



EERC



U N I V E R S I T Y O F
NORTH DAKOTA



Critical Challenges. Practical Solutions.

A photograph of a large, multi-story brick building with a central stone entrance. The building is identified by a sign as the Energy & Environmental Research Center. The sign features a circular logo with a globe and the text "Energy & Environmental Research Center". The building has several windows and a large white structure on the roof. The scene is set against a clear blue sky with some trees in the foreground.

**CRITICAL CHALLENGES.
PRACTICAL SOLUTIONS.**

We are one of the world's leading developers of cleaner, more efficient energy to power the world and environmental technologies to protect and clean our air, water, and soil.

EERC QUICK FACTS FY22



FISCAL YEAR FUNDING
\$76 MILLION

TOTAL ACTIVE
CONTRACTS



179

77%
OF CONTRACTS
WERE WITH

PRIVATE
INDUSTRY



ECONOMIC
IMPACT
IN THE GRAND
FORKS REGION



**\$108.3
MILLION**

OUR PEOPLE

We are fortunate to have a diverse, motivated, and creative team of over 270 employees whose expertise is sought after worldwide to solve energy and environmental challenges in innovative ways.





HIGH-BAY
TECHNOLOGY
DEMONSTRATION

FUEL
PROCESSING

MOBILE
LABORATORIES

WATER
MINIMIZATION
TECHNOLOGY

FUELS OF THE FUTURE

NATIONAL CENTER
FOR HYDROGEN
TECHNOLOGY

CHEMICAL STORAGE

LABORATORIES

IN-HOUSE
FABRICATION
SHOP

TECHNOLOGY
DEMONSTRATION

OFFICES

OUR FACILITIES

254,000 FT² OF FACILITIES

DISCOVERY HALL
MEETING AREA



TECHNOLOGY DEMONSTRATION

Pilot-scale test and demonstration facilities capable of testing gasification technologies, fuel and chemical processing, and combustion systems.

Design and creation of equipment on-site, allowing more rapid, cost-effective technology demonstration.

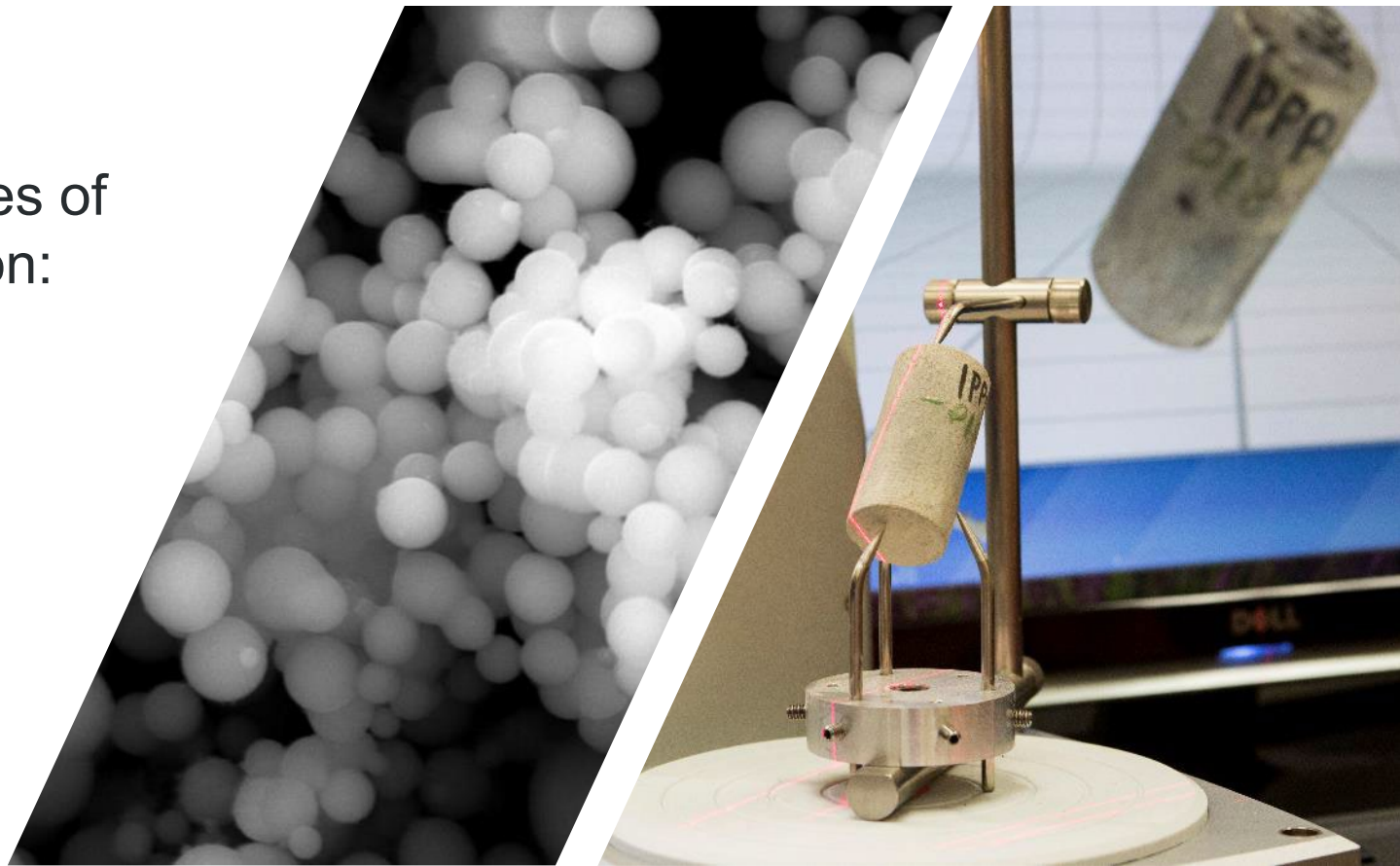




LABORATORIES

Research facilities to perform all scales of materials analysis and characterization:

- Geologic materials characterization
- Environmental chemistry
- Water and wastewater treatability
- Fuel testing
- Emissions research
- Process chemistry
- Fluid and material analysis



CARBON MANAGEMENT

CUTTING-EDGE SOLUTIONS for CO₂ Management

CO₂ Capture

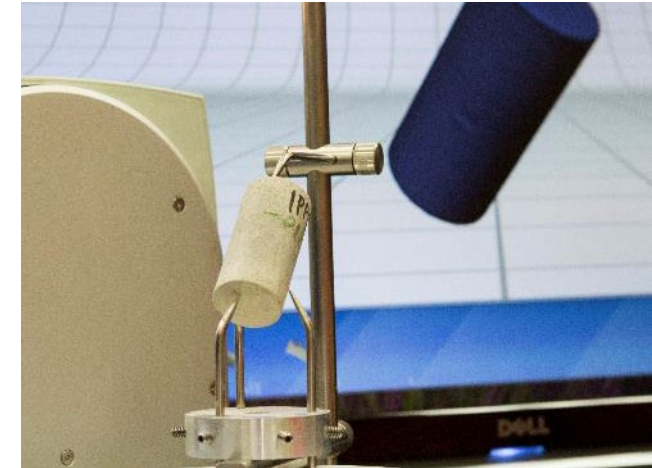
- Precombustion and postcombustion capture and separation technologies

CO₂ Storage

- Characterization, analysis, simulation, and regulatory data

CO₂ Removal

- Direct air capture (DAC) and direct ocean capture (DOC)



OIL & GAS

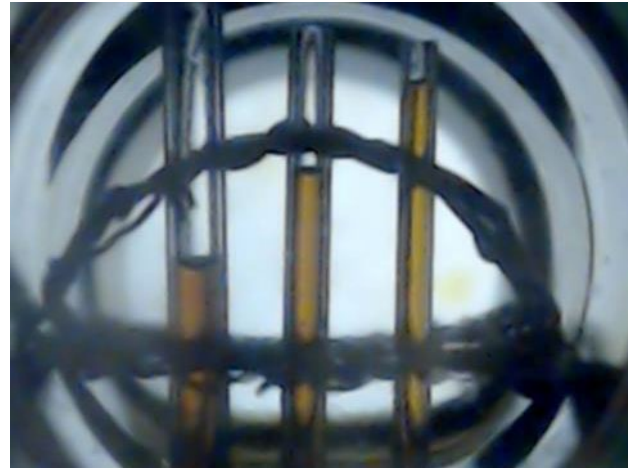
CLEAN AND EFFICIENT Oil and Gas
Exploration, Development, and
Production Technologies

Oil Production Optimization

Enhanced Oil Recovery (EOR)

CO₂ Storage Potential

**Supporting Emerging Technologies
to Enhance Safety and Efficiencies**



ALTERNATIVE FUELS & RENEWABLES

INNOVATIVE SOLUTIONS for
Renewable Fuels and Technologies

Biomass and Alternative Fuels

**Non-Petroleum-Derived Fuels and
Chemicals**

- Electrochemical
- Fuel Cells

Hydrogen

- Production, transportation, and use
- Chemical and fuel synthesis



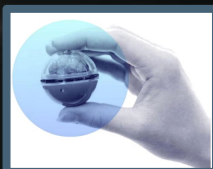


**“My challenge to all of you
is two things.
Keep innovating.
Keep taking risks.”**

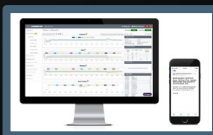
**Governor Doug Burgum, North Dakota
Petroleum Council Annual Meeting,
September 21, 2022**



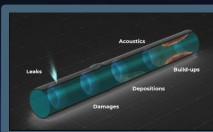
Leak Detection Innovation



In-line inspection
“small diameter”



Artificial intelligence
monitoring



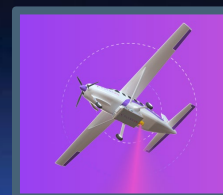
Advanced acoustics



Subsurface polymer
absorption monitoring



Intelligent sensors
for early detection
anywhere



Advanced aerial
sensor technology



New generation
monitoring from
space

MEMBER RECOGNITION



iPIPE MEMBERSHIP

Energy Transfer is involved in a number of organizations that are focused around the constant improvement of pipeline safety and operations. The intelligent Pipeline Integrity Program (iPIPE) is an industry-led consortium whose focus is to contribute to the advancement of near-commercial, emerging technologies to prevent and detect gathering pipeline leaks.

→ VISIT WEBSITE

HESS CORPORATION 2022 Sustainability Report

Intelligent Pipeline Integrity Program

Hess continues active involvement in iPIPE, a collaboration of oil and gas operators and the University of North Dakota's Energy and Environmental Research Center, which aims to review advanced technologies that enhance pipeline integrity efforts (including remote emissions monitoring by drones). Hess works with iPIPE members to review a range of technologies and choose a few for additional investment and testing.

ACKNOWLEDGMENTS

- Media attention
 - 100+ mentions of iPIPE in the media
 - Feature article in *Pipeline & Gas Journal*
 - Feature article in SPE's *Journal of Oil & Gas Facilities*
 - Feature article in *Pipeline Technology Journal*
 - Six-episode series focused on iPIPE on "The Pipeliners Podcast"
- Awards
 - API Industry Innovation Award (Nov 2018)
 - IOGCC Chairman's Stewardship Award (Aug 2019)



OPERATIONS



North Dakota
oil & gas research program

home

history

news

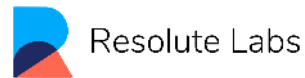


- Established in 2018
- Support
 - Members
 - North Dakota Oil and Gas Research Program
- Membership meets monthly
- Support and execute projects
 - TRL3–6
- Scout technology
- Present program: iPIPE 2.0 (2022–2023)
- Next program: iPIPE 3.0 (2024-2025)

TECHNOLOGY SCOUTING

140+ VETTED

iPIPE RFP Statistics					
	2018	2019	2020	2021	2022
Proposals Received	7	10	13	24	14
Invited to Pitch	7	9	8	10	9
Selected	2	2	2	2	4



FLYSCAN

- ROW collaboration.
- Real-time analysis:
 - Threat detection (RGB camera)
 - Passive LDS (hyperspectral)
- Expand application to produced water.
- Improve software to deliver to multiple operators in one flight.
- Presently testing
- Anticipate beginning flights (Oct-Nov)



FLOWSTATE



- Computational pipeline monitoring (CPM).
- Reduced time to detection by application of ML to volume imbalance determination.
- Alarm algorithms:
 - Leak signature
 - Statistical volume imbalance
 - Over/short monitoring
 - Rupture detection
- Project to apply technology to produced water.
- Demonstration to begin on MPLx System in August.



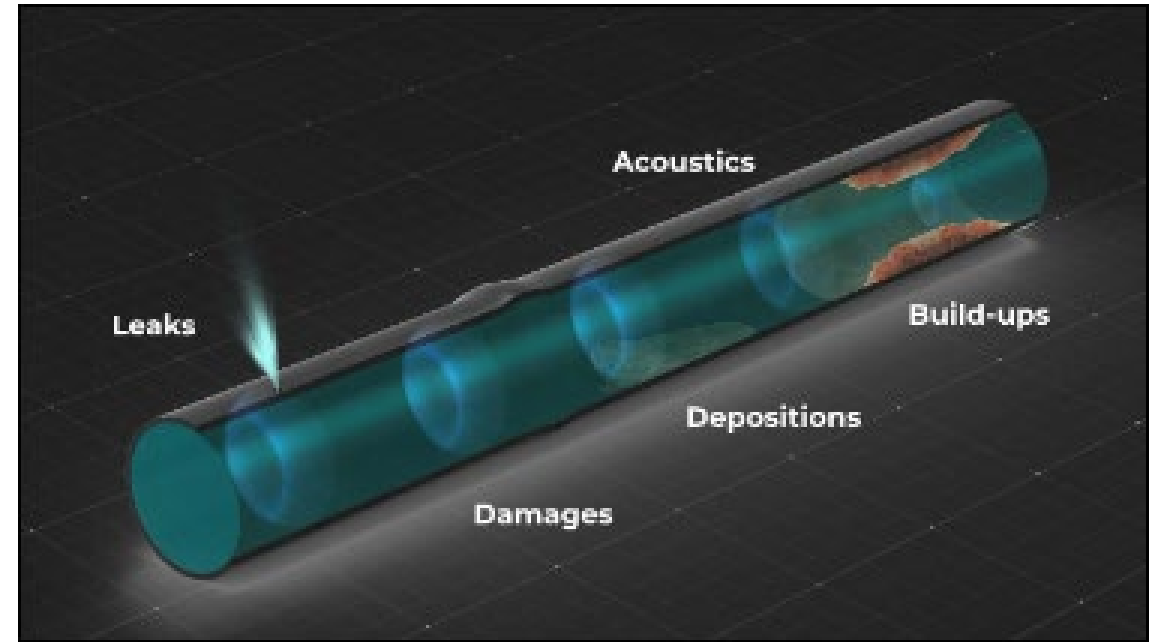
SYSCOR

- Combination of polymer absorption sensor (PAS) technology with IR camera to monitor water bodies.
- Application to high-consequence areas (HCAs) – river/lake crossings.
- Product development and testing.
- Pre-alpha prototype completed, Alpha in development.
- ND field test

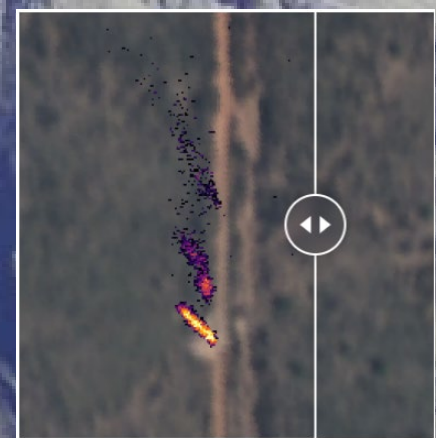
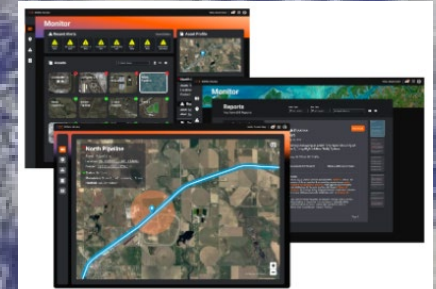
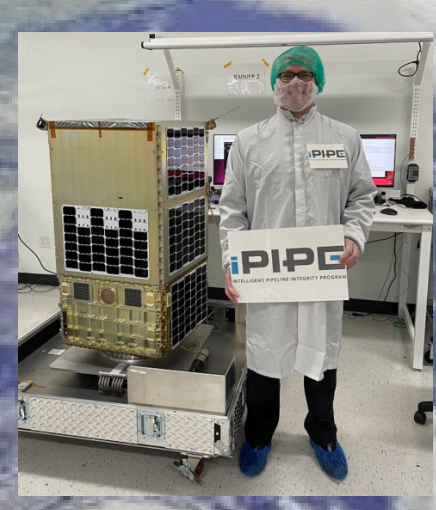
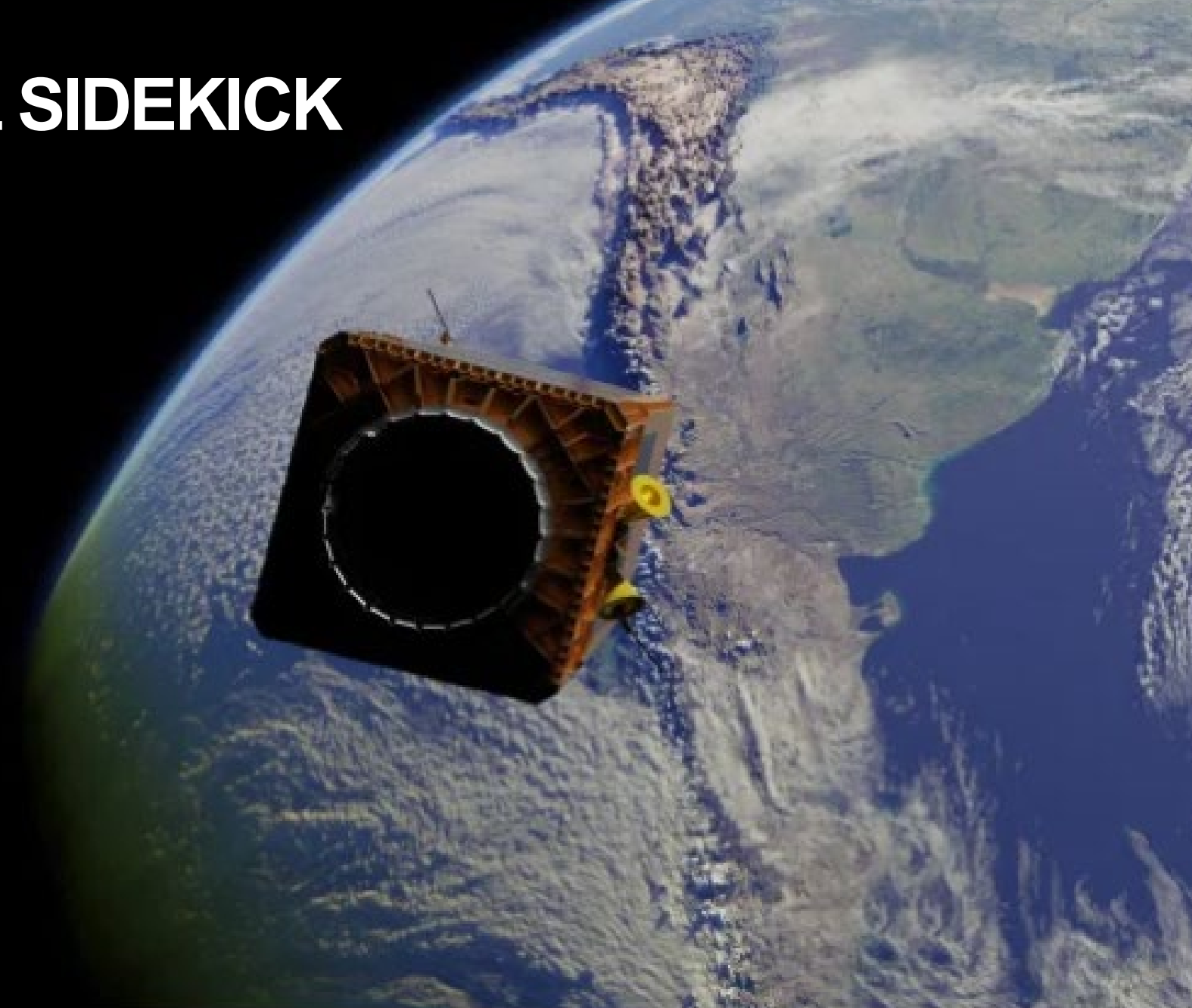


SEISMOS

- PPHM™ – Predictive Pipeline Health Management.
- Acoustic survey of pipeline.
- Applies to lines that cannot be pigged.
- Experience with single-phase fluids.
- Test to determine detection thresholds.
- Scheduled for deployment August 9th.



ORBITAL SIDEKICK



PIPELINE MONITORING WITH HYPERSPECTRAL

Computer rendering of an OSK satellite, which monitors methane emissions on Earth. Courtesy of Orbital Sidekick

EXPECTED RESULTS (2022–2023)



- ✓ Technology selection event
 - ✓ Contracting for four new projects
 - Grow membership
 - ✓ Annual member forum
 - ✓ Continued monthly membership meetings
 - Advance technology to commercial application, and demonstrate commercial deployment
- Advance
 - In-line detection
 - Sensors
 - Satellite
 - Aerial

PIPELINE RISK

Application

- Advanced risk identification.
- Leverage ML processes and technology to support pipeline and facility risk mitigation.

Development

- Explored application with customer and regional data.

Success

- Application identifies higher-risk areas of pipeline segments and ranks risk.

iPIPE



**MACHINE
LEARNING**

DIRECT-C

Sensing of Hydrocarbons and Produced Water



Application

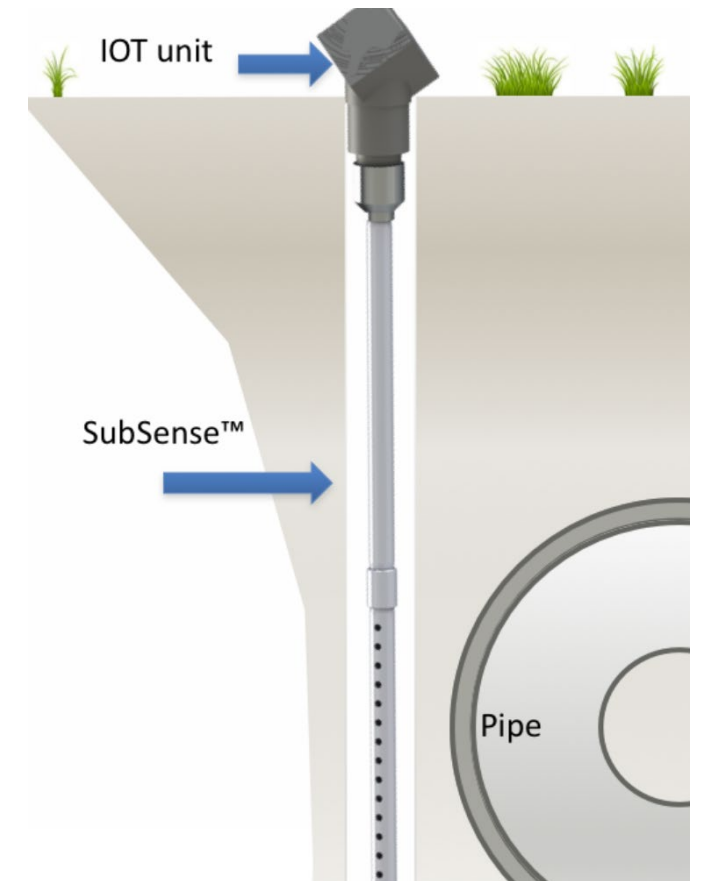
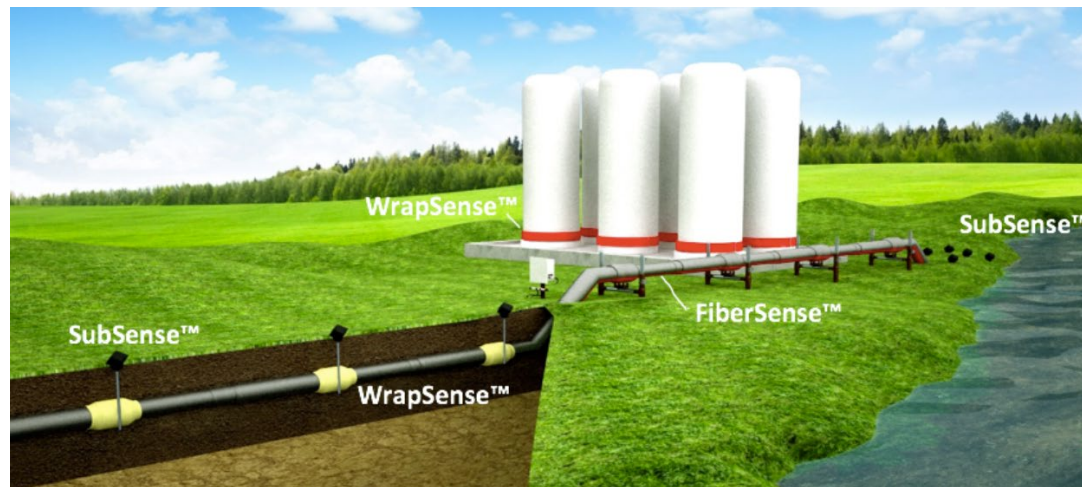
- Useful in focused areas.
- Attached on or near pipe and equipment.

Development

- Pushed technology beyond HC application exploring PW.
- Enhanced installation methods, product hardware, alarm algorithms, and remote communications.

Success

- In use in North Dakota.
- Achieved growth in eight states, Canada, and Europe.



INGU SOLUTIONS



iPIPE

Application

- Advanced in-line inspection.
- Advanced technology for gathering lines that are otherwise difficult to inspect.

Development

- Demonstrated Pipers capability in operational pipelines.
- Developed launch and receive methods.
- Validated repeatability between free-floating and cleaning pig deployments.

Success

- INGU has operated in North Dakota and inspected over 300 pipelines for over 100 customers in 15 countries, building a network of nine agents.



SATELYTICS



EERC JA55379.CDR



Application

- Leak detection from space.
- Advanced processing and algorithms of satellite data to provide actionable alerts.

Development

“We often state that iPIPE was beneficial in providing copious amounts of data to train our algorithms. With 3 years of weekly monitoring, our algorithms were provided with an extensive training opportunity.” – Sean Donegan, Satelytics President and CEO.

Success

- Deployed commercially in North Dakota on the Pelican Pipeline system.
- Projects with BP: leak detection and chemical and carbon accounting.
- Duke Energy (methane), Central Hudson Gas & Electric, Washington Gas, Southern Company, ADNOC, SoCalGas, Italgas, Oxy, Dominion Energy.

TOKU



Application

- Leak detection.
- Advanced pressure sensing applying ML.
- Ability to detect anywhere along a pipeline system.

Development

- Distinguish between operational signals such as pump-off vs. leaks in gathering lines.
- Completed tests and advanced ML algorithms.
- Development of Illumass (customer monitoring package).

Success

- ML can distinguish similar signatures, operational vs. leaks.
- Can detect leaks in the presence of changes occurring simultaneously.
- Sensors presently in use in North Dakota.





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A wide-angle photograph of a university campus at sunset. The sun is low on the horizon, casting a warm glow over the scene. In the foreground, there are large trees with some yellowing leaves. In the background, there are several large, multi-story brick buildings, likely university halls or administrative buildings. A parking lot with several cars is visible in the middle ground.

THANK YOU

Critical Challenges. Practical Solutions.