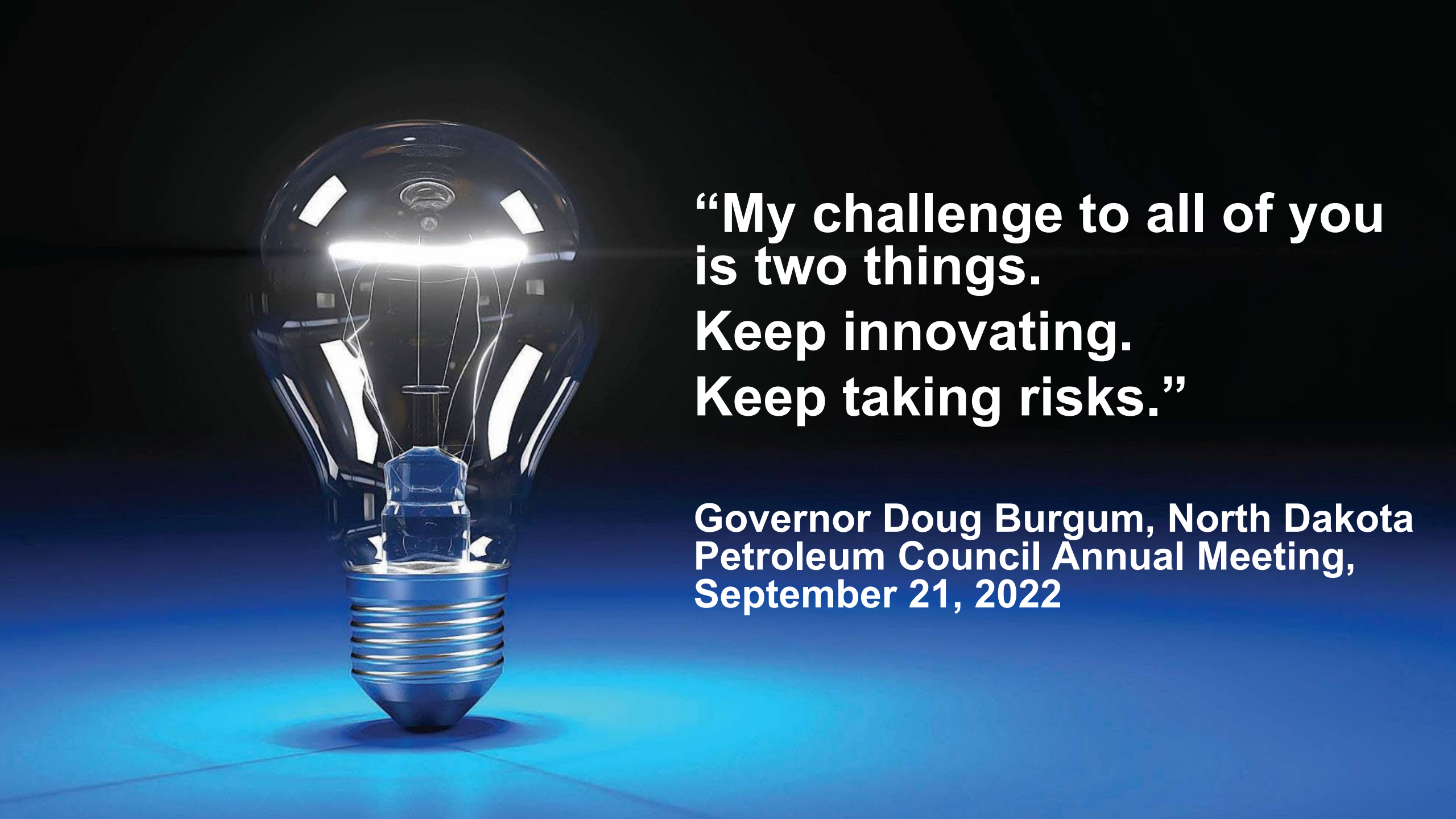
Energy & Environmental Research Center (EERC)

iPIPE 2.0
iNTELLIGENT PIPELINE INTEGRITY PROGRAM

Oil and Gas Research Program

July 21, 2023

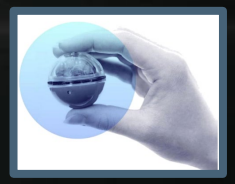
Darren Schmidt, P.E.
iPIPE Program Director and
EERC Assistant Director for Energy, Oil, and Gas


“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

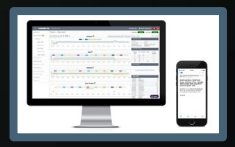
EERC | UND UNIVERSITY OF NORTH DAKOTA

iPIPE
INTELLIGENT PIPELINE INTEGRITY PROGRAM

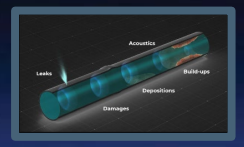
Leak Detection Innovation



In-line inspection
“small diameter”

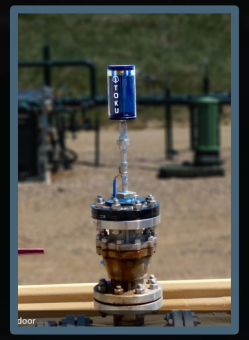


Artificial intelligence
monitoring



Advanced acoustics

Subsurface polymer
absorption monitoring



Intelligent sensors
for early detection
anywhere

Advanced aerial
sensor technology

New generation
monitoring from
space

North Dakota oil & gas research program | ENERGY TRANSFER | dcp Midstream | ENBRIDGE Life Takes Energy | HESS | MPLX | TC Energy | ONEOK

MEMBERSHIP

iPIPE

dcp Midstream

EERC

ENBRIDGE
Life Takes Energy

ENERGY TRANSFER

HESS

MPLX

North Dakota
oil & gas research program

ONEOK

TC Energy

MEMBER RECOGNITION

iPIPE

ENERGY TRANSFER

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

ENBRIDGE
Life Takes Energy

Accelerating the flow of innovation down the iPIPE

In 2019, Enbridge joined the intelligent Pipeline Integrity Program (iPIPE), an association of companies in the upstream and midstream pipeline industry. The association works with entrepreneurs in the pipeline integrity space, driving innovation and accelerating the development of leak detection and prevention technologies.

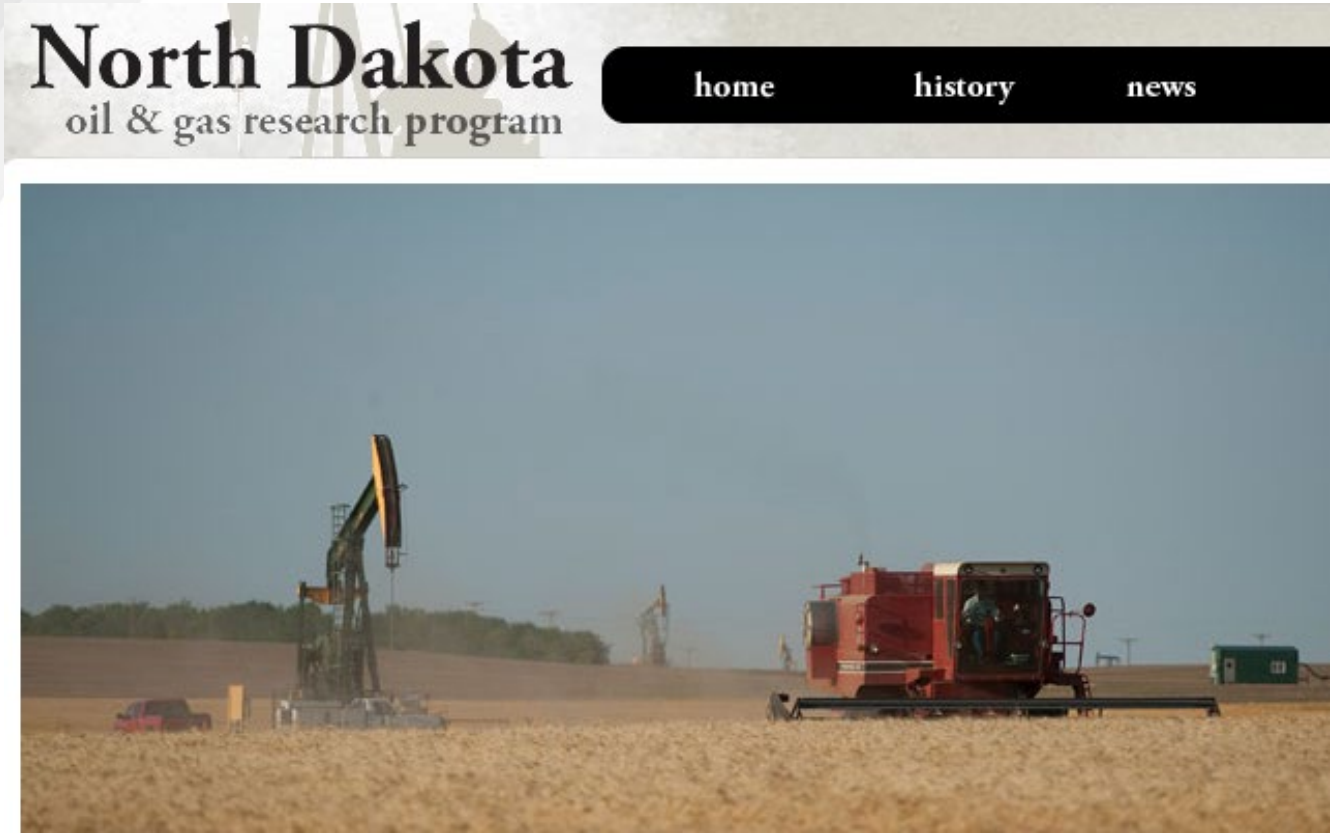
Learn more

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



- 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)

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

PSI Physical Sciences Inc.

SwRI

Resolute Labs

SkySkopes

eSmart Systems

FLYSCAN

Orbital Sidekick

DIRECT-C

Rheidiant

INGU SOLUTIONS

omnisens Securing asset integrity

INSITU

Microsoft

KONGSBERG

Satelytics

BRIDGER PHOTONICS

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 (Aug-Sept)

FLOWSTATE

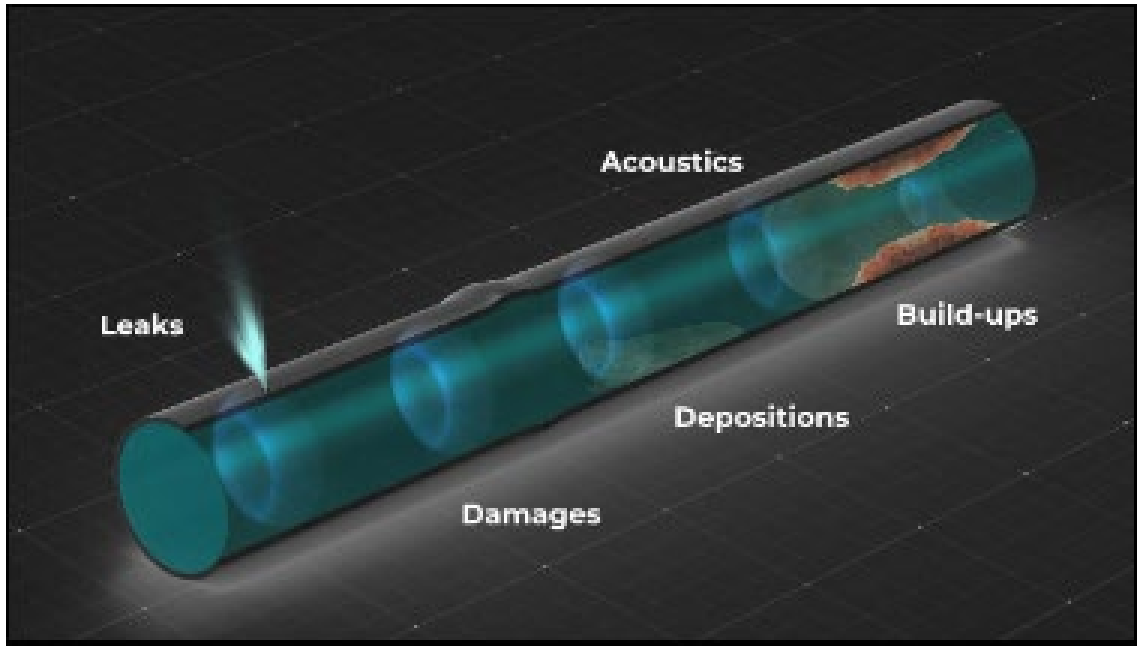
- Computational pipeline monitoring (CPM).
- Reduced time to detection by application of ML to volume imbalance determination.
- Alarm algorithms:
  - Leak signature
  - Statistical volume imbalance
  - Over/short monitoring
  - Rupture detection
- Project to apply technology to produced water.
- Demonstration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

SYSCOR

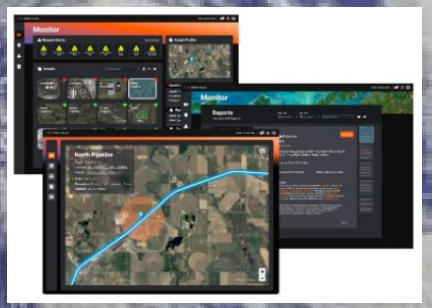
- Combination of polymer absorption sensor (PAS) technology with IR camera to monitor water bodies.
- Application to high-consequence areas (HCAs) – river/lake crossings.
- Product development and testing.
- Pre-alpha prototype completed, Alpha in development.
- ND field test

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

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THANK YOU

Critical Challenges. Practical Solutions.

PIPELINE RISK

iPIPE

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.

DIRECT-C

Sensing of Hydrocarbons and Produced Water

Application

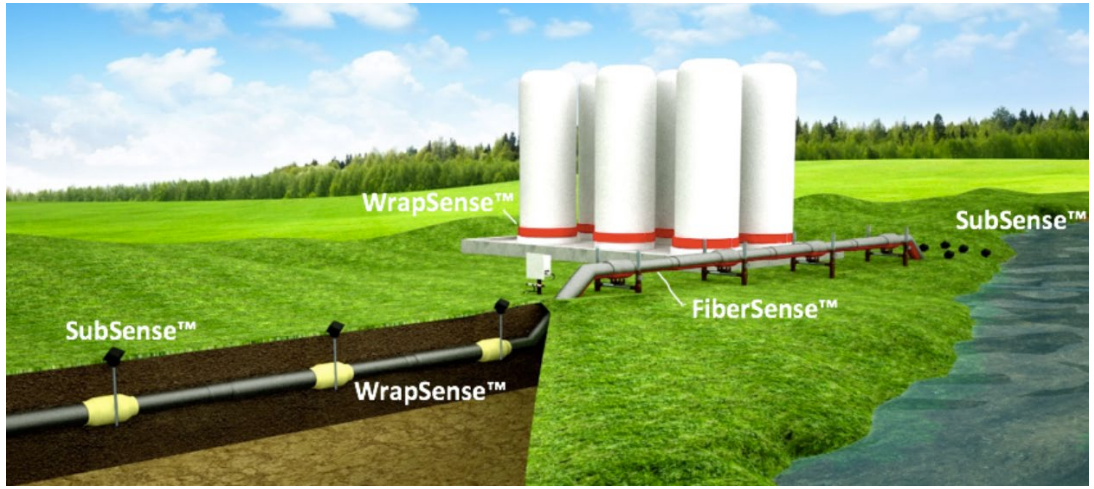
- Useful in focused areas.
- Attached on or near pipe and equipment.

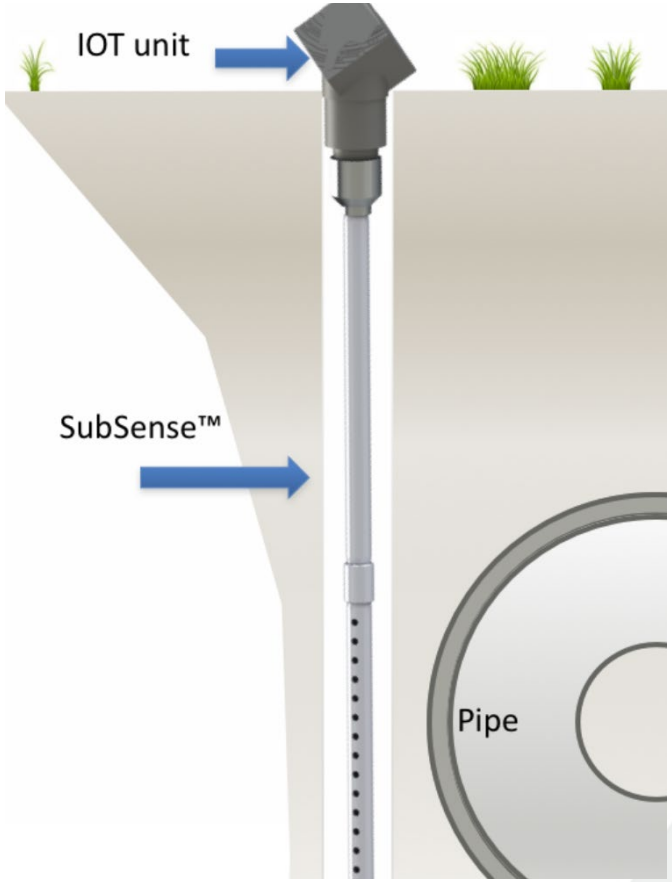
Development

- 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

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

iPIPE

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

iPIPE

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.