GAS RUSH: Increasing Greenhouse Gas Emissions from New Oil, Gas, and Chemical Plants

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The shale gas boom has unleashed a tidal wave of proposals to build new compressors and pipelines, and expand chemical, fertilizer, and petroleum plants that depend on natural gas for feedstock or fuel. Since January 1, 2012, these industries have proposed or already obtained Clean Air Act permits that authorize a 91 million ton increase in greenhouse gas emissions — as much as the output from twenty large (500 megawatt) coal-fired power plants.[i] This total does not include new emissions from proposed gas-fired power plants or the multitude of smaller wells, gas processing plants, compressor stations, and flares springing up across the landscape in shale-gas rich states like North Dakota, Pennsylvania, and Texas.

After the 2007 Supreme Court decision effectively required Clean Air Act regulation of global warming pollutants,[ii] the USEPA phased in rules requiring "New Source Review" permits and up to date emission controls for any new facility or major modification at an existing plant that will cause a significant increase in GHG emissions.[iii] But EPA has yet to meet its legal obligation to establish industry-wide standards with consistent and enforceable emission limits for large sources of carbon dioxide, methane, nitrous oxide, and other pollutants that are heating up the planet.[iv]

Table A summarizes the expected emissions from new projects at large oil and gas facilities, chemical plants, and refineries, based on Clean Air Act permits or applications since January 1, 2012. More than two thirds are located in the Gulf Coast States of Louisiana and Texas, the heartland of the U.S. petrochemical industry.

Table A: Greenhouse Gas Permits Oil, Gas, and Chemical Plants

Sector	# of Permit Applications	# of Draft/Final Permits	Total # of Permits	Projected GHG Emissions (TPY)
Chemical	13	29	42	45,876,275
LNG Terminal	4	3	7	24,233,638
Natural Gas	7	25	32	16,430,883
Refinery	1	13	14	4,389,355
Total	**25**	**70**	**95**	**90,930,151**

See Attachment 1 for a full list of new projects and projected GHG increases from each. The permit data were obtained from information posted on USEPA or state websites for large new projects expected to increase greenhouse gas emissions by at least 100,000 tons per year. The ten largest new sources are listed in Table B:

Table B: Top 10 Projected Oil, Gas, and Chemical Plant GHG Emissions Increases

State	County/Parish	Company	Plant/Project	Sector	GHG (TPY)	Permit Status	Date
LA	Cameron Parish	Sabine Pass	Terminal Johnsons Bayou	LNG Terminal	7,268,538	Application	9/20/2013
LA	Cameron Parish	Sabine Pass	Sabine Pass LNG Terminal	LNG Terminal	4,656,175	Final	3/22/2013
TX	Calhoun County	Formosa Plastics	LDPE Expansion Project, Olefins Expansion, Gas Turbine Project	Chemical	4,067,332	Application	5/20/2013
LA	Cameron Parish	Cameron LNG	Cameron LNG Facility	LNG Terminal	3,958,392	Final	10/1/2013
LA	Ascension Parish	CF Industries	Donaldsonville Nitrogen Complex	Chemical	3,956,292	Final	7/15/2013
TX	San Patricio and Nueces Counties	Corpus Christi Liquefaction	LNG Terminal	Natural Gas	3,238,126	Application	9/4/2012
MD	Calvert County	Dominion Energy	Cove Point LNG Project	LNG Terminal	2,774,250	Application	3/1/2013
OR	Clatsop County	Oregon LNG, LLC	LNG Terminal Project	LNG Terminal	2,602,492	Application	7/3/2013
AR	Union County	El Dorado Chemical Company	DMW Nitric Acid Plant	Chemical	2,484,331	Draft	9/19/2013
IN	Spencer County	Ohio Valley Resources	Nitrogenous Fertilizer Plant	Chemical	2,442,987	Draft	2/28/2013

Natural gas is replacing coal as the fuel of choice for electric power plants. Consequently, GHG emissions from this sector have declined over the last five years, because the combustion of natural gas releases less than half as much carbon dioxide as coal combustion per kilowatt of electricity generated. But the new data suggests that lower GHG emissions from the electric power sector will be partially offset by higher emissions from other industries cashing in on cheap and abundant supplies of oil and gas from shale deposits.

Oil and Gas Sector

The oil and gas sector includes facilities that compress gas for transport through pipelines, separate liquids from dry gas, and process or store liquefied natural gas (LNG) for export.[v] Together, 39 new projects are expected to increase GHG emissions by nearly 41 million tons annually, about as much as nine 500 megawatt coal plants.

Large LNG export terminals in Maryland, Oregon, Louisiana and Texas will account for much of that growth. The Federal Energy Regulatory Energy Commission has identified 21 new LNG export projects in the U.S., and 9 of those have proposed or already obtained Clean Air Act permits that would allow total GHG emission increases of 29 million tons per year.[vi] The U.S exported 115 million barrels of natural gas liquids and refinery liquids in 2012, almost five times the level in 2007, and is on pace to export 150 million barrels in 2013.[vii]

Chemical Manufacturing

Greenhouse gas emissions from the chemical sector will increase by an estimated 45.8 million tons per year, as companies build or expand units that extract ethylene, propylene, methanol and other chemicals from natural gas liquids for use in manufacturing a wide variety of products. Low gas prices have also helped revive the U.S. fertilizer industry after years of flat growth, as gas is a critical to the manufacture of nitrogen based fertilizers.[viii] The proposed expansion of nitric acid production and other processes used to make fertilizer would increase GHG emissions nearly 17 million tons, based on Clean Air Act permits issued or proposed since the beginning of 2012. Nitric acid units at fertilizer plants release large amounts of nitrous oxide, which has a global warming effect more than 300 times that of carbon dioxide.[ix] On May 14, 2012, EPA required nitric acid plants built after October 14, 2011, to meet lower limits for nitrogen oxide and other conventional pollutants to settle a lawsuit filed by environmental organizations, but declined to set standards for nitrous oxide or other greenhouse gases.[x]

Most of the new oil and gas projects are in the Gulf Coast states of Texas and Louisiana, which is the center of U.S. chemical feedstock production in the U.S. Also, much of the well production in the Texas and Oklahoma fields is “wet” condensate that is especially useful in refining or chemical manufacturing.[xi]

Petroleum Refineries

Petroleum refinery expansions are expected to increase GHG emissions by 4.3 million tons per year, based on permits for new projects to add new capacity or to adapt existing units to handle shale oil or gas. U.S. refinery output reached peak levels of 6.8 billion barrels a year between 2010 and 2012, nearly 40% higher than the output in the early 1980’s, when more than twice as many refineries were in operation. Much of the expansion in recent years will be for export of refined products that now account for nearly 15% of total U.S. output, or nearly twice the level just five years ago.[xii] This year, Marathon announced a major expansion that will boost diesel exports from its refinery in Garyville, Louisiana, but will also increase greenhouse gas emissions more than 1.5 million tons annually.

The Clean Air Act requires large new greenhouse gas sources to demonstrate that they have applied the best technologies available to minimize that pollution. So far, neither EPA nor state agencies have required permit applicants to remove and inject carbon dioxide in underground formations, due to its high cost. But there are cost-effective alternatives that can cut emissions while saving money through more efficient use of energy or raw materials. For example:

- Flint Hills Resources (FHR) agreed in a recent permit action to take corrective action whenever exit gas temperatures from new heaters at its Pine Bend, Minnesota refinery exceed 350 F, which will reduce fuel consumption by minimizing heat loss. Based on company estimates, these efficiency improvements should reduce greenhouse gas emissions more than 200,000 tons below permitted levels. [xiii] EPA has estimated that refineries could reduce GHG emissions as much as 4% annually through similar investments that, on average, pay for themselves by lowering energy and operating costs, and recapturing and reusing products otherwise lost to the environment.[xiv]

- As much as one third of the natural gas recovered from the Bakken oil fields in North Dakota is burned off in flares[xv], which are also routinely used to dispose of waste gas at chemical plants, refineries, gas processors, and tank batteries. According to EPA, flare gas recovery systems to be installed at the BP Whiting refinery under a recent settlement will cut GHG emissions by nearly 100,000 tons per year. [xvi]

- Every year, oil and gas storage tanks leak more than a million tons of methane, an especially potent global warming pollutant, along with even higher volumes of volatile compounds that cause smog. EPA's new Clean Air Act standards for the oil and gas industry require tighter seals and vapor recovery systems, which will reduce product losses while eliminating the equivalent of 19 to 33 million tons of GHG emissions every year.[xvii]

Under federal New Source Review rules, states must determine which combination of options can best reduce greenhouse gas emissions and reflect those decisions in each permit for new projects. But industry-wide standards are needed to define minimum standards and help states cope with the sheer number and complexity of permit applications. The Clean Air Act requires EPA to provide this guidance through New Source Performance Standards (NSPS) that set emission limits based on the most cost effective technologies, but the EPA has yet to exercise this authority (although it has quantified GHG benefits that result from standards that address other pollutants, as in the recently revised NSPS standards for the oil and gas industry noted above).

About the Data

The estimates in this report are based on the net increase in greenhouse gas emissions that have been authorized under draft or final Clean Air Act permits issued since January 1, 2012, or which have been proposed for adoption by project sponsors. Actual emissions can be lower than permit limits, which are usually based on plants operating at full capacity. On the other hand, some permits do not cover potential emissions from abnormal events like malfunctions or startups and shutdowns, and do not accurately reflect likely leak rates from tanks and process units. Also, as noted earlier, the analysis is

limited to data that could be obtained online from either the USEPA or state agency websites (citations are provided for each project identified in Attachment 1). Finally, the report does not include emission increases from many smaller projects that can add up quickly over time.

Conclusion and Recommendations:

Energy choices always involve some tradeoffs. Electric generating stations fueled by gas are cleaner than coal plants, and generate far less carbon per megawatt of power produced. Low cost natural gas has helped jump-start manufacturing in the Gulf Coast and other states with industries that rely on gas for feedstock or fuel, and may displace imports (e.g., of fertilizers) that are also carbon-intensive.

But the data shows that these new U.S. projects will add tens of millions of tons of global warming gases to the atmosphere, not to mention other pollutants that contribute to smog and fine particle pollution, and increase exposure to toxins for communities downwind from these plants. The USEPA and state agencies can take some practical steps to minimize these impacts:

- New projects and modifications at major sources are already required to employ the best available technologies to eliminate greenhouse gases as well as "conventional" pollutants like nitrogen oxide, volatile organic compounds, or toxic chemicals like formaldehyde or hexane. Permit requirements should incorporate cost-effective investments that can reduce all of these pollutants through greater energy efficiency, by minimizing product losses (from leaking tanks or process units), and by reducing reliance on flaring.

- These benefits can be realized through better process design, and through closer monitoring of performance, e.g., by measuring exit gas temperatures to identify and prevent heat losses. The research suggests that reducing greenhouse gases from the oil, gas, and chemical sectors may depend, at least in the short run, on establishing and maintaining protocols to help plant managers identify and eliminate waste at multiple points throughout the manufacturing process. The USEPA and states should require establishing these protocols in new permits, along with monitoring and reporting requirements to track performance over time.

- The Environmental Protection Agency is obligated under a Supreme Court decision that is now nearly seven years old to set limits on greenhouse gas pollution under the Clean Air Act. EPA has published rules that require new or modified sources that will significantly increase emissions to obtain permits and meet "best available technology" requirements, and the initial results are summarized in Attachment 1 of this report. But case by case permitting is not a substitute for the national greenhouse gas emission standards that EPA must establish for each of the industrial categories subject to Clean Air Act regulation in the wake of Massachusetts v. EPA.

The Obama Administration approaches its sixth year without having even proposed greenhouse gas standards for the natural gas, chemical or refining sectors, although a review of permits indicates that emissions are escalating rapidly from all three industries. Time is running out.

Endnotes:

[i] The average baseload coal plant is about 500 megawatts and emits about 520 tons of CO_2 per hour, and up to 4.55 million tons per year if operated continuously, according to emission factors developed by the Energy Information Administration and the USEPA. http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11.

[ii] *Mass. v. U.S. Envtl. Prot. Agency*, 549 U.S. 497 (2007).

[iii] EPA amended New Source Review regulations in 2010 to require new facilities that emit more than 100,000 tons of GHG emissions and existing facilities undergoing modifications that would increase GHG emissions by more 75,000 tons or more to obtain a New Source Review permit and apply Best Available Control Technology Standards to minimize emissions. The data in this report is limited to new facilities or modifications that would increase GHG emissions by at least 100,000 tons per year. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule,75 Fed. Reg. 31514 (June 3, 2010) ; 40 C.F.R. § 52.21.

[iv] Greenhouse gases include several pollutants, including carbon dioxide, methane, and nitrous oxide. Each pollutant has its own global warming potential and can be converted to a CO_2 equivalent on a mass basis using ratios defined by EPA. *See* 40 C.F.R. Pt. 98, Subpt. A, Tbl. A-1.

[v] U.S. Envtl. Prot. Agency, Greenhouse Gas Reporting Program 2012: *Reported Data, Petroleum and Natural Gas Systems*, http://www.epa.gov/ghgreporting/ghgdata/reported/petroleum.html.

[vi] Fed. Energy Regulatory Comm'n, Office of Energy Products, *Map of North American LNG Import/Export Terminals* (as of Sept. 12, 2013), https://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-potential.pdf.

[vii] U.S. Energy Info. Admin., *U.S. Exports of Natural Gas Liquids and Liquid Refinery Gases*, Oct. 30, 2013, http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mngexus1&f=m.

[viii] U.S. Dep't of the Interior, U.S. Geological Survey, *Mineral Commodity Summaries 2013* at 112-13 (Jan. 24, 2013), http://minerals.usgs.gov/minerals/pubs/commodity/nitrogen/mcs-2013-nitro.pdf. The USGS "Mineral Commodity Summary" for manfacture of nitrogen for fertilizers shows output in 2012 increased about 20% over 2008 levels.

[ix] U.S. Envtl. Prot. Agency, *Overview of Greenhouse Gases*, http://epa.gov/climatechange/ghgemissions/gases/n2o.html.

[x] 40 CFR 60.7a; U.S. Envtl. Prot. Agency, *Revisions to New Source Performance Standards (NSPS) for Nitric Acid Plants*, http://www.epa.gov/ttn/caaa/t1/fact_sheets/nsps_nitricacid_plants_fr_fs_051412.pdf.

[xi] U.S. Energy Information Administration, Lease Condensate Production, http://www.eia.gov/dnav/ng/ng_prod_lc_s1_a.htm.

[xii] U.S. Energy Info. Admin., *U.S. Exports of Finished Petroleum Products* (Sept. 27, 2013), http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MTPEXUS1&f=A; U.S. Energy Info. Admin., U.S. Refinery and Blender Net Production of Crude Oil and Petroleum Products (Sept. 27, 2013), http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mttrpus1&f=a.

[xiii] Environmental Integrity Project, Minnesota Center for Environmental Advocacy and Environmental Integrity Project Reach Innovative Settlement Agreement with Flint Hills Resources to Reduce Air Pollution Emissions at Minnesota Refinery, http://www.environmentalintegrity.org/news_reports/04_19_2013.php.

[xiv] U.S. Envtl. Prot. Agency, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Petroleum Refining Industry* (2010), http://www.epa.gov/nsr/ghgdocs/refineries.pdf.

[xv] Ryan Salmon & Andrew Logan, Ceres, *Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years* 4 (2013) ("The percentage of flared natural gas in North Dakota peaked in September 2011 at 36 percent. That percentage has since fallen to 29 percent as of May 2013. . . ."), *available at* http://www.ceres.org/resources/reports/flaring-up-north-dakota-natural-gas-flaring-more-than-doubles-in-two-years/view; *see also* U.S. Energy Info. Admin., Today in Energy, *Over one-third of natural gas produced in North Dakota is flared or otherwise not marketed* (2011), http://www.eia.gov/todayinenergy/detail.cfm?id=4030 (last visited Nov. 18, 2013).

[xvi] BP Whiting Consent Decree, U.S Dist. Court Northern Indiana, Civil No. 2:12 CV 207 (2012), http://www2.epa.gov/sites/production/files/documents/whiting-cd.pdf.

[xvii] U.S. Envtl. Prot. Agency, *Fact Sheet: Overview of Final Amendments to Air Regulations for the Oil and Natural Gas Industry* 1-2 (2012), *available at* http://www.epa.gov/airquality/oilandgas/pdfs/20120417fs.pdf.