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Cover Page Footnote

1 United States Energy Information Administration, "Today in Energy," April 2017, <https://www.eia.gov/todayinenergy/detail.php?id=30652>. 2 Hanna Jacobs Wiseman, "Untested Waters: the Rise of Hydraulic Fracturing in Oil and Gas Production and the Need to Revisit Regulation," *Fordham Environmental Law Review*, no. 20, (2019): 115. 3 Lindsey Konkel, "In the Neighborhood of 18 Million: Estimating How Many People Live Near Oil and Gas Wells," *Environmental Health Perspectives*, no. 12, (2017): 124003-1. 4 Eliza Czolowski, Renee L. Santoro, Tanja Srebotnjak, and Seth B. Shonkoff, "Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review," *Environmental Health Perspectives* 125, no. 8 (2017): 086004-1. doi:10.1289/ehp1535.

The Energy Policy Act of 2005:

The Rapid Decline of Jura Majestatis for Communities in Ohio

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Since Nobel Prize recipient Svante Arrhenius realized that fossil fuel combustion increased CO₂ emissions in our atmosphere in 1896, scientists and policy makers have acknowledged the calamitous potential for the oil and gas industry to render substantial deleterious effects on ecosystems. Yet in 2016, the U.S. utilized fossil fuels to facilitate 80.9 percent of all energy consumption.¹ Subsequent to the passage of the Energy Policy Act of 2005, the Federal Energy Regulatory Commission vastly encouraged outside economic investment into our oil and gas infrastructure. Natural resources situated in geologic formations that possess low permeability, which were once considered previously inaccessible and unprofitable, have now been exploited by utilizing horizontal drilling techniques combined with hydraulic fracturing.² There are a multitude of deleterious consequences correlated with this successful venture to achieve energy independence in the U.S. During 2016, 17.6 million Americans resided within 1 mile of an active hydraulically fractured well site.³ Eight states in the U.S. have more than 10 percent of their population located within 1 mile of an active hydraulically fractured well site, including Ohio (24.3 percent).⁴ The final section of this article “Prudent Recommendations to Mitigate Deleterious Consequences” provides potential solutions for combating this emerging neoteric legal and environmental conundrum.

Introduction

The proliferation of unconventional oil and gas extraction has revolutionized production operations in the U.S., following the enactment of the Energy Policy Act of 2005.⁵ This Act established a decentralized approach regarding hydraulic fracturing guidance, inaugurating a monumental loophole in federal regulation, making it extraordinarily difficult to hold any corporation or government actor liable for environmental infractions. The Energy Policy Act of 2005 repealed the Public Utility Holding Company Act of 1935,⁶ which was established to aid individual states with their effort to effectively regulate the energy sector following the Great Depression. Succeeding this repeal, the Federal Energy Regulatory Commission permitted immense private capital investment into the U.S. oil and gas sector, allowing for emerging new exploration methods to flourish, such as horizontal drilling techniques. Horizontal drilling combined with hydraulic fracturing has enabled the oil and gas industry to access natural resources exceeding 27,000 feet beneath the Earth's surface,⁷ highly contrasting the average conventional vertical wellbore design which extends only 6,000 feet below the surface.⁸ Hydraulic fracturing is conducted by propelling millions of gallons of water laced with various toxic chemicals under high pressure, to fracture rock formations that will release natural resources.⁹

Horizontal drilling amalgamated with hydraulic fracturing has aided the U.S. in achieving global dominance in the oil and gas production sector. As of August 2018, the U.S. surpassed the monthly crude oil production of both Russia and Saudi Arabia, and now possesses the distinction as the world's top oil producer for the first time in over two decades.¹⁰ The U.S. was also the global leader in natural gas production during 2017, and has held this favorable advantage over Russia since 2011.¹¹ The United States Energy Information Administration has predicted an even more substantial increase in unconventional oil and gas recovery to be experienced by 2040,¹² ascending from 27 trillion cubic feet (Tcf) in 2015 to over 42 Tcf. A majority, if not all current federal or state energy policies dedicated to transitioning to renewable energy implementation, incorporate natural gas as their future grid baseline for energy distribution.

The Utica and Marcellus Shale Formations, both located in the state of Ohio, contributed to 24 percent of all U.S. natural gas production in 2016, ascending from a mere two percent in 2006.¹³ Ohio and Pennsylvania lead the nation in unconventional gas production, and represent 85 percent of all new growth since 2012. During 2016, approximately one out of four Ohioans

resided within one mile of an active hydraulically fractured well,¹⁴ and currently 3,295,747 individuals live within ½ mile.¹⁵ Currie et al. has clearly demonstrated that infants birthed within one kilometer of an active hydraulic fractured well site will experience a 25 percent increase in the probability of low birth weight, and detrimental consequences arise when infant births occur within three kilometers (1.8 miles).¹⁶ The sampling size associated with this study is significant, over 1.1 million births in Pennsylvania from 2004-2013. Increases in childhood hematologic cancer rates have also been observed in close proximity to hydraulic fracturing activities.¹⁷ Since the oil and gas industry primarily conduct their operations in rural and economically depressed regions, this act of environmental injustice disproportionately affects vulnerable communities, which includes children under the age of 15 in Ohio.¹⁸

Energy Policy Act of 2005

The Energy Policy Act of 2005¹⁹ amended the Safe Drinking Water Act, and specifically exempted hydraulic fracturing wastewater from the Underground Injection Control program.²⁰ Since hydraulic fracturing related hazardous waste is not federally regulated by the Resource Conservation and Recovery Act,²¹ this exemption compromises the already unsafe oversight of hydraulic fracturing wastewater injection controls.ⁱ The Energy Policy Act of 2005 expanded the language of an existing exemption for the oil and gas industry, regarding the Clean Water Act, which allows production sites to not be required submit a National Pollution Discharge Elimination System permit for any stormwater affiliated discharges associated with all processing activities, including wastewater treatment, energy transmission, or any corresponding construction activities.²² The Energy Policy Act of 2005 also initiated a National Environmental Policy Act exclusion eliminating review by the Department of the Interior and the Secretary of Agriculture for oil and gas exploration conducted in National Forest System Lands. This exemption also applies to all surface disturbances of less than five acres, and also to well sites where drilling transpired within the previous five years.²³ Encana Corporation is currently constructing a 64-well “mega pad” in the Permian Basin in western Texas.²⁴ Each individual well has the potential to extend in excess of four miles in opposing directions. Since this well site is approximately 16,000 square yards, these 64 horizontal wells will be exempt

ⁱ Clean Water Act, § 502(6)(B) defines hydraulic fracturing wastewater injection, stormwater runoff, or produced water disposal as not a “pollutant,” unless a State authority determines otherwise. The permanent exemption for stormwater runoff applies to construction, exploration, production, and the roads that are used by the oil and gas industry.

from National Environmental Policy Act review (<24,200 sq. yd.). Widespread well pad drilling techniques were initially employed during 2006 and represented five percent of all new wells constructed. By 2013, that number rose to 58 percent nationally.²⁵

Expanded Limitations as a Result of Current White House Administration

Expansions of advantageous federal environmental exemptions unique to the oil and gas industry have been promoted by our current White House Administration. President Trump's anti-regulatory agenda was initially promulgated by Presidential Executive Order 13771, "Reducing Regulation and Controlling Regulatory Costs," which states that for every new environmental regulation publicly proposed or established, two existing regulations must be eliminated,²⁶ and also directs incremental costs affiliated with the implementation of any future environmental regulation, to be offset by abolishing costs correlated with a minimum of two current regulations.²⁷ This was followed by Presidential Executive Order 13783, "Promoting Energy Independence and Economic Growth," which allows the oil and gas industry to reduce any regulatory burden that restricts their energy production or economic growth,²⁸ and demands a review of all agency action that hinders the development of natural resources, with particular attention to oil and gas.²⁹

A Multitude of Disadvantageous Ecological Consequences

Numerous corporate entities which engage in oil and gas exploration and production in the U.S. have contaminated aquifers, lakes, and streams,³⁰ diminished air quality,³¹ and have augmented the frequency and intensity of anthropogenically induced seismicity.³² A substantial increase in national water volume allocated for oil and gas exploration in the U.S. occurred between 2000-2014, rising from 670 cubic meter (m³) annually to 19,425 m³.³³ There are profuse amounts of poisonous chemical additives utilized in fracturing solutions necessary exploration and production, including carcinogens and endocrine disruptors.³⁴ According to the United States Environmental Protection Agency, chemicals used in the hydraulic fracturing process only comprise a small percentage of the solution, approximately two percent.³⁵ If you consider that each individual hydraulically fractured well requires an average of more than 5 million gallons of liquid for injection in

the U.S., 30 times higher than in the year 2000, two percent is equivalent to over 100,000 gallons of chemicals at the low end of the spectrum, with the ability to generate an astounding 316,000 gallons of toxic chemicals per well, for each fracturing session.³⁶

Historically, seismicity has been perceived as an unpredictable catastrophic event. Currently there is a plethora of litigation transpiring due solely to anthropogenically induced seismicity. In 2011, after the vast rise of unconventional oil and gas exploration, widespread unanticipated seismic activity occurred in Prague, Oklahoma (Moment Magnitude or $M_w=5.6$), Trinidad, Colorado ($M_w=5.3$), Timpson, Texas ($M_w=4.8$), and Guy, Arkansas ($M_w=4.7$).³⁷ In 2016, the United States Geological Survey confirmed that hydraulic fracturing wastewater injection significantly influences earthquake nucleation, and that the volume of injected produced water manipulates the quantity of induced seismic incidences.³⁸ During the time period from 1973–2008, an average of 21 earthquakes equal to or more than 3 M_w were experienced in central and eastern U.S. annually. In 2015 that number rose to over 1,000.³⁹ The Ohio Department of Natural Resources, the sole regulator of hydraulic fracturing in Ohio, has concluded that the primary factor contributing to the abundance of statewide earthquakes is “associated with ancient zones of weakness in Earth’s crust that formed during continental rifting and collision events about a billion years ago.”⁴⁰ This is despite over 109 earthquakes occurring in close proximity to a hydraulic wastewater injection well in Youngstown from January 2011 to February 2012, which were situated in a geographic location where prior seismicity has never existed,⁴¹ and where an astonishing 1,045 earthquakes materialized from January 2011 to November 2014.⁴² This abnormal seismicity was confirmed by geophysicists to be a direct result of sending abundant amounts of hydraulic fracturing wastewater into class II injection wells. Hydraulic fracturing wastewater injection can also have far-reaching seismic effects. Recorded pressure increases from cumulative wastewater injection from as far as 90km away, has been recently confirmed by the Kansas Geological Survey to induce seismicity, as a direct result of far-field pressure diffusion.⁴³

All facets of oil and gas operations and associated storage facilities are also exempt from the Risk Management Plans of the Clean Air Act.⁴⁴ Shockingly, hazardous air pollutants released from oil and gas wells and affiliated equipment, including pipeline compressors and pump stations, cannot be aggregated together to determine a major source of toxic emissions.⁴⁵ Omara et al. has revealed that methane (CH_4) emissions can be significantly underestimated by regulatory agencies, as discovered in Pennsylvania, were five unconventional natural gas facilities emitted 10 to 40 times more CH_4 than officially recorded in their state government inventory.⁴⁶

Methods

The results in this article were obtained by performing a qualitative national historical assessment, by conducting a longitudinal policy-oriented research that focused on numerous state and federal codes, statutes, and regulations protecting communities against repercussions transpiring from oil and gas related activities. This included an exhaustive examination of the Clean Water Act, Safe Drinking Water Act, Clean Air Act, Resources Conservation and Recovery Act, Toxic Substances Control Act, and the Solid Waste Disposal Act. Applying an analytical jurisprudence approach, utilizing qualitative, longitudinal, and explanatory indagation, and evaluating relevant national and state case law and judicial dictum, helped orchestrate viable bipartisan options for federal, state, and local policy makers to utilize as an empirical foundation for implementing ethical environmental policy in the state of Ohio. Case law from the states of Oklahoma, Texas, Pennsylvania, New York, West Virginia, and Ohio were scrutinized to compare and contrast complications associated with state preemption superseding local authority, and with obtaining injunctive relief due to induced seismicity. Federal case law review discovered that federal courts will most likely refer to the abstention doctrine established in *Burford v. Sun Oil Co.*,⁴⁷ and declare that they should not exercise their federal jurisdiction in regards to hydraulic fracturing.⁴⁸ These results were credibly validated by critically analyzing hundreds of peer-reviewed studies that were performed by members of the United States Geological Survey, British Geological Survey, United States Environmental Protection Agency, Oklahoma Geological Survey, Kansas Geological Survey, including longitudinal satellite data produced by the National Aeronautic Space Administration (OCO-2), Japan Aerospace Exploration Agency (GOSAT), and the European Space Administration (ENVISAT). This study also reviewed publications from additional national and international scientific organizations affiliated with government, industry, and academia.

Ohio State Preemption & Rapid Decline of Jura Majestatis for Municipalities

In *State ex rel. Morrison v. Beck Energy Corp.*,⁴⁹ Beck Energy proclaimed that the city of Munroe Falls local zoning ordinances prohibiting oil and gas exploration conflicted with Ohio Revised Code (O.R.C.) Chapter 1509.02,⁵⁰ which states “nothing in this section affects the authority granted to the director of transportation and local authorities in section 723.01⁵¹ or 4513.34⁵² of the Revised Code, provided that the authority granted under

those sections shall not be exercised in a manner that discriminates against, unfairly impedes, or obstructs oil and gas activities and operations regulated under this chapter.”

During 2015, the lower trial court disagreed with Beck Energy and granted the city of Munroe Falls request for a permanent injunction, prohibiting Beck Energy from conducting any drilling operations, and required them to abide by established local zoning ordinances. The Ohio court of appeals decided to reverse this decision, holding that O.R.C. Chapter 1509.02 prohibited the city of Munroe Falls from enforcing their local land use zoning ordinances to protect their community.⁵³ The Ohio court of appeals rejected the city of Munroe Falls argument that local municipalities could enforce powers granted by Ohio Constitution Article XVIII § 3, and freely exercise their sovereign rights.⁵⁴ The city of Munroe Falls responded by appealing to the Ohio supreme court, where there was a 4-3 decision in favor of Beck Energy, striking down the validity of Ohio Constitution Article XVIII § 3, by distorting its relationship to O.R.C. Chapter 1509.02. There has been prior Ohio supreme court precedent ascertained by Justice Skeel’s opinion in *Willott v. Beachwood*, decreeing that “all zoning laws and regulations must find their justification in some aspect of the police power asserted for the public welfare...the line which in this field separates the legitimate from the illegitimate assumption of power is not capable of precise delineation,”⁵⁵ and also in *Hudson v. Albrecht, Inc.*, “the purpose of comprehensive local zoning is the exercise of local police power to promote the health, safety, and general welfare of the public.”⁵⁶ Both of these prior Ohio supreme court decisions affirmed that significant presumption exists in favor of the validity of local land use ordinances when pertaining to upholding the environmental welfare of a community. Yet the Ohio supreme court has awarded damages to communities as a result of a public nuisance claim, “which produced injurious and destructive vapors...causing an annoyance to property owners in the neighborhood.”⁵⁷

There was a key dissenting opinion in *State ex rel. Morrison v. Beck Energy Corp.* delivered by Justice Judith Ann Lanzinger, the only person ever elected to all four levels of Ohio’s judiciary (Supreme Court, 6th District Court of Appeals, Lucas County Court of Common Pleas, Toledo Municipal Court).⁵⁸ She proclaimed that “after an examination of O.R.C. Chapter 1509, and regulations governing the drilling of oil and gas wells, reveals that there is no explicit reference to local zoning. In order for such a conflict [between state laws and local ordinances] to arise, the state statute must positively permit what the ordinance prohibits, or vice versa, regardless of the extent of state regulation concerning the same object...municipalities are more familiar with local conditions and are in the best position to determine which zoning

regulations will best promote the health, safety, and general welfare of their communities.”⁵⁹ Justice Lanzinger went on to state that “ordinances reflect traditional zoning concerns, while the state statutes control technical aspects of the drilling of an oil and gas well. Local zoning exists to address such concerns as traffic control, traffic volume, property values, enhancement of municipal revenue, costs of municipal improvement, land use, nuisance abatement, and the general welfare and development of the community as a whole.”⁶⁰

A similar voter approved local land zoning ordinanceⁱ enacted by the city of Broadview Heights, Ohio was also contested and ultimately defeated by industry in *Bass Energy, Inc. v. City of Broadview Heights*,⁶¹ incapacitating another communities rights provided by Ohio Constitution Article XVIII § 3. The plaintiff’s motion for summary judgment was granted by the court, once again due to the judicial interpretation of state preemption initiated by O.R.C. Chapter 1509.02. Surprisingly, 35 percent of Ohio residents living in townships or counties do not possess any legal access to propose local initiatives or referendum, as compared to the other 65 percent of the Ohio population who reside in cities.⁶² There was a ballot measure introduced and certified for the November 2018 election, which was intended to resolve this oppressive and highly undemocratic practice. The “Ohio Right to Local Initiative and Referendum” unfortunately did not receive the 306,591 signatures necessary to be listed on the final ballot. This proposed amendment to § 23 of Article I of the Ohio Constitution simply stated that “people have the right of initiative and referendum, and initiative and referendum powers are hereby reserved to the people of each county and township, with such powers to be exercised in the manner now or hereafter provided by law.”⁶³

The Youngstown, Ohio “Community Bill of Rights” charter amendment was a valiant attempt to proscribe oil and gas extraction, infrastructure, storage, and the transport or injection of waste from exploration, production, or transmission. Beginning in the May 2013 general election until the November 2018 election, the Youngstown “Community Bill of Rights” achieved status on the official ballot. Unfortunately, this proposed amendment was defeated eight consecutive times.⁶⁴ This collaborative effort was led by Frackfree Mahoning Valley, the Community Environmental Legal Defense

ⁱ Charter Amendment Article XV, § i(2), “It shall be unlawful for any person or corporation, or any director, officer, owner, or manager of a corporation to engage in the creation of fossil fuel, nuclear or other non-sustainable energy production and delivery infrastructures, such as pipelines, processing facilities, compressors, or storage and transportation facilities of any sort that would violate the right to a sustainable energy future for the City of Broadview Heights.”
<https://www.broadview-heights.org/DocumentCenter/View/4580/City-Charter>.

Fund, and Dr. Raymond Beiersdorfer, who recently passed away on October 11, 2018.⁶⁵ Dr. Beiersdorfer, a distinguished geologist from Youngstown State University,⁶⁶ was an integral part of this community-based exertion.ⁱ

Prudent Recommendations to Mitigate Deleterious Consequences

There are potential opportunities for establishing substantial federal reform, if first initiated by the U.S. Congress. Federal legislators can enact safe regulations for the oil and gas industry under powers granted by U.S. Const. art. I, § 8, cl. 3.⁶⁷ Until 1941, clearly articulated in *Schechter Poultry Corp v. United States*,⁶⁸ constitutionally, the power of the U.S. Congress to regulate interstate commerce is "ultimately a judicial function, and could only be determined by the US Supreme Court. However, in *United States v. Darby*,⁶⁹ the U.S. Congress was permitted the ability to control interstate commerce under U.S. Const. article I, section 8, clause 3, which was reaffirmed in *Wickard v. Filburn*,⁷⁰ and in *United States v. Lopez*,⁷¹ defining the substantial relation to commerce as a primary role of the US Congress, which is then enabled by the guidance of the U.S. Supreme Court.

During the 116th Congressional session, H. Con. Res. 436, 2019-2020 (Fracking Disclosure and Safety Act)⁷² was introduced by Congressman Darren Soto (FL-09), which attempts to close loopholes in the Safe Drinking Water Act,⁷³ Solid Waste Disposal Act,⁷⁴ and the Clean Air Act.⁷⁵ H. Con. Res. 436, 2019-2020 fails to address additional existing statutory loopholes initiated by the Energy Policy Act of 2005, including but not limited to, the Clean Water Act,⁷⁶ and a National Environmental Policy Act exclusion.⁷⁷ This resolution also does not resolve complications concomitant with the Toxic Substances Control Act,⁷⁸ which provides an exemption for industry to not reveal the entire composition of a chemical mixture applied during oil and gas exploration or production. It is entirely at the discretion of the United States Environmental Protection Agency (U.S. EPA) to issue a confidential business information release. If the U.S. EPA determines that disadvantageous effects sustained by an individual or community are substantial, then it is their responsibility to obtain this information, but it is not a legal requirement for them to act, due to the ambiguity of the language prescribed in 83 Federal Register 11748⁷⁹ pertaining to the 2016 Toxic Substances Control Act

ⁱ I was fortunate to have had the pleasure of interacting with Dr. Ray on a couple occasions, and I firmly believe that he was an inspiration to everyone he encountered, and a compassionate human being who will be dearly missed.

amendments.⁸⁰ H. Con. Res. 436, 2019-2020 also does not mention the necessity for regulating the fundamental drivers initiating anthropogenically induced seismicity from hydraulic fracturing, which includes injection rates, cumulative produced water volume, and well depth in proximity to the crystalline basement.⁸¹

One potential bipartisan option for Ohio to protect communities, primarily children residing in close proximity to active hydraulically fractured wells, is to mandate the implementation of quantitative methods⁸² for fugitive CH₄ and volatile organic compound (VOC) detection, and prohibit the use of qualitative⁸³ inspection procedures, when an active hydraulically fractured well site is within 3km of a human population. This requirement would reduce fugitive CH₄ and VOC emissions from oil and gas exploration and production sites substantially, and provide monetary incentives for industry to capture CH₄, while simultaneously protecting the health of nearby communities. A quantitative infrared camera analysis conducted in Boulder County, Colorado discovered fugitive gas leaks at 66 percent of the 45 small emitting oil and gas facilities inspected, contradicting the Audio, Visual, and Olfactor (AVO) qualitative inspections performed, which only recognized leaks at 2.5 percent.⁸⁴ Immediately following the quantitative inspection, 99 percent of the leaks were fixed, and an astounding 50 percent within a five day period of time. These results indicate that monthly AVO inspections are not an effective method for detecting fugitive CH₄ or VOC emissions, even from small emitting oil and gas production or exploration sites. Recently proposed amendments formulated by the U.S. EPA to the new source performance standards, to regulate fugitive CH₄ emissions monitoring frequency, do not possess the ability to sufficiently safeguard human populations.⁸⁵ According to U.S. EPA guidance, “Biennial monitoring (once every other year) would be required for well sites with average combined oil and natural gas production for the wells at the site less than 15 [barrel of oil equivalent] per day averaged over the first 30 days of production (low production well sites).”⁸⁶

Optical gas imaging for fugitive CH₄ and VOC detection is achieved from a far distance, ensuring the health and safety of the operator, and can be utilized in natural gas processing plants, oil refineries, power generation plants, and also offshore platforms. Oil and gas extraction workers experience a high rate of traumatic work-related fatalities. During the process of manual tank gauging, along with sampling activities associated with storage tanks, workers can be exposed to excessive amounts of toxic hydrocarbon gases and vapors which can initiate immediate death.⁸⁷ Olfactory fatigue is common trait exhibited by humans. Losing sensitivity to specific odors as a result of extensive exposure is a naturally occurring sensory adaptation.⁸⁸

Anthropogenically induced seismicity in Ohio can be reduced by establishing net fluid budgets for hydraulic fracturing wastewater injection, and by restricting all well depths and wastewater injection wells from encroaching the crystalline basement (which consists of metamorphic or igneous rocks from an earlier deformation beneath the sedimentary cover).⁸⁹ Wastewater injection into nonproducing geologic zones, primarily regions possessing low-permeability, must also not be permitted. The Ohio Department of Natural Resources could also develop a state inventory of geologic boundaries that address every region where unconventional oil and gas exploration is plausible, and designate specific tectonic subprovinces in each physiographic province, to properly distinguish where it is safe tectonically to conduct hydraulic fracturing.

Conclusion

Until the U.S. Congress can develop and pass legislation to culminate this emerging environmental and legal dilemma, the Ohio state legislature must implement safe and practical measures for all stages of oil and gas exploration and production, to safeguard nearby communities and prevent potential ecological degradation. During 2000 there were 49,000 active hydraulically fractured oil and gas wells operating nationally, by 2015 there were over 600,000.⁹⁰ According to the first comprehensive nationwide study providing a cost benefit analysis regarding hydraulic fracturing, economic and quality of life benefits outweigh the adverse health effects, and provide an additional \$1,550 per year, per household, for communities residing in close proximity to operations.⁹¹ Unconventional oil and gas extraction generated over \$22,340,000,000 for the Ohio state economy in 2015.⁹² Despite this favorable increase in state revenue and personal income, at what point do economists and state regulators abandon the standard cost benefit analysis, and equally take into consideration the projected consequences bestowed upon future generations? Economists should consider any impending future threat to society as an equal burden to humanity, and not diminish the cost by applying an intergenerational discounted rate in their equations.⁹³

The United Nations Intergovernmental Panel on Climate Change has alerted the world of the possibility of irreversible negative environmental impacts occurring in the imminent future, if fossil fuel emissions are not reduced significantly.⁹⁴ To avoid a 2° C increase in global warming relative to pre-industrial time, greenhouse gases must become stable at 450 parts per million (ppm) or less. The 5th Assessment Report concluded that “Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped. The risks

of abrupt or irreversible changes increase as the magnitude of the warming increases.⁹⁵ At the present time the Earth's atmosphere is 408 ppm (CO₂), and has been averaging a 2.8 ppm increase for the past decade,⁹⁶ leaving us approximately 15 years to find a solution to mitigate potential unalterable ecological consequences. Since the United States Energy Information Administration predicts a considerable increase in unconventional natural gas production to occur in the next two decades, and Ohio is one of the top producers nationally, shouldn't adequate protections be enacted to protect the next generation Ohioans who will ultimately have burden to fix this conundrum? Or should this successful business venture to obtain energy independence continue to proliferate, since catastrophic environmental complications may be inevitable, irrespective of existing practices?

Notes

¹ United States Energy Information Administration, "Today in Energy," April 2017, <https://www.eia.gov/todayinenergy/detail.php?id=30652.0>.

² Hanna Jacobs Wiseman, "Untested Waters: The Rise of Hydraulic Fracturing in Oil and Gas Production and the Need to Revisit Regulation," *Fordham Environmental Law Review*, no. 20, (2019), 115.

³ Lindsey Konkel, "In the Neighborhood of 18 Million: Estimating How Many People Live Near Oil and Gas Wells," *Environmental Health Perspectives*, no. 12, (2017), 124003-1.

⁴ Eliza Czolowski, Renee L. Santoro, Tanja Srebotnjak, and Seth B. Shonkoff, "Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review," *Environmental Health Perspectives* 125, no. 8 (2017), 086004-1. doi:10.1289/ehp1535.

⁵ Federal Energy Regulatory Commission, "Energy Policy Act of 2005 Fact Sheet," August 2006, <https://www.ferc.gov/legal/fed-sta/epact-fact-sheet.pdf>.

⁶ Public Utility Holding Company Act, 15 U.S.C. §§ 79-79z-6. Repealed. Pub. L. 109-58, Title XII, § 1263, Aug. 8, 2005, 119 Stat. 974.

⁷ World Oil, "Halliburton Eclipse Resources Complete in Longest Lateral Well in the U.S.," *World Oil*, March 31, 2016, <http://www.worldoil.com/news/2016/5/31/halliburton-eclipse-resources-complete-longest-lateral-well-in-us>.

⁸ United States Energy Information Administration, "U.S. Average Depth of Crude Oil Development Wells Drilled," (Last Updated March 8, 2019), https://www.eia.gov/dnav/ng/hist/e_ertwo_xwdd_nus_fwa.htm.

⁹ United States Government Accountability Office, "Unconventional Oil and Gas Development: Key Environmental and Public Health Requirements," Report to Congressional Requestors, October 9, 2012, GAO-12-874, 1-79, <https://www.gao.gov/products/GAO-12-874>.

¹⁰ United States Energy Information Administration, "The United States is Now the Largest Global Crude Oil Producer." September 12, 2018,

<https://www.eia.gov/todayinenergy/detail.php?id=37053>.

- ¹¹ British Petroleum, “BP Statistical Review of World Energy,” 67th edition, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>.
- ¹² United States Energy Information Administration, “Annual Energy Outlook 2016,” September 15, 2016, https://www.eia.gov/outlooks/archive/aeo16/mt_naturalgas.php#natgasprod_exp.
- ¹³ United States Energy Information Administration, “Ohio and Pennsylvania Increased Natural Gas Production More than Other States in 2016,” April 25, 2017, <https://www.eia.gov/todayinenergy/detail.php?id=30932>.
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- ¹⁵ Oil & Gas Threat Map, “Ohio,” 2019 Oil & Gas Threat Map, <http://oilandgasthreatmap.com/threat-map/>.
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- ¹⁹ Energy Policy Act of 2005, 42 U.S.C. § 15801, P.L. 109-58.
- ²⁰ Resource Conservation and Recovery Act, 42 U.S.C. §§ 6921-6939g, Subtitle C, §§ 3001-3023; ———, 42 U.S.C. § 6921, “Identification and listing of hazardous waste.”
- ²¹ Resource Conservation and Recovery Act, 42 U.S.C. §§ 6921-6939g, Subtitle C, §§ 3001-3023
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