Pipeline Research Council International

Greenhouse Gas Emission Reduction Technologies

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December 15, 2022

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LEADING PIPELINE RESEARCH

Pipeline Research Council International is…

PIPELINE
- Natural gas
- Crude oil & petroleum products
- Biofuels
- Hydrogen/renewable natural gas
- CO_2
- Related facilities

RESEARCH
- Knowledge
- Technology
- Deployment & transfer
- Innovation

PRCI™

COUNCIL
- Forum for ideas & opportunities
- Peer-based
- Industry-driven
- Source of research inventory

INTERNATIONAL
- Asia
- Australia
- Europe
- Middle East
- North America

Pipeline Research Council International

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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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Our Vision

Develop innovative solutions that provide for the safest, cleanest, and most efficient transportation and storage of energy via global pipeline systems.

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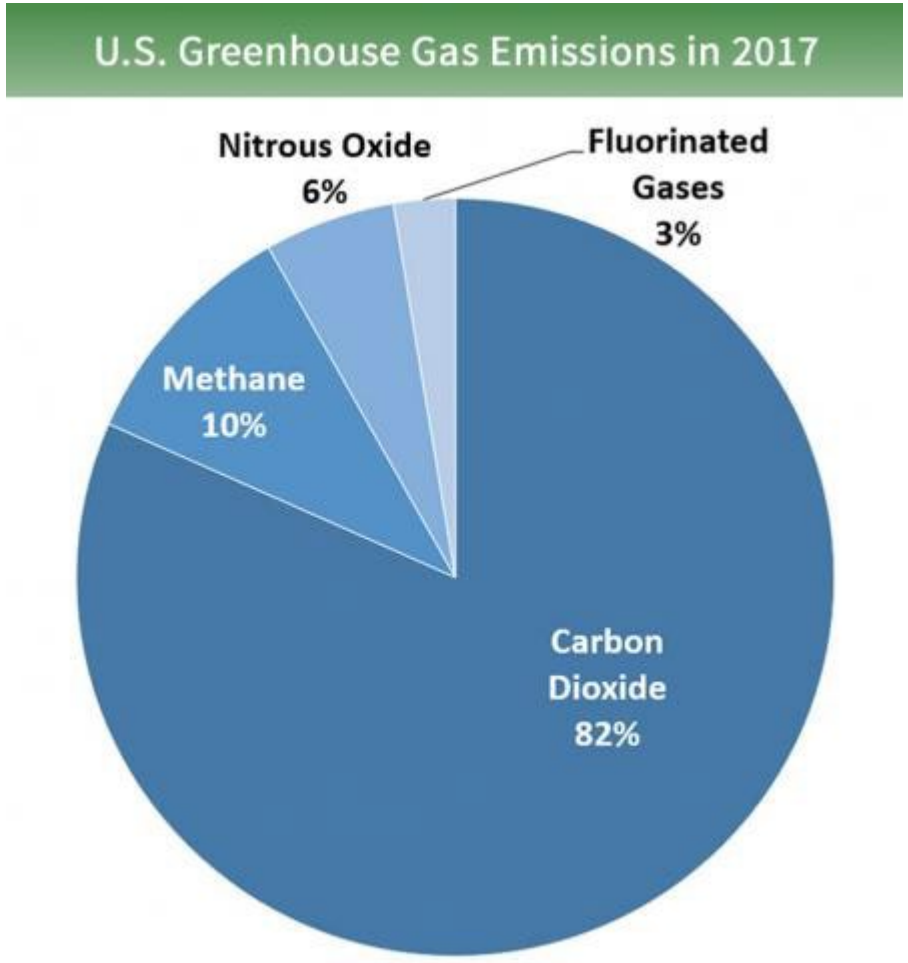
Our Members

- **Worldwide Research Organization**
  - 45 North American Companies (U.S. & Canada)
  - 25 Non-NA (Australia, Brazil, China, Europe, India, Japan, & Saudi Arabia)
- **33 Energy Pipeline Operating Companies**
  - 15 Natural Gas Transmission
  - 10 Liquid
  - 8 Liquid/Natural Gas
- **3 Pipeline Industry Organization (PIO) Members**
  - American Petroleum Institute (API)
  - Liquid Energy Pipelines Association (LEPA)
  - Operations Technology Development (OTD)
- **30 Associate Members & Technical Program Associate Members**
  - Australia, Canada, China, Europe, Japan, U.S.

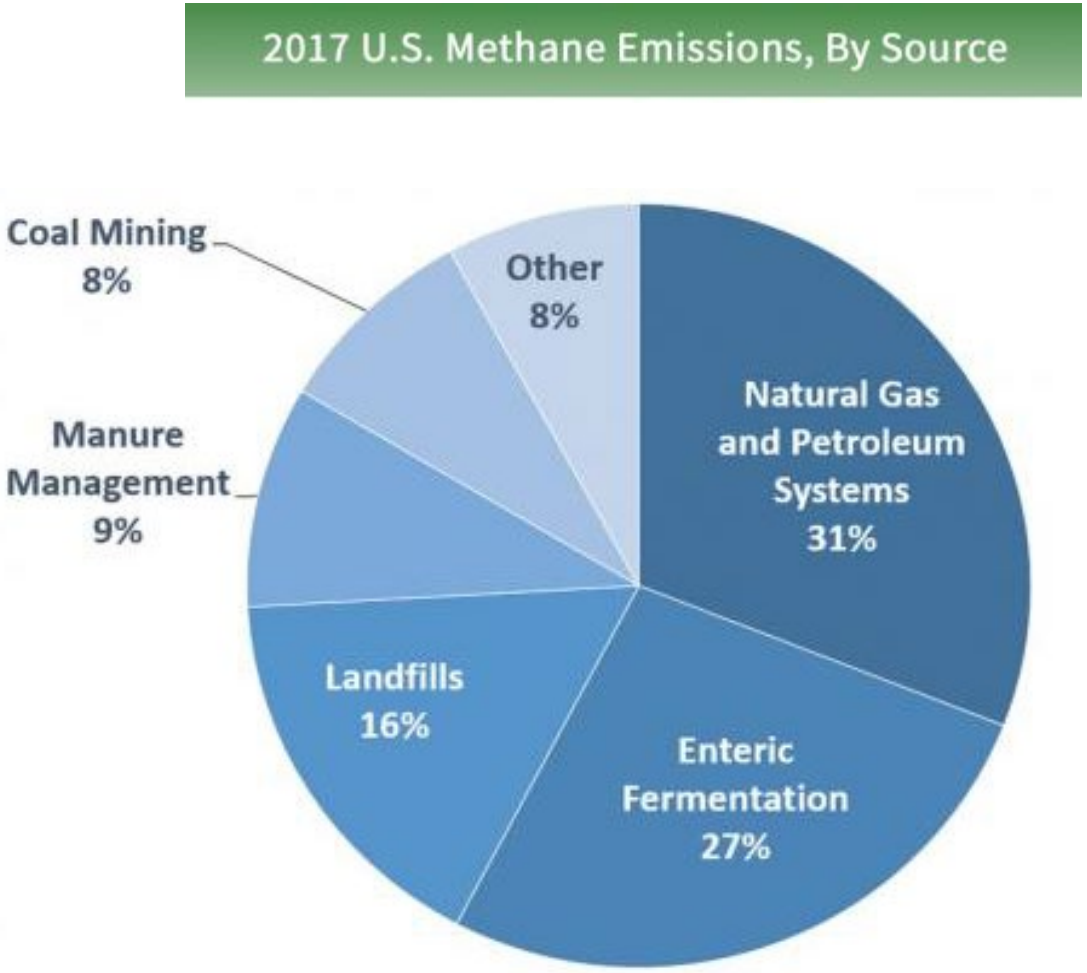
Australia
Canada
China
France
Germany
India
Ireland
Japan
Netherlands
Norway
Saudi Arabia
United Kingdom
United States

Background



- Increased focus on reducing greenhouse gas (GHG) emissions is increasingly becoming a social and, in turn, a business driver.
- Direct combustion of hydrocarbons is by far the highest source of greenhouse gases

Background



- **Methane emissions is the second highest source**
  - Relatively small reductions in methane have a larger net impact in greenhouse emissions as it is a more potent GHG than CO2 (CH4 = 25 X CO2 per EPA Subpart W GHG reporting Global Warming Potential based on 100 year time horizon).
- **So the pipeline industry should tackle reduction in GHG emissions through**
  - Reduced combustion/efficiency optimization
  - Reduced methane emissions

Impact to the Industry

- GHG is a global issue
- It impacts both gas and liquid operators but has a large impact to the gas industry as the equipment used to compress gas utilizes natural gas as a fuel and has methane emissions.
- Regulatory drivers to reduce methane emissions
- Tie to Safety, less methane in atmosphere = safer environment

Executive Summary

- **Greenhouse Gas Strategic Research Priority**
  - It provides a roadmap of research projects to significantly reduce GHG emissions from pipeline transmission (mostly gas but also liquids)
  - Will provide our industry with GHG reduction solutions to implement and reduce our carbon footprint
- **Multi-million-dollar, three-year plan to quantumly accelerate pipeline related research to meaningfully reduce greenhouse gases**

What We Have Done

- **The industry has significantly reduced its greenhouse footprint**
  - Especially with respect to methane emissions
  - Analysis of the EPA Subpart W data shows a marked decrease from 2018 over 2015
    - The 2015 emission factors are significantly lower than the GRI emissions factors currently in use
- **But there will always be areas where additional improvements can be made**

PR-312-18209-E01
Methane Emission Factors for Natural Gas Transmission and Storage Compressors

Compressor Type	EPA GHG Inventory (2013 -) Emission Factor (scf CH_4/day)	Subpart W-based Emission Factor (scf CH_4/day)
Transmission – Reciprocating	15,205	9,582
Transmission – Centrifugal (Wet Seal)	50,222	7,730
Transmission – Centrifugal (Dry Seal)	32,208	8,943
Storage - Reciprocating	21,711	12,602

Measure of Success & Desired Outcomes

- **Successful implementation of research projects over 3 years which covers multiple Technical Committees include:**
  - Develop economic prioritization model / tool to help identify the GHG reduction efforts that provide the largest net reduction in GHG emissions per net present value of spend
    - Work proposed in advance of the SRP but being done in coordination with the SRP
  - Increasing efficiency of both compressor driver and driven equipment
  - Reducing blowdowns
  - Reducing fugitive leaks
  - Develop enhanced natural gas leak detection/quantification methods
  - Enhance leak mitigation programs
  - Develop alternatives to natural gas pneumatic control devices
  - Work to change regulation that doesn't make sense

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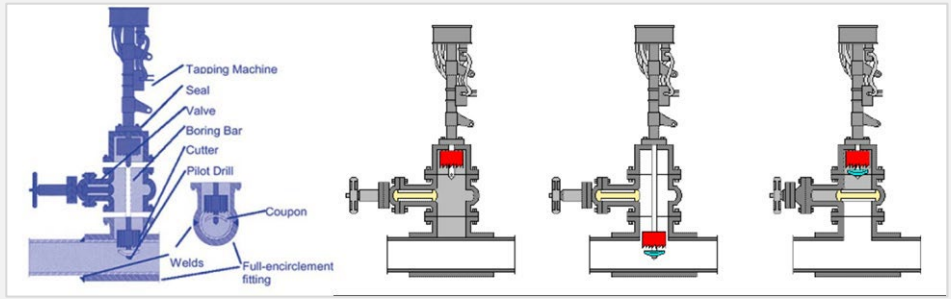
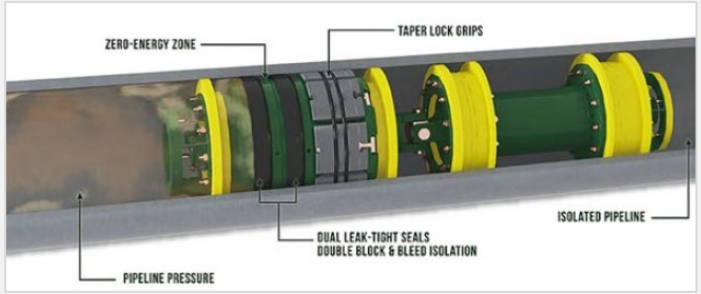
Co-Funding

- **PHMSA award for PRCI project**
  - **– Innovative Leak Detection Methods for Gas Pipelines**
    - Supports both the greenhouse gas and leak detection SRPs
    - Develops methods to reduce measurement uncertainty to allow smaller detection levels with continuous pipeline monitoring and other online hydraulic modeling systems

Mitigating Emissions from Blowdowns and Repairs



- Hot Tapping



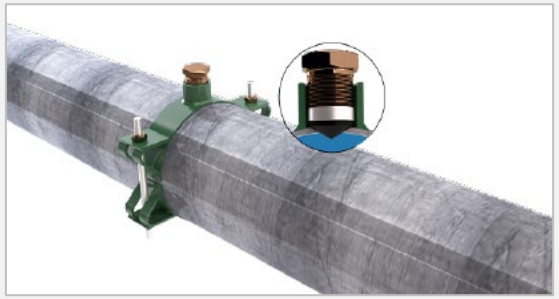
- Smart Pipeline Isolation

- Zero Emission
  Vacuum and Compression

Mitigating Emissions from Blowdowns and Repairs

- Composite Sleeves

- Mechanical Repair Clamps



- Leak clamps

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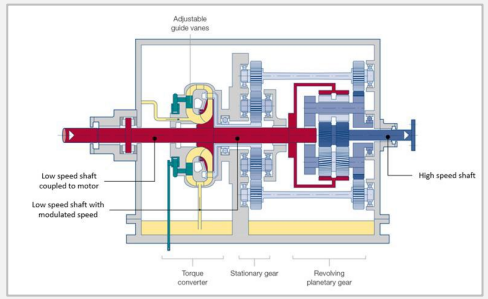
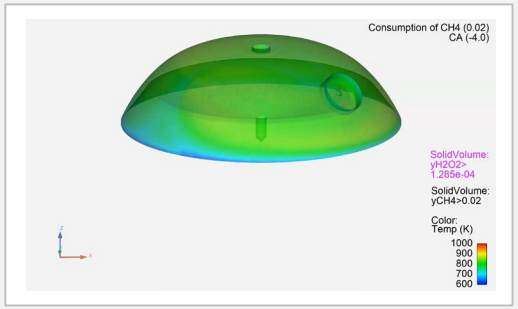
Reducing Emissions through Efficiency Improvements



- Voith Vorecon Gearbox and Speed Controller

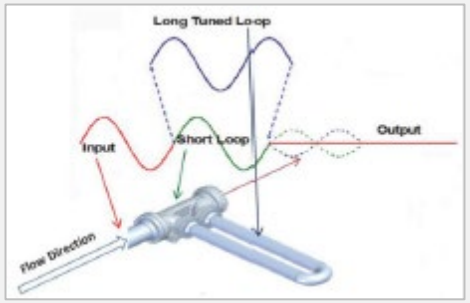


- Pre-Combustion Chamber Enhancements

- Radial Compressor Valves

Efficiency Improvements to Reduce GHG Emission

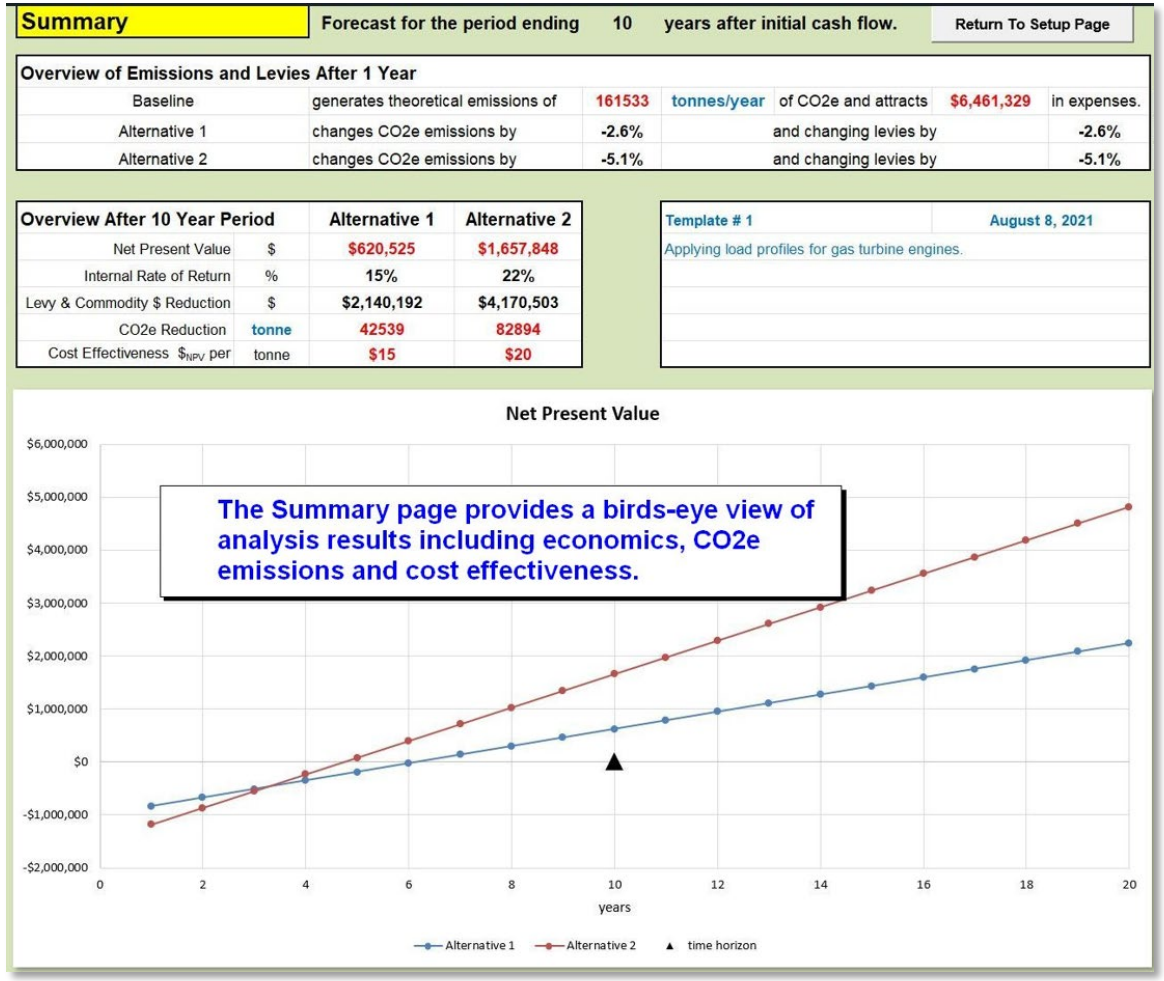
- Dual-Driven System



- Performance Augmentation Network-System

- Continuous Monitoring of Equipment Efficiency

Making Informed GHG Decisions



Summary | Forecast for the period ending 10 years after initial cash flow. | Return To Setup Page

Overview of Emissions and Levies After 1 Year

Baseline	generates theoretical emissions of	161533	tonnes/year	of CO2e and attracts	$6,461,329	in expenses.
Alternative 1	changes CO2e emissions by	-2.6%		and changing levies by		-2.6%
Alternative 2	changes CO2e emissions by	-5.1%		and changing levies by		-5.1%

Overview After 10 Year Period		Alternative 1	Alternative 2
Net Present Value	$	$620,525	$1,657,848
Internal Rate of Return	%	15%	22%
Levy & Commodity $ Reduction	$	$2,140,192	$4,170,503
CO2e Reduction	tonne	42539	82894
Cost Effectiveness $_{NPV}$ per	tonne	$15	$20

Template # 1	August 8, 2021
Applying load profiles for gas turbine engines.	

- **PRCI's CO_{2e} Economic Analysis Tool**

thank you

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