

DOE's Undocumented Orphaned Oil and Gas Well RDD&D Program (BIL)

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**Consortium
Advancing
Technology for
Assessment of
Lost Oil & Gas
Wells.**



Project Overview

- Funding: \$30M over years
- Project Duration: August 2022-August 2022
- Participants: LANL (lead lab), LBNL, LLNL, NETL, Sandia, IOGCC



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Section H2 (a, b)

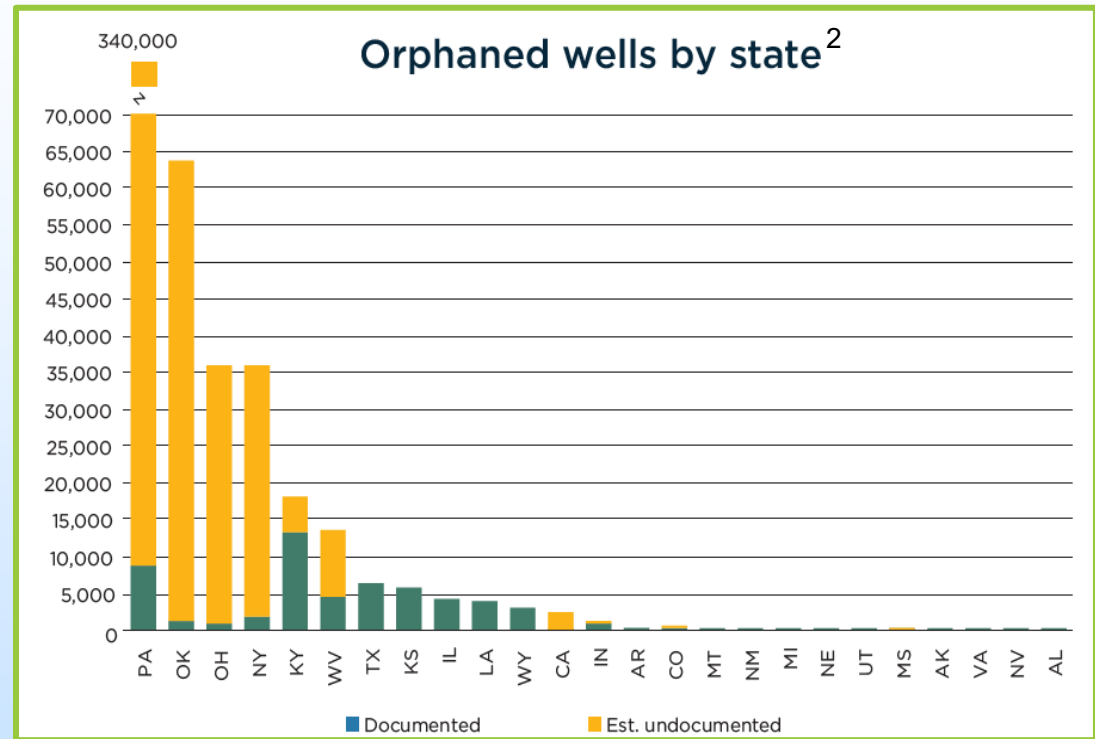
Conduct research and development activities in cooperation with the Interstate Oil and Gas Compact Commission to assist the Federal land management agencies, States, and Indian Tribes in--

(A) identifying and characterizing undocumented orphaned wells; and

(B) mitigating the environmental risks of undocumented orphaned wells;

Project Motivation

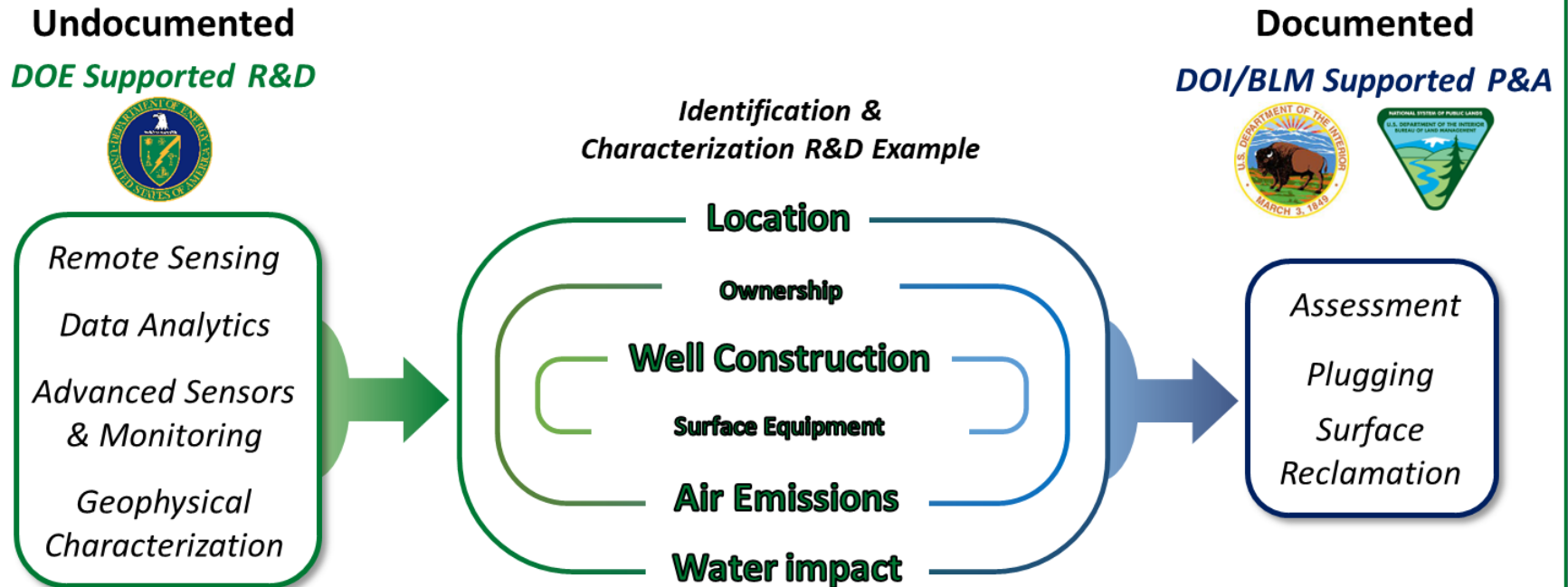
- It is estimated that there are hundreds of thousands of undocumented orphaned wells leaking methane in the U.S. that need to be located.¹
 - The total estimated number of undocumented orphaned wells reported by the states is between 310,000 and 800,000.²
 - Per the EPA, there are 2M unplugged and abandoned wells in the U.S. (which includes orphaned wells).³
- **\$4,700M Available to DOI/BLM/States/Tribes**
 - **\$2,350 - \$23,500 BIL funding per well**
 - **21,000 – 200,000 wells/year over 10-year timeline**
- **Current State of practice: <50 well/year (NM), ~500ish wells/week nationwide.**



DOE Products/Framework need to upscale current decisioning by factor of 40-400x to fully meet expected needs.

Technology Background

Undocumented to Documented Orphaned Well Transition



Challenges of Identifying and Characterizing UOWs

- Location and/or ownership records could be a complete unknown.
- Casing could have been removed (WWII efforts).
- Surface equipment could be overgrown.
- Surface equipment could be removed with subsurface equipment still in place.
- Modern structures could be concealing location.
- Wellbore integrity could be compromised.



Images courtesy of Range Resources Corp.

Methods for Identifying and Characterizing UOWs

- Review of historic production and documents
 - Georeferencing and digitizing
- Desktop studies that include:
 - Soil and Bedrock Geology
 - Anthropogenic Features
 - Surface Cover
 - Water Table & Water Well History
- Ground-based and aerial surveys
 - Electromagnetic Induction
 - Ground penetrating radar
 - Resistivity Tomography
 - Seismic Refraction Tomography
 - Excavations
- Aerial surveys
 - Magnetometer
 - Methane measurements



Images courtesy of Range Resources Corp.

Technical Approach

Comprehensive risk-assessment model to inform prioritization
(what measurements? where, bigger impacts (e.g. groundwater, geothermal, CCS, etc),
tradeoff between economics and number of analyzed wells

everyone

technically trained

specialist knowledge

Citizen Scientist with a
Smartphone

At-the-wellhead
assessment

3D modeling, integrated
analysis, specialized
measurement
discrimination

Offset (satellite, airborne, drone)
characterization and detection

Natural Language Processing
(NLP) and GIS/Data Fusion for
Archival Analysis

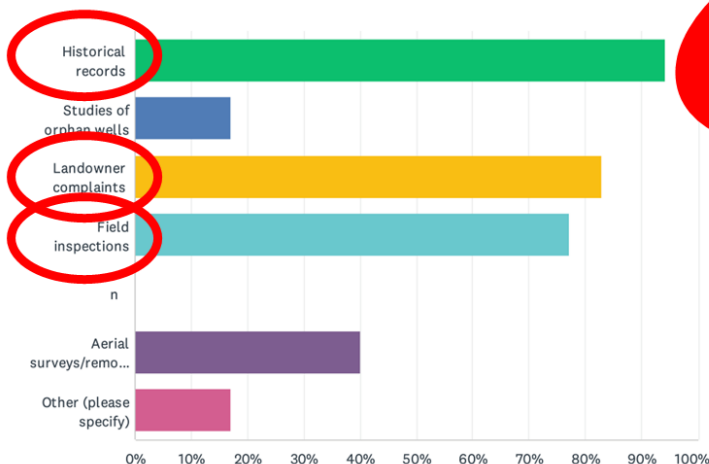
Progress and Current Status of Project

IOGCC Survey Responses

- 37 respondents representing 30 states
- 70% indicated “moderate” or “low” priority -> constrained resources

Q5 What approach/methods has your state been using or contemplated using to identify undocumented orphan wells?

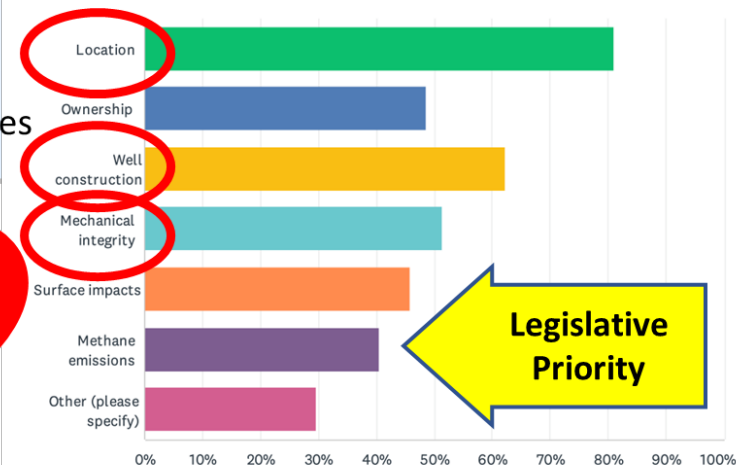
Answered: 35 Skipped: 2



Top Three Responses

Q4 What are your state's biggest data needs/gaps relative to undocumented orphan wells?

Answered: 37 Skipped: 0



State of Practice

- Labor intensive, largely non-technical
- Where is it? What's the state of health?
- Varying local constraints on inspection (e.g. Idaho's no-drone laws)

Project Scope

- Methane Detection and Quantification
- Well Identification
- Sensor Fusion and Data Integration with Machine Learning
- Well Characterization
- Integration and Best Practices

Methane Detection and Quantification Activities

- Quantitative measurement of UOW methane emissions
- Backpack-based and drone measurements
- Used before and after P&A data
- Validates effective P&A
- Provides DOI with important metric of impact of program
- Applies to both undocumented and documented P&A programs

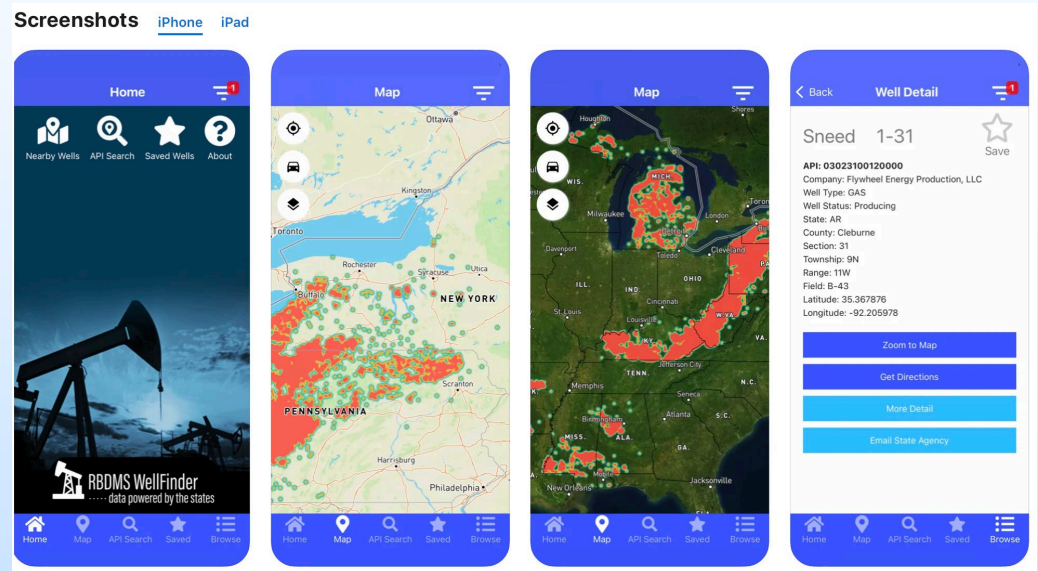


<https://www.licor.com/env/support/Trace-Gas-Analyzers/topics/mobile-measurement-of-emissions.html>

Need: states and other stakeholders currently lack a rapid method for measuring methane emissions

Well Identification

- Well finder App
- Prior DOE investment/experience with geo-location
- Add to this preliminary geophysical reconnaissance
- magnetometry
- Lidar
- Expands the workforce
- Public engagement/outreach/education

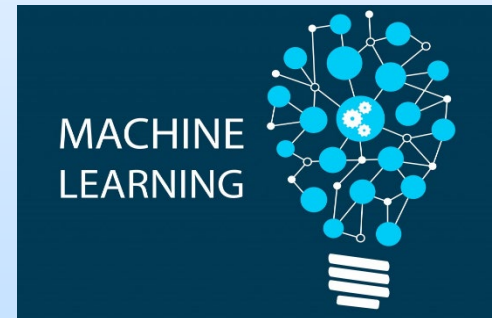


Need: Smartphone data collects to log undocumented orphan wells

Sensor Fusion and Data Integration

- Integrate selected hardware with vehicles, including unmanned air and ground systems, to detect multiple well signatures including:
 - Optical
 - Gas emissions
 - Electromagnetic
 - Topography.
- Use machine learning to extract signal from noisy data

Need: *The combination of multiple signatures will significantly increase the sensitivity of the platform and reduce the number of false detections*

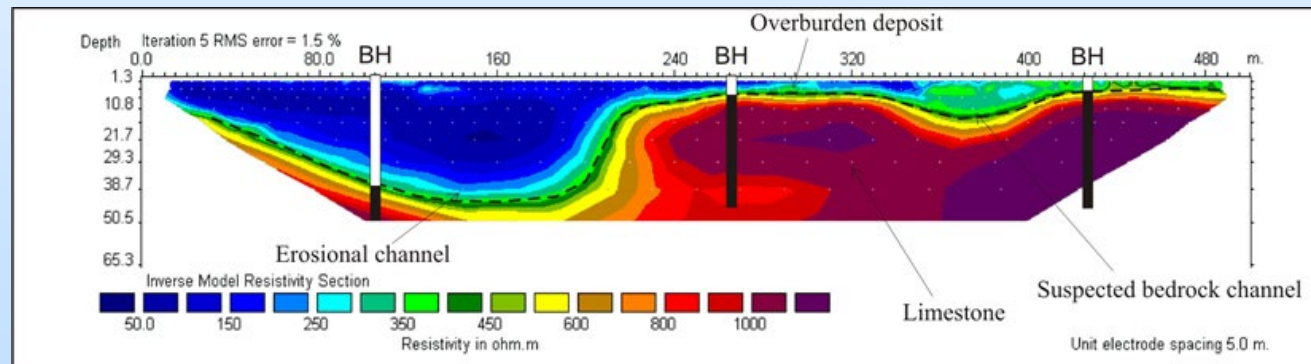
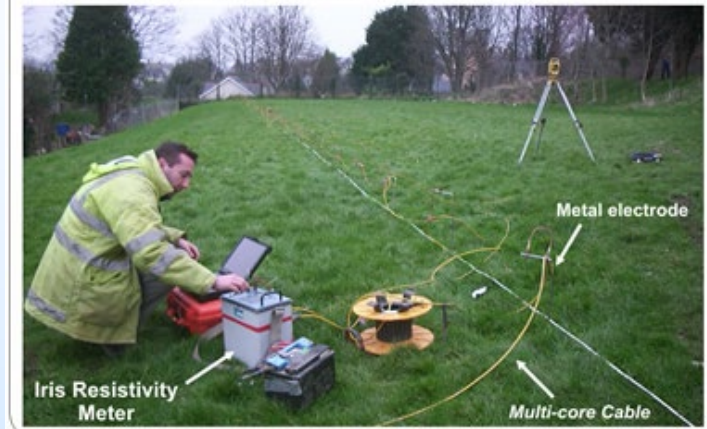


Use multiple signatures & machine learning to determine well locations

Characterization

- Assessing environmental impacts
 - Especially brine leakage
- Variety of methods to be considered
 - Electrical resistivity
 - Conductivity
 - Electromagnetics
 - Seismology
 - Gravity

Typical field set-up

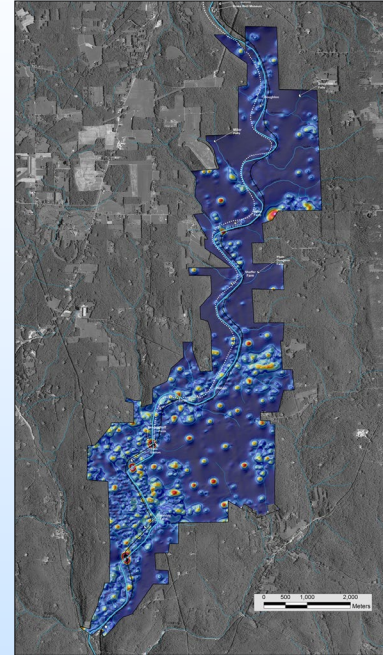


Need: Sub-surface environment characterization

Integration and Best Practices

- Technology transfer - Sharing recommendations and guidelines based on a decade+ of magnetic surveying experience
- Provide a best practices guidance document for use of magnetic surveying to find UOWs
 - Ground-based and drone-based
 - Survey design parameters
 - Grid design and spacing
 - Height above ground
 - Magnetometers
 - Speed of drone
 - Relative to well density, terrain, expected success rate

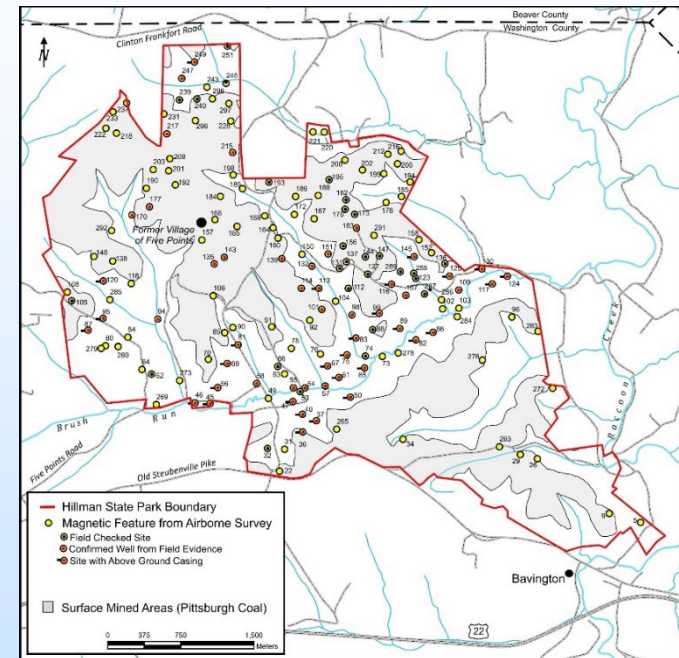
Need: Stakeholders need effective mitigation strategies.



Plans for future testing/development/commercialization

First field demonstration site: Hillman State Park, PA

- 3,600-acre public lands with ~190 wells, most undocumented
- NETL and partners have conducted aerial magnetic surveys at the park starting in 2014 (manned helicopter and drone)
- Methane emissions measured from 31 wells
 - High flow sampling, optical gas imaging, flux chambers, continuous monitoring
- Variety of well types: buried, open hole, open casing cut off at grade, intact well head, etc.
- Suitable for ground-based or terrain-draped drone geophysical surveys



Need: Previously characterized field demonstration site allows testing and demonstration of new/refined technologies against proven methods¹⁵.

Outreach and Workforce Development Efforts or Achievements

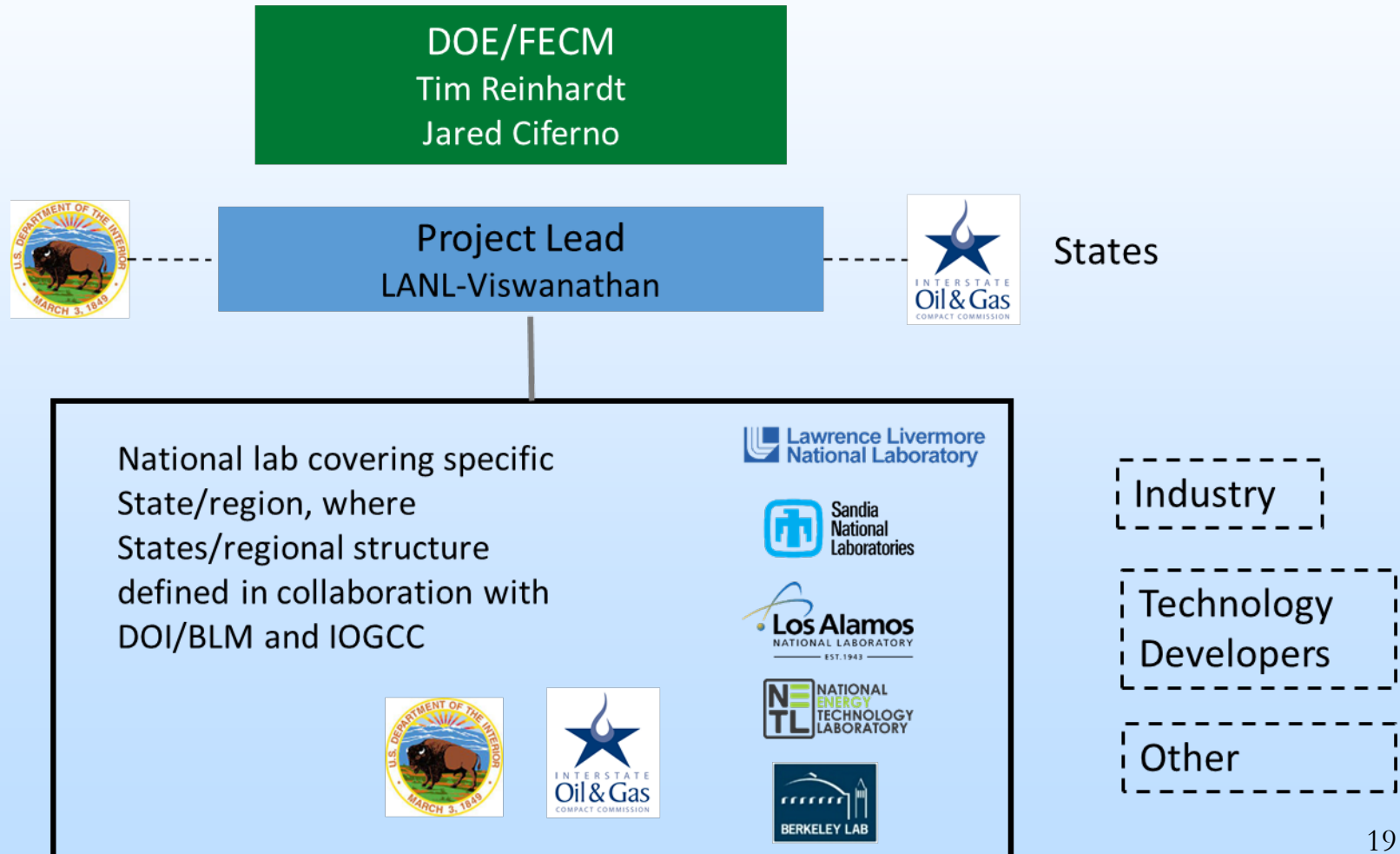
- Outreach - Provide a bulleted list of community outreach efforts or achievements.
 - IOGCC Workshop with States March 17, 2022
 - IOGCC Workshop April 5, 2022 with States, DOI, EDF
 - SEG Image Conference Panel August 30, 2022
- Workforce Development
 - Plan to hire students and postdocs at National Labs

Summary Slide

- Project Kicked off September 2022
- IOGCC Workshop and National Lab planning has identified knowledge gaps that the program aims to fill
- Goal is to integrate existing technologies to economically identify and characterize undocumented orphan wells and work with the states so they will adopt these technologies

Appendix

Organization Chart



Gantt Chart

