UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

STATE OF NEW YORK, *et al.*,	)	
Plaintiffs,	)	
ENVIRONMENTAL DEFENSE FUND,	)	
	)	Civil Action No. 18-cv-0773 (RBW)
Plaintiff-Intervenor,	)	
v.	)	
ANDREW WHEELER, *et al.*,	)	
Defendants.	)	

DECLARATION OF DR. RENEE McVAY AND HILLARY HULL

We, Dr. Renee McVay and Hillary Hull, declare as follows:

1. I, Dr. Renee McVay, am a Senior Research Analyst in the Oil and Gas program at the Environmental Defense Fund ("EDF"). I earned my PhD in Chemical Engineering from the California Institute of Technology, where my research focused on atmospheric chemistry and the formation of atmospheric aerosols. I also have an MS in Chemical Engineering from the California Institute of Technology and a BS in Chemical Engineering from Texas A&M University. After my PhD, I completed a postdoctoral fellowship at the National Oceanic and Atmospheric Administration working with the regional air quality model WRF-Chem to improve performance and predictions of the model. At EDF, my work focuses on using emission inventories to develop state and region-specific emission profiles from the oil and gas sector. My curriculum vitae is attached as Attachment 1.

2. I, Hillary Hull, am a Senior Research and Analytics Manager for the Energy program at EDF. I have an MS from Stanford University in environmental engineering (Atmosphere & Energy Program) and a BS from the University of Texas at Austin in civil engineering. In my role at EDF, I develop analytics in support of EDF's state, federal, and international natural gas work. My work includes emissions inventory compilation, data and economic analytics, technical support for rulemaking and regulation, and policy analysis and development.

3. The Environmental Protection Agency ("EPA") has promulgated standards to reduce methane emissions at new and modified facilities in the oil and gas sector, *Oil and Natural Gas Sector Emission Standards for New, Reconstructed and Modified Sources*, 81 Fed. Reg. 35,824 (June 3, 2016) ("New Source Rule"). The standards reduce methane emissions by requiring regular leak detection and repair ("LDAR") and equipment upgrades at covered facilities in oil and natural gas production, processing, and transmission and storage segments. The New Source Rule has been fully in effect and securing reductions in methane at new and modified facilities for over three years.

4. We are aware that the New Source Rule triggers a legal obligation under Section 111(d) of the Clean Air Act, 42 U.S.C. § 7411(d), for EPA to issue emissions guidelines for existing sources ("Methane Guidelines"), but that EPA has not yet issued such guidelines.

5. We understand that EPA has requested an indefinite stay of this litigation challenging EPA's unreasonable delay in issuing Methane Guidelines until EPA might finalize a proposed rule to revise the New Source Rule by removing methane as a regulated pollutant. EPA's proposal to remove methane regulation claims that, if finalized, the action will remove EPA's legal duty to adopt standards for existing oil and gas sources, but does not contain a

quantitative assessment of the methane pollution emitted by these sources or the foregone benefits of establishing existing source standards, as EPA is now required to do.

6. We performed an analysis to characterize sources that would be affected by Methane Guidelines, along with emissions from these sources, in order to document harm to the public from a continued delay by EPA in promulgating Methane Guidelines. Section I describes our methodology for identifying all affected sources and presents a map of affected wells. Section II characterizes total emissions that have occurred at affected facilities since the New Source Rule was promulgated in 2016, and quantifies the emissions that will result over the course of an additional year-long delay in adopting Methane Guidelines. Section III focuses on the local impacts of EPA's delay in issuing Methane Guidelines.

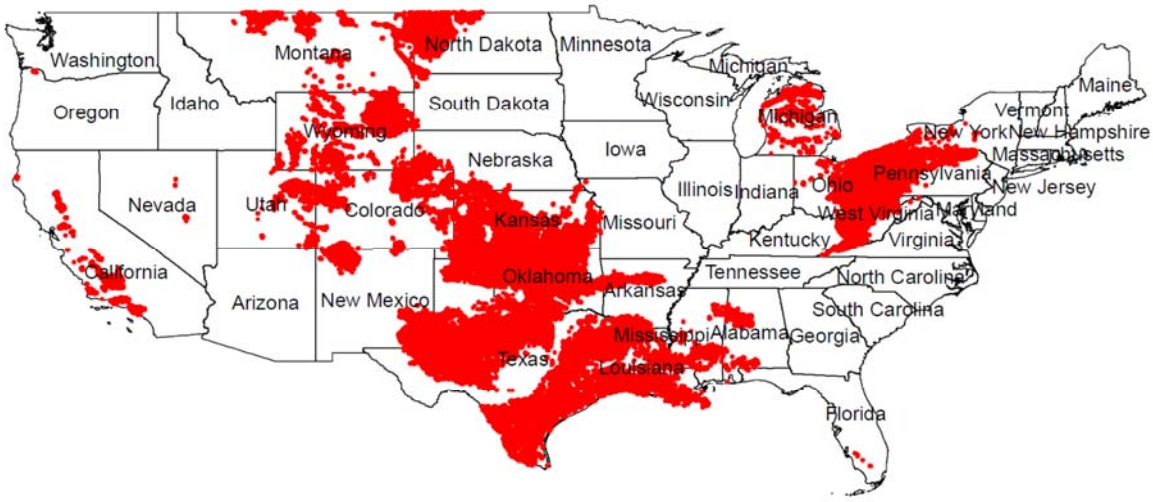
SECTION I: EPA's Continued Delay in Adopting Methane Guidelines Allows Hundreds of Thousands of Oil and Natural Gas Facilities to Forego Emissions Reductions.

7. To identify wells that would be subject to EPA Methane Guidelines, we obtained well data from Enverus (formerly known as DrillingInfo), a proprietary database that compiles a wide range of drilling- and production-related information from state oil and gas commissions. In September 2019, we obtained data for all wells in the U.S., filtering to include only onshore wells with active production during 2018 and 2019 in order to exclude abandoned and shuttered wells. We then excluded from the dataset wells that would be regulated as new or modified facilities under the New Source Rule.[1] The remaining wells, drilled or last modified before

[1] The New Source Rule applies to facilities "constructed, modified or reconstructed" after September 18, 2015—the date of EPA's proposed rule. 81 Fed. Reg. 35824, 35844 (June 3, 2016). As described above, *id.* at 35826, EPA's LDAR standards apply to new well sites and compressor stations that commenced construction after September 18, 2015. The standards also apply to modified well sites and compressor stations. The New Source Rule defines particular circumstances that constitute a modification at each of these facilities. For well sites, these include when a well at an existing site is fractured or re-fractured, an operation that is designed

September 18, 2015 (denoted as "existing wells"), would be covered by Methane Guidelines issued by EPA. In total, there are 855,271 producing existing wells that would be covered by EPA Methane Guidelines. Figure 1 displays a map of existing wells.

Figure 1: Map of Total Affected Well Sources



SECTION II: Delay by EPA in Adopting Methane Guidelines Has Resulted, and Will Continue to Result, in Substantial Emissions of Harmful Methane, Volatile Organic Compounds, and Hazardous Air Pollutants from Affected Facilities.

8. EPA's delay in promulgating Methane Guidelines for existing sources in the oil and natural gas sector has allowed substantial emissions of methane, VOC, and hazardous air pollutant ("HAP") emissions that would otherwise be remediated by Methane Guidelines.

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to increase production of natural gas. 40 CFR § 60.5365a(i)(3). For compressor stations, the New Source Rule defines modifications to include the addition of a compressor at an existing station. 40 CFR § 60.5365a(j).

Enverus includes information on the "spud date" for wells, or the date on which drilling commenced. The database also includes information on well "completion dates," or the most recent date on which a well was cleared of flowback gas associated with hydraulic fracturing or re-fracturing. Using the database, we excluded wells with a spud date after September 18, 2015, which would be "new" for purposes of the 2016 Rule's LDAR requirements. Separately, we excluded wells with a spud date on or before September 18, 2015 but a completion date after September 18, 2015. This distinct category of sources includes both older, re-fractured wells and new wells with their initial fracture delayed to after September 18, 2015, which would be "modified" for purposes of the 2016 Rule's LDAR requirements.

Substantial emissions will continue as long as EPA continues to delay the promulgation of the Guidelines. Methane is a powerful short-term climate forcer with over 80 times the global warming potential of carbon dioxide on a mass basis over the first 20 years after it is emitted. VOCs react with nitrogen oxides to form ground-level ozone, or smog, which can cause respiratory disease and premature death. Other hazardous air pollutants emitted by oil and gas sources include benzene, a known human carcinogen.

9. We estimate the total emissions that have occurred at affected existing sources, as well as the amount of emissions that could have been prevented had EPA timely adopted Methane Guidelines. We further estimate the total amount of emissions that will continue to occur at affected existing sources in the near future if a stay of this litigation is granted and EPA continues to delay the promulgation of Methane Guidelines, as well as the amount of these emissions that could be prevented if Guidelines are adopted.

10. For this analysis, we assume that Methane Guidelines will extend the methane emissions reduction requirements found in the New Source Rule to all affected existing sources, specifically covering high-bleed pneumatic controllers at well sites and transmission and storage compressor stations, all continuous bleed pneumatic controllers at natural gas processing plants, equipment leaks from gas processing plants, well sites, and compressor stations, reciprocating and centrifugal compressors at both processing plants and compressor stations, and pneumatic pumps at well sites and processing plants. Though new technologies and best practices have shown promise of even greater emission reductions, we conservatively assume that the same technologies used in the New Source Rule would apply equally to existing sources. Several states that regulate both new and existing sources (including Colorado and California) largely apply the same measures at both sets of facilities, lending further support to this assumption.

11. To estimate the total emissions that have occurred at affected existing sources, as well as the amount of emissions that could be prevented had EPA adopted Methane Guidelines when it promulgated the New Source Rule, we used our EDF Methane Policy Analyzer model. Briefly, a baseline emissions inventory was developed for 2015, using a combination of EPA Greenhouse Gas Reporting Program data and previously published measurement studies, as reported in Alvarez et al 2018[2] for the alternative inventory (section S1.4). All emissions in 2015 were considered to be "existing" because the relevant date for the NSPS was near the end of 2015. We assumed that emissions attributable to existing sources decline year-over-year as existing sources are removed from operation or undertake modifications that subject them to regulation as modified sources under the New Source Rule based on a turnover rate of 5% for production sources, 4% for gathering and boosting sources, and 1% for all downstream sources. Emissions from sources subject to state regulations applicable to existing sources (California, Colorado, Utah, Wyoming in the Upper Green River Basin ozone non-attainment area, and Texas to a very limited extent) are subtracted from the projected emissions. We estimate that in the over three years since EPA has promulgated the New Source Rule, 33.4 million metric tons of methane have been emitted by existing oil and natural gas sources. We further estimate that 12.2 million metric tons of those methane emissions, or 37%, could have been avoided if Methane Guidelines were in effect.

12. To estimate the total emissions that will continue to occur at affected existing sources if EPA continues to delay the promulgation of Methane Guidelines, as well as the amount of emissions that could be prevented if EPA promulgates Methane Guidelines, we extended the Methane Policy Analyzer to 2030. Each year that EPA delays promulgating

[2] Alvarez et al., *Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain*, 361 SCIENCE, 186–188 (2018).

Methane Guidelines will allow substantial additional emissions. For example, in 2021, 9.8 million metric tons of methane will be emitted by affected existing sources. We further estimate that 3.6 million metric tons of those methane emissions, or 37%, could be avoided if Methane Guidelines were in effect. Table 1 summarizes the emissions allowed by EPA's delay in adopting Methane Guidelines, as well as the emissions reductions possible if Methane Guidelines were promulgated.

Table 1: Estimated Emissions at Affected Existing Sources and Potential Reductions Under Methane Guidelines

Time Period	Total Emissions from Affected Sources [metric tons]			Emissions that Could be Prevented by Methane Guidelines [metric tons[		
	Methane	**VOC**	**HAPs**	**Methane**	**VOC**	**HAPs**
2017	11,689,715	2,741,847	103,115	4,253,249	1,022,588	38,484
2018	11,099,151	2,597,590	97,684	4,067,664	977,969	36,805
2019	10,622,933	2,472,822	92,978	3,915,227	938,202	35,305
Total Emissions Since EPA Issued New Source Rule	**33,411,799**	**7,812,259**	**293,777**	**12,236,140**	**2,938,759**	**110,594**
2020	10,184,924	2,360,138	88,729	3,740,813	893,495	33,620
2021	9,785,180	2,256,193	84,809	3,583,294	852,460	32,072
2022	9,413,009	2,158,703	81,132	3,438,607	814,377	30,635
2023	9,025,023	2,059,736	77,402	3,287,058	775,799	29,181
2024	8,647,856	1,964,209	73,802	3,136,680	737,802	27,749
2025	8,294,707	1,874,858	70,434	2,997,488	702,609	26,423

2026	7,967,127	1,791,676	67,299	2,867,333	669,482	25,175
2027	7,657,181	1,712,896	64,330	2,744,475	638,148	23,994
2028	7,366,050	1,639,260	61,555	2,629,755	609,015	22,896
2029	7,099,500	1,571,426	58,998	2,524,569	582,076	21,880
2030	6,854,814	1,508,791	56,637	2,428,541	557,245	20,944

13. In its proposal to remove methane regulation, EPA claims that many states already regulate oil and gas methane emissions, and so a federal rule would be duplicative. 84 Fed. Reg. at 50,277. However, EPA has not analyzed in any meaningful way whether or not these state rules are applicable to existing sources. *Id.* at n. 104. We assessed the applicability of state standards to existing sources in California, Colorado, Montana, New Mexico, North Dakota, Ohio, Pennsylvania, Texas, Utah, and Wyoming (states that EPA includes in their "Comparison of State Oil and Natural Gas Regulations" table in their proposal to remove methane). These states take widely divergent approaches that vary significantly in stringency, and most states have no standards applicable to existing sources. Appendix 1 provides a detailed analysis of what state standards apply to existing sources.

14. Our Methane Policy Analyzer allows us to also look at the projected reductions from state standards for existing sources. In 2020, state standards applicable to existing sources (certain standards in California, Colorado, Utah, Wyoming in the Upper Green River Basin ozone non-attainment area, and Texas) will reduce only 180,000 metric tons methane, roughly 5% of what federal Methane Guidelines could achieve.

SECTION III: EPA's Delay in Promulgating Methane Guidelines Has Resulted in, and Will Continue to Result in, Substantial Local Air Pollution

15. To look at the effect of EPA's delay on other harmful air pollution (including ozone-forming volatile organic compounds and hazardous air pollutants like benzene), we focus

exclusively on production emissions because we are able to say with a high degree of confidence precisely where these emissions occur. Because of that, we can assess emissions impacts in areas that already suffer from harmful levels of ambient air pollution, like ozone. As a result, the analysis in this section is not intended to capture the total, harmful emissions impact of the delay in adopting Methane Guidelines.

16. We have identified 97,000 wells that would be subject to Methane Guidelines in areas that are currently not in attainment with the 2015 national ambient air quality standards (NAAQS) for ozone. Appendix 2 provides a full list of nonattainment area counties with existing wells. These sources will add an estimated 160,000 metric tons of VOCs to the atmosphere annually if EPA continues to delay the adoption of Methane Guidelines. VOCs contribute to ozone formation and exacerbate smog-related health issues.

17. This estimate is conservative and does not fully capture the effects of EPA's delay in promulgating Methane Guidelines. The analysis does not account for the many affected wells located just outside of ozone non-attainment areas, which can still contribute to the formation of ozone that can be transported into the non-attainment areas. Furthermore, the analysis in this section does not include additional emissions in these areas attributable to midstream and downstream segments that would be mitigated by Methane Guidelines.

18. By identifying existing well sites, we are also able to identify the local communities that are disproportionately impacted by the air pollution allowed by EPA's delay in promulgating Methane Guidelines. Using the US Census Bureau's American Community Survey 5-year estimates for 2012-2016, we were able to estimate the populations living within a half mile radius of the previously identified existing wells using areal apportionment. This method determines the area encompassed within a half mile buffer radius of all affected wells, and

overlays those buffers onto census tracts to calculate the percentage of each tract comprised of buffers (i.e. the area of each tract within a half mile of an affected well). The areal apportionment method assumes that populations are spread evenly across a given census tract (excluding water bodies), and thus we are able to estimate the populations at a census tract level of those living within a half mile of an existing well. This method is commonly used in published literature utilizing distance-based analysis.[3] While some studies have used finer spatial resolutions such as census block groups, we performed our analysis using census tracts in order to minimize margin of error in census estimates. Census tracts, and even larger regions such as zip codes, have often been used in similar analyses.[4] We used a half mile radius because recent scientific evidence indicates close proximity to oil and gas development is associated with HAP exposure and other adverse health impacts for local populations. *See* Declaration of Ananya Roy and Tammy Thompson.

19. Using this methodology, we find that approximately 9,300,000 people live within half a mile of an existing well in the U.S., including 600,000 children under the age of five years and 1,400,000 elderly people over the age of 65 years, who are especially sensitive to the health risks posed by ozone and other local air pollution. Additionally, approximately 1,400,000 people living below the poverty line live within half a mile of an existing well, who may face greater barriers such as accessing medical care.

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[3] *See, e.g.* J. C. S. Long, L. Feinstein, J. T. Birkholzer, W. Foxall, "An Independent Scientific Assessment Of Well Stimulation In California, Vol. 3" (California Council on Science and Technology, 2016), *available at* https://ccst.us/publications/2015/2015SB4-v3.php; J. Chakraborty, J. A. Maantay, J. D. Brender, Disproportionate Proximity to Environmental Health Hazards: Methods, Models, and Measurement. American Journal of Public Health. 101, S27–S36 (2011).

[4] *See, e.g.*, T. Srebotnjak and M. Rotkin-Ellman, "Drilling in California: Who's at risk?" Natural Resources Defense Council, 2014; Mohai P, Saha R. Reassessing racial and socio-economic disparities in environmental justice research. Demography. 2006;43(2):383–399; Kearney G, Kiros GE. A spatial evaluation of socio demographics surrounding National Priorities List sites in Florida using a distance-based approach. Int J Health Geogr. 2009;8:33.

Conclusion

20. EPA's delay in adopting Methane Guidelines for existing sources has already allowed significant air pollution. If this litigation is stayed, any continued delay in promulgating Methane Guidelines requirements will allow numerous sources to continue operating without controls to reduce methane, VOC, and HAP emissions, allowing significant emissions to persist from these sources with each additional year of delay.

I declare that the foregoing is true and correct.

Renee McVay

October 18, 2019

I declare that the foregoing is true and correct.

/s/ Hillary Hull
Hillary Hull

October 18, 2019

Appendix 1

State Standards Applicable to Existing Source Emissions

In its proposal to remove methane regulation, EPA claims that many states already regulate oil and gas methane emissions, and so a federal rule would be duplicative. However, EPA has not analyzed in any meaningful way whether or not these state rules are applicable to existing sources. In fact, most states' regulations are only applicable to new sources, and thus would not apply to any existing sources. Of the ten states EPA includes in their "Comparison of State Oil and Natural Gas Regulations" table, 84 Fed. Reg. 50,277—California (CA), Colorado (CO), Montana (MT), New Mexico (NM), North Dakota (ND), Ohio (OH), Pennsylvania (PA), Texas (TX), Utah (UT), and Wyoming (WY), only six states were proposed to be considered for equivalency to the 2016 NSPS OOOOa[5] (CA, CO, OH, and PA for well sites and compressor stations, TX & UT for well sites only). Only five states currently have oil and gas regulations that would apply to any existing sources: California, Colorado, Utah, Wyoming, and Texas. (Montana, New Mexico, and North Dakota have either very weak permits or guidance applicable to existing sources that EPA previously determined were not equivalent to the NSPS). In Wyoming, only existing sources within the Upper Green River Basin above a certain emissions threshold are covered, so the majority of existing sources within that state are not covered. Texas regulations have various effective dates depending on the location of a facility, but at least one regulation applies to new sources that were constructed/modified after September 2000. Because this date predates the NSPS effective date, some sources considered "existing" for the NSPS will be considered "new" under Texas regulations. However, as detailed below, Texas regulations

[5] EPA, Memorandum: Equivalency of State Fugitive Emissions Programs for Well Sites and Compressor Stations to Proposed Standards at 40 CFR Part 60, Subpart OOOOa (April 12, 2018), *available at* https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-0041.

apply to significantly fewer sources than the NSPS. More detail on each state's regulation is provided below:

California oil and gas methane regulations apply to both new and existing sources and took effect in 2018/2019. The rules cover equipment leaks at well sites, processing plants, and compressor stations, pneumatic pumps at well sites, storage tanks at well sites with emissions greater than 10 MT/yr methane, compressors at well sites, processing plants, and compressor stations, and pneumatic controllers at well sites and compressor stations.

Colorado oil and gas regulations apply to both new and existing sources, often with different emission limits for new vs. existing sources. Most regulations took effect in 2015, with an update for sources in the ozone non-attainment area that took effect in 2017. The regulations cover equipment leaks at well sites and compressor stations (tiered LDAR frequency tied to VOC emissions), pneumatic controllers at well sites and processing plants, liquids unloading, tanks at well sites with VOC emissions greater than 6 tpy, associated gas venting, oil well completions, centrifugal compressors at well sites and processing plants, reciprocating compressors at processing plants, and dehydrators at well sites and processing plants.

Montana's air quality permits cover oil and gas well facilities that were completed or modified after March 16, 1979 (beginning on July 1, 2006). While this is prior to the NSPS effective date, it does not cover all existing facilities. Additionally, facilities must have a PTE more than 25 TPY of VOC (or other specified pollutant not including methane), which will not cover all well sites covered by the NSPS. Monitoring only includes "VOC piping components" using AVO, a monitoring method considered inadequate by the EPA. Montana's regulation also does not cover compressor stations. If the EPA does not consider Montana adequately equivalent

to the NSPS for new and modified sources, it should not consider it adequate for existing sources either.

While the New Mexico Administrative Code restricts production operators from allowing gas to "leak or escape", it does not specify whether this restriction applies to new or existing facilities, or how it enforces this requirement. Even though, as shown in Table 9, it technically covers well sites and storage vessels, the EPA could not evaluate its equivalency to the NSPS in 2018 because they were unable to determine the enforcement mechanism. Current New Mexico regulations therefore should not be considered to contribute to any meaningful emissions reductions should the primary proposal be finalized.

North Dakota regulations cover new and modified wells as of July 1, 1970. North Dakota exempts low-production wells from all monitoring (<15 bbl/day) and does not monitor compressor stations. Additionally, North Dakota's regulation is enforced through company-wide consent decrees, which are negotiated terms for non-compliance and include an expiration data (after which the companies return to compliance). Due to the flexible and temporary nature of these consent decrees, the EPA determined in 2018 that North Dakota's regulation was not equivalent to the NSPS. Even if the compliance could be guaranteed, approximately 4% of the wells covered by the NSPS would be exempt from regulation in North Dakota in addition to all wells existing before 1970.

Utah regulations apply to both new and existing sources. New sources were covered beginning in 2014, and existing sources were added in 2018. Regulations for well sites cover equipment leaks, tanks (with a emissions threshold), dehydrators, associated gas venting, and pneumatics. Regulations for processing plants and compressor stations cover pneumatics. Utah

state regulations do not apply on tribal lands (approximately 20% of emissions are on tribal lands).

When analyzing the equivalency of Wyoming's regulation to the 2016 NSPS OOOOa, the EPA considered the version of Wyoming DEQ's regulation of PAD facilities that was finalized prior to that analysis in 2018. Since that analysis was conducted, Wyoming has released a more comprehensive update to that rule. While this update expands coverage to well sites outside of the Upper Green River Basin, many of the issues which prevented EPA from considering the previous rule adequate still apply. Wyoming regulations apply to new sources, as well as existing sources within the Upper Green River Basin (a nonattainment area). Regulations cover equipment leaks, pneumatic controllers, tanks (with an emissions threshold), oil well completions, pneumatic pumps, and dehydrators (with an emissions threshold). Less than 20% of total production emissions are within the UGRB. While the monitoring frequency and monitoring instrument are acceptable, there is no specified initial monitoring date or repair deadline for facilities with emissions greater than or equal to 4 TPY of VOCs within the UGRB.

Texas regulations apply to new sources, relative to either 2000, 2011, or 2012 depending on location and type of permit. Texas requires a leak detection and repair ("LDAR") program for certain mid-sized to large oil and gas facilities. The specific requirements vary depending on the facility's location and potential to emit uncontrolled volatile organic compounds ("VOC"). Most well sites are not subject to LDAR due to the high emissions threshold uncontrolled VOC emissions (>10 or 25 tpy) and distance from a sensitive receptor, such as a home or school, that triggers the application of LDAR. EDF analysis of Texas Standard Permits found that only roughly 5.5% of well sites in Texas are required to conduct LDAR.

Appendix 2

Counties with wells that would be subject to Methane Guidelines in areas that are currently not in attainment with the 2015 national ambient air quality standards (NAAQS) for ozone are as follows:

Chambers (TX), Brazoria (TX), Harris (TX), Montgomery (TX), Galveston (TX), Fort Bend (TX), Parker (TX), Hood (TX), Palo Pinto (TX), Wise (TX), Jack (TX), Denton (TX), Tarrant (TX), Bexar (TX), Johnson (TX), Duchesne (UT), Uintah (UT), Los Angeles (CA), Orange (CA), San Bernardino (CA), Ventura (CA), San Luis Obispo (CA), Kern (CA), Tulare (CA), Fresno (CA), Kings (CA), Alameda (CA), Sacramento (CA), San Joaquin (CA), Solano (CA), Yolo (CA), Madera (CA), Santa Clara (CA), Contra Costa (CA), Adams (CO), Arapahoe (CO), Boulder (CO), Denver (CO), Larimer (CO), Weld (CO), Broomfield (CO), Ellis (TX), St Clair (MI), Oakland (MI), Livingston (MI), Macomb (MI), Wayne (MI), Washtenaw (MI), Allegan (MI), Monroe (MI), Muskegon (MI), Cuyahoga (OH), Delaware (OH), Fairfield (OH), Geauga (OH), Lake (OH), Licking (OH), Lorain (OH), Medina (OH), Portage (OH), Summit (OH), Mahoning (OH), Hill (TX), Dallas (TX), Kaufman (TX), Atascosa (TX), Morgan (CO)

Attachment 1

Renee C. McVay

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Education

Ph.D., Chemical Engineering ***2016***
California Institute of Technology Pasadena, CA
Advisor: Dr. John H. Seinfeld
National Science Foundation Graduate Research Fellowship (GRFP)
National Science Foundation Graduate Research Opportunities Worldwide (GROW) Award

M.S., Chemical Engineering ***2014***
California Institute of Technology Pasadena, CA
Advisor: Dr. John H. Seinfeld GPA: 4.0

B.S., Chemical Engineering ***2011***
Texas A&M University College Station, TX
Minors in Chemistry and Spanish GPA: 4.0
International Engineering Certificate

Experience

Environmental Defense Fund Austin, TX
Senior Research Analyst 2017-Present
Research Focus: Using emission inventories to develop state and region-specific emission profiles from the oil and gas sector.

Cooperative Institute for Research in Environmental Sciences (CIRES) Boulder, CO
Postdoctoral Fellow 2016-2017
Research Focus: Modeling atmospheric chemistry and secondary organic aerosol (SOA) formation using the Weather Research and Forecasting model coupled to Chemistry (WRF-Chem).

California Institute of Technology Pasadena, CA
Ph.D. Candidate 2011-2016
Advisor: Dr. John H. Seinfeld
Research Focus: Modeling secondary organic aerosol (SOA) formation from the gas-phase oxidation of volatile organic compounds to compare with experimental observations in environmental chambers

Laboratoire Interuniversitaire des Systèmes Atmosphériques Paris, France
International Research Collaboration Jan-May 2015
Advisor: Dr. Bernard Aumont
Research Focus: Working with and updating the Generator for Explicit Chemistry and Kinetics of Organics in the Atmosphere (GECKO-A) and comparing model predictions to experimental observations

Eastman Chemical Company Longview, TX
Engineering Intern Summer 2010
Job Focus: Material balances, rate studies, and sampling programs

Publications and Presentations

Peer-Reviewed Journal Publications

Schwantes, Rebecca H., Katherine A. Schilling, Renee C. McVay, Hanna Lignell, Matthew M. Coggon, Xuan Zhang, Paul O. Wennberg, and John H. Seinfeld. Formation of Highly Oxygenated Low-Volatility Products from Cresol Oxidation, *Atmos. Chem. Phys. Discuss.*, **2017**, *17*, 3453-3474, doi:10.5194/acp-17-3453-201.

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Zhang, Xuan, Christopher Cappa, Shantanu Jathar, Renee McVay, Joseph Ensberg, Michael Kleeman, and John Seinfeld. Influence of vapor wall loss in laboratory chambers on yields of secondary organic aerosol. *Proc. Natl. Acad. Sci.*, **2014**, *111*, 5802-5807.

Conference Presentations

McVay, Renee, Theodora Nah, Jeffrey R. Pierce, John Seinfeld, Nga Lee Ng. Uncertainties in Particle Wall Loss Correction during Secondary Organic Aerosol Formation in Chamber Experiments. American Association for Aerosol Research, 27-21 October 2016, Portland.

McVay, Renee, Xuan Zhang, Bernard Aumont, Richard Valorso, Marie Camredon, Stéphanie La, and John Seinfeld. Uncertainties in SOA Formation from the Photooxidation of α-pinene. American Geophysical Union, 14-18 December 2015, San Francisco.

McVay, Renee, Xuan Zhang, Christopher Cappa, and John Seinfeld. Vapor Wall Loss in Chambers: Theoretical Considerations. American Geophysical Union, 15-19 December 2014, San Francisco.