Climate Times and NC WARN

DUKE ENERGY'S MOVE TOWARD A FRACKING GAS FUTURE WOULD BE DISASTROUS FOR CLIMATE CHANGE AND FOR THE NORTH CAROLINA ECONOMY

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By Harvard Ayers and Nancy LaPlaca

SUMMARY

This paper addresses three of the strongest reasons that North Carolina must not allow Duke Energy to greatly increase the build-out of natural gas-burning power plants and other infrastructure:

1. Methane, the dominant component of natural gas, has a global warming impact 100 times that of carbon dioxide over its initial 10 years in the atmosphere, and a large amount of it is leaking from conventional and shale gas wells. In order to slow global climate change in the critical short term, it is essential to immediately begin to greatly reduce the amount of methane being released into the atmosphere.

2. Estimates of natural gas reserves in the U.S. are overstated by at least 50%, so that future supplies might not be available, leading to fuel shortages and price spikes.

3. There is evidence that the shale gas industry is based on a financial bubble, and because revenues do not cover costs of production, fracking companies continue to lose money. The main beneficiary of this financing arrangement is Wall Street. As a result, investing in a fracking gas future is risky and could lead to a large amount of stranded costs for Duke Energy customers and shareholders.

INTRODUCTION

In recent years, natural gas has been promoted as a "bridge fuel" to a renewable energy future or a path to "energy security" for the United States. Such promotion is due to the advance of drilling based on hydraulic fracturing of shale formations, and to date, almost all shale gas worldwide has been produced in the U.S.[1]

Charlotte-based Duke Energy recently announced plans to build up to the equivalent of 15 large

natural gas-fired power plants in the Carolinas over the next 15 years,[2] including three smaller units in Asheville, N.C., and to acquire Piedmont Natural Gas, Inc. This follows earlier news that Duke plans to take a major role in building and owning a natural gas pipeline from the Gulf states and another from the shale gas fields in West Virginia. Clearly, Duke Energy is betting that natural gas will be a dominant fuel for electricity for the foreseeable future.

NC WARN and the Climate Times believe that increasing North Carolina's dependence on natural gas is extremely short-sighted. Natural gas – in particular shale or "fracked" gas – is now estimated to be far more powerful a greenhouse gas than carbon dioxide, and large amounts are leaking into the atmosphere in recent years due to drilling and handling of natural gas.

2014 was the hottest year on record and 2015 is hotter still and poised to break that record.[3] According to scientists, the Earth will warm to very dangerous levels within the next 15 years, and we must immediately begin reducing greenhouse gas (GHG) emissions – especially methane. Increasing North Carolina's electricity generation from natural gas would be directly at odds with the need to reduce GHG emissions and slow climate change.

The southeastern United States has unique vulnerabilities to the effects of climate change, which is already causing significant damage. An October 2015 report by the U.S. Department of Energy shows the Southeast will suffer increasing temperatures, rising sea levels, flooding, high winds, coastal erosion, large waves from hurricanes, and sea-level-rise-enhanced storm surges.[4] Meanwhile, the Southeast is projected to have the largest increase in natural gas power plants in the U.S. between 2015 and 2030, with each plant having an expected life-span of 30 to 40 years.[5]

BACKGROUND ON DUKE ENERGY'S FRACKING GAS FUTURE

Senate Bill 716,[6] signed into law in June 2015, requires the North Carolina Utilities Commission to render a decision within 45 days on an application for a certificate of public convenience and necessity for new natural gas units at the site of the Asheville Steam Electric Generating Plant, an application Duke Energy says it will submit in January 2016.

It's unlikely that a fully vetted decision can be made within 45 days on whether to permit the 2-unit, 560 total megawatt (MW) natural gas-burning plant, and other proposed infrastructure such as compressing stations and pipeline improvements, as a prudent investment.

According to Duke Energy's 2015 Integrated Resource Plan (IRP), it wants to increase its current production of electricity from natural gas in North Carolina,[7] despite the fact that the price of natural gas for electric utilities in the state is higher than the U.S. average.[8]

Duke Energy's IRP is a road map of its plans to build power plants over the next fifteen years. The 2015 IRPs for the Carolinas provide two scenarios: the base case plan adds 2,328 MW of new nuclear capacity and 8,578 MW of new natural gas plants. The second option, which is not carbon sensitive, shows far less new nuclear capacity (94 MW) and up to 10,928 MW of new natural gas capacity. All told, Duke Energy Carolinas and Duke Energy Progress would have a

total of over 17,400 MW of natural gas in operation by 2030 under its base case planning scenario.[9]

Duke Energy is also moving quickly to own a share of two proposed natural gas pipelines: the 554-mile long, $4.5 - 5 billion Atlantic Coast Pipeline (ACP),[10] and the $3 billion Sabal Trail pipeline that will traverse Alabama, Georgia, and Florida.[11] In October 2015, Duke Energy announced plans to acquire Piedmont Natural Gas in a deal totaling $6.7 billion.[12]

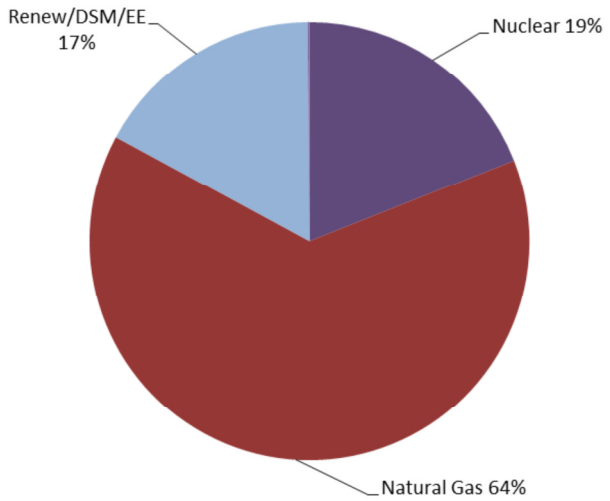

FIGURE 1: Resources Added Over 15 Year Planning Period for Duke Energy Carolinas and Duke Energy Progress. Source: Duke Energy IRP Presentation, November 6, 2015[13]

NATURAL GAS-FIRED ELECTRICITY IS ACCELERATING THE CLIMATE CRISIS

"Switching from coal to shale gas is accelerating rather than slowing global warming."
Dr. Robert Howarth, Cornell University[14]

Mounting evidence shows that power plants burning both conventional and "fracked" natural gas are contributing to accelerating climate change for two core reasons:

1. Large amounts of natural gas, which is mostly methane, leak into the atmosphere during the drilling and transport processes; and

2. Methane is 100 times more potent as a heat-trapping gas than carbon dioxide during the critical first decade after emission, and 86 times more potent over 20 years, according to the latest estimates by the Intergovernmental Panel on Climate Change (IPCC).[15]

Therefore, while the combustion of natural gas at power plants emits less carbon dioxide than does combustion of coal, the climate-warming potential of natural gas is far higher than that of coal when the life-cycle emissions of methane are taken into account. Gas from hydraulic

fracturing is worse for the climate than gas from conventional drilling due to greater leakage rates. In 2013 the IPCC reported that the effects of global methane currently being emitted from all sources equal the effects of all sources of carbon dioxide emissions as drivers of global warming.[16]

Because hydraulic fracture drilling into shale formations has grown rapidly, the total greenhouse gas emissions from fossil fuel use in the U.S. increased from 2009 to 2013, even though carbon dioxide emissions decreased during that period.[17]

Life-cycle emissions of methane from natural gas production

"Natural gas – and shale gas in particular – is not a bridge fuel when methane emissions are considered over an appropriate timescale." Dr. Robert Howarth, Cornell University[18]

Hydraulic fracturing ("fracking") of shale gas was not widely used in the U.S. until 2009. While conventional gas wells are drilled vertically, shale or fracked wells drill horizontally into rock formations. As shale gas drilling increased, and shale ("fracked") gas became a larger percentage of total U.S. natural gas supply, scientists including Dr. Robert Howarth of Cornell University became concerned with the potential climate change effects of leaked methane. In a 2011 study, Dr. Howarth found that fracking is much more destructive compared to conventional gas extraction in that it fractures, or crushes, the shale rock to release the tightly held natural gas. Due to this new source of high-leakage shale gas, natural gas is now producing about 42% of the total power plant greenhouse gases in the U.S., rivaling carbon dioxide as the largest GHG source.[19]

Dr. Howarth's pioneering methane leakage publication was reported by hundreds of newspapers, including *The New York Times*. Dr. Howarth sent out a call to other scientists based on his early work to take a close look at just how problematic methane leakage on the front end of the natural gas cycle could be.

Since 2011, Dr. Howarth's research has expanded and, in October of this year, he incorporated for the first time the observations of satellite imagery by Dr. Oliver Schneising.[20] In this case, Schneising used photographs of the U.S. fracking fields as seen from space, a much more robust, three-dimensional view of leaked methane. Howarth applied the most respected, up-to-date (2013) values for the global warming potential of methane from the IPCC, which indicate that over its first 20 years, methane averages 86 times the greenhouse gas strength of carbon dioxide. Over the shorter term of 12 years – the lifetime of methane in the atmosphere – the warming effect is more than 100 times that of CO2.

Schneising concludes that the upstream emissions of shale gas (those occurring during the drilling process) are 9.5% of the total extracted. Dr. Howarth states that storage and delivery of gas to customers adds another 2.5%, putting total methane leakage from fracked shale gas at 12% of well production.[21] Thus, using 86x over 20 years, Dr. Howarth estimates the life-cycle CO2 equivalent of shale gas is twice that of conventional gas and nearly three times that of coal when both are burned to produce electricity (see figure 2 below).

Dr. Howarth did this knowing that the utility industry, including Duke Energy, and the U.S. Environmental Protection Agency (EPA) use outdated methane numbers (IPCC 2007) that significantly underestimate methane's strength by 3 to 4 times. Even conventionally extracted natural gas releases significantly more greenhouse gases than coal as shown in the chart below. Despite these clear statements that natural gas, especially shale gas, is emitting much larger quantities of greenhouse gases, Duke Energy plans to construct up to 10,928 MW of new electric generation capacity fueled by natural gas in the next 15 years in the Carolinas.[22]

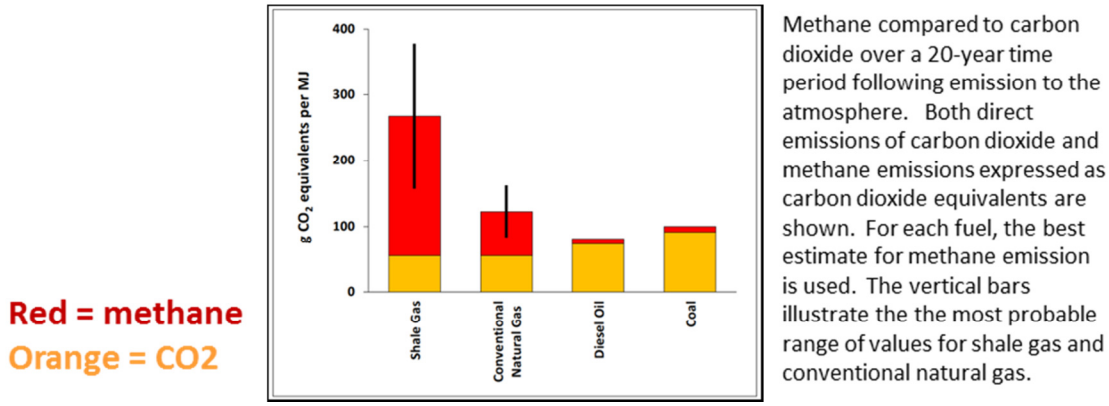

FIGURE 2. The greenhouse gas footprints of shale gas, conventional natural gas, diesel oil and coal as g CO2 equivalents per MJ of heat produced when the fuel is used to produce electricity. Source: Dr. Robert Howarth, October 8, 2015[23]

A recent study published in *Energy Science and Engineering* in September 2015 supports Dr. Howarth's research, [24] noting that the equipment used to measure methane leakage has serious defects, leading to underestimation of emissions. That study found that uncounted emissions from methane leaks could be extremely high, perhaps 10- to 100-fold for a large leak, and that a relatively small number of large leaks produce a large portion of the methane emissions.[25] Although leakage has been documented for several years, the drilling industry has been unable to correct the problems, apparently because much of the leakage occurs through the well casing.

A national push to recognize the climate damage from natural gas is emerging, as Platts recently noted that the Federal Energy Regulatory Commission, which has authority to approve gas pipelines, is being challenged to consider the full life-cycle of natural gas pipelines "from the well-head to the burner tip."[26]

The U.S. EPA had generally concurred with Howarth's 2011 findings, but later reduced its leakage estimates in response to a non-peer reviewed report by the natural gas industry. The EPA inspector general has criticized the agency's approach to estimating methane emissions.[27]

Dr. Howarth also notes the rapidly increasing literature on the damaging environmental and public health consequences of fracking, such as surface and groundwater contamination, degraded air quality, increased frequency of earthquakes, and harm to human and animal health.[28]

The Next Decade is Critical for the Climate

Methane lasts approximately 12 years in the atmosphere, compared with hundreds of years for CO2. This adds enormous importance to decisions over Duke Energy's plans to greatly increase its burning of natural gas and to amplify the nation's shale gas infrastructure. The urgency of reducing natural gas/methane releases into the atmosphere is high, due to its global warming potency and relatively short lifespan.

> *Given current emissions of greenhouse gases, the Earth is predicted to warm by 1.5°C above the preindustrial baseline within the next 15 years and by 2°C within the next 35 years.[29] Not only will the damage caused by global warming increase markedly but also at these temperatures, the risk of fundamentally altering the climate system of the planet becomes much greater.[30] Further, reducing emissions of carbon dioxide will do little if anything to slow the rate of global warming over these decadal time periods.[31]* ***On the other hand, reducing emissions of methane has an immediate effect of slowing the rate of global warming.[32] For these reasons, comparing the global warming consequences of methane and carbon dioxide over relatively short time periods is critical.*** *(emphasis added)*
>
> *Dr. Robert Howarth, Cornell University, October 2015[33]*

NATURAL GAS RESERVES OVERSTATED BY 50%

In 2011, *The New York Times* reported that the Securities and Exchange Commission relaxed rules governing how companies calculate gas reserves, leading to reserve estimates increasing dramatically in the short term. Higher reserves generally lead to higher stock prices. The SEC also declined to require third party audits, leading to gas developers' reserve estimates not being independently verified.[34] To verify fuel availability, future shale gas production and reserve estimates must be carefully reviewed, as 40-50% of U.S. natural gas now comes from shale gas produced by hydraulic fracturing. [35]

Geoscientist and shale gas expert J. David Hughes,[36] along with others, has demonstrated that natural gas reserves are overstated by at least 50% by the EIA and natural gas industry. Hughes' work has been widely cited in the press, including *The Economist, Forbes,*[37] *Bloomberg,*[38] *The Los Angeles Times,*[39] *The New York Times,*[40] and *The Atlantic*,[41] and has been featured on CNBC, Canadian Business, and elsewhere.

It is now well documented that fracked gas wells become depleted far more rapidly than earlier believed. Hughes' data analysis of over 88% of 65,000 fracked oil and shale gas wells shows that average well production declined a staggering 74 to 82% over three years.[42] Dr. Hughes' data demonstrates that four of the top seven shale gas "plays" – large geographic areas where

shale gas exploration is happening or expected – are already in decline, yet the U.S. Energy Information Administration (EIA) reference case gas forecast calls for plays currently in decline to grow to new production highs. On August 26, 2015, the EIA reported declines in nearly every major shale basin in the U.S.[43]

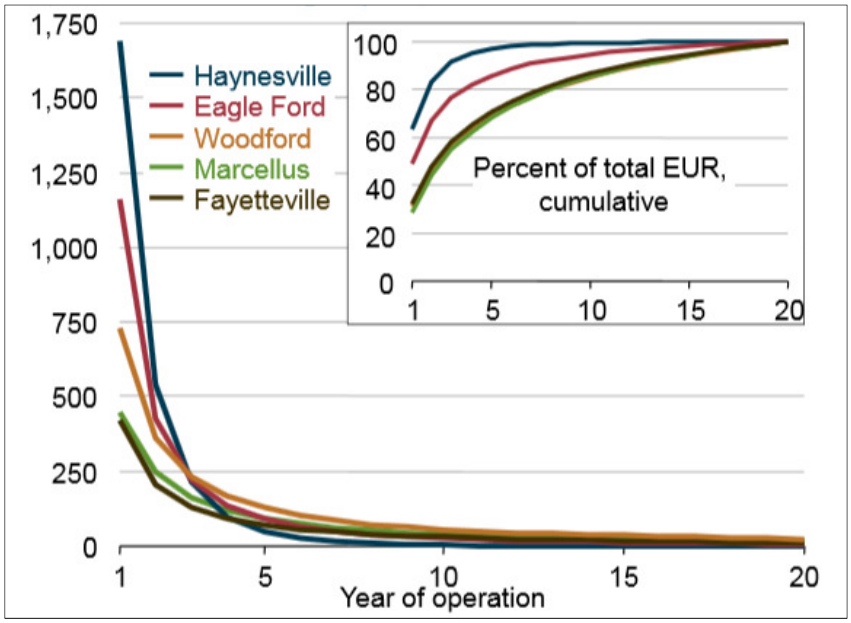

FIGURE 3: Average production profiles for shale gas wells in major U.S. shale plays by years of operation (million cubic feet per year) (EUR is Estimated Ultimate Recovery, or total lifetime well production). Source: U.S. Energy Information Administration[44]

Because productivity of shale wells declines rapidly, many new wells must be drilled just to maintain existing production levels. Approximately 130,000 additional shale gas wells would need to be drilled by 2040 to meet EIA and industry projections, on top of the 50,000 existing wells drilled in these plays through 2013. Assuming an average well cost of $7 million, this would require $910 billion of additional capital input by 2040, not including leasing, operating, and other ancillary costs.[45]

Lawrence Berkeley Lab scientist David Fridley calls this frenetic pace of new drilling an "accelerating treadmill."[46] Hughes is not the only expert disputing the EIA's numbers. Art Berman, a geological consultant with 34 years of experience in petroleum exploration and production, has also sounded the alarm about overly optimistic reserves for many years.[47]

Hughes' analysis was recently proven correct at California's Monterey shale oil play, where he had projected that 2011 estimates by the EIA and industry were overstated by 96%.[48] In October 2015 the U.S. Geological Survey (USGS) downgraded reserve estimates by a startling 99%, thus agreeing with Hughes and others.

USA Today recently reported that several of the largest shale gas regions in the U.S. will post four months in a row of declining production. The article notes that "[w]hile U.S. shale gas

remained resilient through several years of low natural gas prices, the collapse in oil prices are finally putting an end to the boom."[49]

The risk of price spikes from fuel shortages is very real, as natural gas is not stored on-site and must be delivered as it is consumed.[50] If natural gas reserves are indeed far lower than estimated, captive ratepayers in monopoly utilities' service areas could be stuck paying the bill for expensive "stranded assets," including pipelines, compressing stations, and power plants.

Figure 4 below shows the price of U.S. natural gas at the wellhead from 1970 to 2014, with price spikes in 2005 (Hurricane Katrina) and 2008 (when crude oil was $147 per barrel). In June 2011, then Duke Energy CEO Jim Rogers famously called natural gas the "crack cocaine" of the electric power industry, due to its cost volatility.[51]

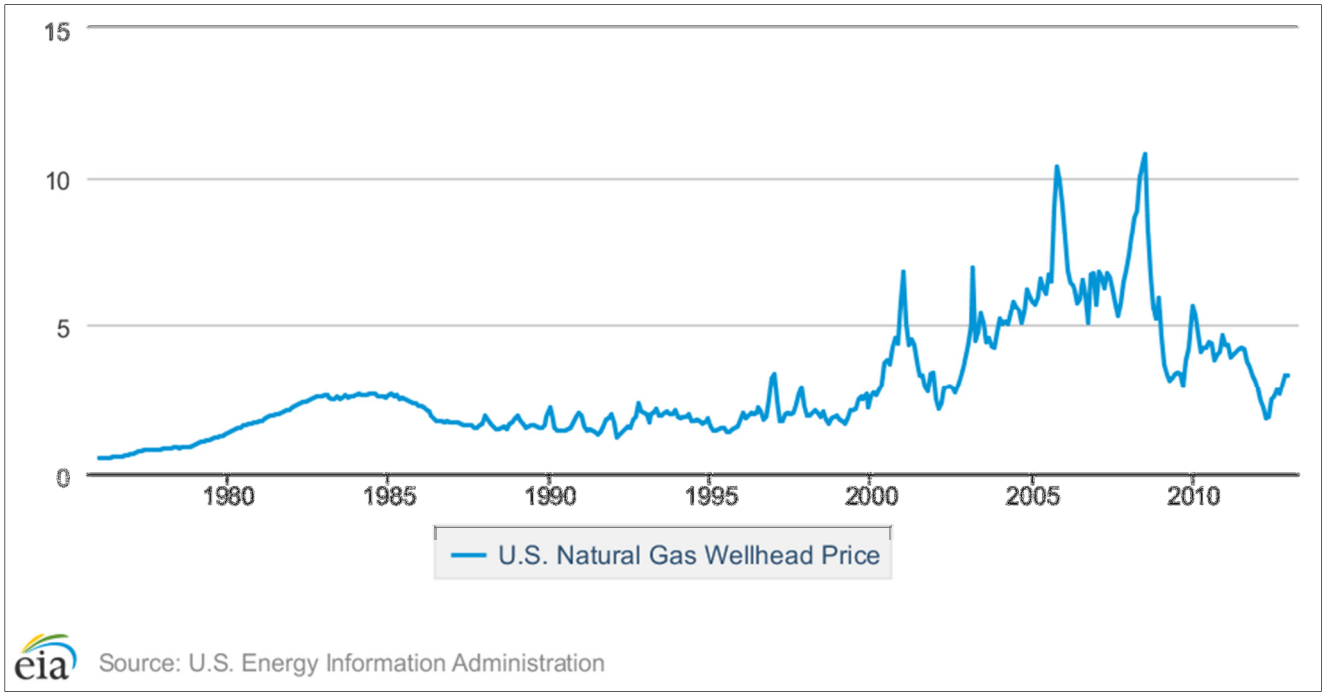

FIGURE 4: U.S. Natural Gas Wellhead Price (dollars per thousand cubic feet). Source: U.S. Energy Information Administration[52]

FINANCIAL RISK

The price of natural gas was at $2.30/MMBtu[53] in early November 2015, a level at which drillers and producers may not be covering the costs incurred to produce the gas. Historically low interest rates have also helped shale gas developers in recent years. However, as interest rates increase, production costs will rise because drillers pay more to borrow money. These cost increases result in the write-down of shale assets.[54]

In order to continue the current level of shale gas production, the U.S. would need to drill 7,000 new wells per year at a cost of $42 to 49 billion annually while U.S. shale gas production in 2012 generated only $33 billion (although some wells also produced substantial liquid hydrocarbons, improving economics).[55]

There is evidence that shale gas plays are a financial "Ponzi scheme" needing ever-more investment capital, driven by "creative financing" whose main beneficiary is Wall Street.[56] In 2011, shale mergers and acquisitions accounted for $46.5 billion in deals, representing one of the largest profit centers for Wall Street investment banks.[57]

Former Wall Street financial consultant Deborah Lawrence asserts that natural gas companies have been illegally, and perhaps intentionally, overstating well production and reserves by 100-500%, creating a cash flow necessary to fund more well drilling while driving higher borrowing and imprudent leverage positions.

Lawrence discovered that companies were spending so much to drill wells and gas prices were so low that many were cash-flow-negative. JP Morgan estimates that the default rate for energy companies taking on high debt loads could soar from 4% this year to 20% in 2016 if natural gas commodity prices are less than the cost of production.[58]

Bloomberg, *Fortune,* and *USA Today* recently reported that shale gas drillers are experiencing very high debt loads that could "swallow" the industry, with highly-indebted shale oil and gas drillers "in survival mode."[59] Companies in the Bloomberg Intelligence North America Independent Exploration and Production Index ("Index") spent $4.15 for every $1.00 earned selling oil and gas in the first quarter of 2015.[60] An estimated $20 billion in bonds issued by 62 companies in the Index are "distressed," meaning they are paying above Treasury rates to borrow money.

This year, Standard and Poor's has lowered the outlook or credit of almost half of the 105 oil and gas companies it rates. The chief oil analyst at a London consulting firm says the current financial problems are just the beginning, and "we haven't seen the worst."[61] *Fortune* reports that "[f]rackers could soon face mass extinction" and as many as one third of the fracking companies could go bust by the end of next year.[62]

Stranded Costs

Former state public utility regulator Dr. Carl Linvill recently warned that the rapid expansion of natural gas power plants could result in investments that become stranded costs. Gas enthusiasts are pushing for $500-$775 billion to be invested in gas plants and pipelines by 2035-2040, despite the fact that natural gas combined cycle power plants are seen as a medium risk for initial cost, a high risk for fuel cost, and a very high risk for carbon price. By comparison, utility-scale solar, wind, and efficiency are rated as low cost and low risk. [63]

Dr. Linvill points out that the risks of a bad bet on natural gas are borne by ratepayers in regulated monopoly markets, not corporate shareholders, as projects are often guaranteed with ratepayer and taxpayer funds.

The Union of Concerned Scientists reported on the most at-risk states due to high levels of dependence on natural gas. North Carolina's current risk was rated "moderate", but the planned build-out of natural gas plants by Duke Energy could increase the risk rating to "high."[64] Meanwhile, renewable energy can displace fossil fuels and save customers money, as the 2014 "polar vortex" events in the Mid-Atlantic and Great Lakes regions of the U.S. demonstrated when the cost of natural gas spiked due to fuel shortages.[65]

CONCLUSION

The choices Duke Energy makes today will affect North Carolina's economy, health, and the global climate for many decades or longer. Locking North Carolina into a natural gas-intensive future would be a climate tragedy, and would set citizens up for persistent fuel cost volatility and potential shortages. A combination of vastly understated climate impacts, overstated shale gas reserves, high shale well depletion rates, huge debt loads, and low shale gas prices that do not cover production costs makes natural gas a bad bet for the Tar Heel state, and for the world.

Harvard Ayers, Ph.D., is professor emeritus of anthropology at Appalachian State University and executive director of The Climate Times.

Nancy LaPlaca, J.D., is senior energy analyst for NC WARN.

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