



## A SNAPSHOT OF THE SHALE GAS BUILDOUT IN PENNSYLVANIA

September 20, 2021

Since the Marcellus shale gas boom took off in western Pennsylvania over ten years ago, the Commonwealth has emerged as the second largest producer in the United States – leapfrogging ahead of Louisiana and Oklahoma, long known for their gas production, and closing fast on the number one producer, Texas (see Table 1 and Figure 1). Pennsylvania’s natural gas output has grown forty-fold since 2010, and production for the entire Appalachian region (Pennsylvania included) is predicted to continue its increase through the middle of this century (see Figure 2).

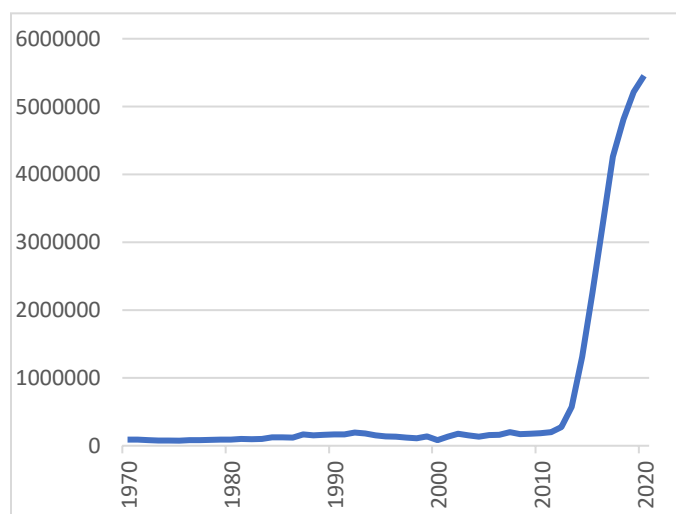
**Table 1: Annual Natural Gas Gross Withdrawals for Top 5 States (million cubic feet)**

Year	US total	TX	PA	LA	OK	OH
2020	40,689,764	10,291,029	<b>7,289,906</b>	3,188,932	2,786,366	2,408,358
2019	40,892,458	10,355,453	<b>6,896,792</b>	3,230,272	3,175,008	2,654,186
2018	37,325,539	9,109,174	<b>6,264,832</b>	2,839,919	2,875,787	2,403,382

Source: U.S. Energy Information Administration. Natural Gas Gross Withdrawals and Production (published June 20, 2021).

Available at: [https://www.eia.gov/dnav/ng/ng\\_prod\\_sum\\_a\\_EPGO\\_FGW\\_mmcf\\_a.htm](https://www.eia.gov/dnav/ng/ng_prod_sum_a_EPGO_FGW_mmcf_a.htm)

**Figure 1. Pennsylvania Natural Gas Gross Withdrawals, 1970-2020 (million cubic feet)**



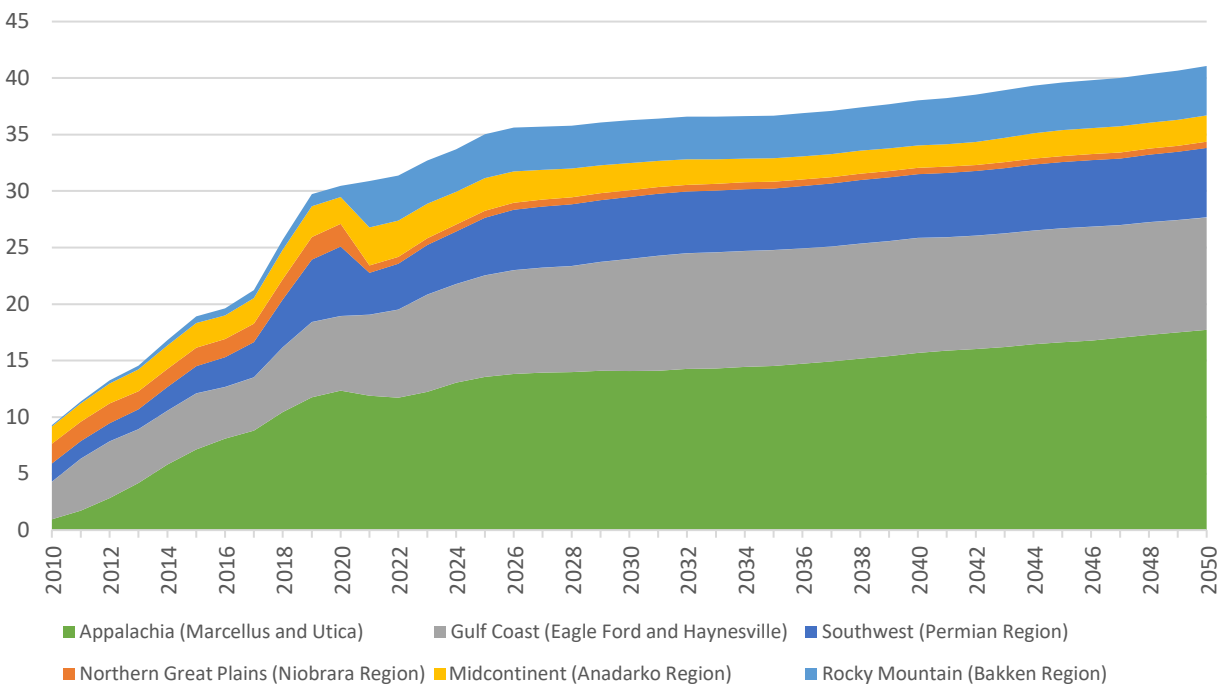
Sources: U.S. Energy Information Administration. June 30, 2021.

Available at <https://www.eia.gov/dnav/ng/hist/n9010pa2A.htm>

This brief report reviews how this growth is fueling emissions of greenhouse gases (GHGs) and other pollutants from petrochemical plants and gas-fired power plants. It does not include emissions from “upstream” sources, such as fracked wells and associated storage tanks, and flares and combustion units that burn off waste gases. While these sources are widespread and include thousands of new well pads and associated infrastructure, the sites where they are located typically fall below the thresholds that trigger EPA’s greenhouse gas reporting requirements or federal and state rules that require the quantification and disclosure of other Clean Air Act pollutants. In addition to examining the rate of growth of the buildout, this report also discusses emerging issues and offers suggestions for how to address public health and environmental impacts.

The data in this report include GHG emissions from sectors with large facilities subject to EPA reporting rules and projected emission increases from new projects that are permitted but not yet fully operational.

**Figure 2: Regional Natural Gas Production, 2010-2050 (trillion cubic feet)**



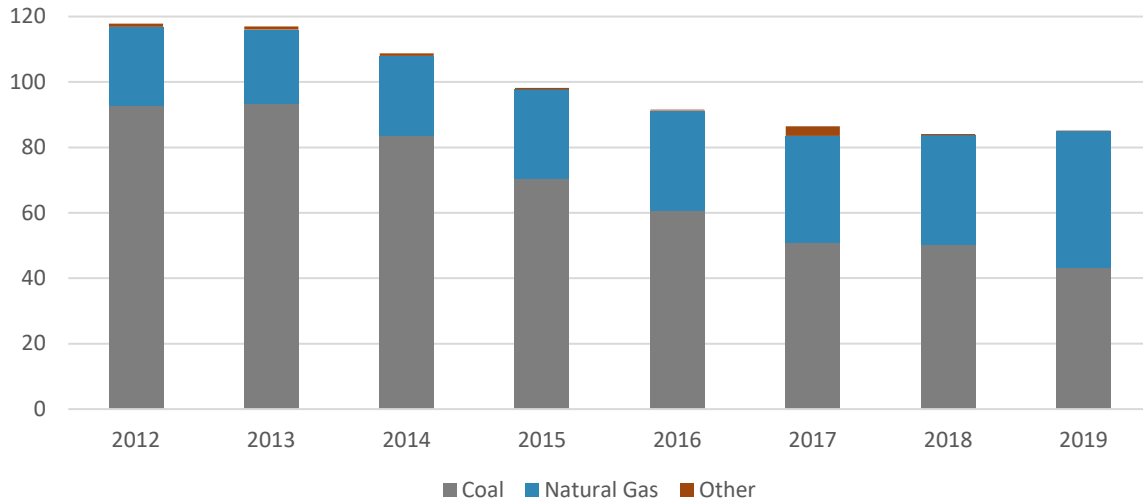
Note: Data from 1/1/2021 onwards are EIA projections. Data Sources: U.S. Energy Information Administration. *Drilling Productivity Report* (published 6/14/2021). Available at: <https://www.eia.gov/petroleum/drilling/>. U.S. Energy Information Administration. *Annual Energy Outlook 2021* (published 2/3/2021), Table 59. Lower 48 Natural Gas Production and Supply Prices by Supply Region (Onshore, Reference Case). Available at: <https://www.eia.gov/outlooks/aeo/>

## GHG emissions from gas-fired power plants in Pennsylvania up sharply

The low price of natural gas has triggered construction of at least 1,215 new gas-fired electric generation units across the United States between 2010 and 2020.<sup>i</sup> Projects in Pennsylvania were responsible for around 10 percent of the growth, adding nearly 11,400 megawatts (MW) of new gas-fired generating capacity over the last decade, and outstripping the total retired generation capacity in the state by about 2,025 MW. While these new PA power plants may emit less carbon pollution from their smokestacks than the aging plants many replaced, their total reported GHG emissions still reached 41.7 million tons in 2019, which was almost as much as the GHG load from Pennsylvania’s remaining coal plants that year.<sup>ii</sup> (See Figure 3). Emissions from natural gas-fired power plants are expected to continue to grow as new gas-fired units begin operating.

Total GHG emissions from power generation in Pennsylvania rose by more than one million tons between 2018 and 2019—the first annual increase reported in over a decade (see Figure 3). This increase was partially attributed to the commissioning of new gas plants in 2018, including the Tenaska Westmoreland Generating Station and the Invenegy Lackawanna Energy Center. These two facilities generated 2,242 MW of electricity from fracked natural gas and released almost 6.2 million tons of GHGs in 2019, according to company-reported data published by EPA.<sup>iii</sup>

**Figure 3: Pennsylvania GHG emissions from power generation, by fuel type (million short ton CO2e)**



Note: "Other" is the sum of fuel combustion emissions from petroleum products and other fuel types reporting to EPA. (CO2e = carbon dioxide equivalents). Source: U.S. Environmental Protection Agency. Facility Level Information on GreenHouse gases Tool (FLIGHT). November 4, 2020. (Accessed July 13, 2021). Available at: <http://ghgdata.epa.gov/ghgp/main.do>.

New projects proposed for Pennsylvania could add another 6 gas-fired electric generating units and 3,499 MW of nameplate capacity, or the intended full-load sustained output of a facility, by 2025. Together, these plants have the potential to emit approximately 13.6 million tons of GHGs per year according to permit documents and application materials reviewed by EIP (Table 2). This would be an increase of about 33 percent over 2019 reported emissions from natural gas plants in the Commonwealth.

**Table 2: Potential emissions increases (short tons per year of CO2e) from new gas-fired power plants in Pennsylvania**

Company, Project (County)	No. Units	Total Capacity (MW)	Potential GHG Emissions
Renovo Energy Center LLC, Renovo Generation Station (Clinton County) <sup>iv</sup>	2	1,240	5,445,541
Robinson Power Company LLC, Beech Hollow Project (Washington County) <sup>v</sup>	2	1,000	3,842,431
Hill Top Energy Center (Greene County) <sup>vi</sup>	1	620	2,324,350
Invenergy LLC, Allegheny Energy Center (Allegheny County) <sup>vii</sup>	1	639	1,948,493
<b>TOTAL:</b>	<b>6</b>	<b>3,499</b>	<b>13,560,815</b>

Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e), expressed in short tons per year. Nameplate capacity and potential emissions increases are from publicly available permit documents.

In addition to the units at the power plants listed above, three more units with the capacity to generate a total of 10.9 MW are planned for Penn State University and Merck & Co.'s West Point facility, according to the most recent data published in the EIA's Annual Electric Generator Report.<sup>viii</sup> Furthermore, three gas-fired electric generating units with a combined nameplate capacity of 125 MW were recently

commissioned at the Shell petrochemical complex in Beaver County (potential emissions are included in Table 3).<sup>ix</sup>

The buildout in western Pennsylvania now includes several proposed and already approved gas-fired power plants. The plants are not needed to supply energy to local communities. In fact, according to the Energy Information Administration, although Pennsylvania is the third-largest producer of electricity, the Commonwealth exports more electricity outside its borders than any other state in the nation.<sup>x</sup>

Instead of providing energy to localities in which these gas plants are being proposed and/or built, each of these facilities is slated to be added to the Pennsylvania-New Jersey-Maryland (PJM) Interconnection, which is part of the Eastern Interconnection grid and is “...the largest independent power system operator (ISO) in the United States, responsible for coordinating the flow of electric power to more than 65 million electric customers across 13 U.S. states and the District of Columbia.”<sup>xi</sup> The local communities hosting these plants will be burdened with all the health and environmental risks while reaping little of the energy benefits.

## **Tracking the gas and petrochemical infrastructure buildout in Pennsylvania**

Unbridled natural gas production has triggered an expansive, massive, and continuing physical infrastructure buildout that includes gas wells and drilling sites, pipelines, compressor stations, pigging operations, as well as various other facilities such as liquefied natural gas (LNG) plants and ethylene crackers designed to unleash a flood of newly manufactured plastics across the region. The impact of the buildout over time is obvious in parts of the country like Texas and Louisiana, where skylines and waterways are lined with vast stretches of petrochemical plants and refineries, and the landscape is scarred with pipeline routes. Pennsylvania is on the brink of a similar fate.

The Environmental Integrity Project (EIP) maintains a database that tracks the impact that large gas processors, midstream compressors, and new petrochemical industry projects are expected to have on emissions of GHGs and other criteria pollutants [available at: <https://environmentalintegrity.org/oil-gas-infrastructure-emissions/>]. These data indicate the Pennsylvania Department of Environmental Protection (PA DEP) has issued final Clean Air Act construction permits for at least 29 large gas and petrochemical infrastructure projects since 2012 (See Table 3 below. For a full list of projects, please see Appendix A and EIP’s data). Fifteen of these projects, with the potential to emit up to 1.9 million tons of GHGs per year, are already operating, including Energy Transfer’s Revolution Cryogenic Plant in Smith Township. This fractionation facility connects to over 100 miles of existing gathering pipelines and ETC’s Revolution Pipeline and was recently placed back into service after it exploded in 2018.<sup>xii</sup>

Eight more projects are currently under construction, including the Shell ethylene cracker in Beaver County, which fired-up its gas-powered electric plant in late summer 2021 and could emit up to 2.3 million tons of GHGs annually once it becomes fully operational in 2022. Another six projects are in the planning phase and could emit nearly two million tons of GHGs per year if the PA DEP continues to routinely approve major gas projects, including New Fortress Energy’s proposed LNG plant in Wyalusing and “Project Phoenix,” which would increase fractionation capacity at Sunoco’s ever-expanding Marcus Hook Industrial Complex in Delaware County.

**Table 3: Potential emissions increases (short tons per year) from the buildout of natural gas and petrochemical projects in Pennsylvania since 2012**

Operating Status	No. Projects	CO <sub>2</sub> e	PM <sub>2.5</sub>	NO <sub>x</sub>	VOCs	SO <sub>2</sub>	CO
Fully or partially operating	16	4,201,852	281	1,260	982	59	1,790
Under construction	7	709,359	63	236	84	17	169
Pre-construction	6	1,976,355	160	428	151	104	489
<b>Total emissions impacts:</b>	<b>29</b>	<b>6,887,566</b>	<b>505</b>	<b>1,925</b>	<b>1,217</b>	<b>181</b>	<b>2,449</b>

For a full list of projects, see Appendix A. Note: Greenhouse gases are measured in carbon dioxide equivalents (CO<sub>2</sub>e), expressed in short tons per year. Potential emissions increases reflect projects' maximum potential to emit, once fully constructed, as specified in their New Source Review permits or federal environmental impact statements. Source: Environmental Integrity Project, *Emissions Increases Database* (as of July 2021). Available at: <https://environmentalintegrity.org/oil-gas-infrastructure-emissions/>

Pennsylvania has also taken steps to make it easier for the petrochemical and fertilizer industries to plant roots in the state, especially with the new tax credit that will be offered to fertilizer and petrochemical manufacturers starting in 2024.<sup>xiii</sup> The promotion of these industries and incentivization with taxpayer dollars makes it increasingly important to push back against projects that will lock in and increase demand for fracked gas.

### **Pennsylvania energy exports fueling downstream petrochemical projects in nearby states**

The gas extracted from Appalachian shale formations has a much higher volume of liquid condensates than gas found in other regions. These condensates have a high market value because they are easier to blend with other feedstocks to make fuel or chemical products. Unsurprisingly, much of the output from Pennsylvania is also feeding the expansion of large petrochemical projects or LNG terminals in other states, and this “downstream” footprint needs to be added to the environmental cost and health impacts of fracking in Pennsylvania.

Consider GHG emissions from petrochemical production in Appalachia: although facility-reported GHG emissions declined from 6.7 to 5.8 million tons per year between 2012 and 2019, a 13 percent decrease, at least three major chemical projects with the potential to emit up to 3.4 million tons of GHGs per year have been approved in Ohio and West Virginia. This includes the greenfield Marcellus Methanol Plant proposed for Marshall County, West Virginia, as well as two new plants in Ohio that have been significantly delayed: PTTGC America’s ethylene cracker proposed for Belmont Country and the Pallas Nitrogen Plant proposed for Columbiana County.<sup>xiv</sup> The West Virginia Department of Environmental Protection also approved two new methanol plants that are considered “minor” sources of air pollution under the so-called “tailoring rule” that EPA adopted in 2010. Although these projects have been excluded from GHG permitting requirements because they do not meet the major source thresholds under the Clean Air Act, they could increase emissions of criteria pollutants by over 500 tons per year.

The projects described above represent only one-fifth of potential emission increases from the natural gas and petrochemical buildout in Ohio and West Virginia. Regulators have issued final Clean Air Act construction permits for at least 67 additional natural gas and petrochemical projects since 2012 that authorize over 13.3 million tons of GHG emissions every year. That’s more than the carbon output

generated from three new baseload coal-fired power plants.<sup>xv</sup> While 57 of these projects are already fully or partially operating and three are currently under construction, the rest are in planning phases and have the potential to increase annual emissions of GHGs by nearly 2.2 million tons. Together with the PTTGC ethylene cracker and the Pallas Nitrogen Plant, these proposed projects in Ohio and West Virginia could add nearly 5.6 million tons of GHGs and hundreds of tons of Clean Air Act criteria pollutants to an already overburdened airshed.

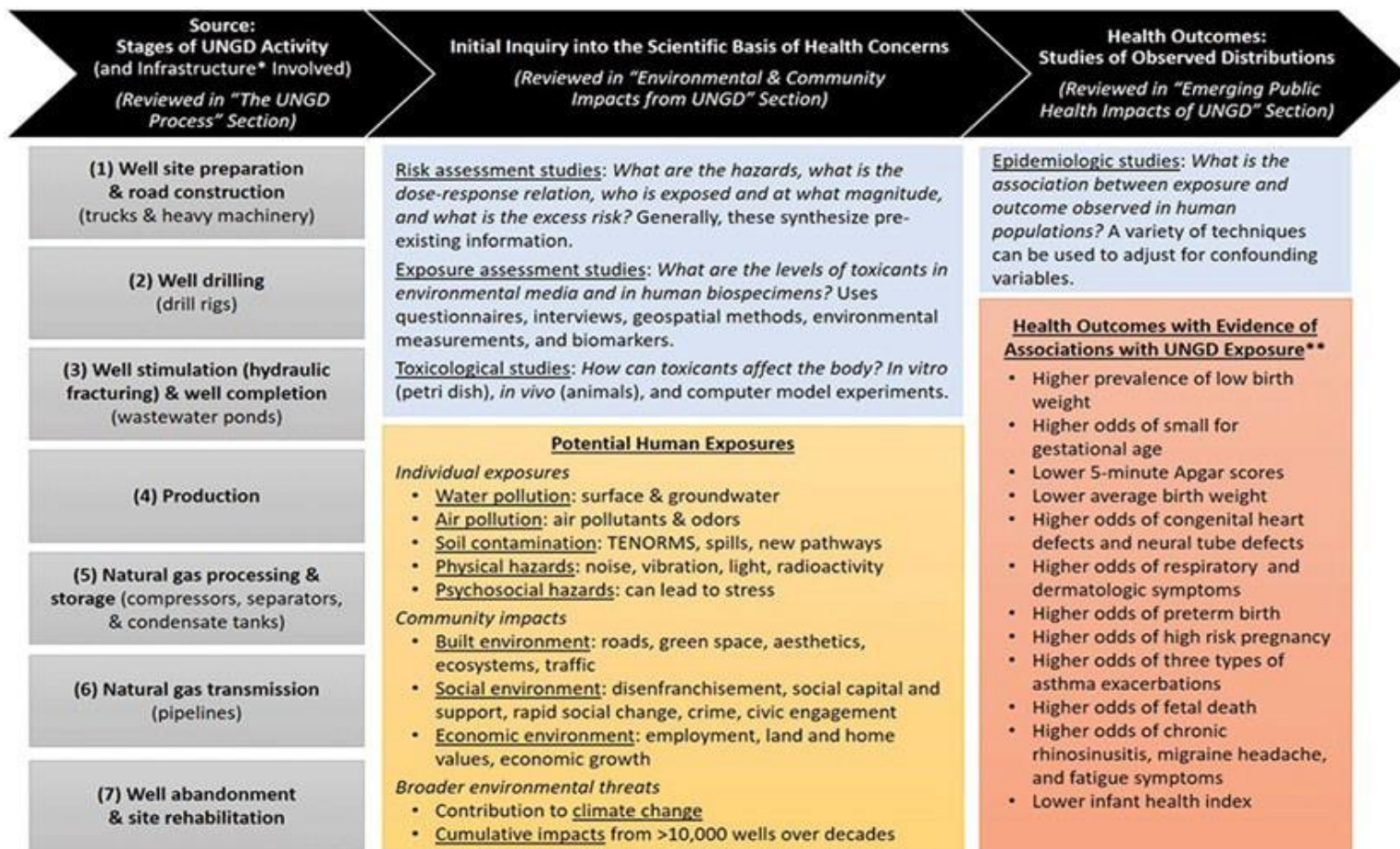
## **Health risks from the natural gas buildout**

Emissions associated with the natural gas buildout in Pennsylvania present a slew of health risks to people living in the region – and particularly those living close to natural gas production facilities. These facilities and their operations release fine particles, toxic fumes, and hazardous chemicals into the environment. Some of the pollutants released into the air include particulate matter (PM), ozone and its precursors, volatile organic compounds (VOCs), hydrogen sulfide, respirable crystalline silica, nitrogen oxides, and greenhouse gases. Individuals living close to natural gas production facilities have experienced many symptoms including respiratory problems such as asthma and coughing, eye, nose, and throat irritation, headaches, nausea, dizziness, trouble sleeping, and fatigue.

Short-term exposure to fine particulate matter and ozone can have critical health implications. For example, there is evidence of an association between out-of-hospital cardiac arrests and short-term exposure to fine particulate matter and ozone.<sup>xvi</sup> A study conducted in Nueces, Texas between 2000 and 2012 found an elevated risk of having a first stroke with higher ozone concentrations and fine particulate matter in the preceding two days.<sup>xvii</sup> A 2018 study estimated that up to 11% of all asthma emergency room visits in the United States are attributed to ozone.<sup>xviii</sup> And looking into the future, the Clean Air Task Force published a 2016 report that predicted that by 2025, increases in levels of ozone from the oil and gas industry will result in more than 2,000 asthma-related emergency room visits and over 600 respiratory-related hospital admissions nationally each summer.<sup>xix</sup>

Several studies conducted over recent years have also found that natural gas production, and fracking in particular, is associated with increased health risks to pregnant women. One study published in the Oxford Research Encyclopedia of Global Public Health in February of 2019 looked at several hundred scientific articles about the community and health impacts of fracking.<sup>xx</sup> Evidence used in this study suggests that women living closer to fracking have increased odds of having preterm births, high-risk pregnancies, and babies with low birth weight. Another study found that a high level of exposure to oil and gas flaring events is associated with a 50% higher risk for preterm birth, compared to women who are not exposed to flaring.<sup>xxi</sup> The researchers defined a high level of exposure as 10 or more nightly flare events within five kilometers of a woman's home.

In addition, health impacts associated with contaminated drinking water and other exposure pathways are becoming increasingly well-documented. The chart below, from the Oxford Research Encyclopedia of Health's February 2019 report, *Environmental Health Concerns From Unconventional Natural Gas Development*, provides a succinct summary:<sup>xvii</sup>



\*Infrastructure listed provide examples of sources of pollutants but are not comprehensive.

\*\*Only health outcomes with evidence from epidemiologic studies where both exposure and outcome were assessed on the individual level are included. Findings are organized in rough chronological order by study.

## Investments in gas plant and petrochemical projects are not a good bet for Pennsylvania's future

An October 2020 report by the Institute for Energy Economics and Financial Analysis (IEEFA) and the Applied Economics Clinic (AEC) detailed increased risks to gas plants proposed as part of the PJM Interconnection. Those risks include the following:

- “Increasing price competitiveness of clean solar, wind, demand response and battery storage alternatives.
- Significant existing overcapacity, flat demand growth and market turmoil.
- High-impact, unpredictable global events such as COVID-19 that radically reshape markets and expectations of future demand.
- Uncertainty over the future direction of gas prices, particularly given the substantial increase in

U.S. liquefied natural gas (LNG) exports.

- Actions by state governments within the PJM market to limit future fossil fuel generation and/or even withdraw from the market entirely.
- Public opposition that can delay project development and raise overall costs.”<sup>xxiii</sup>

Public interest legal organizations are contesting permits and taking other legal actions to hold the industry accountable and to slow down or stop the construction of the most polluting projects. Examples include the appeal of and settlement agreement regarding the Shell plan approval<sup>xxiv</sup> and the pending appeals of the synthetic minor source permit for the MarkWest Smith compressor station, located in Smith Township, Washington County, PA; the February 2021 settlement with the Pennsylvania Department of Environmental Protection (PA DEP) negotiated collaboratively by several organizations to restore public participation requirements denied the public regarding 49 oil and gas liquid waste storage permits issued pursuant to the new WMGR123 general permit; and most recently, the appeal of the construction permit issued by PA DEP for the Beech Hollow Project filed in July 2021. Significant energy and time are also focused on assisting local community members in ensuring they have a voice during the permit application review process.

## **Emerging developments in Pennsylvania**

### *Green and Blue Hydrogen*

In addition to gas-fired electric generation and petrochemical plants, a number of new projects have been proposed to capitalize on the state’s abundance of natural gas and natural gas liquids through the development of “green” hydrogen and “blue” natural gas synthesis manufacturing capacity.

Hydrogen has traditionally been used as an industrial feedstock to produce low-sulfur refined products and petrochemicals. This “grey” hydrogen is produced from fossil fuels – namely natural gas – either as a byproduct or alongside other high-value commodities, such as ammonia fertilizer and methanol. The industrial hydrogen market is already well established in the United States, with over 13 billion cubic feet of grey hydrogen produced each day according to industry estimates.<sup>xxv</sup>

If carbon capture and storage (CCS) is incorporated, grey hydrogen magically becomes “blue.” Blue hydrogen and other blue feedstocks that are synthesized from natural gas are being touted as low-carbon solutions that are critical to the energy transition, and government-sponsored financial incentives have been gaining bipartisan support.

The KeyState Natural Gas Synthesis Plant proposed for Clinton County would use fracked gas from the Utica and Marcellus shale formations as a feedstock and power source for the onsite manufacturing of blue hydrogen, ammonia fertilizer, methanol, and diesel exhaust treatment. Perry Babb, the chairman and CEO of KeyState Energy, recently spoke before the Senate Environmental Resources and Energy Committee to promote the project as “Pennsylvania’s next energy revolution.”<sup>xxvi</sup> The Key State project claims to be able to reduce carbon dioxide emissions by 50 to 80 percent per ton of blue hydrogen or blue ammonia produced by sequestering the carbon captured in saline formations deep underground. The project has already received at least \$555,000 in federal grant funding through the U.S. Economic Development Administration and USDA Rural Business Development Agency,<sup>xxvii</sup> and has sought additional subsidies through Pennsylvania’s Local Resource Manufacturing Tax Credit.<sup>xxviii</sup>



Designed to attract even more investment from the petrochemical and fertilizer industries, the Local Resource Manufacturing Tax Credit would cost taxpayers up to \$667.5 million over a 25-year period.<sup>xxix</sup> The new subsidy is modelled after the Pennsylvania’s Resource Manufacturing Tax Credit, which could award Shell Chemical up to \$1.65 billion for constructing the Beaver County petrochemical complex— the biggest tax subsidy in Pennsylvania’s history.<sup>xxx</sup> These foregone revenues don’t consider the negative externalities associated with fracking and petrochemical manufacturing, like the added pollution burden and health risks discussed earlier in this report. For example, PennFuture estimates that the Shell cracker would produce up to \$400 million annually in air pollution externalities once it fully ramps up early next year. And developing “blue” natural gas synthesis capacity would accelerate natural gas extraction and further lock-in demand for fossil fuels for years to come.

### *Plastics*

As mentioned above, the discovery of large amounts of natural gas liquids (NGLs) or wet gas in western Pennsylvania directly resulted in what we now understand, with hindsight, to be a massive petrochemical buildout. The shale gas extraction has brought with it the industrialization of many communities – some known for generations as prime agricultural areas coveted for their traditionally rural lifestyle. These industrial zones are expanding through interconnected leases and the construction and operation of a massive network of well pads, compressor stations, pipelines, gathering lines, pigging operations, processing plants and plans for ethane cracker plants – much of which feed the manufacture of plastics. Many decision makers at all levels of government have agreed to lock this region into still more dependence on fossil fuels – this time to produce harmful single-use plastics. This inevitably adds to the impact that oil and gas production already has on overburdened communities and on natural resources, such as waterways.

### *Storage and Disposal of Fracking Wastes*

A 2019 report by Earthworks<sup>xxxi</sup> documents a 1,500-percent increase in the volume of toxic, often radioactive waste generated by Pennsylvania natural gas operations between 2003 and 2018. According to the report, the fracking boom in 2018 generated 69 million barrels of liquid waste and 1.4 million tons of solid waste, a 20 percent increase in liquid and a 35 percent increase in solid waste over the previous year. According to FracTracker, that number declined slightly in 2020 (61.8 million barrels). This amount of waste would be more than enough to fill the Beaverdam Run Reservoir in Cambria County, a 382-acre lake with an average depth of 20 feet.<sup>xxxii</sup>

Between 2011 and 2018, 380 billion barrels of liquid waste and 9.5 million tons of solid waste have been sent to landfills, injection wells, and public facilities in Pennsylvania, West Virginia, Ohio, and New York.

PA DEP has not kept up with this growing problem; state permits are insufficient to ensure groundwater and soils are protected against contamination by fracking wastes that contain carcinogens, heavy metals, and radioactive materials that often aren’t fully disclosed by generators of the waste due to legal loopholes.

Liquid fracking wastes generated in Pennsylvania are often disposed in underground injection wells while solid wastes generated by fracking are often disposed in landfills not designed to contain what is essentially hazardous waste. These wastes are not regulated as hazardous waste under either state or federal laws and regulations. According to the Ohio Department of Natural Resources, nearly half (1.6 billion gallons) of the liquid fracking waste disposed in Ohio through underground injection in 2017 came

from Pennsylvania or West Virginia.<sup>xxxiii</sup> In 2017, Ohio had 226 wells authorized to inject frack waste. Pennsylvania had 16, according to US EPA, which regulates injection wells in the Commonwealth, but that number had grown to 19 as of February 2021.<sup>xxxiv</sup>

Although most of the liquid waste, at least for the present, is exported to neighboring states for underground injection, the handling of solid fracking wastes in Pennsylvania is creating multiple concerns. For instance, leachate from landfills that accept solid fracking wastes is either not transparently or accurately tracked by PA DEP. There are a number of recent investigative reports indicating that vast amounts of leachate contaminated with fracking waste, including Technically Enhanced Naturally Occurring Radioactive Materials (TENORM), from dozens of municipal landfills ultimately are discharged into Pennsylvania surface waters. According to Public Herald, for example, PA DEP could not account for the ultimate disposition of 66 percent of the leachate from 30 municipal landfills that accept solid waste from fracking.<sup>xxxv</sup>

Another emerging waste management concern is the reprocessing of fracked wastes at residual waste facilities. As EIP reported in February 2021, and as mentioned above, PA DEP had attempted to issue 49 of these general permits without proper notice. Through threat of legal action, we reached an agreement with PA DEP, but the legislature is taking steps to once again deny the public the right to know and the right to appeal. The reuse of fracking wastewater is problematic, even when subject to transparent, public review, comment, and appeal rights. What ultimately happens to the increasing volumes of fracked wastewaters temporarily stored (and presumably treated) in these reprocessing facilities is uncertain.

## **Efforts focused on community protections**

The solution to what is occurring in western Pennsylvania and the surrounding region is to end dependence on gas and plastics and transition to sustainable, renewable, carbon-neutral alternatives. EIP is pushing toward this goal by empowering community members to raise their voices and by using and enforcing existing laws to ensure that the costs of pollution are shouldered by the industry and not communities. Public interest organizations and collaboratives such as the Breathe Project, are engaged in:

- Assisting local community members in gathering important facts via access to public files;
- Creating databases that inform and educate the public, regulators, and elected officials, such as EIP's Oil, Gas, and Petrochemical Infrastructure Emissions Tracker;
- Arranging important meetings with regulators including the PA DEP and ACHD;
- Ensuring adherence to Environmental Justice (EJ) policy community engagement requirements and working with PA DEP and ACHD as they update their EJ policies and maps identifying those communities;
- Overseeing required Act 14 Municipal Notification letters;
- Conducting on-going meetings with citizen teams and customizing the engagement and outreach to each community;
- Working to encourage new or updated oil and gas ordinances based on recent PA Supreme Court land use rulings that ensure better protections for local residents and natural resources;
- Working with SWPA Environmental Health Project and CMU Create Lab on VOC monitoring network tracking, research, and assistance in understanding public health impacts;
- Researching and preparing detailed technical comments to proposed air and waste permits and where necessary, appealing weak permits;

- Writing data-rich reports, such as EIP's 2020 and 2021 reports that analyze GHG emissions from oil, gas, and petrochemical production and power plants; and
- Using federal regulatory legal tools, where available, to require EPA to update and revise outdated regulations for flares and other emission sources, to ensure emissions from regulated natural gas units are more accurately estimated.

EIP, our partners, and invaluable citizen teams have applied strategic pressure to advance much needed changes to ensure stronger community protections, more protective permits, and increased regulatory oversight and enforcement. EIP and Clean Air Council have been preparing technical comments and filing legal appeals to key facilities associated with the proposed petrochemical buildout. These efforts add depth to the overall effort to halt the petrochemical buildout and protect communities. The engineering, technical, and legal efforts, along with community organizing that gives voice to those directly impacted, make an important difference in the fight. Frontline communities are key to giving voice to what is fast becoming the wrong direction for Pennsylvania's energy future. Too often, regulatory oversight is siloed and fails to consider the cumulative impacts posed by the rapidly expanding petrochemical buildout. Without more effective oversight and accountability at all levels, the damage to front line communities hit the hardest by the reckless expansions of fracking and related petrochemical infrastructure will continue to accumulate over time.

## Appendix A: Overview of permitted and pending GHG emissions increases (short tons per year) from natural gas and petrochemical projects in Pennsylvania

Company, Project Name (County)	Classification	CO <sub>2</sub> e	Initial Clean Air Act Permit or Docket No. (issuance date)	Operating Year
<b>Fully or Partially-Operating</b>				
Shell Chemical Appalachia LLC - Petrochemicals Complex (Beaver)	New	2,303,645	PA-04-00740A (issued 6/18/2015)	2022
EQM Poseidon Midstream LLC - Blue Moon Compressor Station (Washington)	New	227,957	GP5-63-00999A (issued 10/6/2015)	Unknown
Sunoco Partners Marketing and Terminals LP - Marcus Hook Industrial Complex (Delaware)	Expansion	223,200	PA 23-0119 (issued 2/5/2013), PA 23-0119E (issued 2/12/2021)	2013/2022
Texas Eastern Transmission LP - Armagh Compressor Station (Indiana)	Expansion	207,046	32-00230 (issued 6/29/2012)	2015
Laurel Mountain Midstream LLC - Shamrock Compressor Station (Fayette)	New	183,497	26-00588A (issued on 6/10/2013)	2013
Equitrans LP - Redhook Compressor Station (Greene)	New	168,000	30-00234A (issued 10/2/2017)	2019
ETC Northeast Pipeline LLC (Energy Transfer) - Revolution Cryogenic Plant (Washington)	New	162,425	GP5-63-01001 & GP1-63-01001 (issued 8/3/2016)	2021
MarkWest Liberty Midstream & Resources LLC - 3 Brothers Compressor Station (Washington)	New	116,031	SOOP 63-00969 (issued 3/18/2019, but initially permitted in 2011)	2013
Texas Eastern Transmission LP - EntriKen Compressor Station (Huntingdon)	Expansion	110,640	31-05019A (issued 12/30/2013)	Unknown
Laurel Mountain Midstream LLC - Herminie Compressor Station (Westmoreland)	New	106,592	PA-65-00979 (issued on 4/5/2012)	2013
MarkWest Liberty Midstream & Resources LLC - Smith Compressor Station (Washington)	New	92,270	GP5-63-00968 and GP9-63-00968 (issued 3/20/2012)	2012
Empire Pipeline Inc. (National Fuel Gas Company) - Jackson Compressor Station (Tioga)	New	91,488	59-00035A (issued 8/15/2018)	2020
MarkWest Liberty Midstream & Resources LLC - Carpenter Compressor Station (Washington)	New	83,455	GP5 63-00987 (issued 3/31/2014), GP5 63-00987A issued (11/10/2014)	2015
MarkWest Liberty Midstream & Resources LLC - Harmon Creek Gas Plant (Washington)	New	79,795	GP1 63-01011A, GP5 63-01011A, and RFD 63-01011A (issued 1/17/2018)	2020
MarkWest Liberty Midstream & Resources LLC - Godwin Compressor Station (Washington)	New	43,800	63-00934 (draft permit issued 6/26/2021)	Unknown
UGI LNG Inc - Truck Rack Expansion Project (Berks)	Expansion	2,011	FERC Docket No. CP17-14 (authorized 10/18/2018)	2021
<b>Under Construction</b>				
Transcontinental Gas Pipe Line Company LLC - Compressor Station 607 (Luzerne)	New	208,299	AG5-40-00001A (issued 11/25/2019)	2021
Transcontinental Gas Pipe Line Company LLC - Compressor Station 610 (Columbia)	Expansion	133,155	AG5-19-00001A (issued 10/28/2019)	2021
Transcontinental Gas Pipe Line Company LLC - Compressor Station 620 (Schuylkill)	New	128,661	AG5-54-00001A (issued 11/25/2019)	2021

National Fuel Gas Supply Corporation - Tamarack Compressor Station (Clinton)	New	96,587	AG5-18-00002A (issued 1/30/2020)	2021
National Fuel Gas Supply Corporation - Marvindale Compressor Station (McKean)	New	70,253	AG5-42-00002A (issued 2/7/2020)	2021
Adelphia Pipeline Company LLC (NJR Midstream) - Marcus Hook Compressor Station (Delaware)	New	41,056	23-0225 (issued 4/19/2019, extended 10/2/2020)	2021
Adelphia Pipeline Company LLC (NJR Midstream) - Quakertown Compressor Station (Bucks)	New	31,348	09-0242 (issued 4/19/2019; extended 10/2/2020)	2021
<b>Pre-construction</b>				
Bradford County Real Estate Partners LLC (New Fortress Energy) - Bradford County LNG Production Facility (Bradford)	New	1,107,679	08-00058A (7/24/2019, extended 9/15/2020 and 7/22/2021)	2021
Transcontinental Gas Pipe Line Company LLC - Compressor Station 515 (Luzerne)	Expansion	511,413	FERC Docket No. CP21-94 (application submitted 3/26/2021)	2023
PennEast Pipeline Company LLC (Enbridge) - Kidder Compressor Station (Carbon)	New	190,529	AG5-13-00001A (issued 9/18/2020)	2021
MarkWest Liberty Midstream and Resources LLC - Houston Gas Plant (Washington)	Expansion	69,937	63-00936F (issued 10/4/2012, modified 9/5/2013 and 6/19/2015; extended 5/20/2021)	2022
Tennessee Gas Pipeline Company LLC (Kinder Morgan) - Compressor Station 321 (Susquehanna)	Expansion	49,735	FERC Docket No. CP20-493 (application submitted 6/30/2020)	2022
Sunoco Partners Marketing and Terminals LP - Marcus Hook Industrial Complex, "Project Phoenix" (Delaware)	Expansion	47,062	PA 23-0119J (issued 2/12/2021)	2022

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[in-county/](#). In addition to incentivizing increased oil and gas production, these tax credit programs incentivize projects such as the Clinton County project, which is banking on developing and implementing unproven CCS technology, for which there are real questions and concerns, such as the ability to maintain captured CO2 in its intended destination and prevent it from leaking back into the atmosphere, both rapidly and over time. These concerns play havoc with the economic analysis regarding the appeal of subsidizing such projects. See, e.g., FiveThirtyEight: *Why Carbon Capture Hasn't Saved Us from Climate Change Yet*, available at: <https://fivethirtyeight.com/features/why-carbon-capture-hasnt-saved-us-from-climate-change-yet/>.

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