Comments on EPA's Proposed
Reconsideration of the Oil & Gas New
Source Standards

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Overview

• Core concerns with changes to fugitives monitoring in the reconsideration proposal
- Non-Low Production Wells
- Low Production Well
- Compressor Stations
- State Equivalency
• New analyses support retaining (and strengthening) the current NSPS standards
• Alternative compliance pathways

Core Concerns with Proposed Changes to Fugitives Monitoring

Effectiveness of OGI at Different Monitoring Frequencies

• Emissions reductions simulated using the Stanford FEAST model support the assumption of emissions reductions of 40% with annual OGI monitoring, 60% with semiannual OGI monitoring, and 80% with quarterly OGI monitoring
• Model uses EPA assumptions and empirical field data on OGI from METEC at CSU

"Leak Rate" Not Correlated with Site Level Emissions

• Empirical evidence shows no correlation between site-level emissions and the number of leaking components
• Observed emissions at sites are much higher than previously estimated

2,301,640
887,719
1,316 138
0
500,000
1,000,000
1,500,000

2,000,000

2,500,000

0% 2% 4% 6% 8% 10% 12% 14%

Site Methane Emissions [lb/yr]

% of Leaking Components

Leaking Components and Site Methane Emissions

City of Fort Worth Natural Gas Air Quality Study Data (2011)

The highest percentages of leaking components do not occur at the sites with the highest emissions

(Note: only a subsetof tank emissions were measured)

Processing facility with:

1,800 valves

12,590 connectors

10 tanks (3 measured)

12 compressors

Well site with:

2 wells

89 valves

384 connectors

2 tanks (1 measured)

Well Pad with:

8 wells

613 valves

4,291 connectors

6 tanks (3 measured)

Well site with:

1 wells

76 valves

710 connectors

2 tanks (1 measured)

Data from Allen et al 2013

Questions Regarding EPA's Development of

Model Low Production Well Sites

• EPA relied on 27 low production gas wells in Ft.

Worth Study to develop model low production well

sites

- Change to equipment counts are for meters/piping and inline

heaters

- Component counts as high or higher at Fort Worth low

production sites as EPA's non-low production model site

• EPA applied scaling factor from Fort Worth gas

wells to develop two oil production model sites

- In 2016 Rule, EPA constructed different model facilities for

gas and oil well sites precisely because the agency

concluded that these facilities can have different types of

major equipment and components

Limited Correlation between

Production and Emissions

Scatter plots of site-level methane measurements as functions of site-level natural gas production, adapted from Omara et al.

(2018). The figure shows previously reported site-level methane emissions data at over 1,000 sites in eight U.S. basins. The cyan

line is a robust weighted least squares fit to the entire dataset performed in such a way that it downweights the contribution of

extreme CH4 outliers. Site-level measurements were grouped into 10 bins based on the deciles of gas production rates

(numbered sequentially on the top). The data in each bin are then overlaid on the scatter plots as box and whisker plots, where

the horizontal line in each box shows the median while the pink triangles show the mean CH4 emission rate in each bin. Full

description of these data are provided by Omara et al. (2018).

Component Counts at Low-

Production Sites

Analysis of FWNGAQS site-level emissions and component count data for low production (blue) and

non-low production (orange) sites. The data shows that while the number of valves and connectors

are smaller at low production sites, the range of measured emissions at these sites are equivalent to

the measured emissions at 90% of non-low production sites.

Quarterly Monitoring Remains the

BSER for Compressor Stations

Compressor

Station (Quarterly)

Non-Low-

Production Wells

(Annual)

Low-Production

Wells (Biennial)

CH4 Cost-

Effectiveness

(2018 Proposal /
Single-Pollutant /
with Cost-
Savings)
$749/ton $1,140/ton $906/ton

Comparison of Cost-Effectiveness in EPA 2018 Proposal of
Monitoring at Compressor Stations and Well Sites

• EPA's analysis supporting the 2018 Proposal concludes that quarterly monitoring at compressor stations is even more cost-effective than EPA's proposed monitoring frequencies at well sites

Comparing NSPS and State Standards:
Scope of Well Coverage

Combined, the California, Colorado, Ohio, and Texas regulations cover only 34% of the total wells that the Proposed Rule would cover

100%
100%
80%
5.5%
34%
0 5,000 10,000 15,000 20,000
CA
CO
OH
TX
Equivalent States Total
Number of Wells
THE PROPOSAL WELLS COVERED BY STATE
LDAR STANDARDS
Wells covered by state LDAR standards and the Proposal
Wells covered only by the Proposal

Comparing NSPS and State Standards:
Stringency of Requirements

-
5,000
10,000
15,000
20,000
25,000

30,000

35,000

40,000

45,000

50,000

CA CO OH TX Equivalent

States

Total

NSPS Emission Reduction (tons per year)

THE PROPOSAL EMISSION

REDUCTIONS BY STATE LDAR

STANDARDS

Emission Reductions from state Programs

Emission Reductions from the Proposal

-

10,000

20,000

30,000

40,000

50,000

60,000

70,000

80,000

CA CO OH TX Equivalent

States

Total

NSPS Emission Reduction (tons per year)

2016 NSPS EMISSION

REDUCTIONS BY STATE LDAR

STANDARDS

Emission Reductions from state Programs

Emission Reductions from 2016 NSPS

Fugitive Emissions

New Analysis Supports Retaining and

Strengthening Currents NSPS

All

Omara Analysis

• Updated fugitive methane emissions factors for non-low production

and low production wells (<15 BOE/day) based on site-level

measurement data

• Data were obtained in eight independent site-level CH4 emissions measurement studies for over 1,000 wells in 8 basins

• Site-level estimates scaled by ~50% based on an analysis of the fraction of fugitive emissions from 300 measured sites with fugitive emissions data in City of Fort Worth Study to account for fugitive emissions only

- Corroborated by EPA's GHGI, which indicates that fugitives account for ~50% of production emissions

• Used a non-parametric bootstrap approach to develop the EFs from the measured data

• For activity counts, used DrillingInfo to pull list of subject wells; employed a cluster analysis to establish wellsites (50 m radius), Used production data to categorize sites into 6 groupings

Updated Fugitive Emissions Factors

a Based on EPA's TSD estimate because low-production oil wells which were not included in the measured site data

Source: Table 1 of Omara Analysis

15.5

11.8

10.4

6.1

4.7

1.8(a)

5.9

3

2.1

4.8

2.6

1.8

0

2

4

6

8

10

12

14

16

18

non-low Prod: Gas non-low Prod: Oil >

300 GOR

non-low Prod: Oil <

300 GOR

low Prod Sites:

Gas

low Prod Sites: Oil

> 300 GOR

low Prod Sites: Oil

< 300 GOR

Emissions Factors (tpy CH4)

EDF analysis EPA 2018 TSD

Baseline fugitive CH4 emissions and

forgone emission reductions in 2025

Baseline CH4

emissions (tons)

CH4 emissions

from NSPS

recon. (tons)

Forgone

emission

reductions in

2025 (tons)

EDF

analysis TSD

EDF

analysis TSD

EDF

analysis TSD

non-low Prod: Gas 37,046 26,687 51,443 N/A 14,398

43,708

non-low Prod: Oil > 300

GOR 259,664 67,612 374,794 N/A 115,130

non-low Prod: Oil < 300

GOR 58,950 8,553 76,989 N/A 18,038

low Prod Sites: Gas 3,780 4,599 6,115 N/A 2,335

12,242

low Prod Sites: Oil >

300 GOR 13,982 6,990 20,841 N/A 6,860

low Prod Sites: Oil <

300 GOR 9,544 8,668 14,417 N/A 4,873

Total 382,965 123,109 544,599 179,059 161,634 55,950

Key Takeaways from Omara Analysis

• EPA significantly underestimated fugitive emissions at both low and non-low production well sites- this analysis concludes that mean fugitive methane emission factors for sites are 2 to 5 times higher than EPA's estimates

• Both low production and non-low production high-emitting sites (super-emitters) dominate total methane emissions from both groups of sites, accounting for 50% of total methane emissions

• Low production sites lost 11% of their production compared to less than 1% for non-low production wells, suggesting significant emissions mitigation potential exists at low production sites

• Accounting for current state standards, we assessed reductions based on the EPA standards and found forgone reductions 3X higher than EPA estimates

Recent Studies on O&G Methane Emissions Underscore Importance of Retaining and Strengthening Current Standards

• Alvarez et al., Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain (2018)

• Omara, M. et al., Methane emissions from natural gas production sites in the United States: Data synthesis and national estimate (2018)

• EDF analysis of UW Permian data in New Mexico (2019)

EDF estimates New Mexico upstream O&G emits over 1 million MT CH4

https://www.edf.org/energy/explore-new-mexicos-oil-and-gas-pollution

New Mexico Methodology

Production:

Permian

Basin
90+ new well pad OTM
33A measurements by
University of WY
Extrapolated to basinlevel
estimate
Production:
Other
Basins
Applied approach from
Alvarez et al 2018
Science paper based
on >400 well pad
measurements
Updated to 2017
baseline; San Juan
estimate validated with
previously published
aircraft-based estimate of
basin-level emissions
Gathering &
Boosting
Applied approach from
Alvarez et al 2018
NM loss rates based on
previously published
research extrapolated to
basin-level based on gas
production
Total New
Mexico
emissions
estimate

Monitoring Costs and Cost-
Effectiveness
New Analyses Support Retaining and
Strengthening Current NSPS
All
OOOOa Compliance Reports

Analysis

Well Sites Compressor Stations

Number of Sites 3,202 41

Average LDAR

Survey Time

1.25-1.6 hours/ well

(including travel time)

2.8 hours/ compressor

station (not including travel)

% of Surveys

Detecting Leaks

54% 88%

Average Number of

Leaks per Survey

1.7 4.7

• EPA assumed over 3 hours per survey per

well- suggesting EPA overestimated

semiannual LDAR costs by up to 32% per

site per year

Updated Cost Effectiveness Estimates: Well

Sites

EPA (2014) EDF (2014) EDF (2017)

EDF vs. EPA

(2014)

EDF vs. EPA

(2017) EPA (2014) EDF (2014) EDF (2017)

EDF vs. EPA

(2014)

EDF vs. EPA

(2017)

Annual $979 $212 $205 $781 $13 $7 -98% -99%

Stepped $1,041 $225 $218 $842 $27 $20 -97% -98%

Semi-annual $1,164 $252 $244 $965 $53 $46 -94% -95%

Biennial $1,104 $657 $556 $906 $459 $358 -49% -60%

Annual $1,360 $809 $685 $1,140 $611 $487 -46% -57%

Stepped $1,445 $860 $728 $1,247 $662 $530 -47% -58%

Semi-annual $1,616 $961 $814 $1,396 $763 $616 -45% -56%

Note: Assumed same cost per facility as EPA in "1-Proposed Rule OOOOa TSD Section 2 OGI Well Pad Model Plant Costs" workbook.

With Savings ($/ton)

-79%

Low

Producing

Sites

-40% -50%

Production Frequency

Non-Low

Producing

Sites

-78%

Without Savings ($/ton)

• Incorporate updated source counts and baseline emissions factors

from Omara Analysis and updated cost estimates from OOOOa

compliance reports

• Semiannual LDAR is 95% less expensive on a dollars-per-ton-ofmethane-

reduction basis at non-low-production wells, after gas

savings are taken into account, than estimated by EPA in the 2018

TSD

Updated Cost Effectiveness Estimates:

Compressor Stations

Source Count

EPA EDF EPA/EDF

G/B 35.1 189.0 212

Transmission 40.4 502.5 36

Storage 142.4 635.3 2

Facility Type Baseline (tons/facility)

Compressor Stations

EPA EDF EDF vs. EPA EPA EDF EDF vs. EPA

Annual $557 $86 -85% $396 -$62 -116%

Semi-annual $652 $101 -85% $491 -$49 -110%

Quarterly $910 $141 -85% $749 -$15 -102%

Note: Reflects updates to the baseline emissions only.

Production Frequency Without Savings ($/ton) With Savings ($/ton)

Compressor

Stations

Transmission and storage compressor stations baseline emissions: derived using the total station

emissions estimates and the assumption that 75% of total station emissions are fugitive, both from

Zimmerle et al (2015).

Gathering and boosting compressor station baseline emissions: derived using the total station emissions

estimates from Marchese et al (2015), and a conservative assumption that 50% of total station emissions

are fugitive (based on past EPA GHGI inventories and engineering judgement).

Low-Production Well Cost Analysis:

Shut-Ins

Shut-in Not

Shut-in TOTAL AVG

BOE/day

AVG ANN

REVENUE

($ mill)

AVG

BOE/day

AVG ANN

REVENUE

($ mill)

1/1/13 - 8/1/15 (PRE REG) 3,038 11,189 14,227 5.0 $0.120 16.5 $0.348

9/1/15 - 10/1/18 (POST REG) 2,627 1,798 4,425 9.4 $0.117 38.3 $0.567

Shut-in Wells Non Shut-in Wells

Time period

Number of Wells

Summary of New and Modified Marginal Wells Developed in Pre-regulation and

Post-regulation Periods

Low-Production Well Cost Analysis:

Company Revenues

1 745 745 65% $1.7 0.07%

2 326 652 49% $2.0 0.12%

3 163 489 48% $5.0 0.07%

4 115 460 46% $3.6 0.13%

5 - 9 224 1,435 38% $8.8 0.09%

10 - 99 321 8,838 17% $73.8 0.08%

100 - 299 60 9,911 6% $571.6 0.04%

300 - 499 14 5,393 3% $1,847.8 0.03%

500+ 9 6,231 13% $2,988.7 0.03%

TOTAL 1,977 34,154 14%

NUM % MARG

New &

Modified

Wells per

Company

#

Companies

New & Modified

Wells AVG Annualized

Revenue per

Company ($ mill)

LDAR

Compliance

Cost, % of

Revenue

1 692 $0.178

2 236 $0.616

3 100 $1.215

4 58 $1.143

5 - 9 115 $3.299

10 - 99 57 $9.647

100 - 199 1 $23.783

200+ 2 $48.621

TOTAL 1,261

1 From new marginal wells only. Does not

include revenue from new non-marginal

wells.

Marginal

Wells/

Company

#

Companies

AVG Annualized

Revenue per

Company 1

($ mill)

Ownership Profile & Revenue of

Marginal New & Modified Wells

(Sept 2015 - October 2018)

Ownership Profile & Revenue of All New &

Modified Wells

(Sept 2015 - October 2018)

Alternative Compliance

Pathways

EDF/ECOS Report: Pathways for

Alternative Compliance

• Reviews policies from EPA and six states

• Defines a mathematical, technology-neutral

framework for comparing emission reductions

of different practices

• Considers regulatory applications for the

evaluation framework

• https://www.edf.org/sites/default/files/documents/

EDFAlternativeComplianceReport_0.pdf

EDFP-

ENVIRONMENTA11114111*-7

DEFENSE FUND'

Finding the ways that work

Appendix

Liquids Unloading

• Liquids unloading emissions can vary by time of

day due to work schedules.

- https://www.pnas.org/content/115/46/11712.short

• Alvarez et al 2018 reports this issue would only

be important in the Fayetteville Shale.

• A more detailed extrapolation of LU results in

~600 Gg CH4, only a small fraction of "abnormal

emissions" in Alvarez et al

- https://pubs.acs.org/doi/abs/10.1021/acs.est.8b05546

Percentage of Site-Level Emissions that

Are Fugitive: City of Fort Worth Natural

Gas Air Quality Study

% of site- level

emissions that

are fugitive

low production

sites 49%

Mean for all

sites 54%

2018 Wyoming O&G Standards

NSPS Emissions Covered (TPY)

by State Rules

9/18/2015 -

7/1/2016

7/1/2016-

11/20/2018

UGRB Rule 0 3,836

2018 NSPS 4,247 4,247

2016 NSPS 6,371 6,371