

# ***Pipeline Research Council International***

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## ***PRCI Research: Innovation for our Energy Future***



**LEADING PIPELINE RESEARCH**

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*President, PRCI*

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# Our Mission

To collaboratively deliver relevant and innovative applied research to continually improve the global energy pipeline systems.



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## **Emerging Fuels**

# Next Generation of Fuels

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## Hydrogen

- A non-carbon gaseous fuel.
- Ignoring water vapor, it does not contribute as a greenhouse gas.
- Can provide a means of storing surplus electrical power in the form of a clean chemical energy.



## Renewable Natural Gas (RNG)

- Offsets methane emissions that would have otherwise gone into the atmosphere.
- Methane is many times more potent as a greenhouse gas than CO<sub>2</sub>
- Is generally similar to conventional natural gas in combustion characteristics.



## Other

- Other products that could be transported via the pipeline infrastructure that can offset greenhouse gas emissions.
- Gases with high concentrations of CO made from renewable sources still produce CO<sub>2</sub> emissions, but those CO<sub>2</sub> emissions are subsequently reabsorbed by vegetation used to make CO and synthetic methane.
- Not necessarily limited to gases:
  - Ethanol
  - Bio-diesel
  - Ammonia
  - CO<sub>2</sub> for sequestration

# Why Focus on the Next Generation of Fuels?

## Climate Change

The largest driver is reducing greenhouse gas emissions attributed to climate change

- Economically
- Quickly
- Safely

## Existing Pipeline Infrastructure

Has the potential to significantly contribute towards a solution



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**Renewable  
Natural  
Gas**

## Key issues

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- **Composition**
  - What are the trace components and their concentrations that can interfere with safe transportation and/or interchangeability:
    - *Siloxanes, terpenes, water, CO, etc.*
    - *Tolerances to exceptions of existing gas quality tariff specifications for RNG*
      - Can higher CO<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>S, H<sub>2</sub>O be tolerated, if so, under what conditions?
    - *Impact on odorization*
- **Costs**
  - Options to lower the cost to treat/compress/measure RNG
  - Are there lower cost options to measure more gas constituents
    - *Currently must use multiple stand-alone analyzers, especially for trace components*
- **Measurement and integrity**
  - Impact of trace components on system integrity and accurate flow measurement, especially heating value determination



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**Hydrogen**



## Key issues

- **Hydrogen embrittlement**
  - Highest integrity impact issue
  - Not all steels perform the same when exposed to hydrogen
  - Reduced impact when small amounts of oxygen are present, but oxygen is not desirable from an internal corrosion perspective
- **Ductile fracture arrest**
  - The speed of sound of hydrogen is 1270 m/s, by comparison, methane is 446 m/s, should improve fracture arrest margin
- **Soft component permeability**
- **Odorization**
- **Adjustments to performance due to viscosity changes (centrifugal compressors, turbine meters)**
- **Storage, both underground and LNG**
- **Interchangeability**



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**Emerging  
Fuels  
Institute**

## Drivers for the Emerging Fuels Institute

- **Develop a guide to safely convert and operate pipeline systems in hydrogen blend service.**
- **Address the challenges and gaps in the storage and transportation elements of the emerging fuels transition.**
- **Manage an evergreen roadmap for the ongoing industry work across all continents.**
  - Optimization of the significant global efforts focused on transporting and storing emerging fuels via the current or new infrastructure.
  - External participation provides ability to leverage funding and more efficiently deploy research.

# Emerging Fuels Institute – Vanguard Members



## Emerging Fuels Institute – Research

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- **Pipe Material Properties for H2**
- **Assess Compression Equipment Material Compatibility with H2**
- **Renewable Natural Gas Trace Components Database**
- **Enhanced ILI Tools to Detect Crack Like Features**
- **Assess Low-Permeability Coatings as a Barrier to Hydrogen Embrittlement in Steels**



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# Core Research Program

# Technical Committees & Focus



## Compressor & Pump Station

- Cost effective emissions reduction and emissions monitoring
- Equipment reliability, availability and life extension
- Improve fuel efficiency and greenhouse gas emission mitigation and reporting



## Corrosion

- Detection, assessment, prevention, and management of galvanic corrosion and SC
- Coatings
- Quantitative risk assessment
- Improvement and enhancement of CP systems



## Design, Materials & Construction

- Assessment and repairs
- Construction
- Design
- Fracture
- Geohazard management
- Materials
- Welding and welding inspection
- Structural integrity assessment



## Integrity & Inspection

- NDE technology development and inspection methods
- Mechanical damage
- Pipeline integrity

# Pipeline Technical Committees & Focus

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## Measurement

- Improve custody transfer accuracy and reduce metering errors
- Support technical underpinnings of measurement standards
- Reduce lost and unaccounted for gas
- Expand the operating range of existing equipment



## Surveillance, Operations & Monitoring

- Threat analysis and damage prevention; ROW management – environmental and third party damage;
- ROW protection and monitoring; leak detection



## Underground Storage

- Storage reservoirs, bedded salt structures and caverns
- Wellbore and cavern integrity and inspection
- Field deliverability and facility integrity and reliability



## Subsea

- Offshore pipeline design
- Inspection and repair
- Integrity management





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# Strategic Research Priorities

# Strategic Research Priorities

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- 1. Optimize the Detection and Mitigation of Mechanical Damage**
  - 2. Green House Gas Emissions Reductions**
  - 3. Crack Management**
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- Geohazard Management – In Development**
  - Liquid & Gas Leak Detection – In Development**



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**Technology  
Development  
Center**

# Technology Development Center - TDC



- **Established in 2015**
- **Located in Houston, TX**
- **20,000 sq. ft. of indoor workshop space**
- **9,000 sq. ft. of office and state-of-the-art meeting space with conferencing capabilities**
- **8 acres of test facilities and pipe storage**

## Key Activities of the TDC

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### **Validate Sensor Technology**

- The ability to apply current, new or developing sensor technology to the samples and benchmark performance

### **Validate Deployment Platforms**

- The ability to test the deployment of technology in a controlled and consistent manner

### **Train and Qualify**

- Demonstration/training space and amenities to further industry understanding, knowledge transfer and qualification

### **Technology Incubation and Collaboration**

- An identifiable place where industry and technology providers can collaborate on common goals and objectives including data/information sharing

# Pipe Sample Specifications

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- Over 1,500 pipe samples & coupons with various real & manufactured defect types & dimensions from 6" and up to 40' in length.
- Samples and coupons can be crated and shipped directly to you.
- Work at the TDC and construct pipe strings for pull or flow loop testing.
- Over 20,000 square feet of indoor warehouse space to conduct testing, NDE evaluations & storage.
- Third party pipe surface preparation, welding, cutting & moving services available upon request.



# ILI Pull Test Facility Technical Specifications



pipe sizes available.....	from 6" up to 42"
pipe strings length.....	up to 550ft long
operating speed range.....	0.5 to 5 m/s (1 to 11 mph)
average time per pull test.....	25 minutes (up to 15 pull tests per day)
maximum pull force.....	40,000lbs
recorded data.....	distance, speed, and pull force
testing product.....	air
product temperature.....	ambient (above ground piping)



# Liquid Loop Facility Technical Specifications



pipe sizes available.....	6" to 12"
piping length.....	up to 1000 ft
testing product.....	water
product temperature.....	ambient (above ground piping)
maximum operating pressure.....	2,000 Kpa (285 psi)
operating speed range.....	up to 3.3 m/s (7.4 mph)
minimum pipeline bend radius.....	5d (smaller bends available)
average cycle time.....	5 minutes





# Technology Development Center

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# Research Opportunities

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- **Pipe Material Properties for H2**
- **Assess Compression Equipment Material Compatibility with H2**
- **Renewable Natural Gas Trace Components Database**
- **Enhanced ILI Tools to Detect Crack Like Features**
- **Assess Low-Permeability Coatings as a Barrier to Hydrogen Embrittlement in Steels**
- **Alternate pipeline repair methods to reduce GHG emissions**
- **Welding Hot-Taps and Sleeve in a H2-Blend Environment**
- **Enhanced crack management**
- **Eddy current sensor development and USM crack size detection**

# Research Opportunities

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- **Reliability Model Framework for Crack Assessment**
- **Magnetic tomography monitoring**
- **Tools and methods to assess pipe material properties from inside the pipeline**
- **Unified fitness for service tool**
- **Hot tap fitting assessment for >20" pipe**
- **Fatigue assessment of girth welds**
- **Stress relief of pipes in axial strain**
- **CPM Leak Detection during transients and abnormal operating conditions**
- **Online density/viscosity for CPM performance enhancement**



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**Thank you!**

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