January 2024

Statement Regarding Emerging Technologies that Represent False Solutions to the Climate Crisis

No False Solutions PA

Statement regarding emerging technologies that represent false solutions to the climate crisis

A report compiled by No False Solutions, a coalition of advocacy groups and concerned residents of Pennsylvania and other states in our region affected by the oil and gas industry, to educate and inform legislators and decision makers about emerging technologies that claim to be solutions to the climate crisis but in fact exacerbate the climate crisis, damage the environment, and/or harm public health and do not offer more effective or economically viable solutions than those offered by renewable energy and renewable energy storage technologies.

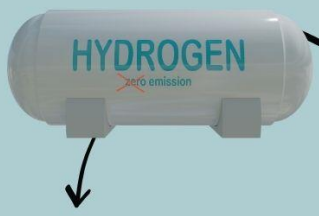
FALSE SOLUTIONS

CCS

This technology has been demonstrated to be extremely expensive, energy-intensive, technically difficult, less economical than renewables, and ineffective at reducing CO2 emissions.

"Chemical Recycling"

This technology has not been demonstrated to work, despite numerous attempts at different plants around the country, most of which have shut down.

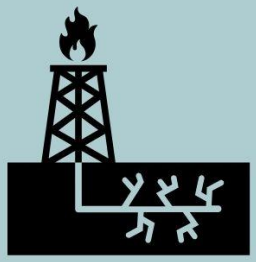


Hydrogen

Risks and costs associated with this industry have not been adequately evaluated.

Fracking

Fracked gas production is associated with unacceptable health and environmental harms and should be phased out in favor of renewable energy alternatives in PA.



Executive Summary

- **Legacy of energy extraction**: Pennsylvania emerged as an energy extraction and production state starting in the 1800s with timber, coal, and oil before shifting to fracked natural gas in the early 2000s. These industries have left behind a legacy of polluted air, water, and landscapes across the commonwealth that has harmed the physical health and economic well-being of Pennsylvanians and will fall to taxpayers to remediate.
- **Pennsylvania's energy future**: In the context of the climate crisis, it is clear that Pennsylvania must transition away from the use of fossil fuels; the state has sufficient alternative energy resources to provide clean, renewable energy to Pennsylvanians as part of a developing new American energy industry that will provide hundreds of thousands of new jobs.
- **False solutions**: Proponents of the oil and gas industry have proposed a number of new technological "solutions" to the climate crisis that will only serve to continue our use of fossil fuels without reducing our carbon emissions or addressing legacy pollution from the industry. Investing in these false solutions wastes time and money that are needed to combat the climate crisis and contributes to the greenhouse gas pollution footprint of Pennsylvania while subjecting our communities to further health and economic harm.
- **Fracked gas**: A number of gas-supported projects proposed for Pennsylvania are being touted as "sustainable" or "clean energy" alternatives to burning coal or oil that will reduce the carbon footprint associated with Pennsylvania's energy industry. The proponents of these projects hold the mistaken belief that fracked gas burns cleaner than coal or oil with a lower carbon footprint and ignore evidence of the harms that the fracked gas industry is doing to Pennsylvanians and our economy.
- **Carbon capture and sequestration (CCS)**: CCS is a technology that seeks to capture CO2 emissions from fossil-fuel burning processes and transport it by pipeline to CO2 markets or to underground geologic formations for long-term storage. CCS will lead to continued burning of fossil fuels using a technology that has been demonstrated to be extremely expensive, energy-intensive, technically difficult, less economical than renewables, and ineffective at reducing CO2 emissions.
- **Advanced recycling**: The claims regarding the technologies that are being referred to as "advanced recycling", the thermal breakdown of post-consumer plastic waste in the presence of a catalyst or chemicals to make fuel or chemicals that can be made into more plastics, have been overstated and are unsubstantiated. These technologies have not been demonstrated to provide a "circular" process to solve the plastics waste crisis but have been shown to be extremely toxic in terms of air and water pollution, placing Pennsylvania communities at risk of exposure to toxic chemicals and microplastics.
- **Hydrogen**: Hydrogen is being touted as the next clean-burning fuel that can be made using either fossil fuel-based processes or with renewable energy. Proponents of this technology have not adequately evaluated the risks associated with this new industry and the push for this technology in PA is focused on continuing the use of fracked gas.
- **Conclusions**: As residents of Pennsylvania, we ask that decision makers in our state envision a new future for Pennsylvania that invests our taxpayer money and our resources in clean, renewable energy and brings an end to the egregious harms of the fossil fuel industry to our health and the economic well-being of our communities.

Statement regarding emerging technologies that represent false solutions to the climate crisis

Summary

As Pennsylvania addresses the climate challenges of our time, we appreciate efforts to adopt solutions that positively impact our state. However, we have serious concerns surrounding several of the "emerging" technologies that are currently being promoted by the governor, legislators, regulators, and project developers. In particular, we are concerned that projects focused on carbon capture and sequestration, hydrogen, and advanced recycling represent false solutions to the climate crisis and, instead, seek to protect and promote Pennsylvania's oil and gas industry. We are troubled by the lack of risk-analysis, cost-analysis, and impact-analysis being done to assess these projects, all of which will involve long-term financial and community commitments to these technologies and their impacts. We are also concerned that the pursuit and/or adoption of these technologies will further delay action to reduce emissions by redirecting resources and investment away from proven, viable solutions that already exist, such as wind, solar, hydro, geothermal, conservation, and stable energy storage.

In light of the dangers, energy requirements, economic concerns, and future uncertainties – and most especially, in light of the clear harms – that these emergent technologies pose to our communities, we reject these false solutions and ask the decision makers in our state to envision a new future for Pennsylvania, one that shifts our resources away from a fossil fuel-based economy and invests in the clean renewable energy that will provide the jobs as well as the health and well-being that our commonwealth deserves.

Topics covered in this document:

HISTORY OF PA EXTRACTIVE INDUSTRIES

1 TIMBER

By 1900, the hills of the Commonwealth had been virtually denuded due to the ravages of the timber industry, leaving behind a ghostly landscape vulnerable to wildfires, erosion, and flooding.

2 COAL

After timber, the state's industrialists focused on coal mining, and on the steel industry that followed, turning Pennsylvania into what some called "a zone of national sacrifice."

3 OIL

In 1859, the first oil well was drilled in Titusville, PA, marking the beginning of the country's petroleum industry and giving the Commonwealth bragging rights as the "energy capital" of the nation.

4 FRACKED GAS

The year 2005 marked the beginning of the fracking boom in Pennsylvania. The discovery of so-called "natural gas" in the Marcellus formation, along with the technology called horizontal drilling, has turned the state into the nation's second largest fracked gas producer, responsible for over 20% of all U.S. gas.

FUTURE

WHAT'S NEXT?

Given the urgency of the climate crisis and the clear evidence that continuing to frack, drill, mine, and burn fossil fuels will only exacerbate the harms to Pennsylvanians, we believe that now is the time to invest in Pennsylvania's renewable energy future.

Background

Pennsylvania's history of extraction

Approximately one-third of our streams are considered too polluted to support aquatic life or to supply clean drinking water

Timber and coal: Pennsylvania has a long history of resource exploitation and extraction. By 1900, the hills of the Commonwealth had been virtually denuded due to the ravages of the timber industry, leaving behind a ghostly landscape vulnerable to wildfires, erosion, and flooding. The state's industrialists focused then on coal mining, and on the steel industry that followed, turning Pennsylvania into what some called "a national sacrifice zone" [UR 2014]. Workers bore the costs in the form of black lung disease and other chronic illnesses, as well as on-site accidents and underground explosions in which many lost their lives. Further environmental degradation also followed, the effects of which are still felt today. A 2022 report by the PA Department of Environmental Protection (DEP) lists 27,886 miles of the state's streams as impaired [PA DEP Integrated Water Quality Report 2022]. In this "water-rich" state, this means that approximately one-third of our streams are considered too polluted to support aquatic life, recreation, and fish consumption, or to supply clean drinking water. Much of this pollution comes from the state's more than 5000 abandoned coal mines, whose effluent – in the form of acid mine drainage – has either been purposely dumped or has inadvertently seeped into our waterways [PA DEP 2020]. After 2008, the coal market in Pennsylvania contracted due to competition with fracked gas, with more than half of the coal mines in Appalachia closing since that time [US EIA 2021 Number; PA DEP 2022]. The coal-fired power plant in Homer City, PA, the largest remaining such plant in the state, retired in July, 2023, leaving only a fleet of plants that burn the coal refuse left behind by abandoned mines. The Sierra Club estimates that 99% of the existing coal in the U.S. is now more expensive than solar or wind [Sierra Club 2023].

Oil: In 1859, the first oil well was drilled in Titusville, PA, marking the beginning of the country's petroleum industry and giving the Commonwealth bragging rights as the "energy capital" of the nation. An oil boom followed, at the height of which the state was producing one-third of the world's oil. Though the boom was over by the early 1900s, Pennsylvania has continued to produce both oil and gas in significant quantities, with thousands of wells found across the state on farms, in forests, and even in residents' backyards. Because the industry has such close ties with state legislators, it has been protected from regulation. Low- or non-producing wells have been, and continue to be, abandoned by owners and operators without regulatory or financial consequences, in what has been called "a culture of non-compliance" [StateImpact 2023a]. Between 400 - 600 conventional wells are deserted annually; 55,000 wells are considered at high risk of being abandoned, and another 51,000 are considered at risk of being transferred to "low-solvency" owners. Some estimate that 500,000 abandoned wells currently litter the landscape, in need of being plugged, the responsibility for which currently falls on the state's taxpayers to the tune of billions of dollars in clean-up costs. Many of these wells are leaking hydrogen sulfide, benzene, arsenic, and methane, and are polluting the air and contaminating soil and water; they are also at risk of explosion [PA DEP 2021;DiGiulio, 2023; PA Environment Digest 2023 DEP]. In August 2023, several environmental organizations sued

Sierra Club estimates that 99% of existing coal in the US is now more expensive than solar or wind

PA's General Assembly and Governor Shapiro, asking the court to rule existing law (Act 96) unconstitutional, thereby paving the way for policies that would shift responsibility for clean-up costs from the communities that suffer from these wells to the operators that profit from them [PA Environment Digest 2023 Lawsuit; Commonwealth Court Pennsylvania 2023].

Fracking of gas has the same carbon footprint as coal

Fracked gas: The year 2005 marked the beginning of the fracking boom in Pennsylvania. The discovery of so-called "natural gas" (referred to herein as "fracked gas") in the Marcellus formation (and, below that, the Utica), along with the technology that boosts hydraulic fracturing called horizontal drilling, has turned the state into the nation's second largest fracked gas producer, responsible for over 20% of all U.S. gas. Before leaving office in 2011, Governor Rendell welcomed the fracking industry to Pennsylvania, a move that opened 2.2 million acres of state forest land to possible extraction, claiming it would bring economic prosperity but failing to assess its health or environmental impacts. Since that time, fracking has been shown to fragment forests and rural landscapes, to cause earthquakes (from wastewater injection wells), and to use massive amounts of fresh water (in the U.S. between 1.5 million and 9.7 million gallons of water are required, on average, to frack a single well, and these numbers are growing) [NRDC 2019]. In addition, an expanding body of scientific evidence implicates fracking directly in the contamination of air, soil, and water with pollutants that include radioactive materials such as radium, radon, and strontium [NRDC 2021]. Disturbing evidence also points to fracking-related illnesses among closely-situated populations who suffer from asthma and other respiratory problems, mental health issues, heart conditions, birth defects and low birth weights, and cancer. [University of Pittsburgh and PA Dept Health 2023; CHPNY 2023] The 9th edition of the *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure*, published by Concerned Professionals of New York and Physicians for Social Responsibility in October, 2023, concludes: "The rapidly expanding body of evidence compiled here is massive, troubling and cries out for decisive action. **Our examination uncovered no evidence that fracking can be practiced in a manner that does not threaten human health directly or without imperiling climate stability upon which human health depends."** [CHPNY, 2023]

Because the state uses only one-fifth of all the fracked gas it produces, Pennsylvania's extensive (largely unregulated) pipeline network has allowed it to become the second largest net supplier of fracked gas to other states. A 2015 report from the Nature Conservancy's PA Pipeline Task Force tells us that the commonwealth has 12,000 miles of large-diameter oil/gas pipelines, with those numbers expected to quadruple by 2030 [The Nature Conservancy 2015]. In addition, efforts are currently underway, in the name of "energy security," to explore the possibility of exporting the state's liquefied gas to other countries through the Port of Philadelphia. Chester, PA, has been chosen by Penn America Energy as the proposed site of what could become the largest LNG export terminal on the east coast. The terminal would become the top purchaser of gas fracked from the Marcellus Shale [DeSmog 2023]. In August 2023, residents of Chester held a protest, citing these plans as yet one more example of using the promise of jobs to manipulate an environmental justice community into allowing an egregious polluter to locate in their midst [PA Environment Digest 2023 150+]. In short, Pennsylvania has a glut of fracked gas and a desperate gas industry in need of additional markets to keep the industry alive. In response, we are currently seeing – in addition to the extant Shell cracker plant that uses ethane to produce

Pennsylvania's extraction legacy:
5,000 abandoned coal mines
500,000 abandoned oil wells
27,886 miles of polluted streams
12,000 miles of gas pipelines
2.6 billion gallons of toxic fracking wastewater per year

ethylene, the basis for plastic products – a spate of planned projects, all of which will allow Pennsylvania's oil and gas industry to continue extracting fossil fuels from under our feet. These projects include the LNG terminal, hydrogen hubs, so-called advanced recycling plants, a plant intended to use gas to produce aviation fuel, and a fertilizer plant that will – the developer's promotional materials claim, without evidence – virtually eliminate all methane and carbon dioxide emissions, and in the process "change the world's approach to energy for good!" [Happy Valley Industry 2023].

One of the arguments used by the fossil fuel industry to justify continued use of fracked gas is that it will replace coal-generated electricity, thereby lowering carbon dioxide (CO_2) emissions in the state. As an increase in gas-fired power plants has permitted coal plants to go offline, carbon dioxide emissions created by the production of electricity at power plants have indeed gone down from a peak in 2007, but only at their source. When carbon dioxide equivalents, such as methane, are taken into consideration, given the leaks and releases that occur all along the production line, fracked gas does not have a lower footprint than coal; in fact, some studies have concluded that the heat-trapping effects of fracked gas emissions are worse than those of coal [The Hill, 2011; Howarth et al., 2011]. Further, since 2019, as fewer coal plants remain to be replaced and as more new, large gas-fired plants come online, greenhouse gas emissions, including methane, have risen in Pennsylvania. According to the 2022 PA Greenhouse Gas Inventory Report, whose statistics have not been updated since 2019, the latest total statewide gross greenhouse gas emissions amount to 266.01 million metric tons of carbon dioxide equivalent [PA DEP GHG report 2022]. As of 2022, the state was producing 1.1 million metric tons of methane per year. Pennsylvania alone is responsible for 1% of the world's warming [PA DEP 2023].

Pennsylvania's renewable energy future:

According to the Yale Program on Climate Change Communication, 70% of people in Pennsylvania believe climate change is happening, and 43% have personally felt the effects of climate change [Yale Program, 2021]. Also, strong majorities of Pennsylvanians support research funding on renewable energy sources (76%), tax incentives for solar panels and electric vehicles (78%), a carbon fee on fossil fuel companies (66%), and action by the government at both the state and local levels to address global warming (51%-60%) [Yale Program, 2021]. Given the urgency of the climate crisis and the clear evidence that continuing to frack, drill, mine, and burn fossil fuels will only exacerbate the harms to Pennsylvanians, we believe that **now is the time to invest in Pennsylvania's renewable energy future.**

78% of Pennsylvania residents support incentives for solar panels and electric vehicles

It is clear that Pennsylvania cannot continue to tie its future to the fossil fuel industry. As the world moves to renewable energy, as it must for survival, PA businesses would be wise to pivot their focus and invest in

markets and industries that will remain profitable in the coming years. Economic projections predict that communities that invest in fossil fuel projects now that are expected to last 30 years or more will end up with stranded assets [MIT news 2022]. With a renewed focus, becoming a renewable energy leader is achievable in PA.

Pennsylvania currently generates 1,767 MW of clean energy, but this is only about 2% of all electricity generated in PA, leaving lots of room for expansion. The clean energy industry currently employs 9,500 Pennsylvanians, and clean energy technician is projected to be the fastest growing job category in the coming years. In addition, clean energy projects have attracted $4 billion in investment to the commonwealth, and these clean technologies, including solar, wind, and energy storage, have been proven to reduce greenhouse gas emissions and bring income to farmers, ranchers, landowners, and communities [ACP 2023]. Energy efficiency is a focus of federal funding in recent legislation, and PA has an opportunity to bring funds to the state that will employ local workers for these projects.

Pennsylvania has sufficient solar resources to generate a significant amount of energy from solar. Pennsylvania's Solar Future Plan, a projection developed by the Pennsylvania Department of Environmental Protection (PA DEP) for what it would take to get PA to 10% solar by 2030, estimates that generating 11 gigawatts (GW) of solar would require:

- a combination of smaller, distributed systems and larger grid-scale systems
- a modest investment of land (79,200 acres/124 square miles or 3 tenths of one percent of PA land)
- access to capital, long-term contracts, and incentives for developers and homeowners
- approval of community solar legislation
- grid modernization and solution of interconnection issues
- carbon pricing
- changes to the alternative energy portfolio standard to favor development of solar in PA

In addition, switching PA to 10% solar would provide:

- 60,000-100,000 jobs
- reductions in greenhouse gas emissions by up to 9.3%
- economic development opportunities
- net benefit in combined savings from energy cost savings and avoided health and environmental damage savings of $1.6 billion annually from 2018-2030 [PA DEP 2018].

It will take only about 79,200 acres or 3 tenths of one percent of Pennsylvania's land to make 10% of our power from solar

Of course, these benefits would increase with increased commitment to more solar; 10% is a fairly modest goal. As of 2022, PA was generating 0.43% of its power from solar energy [Wind Exchange 2023].

Wind energy is expected to be the largest source of renewable energy in the United States as we transition away from fossil fuels [ACP 2023] and, as of 2022, Pennsylvania was only generating 1.61% of its power from wind [Wind Exchange 2023]. Although most American

wind energy will be generated in the midwest and offshore, PA has sufficient wind energy to provide additional power to the commonwealth and to bring jobs and investment to PA in this area [EIA, 2023; ACP 2023].

Generating 10% (11 GW) of PA energy from solar by 2030 would create 60,000-100,000 jobs and save $1.6 billion annually

The benefits of switching to renewable energy can be realized even in southwestern PA, a region with a long history of fossil fuel energy production. A study from the Ohio River Valley Institute (ORVI) that projected a clean energy pathway for the region concluded, “A renewables-based pathway, including energy efficiency and clean energy imports from the PJM market, is more cost-effective than continued reliance on fossil fuels” [ORVI, 2022]. The plan would cost less, avoid stranded assets in fossil fuel and expensive carbon capture projects, decarbonize energy use for the region by 97% by 2050, and result in environmental benefits of $2.7 billion annually. The plan would create jobs and require increased electricity load on the electrical grid [ORVI, 2022].


FRACKING
same carbon footprint as coal
increased cancers in children
false promises of jobs & prosperity
toxic waste & methane leaks
excessive water usage
air and water pollution

False solutions that promote the continued use of fracked gas

A number of gas-supported projects proposed for Pennsylvania are being touted as "sustainable" or "clean energy" alternatives to burning coal or oil that will reduce the carbon footprint associated with Pennsylvania's energy industry. The proponents of these projects cite their belief that fracked gas burns cleaner than coal or oil with a lower carbon footprint.

Our concerns: The proponents of these projects ignore evidence of the harms that the fracked gas industry is doing to Pennsylvanians and our economy:

- Fracking of gas has the **same carbon footprint as coal** when the calculation of its impact includes methane leaks and flaring at the drilling site, leaks along pipelines, and leaks at abandoned wells. Fracked gas cannot reduce our carbon footprint [Alvarez, 2018].

- An increasing number of studies now point to the negative impacts of fracking on public health. Thousands of papers have been published showing multiple problems, including childhood cancers, premature death, respiratory issues, endocrine disruption, and birth-weight issues. The most recent Compendium, published by Physicians for Social Responsibility and Concerned Health Professionals of New York, shows that, since 2014, when New York state banned fracking, 2,303 scientific studies, government reports, and media investigations have been published indicating clear evidence of harm; nearly 1000 of these studies were published after 2018. The physicians concluded their analysis of these studies with a statement that there is "**no evidence that fracking can be practiced in a manner that does not threaten human health directly or without imperiling climate stability upon which human health depends**" [CHPNY 2023].
    - In addition, a recent study conducted by the University of Pittsburgh for the PA Department of Health and released in August 2023 shows links between the fracking of gas and **increased incidence of lymphoma in children, as well as exacerbations of asthma, and lower birth weights** in populations living near oil and gas operations [University of Pittsburgh and PA Dept of Health 2023; PA Environment Digest 2023 Environmental Health].
    - These are further supported by additional studies, including one conducted in 2022 by the Yale School of Public Health that found that Pennsylvania children with fracking wells within a mile of their homes are **twice as likely to develop juvenile leukemia** [Yale News 2022; Clark 2022].

- Investment in fracking and other fossil fuel projects **delays the transition to renewable energy** sources by wasting money and time on projects that will not reduce our carbon emissions.
    - These investments will leave communities with "**stranded assets**" as our economy, and that of the entire world, shifts to renewable energy.

- Fracking projects make **false promises to communities about "jobs and prosperity"** that are not realized and leave communities with negative economic, health, and environmental impacts. Two recent reports from the Ohio River Valley Institute

Investment in fracking and other fossil fuel projects delays the transition to renewable energy

(ORVI) that measured prosperity in counties in the Appalachian region affected by Marcellus Shale fossil gas development point to a worsening of economic well-being since the onset of the fracking boom. According to ORVI's report from July, 2021, "twenty-two counties in Ohio, Pennsylvania, and West Virginia that produce 90% of Appalachian natural gas badly trailed the nation in key measures of economic prosperity, including growth in jobs, personal income, and population" [ORVI 2021]. Their follow-up report from 2023 shows continued economic decline and predicts that the decline will continue as Appalachian shale gas production appears to be plateauing. The reports conclude that we need a more effective and sustainable approach to economic development in Appalachia, one based on energy efficiency and a transition to renewable resources [ORVI 2023].

- In addition to its toxic air pollution, **liquid waste from fracking operations** presents an environmental hazard that is being downplayed by the industry. Fracking wells require large amounts of water from local sources in order to fracture underground shale structures and release the fossil gas within them. The industry adds sand and proprietary chemicals to the water to improve the process. An estimated 2.6 billion gallons of fracking waste is generated in PA per year and over a trillion gallons is generated nationwide. In addition to the chemicals and salts that are added by the company, the waste often contains arsenic, radioactive radium, and other substances that are naturally present underground. The waste, which is not currently classified as hazardous by PA law, is often stored on site before being disposed of by injection into old wells (after being transported out of state by truck or boat), or it is spread on roadways or land, or in landfills. Recent legislation introduced in PA (SB26, SB28, and SB29) seeks to classify this fracking waste as hazardous, closing loopholes in existing law and requiring the industry to properly dispose of this huge amount of hazardous waste. Forced to pay the actual cost of their polluting industry, this appropriate level of regulation could economically cripple the industry, leaving communities with stranded assets and toxic clean-up [Inside Climate News 2023 Awash; Inside Climate News 2023 New].

Example projects:

- Nacero, Northeastern PA:
  A six-billion-dollar plant projected to be built in Luzerne County, Pennsylvania, Nacero promises to "produce sustainable aviation fuel (SAF), lower carbon aviation fuel (LCAF), and lower carbon footprint light fuels," using methane captured by farmers, landfill operators and waste treatment operators (referred to as "renewable natural gas"). They claim their products will be "environmentally superior" because they will contain no sulfur, will be produced by using 100% renewable sources, and will provide the airline industry with low-carbon alternatives. A prototype of the Nacero facility is currently planned for construction in Penwell, Texas, and a close look at that proposal reveals that feedstock for their operation will also include "mitigated flared gas" sourced from the Permian Basin; their interest in northeastern PA, which sits on top of the Marcellus Shale, as the location for their second project reveals their ties to, and dependence on, the fossil fuel industry. In addition, Nacero plans to incorporate "integrated carbon capture" to reduce its carbon footprint. (As of this writing, the status of this project in PA is unclear.)

- Liquified Natural Gas
  The U.S. has become the largest LNG exporter in the world, and Pennsylvania is exploring ways to capitalize on the export of its fracked gas to other countries. In its efforts to become an "energy leader," Pennsylvania is intent on building the infrastructure, including pipelines and terminals, that will allow the state to use its fracked gas to become a primary exporter of LNG. Pipelines are being constructed to carry the products to domestic and Canadian markets, as well as to ports on the East Coast and the Gulf Coast for export.
- Shell's Cracker Plant:
  Pennsylvania's first ethane cracker, located near Pittsburgh and completed in 2022, produces feedstocks for plastics manufacturing. The plant, which received a $1.65 billion tax break from Pennsylvania under the Corbett administration, has the capacity to produce 1.6 million tons per year of polyethylene, using ethane from the Marcellus Shale. However, the plant, which started operation in November 2022, has been plagued with pipeline spills, air pollution violations, malfunctions, and fines, and was forced to shut down in May 2023 to address operational issues. As of April 2023, the plant had already emitted as much volatile organic chemicals and nitrous oxide as it was permitted to emit in a whole year [NBC news 2023 Months; Pennsylvania Capital-Star 2023].
- Gas-fired Power Plants:
  Between 2001 and 2021, fracked gas generation rose from 2% to 52% of the electricity produced in Pennsylvania [US EIA 2023]. In addition, the state has 1.9 gigawatts of fracked gas-fired generation capacity planned to come online by 2025 [US EIA 2021]. Andrew Bradford, an oil and gas analyst, pointed to Pennsylvania as an ideal location for gas-fired power generation: "The Marcellus Shale has always had the advantage of proximity to the large U.S. East Coast population," he said. "Gas plants located in the Marcellus will continue to have the advantage of access to decades of low-cost drillable gas inventory" [ICSC 2022].
- Bitcoin Mining:
  Crypto-currency mining is operating in Pennsylvania at multiple locations, using fossil fuels such as fracked gas and the refuse left behind from coal mining operations to power its generators. When China banned crypto mining in 2021 because it generated too much pollution, the U.S. became ground zero for the industry. Pennsylvania is one of the states on which the industry has set its sights. Oil and gas operators in the state are setting up crypto-currency operations without going through the typical permitting process, thereby allowing them to operate in a black box without regulatory oversight. In a recent expose, the *NY Times* estimated that one bitcoin operation uses "at least 30,000 times as much power as the average U.S. home" [NY Times 2023]. And due to their huge power requirements, these operations have become "a boon to the fossil fuel industry." Bitcoin operations not only raise electricity bills in the states where they have set up shop; they also generate noise that some compare to that of a jet engine. It goes without saying that the industry causes immense pollution [NY Times 2023], sending rates of nitrogen oxides and sulfur dioxides, as well as other toxic pollutants, soaring. To enhance the efficiency of the waste coal used in its operations, one Pennsylvania company is testing fuel derived from shredded tires for use as an additive, raising fears that these operations will release cancer-causing pollutants such as dioxin and risk the health of nearby residents [The

There is no way to practice fracking without harming human health and the environment

Guardian 2023]. In assessing the multiple threats to Pennsylvania's environment, crypto-currency operations cannot be ignored [Pennsylvania Capital-Star 2023 Crypto-mining].

The bottom line: Pennsylvania needs to move away from reliance on fracked gas and shift to renewable energy as soon as possible. This shift will reduce our carbon footprint, provide safe, family-sustaining jobs, and halt the harms that are being inflicted upon our communities by this industry.

CCS:

- **CCS (Carbon Capture and Sequestration) is extremely expensive & energy intensive**
- **CCS has NOT been proven to reduce carbon emissions compared to other solutions**
- **CCS takes funding away from proven effective renewable energy projects**

Carbon capture and sequestration

Carbon capture and sequestration (CCS) is a technology that seeks to remove CO2 emissions from fossil-fuel burning processes, capture the CO2, and transport it by pipeline to CO2 markets (usually enhanced oil recovery) or to underground geologic formations for very long-term storage.

Our concerns: Proponents of this technology seek to continue burning fossil fuels using a technology that has been demonstrated to be extremely expensive, energy-intensive, technically difficult, less economical than renewables, and ineffective at reducing CO2 emissions. In addition, the safety of CO2 pipelines has not been established, and CO2 sequestration in geological formations is untested, poses significant risks, and will require monitoring for generations to come.

- **Extremely expensive**: Attaching CCS technology to an existing facility makes the running of that facility **more expensive**. The world has been experimenting with CCS technology for several decades. During that time, 68 projects have been terminated because they were found to be prohibitively expensive and incapable of meeting the set goals of carbon capture. At this time, only 37 CCS plants are in operation (or under construction) across the world, capturing only 0.1% annually of total global fossil fuel emissions [Global CCS Institute 2023].
    - For example, the largest carbon sequestration facility in the world – the Gorgon gas facility in Australia developed by Chevron – has declared its failure to capture its promised emissions of four million tonnes of CO2 per year. Calling CCS "an expensive failure," Climate Council Senior Researcher Tim Baxter said, "This result is no surprise. **After decades of CCS research and billions of dollars of investment, there is little to show for it.** Over the past decade, the costs of renewable energy like wind and solar have plummeted. Over the same period, CCS has remained extremely expensive. There are still no projects operating anywhere in the world that have delivered CCS on time, on budget, or in the quantities promised" [Climate Council 2021]. The Gorgon plant is now the single largest industrial emitter of greenhouse gases in Australia [The Guardian 2023].

The largest CCS facility in the world, the Gorgon gas facility in Australia, is that country's largest emitter of GHGs

- **Energy intensive**: Any plant with adjunct CCS technology requires **extra energy** to capture its carbon emissions; at a gas-fired power plant with CCS, for example, the additional requirements of CCS can increase energy needs by between 11% and 22%. This means the plant will require more fuel to operate and will create more emissions that need to be captured.
    - As an example, the Petro-Nova coal-fired power plant with CCS in Texas, that was partially funded by taxpayer

money through the Department of Energy (DOE), required the construction of an additional gas-fired power plant to provide the energy for CCS. This additional gas-fired plant did not have CCS, so none of those additional emissions were captured [IEEFA 2020; US EIA 2017]. The project shut down in 2020 amid questions concerning its economic viability and efficacy for removing CO2. It was set to reopen in August 2023 but that event has been delayed [Reuters 2023; IEEFA 2022].

- **Wasting time and money**: CCS is being touted as the next clean energy solution, and significant funding has been earmarked for its research and development in recent federal legislation -- **at the expense of renewable energy projects** that have been proven to be cheaper and to produce fewer carbon emissions.

- **Not effective at reducing CO2 emissions**: Captured CO2 is often used for **extracting more oil**. While the technology was developed to render greenhouse gases harmless by storing them underground, in fact, a majority (81%) of captured carbon is being pumped into existing wells to extract more oil in a process called enhanced oil recovery [Energy Mix 2021]. If the intent is to reduce our carbon emissions, using captured carbon to produce more fossil fuels is simply not a reasonable solution. In a recent review by DeSmog of the operational outcomes of twelve operating CCS projects worldwide, none of the projects are operating to capture and store CO2 as promised and many have experienced cost overruns [DeSmog, 2023]. Seven of the CCS facilities have increased oil production and burning by using CO2 to drill for more oil, five are not meeting CO2 capture targets, two are experiencing leaks at off-shore CO2 storage sites, and one has been demolished as a failure. Rather than providing a solution to the climate crisis, the article concluded that the twelve CCS facilities were responsible for a net increase in CO2 emissions and oil production.

- **Dangerous pipelines**: Transporting carbon dioxide to storage facilities, such as underground rock formations or saline caverns, will necessitate **further build-up of CO2 pipeline infrastructure**, a project that, in addition to requiring huge financial investment, can produce its own problems. Pipelines transporting CO2 under high pressure may corrode and leak or rupture, as happened in Mississippi in 2020, presenting asphyxiation hazards to nearby human and animal populations [NPR 2023]. Nevertheless, DOE appears intent on subsidizing the carbon capture industry, issuing in August 2023 their "Intent to Fund Buildout of a Carbon Dioxide Transportation System to Support National Decarbonization Efforts." Using funds from the Inflation Reduction Act to support future growth, grants designed to expand our carbon dioxide infrastructure will, the Department believes, stimulate pollution emitters to incorporate CCS technology at their facilities, thereby ensuring the continued growth of an industry that many see as a false solution [DOE 2023]. Symptomatic of these infrastructure-expansion plans is the U.S. Forest Service's willingness to consider allowing captured CO2 to be stored in our country's national forests [Reginfo.gov 2023]. Environmentalists are concerned that this precious resource will be degraded and turned into a permanent dumping ground. Pennsylvania's Allegheny National Forest could be targeted should these revisions be implemented. At the federal level, the congressional research service has expressed concern about the siting of CCS pipelines due to opposition from local residents and regulatory challenges

at proposed pipeline sites in various states and has recommended federalizing of CO2 pipeline siting and storage infrastructure [CRS, 2023]. This creates regulatory uncertainty and slows decision making at a time when Pennsylvania and the US should be moving rapidly to expand the renewable energy infrastructure, rather than wasting time and money on development of additional regulations regarding false solutions.

- **Untested storage plans**: Few long-term studies have been done to assess the **environmental impacts of large-scale, long-term underground CO2 storage**. Problems could include leakage, underground spread, contamination of drinking water, sinkhole formation, and tectonic activity. Researchers point out that current low-impact earthquake events associated with fracking's underground injection operations could be replaced by more destructive earthquakes as we attempt to store enormous amounts of carbon underground for thousands of years. The researchers state that "Even a fault slip of a few centimeters could allow stored CO2 to reach the surface – a serious concern, since . . . carbon repositories need a leak rate of less than 1 percent every thousand years to be effective" [SCITECH Daily 2012]. Carbon dioxide also converts to carbonic acid in the presence of moisture, which can result in the dissolving of rock and cement barriers meant to prevent leakage. Additionally, abandoned wells, boreholes and faults could present pathways for leakage, resulting in contamination of the atmosphere as well as of underground aquifers. These repositories will require constant long-term monitoring. The 9th edition of the Concerned Health Professionals of New York (CHPNY) and Physicians for Social Responsibility (PSR) Compendium states: "A 2023 investigation by the Institute for Energy Economics and Financial Analysis (IEEFA) found that CO2 storage projects may carry more uncertainty and risk than drilling for oil or gas, given the lack of knowledge about the capacity of subsurface geological formations to keep CO2 in the ground permanently. The IEEFA report notes that two long-running CCS projects in Norway, once hailed as success stories, are now mired in unexpected problems. In the Sliepner facility, operational since 1996, CO2 from the underground storage area is now migrating upwards, while the Snøhvit facility, operational since 2008, has proven to have nine-fold less storage capacity than originally forecast and will fill up far sooner than predicted" [CHPNY 2023; IEEFA, 2023]. In addition, it is unclear whether the EPA regulations that are currently in place for long-term monitoring, reporting, and verification (MRV) of proposed carbon sequestration sites will be sufficient. An Environmental Integrity Project analysis of the 21 plans that have been approved by EPA concluded that the MRV plans contain ambiguous language, do not require the use of specific monitoring strategies or technologies, allowing companies to write their own rules, and are difficult to enforce with no third-party verification of the data required [EIP, 2023].

81% of CO2 captured by CCS is used to extract more oil from the ground

Example projects:

- Hydrogen Hubs:

Pennsylvania has just received DOE funding for hydrogen hubs to come to the state. These projects will involve generation of blue hydrogen using a process called steam reformation of methane from fracked gas. The labeling of these projects as "clean" requires the addition of CCS to the production plant as well as pipelines to carry the captured CO2 to markets and/or

storage sites.

- Ammonia Plants:
  In what is called the Haber-Bosch process, hydrogen (from fracked gas) reacts with nitrogen (from the air) to produce what is called brown ammonia; this process is energy intensive and accounts for one to two percent of global energy consumption, three percent of global carbon emissions, and between three and five percent of worldwide fossil gas consumption. Ammonia production is both expensive and difficult, requiring high-strength pressure vessels, as well as pipes and valves that are able to resist hydrogen embrittlement. "The energy-intensity of the process contributes to climate change and other environmental problems such as the leaching of nitrates into groundwater, rivers, ponds, and lakes; expanding dead zones in coastal ocean waters, resulting from recurrent eutrophication; atmospheric deposition of nitrates and ammonia affecting natural ecosystems; higher emissions of nitrous oxide (N_2O), now the third most important greenhouse gas following CO_2 and CH_4. The Haber–Bosch process is one of the largest contributors to a buildup of reactive nitrogen in the biosphere, causing an anthropogenic disruption to the nitrogen cycle. Since nitrogen use efficiency is typically less than 50%, farm runoff from heavy use of fixed industrial nitrogen disrupts biological habitats." [Wikipedia 2023]. Commonly used to increase agricultural productivity, ammonia is now being touted as a solution to energy grid storage. However, since the production of brown ammonia (through the reformation of hydrogen from fracked gas) produces significant CO2 emissions, any practical usage cannot be considered sustainable. Presenting brown ammonia as a "bridge" to green ammonia is also suspect. Any discussion of ammonia as a pretext for continued hydrogen production should be considered a false solution. The KeyState project proposed for Clinton County includes use of hydrogen to produce ammonia. [See below]

The bottom line: The conclusion is unmistakable. Though CCS technologies might be used to offset the most intractable emissions, in the production of cement or steel, for example, our main focus must be on aggressive reductions of fossil fuels. In the face of increasingly dire climate warnings, these reductions are the only way to achieve the pathways recommended by the International Panel on Climate Change (IPCC). Far from being a climate crisis solution, CCS is an expensive and energy intensive effort to divert funding and effort from renewable projects and extend the life of fossil fuels indefinitely.

ADVANCED RECYCLING:

"ADVANCED RECYCLING" IS THE PROCESS OF CHEMICALLY BREAKING DOWN OR MELTING (VIA PYROLYSIS) POST-CONSUMER PLASTIC WASTE TO MAKE FUEL OR CHEMICALS THAT CAN BE MADE INTO MORE PLASTICS.

PA EXEMPTS ADVANCED RECYCLING FROM ENVIRONMENTAL LAWS THAT REGULATE SOLID WASTE MANAGEMENT FACILITIES

THE PROCESS OF WASHING AND SORTING THE PLASTICS PRIOR TO PYROLYSIS CAN GENERATE SUBSTANCES THAT CAN CONTRIBUTE SIGNIFICANTLY TO POLLUTION OF LOCAL WATERWAYS

Advanced recycling

"Advanced recycling" is the process of chemically breaking down or melting (via pyrolysis) post-consumer plastic waste to make fuel or chemicals that can be made into more plastics. Proponents of this technology claim that it is creating a "circular" economy for plastics in which the plastics are recycled, thus reducing the need to make plastics from new fossil fuels and offering a solution to our current plastics waste crisis.

Our concerns: This technology has not been demonstrated to work, despite numerous attempts at different plants around the country, most of which have shut down or are running at reduced capacity. Plastics are inherently toxic, and by-products of these processes, including microplastics and per- and polyfluoroalkyl substances (PFAS or "forever"), are not adequately regulated at the state or federal level in air or water to protect communities and the environment. These plants create tons of hazardous waste and toxic emissions, are extremely energy intensive, and contribute to climate change. The chemical products of these processes (pyrolysis oil and volatile organic compounds such as benzene, toluene, and xylene) are also inherently toxic and their generation, storage, and transport creates a health risk for local populations. Proponents' claims that this technology will provide jobs, prosperity, and a solution to the plastics waste crisis are overstated and unsubstantiated [Beyond Plastics, 2023].

- **Air pollution**: Pennsylvania has passed a law, Solid Waste Management Act 127 of 2020, that defines advanced recycling as manufacturing and **exempts advanced recycling from environmental laws** that regulate hazardous air pollution from solid waste management facilities [PA General Assembly 2020]. This change in the law allows these pyrolysis and gasification facilities to be built without following federal regulations that require monitoring of hazardous emissions, set emissions limits, and determine which air pollution control filtration equipment is needed leaving communities unprotected from the toxic emissions from plastics processing [Beyond Plastics, 2023].
    - The EPA has decided not to follow states in making this change to solid waste management law and will continue to regulate plastics waste processing plants as solid waste management facilities, creating **regulatory uncertainty** for proposed plants in PA [EPA 2023; Inside Climate News 2023 EPA].

- **Water pollution**: The process of washing and sorting the plastics prior to pyrolysis can generate substances that can contribute significantly to **pollution of local waterways**, potentially contaminating municipal water supplies and local fisheries.
    - Plastics are made from fossil fuels and can contain many additives, such as dyes, plasticizers, and PFAS chemicals, that are added to achieve a variety of product qualities. As a result, plastics are inherently toxic, and these chemicals may be shed into the wastewater used for washing the plastics prior to pyrolysis [Beyond Plastics, 2023]. For example, PFAS chemicals that are used in plastics production have been shown to leach into food and liquids they contain [Notre Dame news 2023].
    - **PFAS chemicals and microplastics are not regulated by EPA or DEP in wastewater**, so advanced recycling plants are not required to remove or monitor these pollutants as part of their wastewater management system, putting

municipal drinking water supplies and critical watersheds at risk [PA DEP 2023 PFAS; Inside Climate news 2023 Recycling].

Plastic recycling doesn't work and will never work

- Solid and semi-liquid materials in the plastic waste must be removed and dried as "sludge" before being disposed of, either to a landfill or as a "land application" onto nearby farms and fields, creating the possibility that unknown toxic substances will be released into land, water, and air near these plants.
- The waste in post-consumer plastic containers is a mixture of everything that was in the plastic to begin with, from food waste to chemicals to detergents (from ketchup-to-roundup), and this must be removed from wastewater used in the washing process. Wastewater management systems are not equipped to remove/test for such a wide variety of potentially harmful substances.

- **Economically unviable**: There has been **no demonstration that these plants can be economically viable** or that there is a sufficient market for the products of these billion-dollar plants to justify the expense of building them [Reuters news 2021;Beyond Plastics, 2023].
  - In one example, the product created by a plastics-to-styrene chemical recycling plant built in 2012, Agilyx in Tigard, Oregon, was not of sufficient quality for customer use, and 49,000 tons of styrene product was subsequently sent to an incinerator for burning in another state [GAIA, 2020].
  - The Alterra plant in Akron, Ohio was built in 2014 but has only ever run as a demonstration plant that nonetheless generates large quantities of hazardous waste and is nearly exceeding its air pollution limits while operating below capacity [Beyond Plastics, 2023].
  - Other plants have simply shut down after proving to be not economically viable, leaving local residents and governments with stranded assets and toxic waste clean-up to contend with [GAIA, 2020; Beyond Plastics, 2023].

- **Not a solution**: Advanced recycling does not live up to the promise of solving the plastics crisis. Even if all 11 of the currently operating plants were working at full capacity (and only 3 of them are), they would only process 1.3% of plastic waste in the United States [Beyond Plastics, 2023].

- **Worker health concerns**: Workers at advanced recycling plants have reported **health concerns** related to breathing clouds of plastic dust, toxic chemical vapors, and fires [Inside Climate News 2023 Inside; Inside Climate News 2023 Where; NBC news 2023 New Mexico].

- **Does not work**: Experts on advanced recycling and the plastics crisis say that, "Plastic recycling doesn't work and will never work." [The Atlantic 2022].

- **Inherently toxic**: Plastics are made with thousands of toxic chemicals and, when processed, these chemicals go into the recycled plastic or product in addition to other toxic chemicals that are a byproduct of the pyrolysis process, making it difficult to

remove these contaminants from the final product [Beyond Plastics, 2023]. In addition, the volatile organic chemicals generated by these plants are known to present health hazards to humans and present a significant risk to local communities in terms of air pollution, water pollution, and toxic spills/leaks. Benzene, for example, is a known carcinogen.

- **Fire and emergency response concerns**: Local firefighters are not trained to deal with the intense and very toxic fires associated with plastics recycling and advanced recycling facilities. A number of high profile plastics recycling facility fires have raised awareness of the exposure of local fire companies, who are often volunteers in the rural areas these plants are sited in [Inside Climate News 2023 Inside; NBC news 2023 New Mexico]. Several chemical recycling facilities have already had fires that were difficult to control due to the fossil fuel basis of the feedstocks and outputs, even before they were operational, with associated release and ignition of toxic vapors [Beyond Plastics, 2023].

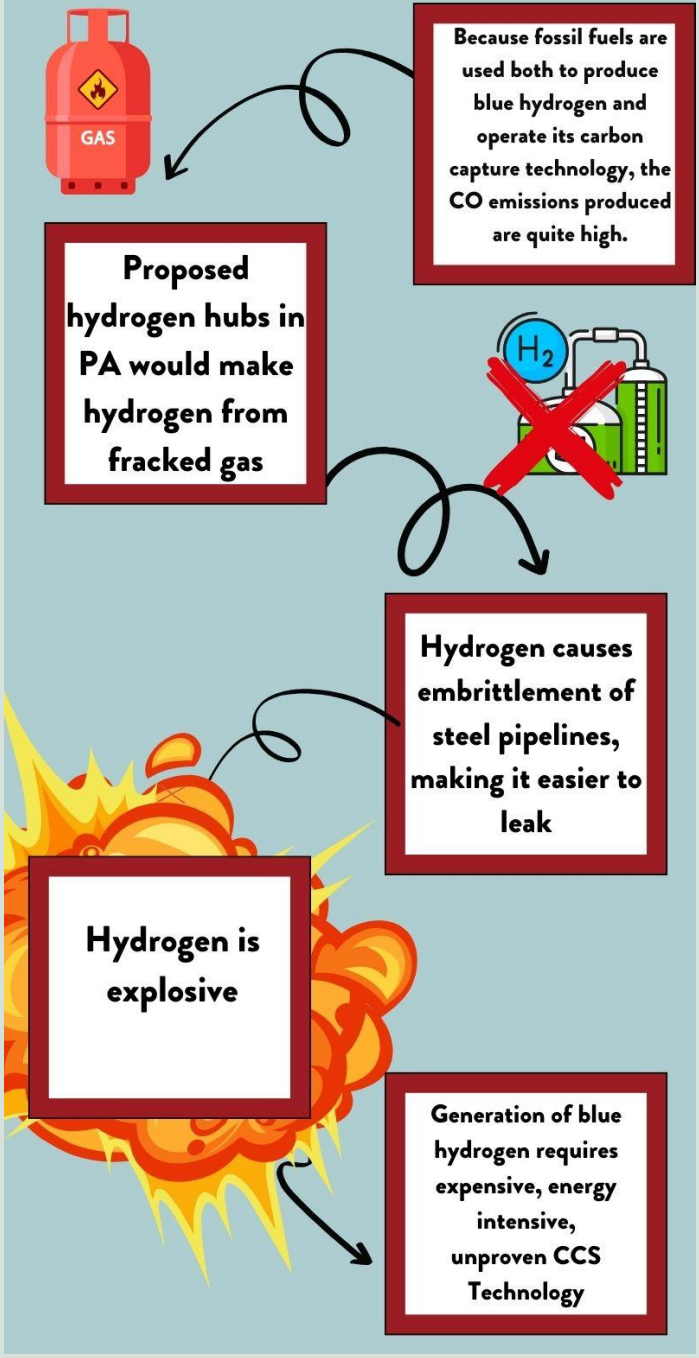
Example projects:

- Encina Point Township:
  This billion-dollar plastics waste processing facility proposed by Encina along the Susquehanna River in Point Township, Northumberland, PA, will process 450,000 tons of post-consumer plastic per year to make volatile organic chemicals (benzene, toluene, xylene, and propylene) using a proprietary catalytic pyrolysis process. The plastics will first be washed and sorted, using 2.9 million gallons of water per day from the Susquehanna River, and then will be melted in the pyrolysis process. The pyrolytic oil generated by melting will then be used to power the plant or be further processed and fractionated into the chemical products that will then be stored on site before being transported by rail, along the river, to customers to make more plastics. The plastics will be transported to the site by truck (170 trucks per day). Local residents are concerned about air pollution, water pollution, light pollution, traffic, noise, trash odors, and the location of the refinery in the 100-year flood plain of the river that provides drinking water for local and downstream residents and is part of the Chesapeake Bay watershed.
- Braven Environmental: The developers of this advanced recycling plant in Zebulon, North Carolina, that has been in operation since 2020, told the Zebulon board of commissioners and the public that their process would break down plastic waste by pyrolysis into chemicals to be used to make plastics or fuel without endangering the public health, safety, or welfare. The site is located 400 feet from a public housing community and 780 feet from a school. Braven claimed they did not handle hazardous materials of any kind but investigations found that they generated and shipped 9.6 tons of hazardous, ignitable waste and benzene in 2021 alone. They also claimed there would be no hazardous air emissions from the plant in their “closed loop” process but emissions reports show that their plastics pyrolysis process emits carbon monoxide, nitrogen oxides, sulfur dioxide, and particulate matter, as well as 5.14 tons of volatile organic chemicals like benzene, similar to a fossil fuel plant. In 2022, North Carolina’s Department of Environmental Quality (DEQ) cited Braven for numerous violations related to improper storage of hazardous waste in a manner that could allow it to leak into the ground or drainage systems, improper transport of hazardous waste by non-licensed operators, and

hazardous waste disposal of pyrolysis oil products that were intended to be the company's product but were disposed of because they couldn't sell them. NCDEQ called the company a "significant noncomplier". In another report, it was found that Braven was supplying Chevron with pyrolysis oil to be made into jet fuel (not other plastics products) in a process that creates air pollution that subjects local residents to an unacceptable 1:4 cancer risk. After claiming to be proactive about safety, Braven did not have safety data forms on file for their pyrolysis oils and did not distribute information about their processes and products to local emergency authorities. In addition, the company has been implicated in a number of financial issues related to misleading investors and the public about their plans for expansion and partnerships. [The Intercept 2023].

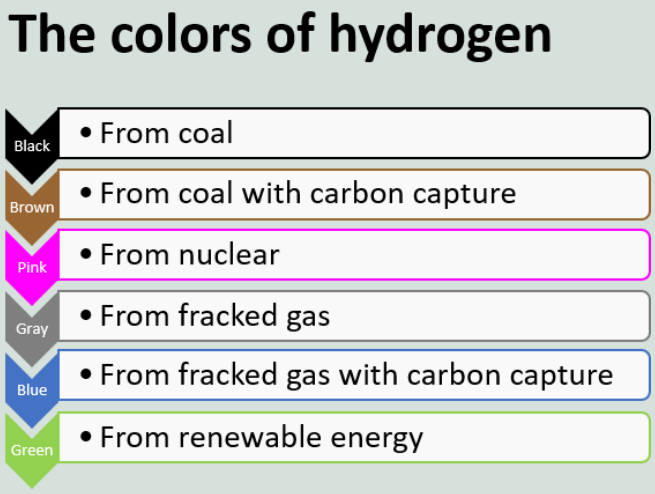
The bottom line: Experts on the plastics crisis agree that advanced recycling technologies do not achieve the stated goals of these projects and have not been proven to be economically viable. In addition, many agree that, despite their stated environmental aspirations, these projects are not designed to solve the plastics crisis but rather to justify continued generation of plastics from fossil fuels with the promise that they can now be "recycled" [The Atlantic 2022]. Experts agree that the solution to the plastics crisis is to make less plastic and use other, more sustainable, less toxic products for our daily needs [Beyond Plastics, 2023].

HYDROGEN


GAS
Because fossil fuels are used both to produce blue hydrogen and operate its carbon capture technology, the CO emissions produced are quite high.
Proposed hydrogen hubs in PA would make hydrogen from fracked gas
H_2
Hydrogen causes embrittlement of steel pipelines, making it easier to leak
Hydrogen is explosive
Generation of blue hydrogen requires expensive, energy intensive, unproven CCS Technology

Hydrogen

Hydrogen production can be understood using a color scheme. Pink hydrogen is produced using nuclear power as its feedstock, black or brown using coal. The most common hydrogen color designations, however, are gray, green, and blue. Ninety-six percent of the hydrogen being produced today, known as gray hydrogen, is produced using fracked gas, a process whose greenhouse gas emissions make it an unacceptable solution for reducing our carbon footprint. At the other end of the spectrum is green hydrogen, which is produced using renewable energy. Although, eventually, green hydrogen could be a means of reducing the emissions of hard-to-decarbonize industries (like cement and steel production, heavy transport, and aviation), at present it is too expensive to produce at scale [DW 2023]. The misleadingly generic term "clean hydrogen" being used today to describe the federally-supported impetus behind a "new economy" is blue hydrogen, a concept promoted by the oil and gas industry and touted in their reports as an environmentally friendly alternative. Blue, like gray hydrogen, is produced using fracked gas, but with carbon capture and storage technology (CCS) added on to hypothetically remove CO2 emissions from the atmosphere and then either store that carbon underground or use it for enhanced oil recovery (EOR). By the year 2050, according to an International Energy Agency report, "fossil fuels will remain the primary source of hydrogen" for the United States, Europe, and Japan [US DOE 2020].



The Department of Energy (DOE) named seven U.S. locations as possible sites for Hydrogen Hubs in October, 2023, two of which include Pennsylvania: the MACH2 or Mid-Atlantic Clean Hydrogen Hub (a coalition that includes Delaware, New Jersey, and southeast Pennsylvania) and the ARCH2 or Appalachian Regional Clean Hydrogen Hub (a consortium that includes West Virginia, Ohio, Kentucky, and Pennsylvania) [MACH2 2023; ARCH2 2023]. Both projects are currently in the initial planning phase. Proponents of these hydrogen hubs are interested in using the commonwealth's abundant fossil fuel resources to make hydrogen from fracked gas with CCS (*blue* hydrogen) and then use pipelines to transport both the hydrogen and the captured carbon dioxide to markets or storage sites. In some cases, transporting hydrogen in already existing fracked gas pipelines as something called "HyBlend" has also been proposed [EERE 2023].

Our concerns: Proponents of this technology have not adequately evaluated the risks associated with transporting hydrogen in pipelines, alone or in combination with fracked gas, the increased carbon footprint associated with making hydrogen from fracked gas with CCS, the costs and uncertainties associated with using CCS in these projects, the increased need for regulation of this new industry, and the cost of tax subsidies for this industry to PA taxpayers. The push for this technology in PA is focused on continuing the use of fracked gas in the commonwealth. According to a recent article from StateImpact Pennsylvania, "The gas industry and its backers are promoting the use of gas to make hydrogen. After the hydrogen hubs announcement, the Marcellus Shale Coalition said on its website, 'The developments are positive for further innovative uses of our abundant natural gas resources'" [StateImpact Pennsylvania 2023b]. Environmental advocates are pushing back against those who claim that investing in hydrogen will bring jobs to the state by raising serious questions about hydrogen production and its concomitant carbon capture and storage, as well as about the necessary regulatory framework that a hydrogen build-out will require.

- **Transportation issues and hydrogen embrittlement:** Hydrogen brings with it a range of transportation issues**.** It is a highly volatile, flammable gas and a very small molecule that can escape containment in pipelines and vessels, meaning it can be expected to leak during transport, particularly from pipelines that were originally constructed for a larger-volume gas like methane. It also causes **hydrogen embrittlement**, or hydrogen-assisted cracking, a process in which hydrogen permeates solid metals, particularly steels, and causes gaps, leaks, and breakdown of the ductile properties of the metal. Once it is absorbed into the metal, hydrogen increases the chances for initiation and propagation of cracks and fissures through which the hydrogen can escape. It will be risky, therefore, to transport meaningful amounts of hydrogen through our existing steel pipelines [TWI Global 2023]. Also, plans to pipe hydrogen into homes and to run appliances will need to take this problem into consideration, adding expense. Additional problems can arise due to the fact that hydrogen flames are invisible to the human eye, meaning that those leaks will not be easily detected -- unless expensive detection devices are put in place -- raising the likelihood of explosion. Thus, to ensure safety, sensors will need to be employed all along the hydrogen distribution route, and our existing transportation networks will need to be overhauled [The Street 2022].

  There are currently no hydrogen pipelines in Pennsylvania. The term "**HyBlend**" has been coined by the U.S. Department of Energy as part of its recent initiative to determine the feasibility of introducing hydrogen into already-existing fracked gas pipelines [NREL 2023]. A recently published report on HyBlend by the Pipeline Safety Trust, a nonprofit public watchdog promoting pipeline safety, raises serious concerns about the safety risks of transporting hydrogen by pipeline, whether as pure hydrogen or as a blend with fracked gas, and cautions that transportation of hydrogen is "significantly more dangerous" than transportation of methane gas. Hydrogen's greater flammability makes it more likely than methane to explode; hydrogen causes embrittlement in steel and polyethylene pipelines, leading to cracking, subsequent leakage and even systemic

failure. And hydrogen's greater propensity to leak means that its transportation will introduce into the atmosphere an additional greenhouse gas, with 33 times the warming power of CO2 in its first 20 years. The report concludes: "Hydrogen blending in most U.S. existing gas pipeline systems may not prove viable" [Pipeline Safety Trust 2023]. In October, 2023 PA state senator Katie Muth released a co-sponsorship memorandum asking colleagues to support legislation to prohibit hydrogen blending in gas pipelines in Pennsylvania based on the dangers inherent in transportation of hydrogen and the lack of data to support the safety of transporting hydrogen in fracked gas pipelines. The memorandum cites the Green Education and Legal Fund as follows, "false solutions often contradict the precautionary principle, which emphasizes caution in dealing with new technology, taking time to review before leaping into innovations that may prove disastrous….corporate support is not a test of whether a technology is best for society as a whole, however, and its main impact is often to increase the revenues of the industry advocating for technological solutions." [PA Senate, 2023; Green Education and Legal Fund, 2023]

- **High carbon emissions and health impacts**: Ninety-six percent of the hydrogen being produced today, known as *gray* hydrogen, is produced using fossil fuels, a process whose greenhouse gas emissions make it an unacceptable solution for reducing our carbon footprint. At the other end of the spectrum is *green* hydrogen, which is produced using renewables. Although, eventually, green hydrogen could be a means of reducing the emissions of hard-to-decarbonize industries (like cement and steel production, heavy transport, and aviation), at present, it is too expensive to produce at scale. The misleadingly generic term "clean hydrogen" being used today to describe the "silver-bullet" projects under consideration is *blue* hydrogen, a concept promoted by the oil and gas industry and touted in their reports, without evidence, as an environmentally friendly alternative. Blue, like gray hydrogen, is produced using fossil fuels, but with carbon capture technology tacked on to hypothetically remove CO2 emissions from the atmosphere and then store that carbon underground. Carbon capture and storage technology, an essential component in the production of blue hydrogen, has been demonstrated to be extremely expensive, energy-intensive, technically difficult, less economical than renewables, and ineffective at reducing CO2 emissions. In addition, the safety of CO2 pipelines has not been established, and CO2 sequestration in geological formations is untested, poses significant risks, and will require monitoring for generations to come [CHPNY 2023]. Because fossil fuels are used both to produce blue hydrogen and operate its carbon capture technology, the carbon emissions produced are quite high. According to Robert Howarth, Cornell professor and co-author of a recent scholarly paper titled "How Green is Blue Hydrogen?", "If we compare it to natural gas, blue hydrogen actually has a worse greenhouse gas footprint than if you simply were to burn natural gas for fuel. So it's just not a good idea in terms of its climate impact" [Better Path Presents 2022; Howarth and Jacobson, 2021].

  Additionally, studies show that burning hydrogen negatively impacts both human health and the environment. When burned in air, hydrogen emits nitrogen oxide (NOx), which contributes to smog and acid rain and reduces lung function as well as causing long-term lung damage [Reuters News 2023]. In agreement with these conclusions, a recent report

from the Institute for Energy Economics and Financial Analysis (IEEFA) criticized the assumptions used by DOE to evaluate the greenhouse gas emissions associated with proposed US hydrogen projects as "unrealistic and flawed" and concluded that blue hydrogen from natural gas has a carbon intensity as much as five times higher than the DOEs Clean Hydrogen Production Standard, meaning blue hydrogen is "dirty and high carbon" [IEEFA 2023].

Approximately 96% of hydrogen produced today in the US comes from fossil fuels

- **No established regulatory framework:** The DOE is rushing to fund hydrogen projects without taking the time to establish a regulatory framework**.** A recent IEEFA report criticized the DOE for underestimating the amount of methane that will be emitted into the atmosphere during transportation from well to facility, for underestimating hydrogen's global warming impact when leaked into the atmosphere, and for overestimating the amount of carbon dioxide that hydrogen projects with carbon capture will be able to remove from the air. The report also faults DOE's analysis for excluding downstream emissions from produced hydrogen as well as from the generation of electricity needed to compress, store, and deliver that hydrogen to its users. The report concludes that blue hydrogen, especially, is neither clean nor low-carbon nor a solution and that IEEFA is "extremely concerned" that the hype around hydrogen will encourage us to support projects that worsen climate change and lock in our dependence on fossil fuels for decades [IEEFA 2023]. Environmentalists are pushing back against those who claim that investing in hydrogen will bring jobs to the state by raising serious questions about hydrogen production and its concomitant carbon capture and storage, as well as about the necessary regulatory framework that a hydrogen build-out will require [Appalachia Hydrogen Facts 2023; ORVI 2023].

- **Burdensome tax subsidies**: With regard to **tax subsidies**, Sean O'Leary, senior researcher with the Ohio River Valley Institute, estimates in a recent report that building one hydrogen hub (with its associated facilities) in the Pittsburgh area will cost taxpayers in that area between $1000 to $2500 per household, per year. The costs of constructing and operating CCS facilities are so prohibitive for owners and shareholders that they're unwilling to consider these projects without financial incentives. And that means that the homeowner will be facing higher utility and tax bills. He concludes: "That leaves us ratepayers and taxpayers on the hook. And make no mistake. We're talking real money. . . . We're talking about actual physical costs –more equipment and more raw materials – which must be paid, whether it is done through your utility bill or your tax bill. And to say, "The federal government will pay" is just another way of saying, "Taxpayers will pay"' [ORVI 2022]. Recent analysis from DOE makes this situation even worse for Pennsylvanians as they predict that blue hydrogen projects will not be clean enough to meet federal standards to qualify for 45V tax credits for clean hydrogen projects due to high upstream methane emissions associated with fracked gas production for the hydrogen generation process and for the electricity to run the CCS, leaving Pennsylvania to shoulder the burden [Hydrogen Insight, 2023].

Example Projects:

- **KeyState Project, Clinton County PA:** A two-billion-dollar project proposed for a 7000-acre tract of land in northwest Clinton County, this "gas-synthesis" plant will use the methane in fracked gas as a feedstock to produce a range of products, including blue hydrogen, ammonia, urea, and nitrogen fertilizer. The developer's claims are wildly overstated and presented without evidence. Claiming the plant will operate as a closed system, he insists it will utilize on-site fracked gas supplies and underground storage facilities (for captured CO2), thereby hypothetically eliminating the methane leaks endemic to large-scale gas production operations and producing negligible-emissions products. "We'll easily have the lowest carbon intensity score in natural gas production at a large scale on the planet," he asserts, claiming for example that the carbon capture rate from the plant's hydrogen production will be above 99%, a rate that at this point in global manufacturing has yet to be achieved in practice. What does appear to be true is the fact that this project will maintain fossil gas production in the state for several decades. New gas wells will be drilled once a year for 20 years, utilizing twelve billion cubic feet of gas a year. The developer brags: "It's historic. The implications are dramatic for the natural gas industry" [Happy Valley Industry 2023; KeyState Energy 2023].

- **Safety Town:** Columbia Gas has set up an experimental micro-village in Beaver County, PA, called Safety Town, where it is testing the effects of various fracked gas-hydrogen blends on indoor appliances and pipeline infrastructure, as well as attempting to determine their environmental impacts. Hoping to profit from the push to establish hydrogen as the "energy of the future," gas companies – touting hydrogen as "a safe and reliable energy source" – are eager to adopt it as a sustainable option. The fact that one such company is already coming forward to embrace what is at this point merely an overblown promise is another indicator of the desire on the part of Pennsylvania's oil and gas industry to ensure its future in the commonwealth. In a report on its initial findings, the spokesperson for Columbia Gas mentions the quiet furnace. What is not mentioned are hydrogen's potential problems, including safety issues which – given the name of the experimental village – the gas company is apparently already eager to preempt [TribLive 2023].

The bottom line: Although there is a potential market for green hydrogen to power hard-to-electrify industries, widespread use of blue hydrogen technologies to make hydrogen for transportation, household use, or lighter industrial applications appears to be too expensive (due to the need for CCS) and too uncertain (due to its transportation and storage problems). It also poses health and environmental hazards, including its risk of explosion as well as its global warming impact. Subsidizing blue hydrogen will lock us into dependence on fossil fuels for decades and will ultimately serve to distract us from expanding development and implementation of proven renewable energy technologies.

Regulatory concerns

In order to carry out all of these new technology projects, developers have pushed through, or are working to push through, industry-friendly legislative changes that will facilitate the projects by decreasing permitting times and reducing landowner's rights to the subsurface beneath their homes.

Our concerns: In this time of climate crisis, legislators, working closely with the oil and gas industry, are working to pass legislation that will push forward false solutions to the climate crisis that continue our use of fossil gas and mislabel these false solutions as "clean and green". This focus both continues the ongoing harm to communities and economies in PA from the oil and gas industry, and slows our progress on transitioning PA to renewable energy and reducing our carbon footprint. In addition, at a time when the PA Department of Environmental Protection has faced funding and staffing cuts, legislators and the fossil fuel industry are seeking to increase the DEP's caseload by adding additional permitting and oversight responsibilities.

- **Primacy Issues:** Due to the need for approved underground locations to store captured CO2 from carbon capture operations, CCS also involves questions regarding the **primacy of state or federal regulators** to manage approval and monitoring of CO2 sequestration wells. Suitable injection wells to store CO2 emissions underground include depleted oil and gas fields, deep coal seams, and saline formations where CO2 is injected into solid but porous rock formations that lie underneath a "cap" formation of non-porous rock [EPA 2017]. However, concerns have been raised regarding leakage of CO2 from these wells through fractures in the rock or through other wells that are no longer in use, including rapid leakage events called blowouts [ICCT 2020]. These leaks have the potential to release a significant portion of the captured CO2 back into the atmosphere, reducing the efficacy of this extremely expensive and energy-intensive CCS process. Concerns have also been raised regarding the long-term health and environmental impacts of these wells, which are largely unknown. However, it has been suggested that leaks from wells can potentially contaminate drinking water, and that the wells can also cause earthquakes. All of these concerns mean that these CO2 wells will require careful monitoring and oversight, forever.

  To date, the federal Environmental Protection Agency (EPA) has had what is called "primacy" over these wells, approving their construction and regulating their operations [EPA 2023]. But the state wants more control. This past April, the PA DEP submitted a letter of intent to the EPA, expressing interest in establishing its own primacy over wells in the state [PA Environment Digest 22]. If granted, the state will be allowed to determine where and how quickly wells could be constructed, how regulations would be enforced, and whether public health impacts would be monitored. Given the fact that the PA DEP is severely underfunded and lacks both the staffing and the expertise to take on additional oversight, many question the feasibility of allowing that agency to take on regulation of operations that could endanger public health and further damage the environment.

  The Class VI well, one of two types used for the injection and storage of CO2 and

eligible for 45Q tax credits, has so far been the focus of these primacy debates. But attention could now be turning to the second type, the Class II well, used mostly for the injection and storage of fluids produced during oil and gas operations. Class II wells also inject CO2 for disposal or enhanced oil recovery, and most states already have primacy over these wells. Pennsylvania is one of only eight states where the EPA still controls the permitting process [EPA UIC]. Because the federal process often involves lengthy delays, it is likely that Pennsylvania will renew its push to establish primacy over both Class VI and II wells.

- **Pore Space Issues:** As discussed in the section above, CCS operations require appropriate underground reservoirs for the sequestration of captured CO2. Such reservoirs are known collectively as "pore space." The recent focus on CCS as a way to theoretically reduce carbon emissions has led to complex legal questions regarding the use and ownership of these potentially valuable spaces under our feet. Do these spaces belong to those who own the mineral rights or to the landowner? Under the "American Rule," which most states follow at this time, the landowner possesses the rights to the pore space under the surface of their property [B3 Insight 2023]. No Pennsylvania court has so far addressed this question directly, but the state will need to come up with a regulatory framework that clarifies these property rights issues. According to Team Pennsylvania (the consortium responsible for one of the state's three hydrogen hub applications), the state has an underground CO2 storage capacity of 88.5 billion metric tons. [Team PA 2022]

The bottom line: PA appears to be investing legislative time and effort in support of expensive and ineffective technologies in ways that overburden our environmental regulatory agencies and appropriate homeowners' rights to the subsurface underneath their property.

Conclusion:

Although Pennsylvania has refused to levy a severance tax on its fossil fuel industry, not wanting to risk sending the industry elsewhere, the state nevertheless imposes an impact fee for each well that gets drilled, an amount that decreases over time. These monies, originally intended to mitigate the negative effects of drilling on local communities, are only loosely monitored. In a 2016 report, the state's auditor general signaled that the Gas Drilling Impact Fee Law needed to be amended to improve "vague spending guidelines, poor reporting requirements, and lack of state oversight." The report found that 24% of impact fees were actually being spent on balancing local budgets, on salaries, on operational expenses, and even on entertainment [PA Auditor 2016]. Nevertheless, neither changes to the Impact Fee Law nor the belated imposition of a severance tax will solve the enormously destructive problems that fracking has brought to the state. For the sake of the climate, the environment, and the health and well-being of its residents, Pennsylvania must follow the lead of other states and declare a moratorium on fracking.

Such a thing is not likely to happen soon. The state continues to offer the industry annual subsidies in the form of tax-breaks, low-interest loans, grants, and direct payments – and continues to look the other way as the industry leaves in its wake an increasingly disturbing roster of harm, including abandoned wells, pollution exceedances, toxic air, soil and

groundwater, degraded landscapes, and damage to public health. In 2019 alone (the last year for which we found data), Pennsylvania subsidized the oil and gas industry to the tune of $3.8 billion [Shale Hub 2021]. Before he left office, Governor Wolf and legislative leaders signed into law a bill that will give close to $4 billion in subsidies to petrochemical and hydrogen projects over the next 20 years, thereby ensuring that the fossil fuel industry will remain alive and well in Pennsylvania for decades [Penn Future 2022].

At the same time, renewable projects are "stuck" in the PJM electricity grid queue due to the costs of interconnection. In a bottleneck that some have described as "severe," grid operators have asked for a 2-year moratorium on new interconnection applications. The wind, solar, and storage projects currently on hold would, if built, support 1.7 million jobs [PV magazine 2022 ; PA Environment Digest 2023].

Initiatives that support and provide financing for energy efficiency and renewable energy projects can benefit all Pennsylvanians, and such programs -- including renewable energy adoption by homeowners and businesses, as well as large-scale renewable energy projects -- should be implemented.

Examples include:

- Incentive programs for solar and wind installations by homes/businesses/farms
- Tax incentives to attract large-scale solar, wind, and battery storage projects to PA
- Investment in electric grid infrastructure
- Relief of the PJM bottleneck
- Incentives to encourage installation of renewable projects on brownfield sites
- Investments that support a more distributed electricity input system
- Community solar
- Investments in electric vehicle charging infrastructure and incentives for EV buyers
- Educational and assistance programs to help homeowners to transition from oil and gas for home heating
- No new Pennsylvania tax incentives for fossil-fuel-based projects

As residents of Pennsylvania, we ask that decision makers in our state envision a new future for Pennsylvania that invests our taxpayer money and our resources in clean, renewable energy and brings an end to the egregious harms of the fossil fuel industry. Our communities have been sacrificed to this industry for 150 years; it is time for this sacrifice to end. Future investments in energy projects in PA should NOT include false solutions to the climate crisis, such as carbon capture and sequestration, advanced recycling, or blue hydrogen, but should utilize the abundant solar, wind, and storage resources of the commonwealth to benefit all Pennsylvanians.

References:

Alvarez RA, et al. Assessment of methane emissions from the U.S. oil and gas supply chain. Science 361,186-188. 2018. Available from: https://www.science.org/doi/10.1126/science.aar7204. Accessed 27 August 2023.

American Clean Power (ACP). Clean Power State-by-State. 2023. Available from: https://cleanpower.org/facts/state-fact-sheets/. Accessed 2 September 2023.

Appalachian Regional Clean Hydrogen Hub (ARCH2). Available from: https://www.arch2hub.com/. Accessed 30 November 2023.

Appalachia Hydrogen Facts. 2023. Available from: https://appalachiahydrogenfacts.org/#:~:text=If%20built%2C%20a%20hydrogen%20hub%20would%20create%20a,will%20continue%20to%20see%20job%20and%20population%20loss. Accessed 30 November 2023.

B3 Insight. Nancy Zalutsky. UNEARTHING THE LEGAL DEBATE: WHO OWNS PORE SPACE FOR CARBON CAPTURE AND STORAGE? 2023. Available from: https://www.b3insight.com/unearthing-the-legal-debate/#:~:text=Most%20states%20that%20do%20not%20have%20specific%20laws,area%20before%20leasing%20the%20pore%20space%20to%20another. Accessed 11 September 2023.

Better Path Presents. Robert Howarth. How Green is Blue Hydrogen? 21 September 2022. Available from: https://vimeo.com/752623478?utm_campaign=5250933&utm_source=affiliate&utm_channel=affiliate&cjevent=1a5ccf8b45c311ee803f03180a82b838&clickid=1a5ccf8b45c311ee803f03180a82b838. Accessed 11 September 2023.

Beyond Plastics. Chemical Recycling: A Dangerous Deception. 2023. Available from: https://www.beyondplastics.org/publications/chemical-recycling. Accessed 18 December 2023.

Clark CJ, et al. Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A Case–Control Study in Pennsylvania, 2009–2017. Environmental Health Perspectives. 2022.130 (8). Available from: https://ehp.niehs.nih.gov/doi/10.1289/EHP11092. Accessed 27 August 2023.

Climate Council. ANOTHER CARBON CAPTURE AND STORAGE FAILURE. 2021. Available from: https://www.climatecouncil.org.au/resources/carbon-capture-and-storage-failure-chevron-gorgon/. Accessed 29 August 2023.

Concerned Health Professionals of New York (CHPNY) and Physicians for Social Responsibility (PSR). Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure. Ninth edition. 2023. Available from: https://concernedhealthny.org/wp-content/uploads/2023/10/CHPNY-Fracking-Science-Compendium-9.pdf. Accessed 25 October 2023.

Congressional Research Service. Paul W. Parfomak. 2023. Siting Challenges for Carbon Dioxide Pipelines. Available from: https://crsreports.congress.gov/product/pdf/IN/IN12269. Accessed 19 December 2023.

Commonwealth Court of Pennsylvania. Petition for Review in the Nature of an Action for Declaratory
Relief. 2023. Available from: https://www.pennfuture.org/Files/Admin/WellBondLawsuit.pdf. Accessed 29 August 2023.

Department of Energy (DOE). U.S. DEPARTMENT OF ENERGY ANNOUNCES INTENT TO FUND BUILDOUT OF A CARBON DIOXIDE TRANSPORTATION SYSTEM TO SUPPORT NATIONAL DECARBONIZATION EFFORTS. 2023. Available from: https://content.govdelivery.com/accounts/USDOEOFE/bulletins/36cb93f. Accessed 29 August 2023.

DeSmog. Edward Donnelly. As EU Weans Itself From Russian Energy, U.S. Shale Gas Industry Pushes New LNG Export Plant in Pennsylvania. 2023. Available from: https://www.desmog.com/2023/08/17/u-s-shale-gas-industry-pushes-lng-export-plant-in-pennsylvania-to-europe/. Accessed 27 August 2023.

DeSmog. Michael Buchsbaum, Edward Donnelly. 2023. Fossil Fuel Companies Made Bold Promises to Capture Carbon. Here's What Actually Happened. Available from: https://www.desmog.com/2023/09/25/fossil-fuel-companies-made-bold-promises-to-capture-carbon-heres-what-actually-happened/. Accessed 19 December 2023.

DiGiulio DC, et al. Chemical Characterization of Natural Gas Leaking from Abandoned Oil and Gas Wells in Western Pennsylvania. ACS Omega 2023, 8, 22, 19443–19454.

DW. Green Hydrogen: How can it help stop climate change? Ajit Naranjan. 2023. Available from: https://www.dw.com/en/green-hydrogen-climate-change-explainer/a-64619574. Accessed 30 November 2023.

EERE. Office of Energy Efficiency and Renewable Energy. HyBlend: Opportunities for Hydrogen Blending in Natural Gas Pipelines. 2023. Available from: https://www.energy.gov/eere/fuelcells/hyblend-opportunities-hydrogen-blending-natural-gas-pipelines. Accessed 30 November 2023.

Energy Information Administration (EIA). Where wind power is harnessed. Available from: https://www.eia.gov/energyexplained/wind/where-wind-power-is-harnessed.php. Accessed 9 September 2023.

Energy Mix. 81% of 'Removed' Atmospheric Carbon is Reused to Extract More Fossil Fuel. 2021. Available from: https://www.theenergymix.com/2021/01/25/81-of-removed-atmospheric-carbon-is-reused-to-extract-more-fossil-fuel/. Accessed 29 August 2023.

Environmental Integrity Project. 2023. EPA's Rules for Verifying Carbon Capture Projects Are Riddled with Holes. Available from: https://environmentalintegrity.org/news/epas-rules-for-

verifying-carbon-capture-projects-are-riddled-with-holes/. Accessed 19 December 2023.

Environmental Protection Agency (EPA). Carbon Capture and Sequestration: Overview. 2017. Available from: https://19january2017snapshot.epa.gov/climatechange/carbon-dioxide-capture-and-sequestration-overview_.html#storage. Accessed 11 September 2023.

Environmental Protection Agency (EPA). Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Other Solid Waste Incineration Units Review; Withdrawal of Proposed Provision Removing Pyrolysis/Combustion Units. 2023. Available from: https://www.epa.gov/system/files/documents/2023-05/Pyrolysis%20Proposed%20Provision%20Withdrawal%20Notice_%20ADMIN%2BDISC.pdf . Accessed 29 August 2023.

Environmental Protection Agency (EPA). Class VI - Wells used for Geologic Sequestration of Carbon Dioxide. 2023. Available from: https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide. Accessed 11 September 2023.

Environmental Protection Agency (EPA). Primary Enforcement Authority for the Underground Injection Control Program. Available from: https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program-0. Accessed 11 September 2023.

Global Alliance for Incinerator Alternatives (GAIA). All Talk and No Recycling. 2020. Available from: https://www.no-burn.org/wp-content/uploads/2021/11/All-Talk-and-No-Recycling_July-28-1.pdf. Accessed 29 August 2023.

Global CCS Institute. CCS Facilities Update. 2023. Available from: https://www.globalccsinstitute.com/news-media/latest-news/q2-2023-ccs-facilities-update/. Accessed 29 August 2023.

Green Education and Legal Fund. Mark A. Dunlea. 2023. Putting Out the Planetary Fire. Chapter 7: False Climate Solutions. Available from: https://gelfny.org/putting-out-the-planetary-fire/chapter-7-false-climate-solutions/. Accessed 19 December 2023.

Happy Valley Industry. Holly Riddle. 2023. $2 billion KeyState project poised to make ‘generational change’. Available from: https://happyvalleyindustry.com/2-billion-keystate-project-poised-to-make-generational-change/?fbclid=IwAR1eOhRyHjTugwGjYKHor4WbjRjUgpZQHpOOI9HGME-9i6Dtc-AIyx9Y0Vw_aem_AZQw_a5GftzqFnyJ36VnBfq6pomM9QChjnosuUH3F2_zM1dZCivFgFOnjo_g9TXUCqE. Accessed 11 September 2023.

Howarth R, Santoro R, and Ingraffea, A. Methane and the greenhouse-gas footprint of natural gas from shale formations. Climatic Change. 2011;106:679-690. Available from: https://link.springer.com/article/10.1007/s10584-011-0061-5. Accessed 30 December 2023.

Howarth R and Jacobson MZ. How Green is Blue Hydrogen? Energy Science and Engineering. 2021;9 (10): 1676-1687. Available from:

https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.956. Accessed 11 September 2023.

Hydrogen Insight. Polly Martin. 2023. Blue hydrogen unlikely to qualify for US H2 tax credits due to high upstream emissions: Department of Energy. Both SMR and ATR with CCS have lifecycle emissions and costs above what the US is targeting for clean H2. Available from: https://www.hydrogeninsight.com/production/blue-hydrogen-unlikely-to-qualify-for-us-h2-tax-credits-due-to-high-upstream-emissions-department-of-energy/2-1-1566907. Accessed 19 December 2023.

Inside Climate News. Stacey Burling. Awash in Toxic Wastewater From Fracking for Natural Gas, Pennsylvania Faces a Disposal Reckoning. Available from: https://insideclimatenews.org/news/16042023/pennsylvania-produced-water-fracking-gas/. Accessed 9 September 2023.

Inside Climate News. Jake Bolster. 2023. New Pennsylvania Legislation Aims to Classify 'Produced Water' From Fracking as Hazardous Waste. Available from: https://insideclimatenews.org/news/06092023/pennsylvania-bills-would-regulate-produced-water-as-hazardous/. Accessed 9 September 2023.

Inside Climate News. James Bruggers. 2023. EPA Spurns Trump-Era Effort to Drop Clean-Air Protections For Plastic Waste Recycling. Available from: https://insideclimatenews.org/news/03062023/epa-pyrolysis-plastic-recycling-clean-air/. Accessed 29 August 2023.

Inside Climate News. James Bruggers. 2023. Where There's Plastic, There's Fire. Indiana Blaze Highlights Concerns Over Expanding Plastic Recycling. Available from: https://insideclimatenews.org/news/12042023/plastics-fire-richmond-indiana/. Accessed 29 August 2023.

Inside Climate News. James Bruggers. 2023. Inside Indiana's 'Advanced' Plastics Recycling Plant: Dangerous Vapors, Oil Spills and Life-Threatening Fires; The Brightmark "plastics renewal" plant can't get past the startup phase, as former employees raise environmental, health and safety concerns. Available from: https://insideclimatenews.org/news/16062023/indiana-advanced-plastics-recycling-vapors-spills-fires/. Accessed 29 August 2023.

Inside Climate News. James Bruggers. 2023. Who Said Recycling Was Green? It Makes Microplastics By the Ton. Available from: https://insideclimatenews.org/news/16052023/recycling-plastic-microplastics-waste/. Accessed 29 August 2023.

Institute for Energy Economics and Financial Analysis (IEEFA). Blue hydrogen: Not clean, not low carbon, not a solution. 2023. Available from: https://ieefa.org/resources/blue-hydrogen-not-clean-not-low-carbon-not-solution/ Accessed 30 November 2023.

Institute for Energy Economics and Financial Analysis (IEEFA). Petra Nova Mothballing Post-Mortem: Closure of Texas Carbon Capture Plant Is a Warning Sign. 2020. Available from: https://ieefa.org/wp-content/uploads/2020/08/Petra-Nova-Mothballing-Post-Mortem_August-

2020.pdf. Accessed 29 August 2023.

Institute for Energy Economics and Financial Analysis (IEEFA). Suzanne Mattei and David Schlissel. The ill-fated Petra Nova CCS project: NRG Energy throws in the towel. 2022. Available from: https://ieefa.org/resources/ill-fated-petra-nova-ccs-project-nrg-energy-throws-towel. Accessed 29 August 2023.

Institute for Energy Economics and Financial Analysis (IEEFA). Grant Hauber. 2023. Norway's Sleipner and Snøhvit CCS: Industry models or cautionary tales? Available from: https://ieefa.org/resources/norways-sleipner-and-snohvit-ccs-industry-models-or-cautionary-tales. Accessed 19 December 2023.

International Centre for Sustainable Carbon (ICSC). MORE THAN 32 GW OF NEW GAS-FIRED POWER PLANTS IN U.S. PIPELINE. 2022. Available from: https://www.sustainable-carbon.org/more-than-32-gw-of-new-gas-fired-power-plants-in-u-s-pipeline/. Accessed 29 August 2023.

International Council on Clean Transportation (ICCT). Yuanrong Zhou. CARBON CAPTURE AND STORAGE: A LOT OF EGGS IN A POTENTIALLY LEAKY BASKET. 2020. Available from: https://theicct.org/carbon-capture-and-storage-a-lot-of-eggs-in-a-potentially-leaky-basket/. Accessed 11 September 2023.

Keystate Energy. Keystate to Zero. 2023. Available from: https://keystate.net/. Accessed 11 September 2023.

Mid-Atlantic Clean Hydrogen Hub (MACH2) Available from: https://mach-2.com/. Accessed 30 November 2023.

MIT News. Mark Dwortzan. Stranded assets could exact steep costs on fossil energy producers and investors. Available from: https://news.mit.edu/2022/stranded-assets-could-exact-steep-costs-fossil-energy-producers-investors-0819. Accessed 3 September 2023.

National Public Radio (NPR). The U.S. is expanding CO2 pipelines. One poisoned town wants you to know its story. 2023. Available from: https://www.npr.org/2023/05/21/1172679786/carbon-capture-carbon-dioxide-pipeline. Accessed 29 August 2023.

National Renewable Energy Laboratory (NREL). Hydrogen Blending as a Pathway Toward U.S. Decarbonization. 2023. Available from: https://www.nrel.gov/news/program/2023/hydrogen-blending-as-a-pathway-toward-u.s.-decarbonization.html. Accessed 17 September 2023.

National Resources Defense Council (NRDC). Fracking 101. 2019. Available from: https://www.nrdc.org/stories/fracking-101#what-is. Accessed 27 August 2023.

National Resources Defense Council (NRDC). A HOT FRACKING MESS: HOW WEAK REGULATION OF OIL AND GAS PRODUCTION LEADS TO RADIOACTIVE WASTE IN OUR WATER, AIR, AND COMMUNITIES. 2021. Available from:

https://www.nrdc.org/sites/default/files/fracking-mess-regulation-radioactive-waste-report.pdf. Accessed 27 August 2023.

NBC news. Katarina Sabados, Kenzi Abou-Sabe and Hannah Rappleye. Months after residents sound the alarm, Pennsylvania 'cracks' down on Shell plant. May, 2023. Available from: https://www.nbcnews.com/news/us-news/pennsylvania-cracks-down-shell-plastics-cracker-plant-rcna82750. Accessed 29 August 2023.

NBC news. Aria Bendix. New Mexico plastics fire that released hazardous pollutants could smolder for days. Firefighters in Albuquerque have contained the fire, which prompted a health alert. August 2023. Available from: https://www.nbcnews.com/news/us-news/new-mexico-plastics-fire-released-hazardous-pollutants-rcna98567. Accessed 29 August 2023.

New York Times. The real-world costs of the digital race for bitcoin. 2023. Available from: https://www.nytimes.com/2023/04/09/business/bitcoin-mining-electricity-pollution.html. Accessed 3 September 2023.

Notre Dame News. Jessica Sieff. Plastic containers can contain PFAS — and it's getting into food. 2023. Available from: https://news.nd.edu/news/plastic-containers-can-contain-pfas-and-its-getting-into-food/#:~:text=In%20a%20new%20study%20published,packaging%20%E2%80%94%20tested%20positive%20for%20PFAS. Accessed 29 August 2023.

Ohio River Valley Institute (ORVI). 2023. Statement on Federal Funding for the Appalachian Regional Clean Hydrogen Hub. Available from: https://ohiorivervalleyinstitute.org/statement-on-federal-funding-for-the-appalachian-regional-clean-hydrogen-hub/. Accessed 30 November 2023.

Ohio River Valley Institute (ORVI). Fracking Counties Economic Impact Report. 2021. Available from: https://ohiorivervalleyinstitute.org/new-report-natural-gas-county-economies-suffered-as-production-boomed/. Accessed 29 August 2023.

Ohio River Valley Institute (ORVI). A Clean Energy Pathway for Southwestern Pennsylvania. 2022. Available from: https://ohiorivervalleyinstitute.org/a-clean-energy-pathway-for-southwestern-pennsylvania/. Accessed 2 September 2023.

Ohio River Valley Institute (ORVI). 2022. What A Pennsylvania Hydrogen and Carbon Capture Hub Would Cost. Sean O'Leary. Available from: https://ohiorivervalleyinstitute.org/what-a-pennsylvania-hydrogen-and-carbon-capture-hub-would-cost/. Accessed 30 November 2023.

Ohio River Valley Institute (ORVI). Frackalachia Update: Peak Natural Gas and the Economic Implications for Appalachia. 2023. Available from: https://ohiorivervalleyinstitute.org/frackalachia-update-peak-natural-gas-and-the-economic-implications-for-appalachia/. Accessed 29 August 2023.

Pennsylvania Auditor. Auditor General DePasquale Says Gas Drilling Impact Fee Law Must Be

Amended to Clarify Spending Guidelines, Improve Oversight. 2016. Available from: https://www.paauditor.gov/press-releases/auditor-general-depasquale-says-gas-drilling-impact-fee-law-must-be-amended-to-clarify-spending-guidelines-improve-oversight. Accessed 11 September 2023.

Pennsylvania Capital-Star. John L. Micek. Report: Cracker plant hasn't delivered for Beaver Co. June, 2023. Available from: https://www.penncapital-star.com/energy-environment/report-cracker-plant-hasnt-delivered-for-beaver-co-tuesday-morning-coffee/. Accessed 29 August 2023.

Pennsylvania Capital-Star. Crypto-mining could be Pa's next big environmental threat. We need to treat it that way. Available from: https://www.penncapital-star.com/commentary/crypto-mining-could-be-pas-next-big-environmental-threat-we-need-to-treat-it-that-way-opinion/. Accessed 3 September 2023.

Pennsylvania Department of Environmental Protection (DEP). Pennsylvania's Solar Future Plan. 2018. Available from: https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx. Accessed 3 September, 2023.

Pennsylvania Department of Environmental Protection (DEP). HOW DEP'S MINING PROGRAM BROUGHT THOUSANDS OF OLD, DECAYING MINE MAPS BACK FROM THE DEAD AND INTO THE DIGITAL AGE. 2020. Available from https://www.dep.pa.gov/OurCommonWealth/pages/Article.aspx?post=59. Accessed 27 August 2023.

Pennsylvania Department of Environmental Protection (DEP). ABANDONED AND ORPHAN OIL AND GAS WELLS AND THE WELL PLUGGING PROGRAM. 2021. Available from: https://www.depgreenport.state.pa.us/elibrary/PDFProvider.ashx?action=PDFStream&docID=1419023&chksum=&revision=0&docName=ABANDONED+AND+ORPHAN+OIL+AND+GAS+WELLS+AND+THE+WELL+PLUGGING+PROGRAM&nativeExt=pdf&PromptToSave=False&Size=411528&ViewerMode=2&overlay=0. Accessed 27 August 2023.

Pennsylvania Department of Environmental Protection (DEP). 2022 Coal and Industrial Minerals Mining Activities. 2022. Available from: https://www.dep.pa.gov/Business/Land/Mining/BureauofMiningPrograms/Reports/Pages/2022-Coal-and-Industrial-Minerals.aspx. Accessed 2 September 2023.

Pennsylvania Department of Environmental Protection (DEP). Pennsylvania Greenhouse Gas (GHG) Inventory. 2022. Available from: https://www.dep.pa.gov/Citizens/climate/Pages/GHG-Inventory.aspx. Accessed 27 August 2023.

Pennsylvania Department of Environmental Protection (DEP). PFAS MCL Rule. 2023. Available from: https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/DrinkingWaterMgmt/Regulations/Pages/PFAS-MCL-Rule.aspx. Accessed 29 August 2023.

Pennsylvania Department of Environmental Protection (DEP). Regional Greenhouse Gas Initiative (RGGI). 2023. Available from: https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx. Accessed 2 September 2023.

Pennsylvania Department of Environmental Protection. Integrated Water Quality Report. 2022. Available from: https://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/IntegratedWatersReport/Pages/2022-Integrated-Water-Quality-Report.aspx. Accessed 27 August, 2023.

Pennsylvania Department of Environmental Protection. Climate Change in PA. 2023. Available from: https://gis.dep.pa.gov/ClimateChange/index.html. Accessed 27 August 2023.

PA Environment Digest. DEP Issues Record 5,653 Notices Of Violation To Conventional Oil & Gas Operators So Far In 2023; 'Culture Of Non-Compliance' Continues. 2023. Available from: https://paenvironmentdaily.blogspot.com/2023/11/dep-issues-record-5653-notices-of.html. Accessed 17 December 2023.

PA Environment Digest. Lawsuit Filed Against General Assembly, Governor Challenges Constitutionality Of Law Preventing DEP From Protecting Public Health, Environment From Harm Caused By Abandoning Conventional Oil & Gas Wells. 2023. Available from: http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=58691&SubjectID=. Accessed 29 August 2023.

PA Environment Digest. 150+ Residents Of Chester Opposed To An LNG Natural Gas Export Facility Proposed In Their Community Let Their Feelings Be Known To The House Philadelphia LNG Export Task Force. 2023. Available from: http://paenvironmentdaily.blogspot.com/2023/08/house-philadelphia-lng-natural-gas.html. Accessed 27 August 2023.

PA Environment Digest. 22 Groups Express Concerns With Pennsylvania's Carbon Storage Plans, Capacity To Regulate Injection Wells. Available from: http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=57738. Accessed 11 September 2023.

PA Environment Digest. PJM Interconnection Announces New Project Evaluation Process Begins July 10; More Than 260,000 MW Of Mostly Renewable Projects In Queue. 2023. Available from: http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=58398&SubjectID=22. Accessed 11 September 2023.

PA Environment Digest. Environmental Health Project Finds Results 'Very Concerning' From University Of Pittsburgh Studies Showing Links Between Natural Gas Development And Lymphoma Cancer, Worsening Asthma Conditions, Lower Birth Weights. 13 September 2023. Available from: http://paenvironmentdaily.blogspot.com/2023/09/environmental-health-project-reviews.html. Accessed 17 September 2023.

Penn Future. Patrick McDonnell. The hydrogen bill gifts $4 billion to the fossil fuel industry. 2022. Available from: https://www.pennfuture.org/News-PennFuture-OpEd-in-The-Patriot-News. Accessed 11 September 2023.

Pennsylvania General Assembly. Solid Waste Management Act 2020 No. 127. Available from: https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2020&sessInd=0&act=127. Accessed 29 August 2023.

Pipeline Safety Trust. Hydrogen Pipelines: Unique Risks Prove Dangerous for Pipeline Transportation. 2023. Available from: https://pstrust.org/hydrogen-pipelines-unique-risks-prove-dangerous-for-pipeline-transportation/. Accessed 17 September 2023.

PV Magazine. William Driscoll. Interconnection delays and costs are the biggest barrier for utility-scale renewables, say developers. 2022. Available from: https://pv-magazine-usa.com/2022/02/14/interconnection-delays-and-costs-are-the-biggest-barrier-for-utility-scale-renewables-say-developers/. Accessed 11 September 2023.

Reginfo.gov. 2023. Office of Information and Regulatory Affairs and Office of Management and Budget. View Rule: Land Uses; Special Uses; Carbon Capture and Storage. Available from: https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202304&RIN=0596-AD55. Accessed 11 September 2023.

Reuters News. Joe Brock, Valerie Volcovici, and John Geddie. THE RECYCLING MYTH BIG OIL'S SOLUTION FOR PLASTIC WASTE LITTERED WITH FAILURE. 2021. Available from: https://www.reuters.com/investigates/special-report/environment-plastic-oil-recycling/. Accessed 29 August 2023.

Reuters News. Timothy Gardner. Restart delayed at Texas coal unit linked to Petra Nova CCS project. 2023. Available from: https://www.reuters.com/business/energy/restart-delayed-texas-coal-unit-linked-petra-nova-ccs-project-2023-08-01/#:~:text=NRG%20shut%20Petra%20Nova%20on,up%20once%20Unit%208%20starts. Accessed 29 August 2023.

Reuters News. Paul Day. Hydrogen as a backup for renewables remains a distant proposition. 2023. Available from: https://www.reuters.com/business/energy/hydrogen-backup-renewables-remains-distant-proposition-2023-02-01/. Accessed 25 October 2023.

SCITECH Daily. Max McClure. Carbon Sequestration Likely to Cause Intraplate Earthquakes. 2012. Available from: https://scitechdaily.com/carbon-sequestration-likely-to-cause-intraplate-earthquakes/#google_vignette. Accessed 29 August 2023.

Shale Gas Knowledge Hub. Report Shines Light On Fossil Fuel Subsidies in Pennsylvania. 2021. Available from: https://www.shalehub.org/post/report-shines-light-on-fossil-fuel-subsidies-in-pennsylvania#:~:text=The%20analysis%20from%20PennFuture%20shows%20$3.8%20billion%20in,gas%20industry%20captured%2052.1%20percent%2C%20or%20$2.0%20billion. Accessed 11 September 2023.

Sierra Club. Largest Coal Plant in Pennsylvania Announces Plans to Retire by July. 2023. Available from: https://www.sierraclub.org/press-releases/2023/04/largest-coal-plant-pennsylvania-announces-plans-retire-july. Accessed 2 September 2023.

StateImpact Pennsylvania. 2023a. Rachel McDevitt. Pa. drillers abandoned thousands of natural gas wells in 5 years, ignored state law, report says. January, 2023. Available from: https://stateimpact.npr.org/pennsylvania/2023/01/24/pa-drillers-abandoned-thousands-of-natural-gas-wells-in-5-years-ignored-state-law-report-says/. Accessed 30 December 2023.

StateImpact Pennsylvania. 2023b. Rachel McDevitt. Pa. lawmakers look for hydrogen models after hub announcement. November, 2023. Available from: https://stateimpact.npr.org/pennsylvania/2023/11/22/pa-lawmakers-look-for-hydrogen-models-after-hub-announcement/. Accessed 2 December 2023.

State of Pennsylvania. Session of 2023-2024. Memorandum. Senator Katie J. Muth. Protecting Communities from Volatile HyBlend in PA pipelines. Available from: https://www.legis.state.pa.us/cfdocs/Legis/CSM/showMemoPublic.cfm?chamber=S&SPick=20230&cosponId=41557. Accessed 19 December 2023.

Team Pennsylvania. A Road Map on Carbon Management and Hydrogen Development in Pennsylvania. 2022. Available from: https://teampa.com/wp-content/uploads/2022/09/PA-Roadmap-Fact-Sheet-9.12.22.pdf. Accessed 11 September 2023.

The Atlantic. Judith Enck and Jan Dell. 2022. Plastic Recycling Doesn't Work and Will Never Work. Available from: https://www.theatlantic.com/ideas/archive/2022/05/single-use-plastic-chemical-recycling-disposal/661141/. Accessed 29 August 2023.

The Guardian. Adam Morton. Emissions from WA gas project with world's largest industrial carbon capture system rise by more than 50%. 2023. Available from: https://www.theguardian.com/environment/2023/apr/21/emissions-wa-gas-project-chevron-carbon-capture-system-pilbara-coast. Accessed 27 October 2023.

The Hill. Ben Geman. Study: Gas from 'fracking' worse than coal on climate. Available from: https://thehill.com/policy/energy-environment/88229-study-gas-from-fracking-worse-than-coal-on-climate/. Accessed 30 September 2023.

The Intercept. Schuyler Mitchell. Garbage In, Toxics Out. 2023. Available from: https://theintercept.com/2023/09/28/braven-plastic-recycling-toxic-waste/. Accessed 27 October 2023.

The Nature Conservancy. Pennsylvania Pipeline Task Force. Nels Johnson. 2015. Pipeline Development – Strategies and Tools to Minimize Landscape Impacts. Available from: https://files.dep.state.pa.us/programintegration/PITF/Meetings/9-23-15/Pipeline%20Development%20-%20Strategies%20and%20Tools%20to%20Minimize%20Landscape%20Impacts.pdf. Accessed

17 December 2023.

The Street. Maxx Chatsko. 2022. The Hydrogen Economy Faces Big Challenges
Despite the hype, hydrogen is a poor fuel facing major obstacles. It may only play a marginal role in the energy transition. Available from: https://www.thestreet.com/investing/the-hydrogen-economy-faces-big-challenges. Accessed 11 September 2023.

The Guardian. Burning tires and bridges: US residents 'shocked' by firm's bitcoin-mining plan. 2023. Available from: https://www.theguardian.com/us-news/2023/aug/31/bitcoin-mining-plan-pennsylvania-tire-burning. Accessed 3 September 2023.

Trib Live. Stephanie Rittenbaugh. 2023. Columbia Gas tests hydrogen blends in natural gas appliances. Available from: https://triblive.com/local/regional/columbia-gas-tests-hydrogen-blends-in-natural-gas-appliances/. Accessed 19 December 2023.

TWI Global. What is hydrogen embrittlement? Causes, effects, and prevention. 2023. Available from: https://www.twi-global.com/technical-knowledge/faqs/what-is-hydrogen-embrittlement. Accessed 30 November 2023.

University of Pittsburgh and PA Department of Health. PA Health and Environment Study. 2023. Available from: https://paenv.pitt.edu/results.html. Accessed 27 August 2023.

University of Richmond. Adrienne Schmidt. UR Scholarship repository. The effects of coal mining on health in Appalachia: global context and social justice implications. Student Honors Thesis. 2014. Available from: https://scholarship.richmond.edu/cgi/viewcontent.cgi?article=1905&context=honors-theses. Accessed 30 December 2023.

US Department of Energy (DOE). Hydrogen Strategy: Enabling a low-carbon economy. Available from: https://www.energy.gov/sites/prod/files/2020/07/f76/USDOE_FE_Hydrogen_Strategy_July2020.pdf. Accessed 11 September 2023.

US Energy Information Administration (EIA). Petra Nova is one of two carbon capture and sequestration power plants in the world. 2017. Available from: https://www.eia.gov/todayinenergy/detail.php?id=33552. Accessed 29 August 2023.

US Energy Information Administration (EIA). The number of producing U.S. coal mines fell in 2020. 2021. Available from: https://docs.google.com/document/d/1TQR2G26NYyPVBTAnMO5qyiJN0jupZjOA/edit. Accessed 2 September 2023.

US Energy Information Administration (EIA). Most planned U.S. natural gas-fired plants are near Appalachia and in Florida and Texas. 2021. Available from: https://www.eia.gov/todayinenergy/detail.php?id=50436. Accessed 29 August 2023.

US Energy Information Administration (EIA). In the past 20 years, natural gas has displaced

most coal-fired generation in Pennsylvania. 2023. Available from: https://www.eia.gov/todayinenergy/detail.php?id=55319. Accessed 29 August 2023.

Wind Exchange. Wind Energy in Pennsylvania. 2023. Available from: https://windexchange.energy.gov/states/pa#capacity. Accessed 9 Sept 2023.

Wikipedia. Haber Process. 2023. Available from: https://en.wikipedia.org/wiki/Haber_process. Accessed 29 August 2023.

Yale News. Proximity to fracking sites associated with risk of childhood cancer. 2022. Available from: https://news.yale.edu/2022/08/17/proximity-fracking-sites-associated-risk-childhood-cancer. Accessed 27 August 2023.

Yale Program on Climate Change Communication.Yale Climate Opinion Maps 2021. 2021. Available from: https://climatecommunication.yale.edu/visualizations-data/ycom-us/. Accessed 2 September 2023.

No False Solutions is a coalition of advocacy groups and concerned residents of Pennsylvania and other states in our region affected by the oil and gas industry. The group aims to educate and inform legislators and decision makers about emerging technologies that claim to be solutions to the climate crisis but in fact exacerbate the climate crisis, damage the environment, and/or harm public health and do not offer more effective or economically viable solutions than those offered by renewable energy and renewable energy storage technologies.