REPORT SUMMARY

Waste Not

Common Sense Ways to Reduce Methane Pollution from the Oil and Natural Gas Industry

The case for taking action on climate change has never been clearer: as the third National Climate Assessment states, the U.S. is already experiencing the effects of climate change, from increasing heat across the country to more extreme weather events totaling billions of dollars in damage. Given these impacts, and much worse to come, the cost of inaction to our health, environment, and economy is far too great, especially when effective and low-cost means for reducing climate-warming pollution are available now. In this report, we show how the U.S. Environmental Protection Agency (EPA) can fulfill the agency's duty under the Clean Air Act to cut in half dangerous, wasteful methane pollution from the largest industrial source—the oil and gas industry—in just a few years, using common sense standards based on available, low-cost control measures for a targeted set of pollution sources.

Natural gas pipeline, Pennsylvania. © Kara Newhouse

Standards for methane can cut total emissions from the oil and gas industry in half in just a few years.

Reducing methane emissions from the oil and gas sector would build on the Obama Administration's actions to date to cut climate pollution. Most recently, in a landmark U.S.-China agreement, the President announced a U.S. target of reducing greenhouse gas emissions 26 to 28 percent below 2005 levels by 2025. This pledge follows on the previous U.S. commitment to reduce emissions by 17 percent below 2005 levels by 2020. In June of 2014, EPA took its most significant climate protection step to date by proposing the Clean Power Plan to tackle the predominant climate pollutant, carbon dioxide (CO_2), from its largest U.S. source, existing power plants. The Administration has also set standards in motion to reduce carbon pollution and improve fuel efficiency from new motor vehicles, addressing the second-largest U.S. source of CO_2.

Oil well and flare in North Park, Colorado. © Jack Dempsey/Flickr

KEY FINDINGS

The oil and gas industry is the nation's largest industrial source of methane, a much more potent climate-warming pollutant than carbon dioxide pound-for-pound, and the oil and gas sector is the second largest industrial contributor to overall climate pollution. Moreover, there is compelling evidence that the industry is releasing a lot more methane than is currently accounted for in government inventories.

EPA could reduce the sector's methane pollution in half in a just few years by issuing nationwide methane standards that require common sense, low-cost pollution controls for the sector's top emitting sources:

- Regular leak detection and repair programs can reduce methane pollution by an estimated 1,700,000 to 1,800,000 metric tons per year. EPA standards should require oil and natural gas companies to control leaks from all equipment at wellpads, gas processing plants, compressor stations, and large aboveground distribution facilities by regularly carrying out these inspections.
- Cleaning up older equipment—compressors and gas-driven pneumatic equipment—with proven technologies and practices can reduce methane pollution by an estimated 1,200,000 to 1,350,000 metric tons per year. Current EPA standards require these technologies and practices for some new compressors and gas-driven pneumatic equipment in select segments of the industry, while states like Colorado extend some requirements to existing sources. EPA should set additional standards that require the same practices for all such equipment—both new and existing—throughout the industry.
- Capturing natural gas that would otherwise be released from oil and gas wells can reduce methane pollution by an estimated 260,000 to 500,000 metric tons per year. EPA standards should require well operators to capture this gas and sell it or use it on-site, instead of releasing it or flaring it.

The methane abatement potentials shown above are conservative estimates based on government inventories. They don't account for the research indicating that actual emissions could be twice the inventory estimates, or higher. The problem and the upsides of controlling it—are likely much greater.

The standards we recommend in this report would also significantly reduce emissions of other air pollutants, specifically smog-forming volatile organic compounds and toxic pollutants like benzene that cause cancer and are associated with a host of other health problems.

The cost of the recommended standards would be low—less than one percent of the industry's sales revenue.

EPA should issue specific methane standards for the sources described above, including standards for new and existing equipment and practices. Methane standards would cut up to ten times more methane and four times more smog-forming pollutants compared to other policy approaches available to EPA, because more sources would be reached.

EPA must now curb methane pollution from the oil and gas sector, the second largest industrial contributor to heat-trapping emissions. Methane is the main component of natural gas. It is a powerful climate-changing pollutant that, according to the most recent international climate science assessment report, packs 36 times the heat-trapping punch of carbon dioxide, pound-for-pound, in the century after it is released. Over a shorter period of 20 years, methane is 87 times more powerful than carbon dioxide.

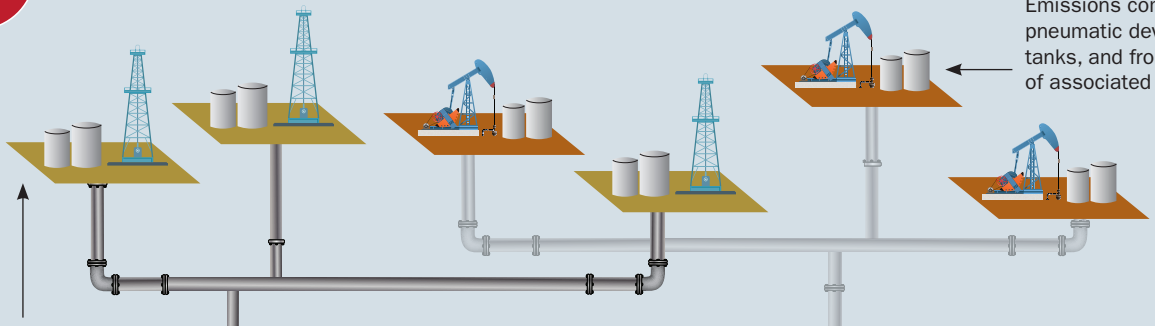
The U.S. oil and gas industry leaks and intentionally releases almost eight million metric tons of methane a year, according to EPA's most recent *Inventory of U.S. Greenhouse Gas Emissions and Sinks*—enough to heat 6.5 million U.S. homes. However, the EPA *Inventory* is very likely an underestimate. Independent research demonstrates that actual methane emissions from the oil and gas sector could be twice as high as shown in current government inventories, and may be even higher. Despite the EPA *Inventory*'s likely underestimate of methane emissions, this report's calculations are based on the EPA *Inventory* to provide conservative estimates. As we describe below, methane is not the only pollutant in natural gas, and the measures we recommend in this report would reduce emissions of those other pollutants, too, benefiting air quality.

EPA took an important step forward on methane in 2012, issuing standards for volatile organic compounds (VOCs) that reduce some methane pollution from the oil and natural gas industry. Most notably, these rules limit completion emissions—the burst of pollution that can occur in the first few days after a well is hydraulically fractured. Instead of allowing methane and other pollutants to escape to the atmosphere, the standard requires operators of gas wells to capture the gas and sell or use it—a procedure known as a "reduced emission completion." EPA recently reported that emissions from natural gas well "completions" have decreased 73 percent since 2011. The standard, however, covers only fractured gas wells and not fractured oil wells, which often produce methane pollution during completion. The standard also addresses a few other types of *new* equipment, such as new tanks and compressors. However, it does not reduce methane from equipment that was already in use when the rule went into effect, such as existing compressors, and/or equipment that emits relatively low levels of VOCs, such as facilities in major cities that receive natural gas. Yet this equipment is responsible for the vast majority of the sector's methane pollution.

Emissions Come from All Segments of Natural Gas and Oil Development

Total Emissions (2014 EPA GHG Inventory) = 7.7 Million Tons of Methane

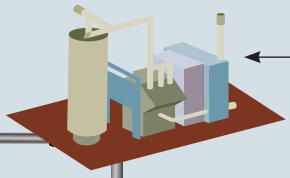
Oil and natural gas production is responsible for 46% of methane emissions.



Oil Well Pad
Emissions come from leaks, pneumatic devices, storage tanks, and from the flaring of associated gas.

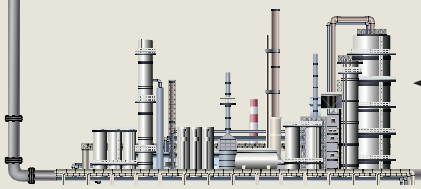
Oil to Market

Natural Gas Well Pad
Emissions come from leaks, unloading liquids from wells, pneumatic devices, compressors, storage tanks, and dehydrators.



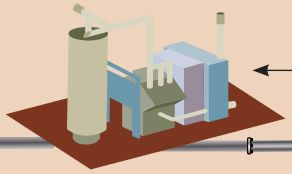
Gathering Compressor
Used to increase the pressure of the gas in the gathering pipelines. Emissions can come from leaks, pneumatic devices,and compressors.

Gas processing is responsible for 11% of methane emissions.

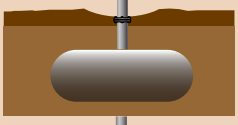


Gas Processing Plant
Large plants used to clean and pressurize gas. Emissions mainly come from compressor venting and leaks.

Gas transmission and storage is responsible for 27% of methane emissions.

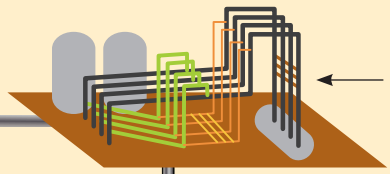


Transmission Compressor
Compressor stations for maintaining gas pressure along interstate pipelines. Emissions can come from from leaks, pneumatic devices, and compressors.



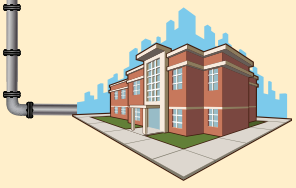
Storage
Gas is often stockpiled in underground storage facilities or stored as a liquid. Emissions can come from compressor venting and leaks.

Gas distribution is responsible for 16% of methane emissions.



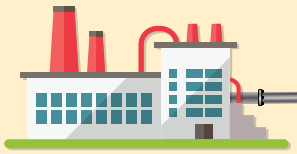
City Gates
Gas is measured and decompressed at the city gate before it is put into final sales lines. Emissions can come from leaks throughout the distribution system including above ground and below ground pipelines.

Gas to Consumers



Commercial

Residential



Industrial

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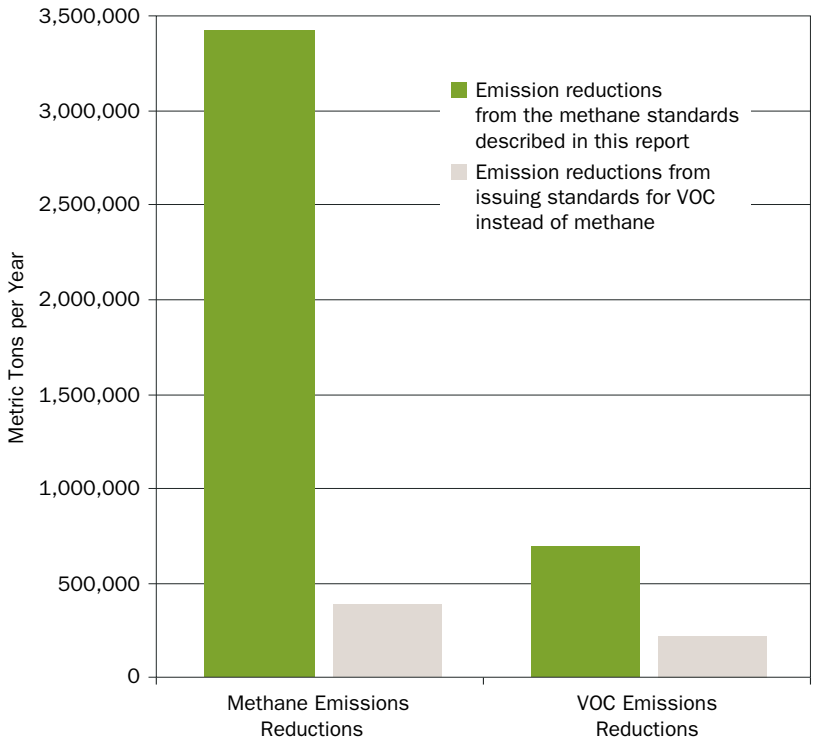
Direct Methane Standards Would Cut Far More Methane and VOC Emissions than a VOC-only Standard



Source: CATF analysis.

Recognizing the importance of further reducing methane pollution, in March 2014, the Obama Administration released a "Strategy to Reduce Methane Emissions." The plan specifically directs EPA to assess methane emissions from the oil and gas sector and determine by fall 2014 whether to set Clean Air Act standards to curb methane pollution from the oil and gas industry. If the agency decides to issue standards, the plan calls for them to be completed by the end of 2016. Moving forward under the Methane Strategy, EPA in April 2014 solicited input from the public and independent experts on technical white papers covering the largest sources of methane leakage across the industry, solutions to reduce emissions, and costs of reductions.

Emissions from oil and natural gas wells, compressors, and other equipment cause billions of dollars' worth of natural gas to be wasted every year—enough to heat over 6 million homes.

In spring 2014, as part of EPA's public comment process under the Methane Strategy, our organizations submitted detailed technical comments in response to the agency's white papers. The present report summarizes and further describes the significant, low-cost opportunities to reduce methane from the oil and gas sector that EPA's white papers, and our comments, describe. We set forth how direct standards for methane can cut total methane emissions from the sector in half—reducing annual methane emissions at least 3.2 million to 3.7 million metric tons—in just a few years. These benefits are well beyond the reductions achievable through other approaches EPA is considering.

A key choice before EPA is whether to set standards to reduce pollution from the oil and gas industry, and if it does so, whether to set standards for emissions of methane, or for smog-forming VOC pollution that would reduce methane to some degree as a "co-benefit." Our report demonstrates that the direct approach of setting methane standards would be far more effective in reducing methane pollution than setting VOC standards, and would also achieve significant VOC reductions. When setting standards for methane, EPA is required to address existing sources of pollutants, which results in greater reach. In addition, methane standards would encompass equipment that puts out high amounts of methane, but relatively low amounts of VOCs, such as sources in the transmission segment. In sum, new methane standards would reach the sector's climate pollution sources left unaddressed by EPA's 2012 standards. As we show in the figure, methane standards would cut methane pollution from the oil and gas sector by up to 10 times as much as the alternative pathway. And though it may seem surprising, methane emission standards would reduce smog-forming VOC pollution three to four times more than VOC emission standards.

EPA can achieve these reductions by setting simple, technology-based emission standards under sections 111(b) and (d) of the Clean Air Act for a few types of new and existing equipment and operations across the sector. This action would have the same climate benefits over a 100-year timeframe as cutting more than 130 million metric tons (MMT) per year of carbon dioxide emissions. Over a 20-year timeframe, this would be equivalent to cutting more than 320 MMT per year of carbon dioxide, because methane is even more potent in the near-term.

Moreover, the actual tonnage of methane reductions achieved by these standards is very likely

greater than what we calculate. As we note above, current emissions are likely to be higher than currently estimated by EPA, possibly significantly so. Strong evidence suggests that unusual but very large emissions resulting from improper conditions at oil and gas sites are important contributors to the methane that is observed in the air but not accounted for in the inventories. These large, unusual sources are referred to as "super-emitters." The measures we recommend target these sources. Most importantly, expanding leak detection and repair (LDAR) programs to cover the many facilities that are not inspected under current rules, as this report recommends, will identify and fix super-emitters. Thus, standards based on these measures could achieve emissions reductions that are twice as large as we estimate in this report, or perhaps even larger.

The measures highlighted in our core analysis are commercially available and in use, though far from universally. They have been demonstrated in the field to reduce emissions. In addition, the net cost of these measures is very low because they keep gas in the system instead of wasting it. Some of the measures pay for themselves in time because of this reduced waste. The overall abatement cost for all the technologies combined is just $8 to $18 per metric ton of carbon dioxide equivalent. To put these costs in perspective, the annual cost of implementing the measures is only one and a half percent of the annual revenue the industry receives from selling gas. Finally, the benefits to our climate and health far outweigh the costs of control to industry.

Plugging the Leaks: Addressing the Industry's Largest Sources of Methane Pollution

Methane is emitted from dozens of types of equipment and processes throughout the oil and gas sector, such as wells, completion operations, storage tanks, compressors, and valves. This report focuses on the sources that EPA examined in its white papers, which are the largest sources of methane pollution in the sector. These emissions can be cut dramatically in just a few years:

- ***Leaks from valves, connectors, and other equipment.*** These leaks can be curbed by requiring monthly or quarterly surveys to find and fix leaks at facilities throughout the sector, from well pads all the way to large aboveground distribution facilities in cities.
- ***Older equipment.*** Methane pollution from existing compressors and automatic pneumatic valve controllers can be cut dramatically by using up-to-date technology and maintenance practices

© Jeremy Buckingham/Flickr

Compressor station.

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Shale gas well, Pennsylvania.

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Natural gas processing plant, Texas.

to reduce emissions, consistent with standards EPA set in 2012 for certain types of new equipment, and with recent regulations in Colorado that apply to both new and old equipment.

- ***Intentional release of gas from oil and gas wells.*** Many oil wells produce and then vent large quantities of natural gas. These emissions can be curbed by requiring oil producers to capture or control gas otherwise emitted from oil wells after hydraulic fracturing, as well as during oil production, consistent with standards EPA put in place for hydraulically fractured gas wells. A similar approach can control venting from gas wells during liquids unloading, when water is removed from the well.

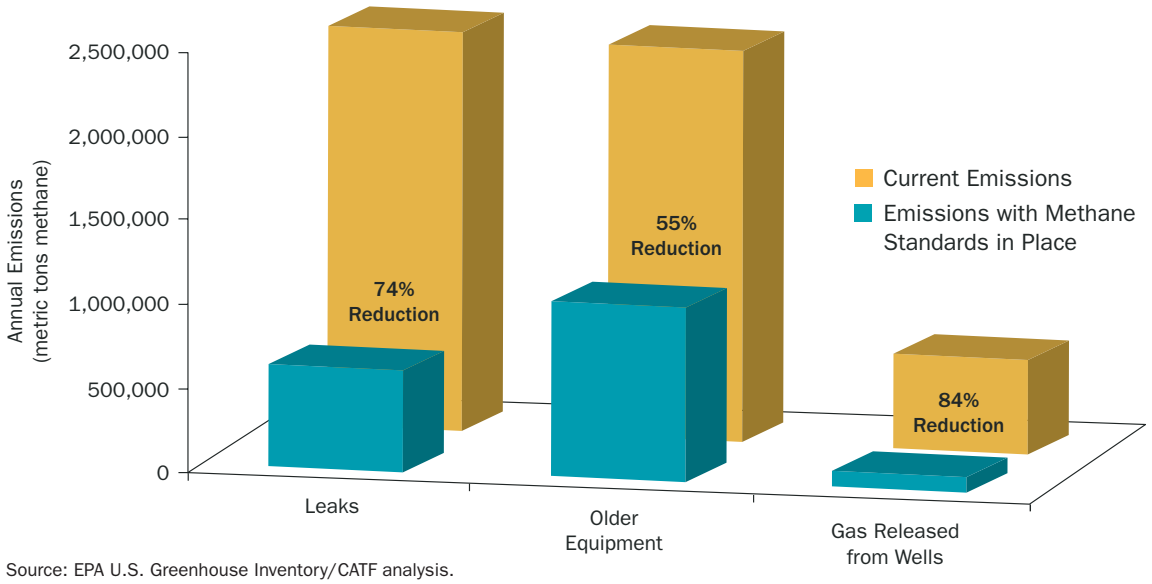
The toxic pollutants from natural gas leaks are linked to cancer, respiratory diseases and neurological damage while also contributing to smog that causes childhood asthma attacks and even premature death.

As we show in the figure, methane emissions from these sources are very large and can be addressed through standards that directly regulate methane emissions from a targeted set of new and existing equipment and operations, under the Clean Air Act authorities described above. Indeed, the methane mitigation measures we describe here would reduce methane pollution from oil and natural gas operations by at least 3.2 to 3.7 million metric tons per year, or 42 percent to 48 percent of the sector's estimated total methane emissions.

Other regulatory approaches are far less effective:

- A focus only on *new* sources to the exclusion of existing, unmodified sources would attain just a small portion of the achievable methane reductions because existing sources currently account for the vast majority of emissions and will continue to do so for years into the future if left unaddressed. According to one analysis, in 2018 nearly 90 percent of methane emissions from the oil and gas sector will come from facilities in operation since at least 2011. Pollution from these sources is not addressed by EPA's 2012 standards for new equipment, and they will probably continue to emit excessively for many more years absent methane standards for exsiting equipment.
- A focus on *another air pollutant* (such as VOCs) would also attain only a small portion of the achievable methane reductions, in this case because VOC regulations under the Clean Air Act provisions identified in the Methane Strategy would (a) likely not apply to any sources, new or existing, downstream of natural gas processing plants, where the VOC content of the gas stream is relatively low, and (b) potentially apply to existing sources only in areas with substantial ozone smog problems.

Significant Methane Reductions are Possible at Sources Identified in this Report



Source: EPA U.S. Greenhouse Inventory/CATF analysis.

Large methane emission reductions are achievable at low cost using available technologies. Furthermore, in designing effective methane standards, EPA can look to model standards from leading states such as Colorado and Wyoming. EPA can also draw on elements of other existing federal standards that incorporate emission control measures like those that we propose here, such as EPA's 2012 VOC standards for the oil and gas industry.

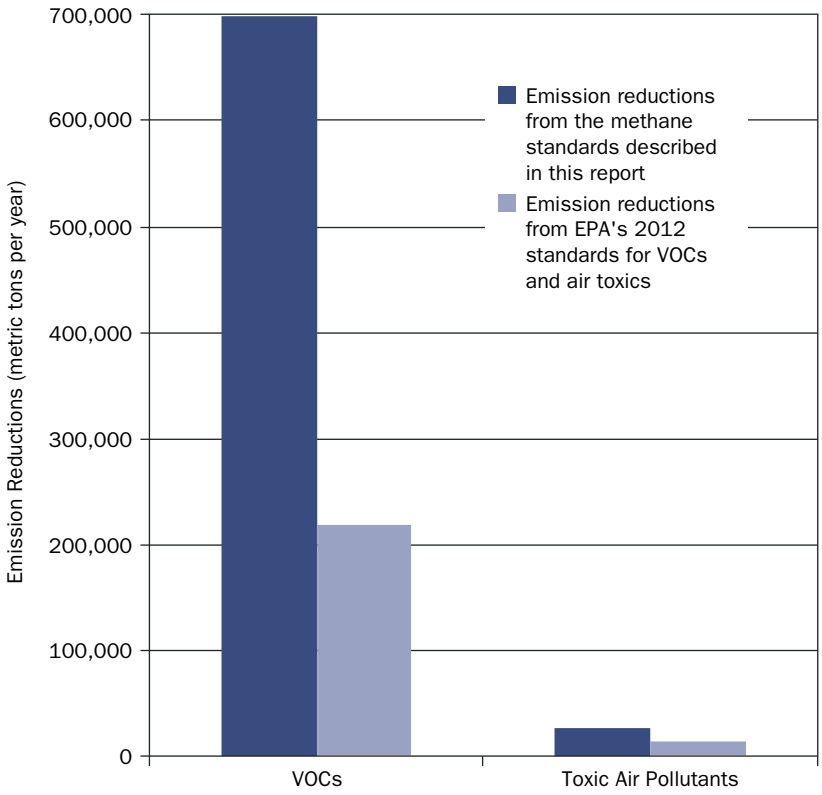
Improving Air Quality by Reducing Methane

Methane is not the only air pollutant from oil and gas operations. Smog-forming VOCs and toxic air pollutants linked to cancer, respiratory and neurological damage also are released throughout the entire oil and gas supply chain. In addition to reducing dangerous heat-trapping pollution, the control measures we describe will reduce smog-forming pollutants and toxics by up to 22 percent and 14 percent, respectively.

In recent years, VOC emissions from oil and gas production have caused severe high-ozone episodes in several areas in the Western U.S., such as oil and gas producing areas in Wyoming and Utah. Research also has reported that in communities near oil and gas sites, toxic air pollutant levels are elevated enough to affect human health. Reductions in VOCs and hazardous air pollutants are critical in regions where oil and gas activities create smog levels that fail to meet health standards and in front-line communities burdened with toxic pollution.

Because they address a larger set of air pollution sources, methane standards based on the control measures we recommend will clean up the air more than the standards EPA issued in 2012 or any potential new standards aimed at VOC pollution. As we show in the figure, while the 2012 standards cut VOCs by an estimated 170,000 to 260,000 metric tons per year, new methane standards would cut VOC emissions by an additional estimated 570,000 to 830,000 metric tons per year or more. And these new methane standards would reduce VOC emissions three to four times more than potential new VOC standards. Reductions in toxic pollutant emissions from the recommended methane measures also are significant, but in addition to standards for methane, stringent standards for toxic pollutants are also needed to ensure compliance with the Clean Air Act and to protect public health.

Benefits for VOC and Toxic Air Pollutants Compared to EPA's 2012 Standards



Source: EPA 2012 RIA Tables 3-4, 3-5, 3-9 and CATF analysis.

The direct methane regulations we discuss in this report would reduce emissions of VOC and toxic air pollutants considerably more than EPA's 2012 standards for VOCs and air toxics.

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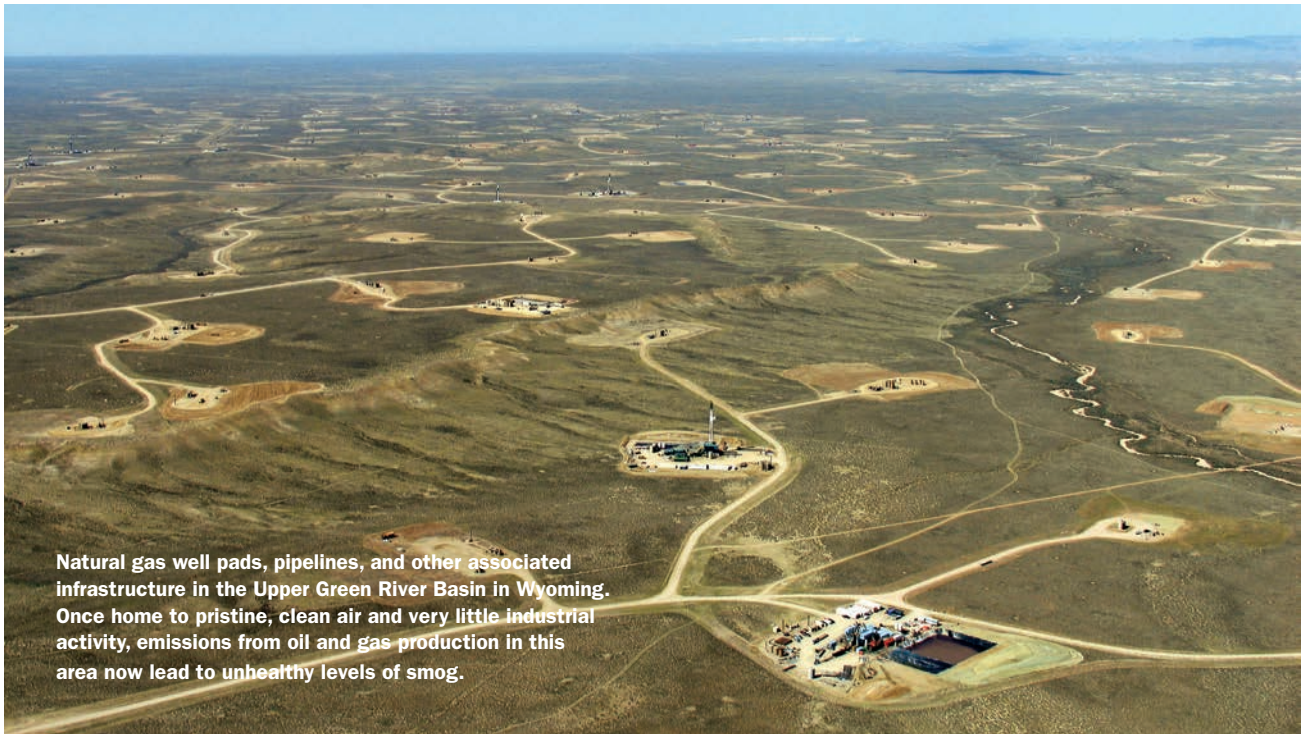
Oil well, tanks and flare near Williston, North Dakota.



Natural gas well pads, pipelines, and other associated infrastructure in the Upper Green River Basin in Wyoming. Once home to pristine, clean air and very little industrial activity, emissions from oil and gas production in this area now lead to unhealthy levels of smog.

© Flickr/John Amos

The full text of the report contains detailed information and data describing the industry and the sources of methane pollution we focus on in this report. For each source category, we present our best estimate of current emissions, based on data sources such as EPA's Inventory of Greenhouse Gas Emissions and EPA's Greenhouse Gas Reporting Program. We then describe proven, in-use technologies and practices that—if implemented across the industry—can cut current emissions from these sources in half in a few years. We demonstrate that EPA can set reasonable, common sense standards to put these technologies and practices into more widespread use, in many cases following and expanding on examples set by states. We present an estimate of the total abatement that can be achieved from each emission source by utilizing these technologies and practices. Finally, we provide an estimate of the abatement cost in each category to show that reducing methane from the oil and gas sector is among the most affordable greenhouse gas reduction opportunities.

We then synthesize these results by considering the pollution reductions that the set of measures would achieve, and compare those pollution reductions to those from other policy approaches, such as creating standards for VOC emissions instead of methane emissions.

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Earthjustice, Earthworks, and Environmental Defense Fund have reviewed this report and fully support its recommendations for EPA standards for methane emissions.

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The full text of the report will be available online at *http://catf.us/resources/publications/view/205*.