Blue Ridge Environmental Defense League

www.BREDL.org PO Box 88 Glendale Springs, North Carolina 28629 BREDL@skybest.com (336) 982-2691

December 4, 2015

Michael Skiffington
Regulatory Coordinator
Department of Mines, Minerals and Energy
1100 Bank Street, 8th Floor
Richmond, VA 23219-3402

Dear Mr. Skiffington:

On behalf of the members and directors of the Blue Ridge Environmental Defense League ("BREDL"), I offer the following comments on the proposed changes to 4-VAC-25-150.

It is our understanding that the purpose of this regulatory action is to ensure the gas and oil regulation reflects current industry best practices and to expand disclosure of ingredients used in gas and oil well stimulation and completion on permitted gas and oil operations in the Commonwealth. It is also stated that the existing regulation will be reviewed to determine if current requirements are sufficient to properly regulate drilling in different geographical areas of the Commonwealth.

BREDL asserts that the current proposed regulations and amendments are pitifully inadequate to protect against the myriad of well-documented harmful effects occurring in other parts of the country due to hydraulic fracturing. Given the track record of the drilling industry at large (which must be taken into consideration given its expanse and influence on current practices), the continuation and expansion of fracking in the Commonwealth of Virginia would result in the degradation of human health, community, and environment. In particular, the unique geological characteristics of the Taylorsville Basin region under consideration for new

gas exploration combined with the increasing risk of flooding, sea level rise, and other interweaving factors stemming from the continued greenhouse gas emissions, presents a unique threat and dangers to those living in the Virginia Coastal Plains. We resolve that this threat must be addressed comprehensively and that it cannot be adequately mitigated through the existing draft regulations.

Objections to the Fracking Process Overall

The most immediate issues that make fracking such a dangerous endeavor to communities are 1) the large volume of fresh water that is wasted in the fracking process, 2) the list of chemicals still unknown to the public that is mixed with fresh water to produce fracking fluid, and 3) the poor industry standards of practice which result in spillage, leaks, and outright dumping of chemically-laced toxic wastewater onto the immediate environment. The amendments to the regulations attempt to address the issue of chemical disclosure but do not explicitly provide for full disclosure of chemicals, solvents, nor their exact quantities for mixture at each wellhead. This information is imperative to knowing what is contaminating a community's rivers, streams, wells, and groundwater in the common event of spills and leaks into the environment. Furthermore, the suggestion by industry representatives to use the Fracfocus website for public disclosure is akin to self-regulation, and without being subject to federal and state public information law and providing full disclosure of ingredients and site-specific quantities, this attempt at regulation has no teeth.

The first stage of the fracking process involves extraction of up to 7.2 million gallons of fresh water per wellhead, often from nearby sources of groundwater and surfacewater. The second stage involves mixing this fresh water with sand and a variety of chemicals prior to well

injection. According to a recent study released by the Environmental Protection Agency, hydraulic fracturing fluids were generally found to contain 88% by mass water, 10% quartz (used as a sand), and 1% additive ingredients.[1] The EPA surveyed 428 fracking well operators for their study, and found that the median number of additive ingredients per well was 14, with 65% of analyzed wells using hydrochloric acid, methanol, and hydrotreated light petroleum. Many of the wells also include added ingredients that are said to be proprietary business information ("trade secrets"). In fact, 11 % of the ingredient records for the operators surveyed by the EPA were said to be confidential. A report done in 2011 lists 750 chemicals and compounds used by 14 oil and gas service companies from 2005 to 2009.[2] The list includes 29 chemicals that are either known or possible carcinogens or are regulated by the federal government, such as lead and benzene.[3]

In the third stage of the fracking process, the well is injected with the fracturing fluid. The oil or gas escapes through the well and is collected at the surface. As the oil and gas travels back up the well, so too does the fracking fluid (also known as flowback). Current means of disposal for this chemically-laced wastewater includes underground injection, spraying onto roads and other ground surfaces, treatment followed by disposal to surface water bodies, or recycling (with or without treatment) to be used in future fracking operations.

The Federal Energy Policy Act of 2005 effectively stripped the Environmental Protection Agency of its authority to regulate fracking through a provision that has come to be known as the "Halliburton Loophole." [4] While previously the EPA regulated the underground injection fluids

[1] http://www2.epa.gov/sites/production/files/201503/documents/fact_sheet_analysis_of_hydraulic_fracturing_fluid_data_from_the_fracfocu.pdf
[2] http://www.propublica.org/article/fracking-chemicals-cited-in-congressional-report-stay-underground
[3] http://democrats.energycommerce.house.gov/index.php?q=news/committee-democrats-release-new-report-detailing-hydraulic-fracturing-products
[4] http://cleanwater.org/page/fracking-laws-and-loopholes

used in hydraulic fracturing under the Safe Drinking Water Act, the loophole created an exemption for gas drilling and extraction from requirements in the underground injection control (UIC) program of the Safe Drinking Water Act. Other exemptions are also present in the Clean Water Act and Clean Air Act.[5]

Several gas-producing states have regulations governing some aspects of fracking. However, they rarely require companies to divulge detailed information on types and quantities of chemicals.[6] In West Virginia, disposal of liquid waste can be injected back underground, recycled and circulated, or disposed at treatment facilities. There are no additional testing regulations with respect to groundwater and surface water, solid waste, or pre-drilling and baseline tests apart from the federal standard, which is tenuous.[7] In Virginia, an advisory panel recommended that energy companies disclose the chemical ingredients used in fracking, including any "trade secrets."[8] The proposal has been submitted to Governor Terry McAuliffe's administration for review. A decision has yet to be reached.

The greenhouse gas (GHG) produced in fracking is not conventional CO_2, but rather, CH_4, methane.[9] According to the EPA, while methane has a shorter atmospheric lifetime than carbon dioxide, it is about 25 times more efficient at trapping radiation over a 100-year period.[10] This means that pound for pound, methane contributes about 25 times more to climate change than carbon dioxide. Thus, while natural gas may help reduce carbon dioxide emissions, it intensifies and substantially contributes to climate change.

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[5] http://cleanwater.org/page/fracking-laws-and-loopholes
[6] https://www.earthworksaction.org/about
[7] http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Capabilities/North-America-Capabilities/USA/Oil-and-Gasoline-Testing/Oil-and-Gas-Production-and-Midstream-Support/Fracking-Regulations-by-State
[8] http://www.washingtontimes.com/news/2015/jun/2/va-panel-recommends-new-fracking-regulations/?page=all
[9] O'Sullivan, Francis, and Sergey Paltsev. "Shale Gas Production: Potential versus Actual Greenhouse Gas Emissions." *Environmental Research Letters*, 2012. doi:10.1088/1748-9326/7/4/044030.
[10] O'Sullivan, Francis, and Sergey Paltsev. "Shale Gas Production: Potential versus Actual Greenhouse Gas Emissions." *Environmental Research Letters*, 2012. doi:10.1088/1748-9326/7/4/044030.

A fracked well begins releasing gas during the flowback period, during which some of the initially injected fluid returns to the surface over the course of a week or more. The amount of gas and how that gas is handled has been central to the debate about the greenhouse gas intensity of shale resource development. Studies have shown that anywhere from 3.9% to 7.9% of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the lifetime of a well.[11] According to Howarth et al., "The footprint for shale gas is greater than that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years. Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon."

Understanding the impacts of fracking on climate change requires knowledge of the duration of the flowback stage, and the rate of gas production during that period.[12] The EPA assumes that the flowback period lasts between 3 and 10 days. A 2012 study done by O'Sullivan and Paltsev of MIT estimates the level of fugitive GHG emission resulting the fracking of about 4000 horizontally drilled shale gas wells in the US. The study estimates that about 216 MG of methane are released per well during the flowback period. There are currently over 1 million active gas wells in the United States.[13] Further, the United States accounts for about 20 percent of global GHG emissions. Continuing to pursue fracking would release millions, perhaps even billions, of additional gallons of methane into the atmosphere. Methane's extreme potency for trapping heat would wreak havoc on the atmosphere, contributing to global warming and increasing the US's GHG emissions. In fact, according to the same study by O'Sullivan and

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[11] Howarth, Robert, Renee Santoro, and Anthony Ingraffea. "Methane and the Greenhouse-gas Footprint of Natural Gas from Shale Formations." *Climatic Change*, 2011, 679-90.
[12] O'Sullivan, Francis, and Sergey Paltsev. "Shale Gas Production: Potential versus Actual Greenhouse Gas Emissions." *Environmental Research Letters*, 2012. doi:10.1088/1748-9326/7/4/044030.
[13] Kelso, Matt. "Over 1.1 Million Active Oil & Gas Wells in the US." FracTracker Alliance. March 4, 2014. Accessed July 9, 2015.

Paltsev, the fracking contributed to about three percent of the nation's total GHG inventory in 2010.

Nationwide, the growth of fracking has been phenomenal, increasing by 259% in just four years to over ten trillion cubic feet of natural gas per year.[14] Altogether, over 29 trillion cubic feet of gas is extracted annually from all sources in the US, including coal beds, oil wells and traditional gas wells. Once the gas has been extracted, it is transported in trucks, compressed and delivered by pipelines. Each stage in this process creates pollution.

The Potomac Aquifer and Land Subsidence

The issue of land subsidence due to water withdrawal from underground aquifers is of particular significance to the Tidewater region, including the lands under consideration for new fracking in the Taylorsville Basin. Land subsidence consists of an ongoing settling or abrupt dropping of the Earth's surface due to underground movement of earth materials. According to the U.S. Geological Survey: "More than 80 percent of the identified subsidence in the Nation is a consequence of our exploitation of underground water, and the increasing development of land and water resources threatens to exacerbate existing land-subsidence problems and initiate new ones. "[15]

The fracking process, as explained above, uses a tremendous amount of water which is then rendered unfit for other utilization. Considering the amount of water that fracking requires, and the fact that this water would most likely be pumped from the Potomac Aquifer underneath which the Taylorsville Basin lies, would mean increased risk for an area already prone to land subsidence. The Tidewater area is under significant threat of increased sea level rise due to

[14] US Energy Information Administration's 2012 Annual Report available at www.eia.gov
[15] http://water.usgs.gov/ogw/subsidence.html

melting glaciers and previous land subsidence from groundwater withdrawal. A 2013 report by the US Geological Survey states that "When groundwater is pumped from an aquifer system, pressure decreases. The pressure change is reflected by water levels in wells, with water levels decreasing as aquifer-system pressure decreases. This is happening over most of the southern Chesapeake Bay region, with the greatest water-level decreases seen near the pumping centers of Franklin and West Point, Virginia. As water levels decrease, the aquifer system compacts, causing the land surface above to subside. Water levels have decreased over the entire Virginia Coastal Plain in the Potomac aquifer, which is the deepest and thickest aquifer in the southern Chesapeake Bay region and supplies about 75 percent of groundwater withdrawn from the Virginia Coastal Plain aquifer system."[16]

BREDL shares the concerns that have been expressed by residents of the Middle Peninsula and Northern Neck regarding excessive water level decline in aquifers. But the concerns do not end with land subsidence. When Mathews County passed a resolution in March asking that the state restrict fracking operations from taking place in and near critical aquifers, many residents and local government officials expressed concern that accelerated pumping of underground aquifers could result in decreased water pressure and an increased flow of salt water from the Chesapeake Bay impact crater into fresh water aquifers. There is great concern that there will come a time in the near future when no more additional ground withdrawals can be permitted. The Service Authority, which has jurisdiction over the water/sewer system, the landfill regulators and the stormwater management plans have all demonstrated an effort to be good stewards with regards to the Chesapeake Bay Watershed. They are concerned that DMME is not displaying the same regard for their only source of drinking water. BREDL shares their

[16] Eggleston, Jack, and Pope, Jason, 2013, *Land subsidence and relative sea-level rise in the southern Chesapeake Bay region: U.S. Geological Survey Circular 1392*, 30 p., http://dx.doi.org/10.3133/cir1392

concerns and insists that communities who stand to be impacted by the harmful effects of fracking be allowed to prohibit it in their communities if they deem necessary.

Though identifying, publicizing and addressing the myriad of health concerns regarding chemicals used in fracking is of critical importance, it cannot and will not address the exponential damage that would be done by furthering the problem of land subsidence by withdrawing vast amounts of water to use for fracking.

Flooding/Sea Level Rise Considerations

Because the areas currently under consideration for fracking are also areas prone to flooding, there are special considerations for the potential damage that fracking would cause in the coastal region of Virginia.

Flooding in areas where fracking is taking place could be devastating to the groundwater in the surrounding area and consequently the Chesapeake Bay. According to the Center for Coastal Resources Management: "Effectively managing flooding requires that flood risk be a consideration at all levels of planning. The challenge for appropriate flood management planning is to reduce risks to people, property and ecosystems associated with existing development while managing or preventing new development in high risk areas."

The risk of flooding is of even greater concern due to the prevalence of extreme weather and the likelihood that flooding risks will increase exponentially due to the effects of climate change. Recently it was noted that: "Hampton Roads is considered a hot spot for sea level rise, and the second most-vulnerable region in the country to rising seas, behind New Orleans. The

rate of rise here is more severe in part because of land subsidence caused by glacial rebound and the loss of groundwater."[17]

"Every year, weather-related disasters injure or kill hundreds of Americans and cause billions of dollars in damage. Many of the risks posed by extreme weather will likely increase in a warming world. Scientists have already noted increases in extreme precipitation and heat waves as global warming raises temperatures and exacerbates weather extremes."[18]

BREDL asserts that the wise management of our water resources should be of utmost consideration. The cascading and interweaving effects of increased groundwater pumping leading to increased land subsidence, increased greenhouse gas emissions leading to increased sea level rise, and the compounding dangers that increased flooding and erosion would have on the very drilling operations in question in this region of the Commonwealth, make the question of fracking in Virginia's Coastal Plain a scenario fraught with risk.

Existing Fracking in Virginia

While the above issues deal most directly with the unique geological conditions of the Taylorsville Basin and Virginia Coastal Plains, the broader pervasive issues of water contamination from unknown chemicals and poor industry management and regulation hold true for any region under threat from fracking. Recent reports from citizens in far Southwest Virginia, where fracking is already happening, call into question the adequacy and efficacy of current drilling regulations.

Some of these reports from residents of Buchanan and Dickenson Counties already include incidents of contaminated drinking water. Citizens reported that "Water was

[17] http://www.dailypress.com/news/science/dp-nws-evg-extreme-weather-map-20151128-story.html
[18] http://environmentamerica.org/page/ame/hitting-close-home-global-warming-fueling-extreme-weather-across-us

murky and had oily films, black sediments, methane, and diesel odors. Individuals experienced rashes from showering. The Buchanan Citizens Action Group reported over 100 documented complaints of adverse effects of hydraulic fracturing and the Dickenson County Citizens Committee reported ground water quality deteriorated throughout the county as a result of the large number of hydraulic fracturing events."[19]

It is of great concern that not all of the negative effects from fracking activity have been accurately documented. Sheila McClanahan from the Buchanan Citizens Action Group says that though citizens have reported more than 100 documented complaints to the state, many have "allegedly been intentionally misclassified and filed as impacts of long-wall coal mining." Additional reports from Dickenson County Citizens Committee claim that "ground water quality has deteriorated throughout the county as a result of the large number of coalbed methane well hydraulic fracturing events. Only 40% of the county is served by public water."[20]

The negative impact of fracking on the environment and the health of citizens is obvious, but there are other issues to consider as well. "Getting every surface owner above a geologic unit to agree to sharing revenue (or even to permit drilling) can be difficult. Under Virginia's Gas and Oil Act of 1990, landowners can be forced to participate in a "pool" and lease their gas rights once a company has leased 25% of the acreage within a geographic area. The Virginia Gas and Oil Board designates a *drilling unit* of land, and determines the most efficient spacing between wells within that unit. The board can require landowners to participate in a pool, but cannot require the surface owner to allow a well pad to be constructed for drilling from the private surface. Each parcel of land in coal/gas country may have a complicated set of surface and

[19] http://switchboard.nrdc.org/blogs/amall/incidents_where_hydraulic_frac.html
[20] http://artvoice.com/issues/v9n25/fracking

subsurface ownership ("split estate") rights, and those determine how much the surface may be disturbed in order to extract underground resources."[21]

There have been many different issues, including complicated lawsuits involving split estates and forced pooling, based on fracking activity in Southwest Virginia.[22] With those as the guide, it is obvious that no more fracking should take place in Virginia and the regulations should simply state that fracking is no longer allowed.

Protecting the Health and Safety of our Children

We must, above all else, protect the health and well-being of our children. The EPA has established guidelines in its Final Rule regarding Executive Order 13045: "Protection of Children from Environmental Health Risks and Safety Risks" concluding that: "The agency has evaluated the environmental health and welfare effects of climate change on children. CO2 is a potent GHG that contributes to climate change and is emitted in significant quantities by fossil fuel-fired power plants. The EPA believes that the CO2 emission reductions resulting from implementation of these final guidelines, as well as substantial ozone and PM2.5 emission reductions as a cobenefit, will further improve children's health."[23]

President Clinton issued Executive Order 13045 in April 1997, establishing the President's Task Force on Environmental Health Risks and Safety Risks to Children.[24] In 2010, the Obama Administration charged the Task Force with:

- Identifying priority issues of environmental health and safety risks to children that are best addressed through interagency efforts

[21] http://www.virginiaplaces.org/boundaries/splitestate.html
[22] http://www.heraldcourier.com/news/ag-new-law-frees-up-gas-royalties-for-southwest-virginia/article_17475ab6-d89a-11e4-a6eb-0f1b665d78a4.html
[23] Pg. 1435: http://www2.epa.gov/sites/production/files/2015-08/documents/cpp-final-rule.pdf
[24] http://www2.epa.gov/children/presidents-task-force-environmental-health-and-safety-risks-children#taskforcemembers

- Developing strategies to protect children's environmental health and safety
- Recommending and implementing interagency actions
- Communicating information to federal, state, and local decision makers for use in protecting children from environmental health and safety risks

The Secretary of the Department of Health and Human Services and the Administrator of the Environmental Protection Agency co-chair the Task Force. A senior staff steering committee coordinates interagency cooperation on Task Force priority areas. To date, these include:

- Climate change
- Asthma disparities
- Healthy homes
- Chemical exposures

The Task Force is comprised of representatives of 17 federal departments and White House offices:

- Consumer Product Safety Commission
- Department of Health and Human Services
- Environmental Protection Agency
- Department of Education
- Department of Labor
- Department of Justice
- Department of Energy
- Department of Housing and Urban Development
- Department of Agriculture
- Department of Transportation
- Department of Homeland Security
- Office of Management and Budget
- Council on Environmental Quality
- Assistant to the President for Economic Policy
- Assistant to the President on Domestic Policy
- Office of Science and Technology Policy
- Council of Economic Advisors

Each representative from this task force must be consulted and those consultations must include recommendations that must be considered before any decision is made regarding these regulations in order to accurately identify and address potential harm to children.

For example, developmental issues often occur when children or embryos are exposed to toxic industrial chemicals. According to a recent study:

> "Because of the extraordinary complexity of human brain development, windows of unique susceptibility to toxic interference arise that have no counterpart in the mature brain, or in any other organ. If a developmental process in the brain is halted or inhibited, there is little potential for later repair, and the consequences can therefore be permanent. During fetal development, the placenta offers some protection against unwanted chemical exposures, but it is not an effective barrier against environmental pollutants. For example, many metals easily cross the placenta, and the mercury concentration in umbilical cord blood can be substantially higher than in maternal blood. The blood-brain barrier, which protects the adult brain from many toxic chemicals, is not completely formed until about 6 months after birth. The human brain continues to develop postnatally, and the period of heightened vulnerability therefore extends over many months, through infancy and into early childhood. Although most neurons have been formed by the time of birth, growth of glial cells and myelinisation of axons continues for several years. The susceptibility of infants and children to industrial chemicals is further enhanced by their increased exposures, augmented absorption rates, and diminished ability to detoxify many exogenous compounds, relative to that of adults."[25]

The most heartbreaking part of this study is that it found that:

> "A pandemic of neurodevelopmental toxicity caused by industrial chemicals is, in theory, preventable. Testing of new chemicals before allowing them to be marketed is a highly efficient means to prevent toxicity, but has been required only in recent years. Of the thousands of chemicals used in commerce, fewer than half have been subjected to even token laboratory testing for toxicity testing. Nearly 3000 of these substances are produced in quantities of almost 500 000 kg every year, but for nearly half of these high-volume chemicals no basic toxicity data are publicly available, and 80% have no information about developmental or pediatric toxicity. Although new chemicals must be tested more thoroughly, access to these data can be restricted, because they could be claimed to constitute confidential business information. Absence of information about the neurotoxic potential of most industrial chemicals is therefore the main impediment to prevention of developmental disorders induced by neurotoxic pollutants."[26]

According to one of the authors of the study: "The brains of our children are our most precious economic resource, and we haven't recognized how vulnerable they are," says

[25] "*Developmental neurotoxicity of industrial chemicals*," by Prof P Grandjean MD and Prof PJ Landrigan MD. The Lancet, November 8, 2006- Vol. 368

[26] "*Developmental neurotoxicity of industrial chemicals*," by Prof P Grandjean MD and Prof PJ Landrigan MD. The Lancet, November 8, 2006- Vol. 368

Grandjean. “We must make protection of the young brain a paramount goal of public health protection. You have only one chance to develop a brain.”[27]

This is of explicit concern because the chemical content of fracking fluid used to extract natural gas and the restrictions placed upon the release of information regarding said chemicals. Without knowledge of precisely what is used to extract the gas, it is all but impossible to determine the toxic levels of chemical contaminants to which vulnerable communities and the children who live there would be exposed.

In order to take into account all of the substantial risks to the health and safety of our children, we must include the evidence that natural gas and the risks associated with the fracking of natural gas have a significantly harmful affect on health and well-being and construct our plan for the future of energy production accordingly. The fracking process includes a multitude of aspects that would be harmful to our children, born and unborn, and each of those aspects must be explicitly explored, addressed and mitigated in order for any such project to proceed with integrity.

Water Contamination

There are several mechanisms by which fracking can contaminate drinking water resources.[28] Among them are overland flow to nearby surface water, soil contamination and eventual transport to surface water, and infiltration and contamination of underlying ground water. In a recent study, the EPA examined 151 spills from fracking operations. Of the spills characterized in its study, fluids reached surface water in 9 percent of cases and soil in 64 percent

[27] http://archive.sph.harvard.edu/press-releases/2006-releases/press11072006.html
[28] EPA. "Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 1, 2015.

of cases.[29] If a spill does occur, there is a 64% chance that the fluid—laced with additives that have unknown environmental impacts—will contaminate the surrounding soil.

Once a spill has occurred, the contaminants may percolate through the soil and could, ultimately, reach ground water. It may take several years, however, for spilled fluids to infiltrate soil and leach into groundwater. Therefore, it may not be immediately apparent whether a spill has reached the ground water or not. It is imperative that we continue to view groundwater contamination as a serious risk associated with hydraulic fracking.

The vast majority of incidents of water contamination are due to the inadequate cement casing of fracked wells (also called wellbores). This allows natural gas and fracking fluid to migrate into groundwater zones. In fact, a 2014 study in *Proceedings of the National Academy of Sciences*, done by Duke and several other universities, found that faulty well integrity—namely, poor casing and cementing—is the primary cause of drinking water contamination from shale gas extraction.

Most wells used in hydraulic fracturing operations have casings and a layer of cement to protect drinking water, however, there is an alarmingly large number of exceptions. A survey conducted by the EPA estimated that at least 3 percent of wells fractured by nine oil and gas service companies in 2009 and 2010 did not have cement casings.[30] This means that escaped fluids have fewer barriers to travel through to reach ground water resources. And while 3 percent may seem like a small fraction of wells, when the sample in question contains upwards of 20,000 wells, 3 percent amounts to 600 wells and over 600 communities at risk.

Pavillion, Wyoming is one such community. The US EPA began investigating claims of drinking water contamination in the heavily-fracked town in 2008. The EPA sampled 39

[29] Ibid.
[30] EPA. "Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources." June 1, 2015. Accessed July 14, 2015.

individual wells in March 2009 and found nitrate, arsenic, and methane gas. The agency conducted a second sampling in January 2010, and found the groundwater to contain high levels of benzene and methane.[31] Benzene is classified as a known carcinogen by the American Cancer Society, and methane is classified as a probable carcinogen.[32] THE EPA advised well owners not to drink the water, at the recommendation of the US Department of Health and Human Services Agency for Toxic Substances and Disease Registry. Owners were also told to use alternate sources of water for drinking and cooking.

It is BREDL's assertion that all water must be protected. It is inconceivable that fracking could proceed in the Commonwealth of Virginia without causing serious harm to our precious and irreplaceable water resources.

Soil

According to the Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development: "Field survey requirements vary with topography, geologic hazard, potential for public and recreational use, or other concerns. Each surface management agency has survey requirements based on design requirements and concerns specific to the area. The surface management agency should be contacted as early as possible to determine the survey requirements."[33] It will be impossible to proceed with fracking in the Commonwealth of Virginia without damaging the soil.

[31] Hoye, Sarah. "EPA Releases Results of Wyoming Water Well Testing." CNN. August 31, 2010. Accessed July 15, 2015.
[32] American Cancer Society. "Known and Probable Human Carcinogens." American Cancer Society. October 2, 2014. Accessed July 15, 2015.
[33] United States Department of the Interior and United States Department of Agriculture. 2007. Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development. BLM/WO/ST-06/021+3071/REV 07. Bureau of Land Management. Denver, Colorado. 84 pp.

Economic Issues

For the majority of the past decade, "Industry leaders have touted that shale gas, along with burgeoning shale oil production, will lead to America's energy independence, kindle a manufacturing renaissance, lower bills for everyday Americans and create millions of much-needed jobs."[34] However, it is clear that the shale gas boom is unsubstantiated hype; the shale gas boom that the United States has been experiencing for almost a decade is actually just a bubble.

In economics, a bubble is a term used to refer to a significant, usually rapid, increase in asset prices that typically arises from speculation or enthusiasm rather than intrinsic increases in value.[35] The issue with all bubbles, however, is that they ultimately pop. Popping the shale gas bubble in the US would leave in its wake a collapse of prices and, potentially, a short-term increase in well drilling as the United States scrambles to find a sliver of profit in an unsustainable economy. Bill Powers, author of the book *Cold, Hungry and in the Dark: Exploring the Natural Gas Supply Myth*, draws a striking parallel between the shale gas boom, and the housing boom in 2007. He writes that similar to the prevailing beliefs about the housing bubble before it burst, "…much of today's thought regarding natural gas supplies has come from people with a vested interest in selling the dream of a 'Shale Gale' that will eliminate foreign energy imports, boost employment and increase GDP."

What could cause such a colossal collapse? Gross overestimates of shale gas reserves and resources in the United States. The United States boasts about its ample supply of natural gas, however, the reality is that natural gas is a finite and depleting commodity. In *Cold, Hungry and in the Dark*, Powers refutes the idea that increasing shale gas production will create a new era in

[34] Powers, Bill. "The Popping of the Shale Gas Bubble." Forbes. September 3, 2014
[35] New Oxford American Dictionary

America's economy, and instead, he suggests that it will create a severe deliverability crisis, leading to unsustainable shale gas production. According to Powers, the majority of shale gas basins in America have already begun exhibiting declining production.[36] Geoscientist and Research Fellow at the Post Carbon Institute J. David Hughes makes the same argument in his report *Drilling Deeper: A Reality Check on US Government Forecasts for a Lasting Tight Oil & Shale Gas Boom*. His report provides an extensive analysis of actual shale gas production data from the top shale gas reservoirs in the US. He concludes that the current boom in domestic oil and gas production is unsustainable at the rates projected by the Energy Information Administration (EIA). He writes, "The EIA's current energy policy—which is largely based on the expectation of domestic oil and natural gas abundance far into the future—is badly misguided and is setting the country up for a painful, costly, and unexpected shock when the boom ends."[37]

While policymakers, media, investors, and the general public look toward DOE reports with little skepticism, the DOE's EIA has a markedly poor record of estimating recoverable shale gas in the United States. In 2011, the EIA had to cut its estimates of technically recoverable shale gas in the Marcellus formation by 80% and in Poland by 99% after the United States Geological Survey came out with much lower numbers.[38] Further, in 2014, the EIA had to cut its estimate of recoverable tight oil from California's Monterey Formation by 96% — this came just two years after the agency estimated that the Monterey Formation held two-thirds of all US tight oil.[39] The EIA keeps producing optimistic forecasts for the future of US shale gas production, however, these estimates are largely unfounded and have contributed to a shale gas bubble that have

[36] Powers, Bill. "The Popping of the Shale Gas Bubble." Forbes. September 3, 20i4
[37] Hughes, J. David. "Drilling Deeper: A Reality Check on U.S. Government Forecasts for a Lasting Tight Oil & Shale Gas Boom." Shale Bubble. October 1, 2014.
[38] Efstathiou Jr., Jim, and Kasia Klimasinska. "U.S. to Slash Marcellus Shale Gas Estimate 80% on Geology Update." Bloomberg. August 23, 2011.
[39] Sahagun, Louis. "U.S. Officials Cut Estimate of Recoverable Monterey Shale Oil by 96%." Los Angeles Times. May 20, 2014.

steered policymakers and the American public in a dangerous direction. An article published in *Nature* done by researchers at the University of Texas at Austin, echoes the findings of Hughes. It suggests that while many gas-bearing shale formations are geographically vast, the number of "sweet spots" where fuel can actually be extracted in worthwhile volumes is much smaller than originally thought.[40] In other words, there is a strict geological limit for natural gas extraction, which the US is rapidly approaching.

Continuing to exploit shale resources will only lead to high decline rates and declining well quality, as the number of spots where gas can be extracted are exhausted. This means that in order to keep production flat, the United States will have to drill even more wells. As the US scrambles to drill more expensive wells, it will require massive amounts of capital, something that "…can only be supported by high levels of debt or higher prices."[41] Thus, from an economic standpoint, continuing to try to tap into shale gas resources will be detrimental to the US economy, as it creates a bubble that will soon burst and wreak economic havoc.

Summary

Natural gas carries with it an array of negative environmental, economic, health, and legal ramifications. Tenuous federal standards and surveillance make this billion-dollar industry exceedingly dangerous and detrimental to United States citizens. Every stage in the natural gas extraction process exposes the surrounding air and groundwater to dozens of deleterious pollutants. What is more, the transportation of natural gas via interstate pipelines not only causes further noise and chemical pollution, but so too does it infringe on the property rights of United

[40] Zeller Jr., Tom. "Does Anyone Really Know How Long the Shale Gas Boom Will Last?" Forbes. January 5, 2015.
[41] Hughes, J. David. "Drilling Deeper: A Reality Check on U.S. Government Forecasts for a Lasting Tight Oil & Shale Gas Boom." Shale Bubble. October 1, 2014.

States citizens. Natural gas threatens the wellbeing of the economy, the environment, and all of its inhabitants.

Countless landowners have been harmed by fracking. In addition to encroaching on property rights, gas development sites are increasingly popping up in public forestlands, once again demonstrating the corruption of power that private corporations exert over not only vulnerable communities and landowners, but also our shared commons.

An increased dependence on extraction, transportation and exportation of natural gas fetters the United States from embarking on a renewable revolution. The United States has made significant gains in green energy technologies. For example, in the past year, major advancements have been made with respect to solar energy batteries. A new design that combines a solar cell and a battery into a single device can now achieve a 20 percent energy savings when compared to traditional lithium-iodine batteries.[42] This marks a remarkable achievement in terms of green energy advancement, and demonstrates that the United States already has, at its disposal, the tools it needs to build a greener nation. Citizens from all walks of life are now willing to fight to safeguard America's resources and secure a sustainable future for our energy needs. Rather than continuing to invest in a billion dollar industry that will only cause harm in both the short and the long term, the United States must choose to focus its resources on developing and improving renewable energy technologies.

Finally, BREDL believes that so-called energy independence via natural gas is a chimera "snorting out the breath of the terrible flame of bright fire."[43]

The currently proposed regulations for oil and gas drilling in Virginia would not protect citizens from even the most minor effects of this hazardous practice. They would instead allow a

[42] Frost Gorder, Pam. "New Design Brings World's First Solar Battery to Performance Milestone." Ohio State University Newsroom. August 3, 2015
[43] *Iliad*, Homer

cascading series of harmful practices to compound already existing realities of climate change, sea level rise, land subsidence, and green house gas emissions that would have game-changing effects on the state of Virginia as a whole.

BREDL acts in the public interest

The Blue Ridge Environmental Defense League was founded in 1984 as a non-profit, independent non-governmental organization. The League is a 501(c)(3) corporation with members, chapters and projects in seven states: Virginia, North Carolina, South Carolina, Tennessee, Georgia, Alabama and Mississippi. The organization's mission is the protection of the natural environment and public health.

Respectfully,

Whitney Whiting
Community Organizer
Blue Ridge Environmental Defense League