

Monitoring of Blended Hydrogen Behaviour in Pipe Systems

Hydrogen is key to achieving the nation's 2050 net-zero emissions goal and research to enable safe transportation and distribution is needed. Compared to trucks and rails, long-distance transportation and distribution of hydrogen through pipelines are safe and economical. Pipelines already exist, including long-distance and distribution networks of natural gas pipelines in which hydrogen can be transported efficiently by blending with natural gas. However, hydrogen is a very light and highly combustible substance, creating transportation safety challenges. This project investigates the flow behaviour of blended hydrogen for safe transportation and distribution through pipelines through judicious combinations of experimental and modeling investigations.



RECIPIENT:
University of
Calgary;
Dr. Kim



PARTNERS:
ATCO,
NSERC, MKS



TOTAL BUDGET:
\$1,160,872.80



AI HCOE FUNDING:
\$500,000



PROJECT DATES:
Feb 2023 –
MAR 2025



PROJECT TRL:
Start: 3
End: 6

APPLICATION

Hydrogen (H₂) integration into Alberta's existing natural gas pipeline infrastructure offers a practical and economically viable pathway for advancing the province's hydrogen economy. Alberta already possesses extensive long-distance and distribution pipelines for natural gas, which can be leveraged to transport blended H₂ without requiring new infrastructure. This approach presents an immediate opportunity for large-scale hydrogen deployment and export, aligning with Canada's 2050 net-zero emissions target. However, H₂'s low molecular weight and high flammability introduce significant transportation safety challenges, especially in terms of leak detection and flow behavior. This project supports Alberta's clean energy strategy by addressing these safety concerns, enabling the province to emerge as a leader in safe hydrogen infrastructure. The developed technologies are designed to be adaptable to Alberta's diverse geography and industrial needs, allowing for rapid commercialization and deployment in both urban and remote areas.

ALBERTA INNOVATES CLEAN RESOURCES

CLEAN TECHNOLOGY

HYDROGEN

PROJECT GOALS

The project's primary goal was to develop and validate technologies that ensure the safe transportation of H₂, particularly when blended with natural gas in existing pipeline systems. To this end, three key research themes were pursued: (A) flow behavior analysis of blended H₂ using high-speed optical sensing and pressure signal data; (B) real-time concentration monitoring of H₂-methane blends containing odorants through sensor calibration and field-testing; and (C) the development and evaluation of multimodal H₂ leak detection systems combining quartz crystal microbalance (QCM) and, resistive sensors. The project also emphasized rapid prototyping and real-world testing of sensor modules, integration with AI-assisted data acquisition systems, and modular system design for flexibility. These efforts aim to fill critical gaps in current sensing and monitoring technologies by offering scalable, low-cost, and robust solutions tailored for pipeline applications. Ultimately, the project contributes to ensuring H₂ can be safely transported over long distances, paving the way for Alberta's hydrogen economy.



**10 kt/yr Project
GHGs Reduced**



**14 Students
Trained**



5 Publications



10 Future Jobs

BENEFITS TO ALBERTA

This project provides Alberta with several tangible benefits across economic, environmental, and social dimensions. Economically, it supports job creation in H₂ infrastructure development, sensor manufacturing, and system integration while enabling new commercialization pathways for Alberta-based companies. The sensor technologies developed are transferable to other gas monitoring applications, enhancing industry competitiveness and export potential. Environmentally, enabling safe H₂ transportation through existing pipelines reduces greenhouse gas emissions by displacing fossil fuels and minimizing the need for new infrastructure development. This aligns with Alberta's climate change mitigation objectives while preserving environmental integrity. Socially, the project fosters public trust and safety in H₂ use, contributing to broader adoption and workforce engagement in clean technology sectors. Additionally, it builds local innovation capacity through university-industry collaboration, highly qualified personnel training, and technology transfer. The knowledge and IP generated through this initiative position Alberta at the forefront of Canada's clean energy transition.



**100 kt/yr Future
GHGs Reduced**



2 Project Jobs



2 Patents Filed

CURRENT STATUS

MAR 2025

Theme A: Completed flow visualization experiments of blended H₂ using a high-speed wavefront sensor and analyzed pressure signal data across various flow conditions.

Theme B: Developed and tested a prototype gas sensing system under blended H₂ and odorant conditions; conducted sensor calibration and validation.

Theme C: Fabricated and verified a multimodal H₂ leak detection system integrating QCM and resistive sensors with environmental modules; confirmed stable response from 10 ppm to 100% of H₂.

The project is now complete. A public report will be available in the Alberta Innovates project library on November 1, 2025.