Partnership for Policy Integrity Comments on Pennsylvania State Implementation Plan for U.S. Environmental Protection Agency's Clean Power Plan

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Partnership for Policy Integrity is pleased to provide these comments to the Pennsylvania Department of Environmental Protection regarding the state's implementation plan for the U.S. Environmental Protection Agency's Clean Power Plan. We are providing comments on bioenergy and waste burning under separate cover.

The Clean Power Plan encourages states to switch from coal- to natural gas-powered electric generation plants to reduce carbon dioxide emissions, but the consideration of upstream methane emissions greatly erodes the effectiveness of this strategy for reducing greenhouse gas emissions.[1] Recent studies have shown that methane, a much more powerful greenhouse gas than carbon dioxide and the major component of natural gas, is leaking into the atmosphere in significant quantities during natural gas drilling, processing, transmission and distribution.[2] At least one prominent study has found that when such leakage is accounted for, natural gas from shale gas wells is worse for the climate than coal over a 20-year period and comparable over 100 years.[3] Yet EPA does not count these so-called "upstream emissions" from natural gas in the Clean Power Plan. The agency discounts the possibility that if upstream emissions were accounted for, greenhouse emissions from natural gas would be worse than those of coal,[4] but in making this argument, EPA refers readers to an agency document called the Regulatory Impact Analysis[5] that likely undercounts the amount of methane leaking from natural gas systems and understates methane's potency as a greenhouse gas. Switching from coal- to natural gas-powered electricity is therefore likely to result in little progress toward reducing greenhouse gas emissions and may make emissions worse. At the same time, increasing reliance on natural gas is likely to lead to water pollution and other serious impacts in Pennsylvania and elsewhere. Instead of relying on natural gas to meet carbon dioxide reduction goals under the Clean Power Plan, Pennsylvania should rely on efficiency and renewable energy such as wind and solar power.

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[1] 80 Fed. Reg. 64,667 (2015).
[2] A.R. Brandt, et al., 2014. Methane Leaks from North American Natural Gas Systems. Science 343, 733-735. doi:10.1126/science.1247045
[3] Howarth et al. Methane and the Greenhouse-gas Footprint of Natural Gas from Shale Formations, 106 Climatic Change Letters, Issue 4, 679-690 (Apr. 14, 2011).
[4] 80 Fed. Reg. 64,802 (2015).
[5] Regulatory Impact Analysis for the Clean Power Plan Final Rule, 3-21. Accessed online Nov. 5, 2015 at http://www2.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.

In the Clean Power Plan, EPA undervalues the climate impact of natural gas in three important ways, creating an inaccurate impression that natural gas is a lower carbon alternative to coal. First, the Clean Power Plan counts only emissions at the stack when fossil fuels are burned, not upstream emissions, so methane leaks in natural gas drilling and distribution that have significant climate impacts are not counted at all. Second, though EPA said it considered the impact of such leaks, the agency likely understated the quantity of such emissions. Third, the agency used an outdated and largely irrelevant number to assess the potency of methane emissions.

Based on EPA's inaccurate analysis, natural gas appears to be a viable alternative to coal. The plan calculates that baseline emissions in Pennsylvania from natural gas power plants as of 2012 were 902 pounds of carbon dioxide per megawatt hour, approximately 58 percent less than coal plants' emission rate of 2,133 pounds per megawatt hour.[6] The plan estimates that coal plants can become somewhat more efficient, lowering their emissions rate 4.3 percent in the Eastern Interconnect[7] to 2,041 tons of carbon dioxide per megawatt hour in Pennsylvania. At this point, natural gas would emit approximately 56 percent less carbon dioxide per megawatt hour than coal at the stack. Based on these figures, under a rate-based reduction approach, Pennsylvania could reduce its rate of carbon dioxide emissions below EPA's Pennsylvania-specific required level of 1,095 tons per megawatt hour by 2030[8] simply by switching from coal to natural gas for all or even most of its fossil fuel-powered generation. No other actions such as substituting wind, solar, or efficiency for coal and gas would be required, though the plan does envision that renewable energy would replace some coal and natural gas. Similarly, under a mass-based approach, the state would be able to reduce its emissions below EPA's required level of 89,822,308 short tons per year simply by replacing all or even most of its coal-burning electricity with natural gas.[9] The 89.8 million tons per year benchmark is about 24 percent lower than the 116,657,632 short tons that EPA calculates Pennsylvania's fossil fuel-based power plants emitted in 2012.[10] The 56 percent reduction in carbon dioxide emissions that EPA attributes to natural gas would result in emissions well below a 24 percent reduction if natural gas replaced coal megawatt for megawatt. The plan discourages new natural gas plants from being used as a substitute for coal. If states switch from coal to natural gas to supposedly reduce emissions, EPA encourages them to do so by increasing capacity factors at existing natural gas plants.[11]

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[6] CO_2 Emission Performance Rate and Goal Computation Technical Support Document for the CPP Final Rule, Appendix 3, State-Level Data. Accessed online November 12, 2015 at http://www2.epa.gov/cleanpowerplan/clean-power-plan-final-rule-technical-documents.

[7] CO_2 Emission Performance Rate and Goal Computation Technical Support Document for the CPP Final Rule, at 3. Accessed online November 12, 2015 at http://www3.epa.gov/airquality/cpp/tsd-cpp-emission-performance-rate-goal-computation.pdf.

[8] 80 Fed. Reg. 64,962 (2015).

[9] 80 Fed. Reg. 64,963 (dividing by two the two-year emissions amount of 179,644,616 short tons for 2030-2031 yields 89,822,308 short tons per year).

[10] U.S. Environmental Protection Agency. Clean Power Plan: State at a Glance – Pennsylvania. Accessed online October 8, 2015 at http://www3.epa.gov/airquality/cpptoolbox/pennsylvania.pdf. See also 80 Fed. Reg. 64,963 (2015) (dividing by two the two-year emissions amount of 179,644,616 short tons for 2030-2031 yields 89,822,308 short tons per year).

[11] 80 Fed. Reg. 64,667, 64,729-64,730 (2015).

Yet this level of greenhouse gas reductions is unlikely to occur even if natural gas replaces all or some coal-powered generation because of methane leakage. Though EPA does not account for such leakage in the Clean Power Plan, the agency notes that it considered the impact of methane leakage and found it to be of little concern. The agency cites a companion document to the Clean Power Plan, the Regulatory Impact Analysis, in concluding that "net upstream methane emissions from natural gas systems and coal mines and CO_2 emissions from flaring of methane will likely decrease under the Clean Power Plan. Furthermore, the changes in upstream methane emissions are small relative to the changes in direct emissions from power plants."[12] The EPA bases its forecast of emissions reductions on voluntary steps the drilling industry will take to reduce emissions, New Source Performance Standards for reducing emissions from oil and gas operations that were enacted in 2012 and rules to reduce methane emissions from oil and natural gas operations proposed this year.[13]

However, a close look at the Regulatory Impact Analysis reveals that even if steps to reduce methane leakage are effective, the starting point for such reductions is probably much higher than the EPA claims. Using figures from 2013 in the agency's U.S. Greenhouse Gas Inventory, the Regulatory Impact Analysis states that methane leakage from natural gas systems is 173.5 million short tons of CO_2 equivalent.[14] (EPA assumes that methane is 25 times more potent a greenhouse gas than carbon dioxide so the amount of methane leakage is multiplied by 25 to obtain the CO_2 equivalent.) Combined with methane leaking from petroleum field operations apparently omitted from the Regulatory Impact Analysis (some natural gas is produced from petroleum wells), EPA's leakage rate is about 1.43 percent of gross natural gas production in 2013.[15] Yet a study published in 2014 of methane leakage measured by airplane from natural gas

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[12] 80 FR 64,802 (2015). Regulatory Impact Analysis for the Clean Power Plan Final Rule, 3-21. Accessed online Nov. 5, 2015 at http://www2.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.

[13] Regulatory Impact Analysis for the Clean Power Plan Final Rule, 3A-7, 3A-8. Accessed online Nov. 5, 2015 at http://www2.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.

[14] Id. at 3A-6 (Table 3A-1 reporting that natural gas systems emitted 173.5 million short tons of CO2 equivalent in 2013) (citing 2015 U.S. Greenhouse Gas Inventory). Accessed online November 9, 2015 at http://www2.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis.

[15] U.S. Environmental Protection Agency, Annex 3 Methodological Descriptions for Additional Source or Sink Categories at A-177, A-178 (reporting that methane emissions from petroleum production field operations were 968.7 kilotons per year or 26.7 million short tons of CO2e). Accessed online November 10, 2015 at http://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2015-Annex-3-Additional-Source-or-Sink-Categories.pdf. Tables A-126, A-133, A-136, A-137, A-138 show that the total methane leaking from petroleum production field operations, natural gas production, natural gas processing, natural gas transmission and natural gas distribution was 7,263,500 metric tons. The total amount of gross natural gas production in 2013 was 29,522,551,000,000 cubic feet. See Natural Gas, Natural Gas Summary, U.S., Annual, Gross Withdrawals. Accessed online November 9, 2015 at http://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm. This figure is multiplied by 0.9 to reflect the fact that about 90 percent of natural gas produced is comprised of methane. See U.S. Environmental Protection Agency, Annex 3 Methodological Descriptions for Additional Source or Sink Categories at A-185, A-186. The product is 26,570,295,900,000 cubic feet of methane. There are 0.000479389 metric tons in each cubic foot of carbon dioxide equivalent (methane multiplied by 25) and therefore 0.000019175560 metric tons in each cubic foot of methane. See U.S. Environmental Protection Agency, Methane Emissions Reduction Calculator Conversion Factors. Accessed online November 9, 2015 at http://www3.epa.gov/gasstar/tools/calculations.html. Multiplying this figure by 26.57 trillion cubic feet produces

wells in southwestern Pennsylvania found an estimated leakage rate between three and 17 percent. The study, conducted on two dates in 2012, also found that methane leakage from the drilling of wells was two to three orders of magnitude higher than in EPA's greenhouse gas inventory.[16] Another study published in 2014 that reviewed previous studies of natural gas emissions found that methane emissions were about 50 percent higher than EPA estimates and that "official inventories consistently underestimate actual [methane] emissions."[17] An analysis reviewing only atmospheric studies of methane emissions conducted since 2011 (during the shale gas era) found an average leak rate of 3.8 percent, or more than double EPA's estimate.[18] A study published in 2013 that examined air sampling data from tall towers and aircraft found that methane leakage from oil and natural gas operations "are likely a factor of two or greater than cited in existing studies" and urged EPA to adjust methane leakage rates from oil and gas operations upward rather than reducing them as the agency had recently done.[19] Another study published in 2013 examined methane emissions collected by an airplane flying over Utah's Uintah County oil and gas field. The authors found that emissions collected on February 3, 2012 were 6.2 to 11.7 percent of hourly natural gas production from the field, much higher than the leakage rate reported by EPA in its Greenhouse Gas Inventory.[20] A study published in 2012 of methane leakage between 2007 and 2010 in Weld County, Colorado, a county that produces significant amounts of natural gas, found that previous estimates of methane leakage from natural gas systems were underestimated "by at least a factor of two."[21] Therefore, more methane is likely to be leaking than EPA reports.

The EPA Office of Inspector General has criticized EPA's methodology for estimating emissions of methane and other pollutants from oil and natural gas production, calling into question the agency's ability to accurately assess methane's leakage rate. The Inspector General found in a report published in 2013 that about half of the emission factors (248 of 495) that EPA uses to estimate releases of methane and other pollutants are "of questionable quality because they are based on limited and/or low quality data." These emission factors are estimates of the quantity of a particular pollutant such as methane that is released from a particular source in the oil and

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509,500,303 metric tons of gross methane production in 2013. 7,263,500 metric tons of leakage is about 1.43 percent of 509,500,303 gross metric tons withdrawn.

[16] Dana R. Caulton et al. Toward a Better Understanding and Quantification of Methane Emissions from Shale Gas Development, 111 Proceedings of the National Academy of Sciences (Apr. 29, 2014) No. 17. Accessed online November 12, 2015 at http://www.pnas.org/content/111/17/6237.full.

[17] A.R. Brandt et al. Methane Leaks from North American Natural Gas Systems, 343 Science (Feb. 14, 2014) No. 6172.

[18] Physicians, Scientists and Engineers for Healthy Energy, Climate Impacts of Methane Losses from Modern Natural Gas and Petroleum Systems, Science Summary (Oct. 2015).

[19] Scott M. Miller et al. Anthropogenic Emissions of Methane in the United States, 110 Proceedings of the National Academy of Sciences (Dec. 10, 2013) vol. 50. Accessed online Nov. 10, 2015 at

[20] Anna Karion et al. Methane Emissions Estimate from Airborne Measurements over a Western United States Natural Gas Field, 40 Geophysical Research Letters (Aug. 27, 2013) Issue 16, pp. 4,393-4,397. Accessed online November 10, 2015 at http://onlinelibrary.wiley.com/doi/10.1002/grl.50811/abstract.

[21] Gabrielle Petron et al. Hydrocarbon Emissions Characterization in the Colorado Front Range: A Pilot Study, 117 Atmospheres: Journal of Geophysical Research (Feb. 21, 2012), Issue D4. Accessed online November 10, 2015 at http://onlinelibrary.wiley.com/doi/10.1029/2011JD016360/full.

natural gas production process such as dehydrators or well completions.[22] The Inspector General also found, among other problems, that EPA has allocated limited resources to the study of oil and natural gas production. Between fiscal years 2008 and 2011, the Inspector General found, EPA's Office of Research and Development and Office and Air and Radiation's Office of Air Quality Planning and Standards (EPA's offices "responsible for collecting emissions data and developing methods to measure and/or estimate emissions") have averaged less than one full-time equivalent employee per year devoted to oil and gas production-related analysis.[23] These findings inspire little confidence that EPA can accurately account for methane leakage. The agency said that it will takes steps to improve but added that for at least some improvements, implementation "will be contingent upon the availability of future resources."[24]

In addition to likely understating the amount of methane leakage, the Clean Power Plan uses an outdated and largely inapplicable figure for estimating the power of methane as a greenhouse gas. According to the fifth report of the Intergovernmental Panel on Climate Change (IPCC), the leading group of scientists working on global climate change, methane has a "global warming potential" over 20 years of 86. In other words, it is 86 times more powerful as a greenhouse gas than carbon dioxide over a 20 year period.[25] Not only is the next 20 years the time period over which the Clean Power Plan seeks to reduce emissions, but the IPCC's scientists have found that it is the critical period in which to act to prevent global temperatures from exceeding a tipping point of two degrees Celsius beyond which reducing warming becomes significantly more difficult. "Delaying additional mitigation [emissions reductions] to 2030 will substantially increase the challenges associated with limiting warming over the 21st Century to below 2°C relative to pre-industrial levels," the scientists write.[26] Therefore, methane emissions during the production and transmission of natural gas in the short term can have an outsize, critical impact on climate change. Yet EPA makes no mention of methane's 20-year global warming potential figure in the Regulatory Impact Analysis, instead stating that methane emissions are presented based on the IPCC's fourth report published in 2007, which found that methane is 25 times more powerful than carbon dioxide as a greenhouse gas.[27] The EPA does not explain that according to this older IPCC report, methane is 25 times more potent than carbon dioxide over a 100-year timescale but 72 times more potent over the more-relevant 20-year timescale. Nor does the EPA mention that the IPCC has shown in its fifth report that both the 20-year and 100-year figures are too low. EPA said in an email to Partnership for Policy Integrity that the Clean Power Plan is focused on carbon dioxide and the choice of global warming potential "was not a central

[22] U.S. Environmental Protection Agency, Office of Inspector General, EPA Needs to Improve Air Emissions Data for the Oil and Natural Gas Production Sector, Report No. 13-P-0161 (Feb. 20, 2013) at 12-15.
[23] Id. at 7, 11.
[24] Id. at 25.
[25] Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2013) at 714. Methane is also 34 times more potent than carbon dioxide over a 100-year period.
[26] Intergovernmental Panel on Climate Change, Climate Change 2014 Synthesis Report, Summary for Policymakers, at 24. Accessed online November 12, 2015 at http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf.
[27] RIA at 3A-6 (using figure of 25 from Working Group I Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007) at 212.

issue."[28] Yet for those interested in reducing greenhouse gas emissions, the global warming potential of methane is central. Using the current 20-year global warming potential for methane would increase EPA's estimates of the carbon dioxide equivalent of methane emissions by almost 3.5 times and shows that natural gas is a far worse option for reducing greenhouse gas emissions.

It is all the more glaring that EPA ignores methane's global warming potential as stated in the Intergovernmental Panel on Climate Change's fifth report, because the agency justifies the Clean Power Plan by citing and quoting the report. The fifth report, the EPA writes, is one of several analyses that "strengthen the case that [greenhouse gases] endanger public health and welfare both for current and future generations."[29] EPA also quotes the fifth report as warning of severe consequences from continued greenhouse gas emissions including "impacts on livelihoods, reductions in crop yields, or destruction of homes."[30] Yet when it comes to using the report's most current and relevant data on the global warming power of methane, the EPA omits any mention. Pennsylvania should do better in its implementation of the Clean Power Plan by following the current science and recognizing that due to relatively high methane leakage rates and methane's global warming potential, investing in natural gas is likely to result in minimal progress in reducing greenhouse emissions.

The nonprofit organization, Physicians, Scientists and Engineers for Healthy Energy,[31] which has played a leading role in focusing attention on the climate impacts of methane, will be releasing a report in the coming weeks analyzing the impact of methane leakage on achieving greenhouse gas emission reductions under the Clean Power Plan. This analysis compares the EPA-projected Clean Power Plan compliance scenarios to higher renewable energy and efficiency scenarios given a range of different upstream methane leakage rates and using both the 100-year and 20-year global warming potential values for methane. Pennsylvania should carefully examine this report in developing its implementation plan.

In addition to jeopardizing Pennsylvania's ability to reduce greenhouse emissions, additional reliance on natural gas is also likely to increase other pollution impacts. Increased reliance on natural gas will require more drilling and hydraulic fracturing, accompanied by expanded infrastructure, including pipelines and compressor stations. There are inherent risks associated with such infrastructure including leaks, spills and explosions as drilling companies disclose to their investors through filings with the federal Securities and Exchange Commission.[32]

The risks are not just hypothetical. The Pittsburgh Post-Gazette reported last year that Pennsylvania DEP records showed 243 private water supplies in more than 20 counties had been contaminated, ran dry or suffered reduced flow as a result of drilling activity over the past seven

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[28] Electronic mail communication from Environmental Protection Agency (Aug. 31, 2015).
[29] 80 FR 64,683 (2015).
[30] 80 FR 64,685 (2015).
[31] See: www.psehealthyenergy.org
[32] See, e.g., Range Resources, Corp., Annual Report (Form 10-K) (Feb. 24, 2015) at 22; http://www.sec.gov/Archives/edgar/data/315852/000156459015000899/rrc-10k_20141231.htm.

years.[33] Most of the water supplies – 234 – were polluted by oil and gas activities (as opposed to running dry). Last year, public health professionals at the Southwest Pennsylvania Environmental Health Project found significant recurring spikes in the amount of particulate matter inside homes near drilling and fracking operations.[34] A peer-reviewed study published last year in Environmental Health Perspectives of 492 people in Washington County found that those who lived near natural gas wells had a higher incidence of skin conditions and upper respiratory problems than those living farther away from the gas wells.[35] Compressor stations that help push natural gas through pipelines have been linked to especially high levels of air pollution. A 2009 study conducted for the Environmental Defense Fund estimated that emissions of smog-forming compounds from natural gas compressor engines in the Dallas-Ft. Worth area would be 65 tons per day in that year—the equivalent of roughly a third of all oil and gas emissions in the area and three times the smog-forming emissions from the area's airports.[36] In the Clean Power Plan, the EPA discourages states from using new natural gas power plants to comply with emissions reduction standards because "the use of new NGCC [Natural Gas Combined Cycle] capacity require the construction of additional CO_2–emitting generating capacity, a consequence that is inconsistent with the long-term need to continue reducing CO_2 emissions beyond the reductions that will be achieved through this rule." The EPA explains further that "new generating assets are planned and built for long lifetimes…" and that "the new capacity is likely to continue to emit CO_2 throughout these longer lifetimes…."[37] Yet, the construction of new pipelines and compressor stations to increase capacity in existing natural gas plants is also likely to create long-lived infrastructure that will contribute to CO_2 and CO_2-equivalent emissions of methane. Pennsylvania should follow the logic of EPA's decision to discourage the use of new natural gas power plants for compliance by reducing the use of natural gas, whether in new or existing plants. This decision would reduce the construction of long-lived natural gas-related infrastructure as well as health and environmental risks.

By accounting for methane leakage, using more up-to-date methane leakage rates than those employed by EPA and considering the most current 20-year global warming potential for methane, it becomes clear that Pennsylvania should steer away from natural gas in its

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[33] Laura Legere, DEP Releases Updated Details on Water Contamination, Pittsburgh Post-Gazette. Accessed online November 11, 2015. Accessed online November 11, 2015 at http://powersource.post-gazette.com/powersource/policy-powersource/2014/09/09/DEP-releases-details-on-water-contamination/stories/201409090010. Pennsylvania Department of Environmental Protection, Water Supply Determination Letters. Accessed online November 11, 2015 at Acchttp://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/OilGasReports/Determination_Letters/Regional_Determination_Letters.pdf.

[34] Jeff McMahon, Air Pollution Spikes in Homes Near Fracking Wells. Accessed online November 11, 2015 at http://www.forbes.com/sites/jeffmcmahon/2014/06/26/air-pollution-spikes-in-homes-near-fracking-wells/.

[35] Rabinowitz et al. Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania. Environmental Health Perspectives. Accessed online November 11, 2015 at http://ehp.niehs.nih.gov/1307732/.

[36] Al Armendariz, Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements, report for Ramon Alvarez, Environmental Defense Fund. Accessed online November 11, 2015 at http://www.edf.org/sites/default/files/9235_Barnett_Shale_Report.pdf.

[37] 80 Fed. Reg. 64,729-64,730 (2015).

implementation of the Clean Power Plan. The risks that natural gas poses to water, air and health, make it even more important that the state instead focus on efficiency, wind and solar power.