DOE NETL Project DE-FE0031702 Quantification of Methane Emissions from Marginal (Small Producing) Oil and Gas Wells





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BACKGROUND – "Marginal" Oil & Gas Wells

- Low production oil/gas wells
 - Produce <90 MCF gas or <15 bbl oil per day (EPA 2016)
 - High production costs (IOGCC 2016)
- Continental U.S. ~770,000 marginal wells represent >65% of wells and >8% of total O&G production (boe basis; IOGCC 2016)
- Most wells will "grow up" to be marginal producers

Issue

New Source Performance Standard 40 CFR 60, Subpart OOOOa

- Marginal well sites are subject to costly leak detection and repair requirements (LDAR)
- EPA decisions based on very limited study data

Key Objective

 Support common sense regulation based on defensible data











STUDY QUESTIONS TO ANSWER

- How do marginal vs. non-marginal wells compare in terms of:
 - Production rates?
 - Type and quantity of equipment?
 - Frequency/timing of episodic high-emission events?
 - Equipment type/age/condition?
 - Absolute contribution to total emissions?
- Correlations of site characteristics to emissions
- > How significant are marginal wells emissions?







KEY POINT: Need equipment-specific analysis to compare marginal vs. non-marginal wells

OVERALL STUDY APPROACH

- Desktop Study / Data Mining
 - Literature and operator surveys
 - Database compilation/statistical analysis
- > Regional Field Investigations
 - Statistically-based sampling design
 - Multiple production basins/regions
 - Established measurement protocols
 - Statistical data analysis
- Messaging and Communication
 - Engagement with industry, state regulators, EPA, etc.
 - Project reporting





Emissions Measurement





WELL SITE DATA – Data Blinded Operator Survey



Site location

• Basin, state, county, etc.

> Activity data

- Production type and rate
- Liquids unloading, associated gas disposition
- Emissions monitoring

Major equipment

- Active/inactive wells
- Tanks, separators, dehydrators, etc.
- Flares/thermal combustors
- Equipment components (e.g., pneumatic devices)



RESPONSES RECEIVED: ~86,700 wells, 29 basins, 23 states

MARGINAL PRODUCTION SITE CLASSIFICATION CATEGORIES

Equip- ment Count	Dry Gas	Wet Gas	Light Oil
1	1	17	33
	2	18	34
	3	19	35
	4	20	36
2-3	5	21	37
	6	22	38
	7	23	39
	8	24	40
4-5	9	25	41
	10	26	42
	<mark> </mark> 11	27	43
	12	28	44
>5	13	29	45
	14	30	46
	15	31	47
	16	32	48

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Key Differentiators											
		Categories									
	Main Product	Dry Gas	Wet Gas	Light Oil	Other*						
Production Rate (BOE/day/site)		0-1	>1-4	>4-8	>8						
	Well Pad Size (Pieces of equipment)	Small (1)	Medium (2-3)	Large (4-5)	Extra-Large (>5)						
	Disposition of Associated Gas (oil wells)	Recovered	Vented	Combusted	Other/NA						



REGIONAL FIELD CAMPAIGNS

- Visited >500 "sites" with
 15 host operators
- Sites located in 8 basins and 13 states
- > 629 wells (~10% non-marginal)







FIELD WORK PLANS

- **Field Investigation Design**
- Site Selection

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- **Representative populations provided** by host operators
- Geographically clustered Random sampling
- **Technology specifications** (Equipment, methods, protocols, etc.)
 - **Emissions Screening Identify key** emission sources
 - **Emissions Measurement Quantify** emission composition from representative emitting sources
- Data analysis (criteria, procedures)



High Flow Sampler



Air Canister Sampling



FIELD CAMPAIGN "SITES" VS. WELLS





FIELD DATA COLLECTED – Activity Data

- > Weather Data
- > Major Equipment Counts
- > Operator "Interview"
 - Production type and rates
 - Liquids unloading details
 - Disposition of associated gas
 - Emissions monitoring
 - Operating conditions typical/variable?
- Component Counts (time permitting)





Site-level activity data to characterize the significance and representativeness of conditions observed, and not observed, at the time of each site visit.

FIELD SITE CHARACTERISTICS

- > Equipment Age Variation:
 - Wellheads: 2 79 years old
 - Separators: 2 72 years old
- > Equipment Count Variation:
 - 0 25 Wellheads
 - 0 11 Separators
 - 0 10 Meters
 - 0 9 Tanks
 - 0 13 Tank Vents
 - 0 8 Tank Hatches
 - 0 5 Emission Control Devices
 - 0 3 Gas-Powered Engines















OBSERVED EQUIPMENT – Combined Field Campaigns





KEY EARLY RESULTS – Field Campaign 1



COLORADO STATE UNIVERSITY

PENDING COMPREHENSIVE DATA EVALUATION





Conceptual example of data analysis to develop representative emission profiles for distinct site populations. Besides product type, other key differentiators may include "size" (equipment count), production rate, and other factors as determined through further analysis.

PROJECT SUMMARY

- Data collection complete Data processing/analysis underway
- > Key early findings :
 - "Site" definition can be ambiguous due to diverse well pad and production system configurations across multiple regions
 - Majority of sites visited exhibited no detected emissions
 - Detected emissions exhibit characteristic "fat-tail" distribution, where a small fraction of sites contributes a large majority of observed emissions

Next Steps

- Exploratory analysis of complete dataset
- TASC (advisory) calls mid September 2021
- Project report December 2021











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- > Benefit to the Program
- > Project Overview
- > Organization Chart
- Gantt Chart





BENEFIT TO THE PROGRAM



- The DOE-NETL program goal addressed is *Methane Emission Quantification*, with research focused on characterization of emissions from specific components of the oil and natural gas production and processing chain.
- > Project benefits to the program include:
 - Quantification and characterization of methane emissions from marginal well sitespecific components (wellheads, valves, piping, separators, compressors, storage tanks, etc.) will address varied regulatory concerns and support EPA greenhouse gas reporting and inventory programs.
 - Study findings will facilitate identification and implementation of appropriate best management practices for continued reliance on traditional oil and gas resources while enhancing environmental protections.





PROBLEM STATEMENT

There are more than 1.1 million oil and natural gas wells in the U.S., of which about 770,000 (~70%) are considered marginal. Debate continues among concerned stakeholders regarding whether marginal well sites should be subject to or exempt from fugitive emissions monitoring and associated leak detection and repair (LDAR) requirements.

PROJECT OBJECTIVE

Collect and evaluate representative, defensible and repeatable data and draw quantifiable conclusions on the extent of methane emissions from marginal wells across oil and gas producing regions of the U.S., and to compare these results to published data available on the emissions from non-marginal wells.

A Technical Advisory Steering Committee (TASC), consisting of stakeholders from industry, academia, regulatory agencies, and non-governmental organizations, has provided recommendations and feedback on project activities, such as strategy development, field implementation, data analysis, and study conclusions, throughout the project.



ORGANIZATION CHART



GANTT CHART



	2019					2020								2021												
Task / Description	MA	A M	J J	Α	s c	N	D	J	FN	ЛΑ	М	J	JA	A S	0	N	DJ	F	Μ	Α	M J	I J	Α	s c) N (D
Project Development																										
Project Management and Planning																										
Technical Advisory Committee																										
Data Source Status Assessment and Workplans																										
Regional Field Campaigns																										
Field Campaign 1																										
Field Campaign 2																										
Field Campaign 3																										
Data Analysis and Reporting																										
Data Processing and Analysis																										
Interim and Final Reports																										

work complete

work pending

