PETITION TO THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Petition for Listing and Rulemaking Under Section 112 of the Clean Air Act to Establish an Area Source Category for Oil and Gas Production Wells and Associated Equipment and to Set National Emission Standards for Hazardous Air Pollutant Emissions

Submitted via U.S. Mail and E-mail to the Administrator and Assistant Administrator of the Office of Air and Radiation, U.S. Environmental Protection Agency

May 13, 2014

EPA MUST LIST OIL AND GAS WELLS AND ASSOCIATED EQUIPMENT AS AN AREA SOURCE CATEGORY AND SET NATIONAL AIR TOXICS STANDARDS TO PROTECT PUBLIC HEALTH

EXECUTIVE SUMMARY

Earthjustice submits this petition on behalf of petitioner organizations listed herein who are concerned about the health effects of toxic air pollution emitted by oil and gas wells on their members and the communities they serve around the United States.

Hazardous air pollutants (“HAP”) emissions from oil and gas wells threaten public health in many areas throughout the United States. The number of oil and gas wells in and near towns and cities has grown swiftly in recent years and is expected to continue to expand. As of 2011, oil and gas wells in the U.S. numbered more than 1.04 million, and as many as 45,000 new wells are expected to be drilled each year through 2035. Technological developments, such as horizontal drilling and hydraulic fracturing techniques, have allowed the industry to reach oil and gas reserves that were previously considered inaccessible. Major oil and gas shale plays – including the Marcellus, Haynesville and Barnett gas plays and the Bakken, Eagle Ford and Monterey oil plays – that were once considered impossible to access, are now expected to produce hundreds of trillions of cubic feet of natural gas and tens of billions of barrels of oil.

This oil and gas expansion has brought drilling activities closer to heavily populated areas, including the Dallas/Fort Worth, Pittsburgh, Denver, and Los Angeles metropolitan regions, placing drill rigs near homes, schools and workplaces and posing an ever increasing threat to public health. If this development continues as predicted, more communities will face greater toxic air emissions and associated harm—most notably from emissions at well sites.

Oil and gas wells and their associated equipment release hazardous air pollutants, including n-hexane, benzene, toluene, ethyl benzene, xylenes, formaldehyde, naphthalene, acetaldehyde, methanol, carbonyl sulfide, ethylene glycol, and 2,2,4-trimethylpentane, methylene chloride, among others. Toxic pollution from oil and gas production is emitted not only at the

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1 See section I.C infra.
wells during drilling, completion and flaring, but also from compressors, condensate tanks, gas sweetening equipment, storage tanks, produced waste water impoundments, and leaks throughout the process. In addition, hydraulic fracturing uses a number of toxic chemicals that can be released into the air and water, yet many such chemicals and the amounts in which they are used and may be released are undisclosed due to industry’s concerns about trade secrets.

The toxic pollutants emitted by these operations present health risks when people are exposed, including increases in cancer risk, heightened risk of developmental disorders in children, and risk of respiratory harm. As oil and gas development reaches the urban interface, the public health threats are compounded further by exposures to existing industrial toxic pollution. Already, residents living close to oil and gas well facilities have documented health problems in their communities – some of which are consistent with exposures to hazardous air pollutants. Continued, uncontrolled toxic pollution from oil and gas production creates serious health threats in metropolitan areas across the country.

Despite widespread awareness of the rapid expansion in domestic oil and gas production, health concerns about the increased number of wells have not been adequately addressed. Under EPA’s current regulations for the oil and gas sector (which do not directly regulate toxic pollution coming from oil and gas wells or set necessary protections for people living near them), it is estimated that less than 10 percent of the industry’s total hazardous air pollutant emissions will be reduced. Yet, technology that is available and already in use at some wells can reduce oil and gas well emissions, including green completions, closed loop systems, vapor recovery units, and capping or reductions in flaring.

To protect public health, this petition urgently requests EPA to exercise its authority under the Clean Air Act to list oil and gas wells (and associated equipment) located in the appropriate geographical areas as area sources, and set limits on hazardous air pollutant emissions from oil and gas wells and associated equipment in accordance with 42 U.S.C. §§ 7412(c), (d), (k), and (n)(4)(B). EPA has the authority to establish an area source category “for oil and gas production wells located in any metropolitan statistical area or consolidated metropolitan statistical area with a population in excess of 1 million if the Administrator determines that emissions of hazardous air pollutants from such wells present more than a negligible risk of adverse effects to public health” under section 112(n)(4)(B) of the Act, 42 U.S.C. § 7412(n)(4)(B). This authority embraces not only regulation of wells themselves, but also a broad class of “associated equipment” that EPA has defined to include almost all production-related facilities leading to the point of custody transfer.

EPA also has a responsibility under the Clean Air Act to protect people from toxic air emissions nationwide, and under section 112(n)(4)(B) it must do so. Indeed, EPA has the authority to take the important and necessary action of designating oil and gas wells as area sources and setting standards to limit toxic pollution released from these facilities, and doing so would be consistent with the Secretary of Energy Advisory Board’s recommendations: “Measures should be taken to reduce emissions of air pollutants, ozone precursors, and methane

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2 See id.
3 See section II.A infra.
as quickly as practicable. The Subcommittee supports adoption of *rigorous* standards for new and existing sources of . . . air toxics, ozone precursors and other air pollutants from shale gas operations.”

In his 2012 State of the Union Address, President Obama promised that his “administration will take every possible action to safely develop this energy . . . without putting the health and safety of our citizens at risk.”

The evidence presented in this petition provides a clear basis for EPA to conclude that the Clean Air Act section 112(n)(4)(B) test is met. Substantial numbers of oil and gas wells exist in section 112(n)(4)(B) areas, emitting large amounts of hazardous air pollutants on a daily basis. People living in the relevant areas need health protection from oil and gas wells because such emissions pose a risk to public health. Some of the documented health effects of the many types of HAPs emitted during oil and gas production include increased risks of cancer, respiratory diseases, and birth defects, among others. HAPs are of particular concern in the areas covered by section 112(n)(4)(B) because now more than ever, people and sources of emissions are concentrated in the same geographic area leading to an increased likelihood of multiple exposures. In addition, children, pregnant women, the elderly and individuals with underlying health problems, such as respiratory and cardiovascular disease, are particularly vulnerable and at risk from exposure to HAPs.

EPA also has a duty to establish robust emission standards for oil and gas production wells and their associated equipment in accordance with Clean Air Act sections 112(c), (d), and (k). For example, such regulation would advance the purposes of sections 112(c)(3) and 112(k), which direct EPA to establish emission standards for sources that account for 90 percent of each of the 30 HAPs that represent the greatest threats to public health in urban areas. To adequately address the health risk of major oil and gas development expansion in section 112(n)(4)(B) areas, and to follow upon EPA precedent in promulgating emission standards for area source categories such as chrome platers, secondary lead smelters and halogenated solvent cleaning, EPA must set HAP standards for oil and gas well area sources pursuant to section 112(d)(2)-(3) by requiring “the maximum degree of reduction in emissions” that EPA “determines is achievable.”

In sum, EPA must act now to protect public health by requiring that oil and gas wells in the covered statistical areas meet limits on the amount of toxic air pollution that they may emit into local communities’ air. Pursuant to the Administrative Procedure Act, 5 U.S.C. § 553(e), and the Clean Air Act, 42 U.S.C. §§ 7412(n)(4)(B), 7412(c), 7412(d), and 7412(k), Petitioners file this Petition for Listing and Rulemaking and respectfully request that EPA exercise its authority to:

1. List an area source category of oil and gas production wells (and associated equipment) located in metropolitan statistical areas and consolidated metropolitan statistical areas with a population in excess of one million; and

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(2) Set emissions standards for oil and gas production wells (and associated equipment) within the newly listed area source category in accordance with 42 U.S.C. §§ 7412(c)(2), 7412(d)(2)-(3), and 7412(k), that require the “maximum achievable” degree of emission reduction.

Petitioners hereby request that EPA take public comment on the issues raised herein and issue a substantive response to this petition within one hundred eighty (180) calendar days. Given the urgent threats to public health posed by unregulated oil and gas well emissions, we urge EPA to give prompt consideration to this petition. In addition to the important protections requested by this Petition, Petitioners urge EPA to put in place comprehensive, clean air protections addressing the full suite of harmful air pollution from the oil and gas sector.

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II. BASED ON THE NEED TO PROTECT PUBLIC HEALTH, THE ADMINISTRATOR MUST LIST AN AREA SOURCE CATEGORY FOR OIL AND GAS PRODUCTION WELLS AND ASSOCIATED EQUIPMENT LOCATED IN THE SECTION 112(N)(4)(B) AREAS.

A. EPA has authority to list oil and gas wells and their associated equipment and to regulate their toxic air emissions.

1. The best available evidence shows EPA must find wells pose “more than a negligible risk of adverse effects to public health.”
   a. Cancer risk is more than negligible.
   b. Non-cancer chronic and acute health risks are more than negligible.
   c. Listing oil and gas wells would serve the objectives of § 112(c)(3) and would be consistent with EPA’s past area source listings.
   d. Listing oil and gas wells would fulfill the objectives of the Area Source Program under 112(k).

2. EPA must protect all communities covered by CAA § 112(n)(4)(B) from the health risk created by oil and gas wells.

B. The Administrator has a duty to establish robust emissions standards for the oil and gas well area source category.

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ARGUMENT

I. FACTS

A. Petitioners

The undersigned Petitioners listed on the final page of this Petition urge EPA to take prompt action on this Petition.
Petitioners are national and local nonprofit organizations with over one million members and supporters who have an interest in securing and strengthening regulatory safeguards to protect communities and ecosystems from the significant toxic pollution emitted by oil and gas development. Petitioners include organizations that have thousands of members who live, work, and enjoy outdoor activities and recreation throughout the United States, including in statistical areas covered by Clean Air Act § 112(n)(4)(B) that contain or are expected to contain oil and gas wells and associated equipment.\footnote{For example, this is a sampling of Sierra Club membership in some of the counties that meet the section 112(n)(4)(B) criteria: Fresno County, CA – 1,238 members; Kern County, CA – 932 members; Los Angeles County, CA – 29,877 members; Madera County, CA – 244 members; Weld County, CO – 250 members; Cooke County, TX – 29 members; Dallas County, TX – 2,304 members; Denton County, TX – 578 members; Ellis County, TX – 70 members; Harris County, TX – 3,479 members; Hood County, TX – 51 members; Johnson County, TX – 91 members; Palo Pinto County, TX – 17 members; Parker County, TX – 99 members; Somervell County, TX – 7 members; Tarrant County, TX – 1507 members; Travis County, TX – 3,418 members; Wise County, TX – 33 members; Allegheny County, PA – 3,041 members; Bucks County, PA – 1,481 members; Chester County, PA – 1,572 members; Delaware County, PA – 1,371 members; Montgomery County, PA – 2,453 members; Philadelphia County, PA – 1,999 members; Caddo Parish, LA – 151 members; Belmont County, OH – 31 members; Knox County, OH – 86 members; Licking County, OH – 230 members; Mahoning County, OH – 208 members; Stark County, OH – 370 members; Summit County, OH – 1,015 members.}

**B. Thousands of oil and gas production wells are located in the areas covered by section 112(n)(4)(B).**

Administration ("EIA") projected that the United States would produce more petroleum and natural gas than any other nation in 2013, surpassing Russia and Saudi Arabia.9

Recent technological developments in the oil and gas industry—most notably horizontal drilling and hydraulic fracturing, or "fracturing," techniques—have enabled this growth by allowing companies to extract previously inaccessible oil and gas resources.10 EIA estimates that overall, due to recently developed techniques, at least 750 trillion cubic feet of shale gas and 23.9 billion barrels of shale oil are now technically recoverable in the United States.11 Thus far, EPA estimates that 11,400 new wells are fractured each year, while 1,400 existing wells are re-fractured to stimulate production.12 In all, EIA estimates that the total number of potential wells from U.S. shale gas plays alone could number around 410,722, while the total number of potential wells from "tight" (or shale) oil plays could be around 219,729.13

Hydraulic fracturing techniques have already led to a noticeable increase in natural gas production, which in 2011 reached record levels.14 Although there were just over 300,000 wells producing primarily natural gas in 1999, there are now over 500,000 in operation in at least thirty states.15 Shale gas plays in particular, EIA has predicted, are likely to be the largest contributor to the projected growth in domestic natural gas production, and by 2040 are expected to account for 50 percent of U.S. natural gas production.16

Similarly notable increases have also occurred in crude oil production, largely due to the use of horizontal drilling and fracturing.17 Since September 2011, U.S. oil production has increased by more than 900,000 barrels per day.18 As the EIA recently noted, U.S. crude oil production averaged almost 6.5 million barrels per day in September 2012, the highest volume

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11 Id.
12 RIA, supra note 8, at 3-16, tbl. 3-3.
18 Id.
reached in nearly 15 years. This is in part because fracturing techniques have been increasingly applied to conventional wells to boost productivity.

As the U.S. domestic energy outlook transforms, so do landscapes in many areas of the country. People living in heavily populated areas that have been exposed to little, if any, drilling activity in the past are now seeing drilling rigs pop up near their homes, schools, and workplaces, as the locations of shale basins around the country trigger the placement of new oil and gas wells. In the U.S., the largest shale gas plays are projected to be the Marcellus in the Northeast (410.3 trillion cubic feet, 55 percent of the total), the Haynesville in the South (74.7 trillion cubic feet, 10 percent of the total), and the Barnett in the Southwest (43.4 trillion cubic feet, six percent of the total).

Map 1 (attached) shows the significant overlap between the approximate locations of shale basins in the lower 48 states and population centers. The largest shale oil plays are expected to be the Bakken in North Dakota (3.6 billion barrels), the Eagle Ford in Texas (3.4 billion barrels), and the Monterey Shale in California, which may hold as much as 64 percent of the total shale oil reserves in the continental United States (over 15 billion barrels).

Moreover, as illustrated in Map 2 (attached), oil and gas drilling is already occurring in a number of highly populated areas across the country, including many areas covered by CAA § 112(n)(4)(B).

Examples from around the country illustrate the impact of these numbers on public health. The following examples in the states of California, Colorado, Pennsylvania, Texas, Ohio and Louisiana show large numbers of oil and gas wells, and other sources associated with well activities such as exploration, drilling, flaring, compression and waste water impoundments, emitting hazardous air pollutants very near densely populated communities. People living in these example counties and other statistical areas covered under section 112(n)(4)(B) should receive the full health protection that EPA has authority to provide. Information about oil and gas wells from these example counties, when viewed in light of this petition’s subsequent information on the health effects that can be caused by oil and gas well emissions, demonstrates that oil and gas wells pose health risks in such areas (covered by § 112(n)(4)(B)) that are “more than negligible” and that warrant regulation under § 112(d). EPA therefore must regulate such wells as an “area source” category, as authorized by § 112(n)(4)(B) and required by § 112(c)(3). EPA must protect communities in the following areas and all other parts of the country covered

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19 Id.
21 *EIA I*, supra note 10, at 4.
23 *EIA I*, supra note 10, at 4.
24 See U.S. Oil and Gas Wells and Population Centers (attached as Map 2 in Appendix B). Section II.A.2 of this Petition describes the statistical areas covered by this provision in more detail.
by CAA § 112(n)(4)(B). As noted in part I.C.2 below, individual states (including some of those identified here) have begun to recognize some of the harmful effects that well emissions pose to surrounding communities by requiring measures to reduce some emissions, but nearly all states have yet to regulate toxic air pollution as needed to protect public health and current national scale oil and gas well standards are not adequate.

1. California

The State of California’s Department of Conservation, Division of Oil, Gas & Geothermal Resources (DOGGR) oversees the drilling, operation, maintenance, plugging and abandonment of oil, natural gas, and geothermal wells in California, which in 2011 produced approximately 200 million barrels of oil and 255 billion cubic feet of gas.\textsuperscript{25} As of 2011, there were over 54,076 producing oil and gas wells in the state—located in over half of California’s counties—and another 3,081 wells were drilled in 2012.\textsuperscript{26}

As shown in Map 3 (attached), several of the most densely populated areas in California—including Los Angeles County, the most populated county in the U.S.—already have large numbers of oil and gas production wells within their borders.\textsuperscript{27} Although historically most oil and gas production in California has been from “conventional” sources, oil and gas reservoirs

\textsuperscript{25} A non-exclusive list of example counties in California that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs includes: Alameda County (6 active wells), Contra Costa County (27 active wells), Fresno County (1,963 active wells), Kern County (42,159 active wells), Los Angeles County (3,751 active wells), Madera County (12 active wells), Monterey County (609 active wells), Orange County (1,036 active wells), Sacramento County (128 active wells), San Benito County (22 active wells), San Bernardino County (18 active wells), San Mateo County (11 active wells), Santa Clara County (13 active wells), Sutter County (299 active wells), Ventura County (1,708 active wells), and Yuba County (1 active well). \textit{See CAL. DEP’T OF CONSERVATION, DIV. OIL, GAS & GEOTHERMAL RES., Producing Wells and Production of Oil, Gas, and Water by County – 2011, ftp://ftp.consrv.ca.gov/pub/oil/temp/NEWS/Producing_Wells_OilGasWater_11.pdf; OFFICE OF MGMT. & BUDGET, EXECUTIVE OFFICE OF THE PRESIDENT, OMB BULLETIN NO. 13 01, REVISED DELINEATIONS OF METROPOLITAN STATISTICAL AREAS, MICROPOLITAN STATISTICAL AREAS, AND COMBINED STATISTICAL AREAS, AND GUIDANCE ON USES OF THE DELINEATIONS OF THESE AREAS (Feb. 28, 2013) [“OMB BULLETIN 13-01’’], available at http://www.whitehouse.gov/sites/default/files/omb/bulletins/2013/b13-01.pdf. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, METROPOLITAN AREAS AND COMPONENTS, 1990 WITH FIPS CODES (June 30, 1990), available at http://www.census.gov/population/metro/files/lists/historical/90mfips.txt (only Madera and San Benito are not shown as part of an MSA or CMSA).}


\textsuperscript{27} \textit{See California: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 3 in Appendix B); Producing Wells and Production of Oil, Gas, and Water by County – 2011, supra note 25 (in 2011, Kern County had 42,159 producing wells, Los Angeles County had 3,751 producing wells, and Orange County had 1,036 producing wells).}
that require unconventional recovery techniques, such as fracturing, are expected to greatly expand in the state in the near future. According to EIA estimates, the massive Monterey and Santos shale formations, which underlie 1,752 square miles in the San Joaquin and Los Angeles basins in California, are estimated to hold as much as 64% of the nation’s shale oil reserves—between 13.7 and 15.4 billion barrels. As one industry consultant recently explained, they are “just getting started” with drilling in the Monterey Shale, predicting that, “there will be as much drilling as they possibly can do.”

Although much information has not been disclosed publicly about the extent of hydraulic fracturing that is taking place in California, residents of the state have already expressed a great deal of public concern over its potential health and environmental impacts. One example is Inglewood Oil Field, located in the Baldwin Hills neighborhood in southwestern Los Angeles County. This more than 1,000-acre oil field is closely surrounded by a community of over 300,000 people.

Overall, as the Western States Petroleum Association reports, the number of wells that had been fractured in California as of 2011 was 628, and as of August 2, 2013, a website titled “FracFocus” listed 1,045 wells that have been fractured in California since January 1, 2011. These numbers are voluntarily reported by some oil and gas operators. Given the voluntary nature of this reporting, these figures likely underestimate the full extent of hydraulic fracturing in California. Moreover, no number can fully represent the human impacts of additional drilling in such a densely populated state, where many wells are already located in urban areas.

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28 EIA I, supra note 10, at 4.
30 On October 16, 2012, four environmental groups [including Petitioner Sierra Club, represented by Earthjustice] filed a state court action alleging that DOGGR has failed to comply with the California Environmental Quality Act (CEQA) in the permitting process for oil and gas operations, including hydraulic fracturing, or “fracking,” in the state. See Ctr. for Biological Diversity v. Cal. Dep’t of Conservation, No. RG12652054 (Ca. Super. Ct. Alameda County, filed Oct. 16, 2012).
conventional wells even operate adjacent to or on school properties, as is the case for the Carson-Gore Academy of Environmental Sciences, where there is an oil well across the street.\footnote{See, e.g., Howard Blume, \textit{Los Angeles School Named after Al Gore}, L.A. TIMES, Sept. 5, 2010, http://articles.latimes.com/2010/sep/05/local/la-me-gore-school-20100906.}

2. Colorado

The Colorado Oil and Gas Conservation Commission (“COGCC”), a division of the Colorado Department of Natural Resources, oversees the development of Colorado’s oil and gas natural resources.\footnote{A non-exclusive list of example counties in Colorado that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs includes: Adams County (993 active wells), Arapahoe County (198 wells), Boulder County (321 wells), Broomfield County (97 wells), Denver County (52 wells), Elbert County (72 wells), Jefferson County (6 wells), Park County (1 well), and Weld County (20,794 active wells). See \textit{COLORADO OIL AND GAS CONSERVATION COMM’N, Colorado Weekly and Monthly Oil and Gas Statistics} (Nov. 7, 2013) at 13, http://cogcc.state.co.us/Library/Statistics/CoWklyMnthlyOGStats.pdf (last visited Nov. 20, 2013); OMB BULLETIN 13-01 supra note 25. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See \textit{U.S. CENSUS BUREAU, supra} note 25 (only Broomfield, Elbert, and Park are not shown as part of an MSA or CMSA).} A state at the forefront of drilling’s new frontier, Colorado has over 51,000 active oil and gas wells located in 43 of its 63 counties.\footnote{\textit{COLORADO OIL AND GAS CONSERVATION COMM’N, Staff Report} (Jan. 27, 2014) at 19, available at http://cogcc.state.co.us (click “Staff RPT” and select “January 27, 2014”).} The number of horizontal wells in particular has risen dramatically in recent years in Colorado—although horizontal well permits made up only 2.8% of the total oil and gas drilling permits issued in 2009, this number has since risen to 29.3% in 2012, and 61.8% in 2013.\footnote{Testimony of Matthew Lepore, Dir., Colorado Oil and Gas Conservation Commission, Colorado Department of Natural Resources, House Committee on Energy & Commerce Subcomm. On Env’t and Economy at 1 (Feb. 15, 2013), http://democrats.energycommerce.house.gov/sites/default/files/documents/Testimony-Lepore-EE-Protecting-Environment-Under-Law-2013-2-15.pdf.} Colorado has been adding about 2,000 new wells per year for the past nine years, with 2012 production expected to exceed 47 million barrels, and the Colorado Oil and Gas Conservation Commission anticipates that this growth will continue.\footnote{See Colorado: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 4 in Appendix B).} Map 4 (attached) shows the significant concentration of oil and gas production in the most populous parts of the state.\footnote{See Colorado: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 4 in Appendix B).}

The number of wells in Colorado is predicted to grow for many years, as new techniques allow companies to drill in the Niobrara shale oil bed located in the northeastern portion of the state. This shale bed, like many across the U.S., lies beneath the homes, schools, and businesses

of thousands of people. As one author aptly described the situation in Colorado, wells from the still-emerging oil and gas boom are “completely surrounding the metro area.”

Yet, even while the oil and gas boom is still emerging, oil and gas production activities have already caused noticeable air quality problems in Colorado. A consortium of authors that included both NOAA and University of Colorado researchers recently conducted an in-depth study to investigate the source of air pollutants at a tower north of Denver, downwind of the Denver-Julesburg Fossil Fuel Basin. The study’s analysis of the tower data, filtered by wind sector, revealed “a strong alkane and benzene signature in air masses coming from northeastern Colorado.” Specifically, the authors determined that emissions from oil and gas facilities in the study area were likely responsible for increased levels of hydrocarbons, and benzene in particular, measured at both the stationary and mobile testing sites.

The study also concluded that the available inventories of hydrocarbon emissions from oil and gas facilities in the study area did not correlate with observed atmospheric observations, and were likely underestimates. Specifically, the study found “notable inconsistencies” between monitoring results and state and national emissions inventories, suggesting “that the emissions of the species measured are most likely underestimated in current inventories and that the uncertainties attached to these estimates can be as high as a factor of two.” A lead author of the study explained: “We found gas operations in the region leaked about twice as much methane into the atmosphere as previously estimated,” adding, “[a]nd the oil and gas infrastructure was leaking other air pollutants, too, including benzene, which is regulated because of its toxicity.” Subsequent research has confirmed these findings. A more detailed source apportionment study conducted by another team from NOAA and the University of Colorado confirmed the contribution of oil and gas operations to hydrocarbon and benzene emissions, and concluded that oil and gas sector sources emit approximately 55% of the volatile organic

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42 Kirk Johnson, *Drilling in Fast-Growing Areas Ushers in New Era of Tension*, N.Y. TIMES, October 25, 2011, at A16, available at http://www.nytimes.com/2011/10/25/us/oil-drilling-in-new-areas-ushers-in-era-of-tension.html?_r=0 (“Drilling permits in suburbs, parks and even in lakes have made the local news. Using hydrofracturing technologies—breaking the shale with water, sand and chemicals to release the oil—and horizontal, spiderlike tentacle borers that can spin out beneath communities, the still-emerging boom is bringing energy exploration to some of the fastest-growing counties in the nation, and to places with no experience whatsoever in dealing with it. ‘It’s completely surrounding the metro area,’ said Thom Kerr, the permit and technical services manager at the Colorado Oil and Gas Conservation Commission, which regulates the industry.’’).


44 Id. at 8, 13.

45 Id. at 1, 18.

compounds in northeastern Colorado.\textsuperscript{47} The study similarly found that current emission inventories overestimate the contribution of “urban” (essentially, non-oil and gas) hydrocarbon emissions by more than a factor of two.\textsuperscript{48}

And a 2014 study provides further evidence that existing emission inventories are significantly underestimating air toxics emissions, particularly benzene.\textsuperscript{49} These findings suggest that the health risk assessments conducted using these inventories are similarly inaccurate and therefore underestimate exposures and health risks. This study used air quality measurements taken from an airplane over Weld County, Colorado to derive estimates of emission rates for benzene and other VOCs. The researchers found that current inventories estimating benzene emissions from oil and gas facilities in the study area underestimated emissions by 7 times and that the difference could be anywhere from 4 to as great as 9 times. The researchers conclude that other HAPs (such as toluene, ethylbenzene, etc.) could similarly be underestimated and that oil and gas sites could be a bigger source of benzene than vehicle emissions, previously thought to be the largest source in the area. The researchers highlight that accurate estimates of emissions from oil and gas production and processing are needed to quantify and reduce threats to air quality and that the sources of benzene and other hazardous air pollutants should be investigated.

The conclusions of these studies are particularly disturbing because the primary source of the air pollutants—the oil and gas facilities that the initial air monitoring tower was downwind of—are located in Weld County, one of Colorado’s most-populated counties. In addition to being Colorado’s main oil and gas producing county, with 20,324 active wells, Weld County is home to over a quarter million people, and is part of the Denver-Aurora Combined Statistical Area, which has a combined population of over three million people.\textsuperscript{50}

Yet another recent Colorado study, conducted in Garfield County, sheds light on the public health risks that Colorado residents and countless others across the country will face from the oil and gas drilling boom. Specifically, this study suggests the existence of increased respiratory, neurological, and cancer risks for people in proximity to wells, with benzene as the major contributor to cancer risk.\textsuperscript{51} The results of the Garfield County study underscore public health concerns in Weld County, where there is both more oil and gas development activity and more people. There are approximately twice as many active wells in Weld, compared to the

\textsuperscript{47} Gilman, J.B. et al., \textit{Source Signature of Volatile Organic Compounds from Oil and Natural Gas Operations in Northeastern Colorado}, 47 ENVTL. SCI & TECH. 1297, 1303 (2013).
\textsuperscript{48} Id. at 1302.
\textsuperscript{50} OMB BULLETIN 13-01 supra note 25.
10,337 operating in Garfield, and Weld County also has over 200,000 additional people living within its borders.

Moreover, the issues noted by the aforementioned Colorado studies are concerning in light of the fact that much of the oil and gas production in the state is taking place in very close proximity to people—often within a range of less than one-half mile—as Colorado law only mandates a 500-foot setback from schools and residential areas for oil and gas wells. Further, the Commission is authorized to approve exceptions allowing oil and gas development activities closer to occupied building units. Indeed, a recent review of active and prospective well data in four northern Colorado counties, researched by Western Resource Advocates, found nearly 200 wells within 2,000 feet of a public school. According to Western Resource Advocates’ research, in Adams, Boulder, Broomfield and Weld counties, each of which is part of one of the areas covered by section 112(n)(4)(B), as further discussed in Part II.A.2 below, there are 87 active and proposed oil and gas wells within 1,000 feet of a public school. Likewise, a COGCC Staff Report revealed that at least 10 buildings are less than 150 feet from a well spot, 230 are 150 to 300 feet from a well spot, 383 are 350 to 500 feet from a well spot, and 1,211 are within 500 to 1000 feet of a well spot. COGCC’s recent Well to Setback Review also showed that at least two residences are less than two hundred feet from wells in Weld County.

One notable illustration of this proximity is Red Hawk Elementary school, which is located in Erie, CO and is part of the Boulder, Colorado MSA. Host to over 400 students, Red Hawk is located within a 2-mile radius of 66 well pads, including 8 which were recently drilled within 600 yards of the school.

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52 Colorado Weekly and Monthly Oil and Gas Statistics, supra note 37.
54 Id.
56 Id.
57 Staff Report, supra note 39, at 20.
58 Id. at 21.
3. Pennsylvania

The Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management, is responsible for facilitating the exploration and development of Pennsylvania’s oil and gas reservoirs. As of 2011, there were over 77,310 producing oil and gas wells in Pennsylvania, located in a number of areas across the state, as illustrated in the attached Map 5.

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61 A non-exclusive list of example counties in Pennsylvania that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs includes: Allegheny County (1,169 active wells); Armstrong County (8,783 active wells); Beaver County (282 active wells); Bucks County (1 active well); Butler County (1,541 active wells), Chester County (5 active wells); Fayette County (3,690 active wells); Pike County (2 active wells); Washington County (3,112 active wells); Westmoreland County (6,514 active wells). PA DEP’T OF ENV. PROT., Operator Well Inventory Report by County, http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?Oil_Gas/Operator_Well_Inventory_By_County (On Jan. 9, 2013 a report was generated for each of the counties listed. Wells listed as “regulatory inactive status” are not included in these totals.); see OMB BULLETIN 13-01 supra note 25. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, supra note 25 (only Armstrong, Butler, and Pike are not shown as part of an MSA or CMSA).

62 See Pennsylvania: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 5 in Appendix B); see also PA. DEP’T OF ENVTL. PROT., BUREAU OF OIL AND GAS MGMT., Oil and Gas Permits Issued, available at www.dep.state.pa.us/dep/deputate/minres/oilgas/photogallery/photo13295/PAOilFieldsmap1.gif (last accessed Jan. 24, 2013).
Pennsylvania has a long history of oil and gas development, but because of new fracturing techniques, such development is now occurring in the state more rapidly and with more extensive impacts than in the past. In 2012 alone, the state issued 4,090 permits for oil and gas wells, and 2,484 (60%) of those permits were for unconventional (or fractured) wells.\(^6^3\) State data show that 2,390 of those permits were active in 2012, including 1,365 (57%) which were for unconventional wells.\(^6^4\) With an estimated 60 percent of the state containing the Marcellus Shale formation, the number of wells is growing swiftly. As one report states, “the pace of expansion has been stunning, with 75 percent of all unconventional wells having been drilled just since 2010.”\(^6^5\)

Recent studies illustrate the risks that shale gas drilling poses to public health in Pennsylvania. One health survey and environmental testing project, conducted by Earthworks Oil and Gas Accountability Project, documented reports of adverse health symptoms experienced by residents living in proximity to oil and gas development and found correlations between these symptoms and air and water contaminants.\(^6^6\)

Yet, despite these concerns, little has been done to document, investigate, or mitigate the health effects related to oil and gas emissions in Pennsylvania, whether from fractured or traditional wells. In fact, as recently as October 8, 2012, Pennsylvania Governor Tom Corbett signed into law Pennsylvania Senate Bill 367, the “Indigenous Mineral Resources Development Act,” which allows oil and gas development (including hydraulic fracturing) operations on college campuses across the state.\(^6^7\)

4. Texas

The Texas Railroad Commission, through its Oil and Gas Division, regulates the exploration, production, and transportation of oil and natural gas in Texas. Texas has more producing oil and gas wells than any other state in the U.S., with over 263,096 producing oil and gas wells as of 2009.\(^6^8\) Consequently, most of the counties in Texas that meet the CAA §


\(^{64}\) Id. at 3.


\(^{66}\) Id. at 31.

\(^{67}\) The Act allows the Department of General Services “to make and execute contracts or leases for the mining or removal of coal, oil, natural gas, coal bed methane and limestone found in or beneath land owned by the state or state system of higher education.” See Indigenous Mineral Resources Development Act, P.L. 1194, No. 147, enacted Oct. 8, 2012, at § 3(a)(1).

112(n)(4)(B) statistical area criteria also have oil and gas wells.\textsuperscript{69} As shown in the attached Map 6, active wells are located all across the state.\textsuperscript{70}

In addition to its long history of conventional oil and gas production, Texas has been at the forefront of the recent boom in shale oil and gas drilling, which has brought an expansion of drilling activity in highly populated areas of Texas that have already experienced significant benzene exposures. One example is the Barnett Shale, where nearly 14,000 gas wells have been installed since the late 1990s.\textsuperscript{71} As recently as 2010, “[n]early one-fourth of the sites monitored in North Texas’ Barnett Shale natural-gas region had levels of cancer-causing benzene in the air that could raise health concerns….”\textsuperscript{72} The Texas Commission on Environmental Quality (TCEQ) has also measured benzene at levels above 180 parts per billion – TCEQ’S short term, health-based comparison level – at some sites, which it noted as examples of similar problems at other sites that need to be monitored and addressed.\textsuperscript{73} Data from 2010 Barnett Shale air quality

\textsuperscript{69} A non-exclusive list of example counties in Texas that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs includes: Austin County (197 wells), Bastrop County (360 wells), Bexar County (2,641 wells), Brazoria County (440 wells), Caldwell County (3,179 wells), Chambers County (241 wells), Dallas County (32 wells), Denton County (2,989 wells), Ellis County (74 wells), Fort Bend County (481 wells), Galveston County (146 wells), Grayson County (747 wells), Guadalupe County (1,798 wells), Harris County (481 wells), Hood County (810 wells), Johnson County (3,386 wells), Kaufman County (26 wells), Liberty County (812 wells), Montgomery County (251 wells), Parker County (1,865 wells), Somervell County (95 wells), Tarrant County (3,844 wells), Travis County (19 wells), Waller County (242 wells), Webb County (5,412 wells), Williamson County (60 wells), Wise County (4,991 wells). Well counts include regular producing oil wells and regular producing gas wells. See TEXAS R.R. COMM’N, Oil Well Counts by County as of September 2013, (Sept. 4, 2013), http://www.rrc.state.tx.us/data/wells/wellcount/OilWellCt_092013.pdf; TEXAS R.R. COMM’N, Gas Well Counts by County as of September 2013, (Sept. 4, 2013), http://www.rrc.state.tx.us/data/wells/wellcount/gaswellct_092013.pdf; OMB BULLETIN 13-01 supra note 25. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, supra note 25 (only Austin, Bastrop, Caldwell, Chambers, Hood, Somervell, and Wise are not shown as part of an MSA or CMSA).

\textsuperscript{70} See Texas: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 6 in Appendix B); see also TEXAS R.R. COMM’N ENVT'L. QUALITY, Active Oil and Gas Wells (2012), http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/bi_images/txOilGasWells.png.


monitoring also found levels of benzene that could contribute to long-term health impacts. EPA should review and evaluate the air monitoring data that TCEQ is collecting, as well as the point source emission reports from oil and gas wells and associated equipment.

Additionally, concerns about air quality in the town of DISH, Texas, located atop the Barnett Shale, led to a citizen-funded study, which stated:

“Laboratory results confirmed the presence of multiple Recognized and Suspected Human Carcinogens in fugitive air emissions present on several locations tested in the Town of DISH. The compounds identified are commonly known to emanate from industrial processes directly related to the natural gas industrial processes of exploration, drilling, flaring and compression. The laboratory results confirmed levels in excess of TCEQ’s Short Term and Long Term [Effects Screening Levels]. In addition, several locations confirmed exceedances in a chemical identified by TCEQ with the capability for ‘disaster potential.’”

In all, the Texas Railroad Commission estimates that the Barnett Shale extends 5,000 square miles, into parts of at least 21 Texas counties. Notably, all four of the “Core Counties” it considers most affected by the Barnett Shale (Denton, Johnson, Tarrant and Wise) are located in metropolitan statistical areas. Moreover, Fort Worth, a fast-growing Texas city of nearly one billion, in addition to long-term concentrations in excess of TCEQ’s long term health-based comparison level).

74 Ethridge, S., TCEQ, Toxicology Div., Ch. Eng’r’s Ofc., Interoffice Memo., Health Effects Evaluation of City of Fort Worth Follow-Up Survey Project, Fort Worth, Texas Area April 19-23, 2010 (July 7, 2010), http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/samplingFtWorth/2010.07.07-HealthEffectsFollow-upApril%202010.pdf. See also CAL. EPA OEHHA, Revised Proposed Reference Exposure Levels for Benzene (Jan. 22, 2014) (Proposing 8-hour and chronic RELs to be 3 µg/m³ (1 ppb) and 3 µg/m³ (1 ppb) respectively; and noting “These were developed using the latest version of the non-cancer REL guidelines, including application of the revised methodology to protect infants, children and other sensitive subpopulations.”), draft proposal available at http://www.oehha.org/air/chronic_rels/012214SRPRev_RELS.html.


76 Chemicals identified include benzene, dimethyl disulfide, methyl ethyl disulfide, ethyl-methylthethyl disulfide, trimethyl benzene, diethyl benzene, methylmethylthethyl benzene, tetramethyl benzene, naphthalene, 1,2,4-trimethyl benzene, m&p xylenes, carbonyl sulfide, carbon disulfide, methyl pyridine, and diethyl pyridine. WOLF EAGLE ENVT'L., Town of DISH, Texas Ambient Air Monitoring Analysis Final Report 6 (2009) (emphasis omitted).


750,000 people, has been called the epicenter of “urban drilling” in the U.S., as it sits directly atop the Barnett Shale. EPA has air quality data available on emissions of volatile organic compounds (which include many listed HAPs) in the Dallas Fort Worth area that it should evaluate here, including from the Technical Support Document for the ozone National Ambient Air Quality Standards designation for Dallas Fort Worth.  

Another fast-developing shale play impacting communities in Texas is the Eagle Ford, which underlies a crescent-shaped swath of land located between Austin, College Station, Houston, Victoria, Laredo, and San Antonio. The Eagle Ford shale region includes parts of several areas that meet the section 112(n)(4)(B) criteria. Development in the Eagle Ford is already suspected to be impairing air quality in the San Antonio area, and both shale oil and shale gas drilling are rapidly expanding throughout the formation. Gas well permits issued rose from 67 in 2009 to 2,418 in 2013. Oil wells permitted similarly rose from 40 in 2009 to 2,521 in 2013. As of March 3, 2014, there were a total of 5,433 permitted oil and gas wells in the Eagle Ford play, with an additional 5,628 oil wells and 2,715 gas wells scheduled to be permitted. Production at Eagle Ford is expected to continue to grow. The 30 million barrels of

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80 EPA, Texas: Area Designations for the 2008 Ozone National Ambient Air Quality Standards at 6-7, available at http://www.epa.gov/glo/designations/2008standards/rec/eparesp/R6_TX_tsd.pdf (reporting that VOC emissions from oil and gas production activities in the 19-county Dallas-Fort Worth ozone nonattainment area totaled 18,383 tons in 2009, according to the TCEQ Barnett Shale Area Special Inventory. Applying EPA’s conversion factor of 0.0377 lb HAP/lb VOC for gas in the production segment (see Document ID No. EPA-HQ-OAR-2010-0505-0084), this inventory translates into approximately 683 tons of HAP emissions).
82 For example, Atascosa & Wilson Counties are located in the San Antonio-New Braunfels MSA; Brazos, Burleson, and Robertson Counties are located in the College Station-Bryan MSA, and Webb County is located in the Laredo MSA. See OMB BULLETIN 13-01 supra note 25.
85 Id.
86 TEXAS R.R. COMM’N, supra note 81.
oil equivalent it produced in 2011 is expected to rise to 1.2 million barrels of oil equivalent per day by 2015, with new permits issued rising to 25,000 per year.  

5. Ohio

Ohio’s Department of Natural Resources, Division of Oil and Gas Resources Management is responsible for the regulation of the state’s oil and gas drilling operations. As of 2012, Ohio had 64,481 active oil and gas wells, as illustrated in the attached Map 7. Many counties in Ohio meet the section 112(n)(4)(B) criteria, including six of the top ten counties with the most active drilling activity.

Ohio drilling operator Chesapeake Energy has confirmed that its activities potentially release a number of air pollutants from well sites and compressor stations, including formaldehyde.

A pilot study conducted by West Virginia University and the Wheeling-Ohio County Health Department monitored air quality and threats to public health around Marcellus Shale gas drilling sites in Ohio County, West Virginia, which is located on the Ohio border. Beginning in December 2012, air quality monitors were set up throughout the region, including on the property of residents living adjacent to well pads, to survey toxic exposures. This program demonstrates both that heightened public concerns exist over continued oil and gas development near Ohio County, West Virginia, which is located on the Ohio border. Beginning in December 2012, air quality monitors were set up throughout the region, including on the property of residents living adjacent to well pads, to survey toxic exposures.

Ohio had 64 counties in Ohio that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs and the number of new wells drilled there in 2011 includes: Ashtabula County (5 wells), Belmont County (26 wells), Cuyahoga County (14 wells), Geauga County (8 wells), Jefferson County (2 wells), Knox County (32 wells), Lake County (1 well), Licking County (18 wells), Mahoning County (21 wells), Medina County (2 wells), Morrow County (7 wells), Pickaway County (4 wells), Portage County (14 wells), Stark County (40 wells), Summit County (11 wells), Trumbull County (11 wells), and Washington County (2 wells). See OMB BULLETIN 13-01 supra note 25; OHIO DEPT. OF NAT. RES., DIV. OF OIL AND GAS RES. MGMT., id., at 5. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, supra note 25 (only Ashtabula and Morrow are not shown as part of an MSA or CMSA).


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89 A non-exclusive list of example Ohio counties that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs and the number of new wells drilled there in 2011 includes: Ashtabula County (5 wells), Belmont County (26 wells), Cuyahoga County (14 wells), Geauga County (8 wells), Jefferson County (2 wells), Knox County (32 wells), Lake County (1 well), Licking County (18 wells), Mahoning County (21 wells), Medina County (2 wells), Morrow County (7 wells), Pickaway County (4 wells), Portage County (14 wells), Stark County (40 wells), Summit County (11 wells), Trumbull County (11 wells), and Washington County (2 wells). See OMB BULLETIN 13-01 supra note 25; OHIO DEPT. OF NAT. RES., DIV. OF OIL AND GAS RES. MGMT., id., at 5. Most of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, supra note 25 (only Ashtabula and Morrow are not shown as part of an MSA or CMSA).

expansion and the need for EPA to evaluate and act on the available information about toxic exposures and public health impacts.

6. Louisiana

Louisiana has a long history of oil and gas drilling, and has been subject to an influx of new drilling activity recently due to the presence of the Haynesville Shale in the northwest portion of the state. Several parishes in Louisiana that have oil and gas wells meet the section 112(n)(4)(B) criteria. All of these areas are increasingly affected by shale gas drilling, as shown in Map 8 (attached). For example, a recent study modeled the impact of oil and gas development in the Haynesville Shale region and found that hydrocarbon emissions from projected Haynesville Shale development will affect air quality in Shreveport.

C. Emissions from oil and gas wells pose more than a negligible risk of adverse effects to public health.

1. Oil and gas wells, and associated equipment, emit significant toxic air emissions.

EPA estimated in 2011 that hazardous air pollutant emissions from the oil and gas industry were roughly 127,000 tons per year. The annual emissions of benzene, toluene, ethyl benzene, and xylenes (“BTEX compounds”) from the industry are between 8,600 and 21,800 tons per year, depending on the source of their emission. Emissions of eight HAPs make up a large percentage of the total HAP emissions by mass from the oil and gas sector: toluene,

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92 A non-exclusive list of example Louisiana parishes that meet the section 112(n)(4)(B) criteria under OMB’s current delineations for MSAs and CSAs includes: Bossier Parish (136 wells), Caddo Parish (343 wells), De Soto Parish (1,299 wells), and Webster Parish (5 wells). See OMB BULLETIN 13-01 supra note 25; LA. DEP’T. OF NATURAL RES., Haynesville Shale Wells Scout Reports (updated Nov. 14, 2013), available at http://dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=442&pnid=0&nid=186. Many of these counties would also meet the 112(n)(4)(B) criteria under the delineations in place when the provision was enacted. See U.S. CENSUS BUREAU, supra note 25 (only De Soto and Webster are not shown as part of an MSA or CSA).

93 See Louisiana: Oil and Gas Wells, Shale Plays and Population Centers (attached as Map 8 in Appendix B); see also LA. DEP’T OF NATURAL RES., Haynesville Shale Gas Play Activity Map (2013), http://dnr.louisiana.gov/assets/OC/haynesville_shale/haynesville.pdf.

94 Susan Kemball-Cook et. al., Ozone Impacts of Natural Gas Development in the Haynesville Shale, 44 ENVTL. SCI. TECH., 9357, 9361-2 (2010) (finding that projected oil and gas development in the Haynesville Shale would likely increase ozone design values for monitors in the region by up to 5 ppb).

95 See EPA, Proposed Air Rule Fact Sheet 2 (using EPA estimate that a reduction of 38,000 tons per year of HAPs that would be achieved by the proposed rule represents “a reduction of nearly 30 percent”), available at http://www.epa.gov/airquality/oilandgas/pdfs/20110728factsheet.pdf. This shows that EPA estimates a total of about 127,000 tons per year of HAPs from these sources.

96 Id. at 1; Memorandum from Heather P. Brown, P.E., EC/R Incorporated, to Bruce Moore, EPA, Re: Composition of Natural Gas for use in the Oil and Natural Gas Sector Rulemaking 10 Tbl. 6, 12 Tbl. 9 (July 28, 2011), Document ID No. EPA-HQ-OAR-2010-0505-0084 [hereafter Gas Composition Memo] (using production and well completion weight ratios of BTEX:VOC against total annual VOC emissions).
hexane, benzene, mixed xylenes, ethylene glycol, methanol, ethyl benzene, and 2,2,4-trimethylpentane. Some major HAPs of concern from the oil and natural gas sector include: benzene, toluene, carbonyl sulfide, ethyl benzene, mixed xylenes, and n-hexane, and the state-specific section above describes some of the air monitoring data, including the 2014 Petrón study, illustrating the major HAP emissions coming from oil and gas operations. However, based on EPA figures for HAP emissions per facility and the count of facilities nationwide, EPA’s 2011 estimate appears to underestimate oil and gas sector HAP emissions. EPA’s data on the HAP emissions per individual facility show that a typical natural gas production facility (i.e., wellpad) will leak HAPs at a rate of 0.671 tons per year. With around a half million gas wells in the United States, this suggests over 100,000 tons of HAP pollution just from wellpad leaks, even with a conservative assumption that the average wellpad has three wells. If the number of wells per wellpad is in fact lower than two, this figure would exceed 150,000 tons of HAPs just from wellpads. Typically venting emissions of natural gas from wellpads are larger than leaking emissions from wellpads, and therefore venting emissions of HAPs from wellpads will be as high or higher than the leaking emissions of HAPs. In addition, the average gathering and boosting facility leaks 3.10 tons of HAPs per year, and the average storage facility leaks 0.33 tons of HAPs per year. Moreover, a recent review of emission events (i.e., emissions from events such as malfunctions and other upsets) reported in the Texas Commission on Environmental Quality’s (‘TCEQ’s”) Emissions Event database shows that individual compressors and fractionators can emit as much as 25.76 and 41.28 tons of HAPs per year, respectively. This Texas review sheds light on another important issue—that the industry releases a significant amount of air pollution from emissions events alone. In fact, between 2009 and 2011, Texas-wide emissions events from components in the natural gas industry for which data

97 RIA, supra note 8, at 4-13 to 4-14.
98 Id. at 4-14; supra Part I.B.
100 See supra note 15.
102 Equipment Leak Memo, supra note 99, at 6 Tbl. 2.
104 Id. at 1-4.
was available released a total of 779.01 tons of HAPs, with 633.39 tons of HAP emissions reported in 2011 alone.\textsuperscript{105}

This review of the TCEQ Emissions Event database also illustrates the extent to which HAP emissions are underestimated.\textsuperscript{106} As explained above, these data are limited to “emissions events” occurring in Texas, which are releases that occur in addition to a facility’s normal operations. These releases tend to be caused by malfunctions, power outages, startup and shutdown activities, and maintenance, and manifest themselves as venting, leaks, and flares.\textsuperscript{107} Because the TCEQ data is based on industry reporting, which often underreports the releases or aggregates the releases under the heading of “natural gas” or “VOCs,” the data are inherently incomplete.\textsuperscript{108}

2. Significant toxic emissions from oil and gas wells are uncontrolled.

Although EPA recently finalized a new set of air pollution regulations that address part of the oil and gas sector (the “2012 Rule”),\textsuperscript{109} only some of the new standards cover any wells at all, and there are still a number of hazardous air pollution sources at oil and gas wells that remain largely unregulated or receive an exemption under those standards. For example, as Table 1 (attached) shows, the new source performance standards EPA finalized in 2012 under CAA § 111 regulate only completion emissions from certain new and refractured gas wells.\textsuperscript{110} Completion emissions from fractured oil and condensate-producing wells, and equipment leaks from all types of new and existing wells remain completely unregulated under both § 111 and § 112 despite a high rate of leaks. Moreover, the area source category that EPA established under CAA § 112 in 2007 for oil and gas production does not cover any wells—it only includes glycol

\textsuperscript{105} \textit{Id.} at App. A: Natural Gas HAPs (TPY) at 22.
\textsuperscript{106} See generally Accident Prone, supra note 103.
\textsuperscript{107} \textit{Id.} at 1-4.
\textsuperscript{108} Among other underestimations, industry reporters often provide emission event numbers on the basis of formulas, which understate leak rates from sources such as storage tanks. \textit{Id.} at 8. In fact, a study followed up on a chemical plant’s reporting with actual monitoring based on differential absorption light detection and ranging (“DIAL”) and found that the actual emissions were greater by an order of magnitude or more. For example, the DIAL measurements found that benzene emissions from storage tanks were 93 times greater than reported, and VOC emissions from other tanks were 132 times greater than reported. \textit{Id.} at 8 Tbl. 5.
\textsuperscript{110} See Table 1 – NSPS V. NESHAP Coverage Comparison: Regulation of Wells and Associated Equipment (attached as Table 1 in Appendix A); see also 2012 Rule, 77 Fed. Reg. at 49,492 (summarizing coverage of wells).
And the major source rules EPA has issued under CAA § 112 do not set any standards for wells or their associated equipment, so there are no HAP-specific controls in place at all for these sources.\textsuperscript{112} EPA’s own analysis of the 2012 Rule confirms the limited impact the new standards will have on HAP emissions. EPA estimates that the new standards will reduce emissions of HAPs by only 12,000-20,000 tons per year, leaving the vast majority of the industry’s over 100,000 tons of HAP emissions uncontrolled.\textsuperscript{113}

Table 1 and Table 2 (attached) confirm that significant gaps remain in the regulation of HAP emissions from oil and gas production. This analysis of available data (mainly for the gas sector) shows that at least 64,935 tons of HAP emissions are left uncontrolled, of which about 27,149 tons (42\%) come from wells.\textsuperscript{114}

Although some individual states have begun to recognize the harmful effects that well emissions pose to their surrounding communities by requiring measures to reduce some emissions,\textsuperscript{115} nearly all states have yet to regulate toxic air pollution as needed to protect public health and current national scale oil and gas well standards are not adequate. EPA has a responsibility under the Clean Air Act to protect people from toxic air emissions nationwide, and to do so under section 112(n)(4)(B). It is especially important for these emissions to be regulated on the federal level to ensure equal, national, and effective health protection for all communities affected by oil and gas pollution, without delay. EPA should consider the work being done in some states, like Colorado, particularly around emission control technologies, as the agency addresses this petition and considers the need for strong national protection from toxic oil and gas well air pollution nationwide.

\textsuperscript{111} EPA, National Emission Standards for Hazardous Air Pollutants: National Emission Standards for Hazardous Air Pollutants for Source Categories from Oil and Natural Gas Production Facilities, 72 Fed. Reg. 26, 28 (Jan. 3, 2007) [hereinafter “2007 Oil and Gas Area Source NESHAP”] (defining “the affected source” as “each TEG dehydration unit located at an area source oil and natural gas production facility,” and excluding all “[o]ther types of dehydration units or other emission points (e.g., equipment leaks) at area source oil and natural gas production facilities”).

\textsuperscript{112} See 2012 Rule, 77 Fed. Reg. at 49,492 (summarizing revisions to NESHAP regulations).

\textsuperscript{113} See 2012 Rule, 77 Fed. Reg. at 49,533-34; section I.C.1 supra.

\textsuperscript{114} Table 2 - Oil and Gas Sector Summary: Comparison of Emissions Controlled by EPA’s Final Rule (“Controlled”) vs. Emissions that Could Have Been Controlled by EPA’s Final Rule But Were Not (“Not Controlled”) (attached as Table 2 in Appendix A).

3. Oil and gas drilling poses particular concerns regarding HAP emissions because of the toxic constituents it causes to be released into the air.

In the face of the rapid growth of oil and gas production discussed above, the toxic constituents of natural gas released during well completions, production, and flaring pose added public health concerns. In a recent memorandum regarding the composition of natural gas, EPA drew from a number of sources and estimated the components of gas—and specifically the HAPs and VOCs—produced and released by oil and gas operations.\footnote{Gas Composition Memo, supra note 96 at 1.} On this basis, EPA determined representative compositions for natural gas during production, as well as during completions and recompletions.\footnote{Id. at 1-2, 9.} Because the relative composition likely varies considerably depending on the geology of each play, and the impacts in some locations may therefore be more severe,\footnote{E.g., id. at 5 Tbl. 3 (showing variations in n-Hexane composition from 88.7 to 2783 ppmv).} the broad array of HAP emission sources at or near well sites (described in detail below) must be included in any area source listing of wells and their “associated equipment” to ensure the public is adequately protected from the health threats posed by these significant sources of HAP emissions.

a. Emissions During Production at Oil and Gas Wells

From EPA’s analysis of gas composition during production, a few of the pollutants applicable to this area source listing were, in order of presence and with volume and weight percentages:

- n-Hexane: 0.09 percent volume, 0.39 percent weight;
- Benzene: 0.022 percent volume, 0.083 percent weight;
- Toluene: 0.016 percent volume, 0.074 percent weight;
- Ethylbenzene: 0.00090 percent volume, 0.0047 percent weight;
- Xylenes (m-, p-, and o-): 0.0041 percent volume, 0.021 percent weight.\footnote{Id. at 8 Tbl. 5.}

b. Well Completions and Recompletions

From EPA’s analysis of gas composition for natural gas well completions and recompletions specifically, a few of the pollutants applicable to this area source listing were, by volume:

- n-Hexane: 0.155 percent volume;
- Benzene: 0.005 percent volume;
- Toluene: 0.003 percent volume;
- Xylenes: 0.001 percent volume.\footnote{Id. at 11 Tbl. 8.}
EPA also estimated pollutant volumes for oil well completions and recompletions:

- n-Hexane: 0.0052 percent volume
- Benzene: 0.0062 percent volume
- Toluene: 0.0002 percent volume
- Ethylbenzene: 0.0004 percent volume

**c. Flaring at Oil and Gas Wells**

For the purposes of determining the composition of natural gas constituents after flaring, the Ventura County Air Pollution Control District developed HAP emission factors for natural gas fired power plants in 2001 based on EPA data. By the factors’ estimation, toxic pollutants are released in the following proportions during flaring, in pounds per million cubic feet of natural gas.

- Benzene: 0.159
- Formaldehyde: 1.169
- Naphthalene: 0.011
- Acetaldehyde: 0.043
- Acrolein: 0.010
- Toluene: 0.058
- Xylenes: 0.029
- Ethylbenzene: 1.444
- Hexane: 0.029

Toxic air emissions via flaring are notable due to their prevalence, their significance, and their data concerns. For example, the Energy Information Administration has estimated that, as of 2010, roughly 0.62 percent of all natural gas in the U.S.—or 166 billion cubic feet—is vented or flared. Both this amount and the proportion of production that is flared have been increasing over the past decade. In 2002, for example, only 99 billion feet of natural gas were vented or flared, or 0.41 percent of the total gas produced. EPA recently performed a study on flare efficiency that identified several factors that can degrade flare performance, potentially

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121 Id.
123 Id.
125 GAO, Natural Gas Flaring and Venting: Opportunities to Improve Data and Reduce Emissions 17 Tbl. 2 (2004).
leading to the release of much higher amounts of toxic air emissions than EPA has assumed for years.\footnote{See EPA, Parameters for Properly Designed and Operated Flares 1-2 to 1-3 (2012) [hereinafter EPA Flare Parameters]. Although this study focused on flares used at refineries and chemical plants, EPA concluded that some of the factors it found to affect flare performance would also apply to other types of flares. See id. at 1-3.}

The impacts of this trend are clearer in light of the Ventura County Air Pollution Control District HAP emission factors for flaring discussed above. Because the emissions factors are based on the composition of processed gas used at power plants and not the raw gas found at production sites and because flaring likely produces fewer toxic emissions than venting, applying these factors to the estimated 2010 venting or flaring of 166 billion cubic feet of gas produces a conservative estimate of HAP emissions:

- Benzene: 26,383 lbs.
- Formaldehyde: 193,970 lbs.
- Naphthalene: 1,825 lbs.
- Acetaldehyde: 7,135 lbs.
- Acrolein: 1,659 lbs.
- Toluene: 9,624 lbs.
- Xylenes: 4,812 lbs.
- Ethylbenzene: 239,600 lbs.
- Hexane: 4,812 lbs.\footnote{Flaring Emission Factors, supra note 122, at 1; Natural Gas Annual 2010, supra note 124, at 1 Tbl. 1.}

The emissions described above become significant when considered in the context of the ongoing boom in oil and gas production and the concentration of that development in certain areas, as shown on the attached maps. Having multiple wells concentrated near one another exposes a single community to emissions from many oil and gas sources.

d. Equipment Leaks

An analysis of the data provided with the 2012 Rule suggests that equipment leaks total at least 23,228 tons per year.\footnote{See Table 2 - Oil and Gas Sector Summary (Appendix A).} However, this appears to be a substantial underestimate. As previously stated, based on EPA data, the equipment at an average well facility leaks HAPs at a rate of 0.671 tons per year.\footnote{Equipment Leak Memo, supra note 99 at 6 tbl. 2.} This is not a measured average value; rather, it is the emissions rate for a “model” wellpad with an assumed count of connectors, valves, open-ended lines, and pressure reducing valves, all emitting at the rate predicted by GRI/EPA emission factors. However, the 0.671 tons per year estimate is striking, in that, if it is accurate, natural gas well facilities alone would emit at least 100,000 tons per year of HAPs just from leaks, even if we conservatively assume that there are an average of three wells per wellpad.\footnote{See section I.C.1 supra.} In addition, EPA’s data suggest that the average rate of leakage from valves, pressure relief devices, and other...
equipment at gathering and boosting operations is 3.10 tons of HAPs per year, and similar equipment in the storage component leaks an average of 0.33 tons of HAPs per year.\textsuperscript{131}

e. Other Equipment at or Associated with Oil and Gas Wells

In addition to the sources discussed above, certain other pieces of oil and gas production equipment are also sources of hazardous air pollutant emissions:

- **Condensate tanks:** The liquid mixture of hydrocarbons and aromatic hydrocarbons that is removed from the gas stream and collected in tanks during production includes BTEX compounds.\textsuperscript{132}
- **Glycol dehydrators:** Most dehydrators use glycols for water absorption, including the HAP ethylene glycol.\textsuperscript{133}
- **Gas sweetening:** The amine solution process is the most common gas sweetening technique, and one of the amines used is the HAP diethanolamine.\textsuperscript{134} Sweetening removes hydrogen sulfide, and the recovered hydrogen sulfide gas stream may be vented, flared, incinerated, or sold as elemental sulfur.\textsuperscript{135} Moreover, BTEX compounds are readily absorbed by the amine solution, and sweetening may therefore be a “significant source” of BTEX emissions if the byproducts are released at the end of the process.\textsuperscript{136}
- **Storage tanks:** Vessels are used for storage and other activities throughout natural gas processing, and they therefore hold a variety of different toxic chemicals and mixtures thereof. Emissions from the vessels are accordingly significant. For example, in the 2012 Rule, EPA estimated an average reduction of 2.88 tons per year of HAPs from each regulated vessel.\textsuperscript{137}
- **Produced water ponds:** As described in more detail in the next section, these open “frack pits” are a significant source of toxic emissions because they hold fracturing fluids,

\textsuperscript{131} Equipment Leak Memo, supra note 99 at 6 tbl. 2.
\textsuperscript{132} EARTHWORKS, Sources of Oil and Gas Air Pollution, http://www.earthworksaction.org/issues/detail/sources_of_oil_and_gas_air_pollution (last visited Nov. 21, 2013).
\textsuperscript{135} See RIA, supra note 8, at 2-8; EPA, Stationary Point and Area Sources 5.3-1 (5th ed. 1995), available at http://www.epa.gov/ttn/chief/ap42/ch05/index.html.
\textsuperscript{137} RIA, supra note 8, at 3-12 Tbl. 3-2 (estimating number of regulated vessels), 3-20 Tbl. 3-4 (providing total emission reductions from regulated storage vessels). The 2.88 tpy per regulated vessel estimate comes from dividing the total emissions from regulated storage vessels, 876 tpy, by the total number of regulated storage vessels, 304.
including flowback water and produced water, and are typically open to the air allowing toxics such as BTEX compounds, hydrogen sulfide, and methanol escape into the air. EPA itself has even identified produced water ponds as a “potentially significant source of emissions” for which additional data needs to be collected.\textsuperscript{138}

- **Compressors:** The TCEQ Emissions Event database shows that individual compressors and fractionators emit as much as 25.76 and 41.28 tons of HAPs per year, respectively.\textsuperscript{139} Analysis of available data in the 2012 Rule record also shows that compressors emit a total of about 9,091 tons of HAPs that are uncontrolled.\textsuperscript{140}

- **Pneumatic controllers:** Analysis of data in the 2012 Rule record shows that pneumatic devices emit approximately 4,667 tons of HAPs that are uncontrolled.\textsuperscript{141}

4. **Hydraulic fracturing raises unique concerns regarding toxic air emissions because this technique uses many additional toxic chemicals as inputs.**

Currently nine out of ten natural gas wells use hydraulic fracturing and its associated processes.\textsuperscript{142} According to industry responses to a 2011 House Committee investigation, between 2005 and 2009, hydraulic fracturing companies used at least 595 products containing 24 different hazardous air pollutants as components of fracturing fluids.\textsuperscript{143} In fact, the most widely used chemical component in hydraulic fracturing during this time period—methanol, which appears in 342 products—is a listed HAP.\textsuperscript{144} In all, toxic chemicals appeared in over a quarter of the total products used in fracturing fluids.\textsuperscript{145} A few particular chemicals of note are hydrogen fluoride and lead. As the House Committee Report explains, hydrogen fluoride—which is in two products of which one hydraulic fracturing company used 67,222 gallons from 2008 to 2009—“is a hazardous air pollutant that is a highly corrosive and systemic poison that causes severe and sometimes delayed health effects due to deep tissue penetration. Absorption of substantial

\textsuperscript{139} See Accident Prone, supra note 103, at App. A: Natural Gas HAPs (TPY) at 21-22 (providing data from individual sources).
\textsuperscript{140} See Table 2 - Oil and Gas Sector Summary (Appendix A).
\textsuperscript{141} See id.
\textsuperscript{144} Id. at 6.
\textsuperscript{145} Id. at 5 (oil and gas service companies reported using more than 2,500 hydraulic fracturing products), 8 (652 of these products contained toxic chemicals).
amounts of hydrogen fluoride by any route may be fatal.” Other HAPs commonly used in fracturing operations include ethylene glycol, naphthalene, formaldehyde, and BTEX compounds.

Excerpt from Table 3 from page 8 of House Committee Report showing hydraulic fracturing chemical components of concern that are listed hazardous air pollutants (also listing carcinogens and Safe Drinking Water Act-regulated chemicals):

<table>
<thead>
<tr>
<th>Chemical Component</th>
<th>Chemical Category</th>
<th>No. of Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol (Methyl alcohol)</td>
<td>HAP</td>
<td>342</td>
</tr>
<tr>
<td>Ethylene glycol (1,2-ethanediol)</td>
<td>HAP</td>
<td>119</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>Carcinogen, HAP</td>
<td>44</td>
</tr>
<tr>
<td>Xylene</td>
<td>SDWA, HAP</td>
<td>44</td>
</tr>
<tr>
<td>Hydrogen chloride (Hydrochloric acid)</td>
<td>HAP</td>
<td>42</td>
</tr>
<tr>
<td>Toluene</td>
<td>SDWA, HAP</td>
<td>29</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>SDWA, HAP</td>
<td>28</td>
</tr>
<tr>
<td>Diethanolamine (2,2-iminodiethanol)</td>
<td>HAP</td>
<td>14</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Carcinogen, HAP</td>
<td>12</td>
</tr>
<tr>
<td>Benzyl chloride</td>
<td>Carcinogen, HAP</td>
<td>8</td>
</tr>
<tr>
<td>Cumene</td>
<td>HAP</td>
<td>6</td>
</tr>
<tr>
<td>Dimethyl formamide</td>
<td>HAP</td>
<td>5</td>
</tr>
<tr>
<td>Phenol</td>
<td>HAP</td>
<td>5</td>
</tr>
<tr>
<td>Benzene</td>
<td>Carcinogen, SDWA, HAP</td>
<td>3</td>
</tr>
<tr>
<td>Di (2-ethylhexyl) phthalate</td>
<td>Carcinogen, SDWA, HAP</td>
<td>3</td>
</tr>
<tr>
<td>Acrylamide</td>
<td>Carcinogen, SDWA, HAP</td>
<td>2</td>
</tr>
<tr>
<td>Hydrogen fluoride (Hydrofluoric acid)</td>
<td>HAP</td>
<td>2</td>
</tr>
<tr>
<td>Phthalic anhydride</td>
<td>HAP</td>
<td>2</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>Carcinogen, HAP</td>
<td>1</td>
</tr>
<tr>
<td>Acetophenone</td>
<td>HAP</td>
<td>1</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Carcinogen, HAP</td>
<td>1</td>
</tr>
<tr>
<td>Lead</td>
<td>Carcinogen, SDWA, HAP</td>
<td>1</td>
</tr>
<tr>
<td>Propylene oxide</td>
<td>Carcinogen, HAP</td>
<td>1</td>
</tr>
<tr>
<td>p-Xylene</td>
<td>HAP</td>
<td>1</td>
</tr>
</tbody>
</table>

Number of Products Containing a Component of Concern 652

Another listing of the chemicals used by the industry in fracturing fluids was created by the New York Department of Environmental Conservation as part of its environmental impact statement on the development of Marcellus shale in the state. To compile the list, the state

146 Id. at 11 (citing HHS, Agency for Toxic Substances and Disease Registry, Medical Management Guidelines for Hydrogen Fluoride (online at www.atstdr.cdc.gov/hhmi/mmg11.pdf) (accessed Nov. 22, 2013)).
147 Id. at 8.
148 See N.Y. DEP’T OF ENV. CONSERVATION, Revised Draft Supplemental Generic Environmental Impact Statement, On the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for
agency drew on Material Safety Data Sheets (“MSDS”) provided by the industry. The agency’s listing of chemicals included (in part) the following HAPs:

- 1, 4 Dioxane
- Acrylamide
- Benzene
- Ethyl Benzene
- Ethylene oxide
- Formaldehyde
- Hydrochloric Acid
- Methanol
- Naphthalene
- Toluene
- Xylene

Most obvious sources of emissions from the oil and gas industry come from processing at wells and from natural gas constituents. Yet a large quantity of emissions also results from the open “frack pits” (also known as “produced water ponds”) and other such impoundments that hold fracturing fluids, including flowback water and produced water, as well as from leaks, venting, and evaporative loss from the tanks that may also hold these substances. As the pits, in particular, are typically open to the air, the volatile chemicals contained in the fluids—such as BTEX compounds and hydrogen sulfide—will inevitably evaporate and escape into the air. For obvious reasons, data on these emissions are developing, but the data available and extent of chemicals involved in the fluids give some idea of the emissions involved as well as the related health risks.

As a general matter, EPA stated in proposing the 2012 Rule that it “believes that produced water ponds are . . . a potentially significant source of emissions,” and specifically sought comments on control options for such ponds. This produced water can emit significant amounts of VOCs, and EPA’s own research has demonstrated that such open-air impoundments can emit HAPs such as the BTEX compounds and methanol.

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149 Id. at 5-55 to 5-63, Tbl. 5.7.
150 See Sources of Oil and Gas Air Pollution, supra note 132; see also ATSDR, Exposure Investigation. Natural Gas Activities Ambient Air Monitoring Initiative: Marcellus Shale—Washington County, PA, 4, 6-7 (June 1, 2012) (discussing emissions from oil and gas wastewater impoundments).
151 Id.
153 See Sierra Club et al., Comments on National Emission Standards for Hazardous Air Pollutants: Oil and Natural Gas Sector, Review and Proposed Rule for 40 C.F.R. Part 63 at 16-17 (Nov. 2011) (Document ID No. EPA-HQ-OAR-2010-0505-4457) [hereinafter Sierra Club NESHAP Comments]; Dr. Ranajit Sahu, Technical Report and Comments on EPA’s Proposed NESHAP Rule for Oil and Natural Gas Activities Ambient Air Monitoring Initiative: Marcellus Shale—Washington County, PA, 4, 6-7 (June 1, 2012) (discussing emissions from oil and gas wastewater impoundments).
The New York Department of Environmental Conservation has also gathered data on such emissions and concluded that the impoundments could be significant sources of methanol:

Analysis of air emission rates of some of the compounds used in the fracturing fluids in the Marcellus Shale reveals potential for emissions of hazardous air pollutants (HAPs), in particular methanol, from the recovered (flowback) water stored in central impoundments. This methanol is present as a major component of the surfactants, cross-linker solutions, scale inhibitors and iron control solutions used as additives in the frac water. Current field experience indicates that an approximately 25% recovery of fracturing water from Marcellus shale wells may be expected. Thus, using a 25% recovery factor of a nominal 5,000,000 gallons of frac water used for each well, an estimated 6,500 pounds (3.25 tons) of methanol will be contained in the flowback water. Since methanol has a relatively high vapor pressure, its release to the atmosphere could possibly occur within only about two days after the recovered water is transferred to the impoundment. Based on an assumed installation of ten wells per wellsite in a given year, an annual methanol air emission of 32.5 tons (i.e., “major” quantity of HAP) is theoretically possible at a central impoundment.\footnote{N.Y. DEPT’ OF ENV. CONSERVATION, \textit{Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Program} at 6-56 to 6-57 (2009). The Department’s recent revised environmental impact statement, as cited above, has deleted this statement, not on the basis of its veracity, but rather on the grounds that “[t]he Department was informed in September 2010 that operators would not routinely propose to store flowback water either in reserve pits on the well pad or in centralized impoundments” and therefore the Department opted not to address such practices in the revised draft.  \textit{See} N.Y. DEC Revised DSGEIS, supra note 148, at 1-2.}

5. Toxic air emissions from oil and gas production threaten public health

In EPA’s analysis for the 2012 Rule, the agency flagged the following as “the main HAP[s] of concern”: benzene, toluene, ethylbenzene, xylenes, carbonyl sulfide, and n-hexane.\footnote{RIA, supra note 8, at 4-14.} As described in part below, these HAPs are known to cause significant harmful effects to human health.

- \textbf{Benzene:} EPA has described benzene as one of two “key pollutants that contribute most to the overall cancer risks” nationwide.\footnote{\textit{Id.} at 4-9.} It is a known human carcinogen “by all routes of exposure”—specifically causing leukemia—and also has serious non-cancer effects, such as preleukemia, aplastic anemia, and “the depression of the absolute lymphocyte

\footnote{Gas Production and Natural Gas Transmission and Storage Source Categories at 10 (Nov. 2011) (attached in addenda to \textit{Sierra Club NESHAP Comments}); Eben Thoma, \textit{Measurement of Emissions from Produced Water Ponds: Upstream Oil and Gas Study #1} (2009), available at http://permanent.access.gpo.gov/lps120786/600r09132.pdf.}
count in blood.” Though most of these non-cancer effects result from long-term exposure, recent research has found “that biochemical responses are occurring at lower levels of benzene exposure than previously known.” Benzene has also been listed by the state of California to cause developmental toxicity. A 2001 California EPA (“CalEPA”) review of the literature concluded that “there is evidence that benzene exposure early in life elicits a stronger carcinogenic response than equivalent exposures of working-age adults.” This increased susceptibility is not accounted for in the dose-response values used by the US EPA or CalEPA and thus standards or assessments based on these values “may underpredict the risk from early life exposures” and “would not be adequately protective of children.” Studies of human biological tissues which found benzene detected in fetal cord blood at levels equal to or greater than that of maternal blood and in breast milk indicate the potential for increased exposures during prenatal development and infancy.

- **Toluene:** While there is not yet adequate information to classify toluene as a human carcinogen, it is known to cause serious neurological and developmental effects. For example, central nervous system (“CNS”) dysfunction and narcosis have been “frequently observed” in humans acutely exposed to toluene by inhalation, even in low levels. In more chronic exposures with high levels of toluene, CNS depression has occurred, resulting in symptoms such as “ataxia, tremors, cerebral atrophy, nystagmus (involuntary eye movements), and impaired speech, hearing, and vision.” Chronic inhalation has also caused non-CNS effects such as “irritation of the upper respiratory tract, eye irritation, dizziness, headaches, and difficulty with sleep.” And developmental effects have occurred in the children of women who have abused toluene during pregnancy. In studies of occupational exposures to toluene, “neurological effects (i.e., impaired color vision, impaired hearing, decreased performance in neurobehavioral analysis, changes in motor and sensory nerve conduction velocity, headache, and dizziness) [were] the most sensitive endpoint.”

- **Ethylbenzene:** In acute exposure in humans, ethylbenzene has been found to result in respiratory effects such as throat irritation and chest constriction, as well as neurological effects such as dizziness. In cases of chronic exposure, ethylbenzene “may cause eye

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157 Id. at 4-15.
158 Id.
160 Id.
162 RIA, supra note 8, at 4-16.
163 Id.
164 Id.
165 Id.
166 Id.
167 Id. at 4-17.
and lung irritation, with possible adverse effects on the blood."\textsuperscript{168} Although there is not yet ample human evidence to demonstrate the carcinogenic and developmental effects of ethylbenzene, animal studies have found both, and the International Agency for Research on Cancer has classified ethylbenzene as “possibly carcinogenic” to humans based on animal studies.\textsuperscript{169}

- **Xylenes**: Although EPA has found xylenes to be “not classifiable with respect to human carcinogenicity,” effects via acute inhalation include “irritation of the nose and throat, nausea, vomiting, gastric irritation, mild transient eye irritation, and neurological effects.”\textsuperscript{170} Chronic effects via inhalation include nervous system effects such as “headaches, dizziness, fatigue, tremors, and impaired motor coordination.”\textsuperscript{171}

- **n-Hexane**: Exposure to n-hexane includes a variety of effects to the nervous system, which is the chemical’s primary target via inhalation.\textsuperscript{172} Effects via acute exposure include “dizziness, giddiness, slight nausea, and headache,” and effects via chronic exposure include “numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue.”\textsuperscript{173} As with xylenes, EPA has classified n-hexane as “not classifiable as to human carcinogenicity” due to limited human data.\textsuperscript{174}

The IRIS reports for each of these pollutants are incorporated here and attached in the Appendix. Additional HAPs also warrant considerable attention from EPA.

- **Formaldehyde**: Along with benzene, formaldehyde is one of two “key pollutants” that EPA has determined “contribute most to the overall cancer risks.”\textsuperscript{175} Formaldehyde is also a potent respiratory irritant that is “associated with decrements in lung function and elevated respiratory symptoms in children.”\textsuperscript{176}

- **Mercury**: Mercury is a potent neurotoxin that is particularly hazardous to the developing brain. Once released into the environment in elemental form, it is converted to methylmercury which bioaccumulates in the food chain. Therefore, even low emission levels can pose significant harm to human health. Mercury content in natural gas has been reported up to 5,000μg/m\textsuperscript{3}, but concentrations are highly variable among specific regions and deposits.\textsuperscript{177} Most authors agree that all natural gas deposits contain some

\textsuperscript{168} \textit{Id.}  
\textsuperscript{169} \textit{Id.} at 4-17 to 4-18.  
\textsuperscript{170} \textit{Id.} at 4-18.  
\textsuperscript{171} \textit{Id.}  
\textsuperscript{172} \textit{Id.} at 4-18.  
\textsuperscript{173} \textit{Id.} at 4-19.  
\textsuperscript{174} \textit{Id.}  
\textsuperscript{175} Id at 4-9.  
\textsuperscript{176} CAL. EPA, OEHHA, \textit{Chemical Summary: Formaldehyde. Prioritization of Toxic Air Contaminants – Children’s Environmental Health Protection Act} 13 (2001).  
mercury.\textsuperscript{178} A figure for “typical” mercury concentrations in natural gas that is often cited is 1-200μg/m\textsuperscript{3}.\textsuperscript{179}

- **Polycyclic Aromatic Hydrocarbons (PAH):** Animal studies have found that ingestion of PAHs during pregnancy results in much greater genetic damage in the fetus compared to the mother.\textsuperscript{180} Human children exposed prenatally to PAHs have statistically significant increases in DNA aberrations in specific chromosomes, low birth weight, intrauterine growth restriction, and reduced IQ.\textsuperscript{181}

- **Arsenic:** Arsenic is a known carcinogen, a persistent toxin, and has also been listed by the state of California as known to cause developmental toxicity.\textsuperscript{182} A 2001 CalEPA review of the literature concluded that, “there is evidence that infants and children may be more susceptible to arsenic exposure than adults.”\textsuperscript{183} According to a 2003 evaluation conducted by the EPA Office of Water, “[a]rsenic, and/or its metabolites, is a chemical that bioaccumulates in tissues of aquatic organisms.”\textsuperscript{184}

- **Methylene Chloride:** Methylene chloride is a carcinogen and can also have cardiovascular and neurological impacts. A 2001 CalEPA review determined that

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\textsuperscript{178}E.g., Bingham, M.D., *Field Detection and Implications of Mercury in Natural Gas*, 5(2) SPE PRODUCTION ENGINEERING 120-124 (1990).

\textsuperscript{179}Id. at 120; Abu El Ela, M., et al., *Egyptian Gas Plant Employs Absorbents for Hg Removal*, 104(46) OIL & GAS J. 52–58 (Dec. 11, 2006).

\textsuperscript{180}Harper, BL, et al., *Micronucleus Formation by Benzene, Cyclophosphamide, Benzo(a)pyrene, and Benzidine in Male, Female, Pregnant Female, and Fetal Mice*, 9(4) TERATOGENESIS, CARCINOGENESIS, AND MUTAGENESIS 239-252 (1989).


through its metabolism to carbon monoxide in the body methylene chloride can have an increased toxicity for infants which is not accounted for in the dose-response values.\(^{185}\)

- **Acrolein:** Acrolein is a powerful respiratory irritant and there is substantial evidence that it exacerbates asthma. Due to the high rates of asthma among children, the CalEPA has prioritized acrolein as a toxic air contaminant of particular concern for children and added a 10 fold factor to the derivation of dose-response values to account for this increased vulnerability.\(^{186}\)

6. **Scientific research provides significant support for the determination that oil and gas wells pose more than a negligible risk to public health.**

EPA has an abundance of evidence upon which it should base its section 112(n)(4)(B) determination. For example, local, state, and national health agencies have been examining the potential health impacts that HAP emissions from oil and gas facilities pose, including the Center for Disease Control and Prevention (CDC) Agency for Toxic Substances and Disease Registry (ATSDR),\(^{187}\) Association of Occupational and Environmental Clinics (AOEC) Pediatric Environmental Health Specialty Unit (PEHSU),\(^{188}\) and the Colorado Health Department.\(^{189}\) The Secretary of Energy Advisory Board, Shale Gas Production Subcommittee (SEAB) has also weighed in on the subject, recommending the adoption of rigorous standards to reduce emissions from shale gas operations.\(^{190}\) Many researchers and groups of concerned residents in communities across the county have also conducted their own studies of toxic air emissions from oil and gas production, and the elevated levels of HAP emissions detected in these and other studies raise serious concerns about increased health risks—including cancer, respiratory and

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\(^{190}\) *90-Day Report,* supra note 4, at 2 (emphasis added).
neurological toxicity—for residents living near oil and gas facilities.\textsuperscript{191} This and other research provides important information showing that oil and gas wells and their associated equipment pose more than a negligible risk to public health.

One recent exploratory study of particular note was designed to assess air quality and explore the presence of volatile chemicals in a rural western Colorado area “where residences and gas wells co-exist.” The study involved weekly sampling for one year—before, during, and after the drilling and hydraulic fracturing of a new natural gas well pad.\textsuperscript{192} Development during this time included drilling, hydraulic fracturing, and production operations. This study reached a number of conclusions that EPA must consider.

- The report found that methylene chloride, a listed HAP and a toxic solvent not reported in products used in drilling or hydraulic fracturing, was detected 73\% of the time; several times in high concentrations.\textsuperscript{193} As the report states regarding these findings: “Methylene chloride stood out due to the extremely high concentrations in some of the samples, including one reading of 1730 ppbv, and three other readings more than 563 ppbv (the cutoff value for spikes) during the period of well development. In contrast, after activity on the pad came to an end and the wells went into production, the highest level of methylene chloride detected was 10.6 ppb. . . . Given that methylene chloride was found in such high concentrations in air samples in the present study, its source and potential exposure scenarios should be explored with respect to exposure of individuals working on the pads and living nearby.”\textsuperscript{194}

- The report also found that selected polycyclic aromatic hydrocarbons (PAHs), some of which are listed HAPs, were at concentrations greater than those at which prenatally exposed children in urban studies had lower developmental and IQ scores.\textsuperscript{195}

\textsuperscript{191} See, e.g. WOLF EAGLE ENVTL., \textit{supra} note 76; EASTERN RESEARCH GROUP, INC., City of Fort Worth Natural Gas Air Quality Study (2011), \textit{available at} http://fortworthtexas.gov/uploadedFiles/Gas_Wells/AirQualityStudy_final.pdf; \textit{ATSDR 2008, supra} note 187, at 1 (the ATSDR 2008 investigation was spurred by health complaints including that some Garfield County residents are experiencing health effects that they believed may have environmental causes. Community concerns ranged from mild complaints such as dizziness, nausea, respiratory problems, and eye and skin irritation to more severe concerns including cancer.); GLOBAL COMMUNITY MONITOR, \textit{GASSED! Citizen Investigation of Toxic Air Pollution from Natural Gas Development} 19-21 (2011), \textit{http://www.gcmonitor.org/downloads/gassedreport.pdf} (this investigation found elevated cancer risk at one site and recommended further investigation into HAP emissions and risks.).

\textsuperscript{192} Colborn, T., et al., \textit{An Exploratory Study of Air Quality near Natural Gas Operations}, TEDX, The Endocrine Disruption Exchange, Paonia, CO (p. 2 of manuscript, peer-reviewed and accepted for publication by HUMAN AND ECOLOGICAL RISK ASSESSMENT (November 9, 2012)).

\textsuperscript{193} \textit{Id.} at 2.

\textsuperscript{194} \textit{Id.} at 10 (citations omitted).

\textsuperscript{195} \textit{Id.} at 2.
• The report concluded, “[t]he human and environmental health impacts of the [nonmethane hydrocarbons], which are ozone precursors, should be examined further given that the natural gas industry is now operating in close proximity to human residences and public lands.”196

• Finally, the study recommended that “[i]n order to determine how to reduce human exposure for both those who work on the well pads and those living nearby, systematic air quality monitoring of natural gas operations must become a regular part of permitting requirements.”197

Other notable studies that EPA must examine offer further evidence of the “more than negligible risk to public health” that oil and gas wells pose. For example:

• A new look at methane and non-methane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin, summarized in the Colorado section above.198

  o This article assessed ambient air data for benzene and various volatile organic compounds and found an average emission rate of 173 kg/hr of the carcinogen benzene in the air above an oil and gas producing region, which corresponds to annual emissions of nearly 1,700 tons for Weld County, Colorado, alone. This county has a population of close to 264,000 people and is part of the Denver-Aurora Combined Statistical Area, where more than three million people live. The findings of this study support the need for new measures nationwide to adequately characterize and reduce air contaminants, including benzene and other HAPs from oil and gas development, which can be associated with significant public health threats.

• Natural gas operations from a public health perspective, a review of over 600 known chemicals used in natural gas operations.199

  o This report concluded that many of the chemicals used in natural gas operations could have long-term health impacts, including on skin, eyes, and kidneys, and respiratory, gastrointestinal, brain/nervous, immune, endocrine, and cardiovascular systems, as well as causing cancer and mutations.200

196 Id.
197 Id. at 12.
198 Petrón et al., supra note 49.
200 Id. at 1039.
• *Maternal Exposure to Ambient Levels of Benzene and Neural Tube Defects among Offspring: Texas, 1999–2004*, a study in Texas linking benzene exposure (from various sources’ emissions) to birth defects.\(^{201}\)
  
  o Among other things, the report stated that “maternal exposure to ambient levels of benzene is associated with the prevalence of spina bifida among offspring.”\(^{202}\)

• *Impacts of Gas Drilling on Human and Animal Health*, a report documenting cases in which animals (both livestock and pets) exposed to natural gas operations and related toxic substances suffered negative health impacts and even death.\(^{203}\)

  o This report concludes that complete evidence regarding health impacts of gas drilling cannot be obtained due to incomplete testing and disclosure of chemicals and nondisclosure agreements, and notes that “[w]ithout rigorous scientific studies, the gas drilling boom sweeping the world will remain an uncontrolled health experiment on an enormous scale.”\(^{204}\)

• *The Potential Near-Source Ozone Impacts of Upstream Oil and Gas Industry Emissions*, a study of air emissions on the Barnett Shale in Texas.\(^{205}\)

  o “Our findings suggest that improved regulation of the upstream oil and gas industry in nonattainment areas should include reporting of emission events, and more aggressive deployment of control strategies, such as vapor recovery to avoid flaring, and the use of oxidation catalysts on stationary engines. The control of formaldehyde emissions is especially desirable both from an air toxics perspective, and with regard to attainment of the federal ozone standard in surrounding or nearby urban areas.”\(^{206}\)

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\(^{202}\) Id. at 401.


\(^{204}\) Id. at 51.


\(^{206}\) Id. at 976.
“Based on the modeling exercise discussed earlier, we conclude that oil and gas activities can have significant near-source impacts on ambient ozone, through either regular emissions or flares and other emission events associated with process upsets, and perhaps also maintenance, startup, and shutdown of oil and gas facilities. Besides flares, candidate facilities that have the potential to emit large amounts of formaldehyde and/or [highly reactive VOCs] as well as NOx in transient events include compressor or drill rig engines, and glycol or amine reboilers used in gas dehydration or sweetening.”

“Major metropolitan areas in or near shale formations will be hard pressed to demonstrate future attainment of the federal ozone standard, unless significant controls are placed on emissions from increased oil and gas exploration and production.”


This article discusses fracturing, arguing that “it would be prudent to invoke the precautionary principle before further degradation and damage to the public’s health and the environment occur.”

This article summarizes other recent research including: one “study based on Pennsylvania Department of Environmental Protection and the Susquehanna River Basin Commission Material Safety Data Sheets for 41 products used in fracturing operations, which assessed the chemicals used in fracturing and found that 73% of the products had between 6 and 14 different adverse health effects including skin, eye, and sensory organ damage; respiratory distress including asthma; gastrointestinal and liver disease; brain and nervous system harms; cancers; and negative reproductive effects. . . . Some of the negative health effects appeared fairly immediately after exposure whereas others appeared months or years later, as was the case with some cancers, harm to the reproductive system, or developmental effects. Of concern is that endocrine-disrupting chemicals may alter developmental pathways, manifesting decades after exposure or even transgenerationally by altering epigenetic pathways.”

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207 *Id.*
208 *Id.* at 966.
210 *Id.* at 785.
211 *Id.* (citing Diamanti-Kandarakis, E, et al., *Endocrine-Disrupting Chemicals: an Endocrine Society Scientific Statement*, 30(4) ENDOCRINE REVS. 293 (2009).
• **Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources**, a recent Colorado study on the public health risks from oil and gas drilling.\(^{212}\)
  
  o This study suggests the existence of increased respiratory, neurological, and cancer risks for people in proximity to wells, with benzene as the major contributor to cancer risk.\(^{213}\)

• **Air, Noise, and Light Monitoring Results for Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations**, a study conducted at the behest of the West Virginia Department of Environmental Protection.\(^{214}\)
  
  o Measurements in this study found benzene concentrations “above what the CDC calls the ‘the minimum risk level for no health effects.’ This is a concern for potential health effects that might arise due to these exposures over a long time.”\(^{215}\)

• **Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development**, a review of the literature on public health impacts and threats posed by gas drilling sites and related infrastructure.
  
  o This review identified 15 different sources and processes which present a chemical exposure hazard via the emission of air pollutants and summarized risk assessment findings that air exposures could result in acute, subchronic, and elevated cancer risk.\(^{216}\)

• **Birth Outcomes and Maternal Residence Proximity to Natural Gas Development in Rural Colorado**
  
  o Researchers found that babies whose mothers lived in close proximity to multiple oil and gas wells were 30% more likely to be born with defects in their heart than babies born to mothers who did not live close to oil and gas wells. Although the study does not include exposure monitoring, the


\(^{213}\) *Id.* at 83-86.


\(^{215}\) *Id.* at 2.

study authors suggest that exposures to air pollutants, including benzene, could be a possible cause.\textsuperscript{217}

These studies demonstrate that air toxics emitted by oil and gas well site activity threaten human health, and provide a strong basis for EPA to take action under section 112(n)(4)(b).

7. **The real-world health impacts of oil and gas well emissions are likely greater even than current data illustrate.**

EPA must also consider the cumulative impacts of emissions, the uncertainties in current emissions inventories, the greater vulnerability of children to health impacts from air toxics, and the numerous oil and gas well safety and drilling violations in making its determination. As explained below, these factors amplify the risks that well emissions pose, and when properly considered, provide further evidence that the risk to public health easily meets the section 112(n)(4)(B) threshold.

a. **EPA must consider and account for the fact that children are more vulnerable to toxic air emissions and exposed at a greater rate, leading to greater health impacts from early life exposure.**

The science on the greater vulnerability and exposure of children to toxic air pollution—and the need to better protect minority and low-income children in particular from pollution—is robust, and must be considered by EPA both when deciding whether oil and gas wells pose more than a negligible risk to public health and when deciding what emission limits to set on oil and gas wells. As discussed below, relevant studies are available from the National Academy of Sciences, the Office of Children’s Health Protection, the U.S. Children’s Health Protection Advisory Committee, scientists in the EPA Office of Research and Development who focus on children’s and community health (such as experts in the National Center for Environmental Research), and the California EPA’s Office of Environmental Health Hazard Assessment (OEHHA). In addition, Executive Order 13045 requires that EPA “ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.”\textsuperscript{218}

It is well-established that biological differences in the developing child and fetus can result in increased cancer and non-cancer risk due to both increased exposure and increased vulnerability.\textsuperscript{219} The most recent review of EPA risk assessment practices by the National


\textsuperscript{218} The President, Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks, 62 Fed. Reg. 19,885, 19,885 (Apr. 23, 1997) (Sec. 1-101(b)).

Academy of Sciences (NAS) highlights the need to more fully address children’s health and vulnerability in EPA health risk assessments, including through the use of default or uncertainty factors.\(^{220}\)

As EPA noted in its 2008 *Child-Specific Exposure Factors Handbook*, “[i]n terms of risk, children may also differ from adults in their vulnerability to environmental pollutants because of toxicodynamic differences (e.g., when exposures occur during periods of enhanced susceptibility) and/or toxicokinetic differences (i.e., differences in absorption, metabolism, and excretion).”\(^{221}\) As EPA explained, environmental contaminants may have longer half-lives in young children, due to the immaturity of metabolic enzyme systems and clearance mechanisms, and the cellular immaturity of children and the ongoing growth processes account for elevated risk.\(^{222}\) Thus, “[t]oxic chemicals in the environment can cause neurodevelopmental disabilities, and the developing brain can be particularly sensitive to environmental contaminants.”\(^{223}\) For example, the Handbook states that “elevated blood lead levels and prenatal exposures to even relatively low levels of lead can result in behavior disorders and reductions of intellectual function in children,” and “exposure to high levels of methylmercury can result in developmental disabilities among children.”\(^{224}\)

In addition to EPA’s 2008 Handbook, the agency’s 2011 *Exposure Factors Handbook* should help guide the analysis of children’s vulnerability to emissions from oil and gas production.\(^{225}\) EPA’s 2011 Handbook states that while the risks due to bioaccumulative HAPs might be lower in an urban setting, the combined exposures from multiple sources and multiple persistent chemicals could potentially be much greater, as soil contaminants are a particular risk to children due to play activities and behaviors, such as increased hand to mouth and object to mouth frequency, which increase their exposures via incidental ingestion.\(^{226}\)

To account for real-world risk to children, EPA must use age-dependent adjustment factors for all carcinogens. This would be consistent with the NAS recommendations and with the scientific approach developed by OEHHA.\(^{227}\)

EPA should also use a 10X default factor to account for cancer risk created by in-utero exposure. The NAS identified the lack of accounting for “in utero periods” of exposure as a

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\(^{221}\) EPA, *Child-Specific Exposure Factors Handbook* 1-2 (2008), EPA/600/R-06/096F (citation omitted).

\(^{222}\) Id. (citations omitted).

\(^{223}\) Id.

\(^{224}\) Id. (citations omitted).


\(^{226}\) Id.

major omission in EPA’s 2005 cancer guidelines. OEHHA conducted its own review of the scientific literature to account for pre-natal susceptibility and exposures, which EPA should also consult and use. It has also developed methods and adjustment factors to account for pre-natal susceptibility and exposures that EPA should use. In its new risk assessment guidelines, OEHHA includes procedures for exposure assessment during fetal development, which EPA should evaluate. OEHHA specifically discusses the use of a 10X adjustment factor for cancer risk due to pre-natal to age 2 exposures, and EPA should consider using at least this same factor.

At least until the IRIS values fully account for the increased risk caused by early-life exposure to an emitted pollutant, EPA should use the OEHHA child-specific reference doses or benchmarks available to assess chronic non-cancer health risk from ingestion for certain pollutants. OEHHA has generated these child-specific reference values based on the latest science to take into account children’s greater exposure and greater vulnerability.

Until EPA has child-specific or child-based reference values available for a given pollutant, EPA should apply a default or uncertainty factor of at least 10 to account for increased risk from early-life exposures for non-cancer risk assessments. This would be consistent with the NAS recommendation on the need for EPA to use default factors to account for greater risk, with the science developed and considered by OEHHA, and with the 10X factor enacted

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228 NAS 2009, id., at 112 (observing that “EPA treats the prenatal period as devoid of sensitivity to carcinogenicity”); see also id. at 196 (noting that it is a “missing” default that EPA recognizes in utero carcinogenic activity, but fails to take account of it or calculate any risk for it).
230 Id. at App. J at 7-8 & tbl. 1.
232 See id.
233 A full list, with links to each scientific determination document, is available here: OEHHA, Table of all Child-chRDs Finalized to Date (updated 06/22/09), http://oehha.ca.gov/public_info/public/kids/chrdtable.html.
234 NAS 2009, supra note 220, at 190-93, 203.
b. To protect public health, EPA must consider and account for the cumulative health impacts of oil and gas well emissions for people exposed to more than one well or production facility.

EPA has a responsibility to consider the cumulative impacts of oil and gas well emissions when determining whether those emissions pose a risk to public health that exceeds the low threshold stated in section 112(n)(4)(B) and when determining the emission limitations to impose on these facilities. Cumulative risk assessments include “aggregate exposures by multiple pathways, media and routes over time, plus combined exposures to multiple contaminants from multiple sources.” In authorizing the listing and regulation of wells, section 112(n)(4)(B) explicitly states that EPA may do so if “emissions of hazardous air pollutants from such wells present more than a negligible risk of adverse effects to public health.” Although section 112(n)(4)(A) generally bars aggregation of emissions under section 112, section 112(n)(4)(B) creates a specific exception that reflects the reality of oil and gas production’s concentration in areas where those resources are available.

Thus, EPA must consider the combined risk from multiple wells in this analysis, and not just look at the impact of a single well, in isolation. Further, section 112(c) confirms that listing is appropriate where an area source category presents a threat of adverse health effects “individually or in the aggregate,” again recognizing that EPA must consider the combined impact of such sources as part of its listing decision.

Both EPA and the National Academy of Sciences have highlighted the importance of including cumulative impacts and risk in risk assessments and risk-based decision making. As EPA has previously noted, it “understands the potential importance of considering an individual’s total exposure to HAP,” and is “interested in placing source category and facility-wide HAP risks in the context of total HAP risks from all sources combined in the vicinity of

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236 EPA, Concepts, Methods, and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document, at xxxii (2007), EPA/600/R-06/013F.
238 Id. § 7412(c)(3).
each source.” Moreover, as the most recent National Academy of Sciences report on risk assessment states, “it is difficult to imagine any risk assessment in which it would not be important to understand the effects of coexposures to agents or stressors that have similar [Modes of Action].”

The Science Advisory Board also has urged EPA to consider cumulative risks. As the Board stated regarding Risk and Technology Reviews, “[it] will be most useful to decision makers and communities if results are presented in the broader context of aggregate and cumulative risks, including background concentrations and contributions from other sources in the area.” The Board explained, “[a] residual risk analysis that does not add exposures to baseline contamination to the estimates of on-going contamination may vastly underestimate the hazard quotient at the site and incorrectly conclude that the on-going releases pose risks at less than threshold levels.

c. EPA must consider and account for environmental justice and the need for greater protection for communities overburdened by toxic air pollution from oil and gas wells.

Unregulated oil and gas well emissions implicate concerns regarding environmental justice. As EPA has noted, “urban air toxics . . . have a potential to elevate health risks among particular urban subpopulations, including children, the elderly, and persons with existing illnesses.” Additionally, “the prevalence of minority and low-income communities in urban industrial and commercial areas, where concentrations of air toxics may be greatest, increases the likelihood of elevated exposures among these subpopulations.”

Moreover, as EPA’s recent review found for the oil and natural gas production, transmission, and storage sectors, there are disparities attributable to this sector for several demographic groups. In particular, racial minorities and people below the poverty level face increased cancer risk from this sector at a greater rate than their representation in the U.S. population. EPA found the following disproportionate exposure to cancer risk at or above 1-in-1 million from oil and gas sources (and facilities that include such sources as well as other source categories) for the following demographic groups:

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241 SAB May 2010, supra note 235, at ii.
242 Id. at 41.
244 Id.
**Oil & Natural Gas Production (ONGP)**

<table>
<thead>
<tr>
<th>Demographic group</th>
<th>% of U.S. population as a whole</th>
<th>% with increased cancer risk due to exposure to a facility that includes ONGP</th>
<th>% with increased cancer risk due to exposure to oil and gas source covered by the ONGP NESHAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minority (non-white)</td>
<td>25%</td>
<td>39%</td>
<td>38%</td>
</tr>
<tr>
<td>Other/multi-racial</td>
<td>12%</td>
<td>30%</td>
<td>25%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>14%</td>
<td>34%</td>
<td>22%</td>
</tr>
<tr>
<td>Below the poverty level</td>
<td>13%</td>
<td>19%</td>
<td>14%</td>
</tr>
</tbody>
</table>

In sum, even if considering only those parts of the oil and gas sector covered by the NESHAP, EPA’s own data indicate significant concerns regarding the environmental justice impact of oil and gas activities. EPA must take this into account when determining the significance of the health risks posed by oil and gas well emissions.

d. **EPA must consider and account for the numerous oil and gas well safety and drilling violations which lead to higher toxic air emissions.**

EPA also must consider the many oil and gas well safety and drilling violations that occur each year, as these violations further exacerbate the risk that well emissions pose to public health. Recently, an Earthworks report that examined in detail the current state of oil and gas enforcement in several states concluded that “[t]he U.S. faces a crisis in the enforcement of rules governing the oil and gas industry,” adding that “states are dangerously unprepared to oversee current levels of extraction, let alone increased drilling activity from the shale boom.”

“As based on their own data, every state we studied fails to adequately enforce regulations on the books. Among our findings:

- Every year hundreds of thousands of oil and gas wells – 53 to 91% of wells in the states studied (close to 350,000 active wells in the six states in 2010) – are operating with no inspections to determine whether they are in compliance with state rules.
- When inspections do uncover rule violations, the violations often are not formally recorded – and the decision whether or not to record a violation is often left to the discretion of the individual inspector.
- When violations are recorded, they result in few penalties.

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246 *Id.*

When penalties are assessed, they provide little incentive for companies to not offend again. 248

A subsequent report examining the impacts of drilling in Texas’s Eagle Ford shale play contrasts the growth in “emission events” at oil and gas production facilities with the decline in TCEQ’s enforcement resources. Since 2009, “unplanned toxic air releases associated with oil and gas production” have increased 100 percent statewide, but the state legislature “has cut the TCEQ’s budget by a third since the Eagle Ford boom began, from $555 million in 2008 to $372 million in 2014.” 249 Similarly, the report notes that “[t]he number of employees in the TCEQ’s Office of Compliance and Enforcement, which conducts investigations and performs air monitoring and other health-related duties, has fallen 13 percent since 2010.” 250

These issues pose potentially serious threats to public health, as those living near wells risk significant HAP exposure from excess emission events caused by mechanical malfunctions and operator errors—exposures that could be minimized by setting stronger standards and compliance requirements through an area source listing.

Additionally, a recent report prepared by the Democratic Staff of the House Natural Resources Committee discusses the failure to oversee drilling on public lands and how this endangers health and the environment. In all, 2,025 safety and drilling violation notices were issued to 335 companies drilling on public lands in seventeen states between February 1998 and February 2011. 251 Of these, 27 percent were classified by Committee staff as a major environmental or safety violation. 252

There were many violations that could endanger health and safety of workers and the environment. An evaluation of the data found many examples of major environmental or safety violations reported during this period, including a 2008 blowout of a well in North Dakota that was not immediately reported to the DOI; an operator in Mississippi that did not install a blowout preventer or any other safety equipment to control the well in the event of a blowout; and an improper casing and cement job in Wyoming that led to leaks of water and gas through the cement of the well. 253

Another example of health risks posed by a lack of regulation and oversight in the oil and gas industry recently made headlines in Texas, where high levels of benzene were documented

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248 Id.
249 Jim Morris et al., Big Oil, Bad Air: Fracking the Eagle Ford Shale of South Texas (Feb 18, 2014), at http://eagleford.publicintegrity.org/.
250 Id.
252 Id.
253 Id.
on the Barnett Shale. At one well site in particular, “[b]enzene was one of 35 airborne chemicals leaking at the well in amounts above the environmental commission’s level for short-term effects, signaling the potential for health problems with only brief exposure. The benzene level at the well, 15,000 parts per billion, was more than 83 times the short-term effects level of 180 ppb.”

**e. EPA must consider and account for the data gaps that exist in current emissions inventories and fracturing chemical disclosures.**

The risks well emissions pose to public health are likely much greater than current studies show because emissions estimates and inventories are not complete. As some Petitioners requested in their petition to EPA for reconsideration of the 2012 NESHAP for the oil and gas sector, the agency must collect current data on the amount of toxic air emissions from oil and gas operations, including wells. A 2013 report from EPA’s Inspector General (“IG”) reiterates the need for EPA to strengthen the quantity and quality of data it has on the entire oil and gas sector, including wells. As the IG found, “EPA has limited directly-measured air emissions data for air toxics and criteria pollutants for several important oil and gas production processes and sources, including well completions and evaporative ponds,” and its emission factors are of “questionable quality.” As a result of these problems, and the fact that the national emission inventory includes so little data, the IG found that the emission inventory “likely underestimates oil and gas emissions.” Further, as the aforementioned study published by a consortium of authors from NOAA and the University of Colorado found, the available inventories of hydrocarbon emissions from oil and gas facilities in the study area did not correlate with observed atmospheric observations and were likely underestimates. Additionally, a report by the Central States Regional Air Partnership (“CENRAP”) identified the need to improve the oil and gas area source inventories for the CENRAP region, with a focus on the states of Texas, Louisiana, Oklahoma, Arkansas, Kansas and Nebraska. Remarks made in both citizen petitions and comments related to the oil and gas production industry have also noted this issue.

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254 Loftis, supra note 72.
256 EPA, INSPECTOR GEN., EPA Needs to Improve Air Emissions Data for the Oil and Natural Gas Production Sector, Report No. 13-P-0161 (Feb. 20, 2013).
257 Id. (executive summary).
258 Id.
259 Pétron, supra note 43, at 1 (This study was conducted in Weld County, CO. It took a regional approach, using data collected over 3 years by both fixed and mobile sampling equipment looking for sources and mixing ratios of methane and benzene and several other non-methane hydrocarbons.).
in greater detail.\textsuperscript{261} As such, EPA should take a comprehensive approach to address the data gaps on the oil and gas sector for wells and all other parts of the sector, in response to this petition and the Sierra Club \textit{et al.} petition for reconsideration of the 2012 oil and gas sector NESHAP.

Additional data gaps exist in fully evaluating potential health effects caused by emissions from hydraulically fractured wells. Many of the chemicals used by these wells (and their associated HAP emissions) are unknown, in part due to a “trade secret” exemption to the chemical disclosure process that drilling companies frequently utilize.\textsuperscript{262} EPA’s decision to perform a study on hydraulic fracturing and its human health effects on drinking water shows that EPA must also perform a full assessment to evaluate the ways in which fracturing affects air toxics in areas near wells, starting by collecting emission test data.\textsuperscript{263}

Although EPA should gather additional data to further evaluate the health effects and promulgate an appropriate regulatory response, EPA must not delay in listing well facilities as area sources. There is ample existing evidence referenced in and attached to this Petition demonstrating that these sources pose more than a negligible risk to public health, thereby warranting an immediate area source designation.

\textbf{D. Existing technology is available to reduce oil and gas wells’ toxic emissions.}

Technology that is available and is already in use in some places can reduce oil and gas well emissions, showing that HAP reductions have been achieved and are achievable. These technologies have been demonstrated throughout well facilities.

- Well completion: EPA’s regulation of some wells in the New Source Performance Standards for the oil and gas sector shows that green completions and other reduced VOC emission requirements are available and effective.\textsuperscript{264} These techniques can also be applied to oil-producing wells, which are currently not subject to the New Source Performance Standards, but are a rapidly growing source of HAP emissions in light of

\textsuperscript{261} See \textit{Sierra Club NESHAP Comments}, supra note 153 at 22 (“Other HAPs are also likely to be emitted that EPA did not capture due to its lack of emission test data. Both EPA and the public need more information about oil and gas chemicals used in the United States today for hydraulic fracturing, because many are either not disclosed, or the public has limited or no information about the health risks associated with them.”); see also Earthjustice et al., \textit{Citizen Petition under TSCA Regarding the Chemical Substances and Mixtures Used in Oil and Gas Exploration or Production} (Aug. 4, 2011).

\textsuperscript{262} See \textit{House Committee Report}, supra note 143, at 2 (“Between 2005 and 2009, the companies used 94 million gallons of 279 products that contained at least one chemical or component that the manufacturers deemed proprietary or a trade secret.”).


major shale oil reservoir development expansion in Texas’ Eagle Ford and California’s Monterey shale reserve, among others.  

- Flares: Flaring can be reduced or capped except when necessary to avoid emergencies. As EPA’s own research shows, flaring also can be made more effective by implementing better flare monitoring programs, requiring operators to justify each time they flare, and requiring operators to ensure efficient flare operation.  

- Plunger lifts for liquids unloading: Emissions released from liquids unloading and other well cleanup activities can be reduced or eliminated with the use of plunger lifts. Emissions from liquids unloading are not controlled by EPA’s new source performance standards.  

- Compressors: Gas leakage and emissions from wellhead compressors (which are not subject to the NSPS) can be substantially reduced using centrifugal compressors.

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265 See, e.g., 2 Colo. Code Regs. § 404-1(805)(b)(3)(A) (requiring green completions on both oil and gas wells “where reservoir pressure, formation productivity, and wellbore conditions are likely to enable the well to be capable of naturally flowing hydrocarbon gas in flammable or greater concentrations at a stabilized rate in excess of five hundred (500) MCFD to the surface against an induced surface backpressure of five hundred (500) psig or sales line pressure, whichever is greater”); WYOMING DEPT’ OF ENVTL. QUALITY, Oil and Gas Production Facilities Chapter 6, Section 2 Permitting Guidance at 15, 20 (2010) [hereinafter Wyoming Guidance], available at http://deq.state.wy.us/aqd/oilgas.asp; Clean Air Council et al., Petition for Reconsideration of Oil and Natural Gas Sector New Source Performance Standards, Dkt. ID No. EPA-HQ-OAR-2010-0505-4575 at 10-14 (Oct. 15, 2012) (discussing growth in oil production and recent data showing significant emissions from co-producing oil and gas wells).  


268 See, e.g., EPA Flare Parameters, supra note 126, at 1-1 to 1-2 (listing factors that can impair flare efficiency); id. at 8-1 (explaining the monitoring equipment needed to ensure efficient flare operation); see also, e.g., Bay Area Air Quality Mgmt. Dist., Regulation 12, Rules 11 & 12 (Flare Monitoring at Petroleum Refineries and Flares at Petroleum Refineries).  

equipped with tandem dry seal systems. Emissions from compressor turbines also can be reduced if driven by electric motors.

- Storage vessels/Produced water ponds: Storage vessels already are achieving 98% emissions reductions in jurisdictions such as Wyoming through the use of certain types of vapor recovery units. This level of emission reduction exceeds the 95% control efficiency required for certain new storage vessels under the NSPS. Similarly rigorous controls could be applied to existing storage vessels at area sources, which are currently not subject to NSPS or NESHAP. Measures addressing emissions from similar impoundments, pits, sumps, and well cellars include prohibitions against organic liquid storage in well cellars and on primary sumps, requirements to cover vessels/pits with VOC impervious material, and replacing open pits with liquid storage tanks equipped with a vapor recovery unit.

- Leak Detection and Repair: LDAR programs should apply to wellheads, compressors and storage vessels and related components and equipment, requiring highly sensitive monitoring systems, use of leakless components, frequent monitoring and low leak detection thresholds of 100 ppm for valves in gas/vapor/light liquid services, and 500 ppm for pumps in light liquid service, and prompt repair requirements with no loopholes. Currently, the NSPS and NESHAP for oil and gas facilities only require LDAR at natural gas processing plants and for certain types of closed vent systems on storage vessels located at major sources.

Requirements to implement these technologies and practices at oil and gas wells and their associated equipment will achieve significant toxic pollution reductions not accomplished by the 2012 Rule. As discussed above, among other loopholes, the NSPS only applies to new wells, leaving the entire fleet of existing wells unregulated, and it exempts oil producing wells from regulation.

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270 EPA Natural Gas STAR, Lessons Learned: Replacing Wet Seals with Dry Seals in Centrifugal Compressors, 1 (Oct. 2006), www.epa.gov/gasstar/documents/ll_wetseals.pdf; see also EPA, Methane Savings from Compressors and VRUs, 11-14 (July 27, 2006), epa.gov/gasstar/documents/savings.pdf (showing low emissions from dry seals and concluding that such seals “often used in tandem” are profitable to install in many circumstances).

271 Copeland and Williams, supra note 267, at 52; See also Wyoming Guidance, supra note 265, at 5, 11, 18 (requiring such controls).

272 Ventura County Air Pollution Control Dist. Rule 71.4(B), (C)(1)(c); So. Coast Air Quality Mgmt. Dist. Rule 1148.1(d)(1)-(3), (6); Santa Barbara County Air Pollution Control Dist. Rules 344(D)(1)-(3), 325(D); San Joaquin Valley Air Pollution Control Dist. Rule 4402(5).

273 See generally Bay Area Air Quality Mgmt. Dist. Regulation 8, Rule 18; Carbon Limits AS, Quantifying Cost-Effectiveness of Systematic Leak Detection and Repair Programs Using Infrared Cameras 6 (prepublication draft Dec. 24, 2013), at http://www.catf.us/resources/publications/files/CATF-Carbon_Limits_Leaks_Interim_Report.pdf (finding that abatement costs for LDAR programs at well sites range from $0 to $300 per ton of VOC emissions eliminated); ICF International, Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries 4-11 to 4-13 (Mar. 2014), at www.edf.org/content/ifc-methane-report (showing cost-effectiveness of HAP reductions achieved through control measures at oil and gas facilities, including LDAR programs).
II. BASED ON THE NEED TO PROTECT PUBLIC HEALTH, THE ADMINISTRATOR MUST LIST AN AREA SOURCE CATEGORY FOR OIL AND GAS PRODUCTION WELLS AND ASSOCIATED EQUIPMENT LOCATED IN THE SECTION 112(n)(4)(B) AREAS.

A. EPA has authority to list oil and gas wells and their associated equipment and to regulate their toxic air emissions.

Section 112(c)(3) of the CAA directs EPA to list “each category or subcategory of area sources which the Administrator finds presents a threat of adverse effects to human health or the environment (by such sources individually or in the aggregate)” warranting regulation under section 112. 274 EPA listed oil and natural gas production as an area source category after EPA identified it in the Urban Air Toxics Strategy as warranting regulation in part because of benzene emissions. 275 However, EPA has not yet regulated toxic air emissions from oil and gas wells under section 112. 276

EPA has the authority to regulate these sources pursuant to section 112(n)(4)(B), which provides an exception to what is otherwise a prohibition on listing oil and gas wells and associated equipment as an area source category under section 112(c). 277 This provision authorizes EPA to list oil and gas production wells and their associated equipment 278 located in “any metropolitan statistical area” or “a consolidated metropolitan statistical area with a

274 42 U.S.C. § 7412(c). An “area source” is “any stationary source of hazardous air pollutants that is not a major source.” Id. § 7412(a)(2).
276 See 40 C.F.R. § 63.760 (applicability and designations of affected sources for oil and gas production NESHAP). EPA’s area source standards regulate only glycol dehydrators at oil and gas production facilities above certain thresholds, with differing regulation depending upon proximity to populated areas. See id.
278 Although section 112(n)(4)(B) does not repeat the clarifying parenthetical, “(with its associated equipment)” when directing EPA to “establish an area source category for oil and gas production wells,” 42 U.S.C. § 7412(n)(4)(B), nothing in the Act compels the irrational interpretation that an area source category covering oil and gas wells must apply standards to the wells exclusively, and not also the equipment used in the production operations that occur at those wells. The term “associated equipment” is not defined in the Act, but EPA has interpreted it to include “all equipment from the wellbore to the point of custody transfer, except glycol dehydration units and storage vessels.” See 40 C.F.R. § 63.761; cf. 40 C.F.R. § 63.765 (glycol dehydration unit process vent standards); 40 C.F.R. § 63.766 (storage vessel standards).
population in excess of one million” as area sources if EPA determines that emissions of hazardous air pollutants from such wells present “more than a negligible risk” of adverse effects to public health. As explained below, this test is met and EPA action is urgently needed to make this determination.

1. The best available evidence shows EPA must find wells pose “more than a negligible risk of adverse effects to public health.”

In order for EPA to exercise its authority under section 112(n)(4)(B), it must make a determination that oil and gas well emissions pose “more than a negligible risk of adverse effects to public health.” The plain meaning of “negligible” makes clear that this was intended to be a low threshold.

According to Webster’s dictionary, “negligible” means “so small or unimportant or of so little consequence as to warrant little or no attention.” Under a faithful reading of this phrase, for EPA to regulate oil and gas wells, they just need to pose a health risk that is not unimportant or inconsequential. This is a low threshold that is easily met by the evidence presented in this Petition.

As described in Part I above and shown by sources listed in the Appendix, studies have found pollutants emitted by oil and gas wells (and associated equipment) cause cancer and other kinds of dangerous chronic and acute health impacts. Substantial numbers of oil and gas wells and associated equipment (such as nearby compressors, waste water impoundments, condensate and storage tanks, and drilling equipment), exist in section 112(n)(4)(B) areas and emit hazardous air pollutants on a daily basis. People living in the relevant areas need health protection from oil and gas well facilities. Toxic air pollutants are of particular concern in the areas covered by section 112(n)(4)(B) because now more than ever, people and sources of emissions are concentrated together in the same geographic area. For people living near current and potential wells, the increased likelihood of cancer, neurological harm, birth defects, trouble breathing, nausea, and other impacts is certainly “more than a negligible” health threat, and EPA should so find and list this new area source category.

280 In addition, EPA defined the oil and natural gas production source category as a whole to include “equipment leaks, storage tanks, power generating equipment, wastewater treatment, and process vents.” EPA, Documentation for Developing the Initial Source Category List, supra note 275, at A-25 (including “the processing and upgrading of crude oil prior to entering the petroleum refining process and natural gas prior to entering the transmission line”). Thus, in addition to listing and regulating oil and gas wells and associated equipment, EPA must fulfill its responsibility to regulate the full, listed area source category (not just TEG dehydration units or glycol dehydrators), as required by section 112(c)(5) and (d)(1). 42 U.S.C. § 7412(c)(5), (d)(1) (requiring EPA to set standards under § 112(d) to control emissions from each listed source category within 2 years after listing the source category, or by November 15, 2000, whichever is later).
282 WEBSTER’S NEW COLLEGIATE DICTIONARY 769 (1974 ed.).
283 EPA, RISK ASSESSMENT AND MODELING, supra note 243, Part I Background, at 1-2.
a. Cancer risk is more than negligible.

The fact that these sources emit pollutants that create cancer risk, as described in Part I, above, requires listing. No level of exposure to cancer-causing pollutants and no level of cancer risk is insignificant or negligible. In enacting section 112 of the Act, Congress made this clear, stating that “Federal Government health policy since the mid-1950s has been premised on the principle that there is no safe level of exposure to a carcinogen and, unless all of the sources in the category are so remote that no human exposure occurs (a circumstance unclaimed for any source category at this time), standards should be imposed and the discretion not to act would be inappropriate.”

In addition, EPA should fully evaluate this source category to assess the real-world cancer risk that it causes. Available data suggest that residents living near well pads face an estimated lifetime excess cancer risk well above one-in-one million, which is at least “more than negligible.” Congress has repeatedly recognized this level of cancer risk as problematic under CAA § 112. For example, under section 112(c)(9), EPA may not delete any source category from the list of area sources if it poses a cancer risk “greater than one in one million” to the most exposed person. This prohibition on delisting shows that Congress believed cancer risk above that level is, at least, more than negligible. As another example, in defining the requirement for health risk standards under section 112(f)(2), Congress directed that if lifetime cancer risk for the most-exposed person has not been reduced to “less than one in one million, the Administrator shall promulgate standards” under section 112(f). Because the statute triggers regulation at that level, it, at minimum, also shows a congressional concern for cancer risk at that level, indicating that it is, at least, more than negligible.

Consistent with Congress’s approach, the D.C. Circuit has also recognized that preventing cancer risk above one-in-one million is an “aspirational goal” established by section 112(f)(2). Similarly, EPA has found that cancer risk of one in one million or more contributes

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285 See, e.g., Witter, supra note 189, at 24-25.
286 As discussed in section I.C.7 above, current data likely underestimates the total risk, and to account for this, EPA must evaluate the real-world health risk for children and overburdened communities. For example, EPA must use children’s health (i.e., age-dependent adjustment factors) to assess risk from all carcinogens (as Cal. EPA OEHHA does); EPA must use an in-utero (children’s health) exposure factor of 10X to assess cancer risk (as OEHHA does); EPA must apply child-health reference doses where they have been developed (including those created by OEHHA); EPA must evaluate the cumulative impacts of exposure to multiple pollutants, from multiple sources, through multiple pathways; EPA must use additional factors to account for uncertainty and vulnerability, including based on environmental justice impacts. Petitioners have provided EPA with information on these issues and will be glad to provide additional information at EPA’s request.
288 Id. § 7412(f)(2)(A).
289 NRDC v. EPA, 529 F.3d 1077, 1082 (D.C. Cir. 2008). The court also found that 1-in-200,000 or 5-in-1 million was “sufficient to support standing,” demonstrating that this level could not be negligible.

NRDC v. EPA, 464 F.3d 1, 7 (D.C. Cir. 2006).
to a “determination of [the] unacceptability” of health risk created by an air toxics source category.\textsuperscript{290}

b. Non-cancer chronic and acute health risks are more than negligible.

The threat of other non-cancer health impacts from wells’ toxic air emissions is also important and shows the need for listing. As described above, oil and gas wells can emit many pollutants that are associated with non-cancer chronic and acute health risks. And, as an example, one community health risk assessment found acute and chronic non-cancer risk well above the level at which harmful health impacts can occur.\textsuperscript{291} Moreover, similar to the one in one million cancer risk threshold discussed above, the fact that EPA may not delist a source category under section 112(c)(9) unless no source’s emissions “exceed a level which is adequate to protect public health with an ample margin of safety and no adverse environmental effect will result from emissions from any source ([or group of sources]),” indicates that Congress considered that level of health risk to be, at least, more than negligible for pollutants that may result in adverse effects other than cancer.\textsuperscript{292} Because oil and gas wells emit HAPs that cause acute and chronic (non-cancer) health impacts, EPA has information showing that it must list oil and gas wells as an area source.

c. Listing oil and gas wells would serve the objectives of § 112(c)(3) and would be consistent with EPA’s past area source listings.

CAA § 112(c)(3) directs EPA to list each area source category “which the Administrator finds presents a threat of adverse effects to human health or the environment (by such sources individually or in the aggregate) warranting regulation.”\textsuperscript{293} This test is similar to the “more than negligible risk” test enacted in § 112(n)(4)(B). In each instance, as EPA has recognized, all that is required is a “threat” of harm.\textsuperscript{294}

EPA has interpreted the Act as not creating a “bright line” rule for what is required to list and regulate area sources, but directing a consideration of various relevant factors, including “the number of sources in a category, the quantity of emissions from sources individually or in aggregate, the toxicity of the HAP emissions, the potential for individual and population exposures and risks, and the geographical distribution of sources.”\textsuperscript{295} EPA has evaluated cancer

\begin{footnotes}
\item[291] Witter, supra note 189, at 23-24 (finding hazard index of 40 for acute risks and of 2 for chronic non-cancer risks); McKenzie, supra note 51, at 83-86 (suggesting the existence of increased respiratory, neurological and cancer risks for people in proximity to wells).
\item[293] Id. § 7412(c)(3).
\item[294] Initial Listing Rule, 57 Fed. Reg. at 31,586-87 (finding § 112(c)(3) requires a “threat of adverse effect, not a demonstration of the adverse effect, per se”).
\end{footnotes}
and other kinds of health threats, including “carcinogenicity, mutagenicity, teratogenicity, neurotoxicity, reproductive dysfunction and other acute and chronic effects.”

Regarding cancer risk, the agency has also noted that:

In making area source listing determinations, the EPA strives to provide maximum feasible protection against risks to health from HAP’s by: (1) Protecting the greatest number of persons possible to an individual lifetime cancer risk level of no higher than approximately 1 in 1 million and (2) limiting to no more than 1 in 10,000 the estimated cancer risk to the hypothetical maximum exposed individual.

Listing oil and gas wells would be consistent with that approach for area sources because these sources have cancer risk above the level of one-in-one million, and also cause other kinds of health threats identified by EPA, as described in Part I.

Further, listing oil and gas wells and associated equipment would be consistent with EPA’s listings of other specific categories of area sources, including glycol dehydrators at oil and gas production facilities. Oil and gas wells (and associated equipment) emit similarly dangerous pollutants, cause similarly harmful health risks (including a risk of cancer), and are affecting populated communities, as EPA found for other listed area sources.

d. Listing oil and gas wells would fulfill the objectives of the Area Source Program under 112(k).

EPA also must list oil and gas wells to meet the objectives of the Area Source Program and CAA § 112(k), as well as § 112(n)(4)(B). As Congress found in establishing the Area Source Program of the Clean Air Act, “emissions of hazardous air pollutants from area sources may individually, or in the aggregate, present significant risks to public health in urban areas.” Further, “[c]onsidering the large number of persons exposed and the risks of carcinogenic and other adverse health effects from hazardous air pollutants,” Congress determined that “ambient concentrations characteristic of large urban areas should be reduced to levels substantially below those currently experienced.”

Benzene is one of the 30 pollutants EPA included in the Urban Air Toxics Strategy under CAA § 112(k)(3)(B)(i), “which, as the result of emissions from area sources, present the greatest

298 See supra notes 275-76, and accompanying text.
299 For example, EPA listed secondary lead smelters as an area source category because of their cancer and non-cancer risk. Secondary Lead Smelting Rule, 60 Fed. Reg. at 32,591. In other area source determinations, EPA listed sources due to their combination of health risks, including cancer. Initial Listing Rule, 57 Fed. Reg. at 31,588-80 (describing findings for commercial sterilizers using ethylene oxide, chromium electroplaters and anodizers, halogenated solvent cleaners, and asbestos processing).
300 42 U.S.C. § 7412(k)(1).
301 Id.
threat to public health in the largest number of urban areas.” 302 This provision requires EPA to “assure that sources accounting for 90 [percent] or more of the aggregate emissions of each of the 30 identified hazardous air pollutants are subject to standards pursuant to subsection (d) of [section 112].” 303 EPA identified certain pieces of equipment in the oil and gas production sector as an area source requiring regulation as part of the Strategy, in part because they contributed 47 percent of the national urban benzene emissions from area sources. 304 Oil and gas wells are also a significant source of benzene in urban areas covered by § 112(n)(4)(B), as well as formaldehyde and other listed pollutants, and they likely will become even more significant sources with the continued expansion of oil and gas development at the urban interface. EPA should therefore regulate them to fulfill the directives of § 112(k) and 112(c) and its outlined objectives for the Area Source Program.

2. EPA must protect all communities covered by CAA § 112(n)(4)(B) from the health risk created by oil and gas wells.

Substantial areas of the United States are included in the geographical areas to which section 112(n)(4)(B) applies. Part I, above, has provided many examples of these areas that have oil and gas wells, and many additional areas are slated for potential shale development, requiring urgent EPA action.

Section 112(n)(4)(B) authorizes EPA to list oil and gas wells as area sources in any “metropolitan statistical area” (“MSA”) or “consolidated metropolitan statistical area with a population in excess of one million” (“CMSA”). 305 This covers both metropolitan areas (including counties connected to cities) and larger, consolidated areas (of multiple cities and counties). It is consistent with the purposes of the Clean Air Act, including the protection of public health and welfare and pollution prevention 306 and the objectives of the air toxics program in section 112 to ensure that EPA effectively regulates dangerous air toxics, 307 to interpret the relevant statistical area terms to cover as many affected communities as possible.

As an initial matter, the “population in excess of 1 million” requirement in § 112(n)(4)(B) applies only to consolidated metropolitan statistical areas. The statute extends coverage under

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304 2007 Oil and Gas Area Source NESHAP, 72 Fed. Reg. at 28. However, in setting area source standards for oil and gas production, EPA only restricted the emissions of glycol dehydrators (TEG dehydration units), and did so based on a cut-off and geographical distinctions, so that it did not even regulate all of these sources, or apply the same standard. *Id.* at 28-29.
306 42 U.S.C. § 7401(b)(1), (c).
this provision to sources in “any metropolitan statistical area or consolidated metropolitan statistical area with a population in excess of 1 million,” not “any metropolitan statistical area with a population in excess of 1 million or consolidated metropolitan statistical area with a population in excess of 1 million.” The “rule of last antecedent” confirms that the population requirement applies only to CMSAs. Under this rule, relative or modifying phrases such as “with a population in excess of 1 million” are to be applied only to words immediately preceding them—here, “consolidated metropolitan statistical areas”—and are not to be construed as extending to more remote phrases, such as “metropolitan statistical areas.”

Although it is clear that the population threshold in section 112(n)(4)(B) applies only to CMSAs, neither section 112, nor the rest of the Clean Air Act provides a specific definition of the terms MSA and CMSA. Elsewhere in some places, the Act refers to the definitions “established by the Bureau of the Census” or “the Office of Management and Budget.” These references reflect the shifting responsibility within the federal government for identifying MSAs and CMSAs. Formerly, the Census Bureau used MSA and CMSA delineations created by the Department of Commerce, but now OMB establishes these delineations.

At the time of the 1990 Clean Air Act Amendments, the standards defining the terms MSA and CMSA for use by the Census Bureau were issued in 1980 by the Office of Federal

309 See generally Barnhart v. Thomas, 540 U.S. 20, 26 (2003) (explaining that according to the grammatical “rule of the last antecedent,” a limiting clause or phrase should ordinarily be read as modifying only the noun or phrase that it immediately follows, and that while this rule is not an absolute and can be overcome by other indicia of meaning, construing a statute in accord with the rule is “quite sensible as a matter of grammar”).
310 See, e.g., 42 U.S.C. § 7407(d)(4)(A)(iv) (referring to “a metropolitan statistical area or consolidated metropolitan statistical area (as established by the Bureau of the Census),” and expanding ozone and carbon monoxide nonattainment areas to include the entire MSA or CMSA within which they are located); id. § 7511a(h)(1) (referring to “a Metropolitan Statistical Area or, where one exists, a Consolidated Metropolitan Statistical Area (as defined by the United States Bureau of the Census),” and addressing “rural transport areas” for ozone); id. § 7512a(b)(3)(A) (referring to “the Consolidated Metropolitan Statistical Area (as defined by the United States Office of Management and Budget) (CMSA)” and if the area is not located in a CMSA, the Metropolitan Statistical Area (as defined by the United States Office of Management and Budget),” and addressing requirements for oxygenated gasoline). The following CAA provisions also use these terms, like § 112(n)(4)(B), without reference to the Census Bureau or OMB: 42 U.S.C. §§ 7511c(a) (ozone transport regions), 7545(m)(2) (oxygenated gasoline in CO nonattainment areas), 7554(c)(2)(A) (low-polluting fuel requirement for urban buses in MSAs or CMSAs with a 1980 population of 750,000 or more).
Statistical Policy and Standards (Department of Commerce). The Department of Commerce then defined the term “metropolitan statistical area” to mean an area that includes a city with a population of at least 50,000, or an urbanized area with a population of at least 50,000 and a total MSA population of at least 100,000. A typical MSA included central counties (with the main population concentration) and “outlying counties which have close economic and social relationships with the central counties,” including commuting ties, and a certain level of population density. At that time, CMSAs were areas that included over 1 million population, with more than one MSA with a large urbanized county or county cluster and “very strong internal economic and social links.” Each term also included both urban areas and less-populated areas related to them, including some territory “where the population density is less than 1,000 persons per square mile.”

In the intervening decades, OMB has made several adjustments to the criteria governing metropolitan area delineations. OMB issued its most recent interpretation of these terms in 2010. OMB currently defines the term “metropolitan statistical area” to mean: at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. The term “urbanized area” means: “A statistical geographic entity delineated by the Census Bureau,

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312 See Dep’t of Commerce, Ofc. of Fed. Statistical Policy & Standards, Metropolitan Statistical Area Classification, 45 Fed. Reg. 956 (Jan. 3, 1980) [hereinafter “1980 Standards”]. While Congress was considering the 1990 amendments to the Clean Air Act, OMB issued revised standards for delineating MSAs and CMSAs. See OMB, Revised Standards for Defining Metropolitan Areas in the 1990’s, 55 Fed. Reg. 12,154 (Mar. 30, 1990). However, the OMB standards did not take effect until after the 1990 Clean Air Act amendments were enacted. See id. at 12,154 (explaining that the 1980 standards “remain in effect until the list of metropolitan areas [meeting the new standards] is issued in June 1992”).


314 Id. at 956. In New England, MSAs include cities and towns instead of whole counties. Id. (the 1980 statistical area definitions that the 1990 delineations were based on defined consolidated metropolitan statistical areas as follows: “In areas with over 1 million population . . . primary metropolitan statistical areas may be identified. These areas consist of a large urbanized county, or cluster of counties, that demonstrates very strong internal economic and social links, in addition to close ties to neighboring areas. When primary metropolitan statistical areas are defined, the large area of which they are component parts is designated a consolidated metropolitan statistical area.”).

315 Id. at 957.


318 2010 Standards, 75 Fed. Reg. at 37,252 (defining metropolitan statistical area as: “A Core Based Statistical Area associated with at least one urbanized area that has a population of at least 50,000. The Metropolitan Statistical Area comprises the central county or counties containing the core, plus adjacent outlying counties having a high degree of social and economic integration with the central county or counties as measured through commuting.”).
consisting of densely settled census tracts and blocks and adjacent densely settled territory that
together contain at least 50,000 people.”  

The other term in section 112(n)(4)(B), “Consolidated Metropolitan Statistical Area,” is not currently in use by OMB. In 2000, OMB ended use of that term, and created a new term called “Combined Statistical Area” (“CSA”). The term CSA currently means the following: “A geographic entity consisting of two or more adjacent Core Based Statistical Areas with employment interchange measures of at least 15.” A combined statistical area may include two or more areas that are either metropolitan or micropolitan. The most recent list of cities and counties within MSAs and CSAs was published by OMB in 2013, applying the 2010 OMB Standards.

The Census Bureau’s and OMB’s treatment of these terms can provide guidance as to their meaning in section 112(n)(4)(B). Consistent with OMB’s evolving approach, EPA should substitute the term CSA for CMSA in applying § 112(n)(4)(B). This would fulfill Congressional intent to capture not only MSAs, but also certain combined geographical areas that share social and economic ties and have a population of one million or more. In sum, based on the current OMB guidance, the coverage of section 112(n)(4)(B) includes all MSAs and all CSAs that meet the population requirement. However, at a minimum, the provision applies to all metropolitan statistical areas and all consolidated metropolitan statistical areas with a population of more than 1 million that would meet the standards in effect when the section 112(n)(4)(B) was enacted.

In Part I, above, this Petition describes a number of areas that meet the section 112(n)(4)(B) criteria based on the 1980 standards and OMB’s most recent delineations in 2013. A more complete, but not exhaustive, list of the areas covered by MSAs and CSAs (with a population in excess of 1 million) is attached. Generally, areas that would have been covered under the 1980 standards continue to be covered, and some additional areas would now be covered under the 2010 standards. EPA should also interpret the statutory terms in section 112(n)(4)(B) to include areas that later became covered by the OMB’s new delineations of these terms, in view of the fact that Congress should be presumed aware of the ongoing evolution of

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320 Id.
323 The core based statistical area referred to in the definition of a CSA is either a metropolitan statistical area, or a micropolitan statistical area. 2010 Standards, 75 Fed. Reg. at 37,252 (defining micropolitan statistical area as: “A Core Based Statistical Area associated with at least one urban cluster that has a population of at least 10,000, but less than 50,000.”).
324 See OMB BULLETIN 13-01, supra note 25, at 116 (List 6, showing counties designated in each state and level of designation).
325 See, e.g., supra notes 25, 38, 61, 69, 89 and 92.
326 See Table 3 – Metropolitan Statistical Areas (MSAs) with Active Oil and Gas Wells (Appendix A); Table 4 – Combined Statistical Areas (CSAs) with Population Greater than 1 Million and Active Oil and Gas Wells (Appendix A); Table 5 – Presence of Active Oil and Gas Wells in -- (1) Combined Statistical Areas (CSAs) with population greater than 1 million and (2) Metropolitan Statistical Areas (MSAs) not located in such a CSA (Appendix A).
these terms. For years before 1990, the terms Congress chose to use had been updated at various points in time, so it is reasonable to assume that Congress would expect this to continue to occur.\footnote{327}

The lists of states, counties and corresponding statistical areas given in this petition are provided as examples (and not intended to be an exclusive account of the areas that would be covered by an area source listing under section 112(n)(4)(B)). These examples of significant numbers of communities affected by oil and gas production and resulting toxic air emissions illustrate that a substantial number of people in the U.S. -\textit{i.e.}, over 150 million - live in an area covered by section 112(n)(4)(B).\footnote{328} However the terms in section 112(n)(4)(B) are interpreted, the examples given in this petition illustrate that significant numbers of oil and gas wells are also located in areas covered by section 112(n)(4)(B). To ensure adequate air pollution safeguards in the many areas impacted by drilling, EPA must evaluate and act on this Petition without delay.

\textbf{B. The Administrator has a duty to establish robust emissions standards for the oil and gas well area source category.}

Upon listing oil and gas wells as an area source category, EPA has a duty to set emissions standards for oil and gas production wells and their associated equipment in accordance with Clean Air Act sections 112(c), (d), and (k).\footnote{329} EPA must set standards under section 112(d) for a listed area source category within two years of listing.\footnote{330}

Under section 112(d), EPA may set emission standards for area sources either pursuant to section 112(d)(2)-(3) (i.e., “MACT” standards), or section 112(d)(5) (i.e., “GACT” standards). MACT standards promulgated pursuant to section 112(d)(2) require “the maximum degree of reduction in emissions” of the hazardous air pollutants subject to section 112 of the Clean Air Act, including a prohibition on such emissions, where achievable, that EPA, “taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable.”\footnote{331} The statute directs that “[t]he maximum degree of reduction in emissions that is deemed achievable for new sources. . . shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source.”\footnote{332} For existing sources, emission standards “shall not be less stringent, and may be more stringent than – the average emission limitation achieved by the best performing 12 percent of the existing sources (for which the Administrator has emissions information),”\footnote{333} Alternatively, GACT standards “provide for the use of generally available

\begin{footnotes}
\item[327] See sources cited \textit{supra} note 311.
\item[328] See sources cited \textit{supra} note 326; Tables 3-5, Appendix.
\item[329] 42 U.S.C. §§ 7412(c), (d), & (k).
\item[330] \textit{Id.} §§ 7412(c)(2) & (5).
\item[331] \textit{Id.} § 7412(d)(2).
\item[332] \textit{Id.} § 7412(d)(3).
\item[333] \textit{Id.} §§ 7412(d)(3)(A) (setting emission floor requirements), (B) (also providing that if there are fewer than 30 sources, the floor must be “the average emission limitation achieved by the best performing 5 sources”).
\end{footnotes}
control technologies or management practices by such sources to reduce emissions of hazardous air pollutants.”

Public health warrants strong regulations for oil and gas wells, under § 112(d)(2)-(3). EPA must set MACT standards for these oil and gas wells (and associated equipment), because of the significant health concerns that they pose. Doing so would be consistent with the Congressional findings in the Clean Air Act that “emissions of hazardous air pollutants from area sources may individually, or in the aggregate, present significant risks to public health in urban areas” and that “[c]onceiving the large number of persons exposed and the risks of carcinogenic and other adverse health effects from hazardous air pollutants, ambient concentrations characteristic of large urban areas should be reduced to levels substantially below those currently experienced.”

Once listed, the oil and gas well area source category will contribute to EPA’s urban air toxics strategy, through which EPA must reduce cancer and other health risks from emissions by area sources. The stated purpose of this program is “to achieve a substantial reduction in emissions of hazardous air pollutants from area sources and an equivalent reduction in the public health risks associated with such sources including a reduction of not less than 75 per centum in the incidence of cancer attributable to emissions from such sources.” This program includes both a national strategy and area-wide activities.

As the Secretary of Energy Advisory Board stated in a recent report: “Measures should be taken to reduce emissions of air pollutants . . . as quickly as practicable. The Subcommittee supports adoption of rigorous standards for new and existing sources of . . . air toxics, ozone precursors and other air pollutants from shale gas operations.” Moreover, in his 2012 State of the Union Address, President Obama promised that his “administration will take every possible action to safely develop this energy . . . without putting the health and safety of our citizens at risk.”

It would be consistent with EPA’s past action on other area sources to set MACT standards for oil and gas wells. As EPA explained in regulating area sources in the halogenated solvents source category, “[a]rea sources are regulated with a MACT standard, unless there is

334 Id. § 7412(d)(5).
335 Id. § 7412(k)(1) (emphasis added).
336 Id. (emphasis added).
337 Id. §§ 7412(k)(3)-(4).
338 Id. § 7412(k)(1).
339 See id. § 7412(k)(3)-(4).
340 90-Day Report, supra note 4, at 2 (emphasis added).
justification for regulating them under GACT.\textsuperscript{342} Here, there is no valid justification not to set strong MACT standards.

Rather, key reasons that EPA has given for setting MACT standards for area sources in prior rules are also present here. Oil and gas wells emit HAPs that can cause serious health effects, including increased cancer risks, and their emissions implicate environmental justice concerns. As EPA has explained in other area source rulemakings, such as its rule for secondary lead smelters, emissions of dangerous HAPs like carcinogens and environmental justice concerns, considering sources operate in disproportionately minority and low-income communities, direct the use of MACT (not GACT) standards.\textsuperscript{343} Here, benzene, n-hexane, formaldehyde, toluene, and ethylbenzene (among other hazardous air pollutants that oil and gas wells emit) are extremely toxic. Likewise, since oil and gas development also implicates environmental justice concerns (as discussed in Part I, above), a reduction in emissions from these sources would help advance the objectives of both the CAA and the Executive Order on Environmental Justice, No. 12,898.\textsuperscript{344}

Finally, EPA should set area source standards that apply Title V requirements to oil and gas wells and their associated equipment. Title V is an important program that allows affected communities the opportunity to review and comment on proposed permits and facilitates enforcement and compliance with emission standards by requiring monitoring and reporting.\textsuperscript{345}

III. CONCLUSION

The swift expansion of oil and gas development in the United States—particularly development utilizing new drilling techniques—continues to bring oil and gas wells closer to homes, schools, and businesses nationwide, often in areas of the country that are home to large numbers of people. Because only a small set of emission points related to oil and gas production is currently subject to any air toxics regulation under section 112, increased development means that large numbers of people are now being exposed to more and more toxic air emissions on a steady, daily basis. With oil and gas companies poised to add tens of thousands of additional wells across the country annually, public health threats posed by this development will only increase unless EPA acts to list oil and gas wells as a source category and set emission standards to limit their toxic air emissions.

Oil and gas well emissions pose a “more than negligible” risk to public health, as shown by the data cited in and attached to this Petition. Based on available health studies, EPA has a duty to list oil and gas wells as an area source category pursuant to section 112(n)(4)(B), and it


\textsuperscript{344} See The President, Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations, 59 Fed. Reg. No. 32 (Feb. 16, 1994). Moreover, as described in section I.D above, the majority of HAP emissions from wells and associated equipment can be controlled by existing technologies already in use in the industry.

\textsuperscript{345} See generally 42 U.S.C. § 7661a; 40 C.F.R. §§ 70.1-70.12.
must do so now to protect the health of communities across the United States that are already facing emissions from massive oil and gas expansions.

For more information and to provide a timely response to this petition within 180 days, as requested above, please contact us at your earliest convenience. For your reference, please find the tables, maps, and major sources cited in the Appendix, and also provided on an accompanying CD-ROM.

Thank you for your time and prompt consideration of this petition.

Sincerely,

Emma Cheuse  
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Miriam Rotkin-Ellman  
NATURAL RESOURCES DEFENSE COUNCIL  
mrotkinellman@nrdc.org  
(415) 875-6128

SUBMITTED ON BEHALF OF THE FOLLOWING UNDERSIGNED PETITIONERS:

**California:**  
California Communities Against Toxics  
California Kids IAQ  
California Safe Schools  
Center on Race, Poverty & the Environment  
Citizens Coalition for a Safe Community  
Clean Water & Air Matter  
Coalition For A Safe Environment  
Comite Pro Uno  
Communities for a Better Environment  
Community Dreams  
Esperanza Community Housing Corporation  
Physicians for Social Responsibility - Los Angeles  
Tri-Valley CAREs  

**Colorado:**  
Citizens for Clean Air  
Colorado Citizens Lobby  
Douglas County Green Party  
Sheep Mountain Alliance  
Sierra Club Rocky Mountain  

**Connecticut:**  
Mitchell Environmental Health Associates  

**Louisiana:**  
Louisiana Bucket Brigade  
Louisiana Environmental Action Network  
Sierra Club Delta Chapter (Louisiana)  

**New York:**  
Catskill Citizens for Safe Energy  
Catskill Mountainkeeper  
Citizens’ Environmental Coalition  
Concerned Health Professionals of New York  
Riverkeeper, Inc.
Ohio:
Athens County Fracking Action Network
Buckeye Forest Council

Pennsylvania:
Berks Gas Truth
Breathe Easy Susquehanna County (BESC)
Lehigh Valley Gas Truth
Pennsylvania Forest Coalition
Sierra Club Pennsylvania Chapter
Clean Air Council

Texas:
Air Alliance Houston
Downwinders At Risk
Sierra Club Lone Star Chapter (TX)
Texas Campaign for the Environment

Wyoming:
Clark Resource Council
Pavillion Area Concerned Citizens
Powder River Basin Resource Council

National and Regional:
Alliance of Nurses for Healthy Environments
Center for Biological Diversity
Center for Effective Government
Center for Health, Environment and Justice
Clean Air Taskforce
ClimateMama
Delaware Riverkeeper Network
Earthworks
EcoFlight
Environmental Defense Fund
Global Community Monitor
Greenpeace
Natural Resources Defense Council
Physicians Scientists & Engineers for Healthy Energy
SafeMinds
Sierra Club Beyond Natural Gas Campaign
Sierra Club Beyond Oil Campaign
TEDX, The Endocrine Disruption Exchange
The Mothers Project, Inc.
U.S. Climate Plan
Western Environmental Law Center
WildEarth Guardians
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**Table 1 - NSPS V. NESHAP COVERAGE COMPARISON: REGULATION OF WELLS AND ASSOCIATED EQUIPMENT**

<table>
<thead>
<tr>
<th>REGULATED</th>
<th>NOT REGULATED</th>
<th>REGULATED</th>
<th>NOT REGULATED</th>
<th>NOT COVERED BY NSPS OR NESHAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NSPS</strong></td>
<td></td>
<td><strong>NESHAP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• New or reconstructed facilities that are covered; and</td>
<td>Existing oil and gas wells (and associated equipment) that have not undergone modification since Aug. 23, 2011.</td>
<td>New and existing covered facilities, which include: glycol dehydrators and storage vessels at oil and natural gas production facilities, and certain equipment leaks at natural gas processing plants, if located prior to the point of custody transfer at a major source.</td>
<td>Everything else at well sites and production facilities located prior to the point of custody transfer, including oil and gas wells (unless they meet the 10 tpy single HAP/25 tpy total HAP threshold, which seems to be few or none).</td>
<td>1. Oil wells (new and existing)</td>
</tr>
<tr>
<td>• Covered facilities that undergo modification.</td>
<td>In 2009 there were an estimated 1.02 million onshore oil and natural gas wells in the United States, split roughly evenly between the two types.</td>
<td>Only glycol dehydrators and storage vessels can be aggregated to determine major source status.</td>
<td>Additional exemptions:</td>
<td>2. Conventional gas wells (new and existing)</td>
</tr>
<tr>
<td>• Modification: any physical change in, or change in the method of operation of, a facility which increases the amount of any air pollutant emitted or results in the emission of any air pollutant not previously emitted.</td>
<td>Significant sources of emissions that not regulated under the NSPS include:</td>
<td></td>
<td>* Black oil facilities.</td>
<td>3. Existing hydraulically fractured gas wells (unless modified)</td>
</tr>
<tr>
<td></td>
<td>• Most pneumatic controllers</td>
<td></td>
<td>* A major source facility, prior to the point of custody transfer, with a facility-wide annual average natural gas throughput less than 18.4 thousand cubic meters per day and a facility-wide actual annual average hydrocarbon liquid throughput less than 39,700 liters per day.</td>
<td>4. New hydraulically fractured gas wells that are exempted from the NSPS</td>
</tr>
<tr>
<td></td>
<td>• Most well completions</td>
<td></td>
<td>Additional exemptions:</td>
<td>5. Most equipment associated with wells, including: many storage vessels, pneumatic controllers, compressors, and equipment leaks. All equipment is unregulated (except certain large TEG glycol dehydrators, which are subject to area source standards, if not major source standards) if located at facilities that do not meet major source threshold due to aggregation prohibition (42 USC § 112(n)(4)(A)).</td>
</tr>
<tr>
<td></td>
<td>• Some storage vessels</td>
<td></td>
<td>* Black oil facilities.</td>
<td>Note: coverage under both NSPS and NESHAP depends largely on whether a piece of associated equipment is located “prior to the point of custody transfer.” See 40 C.F.R. §§ 60.5365, 5430; 40 C.F.R. §§ 63.1270-71, 760-761.</td>
</tr>
<tr>
<td></td>
<td>• Many compressors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Liquids unloading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Produced water ponds</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

42 U.S.C. § 7411(a)(2); 40 C.F.R. pt. 60 subpt. OOOO (§§ 60.5360 - 60.5430).
### Table 2 - Oil and Gas Sector Summary

Comparison of Emissions Controlled by EPA's Final Rule ("Controlled") vs. Emissions that Could Have Been Controlled by EPA's Final Rule But Were Not ("Not Controlled")

<table>
<thead>
<tr>
<th>Emission Type</th>
<th>Emissions (tons/year) in 2012</th>
<th>Methane</th>
<th>VOC</th>
<th>HAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Natural Gas Wells Drilled and Completed using Hydraulic Fracturing</td>
<td>1,589,622</td>
<td>215,559</td>
<td>16,844</td>
<td></td>
</tr>
<tr>
<td>New Wild Cat Exploration, Delineation, and Low Pressure Wells Routed to Control Device During Completion Operations</td>
<td>218,323</td>
<td>29,606</td>
<td>2,313</td>
<td></td>
</tr>
<tr>
<td>Gas Wells Refractured</td>
<td>224,665</td>
<td>30,466</td>
<td>2,381</td>
<td></td>
</tr>
<tr>
<td><strong>Wells Subtotal</strong></td>
<td><strong>2,032,611</strong></td>
<td><strong>275,630</strong></td>
<td><strong>21,538</strong></td>
<td></td>
</tr>
<tr>
<td>Oil and Gas Production Segment: Pneumatic controllers &gt;6 scfh installed after 8-23-11.</td>
<td>90,685</td>
<td>25,210</td>
<td>952</td>
<td></td>
</tr>
<tr>
<td>Gas Processing Plant Segment: All pneumatic controllers in installed after 8-23-11.</td>
<td>225</td>
<td>63</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Pneumatic Controllers Subtotal</strong></td>
<td><strong>90,910</strong></td>
<td><strong>25,273</strong></td>
<td><strong>954</strong></td>
<td></td>
</tr>
<tr>
<td>New Gas Production (Gathering &amp; Boosting) Reciprocating Compressors</td>
<td>1,437</td>
<td>400</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>New Gas Processing Plant Reciprocating Compressors</td>
<td>3,892</td>
<td>1,082</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>New Gas Processing Plant Centrifugal Compressors</td>
<td>2,810</td>
<td>254</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Compressors Subtotal</strong></td>
<td><strong>8,139</strong></td>
<td><strong>1,736</strong></td>
<td><strong>65</strong></td>
<td></td>
</tr>
<tr>
<td>New Storage Vessels &gt;6 tpy VOC</td>
<td>6,490</td>
<td>29,746</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td><strong>Storage Vessels Subtotal</strong></td>
<td><strong>6,490</strong></td>
<td><strong>29,746</strong></td>
<td><strong>68</strong></td>
<td></td>
</tr>
<tr>
<td>New Gas Processing Plants</td>
<td>1,490</td>
<td>415</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Equipment Leaks Subtotal</strong></td>
<td><strong>1,490</strong></td>
<td><strong>415</strong></td>
<td><strong>16</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal of Emissions Controlled by EPA's Final Rule</strong></td>
<td><strong>2,139,640</strong></td>
<td><strong>332,800</strong></td>
<td><strong>22,641</strong></td>
<td></td>
</tr>
<tr>
<td>Gas Well Venting - Liquids Unloading (Existing Wells)</td>
<td>2,464,800</td>
<td>359,614</td>
<td>26,127</td>
<td></td>
</tr>
<tr>
<td>Gas Well Venting - Liquids Unloading (New Wells) (Note 1)</td>
<td>96,440</td>
<td>14,071</td>
<td>1,022</td>
<td></td>
</tr>
<tr>
<td><strong>Wells Subtotal</strong></td>
<td><strong>2,561,240</strong></td>
<td><strong>373,685</strong></td>
<td><strong>27,149</strong></td>
<td></td>
</tr>
<tr>
<td>Oil and Gas Production and Gas Processing Plant Segments: Convert existing high-bleed devices to low-bleed devices.</td>
<td>439,432</td>
<td>122,248</td>
<td>4,626</td>
<td></td>
</tr>
<tr>
<td>Transportation and Storage Segments: Convert existing high-bleed devices to low-bleed devices.</td>
<td>43,520</td>
<td>1,210</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Transportation and Storage Segments: Require low-bleed pneumatic controllers installed after 8-23-11.</td>
<td>212</td>
<td>6</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td><strong>Pneumatic Controllers Subtotal</strong></td>
<td><strong>483,164</strong></td>
<td><strong>123,464</strong></td>
<td><strong>4,667</strong></td>
<td></td>
</tr>
<tr>
<td>New Wellhead Reciprocating Compressors</td>
<td>20,520</td>
<td>3,131</td>
<td>114.9</td>
<td></td>
</tr>
<tr>
<td>New Transmission Reciprocating Compressors</td>
<td>423</td>
<td>12</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>New Storage Reciprocating Compressors</td>
<td>87</td>
<td>2</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>New Transmission and Storage Centrifugal Compressors</td>
<td>1,546</td>
<td>43</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Existing Oil and Gas Reciprocating Compressors</td>
<td>1,108,432</td>
<td>169,120</td>
<td>6,240</td>
<td></td>
</tr>
<tr>
<td>Existing Oil and Gas Centrifugal Compressors</td>
<td>416,416</td>
<td>73,537</td>
<td>2,734</td>
<td></td>
</tr>
<tr>
<td><strong>Compressors Subtotal</strong></td>
<td><strong>1,547,424</strong></td>
<td><strong>245,845</strong></td>
<td><strong>9,091</strong></td>
<td></td>
</tr>
<tr>
<td>Existing Storage Vessels &gt;6tpy</td>
<td>76,312</td>
<td>366,783</td>
<td>801</td>
<td></td>
</tr>
<tr>
<td><strong>Vessels Subtotal</strong></td>
<td><strong>76,312</strong></td>
<td><strong>366,783</strong></td>
<td><strong>801</strong></td>
<td></td>
</tr>
<tr>
<td>New Well Pads; Control of Valves Only</td>
<td>63,412</td>
<td>17,572</td>
<td>665</td>
<td></td>
</tr>
<tr>
<td>New Gathering &amp; Boosting Facilities; Control of Valves Only</td>
<td>7,040</td>
<td>1,955</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>New Transmission &amp; Storage Facilities; Control of Valves Only</td>
<td>3,403</td>
<td>94</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Existing Oil &amp; Gas Sector Equipment Leaks</td>
<td>2,141,568</td>
<td>595,356</td>
<td>22,486</td>
<td></td>
</tr>
<tr>
<td><strong>Equipment Leaks Subtotal</strong></td>
<td><strong>2,215,423</strong></td>
<td><strong>614,977</strong></td>
<td><strong>23,228</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal of Emissions Not Controlled by EPA's Final Rule</strong></td>
<td><strong>6,883,563</strong></td>
<td><strong>1,724,755</strong></td>
<td><strong>64,935</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Table created by Susan Harvey, Harvey Consulting LLC, M.S., Environmental Engineering, Univ. Alaska-Anchorage; B.S., Petroleum Engineering, Univ. of Alaska-Fairbanks. Note: Annual emission estimate as of Year 5.
Table 3 - Metropolitan Statistical Areas (MSAs) with Active Oil and Gas Wells

<table>
<thead>
<tr>
<th>MSA Code</th>
<th>MSA Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of the MSA Area with wells**</th>
<th>Part of a CSA &gt;1 million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>11260</td>
<td>Anchorage, AK Metro Area</td>
<td>AK</td>
<td>380,821</td>
<td>13</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>13820</td>
<td>Birmingham-Hoover, AL Metro Area</td>
<td>AL</td>
<td>1,128,047</td>
<td>631</td>
<td>3</td>
<td>X</td>
</tr>
<tr>
<td>26620</td>
<td>Huntsville, AL Metro Area</td>
<td>AL</td>
<td>417,593</td>
<td>1</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>33660</td>
<td>Mobile, AL Metro Area</td>
<td>AL</td>
<td>412,992</td>
<td>271</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>46220</td>
<td>Tuscaloosa, AL Metro Area</td>
<td>AL</td>
<td>219,461</td>
<td>1,992</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>19460</td>
<td>Decatur, AL Metro Area</td>
<td>AL</td>
<td>153,829</td>
<td>4</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>30780</td>
<td>Little Rock-North Little Rock-Conway, AR Metro Area</td>
<td>AR</td>
<td>699,757</td>
<td>6</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>22220</td>
<td>Fayetteville-Springdale-Rogers, AR-MO Metro Area</td>
<td>AR-MO</td>
<td>463,204</td>
<td>155</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>22900</td>
<td>Fort Smith, AR-OK Metro Area</td>
<td>AR-OK</td>
<td>298,592</td>
<td>3,034</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>31100</td>
<td>Los Angeles-Long Beach-Santa Ana, CA Metro Area</td>
<td>CA</td>
<td>12,828,837</td>
<td>889</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>41860</td>
<td>San Francisco-Oakland-Fremont, CA Metro Area</td>
<td>CA</td>
<td>4,335,391</td>
<td>130</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>40140</td>
<td>Riverside-San Bernardino-Ontario, CA Metro Area</td>
<td>CA</td>
<td>4,224,851</td>
<td>21</td>
<td>&lt; 1</td>
<td>X</td>
</tr>
<tr>
<td>40900</td>
<td>Sacramento--Arden-Arcade--Roseville, CA Metro Area</td>
<td>CA</td>
<td>2,149,127</td>
<td>492</td>
<td>2</td>
<td>X</td>
</tr>
<tr>
<td>41940</td>
<td>San Jose-Sunnyvale-Santa Clara, CA Metro Area</td>
<td>CA</td>
<td>1,836,911</td>
<td>39</td>
<td>&lt; 1</td>
<td>X</td>
</tr>
<tr>
<td>23420</td>
<td>Fresno, CA Metro Area</td>
<td>CA</td>
<td>930,450</td>
<td>521</td>
<td>2</td>
<td>X</td>
</tr>
<tr>
<td>12540</td>
<td>Bakersfield-Delano, CA Metro Area</td>
<td>CA</td>
<td>839,631</td>
<td>2,830</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>37100</td>
<td>Oxnard-Thousand Oaks-Ventura, CA Metro Area</td>
<td>CA</td>
<td>823,318</td>
<td>437</td>
<td>5</td>
<td>X</td>
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<tr>
<td>44700</td>
<td>Stockton, CA Metro Area</td>
<td>CA</td>
<td>685,306</td>
<td>158</td>
<td>3</td>
<td></td>
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<tr>
<td>33700</td>
<td>Modesto, CA Metro Area</td>
<td>CA</td>
<td>514,453</td>
<td>3</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>42220</td>
<td>Santa Rosa-Petaluma, CA Metro Area</td>
<td>CA</td>
<td>483,878</td>
<td>6</td>
<td>&lt; 1</td>
<td>X</td>
</tr>
<tr>
<td>47300</td>
<td>Visalia-Porterville, CA Metro Area</td>
<td>CA</td>
<td>442,179</td>
<td>68</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>42060</td>
<td>Santa Barbara-Santa Maria-Goleta, CA Metro Area</td>
<td>CA</td>
<td>423,895</td>
<td>510</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>41500</td>
<td>Salinas, CA Metro Area</td>
<td>CA</td>
<td>415,057</td>
<td>75</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>46700</td>
<td>Vallejo-Fairfield, CA Metro Area</td>
<td>CA</td>
<td>413,344</td>
<td>348</td>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>MSA Code</td>
<td>MSA Name</td>
<td>State</td>
<td>Population</td>
<td>No. of Oil and Gas Wells*</td>
<td>% of the MSA Area with wells**</td>
<td>Part of a CSA &gt;1 million population</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------</td>
<td>-------</td>
<td>------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>42020</td>
<td>San Luis Obispo-Paso Robles, CA Metro Area</td>
<td>CA</td>
<td>269,637</td>
<td>73</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>32900</td>
<td>Merced, CA Metro Area</td>
<td>CA</td>
<td>255,793</td>
<td>8</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>17020</td>
<td>Chico, CA Metro Area</td>
<td>CA</td>
<td>220,000</td>
<td>28</td>
<td>&lt; 1</td>
<td></td>
</tr>
<tr>
<td>49700</td>
<td>Yuba City, CA Metro Area</td>
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Table 3 - Metropolitan Statistical Areas (MSAs) with Active Oil and Gas Wells

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<th>MSA Code</th>
<th>MSA Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of the MSA Area with wells**</th>
<th>Part of a CSA &gt;1 million population</th>
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<td>Population</td>
<td>No. of Oil and Gas Wells*</td>
<td>% of the MSA Area with wells**</td>
<td>Part of a CSA &gt;1 million population</td>
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<td>Part of a CSA &gt;1 million population</td>
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<td>State</td>
<td>Population</td>
<td>No. of Oil and Gas Wells*</td>
<td>% of the MSA Area with wells**</td>
<td>Part of a CSA &gt;1 million population</td>
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Table 3 - Metropolitan Statistical Areas (MSAs) with Active Oil and Gas Wells

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<tr>
<th>MSA Code</th>
<th>MSA Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of the MSA Area with wells**</th>
<th>Part of a CSA &gt;1 million population</th>
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<td><strong>Totals</strong></td>
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<td><strong>156,322</strong></td>
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</table>

* Due to claims of proprietary information, precise well locations are unavailable in all states. The numbers in this table are taken from a publically available map which identified those quarter mile square cells where at least one active oil or gas well was located. Therefore, the numbers in this column reflect the lower bounds of the true range because there may be more than one well within the quarter mile square cells.

** This column represents the percent of the designated area that is covered by quarter mile square cells containing at least one active oil or gas well.

<table>
<thead>
<tr>
<th>CSA Code</th>
<th>CSA Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of the CSA Area with wells**</th>
<th>No. of MSAs included in CSA</th>
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<td>Population</td>
<td>No. of Oil and Gas Wells*</td>
<td>% of the CSA Area with wells**</td>
<td>No. of MSAs included in CSA</td>
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* Due to claims of proprietary information, precise well locations are unavailable in all states. The numbers in this table are taken from a publically available map which identified those quarter mile square cells where at least one active oil or gas well was located. Therefore, the numbers in this column reflect the lower bounds of the true range because there may be more than one well within the quarter mile square cells.

** This column represents the percent of the designated area that is covered by quarter mile square cells containing at least one active oil or gas well.

Sources

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<th>Code</th>
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<th>Population</th>
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<th>% of Census Area with Wells**</th>
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### Table 5 - Presence of Active Oil and Gas Wells in
(1) Combined Statistical Areas (CSAs) with population greater than 1 million and
(2) Metropolitan Statistical Areas (MSAs) not located in such a CSA

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<th>Code</th>
<th>Name</th>
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<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of Census Area with Wells**</th>
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<td>Columbus-Marion-Chillicothe, OH CSA</td>
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<td>30020</td>
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<td>27780</td>
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<tr>
<td>11020</td>
<td>Altoona, PA Metro Area</td>
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<td>Williamsport, PA Metro Area</td>
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<td>116,111</td>
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<td>MSA</td>
</tr>
<tr>
<td>400</td>
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<td>TN</td>
<td>1,670,890</td>
<td>57</td>
<td>&lt; 1</td>
<td>CSA</td>
</tr>
</tbody>
</table>
Table 5 - Presence of Active Oil and Gas Wells in
(1) Combined Statistical Areas (CSAs) with population greater than 1 million and
(2) Metropolitan Statistical Areas (MSAs) not located in such a CSA

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of Census Area with Wells**</th>
<th>Census Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>314</td>
<td>Knoxville-Sevierville-La Follette, TN CSA</td>
<td>TN</td>
<td>1,055,086</td>
<td>105</td>
<td>1</td>
<td>CSA</td>
</tr>
<tr>
<td>16860</td>
<td>Chattanooga, TN-GA Metro Area</td>
<td>TN-GA</td>
<td>528,143</td>
<td>1</td>
<td>&lt; 1</td>
<td>MSA</td>
</tr>
<tr>
<td>17300</td>
<td>Clarksville, TN-KY Metro Area</td>
<td>TN-KY</td>
<td>273,949</td>
<td>159</td>
<td>2</td>
<td>MSA</td>
</tr>
<tr>
<td>28700</td>
<td>Kingsport-Bristol-Bristol, TN-VA Metro Area</td>
<td>TN-VA</td>
<td>309,544</td>
<td>28</td>
<td>&lt; 1</td>
<td>MSA</td>
</tr>
<tr>
<td>206</td>
<td>Dallas-Fort Worth, TX CSA</td>
<td>TX</td>
<td>6,731,317</td>
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</tr>
<tr>
<td>288</td>
<td>Houston-Baytown-Huntsville, TX CSA</td>
<td>TX</td>
<td>6,051,363</td>
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<tr>
<td>41700</td>
<td>San Antonio-New Braunfels, TX Metro Area</td>
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<td>MSA</td>
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<tr>
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<td>Austin-Round Rock-Marble Falls, TX CSA</td>
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<td>1,759,039</td>
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</tr>
<tr>
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<td>11100</td>
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<td>47380</td>
<td>Waco, TX Metro Area</td>
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<td>137,130</td>
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<td>1,744,886</td>
<td>107</td>
<td>&lt; 1</td>
<td>CSA</td>
</tr>
</tbody>
</table>
Table 5 - Presence of Active Oil and Gas Wells in
(1) Combined Statistical Areas (CSAs) with population greater than 1 million and
(2) Metropolitan Statistical Areas (MSAs) not located in such a CSA

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>State</th>
<th>Population</th>
<th>No. of Oil and Gas Wells*</th>
<th>% of Census Area with Wells**</th>
<th>Census Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>41100</td>
<td>St. George, UT Metro Area</td>
<td>UT</td>
<td>138,115</td>
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<tr>
<td>25500</td>
<td>Harrisonburg, VA Metro Area</td>
<td>VA</td>
<td>125,228</td>
<td>1</td>
<td>&lt; 1</td>
<td>MSA</td>
</tr>
<tr>
<td>500</td>
<td>Seattle-Tacoma-Olympia, WA CSA</td>
<td>WA</td>
<td>4,199,312</td>
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<td>&lt; 1</td>
<td>CSA</td>
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<tr>
<td>28420</td>
<td>Kennewick-Pasco-Richland, WA Metro Area</td>
<td>WA</td>
<td>253,340</td>
<td>3</td>
<td>&lt; 1</td>
<td>MSA</td>
</tr>
<tr>
<td>13380</td>
<td>Bellingham, WA Metro Area</td>
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<td>WV</td>
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<td>Morgantown, WV Metro Area</td>
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</tr>
<tr>
<td>26580</td>
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<td>WV-KY-OH</td>
<td>287,702</td>
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<td>16</td>
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<td>Total</td>
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<td>151,032,896</td>
<td>166,075</td>
<td></td>
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</tr>
</tbody>
</table>

* Due to claims of proprietary information, precise well locations are unavailable in all states. The numbers in this table are taken from a publically available map which identified those quarter mile square cells where at least one active oil or gas well was located. Therefore, the numbers in this column reflect the lower bounds of the true range because there may be more than one well within the quarter mile square cells.

** This column represents the percent of the designated area that is covered by quarter mile square cells containing at least one active oil or gas well.

Sources
APPENDIX B: MAPS

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CALIFORNIA

Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers
designated by the Census¹
- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

Oil and Gas Production Wells²
- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays³
- Shale Play

Notes:
¹ US Census 2012 Annual Estimates of the Resident Population
   for Incorporated Places:
   http://www.census.gov/popest/data/estimates/2012/index.html

² US Census 2009 CSA and MSA designations:

³ Colored markers represent the presence of at least one well
   within quarter mile square cells. Well locations are derived from
   IHS through 2005 and supplemented with state databases from
   IN, PA, KY, IL, and OH covering 2004-2006. Binick, Laura R.H.,
   2008, Oil and Gas Exploration and Production in the United
   States Shown as Quarter-Mile Cells: U.S. Geological Survey,
   net/tmp/thick/quadofc100g.html#hot1

⁴ EPA 2011, Lower 48 Shale Plays:
   http://www.epa.gov/otaq/gas/natural_gas/
   analysis_publications/maps/maps.html#geodata
Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census:
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- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

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- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays:
- Shale Play

Notes:
Oil and Gas Wells, Shale Plays and Population Centers

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- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

Oil and Gas Production Wells²
- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays³
- Shale Play

Notes:
¹ US Census 2012 Annual Estimates of the Resident Population for Incorporated Places:
http://www.census.gov/places/annual/2012/index.html
² US Census 2009 CSA and MSA designations:
http://www.census.gov/popest/metro/ota/otc/otc.html
Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census:
- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Area (CSA) where total population > 1 million

Oil and Gas Production Wells:
- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays:
- Shale Play

Notes:
Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census:
- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

Oil and Gas Production Wells:
- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays:
- Shale Play

Notes:
1 US Census 2012 Annual Estimates of the Resident Population for Incorporated Places:
   http://www.census.gov/popest/datasets/totals/2012/index.html

2 US Census 2009 CSA and MSA designations:

3 Colored markers represent the presence of at least one well within quarter mile square cells. Well locations are derived from
   IRS through 2005 and supplemented with state databases from IN, PA, KY, IL, and OH covering 2004-2006. Biewied, Laura R.H.,
   2009, Oil and Gas Exploration and Production in the United States Shown as Quarter-Mile Cells: U. S. Geological Survey,

4 EIA 2011: Lower 48 Shale Plays:
   http://www.eia.gov/pub/tv/gas/natural_gas/analysis_paddocks/maps/maps.html#eia100a
MICHIGAN

Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census:

- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

Oil and Gas Production Wells:

- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays:

- Shale Play

Notes:

1. US Census 2012 Annual Estimates of the Resident Population for Incorporated Places:
   http://www.census.gov/popest/annua/total/2012/index.html
2. US Census 2009 CSA and MSA Designations:
   http://www.census.gov/popest/metro/annua/def.html

EIA 2011. Lower 48 Shale Plays:
http://www.eia.gov/petroleum/natural_gas/
analysis_publications/maps/maps.html#explo
NEW YORK

Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census

- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Areas (CSA) where total population > 1 million

Oil and Gas Production Wells

- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays

- Shale Play

Notes:

1. US Census 2012 Annual Estimates of the Resident Population for Incorporated Places:
   http://www.census.gov/popest/data/siteselected/2012/index.html
2. US Census 2009 CSA and MSA designations:
4. EIA 2011, Lower 48 Shale Plays:
   http://www.eia.gov/petroleum/shalegas/

analysis_publications/maps/maps.html#prodad

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OKLAHOMA

Oil and Gas Wells, Shale Plays and Population Centers

US Population Centers designated by the Census^1
- Cities where total population > 250,000
- Metropolitan Statistical Area (MSA)
- Combined Statistical Area (CSA) where total population > 1 million

Oil and Gas Production Wells^2
- At least one productive oil well, but no productive gas wells
- At least one productive gas well, but no productive oil wells
- At least one productive oil well and at least one productive gas well or one well producing both oil and gas

Shale Plays^3
- Shale Play

Notes:
APPENDIX C: ALL OTHER SOURCES


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55. EPA, Child-Specific Exposure Factors Handbook (2008), EPA/600/R-06/096F.


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72. EPA, Parameters for Properly Designed and Operated Flares (2012).


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143. Sahu, R., Technical Report and Comments on EPA’s Proposed NESHAP Rule for Oil and Natural Gas Production and Natural Gas Transmission and Storage Source Categories (Nov. 2011) (attached in addenda to Sierra Club NESHAP Comments).


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190. Also attached are the summaries for each of the following pollutants available from EPA’s Integrated Risk Information System (“IRIS”), available at: http://www.epa.gov/iris/, or EPA’s TTN website.

- Acetaldehyde (last updated 08/09/2012)
- Acetophenone (last updated 08/09/2012)
- Acrolein (last updated 08/09/2012)
- Acrylamide (last updated 08/09/2012)
- Arsenic (last updated 08/09/2012)
- Benzene (last updated 01/24/2013)
- Benzyl chloride (last updated 08/09/2012)
- Carbon disulfide (last updated 08/09/2012)
- Carbonyl sulfide (last updated 08/09/2012)
- Cumene (last updated 08/09/2012)
- 1, 4 Dioxane (last updated 10/21/2013)
- Di (2-ethylhexyl) phthalate (Bis (2-ethylhexyl) phthalate) (last updated 08/09/2012)
- Dimethyl formamide (N, N-Dimethylformamide) (last updated 08/09/2012)
- Ethylbenzene (Ethyl benzene) (last updated 08/09/2012)
- Ethylene glycol (1,2-ethanediol) (last updated 08/09/2012)
- Formaldehyde (last update 08/09/2012)
- Hexane (n-Hexane) (last updated 08/09/2012)
- Hydrogen chloride (Hydrochloric acid) (last updated 08/09/2012)
- Lead (last updated 01/24/2013)
- Mercury (last updated 08/09/2012)
- Methylene chloride (dichloromethane) (last updated 08/09/2012)
- Methanol (Methyl alcohol) (last updated 09/30/2013)
- Naphthalene (last updated 08/09/2012)
- Phenol (last updated 08/09/2012)
- Phthalic anhydride (last updated 08/09/2012)
- Propylene oxide (last updated 08/09/2012)
- Toluene (last updated 04/01/2013)
- 2,2,4-trimethylpentane. (last updated 08/09/2012)
- Xylenes (last updated 08/09/2012)