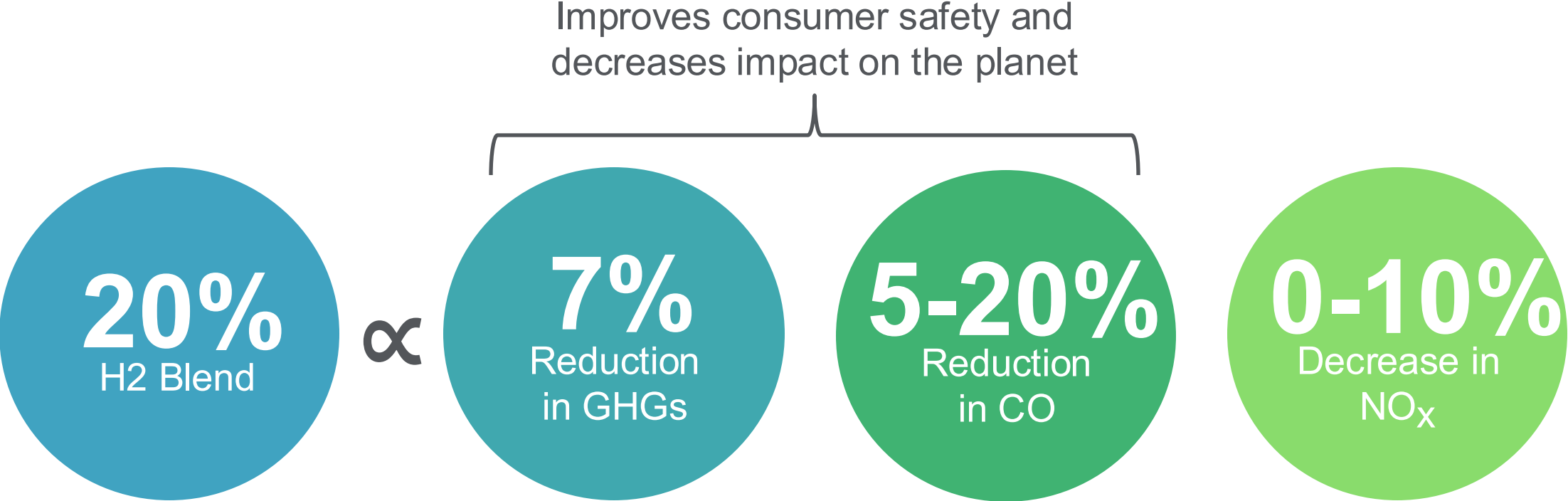


Grid Injection and Existing Infrastructure



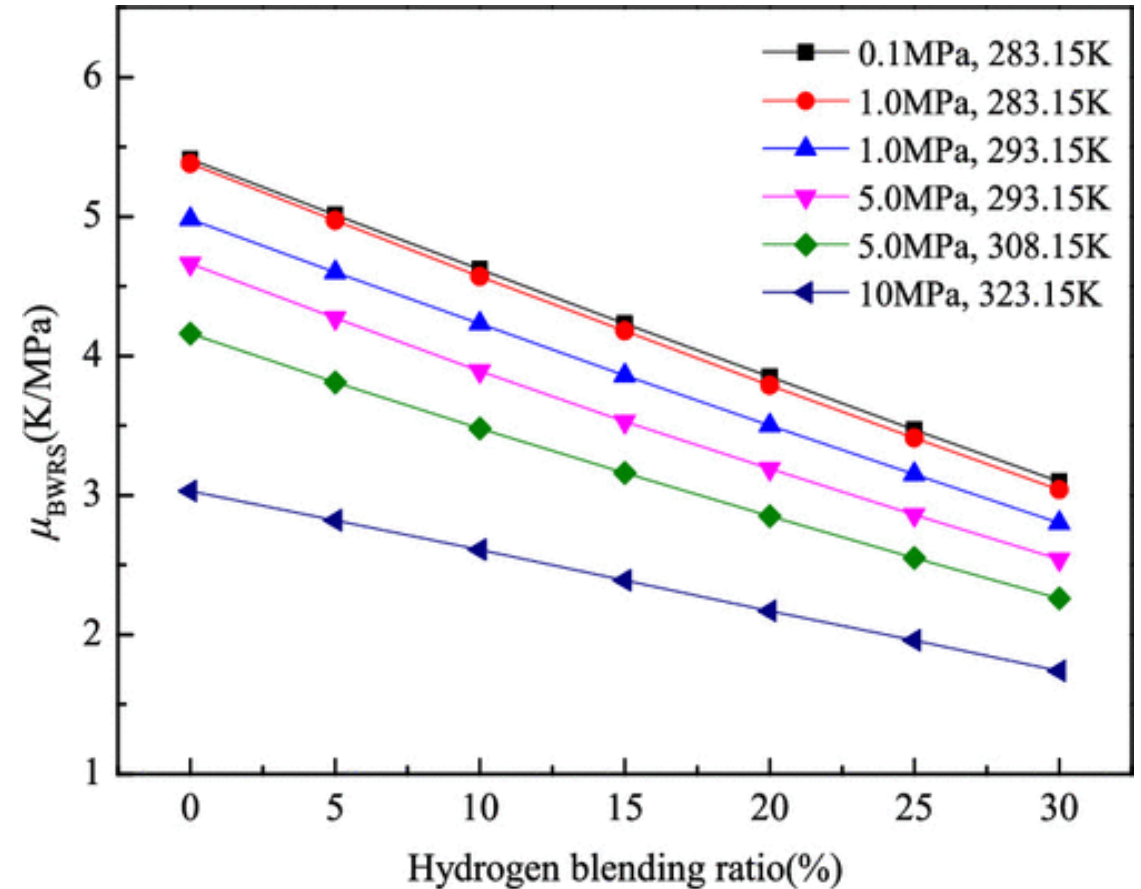
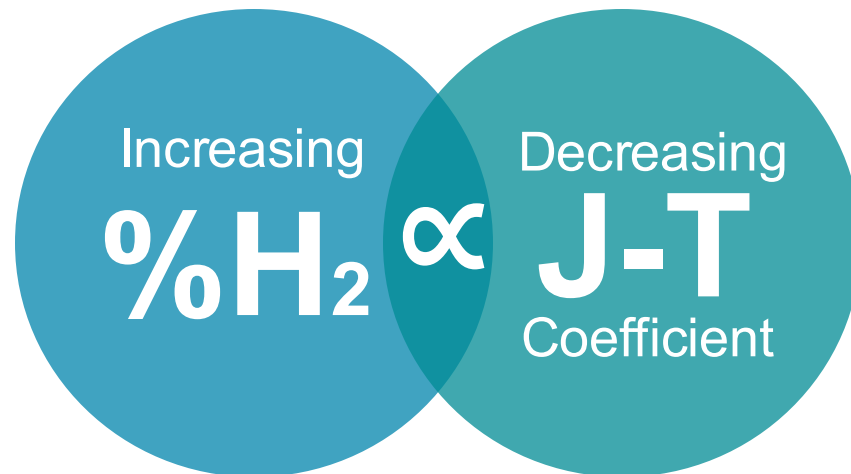
Existing grid can handle up to **20% hydrogen blends** without major changes

Hydrogen Impact on Emissions



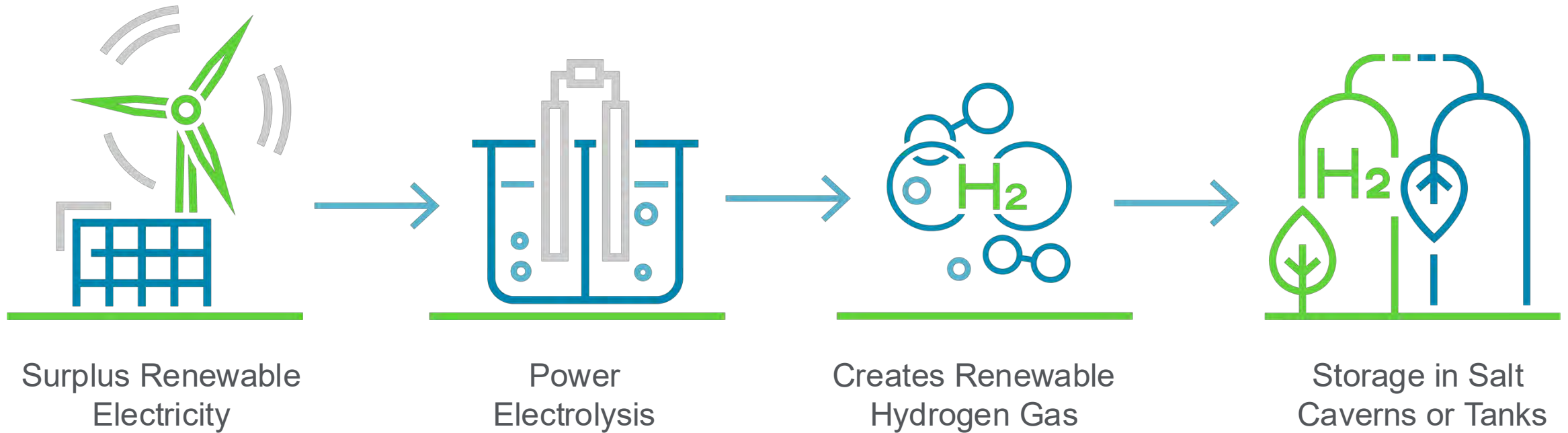
Improves consumer safety and decreases the impact on the planet

Joules-Thompson (J-T) Coefficient



Reduced energy needed for line heaters

Hydrogen as Energy Storage



Explored as a way to 'flatten the curve' associated with renewables

The Downside of Hydrogen

Process
Management
Change



Limits of Existing
Technology

Cost of
Implementation



Alignment of
Standards and
Regulations

The background of the slide is a dark blue-grey color, populated with numerous 3D molecular models. These models consist of dark blue spheres of varying sizes connected by thin, dark grey rods, representing chemical bonds. The molecules are scattered across the frame, with some appearing larger and more prominent than others, creating a sense of depth and scientific focus.

A Roadmap for Hydrogen Blending

Hydrogen Roadmap



Contracts, Tariffs,
Industry Standards



Equipment
Compatibility



Standard Operation
Procedures & Training



Data Collection
& SCADA



Measurement
Systems



Accounting
& Billing

Contracts, Tariffs, Industry Standards

Systematic review of standards



Minimum heating value and definitions of allowed hydrocarbons will need to be updated



Existing documentation is either silent about hydrogen or treats it as a contaminant



Quality standards for gas blends need to be created

Hydrogen Roadmap



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Equipment Compatibility

Full Inventory of Equipment:

- Meters
- Flow Computers
- Control Valves & Regulators
- Pipes & Lines
- Analyzers
- Chromatographs
- More



Full or partial
replacement needed

Firmware, software,
hardware changes

Calibration standard
updates

Hydrogen Roadmap



Contracts, Tariffs,
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Equipment
Compatibility



Standard Operation
Procedures & Training



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Measurement
Systems

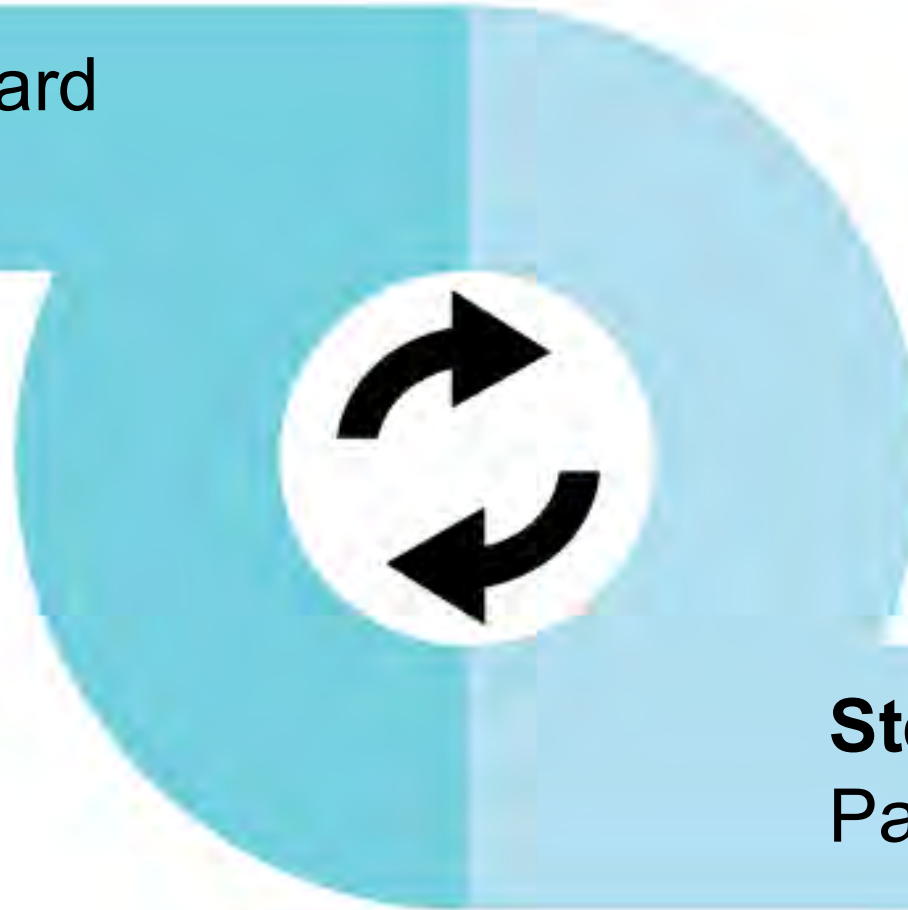


Accounting
& Billing

Standard Operation Procedures & Training

Step 1: Update Standard Operation Procedures

- Safety
- Device configuration
- Calibration
- Testing



Step 2: Train Necessary Parties

Hydrogen Roadmap



Contracts, Tariffs,
Industry Standards



Equipment
Compatibility



Standard Operation
Procedures & Training



Data Collection
& SCADA

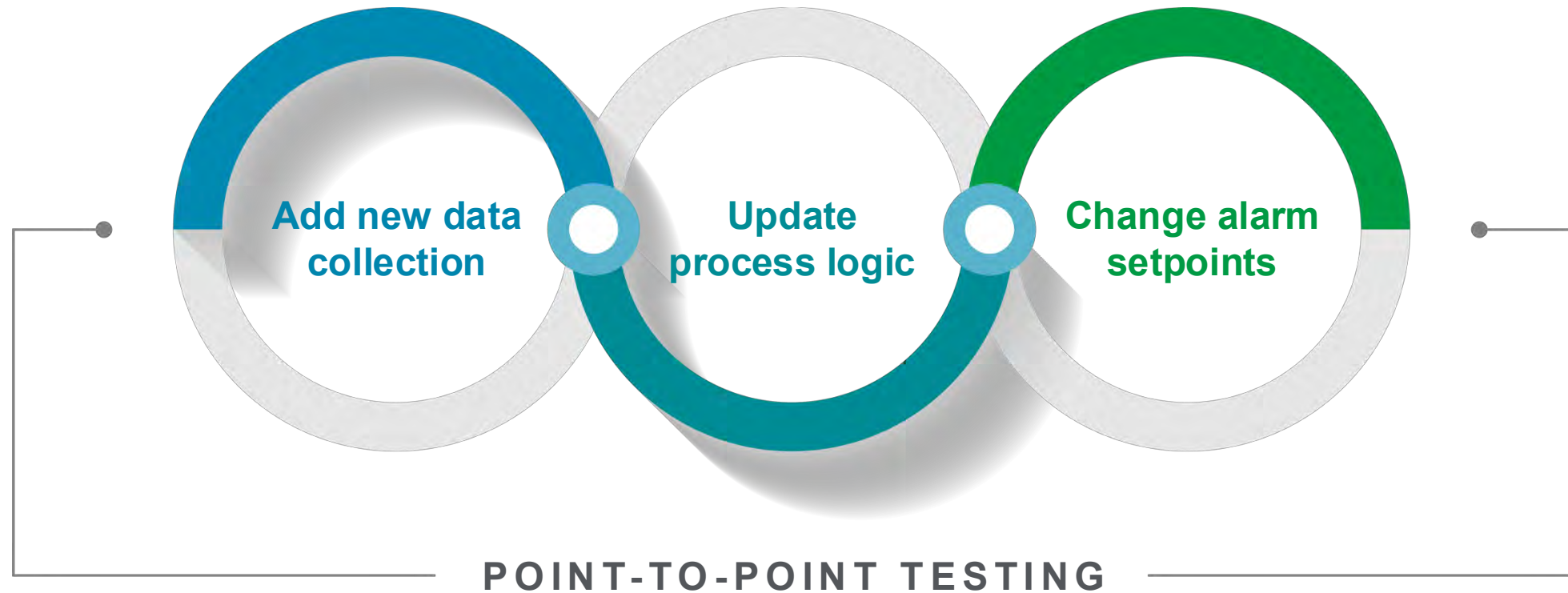


Measurement
Systems



Accounting
& Billing

Data Collection & SCADA Systems



Hydrogen Roadmap



Contracts, Tariffs,
Industry Standards



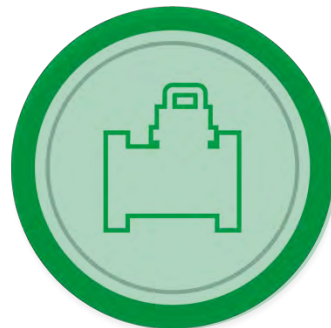
Equipment
Compatibility



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Measurement
Systems



Accounting
& Billing

Measurement Systems



UPDATE PHYSICAL PROPERTIES TABLES

- Heating value
- Specific gravity
- Compressibility



VERIFY ACCURACY

- Internal Calculations
- Measuring mechanics



ADJUST DATA FLOW

- Internal reports
- customer facing portals

Hydrogen Roadmap



Contracts, Tariffs,
Industry Standards



Equipment
Compatibility



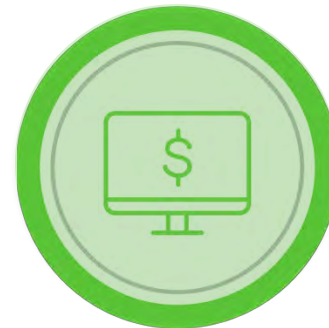
Standard Operation
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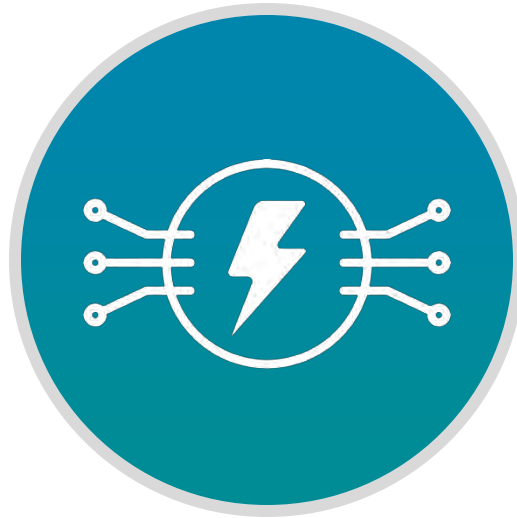


Accounting
& Billing

Hydrogen is Possible



Partner to solve



Energy portfolio mix



Project management

Sources and More Information

Hydrogen Resource Center

The gas industry has a tremendous opportunity to leverage alternative fuels to reduce carbon emissions while ensuring safe, affordable, and reliable gas for customers in the future. Green hydrogen is emerging as a leading option for natural gas utilities to meet their emission reduction goals.

We want to help your utility prepare for hydrogen by providing you with the latest hydrogen information and metering solutions.

Fundamentals

Step through the value stream of hydrogen from production to end use

Explore Now

Material Compatibility

Discover the factors that influence how hydrogen may affect your infrastructure

Learn More

Resources

See top hydrogen reports and a summary of what each means for your utility

[Discover More](#) >

Our Solutions

Explore the Sensus meters approved for hydrogen use

[More Info](#) >



<https://sensus.com/hydrogen-resource-center/>

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