

Greenhouse Gases from a Growing Petrochemical Industry

FRACKING AND LOW GAS PRICES SPARK PROJECTS IN 2015 WITH EMISSIONS EQUIVALENT TO 19 COAL POWER PLANTS



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THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (<http://www.environmentalintegrity.org>) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws.

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PHOTO CREDITS

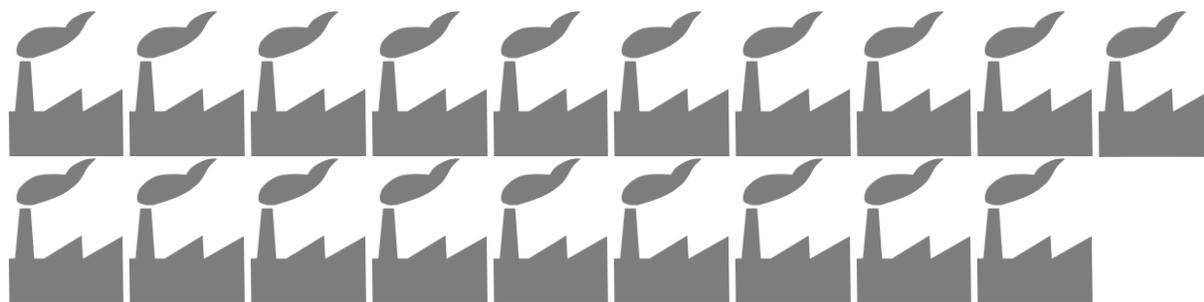
Cover photo of Liquid Natural Gas (LNG) terminal and rear photo of fertilizer plant purchased from iStockphoto.

Climate Footprint of a Growing Industry

Although natural gas is often touted as a clean, “green” fuel because it produces less carbon dioxide than coal, low natural gas and oil prices – driven by the hydraulic fracturing boom – continue to spark extraordinary growth in the petrochemical industry and create waves of projects with a heavy greenhouse gas footprint. The emissions from these new or expanded chemical plants, fertilizer factories, liquid natural gas export facilities, and refineries that rely on cheap fossil fuels must be taken into account when calculating the climate impact of fracking. Many of the new industrial projects being built because of the fracking boom are in Louisiana, which may see its greenhouse gas emissions grow by a third because of 20 projects proposed or approved in 2015. Other major projects are in Texas, West Virginia, Oklahoma, and other states.

In 2015, 44 petrochemical industry construction and expansion projects were proposed or permitted in the U.S. that are expected to pump about 86 million tons of greenhouse gases¹ per year into the atmosphere. That would be a 16 percent increase over the industry’s total in 2014, or pollution equivalent to the emissions from 19 coal-fired power plants, according to state and federal records for air pollution control permits.²

New greenhouse gas emissions will be equal to the emissions from 19 coal-fired power plants



In 2014, the industry proposed 45 projects that are expected to release up to 53 million tons of greenhouse gases per year. All of these planned projects are in industries that use natural gas either as a main ingredient or primary fuel (not including electric utilities).

The recent crash in oil and gas prices is causing bankruptcies and layoffs among drilling companies. But industries that benefit from cheap gas and oil – such as the chemical and fertilizer manufacturers – are using the low prices as an opportunity to expand. Overall, over the last five years, 140 petrochemical projects have been proposed or approved that are expected to produce 179 million tons of greenhouse gases per year – the amount that would rise from 39 coal plants. Some of these new projects, however, are Liquid Natural Gas (LNG) terminals, not all of which are likely to be built, especially if changes in gas prices cut into the export market.

Some of the recent petrochemical projects will release far more than a coal-fired power plant. A 500 megawatt coal plant running at full capacity around the clock will release about 4.6 million tons of carbon dioxide a year.³ By comparison, the Cameron LNG Liquefaction plant in Louisiana, which received a permit on January 14, 2016, is authorized to emit twice that much -- up to 9 million tons of greenhouse gases per year. For a list of the 10 biggest projects overall in 2015, see Table A.

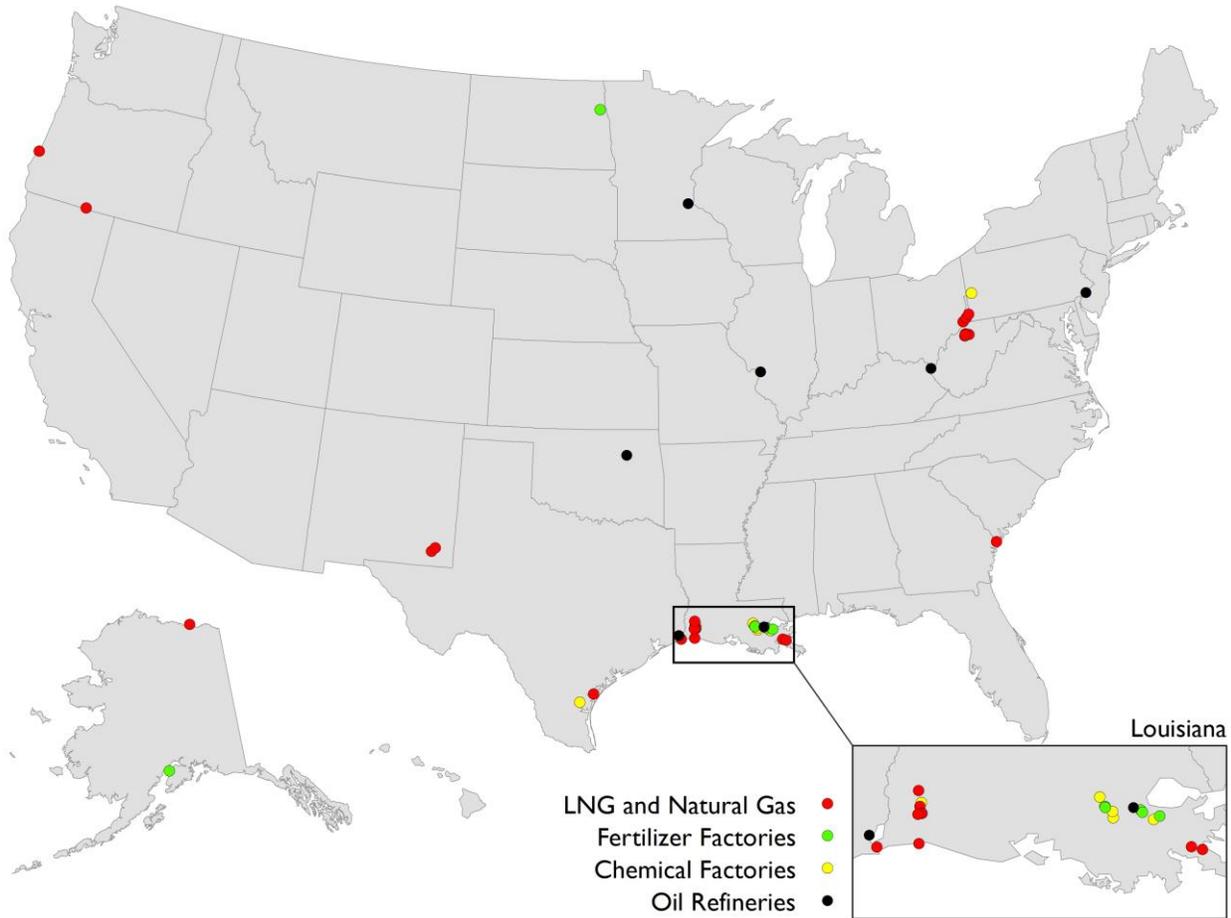
Table A. Greenhouse gas emissions from the ten largest new petrochemical projects, 2015

Rank	Company/Project	Location (County/Parish, State)	Sector	Annual Emissions (tons)
1	FPPC USA, Inc. Ethylene/Propylene Plant *	St. James, LA	Chemical	10,280,160
2	Venture Global Plaquemines LNG, LLC *	Plaquemines, LA	LNG	9,148,291
3	Sabine Pass LNG Terminal	Cameron, LA	LNG	7,919,243
4	Lake Charles Methanol, Lake Charles Methanol Gasification Facility	Calcasieu, LA	Natural Gas	6,015,208
5	Trunkline LNG Export, LLC, Lake Charles Luquefaction Export Terminal	Calcasieu, LA	LNG	4,513,540
6	Venture Global Calcasieu Pass, LLC, TransCameron Pipeline, LLC *	Cameron, LA	LNG	4,505,232
7	CF Industries Nitrogen, LLC, Donaldsonville Nitrogen Complex, Expansion Project	Ascension, LA	Fertilizer	4,431,024
8	Eurochem Louisiana, Louisiana Fertilizer Plant *	St. John the Baptist, LA	Fertilizer	3,607,487
9	Corpus Christi Liquefaction, LNG Terminal	San Patricio and Nueces, TX	LNG	3,440,566
10	Magnolia LNG, LLC, LNG Facility *	Calcasieu, LA	LNG	2,506,994

(* Projects have pending permit applications. Greenhouse gas emissions are in CO₂e tons, or carbon dioxide equivalent tons)

The lion's share of this growth – especially last year – was in Louisiana. In the Bayou state, 20 petrochemical projects were proposed or authorized in 2015 that are expected to produce the equivalent of 68 million tons per year of carbon dioxide, as much as 15 new coal power plants. To put this in perspective, Louisiana today only has only six coal plants operating at four locations. The entire state – including its electric utility sector -- produces about 230 million tons of greenhouse gases per year, according to a 2012 estimate from the World Resource Institute.⁴ That means the projects proposed or permitted in just one year -- 2015 – will boost the state's total emissions by about 30 percent. (For a map with locations of projects, see Figure 1 below)

Figure 1: Locations of proposed and authorized petrochemical projects, 2015



Greenhouse gas emissions from projects by sector, 2015

Sector	Number of projects	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
LNG & Natural Gas Processing	23	47,287,522
Fertilizer Manufacturing	7	15,865,894
Chemical Manufacturing	7	17,587,962
Petroleum Refineries	7	5,397,593
Total	43	86,138,970

(CO₂e means carbon dioxide equivalent tons.)

Largest among all the projects proposed in Louisiana are massive liquid natural gas (LNG) export terminals that will supercool the gas into a more compact form so it can be shipped around the globe in tankers. Seven LNG facilities were proposed or permitted in Louisiana in 2015, along with two natural gas processing and distribution plants, five fertilizer factories, five chemical plants, and a petroleum refinery.

The Environmental Integrity Project obtained the data in this report from U.S. Environmental Protection Agency (EPA) and state websites that have federal Clean Air Act permits or permit applications for large construction projects that would increase greenhouse gas emissions by at least 100,000 tons annually. Clean Air Act permits establish legally enforceable emission limits and other operating requirements that reflect the best available pollution controls. For greenhouse gas emissions from petrochemical plants, that usually means operating at maximum efficiency to eliminate the waste of energy or raw materials, actions that often save money and eliminate pollution at the same time. Investigations by the EPA and independent studies have shown repeatedly, however, that these cost-effective opportunities often are missed when companies are not required to pursue them.

The scale of the proposed pollution increases from the petrochemical industry – combined with the U.S. Supreme Court’s recent 5-4 decision to put on hold the Obama Administration’s rules for greenhouse gases from the electric utility sector – suggest that state and federal governments still have a significant amount of work to do on climate issue. Regulators will need to be even more vigilant about monitoring and controlling these new and expanding sources of climate-warming pollutants.

Table B. Greenhouse gas emissions from petrochemical projects proposed or permitted, by year

Year	Number of Projects	Total Emissions (CO2 equivalent tons per year)
2012	11	4,226,093
2013	39	26,777,165
2014	45	53,094,634
2015	44	86,138,970
2016*	1	9,029,617
Total	140	179,266,479

* January 2016

LNG and Natural Gas Processing Plants

In the 1980's and 1990s, the U.S. was looking to import liquid natural gas (LNG) from overseas to help meet domestic demand amid a perception of limited affordable supply in this country. But then about decade ago, the expanded use of innovative techniques to extract oil and gas from shale rock formations -- hydraulic fracturing and horizontal drilling -- made natural gas produced in the U.S. so much cheaper that the LNG industry reversed direction. Instead of importing gas, shipping terminals are now cooling and compressing natural gas into a liquid form to ship it to Asia and Europe. The facilities that process natural gas -- and also transform it into methanol and other products -- expend a significant amount of energy and release large amounts of carbon dioxide pollution.

Last year, 23 new LNG and gas processing and compressing facilities were proposed or permitted across the U.S. that will -- when built in a few years -- release 47 million tons of greenhouse gases per year, according to state permitting records. By comparison, this entire sector of the industry released about 139 million tons of greenhouse gases in 2014.⁵ That suggests the 2015 projects alone will eventually produce a 34 percent surge in emissions from the LNG and natural gas processing industry. For a list of the largest 2015 projects, see Table C below.

Table C. Greenhouse gas emissions from the ten largest LNG and natural gas projects proposed or permitted in 2015

Company/Facility	Location (County/Parish, State)	Permit or Application Date	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
Venture Global Plaquemines LNG, LLC *	Plaquemines, LA	9/15/2015	9,148,291
Sabine Pass LNG Terminal	Cameron, LA	6/3/2015	7,919,243
Lake Charles Methanol, LLC, Gasification Facility	Calcasieu, LA	11/16/2015	6,015,208
Trunkline LNG Export, LLC, Lake Charles Liquefaction Export Terminal	Calcasieu, LA	5/1/2015	4,513,540
Venture Global Calcasieu Pass, LLC, TransCameron Pipeline, LLC *	Cameron, LA	8/31/2015	4,505,232
Corpus Christi Liquefaction, LNG Terminal	San Patricio and Nueces , TX	2/27/2015	3,440,566
Magnolia LNG, LLC LNG Facility *	Calcasieu, LA	7/23/2015	2,506,994
Jordan Cove Energy Project, LNG Terminal Project	Coos, OR	6/16/2015	2,166,000
Louisiana LNG, LLC, Liquefaction Facility *	Plaquemines, LA	9/25/2015	2,038,730
Live Oak LNG LLC, LNG Export *	Calcasieu, LA	9/22/2015	1,968,499

(*Projects have pending permit applications. CO₂e means carbon dioxide equivalent tons.)

Of the LNG and natural gas plants permitted in 2015, eight out of the 10 largest are all in Louisiana, with one LNG facility each in Texas and Oregon. Seven LNG terminals were proposed or permitted in Louisiana last year that could eventually release 32.6 million tons per year of greenhouse gases – the equivalent of seven new coal-fired power plants.⁶

Across the U.S. over the last five years, 60 LNG and natural gas processing and distribution facilities have been proposed or authorized that will eventually release – when built – 86.7 million tons of greenhouse gases per year, the equivalent of 19 coal-fired power plants. That will be a 62 percent increase over the 2014 totals from this industry.

Fertilizer Manufacturing Plants

Chemical nitrogen fertilizer is one of the mainstays of modern agriculture, with large quantities sprayed on fields around the world to grow corn and other crops. Natural gas is the primary ingredient in the production of ammonia, from which these fertilizers are made. When natural gas prices were high in the U.S., a decade and more ago, producing nitrogen fertilizer in this country was not economically viable. So many farmers purchased chemical fertilizer made in Russia and other countries where natural gas was cheaper. With the popularization of hydraulic fracturing, however, domestic natural gas prices plummeted – which was a game changer for North American fertilizer manufacturers.

Last year, seven new fertilizer industry projects were proposed or permitted in the U.S., including five in Louisiana and one each in Arkansas and North Dakota. When built, these factories will eventually release 15.8 million tons of greenhouse gases per year, or 39 percent more than the 40.9 million tons this industry reported releasing in 2014. See table D below for a list of the seven projects proposed or permitted in 2015.

Table D. Greenhouse gas emissions from new projects at fertilizer plants, 2015

Company/Facility	Location (County/Parish, State)	Permit or Application Date	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
CF Industries Nitrogen, LLC, Donaldsonville Nitrogen Complex Expansion Project	Ascension, LA	3/27/2015	4,431,024
Eurochem Louisiana, LLC, Louisiana Fertilizer Plant*	St. John the Baptist, LA	9/10/2015	3,607,487
Agrium I.S., Inc. Kenai Nitrogen Operations Facility	Kenai, AK	1/6/2015	2,160,432
AM Agrigen Industries, LLC, Amai Ammonia and Urea Plant	St. Charles, LA	4/7/2015	2,060,333
Dyno Nobel Louisiana Ammonia, Ammonia Production Facility	Jefferson, LA	1/20/2015	2,029,020
Northern Plains Nitrogen, LLP, Grand Forks Fertilizer Plant	Grand Forks, ND	8/10/2015	1,159,934
CF Industries Nitrogen, LLC, Donaldsonville Nitrogen Complex, Ammonia Plant Debottlenecking Project	Ascension, LA	3/27/2015	417,664

(* Projects have pending permit applications. CO₂e means carbon dioxide equivalent tons.)

Across the country over the last five years, 18 fertilizer plant construction projects have been proposed or permitted, including two each in Indiana, Iowa, Oklahoma, and North Dakota. These facilities, when built, will eventually release 32.6 million tons of greenhouse gases -- an 80 percent increase above 2014 total from the industry.⁷ For a list of the 10 largest proposed or permitted projects at fertilizer plants nationally over the last 5 years, see Table E in appendix.

Chemical Manufacturing Plants

Natural gas is both a primary ingredient and fuel in industries that manufacture an array of chemicals that are used for plastics and a variety of other products. Because of low natural gas prices, seven new chemical factories were proposed last year – including three methanol plants (in Louisiana and Texas), two ethylene plants (in Louisiana) and an expansion of a pesticide factory. In June 2015, Monsanto announced⁸ a \$1 billion project to expand a plant in St. Charles Parish, Louisiana, that makes a chemical, called dicamba, for the herbicide glyphosate (brand name “Roundup.”)

When all seven of these chemical plants are built, they are expected to release 17.6 tons per year of greenhouse gases into the atmosphere. Compared to a sector total of 153 million tons of carbon dioxide equivalent gas in 2014, the increase will be 12 percent.⁹ That’s about the same amount of heat-trapping gas as would be produced by four new coal-fired power plants.

Across the U.S. over the last five years, there have been 45 chemical plant construction or expansion projects proposed or permitted that could produce about 52 million tons per year of greenhouse gases – a 34 percent increase over what the sector released 2014.¹⁰ That’s the equivalent of about 11 coal-fired power plants.

Table F. Greenhouse gas emissions from new projects at chemical manufacturing plants, 2015

Company & Project	Location (County/Parish, State)	Date Issued	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
FPPC USA, Inc. Ethylene/Propylene Project *	St. James, LA	9/28/2015	10,280,160
Shell Chemical Appalachia, LLC, Petrochemicals Complex (Ethane Cracker)	Beaver, PA	6/18/2015	2,248,293
Methanex USA, Geismar Methanol Plant, Geismar 1 and 2	Ascension, LA	11/26/2015	1,967,558
Eagle US 2, LLC, Lott Chemical USA, Ethylene Plant Project	Calcasieu, LA	12/14/2015	1,155,059
South Louisiana Methanol, LP, St. James Methanol Plant *	St. James, LA	9/30/2015	809,731
Ticona Polymers, Bishop Plant Methanol Unit Project	Nueces, TX	11/12/2015	580,619
Monsanto, Dicambia Manufacturing Project *	St. Charles, LA	9/18/2015	546,542

(* Projects have pending permit applications. CO₂e means carbon dioxide equivalent tons.)

For a list of the largest 10 chemical industry projects proposed or permitted over the last five years, see Table G in appendix.

Petroleum Refineries

Hydraulic fracturing and horizontal drilling have produced not only cheap natural gas, but such a dramatic plunge in oil prices that some drilling and production companies are now threatened with bankruptcy. Firms that refine petroleum, however, are exploiting an opportunity, running at full capacity, and building their capacity.

In 2015, seven petroleum refinery projects were proposed or permitted across the U.S. in Oklahoma, Texas, Louisiana, Minnesota, Pennsylvania, Illinois and Kentucky. When built, these facilities will produce about 5.4 million tons per year of greenhouse gases. That compares to a sector total of 192 million tons in 2014, or about a three percent increase.

Over the last five years, there have been 17 proposed or permitted petroleum refinery projects that will eventually produce about eight million tons of greenhouse gases, a four percent increase over the 2014 industry totals. (See Table I in appendix for a list of the 10 largest petroleum refinery projects proposed or permitted since 2012)

Conclusion

The revolution in energy production triggered by hydraulic fracturing and horizontal drilling has brought real benefits to the U.S. economy, including lower gas and oil prices and a reduced need to import foreign fuel. The petrochemical industry has also enjoyed strong growth – with LNG terminals, chemical plants, fertilizer factories, and refineries all expanding to exploit the cheap fuel prices. This is positive news for American business, even though it is coming at a time when drilling companies are laying off workers because of the glut of oil and gas on the market.

The greenhouse gas benefits of fracking and natural gas, however, are murkier. The cost-benefit calculations are made more complex not only because methane escapes during drilling and transport (methane is a potent heat-trapping gas), but also because the industrial expansion triggered by the fracking boom will add tens of million tons of global warming pollution to the atmosphere.

This report documents 44 petrochemical industry construction and expansion projects proposed or permitted in 2015 alone that are expected to pump about 86 million tons of greenhouse gases per year into the atmosphere – the equivalent to the pollution from 19 coal-fired power plants. Looking at all the projects proposed or approved over the last five years, the emissions from this burgeoning industry could equal the pollution from 39 coal plants.

As state and federal governments decide what they will do to cut back their overall greenhouse gas emissions – whether by requiring greater efficiencies from industry, or by encouraging more clean energy sources, like solar or wind – those efforts will have to be enhanced to keep pace with the petrochemical industry's expansion. The numbers are far too large to ignore.

APPENDIX

Table E. Greenhouse gas emissions from the ten largest new fertilizer projects, 2012-2015

Company/Facility	Location (County/Parish, State)	Permit or Application Date	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
CF Industries Nitrogen, LLC, Donaldsonville Nitrogen Complex	Ascension, LA	3/27/2015	4,431,024
Eurochem Louisiana, LLC, Louisiana Fertilizer Plant*	St. John the Baptist	9/10/2015	3,607,487
Midwest Fertilizer Co., LLC, Nitrogen Fertilizer Manufacturing Facility	Posey, IN	6/4/2014	2,573,349
Ohio Valley Resources, Nitrogenous Fertilizer Plant	Spencer, IN	9/25/2013	2,442,987
CF Industries Nitrogen, LLC, Port Neal Nitrogen Complex	Woodbury, IA	7/12/2013	2,262,960
Agrium U.S. Inc, Kenai Nitrogen Operations Facility	Kenai, AK	1/6/2015	2,160,432
AM Agrigen Industries, LLC, Amai Ammonia and Urea Plant	St. Charles, LA	4/7/2015	2,060,333
Dyno Nobel Louisiana Ammonia Production Facility	Jefferson, LA	1/20/2015	2,029,020
Iowa Fertilizer Company (Orasco), Fertilizer Plant	Lee, IA	3/13/2014	1,977,370

(* Projects have pending permit applications.)

Table G. Greenhouse gas emissions from the ten largest proposed and authorized new chemical projects, 2012-2015

Company/Facility	Location (County/Parish, State)	Permit or Application Date	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
FPPC USA, Inc., Ethylene/Propylene Plant*	St. James, LA	9/28/2015	10,280,160
Sasol North America, Inc, Lake Charles Cracker Project	Calcasieu, LA	5/23/2014	3,955,120
Formosa Plastics, Olefins 3 and Propane DeHydrogenation Plant	Calhoun, TX	8/1/2014	2,627,187
Dow Chemical Company, Light Hydrocarbon 9	Brazoria, TX	5/20/2014	2,361,294
Appalacian Shale Cracker-Enterprise, LLC, Ethane Cracker/Polyethylene Plant*	Wood, WV	5/15/2014	2,311,914
Shell Chemical Appalachia, LLC, Petrochemicals Complex (Ethane Cracker)	Beaver, PA	6/18/2015	2,248,293
Methanex, USA, Geismar Methanol Plant Geismar 1 and 2	Ascension, LA	11/26/2015	1,967,558
Chevron Phillips, Cedar Bayou Plant, New Ethylene Unit	Harris, TX	1/17/2013	1,615,000
ExxonMobil Baytown Olefins Plant: Ethylene Expansion Unit	Harris, TX	11/25/2013	1,453,293

(* Projects have pending permit applications.)

Table H. Greenhouse gas emissions from the ten largest projects at petroleum refineries, 2012-2015

Company/Project	Location (County/Parish, State)	Permit Date	Annual Greenhouse Gas Emissions (Tons CO ₂ e)
Holly Energy Partners, LP, Holly Tulsa Refinerly East, West, and Loading Terminal	Tulsa, OK	4/20/2015	2,017,796
Marathon Petroleum, LLC, Resid Oil Upgrader Expansion and Capital Improvement Project	St. John the Baptist, LA	8/27/2015	1,926,111
Flint Hills Resources, Refinery Expansion	Dakota, MN	9/11/2013	412,553
Motiva, HUCU2/DHT Expansion Project	Jefferson, TX	7/31/2015	400,000
Flint Hills Resources, Refinery Expansion	Dakota, MN	3/17/2015	384,427
Flint Hills Resources, West Plant	Nueces, TX	5/13/2014	359,991
Sinclair Casper Refining Company	Carbon, WY	3/21/2013	359,915
Philadelphia Energy Solutions, Increasing heater capacity	Philadelphia, PA	8/12/2015	280,909
Holly Refining and Marketing Co., Heavy Crude Processing Project	Woods Cross, UT	11/18/2013	279,610
Phillips 66 Carrier LLC, Refinery CORE Expansion (Crude Oil) and Wood River Products Terminal Expansion	Roxana, IL	1/23/2015	209,350

NOTES:

¹ Carbon dioxide equivalent tons

² Figures are for Clean Air Act permitting documents available online from the U.S. Environmental Protection Agency and state environmental agencies in Alaska, Arkansas, Colorado, Florida, Georgia, Illinois, Iowa, Idaho, Indiana, Kansas, Louisiana, Maryland, Michigan, Minnesota, Mississippi, North Dakota, New Mexico, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Utah, Virginia, West Virginia and Wyoming. Numbers include both draft and final permits, as well as projects for which companies have submitted permit applications which are still pending. The average baseload coal plant is about 500 megawatts and emits about 520 tons of CO₂ 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 U.S. Environmental Protection Agency Greenhouse Gas Reporting Program (2014). The estimate for fertilizer manufacturing includes emissions from subsectors that engage in nitric acid production, ammonia manufacturing, and phosphoric acid production, in short tons. <http://www2.epa.gov/ghgreporting/ghgrp-2014-chemicals>

³ The average baseload coal plant is about 500 megawatts and emits about 520 tons of CO₂ 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>.

⁴ 2012 figures from World Resources Institute published by U.S. News and World Report on August 3, 2015, in online database titled: "Clean Power Plan: Your State-by-State Greenhouse Gas Emissions." Available at <http://www.usnews.com/news/blogs/data-mine/2015/08/03/clean-power-plan-your-state-by-state-greenhouse-gas-emissions>

⁵ U.S. Environmental Protection Agency Greenhouse Gas Reporting Program

⁶ Numbers are from federal Clean Air Act permits. The average baseload coal plant is about 500 megawatts and emits about 520 tons of CO₂ 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>

⁷ U.S. Environmental Protection Agency Greenhouse Gas Reporting Program

⁸ Monsanto press release, "Monsanto Announces Potential \$1 Billion Expansion in Louisiana," June 24, 2015. Link: <http://news.monsanto.com/news/corporate/monsanto-announces-potential-1-billion-expansion-louisiana>

⁹ U.S. Environmental Protection Agency Greenhouse Gas Reporting Program

¹⁰ Ibid.



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