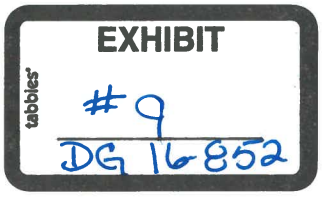
State of New Hampshire Public Utilities Commission



DG 16-852

Liberty Utilities (EnergyNorth Natural Gas) Corp. d/b/a Liberty Utilities Petition for Expansion of Franchise to the Town of Hanover and City of Lebanon, New Hampshire.

DIRECT TESTIMONY OF
JONATHAN CHAFFEE
July 17, 2017

Mr. Chaffee summarizes the direct testimony which addresses the marketability of natural gas to customers in Lebanon and Hanover by presenting analysis on his representative oil heating household; that it would cost him more to switch to natural gas at current pricing, that he expects the cost of gas to increase, that energy efficiency improvements decrease his fuel costs without switching fuels, that his current fuel is less harmful to the environment than natural gas, that environmentally friendly heat pumps are about the same cost as natural gas, and that because of public policy support for renewable energy, citizens are actively working to influence potential customers not to contract with Liberty Utilities for pipeline natural gas.

Q1: Please state your name, occupation and address.

A1: My name is Jonathan Chaffee. I live at 21 Highland Avenue, West Lebanon, NH. I am retired.

Q2: Please describe your education and work experience.

A2: I graduated from Hanover High School and Harvard University and received a PhD in Cellular and Developmental Biology from Harvard University. I conducted research into cellular interactions in early brain development, and briefly taught neuroanatomy. In 1980 I moved back to New Hampshire and worked in social services, primarily in the development of housing for low and moderate income households. I served as Executive Director of Lebanon Housing Authority for 15 years before retiring in 2011. During my tenure the Authority performed major energy efficiency upgrades to its existing housing stock (often aided by Liberty Utilities energy efficiency programs) and constructed very energy efficient new housing. I volunteer at my local church and am a volunteer member of the Lebanon Energy Advisory Committee.

Q3: Have you previously provided testimony before the Public Utilities Commission (PUC) or in other judicial or administrative proceedings?

A3 No

Q4 What is the purpose of your testimony?

A4 Presenting data from my own residence in West Lebanon I will testify that Liberty Utilities will have difficulty attracting customers for its proposed natural gas product because:

- **The annual cost of heating with natural gas would exceed the cost of heating with oil for most residences, even at today's tarrifs and cost of gas.**

- **Payments on the initial capital investment to convert to gas quipment, added to operating cost, make natural gas way more expensive.**
- **The cost of gas is projected to increase soon.**
- **Energy efficiency improvements pay for themselves without fuel switching.**
- **A resident could install heat pumps and heat renewably for a cost comparable to investing in natural gas.**
- **Despite a wide-spread inference that natural gas is good for the environment, it is becoming more widely understood that natural gas is a non-renewable fossil fuel over-all worse for the environment than other heating fuels and is incompatible with adopted municipal goals to decrease emissions and move to renewable energy.**
- **Public opinion and publicity are growing against the pipeline and some citizens are dedicated to influencing potential customers not to utilize natural gas.**

Q5 Are you a representative potential customer for Liberty Utilities?

A5 I heat with oil, like 59.4% of owner occupied residences in Lebanon.

My residence at 21 Highland Avenue is 0.4 miles from the proposed gas pipeline along Rt. 4 up Seminary Hill in West Lebanon. It is one of 6,391 owner occupied housing units in Lebanon (data table provided in ATTACHMENT pages 1and 2). My house has 2-3 bedrooms, like 70% of homes. As a homeowner I try to minimize my heating costs and the environmental impact of my fuel use.

Q6 How did you compare your cost of heating with natural gas to heating with oil?

A6 I used the cost calculator for a residential customer provided by Liberty Utilities.

Excel spreadsheet "Arwen-Chaffee 2-2.xlsx" in response to Data Request No. Arwen/Chaffee 2-2. I used the R-6 rates including the 30% MEP rate premium and the cost of gas provided and initially changed only the heat use of my particular home.

Q7 Would you save money by switching to natural gas?

A7 No. The annual operating cost of heating my home with natural gas would be greater than the cost of heating with oil.

Cost of natural gas…….	**$892.31**
Cost of oil	**$839.36**
Savings with oil	**$52.95**

The Liberty spreadsheet page titled "R-6 Chaffee" with my heat load (50 MMBTU) (Therms) entered in cell F2 is shown in ATTACHMENT page 3.

Q8 Could you save even more money with oil?

A8 Yes. With oil I can shop around and wait for the best price, which I could not do with natural gas. I bought last year's oil on 4/29/16 at $2.01 per gallon through the fuel club.

Cost of natural gas	**$892.31**
Cost with fuel club oil…	**$727.20**
Savings with oil	**$165.11**

A copy of one of the stubs is on ATTACHMENT, page 4. ATTACHMENT, page 5 shows the spreadsheet with my fuel club oil cost entered in M26.

A9 As a homeowner trying to project the cost of switching to natural gas, would you be concerned that the cost of gas might go up?

Q9 Yes. A reference provided by Liberty predicts that the cost of gas is likely to increase in the range of 50% in the next 5 years, and may actually double. This concern is reinforced by academic research. An uninformed customer who made the mistake of locking-in to natural gas would then really regret it:

Cost of natural gas with 50% increase…	**…$1,034.48**
Cost of fuel club oil	**$727.21**
Savings with oil	**$307.21**

Liberty asserts that prices will remain stable, and perhaps is representing this to potential customers, saying in answer to OCA 1-44:

"…the Company does not foresee any circumstances where CNG and LNG commodity prices rise by 50 percent over the next five years. Should that unlikely event occur, the Company expects that it will be more difficult to attract new customers."

And, in response to OCA 2-10 Liberty says:

"Based on long-term natural gas price forecasts (as provided in response to Arwen/Chaffee 1-13), and with CNG and LNG pricing being indexed off natural gas, the Company does not anticipate such major commodity

price increases as being realistic. Thus, the Company determined that such a scenario is not relevant to the petition."

Yet exactly the opposite is shown in the source Liberty referenced for this conclusion in its response to Arwen/Chaffee 1-13. "Natural gas prices are projected to increase" is the title of page 55 of the U.S. Energy Information Administration (EIA) report titled "Annual Energy Outlook 2017 with projections to 2050" (AEO2017) (ATTACHMENT, page 6). Natural gas prices increase in all three scenarios in the graph on page 55 The scenarios, Reference, High Resource and Technology and Low Resource and Technology are defined in ATTACHMENT, page 7. The magnitude of these graphed increases are published elsewhere in table form and shown here:

AEO2017 Total Energy Real Prices Gas Price at Henry Hub

Year	**Reference case** 2016 $/MMBtu	% change from 5 years earlier	**High oil and gas resource and technology** 2016 $/MMBtu	% change from 5 years earlier	**Low oil and gas resource and technology** 2016 $/MMBtu	% change from 5 years earlier
2015	2.65714		2.65714		2.65714	
2016	2.500707		2.419441		2.553294	
2017	2.995931		2.768105		3.170192	
2018	3.403222		3.111569		3.674769	
2019	3.964807		3.529295		4.41391	
2020	4.505039	70%	3.557534	34%	5.397064	103%
2021	4.391413	76%	3.265919	35%	5.760227	126%
2022	4.255652	42%	3.146479	14%	6.317814	99%

Source: U.S. Energy Information Administration
https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2017&region=0-0&cases=ref2017~ref_no_cpp~highrt~lowrt&start=2015&end=2050&f=A&linechart=~~~~~ref2017-d120816a.44-1-AEO2017~highrt-d120816a.44-1-AEO2017~lowrt-d120816a.44-1-AEO2017&ctype=linechart&sid=ref2017-d120816a.44-1-

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Please note that substantial increases are predicted in the most likely Reference case, and doubling of prices are projected in the Low Resource and Technology case. Only in the particularly favorable High Resource and Technology case are increases much less than 50%.

Increases in natural gas prices are also predicted in studies published in peer-reviewed academic journals and energy trade publications. For example, a December, 2014 *Nature* article titled "Natural gas: The Fracking Fallacy" challenged the widely reported industry and government assessment that U.S. reserves in shale deposits are so abundant as to provide decades, or more, of inexpensive gas to be unlocked by fracking. A team of petroleum engineers, geoscientists and economists from the University of Texas studied the four major "shale plays" and forecast a decline in production starting around 2020. This article is reproduced in the ATTACHMENT, pages 8, 9 and 10.

Inman, M., "Natural gas: The fracking fallacy", *Nature*, http://www.nature.com/news/natural-gas-the-fracking-fallacy-1.16430

That study's forecast is supported by a report appearing in *OilPrice.com* in January 2017. The author, Arthur Berman, is a petroleum geologist and an expert on U.S. shale plays with 36 years of oil and gas industry experience. He cites data that gas production has been dropping since February 2016. He says, "Shale gas production is declining and conventional gas has been in terminal decline for the past 15 years." Berman says, as of late January 2017, "current gas prices are under-valued and should be at least $3.75 and probably closer to $4.00". (From late January to mid-March, gas prices fell from around $3.25 to less than

$2.50 before rebounding to a bit over $3.00.) This article is reproduced in the ATTACHMENT, pages 11-14.

Berman, A. "Why Cheap Natural Gas Is History", http://oilprice.com/Energy/Natural-Gas/Why-Cheap-Natural-Gas-Is-History.html

If the cost of gas were to increase, as at least seems highly possible, the operating cost of my heating with natural gas would become much worse than continuing to use oil, $227.68 worse annually. This is shown in a page of the cost calculator into which my heat use, my current quoted fuel club price of oil ($2.23), and a 50% increase in COG have been entered, ATTACHMENT, page 15. Being aware of this uncertainty makes me much less likely to become a Liberty customer.

Q10 What other factors would a homeowner consider in deciding whether to switch from oil to natural gas as a heating fuel?

A10 The payments I would have to make on my capital investment in gas heating equipment would make gas more than twice as expensive.

Annual Capital costs of natural gas equipment	**$994.56**
Annual Operating cost of natural gas	**$892.31**
Total gas annual cost	**$1,886.87**
Annual Cost of oil	**$727.21**

I obtained estimates from two different heating contractors that converting to natural gas heating equipment would cost between $7,000 and $9,000 including disposal of my current oil boiler and tank. My

bank, Mascoma Savings Bank, would make me a home equity loan for 10 years at 4.5%. The annual cost of an $8,000 loan would be $994.56.

Q11 How do your cost calculations generalize to other potential customers?

A11 When even a modest cost of converting equipment is taken into account, almost no residential oil customer should switch to natural gas. Only for an extremely inefficient home using roughly 3 times the average amount of heat would switching from oil to gas be an advantage.

This is because natural gas pricing goes down as the volume used goes up, unlike the pricing of oil. My relatively efficient home using 50 MMBTU of heat energy per year is cheaper to heat with oil. Analyzing the cost calculator spreadsheet, at 56 MMBTU/year the operating cost of gas and oil are the same. For any home using less heat than that, It would be cheaper to heat with oil, without even considering the cost of capital investment in equipment. The average NH house uses about 72 MMBTU a year (U.S.Census gives 618,950 housing units in 2015. 2015 residential oil use in NH was 21.1 trillion BTUs according to EIA). The annual operating natural gas savings for an average house would be $82.94 (ATTACHMENT, page 16), not enough to pay for making a conversion. Operating savings increase as heat use increases, but only a home that used an astronomical 211 MMBTU a year, almost three times the average, would “save” enough in natural gas operating costs to balance the cost of the conversion investment which for my home would be $994 a year (ATTACHMENT, page 17).

Q12 What other alternatives have you considered to reduce your fuel costs?

A12 Energy efficiency improvements to my home have paid for themselves in reduced fuel costs.

Oil cost before efficiency	**$1,208.68**
Oil cost after efficiency	**$839.36**
Efficiency Savings… …… …….	**$369.32**

My home heat use dropped by a remarkable 31% from 73 MMBTU/year to 50 MMBTU/year after I contracted in 2014 through NHSaves for efficiency measures. The total cost was $6,299, of which I paid $2,790 and Liberty Utilities contributed $3,409. If I had used the 2% financing available to me on my $2,790, my total annual payments would have been $136. Had Liberty not contributed and I financed the whole $6,299 at 2%, the annual total of my payments would have been $308. Comparing the oil heating cost given by entering my previous heat use into the otherwise unchanged spreadsheet provided by Liberty ($1,208.68) to the oil heat cost given to my present heat use ($839.36) I saved $369.32 Investing in efficiency pays for itself, unlike investing in natural gas heating equipment. The energy efficiency program of Liberty Utilities immediately benefits the customer, and offers a positive value to Lebanon oil heating customers, while offering a conversion to natural gas heating is for almost all oil customers a net negative.

Q13 In your opinion, would an informed oil user switch to natural gas to reduce impact on the environment?

A13 No. My conclusion is that natural gas, and especially shale, or "fracked" natural gas, is far worse for the environment than oil, because of the outsized impact of leaked gas.

Liberty Utilities says on its web site that:

"Our vision for energy efficiency is to help our customers make smart energy choices that will reduce the impact that energy generation has on our environment."

My analysis using Liberty Utilities' own cost calculator shows that based on economic considerations alone it would not be smart for most residential oil heating customers to convert to natural gas. It would be far smarter in economic terms to invest in energy efficiency and reduce oil usage.

Then would it be smart to switch from oil to natural gas to reduce the impact on the environment? Five years ago the impression was wide spread that natural gas was a bridge fuel to eventual renewable energy use, and that while not renewable, natural gas is virtually inexhaustible and is better for the environment than other fossil fuels. This inference has been widely purveyed in television ads sponsored by the American Petroleum Institute but in the past few years has been contradicted by a growing body of scientific research investigating the environmental impact of natural gas escaping unburned directly into the atmosphere, during production at wellheads, at compressor stations and along distribution pipelines. The Intergovernmental Panel on Climate Change says that unburned natural gas (mostly methane) has a direct impact on global warming 86 times that of CO2 over a 20 year time frame (ATTACHMENT, page 18). This huge 86 times multiplier makes the direct negative effects of fugitive methane overwhelm the positive effects of lower CO2 emissions in burning natural gas.

(IPCC. 2013. Climate change 2013: the physical science basis. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar5/wg1/)

One review of research concludes that: “Using these new, best available data and a 20-year time period for comparing the warming potential of methane to carbon dioxide, the conclusion stands that both shale gas and conventional natural gas have a larger GHG than do coal or oil, for any possible use of natural gas and particularly for the primary uses of residential and commercial heating.” Page 19 of the ATTACHMENT shows this quote and page 20 compares natural gas to oil and coal graphically.

(Howarth, R. W., “A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas”, *Energy Science and Engineering*, http://www.eeb.cornell.edu/howarth/publications/Howarth_2014_ESE_methane_emissions.pdf)

While there is some disagreement on exactly what percentage of natural gas escapes there is no question that it is a lot. Satellite measurements of global atmospheric concentrations of methane show that a 20% increase coincides with the fracking boom in the United States (ATTACHMENT, page 21). Satellite images give direct visual evidence of increased concentrations of methane above the geographical areas of fracking (ATTACHMENT, page 21). It appears that shale, or fracked, natural gas is a major contributor to global warming.

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While all the natural gas distributed by Liberty Utilities may not be the “worst” shale gas, it would be difficult to obtain and supply to environmentally concerned Lebanon and Hanover customers natural gas specifically produced conventionally. Shale gas now makes up approximately 50% of all domestic natural gas production (ATTACHMENT, page 22).

As evidence about the true environmental impact of natural gas becomes more widely known, it will create a marketing problem for Liberty Utilities

with environmentally concerned potential customers.

Q14 What heating choices could you make that would be "smart" according to your environmental concerns?

A14 Air source heat pumps would heat my house for only slightly more than natural gas.

	Annual Operating Cost	Cost of Installing Equipment	Operating + Capital cost
Natural Gas	**$1,020.52**	**$8,000**	**$2,015.08**
Air Source Heat Pumps	**$985.77**	**$8,500**	**$2,042.49**

Pages of the spreadsheet making these calculations are shown in ATTACHMENT, pages 23, 23 and 25. Note that this spreadsheet uses a different time period and different degree days than the Liberty Utilities calculator and derives slightly different cost projections. ARC Mechanical installs 100 residential and commercial heat pumps a year locally and estimated the installation cost of heat pumps sized to provide all the heating for my house (rather than the more usual supplemental heating) to be $8,500 (including electrical circuitry). Capital costs are a 4.5% home equity loan.

I could heat with renewable energy with heat pumps if I purchased renewably generated electricity, such as through Arcadia Power. Similarly, in their Green Power Challenge, enough Hanover residents and businesses have participated in renewable energy purchases that 22.5% of Hanover's electricity has been renewably generated. Renewably generated electricity is the fastest growing segment of electricity

generation (ATTACHMENT, page 26). If I installed solar panels or participated in community solar I could generate my own renewable electricity. Perhaps in another year I could purchase electricity generated renewably from landfill gas (methane) at the Lebanon landfill.

Q14 Do you believe that enough potential gas customers share your environmental concerns to detract from the marketability of natural gas?

A14 Yes. Both Hanover and Lebanon are officially committed to radically reducing the use of fossil fuel within decades. Liberty's proposal to solicit new residential and commercial capital investment in a particularly "bad" fossil fuel is widely understood to be directly at odds with those commitments, motivating citizen opposition.

Popular unanimous vote in Hanover's Town Meeting on May 9, 2017 adopted the goal of being 100% renewable in energy use by 2050. Similarly, the Energy Chapter of the Lebanon Master Plan commits the City of Lebanon to "comply with the New Hampshire Climate Action Plan, which aims to reduce greenhouse gas emissions 80% below 1990 levels by 2050." Many Lebanon residents attended hearings before the City Council on June 7, 2017 and the Planning Board on July 10, 2017, all in support of a proposal by the Lebanon Energy Advisory Committee to strike references supporting natural gas from the Energy Chapter as being inconsistent with the Chapter's fossil fuel-reducing goals. Except for the representative of Liberty Utilities who attended those meetings, there was no dissention by any board or audience member about the negative impact of natural gas on renewable energy goals. (See the Valley News coverage in ATTACHMENT, page 27-29). The citizen's float in the Hanover Fourth of July parade supporting renewable energy and opposing the proposed pipeline was cheered and won second prize for best float. Over 100 residents attended a forum against the pipeline on

March 29, 2017 and 80 attended a second forum on April 21, 2017, (both broadcast on CATV) deciding among other things to hold a major public rally against the pipeline, scheduled for August 12, 2017 on the Lebanon green. Nine local organizations are actively cooperating in contacting known management leaders of large potential Liberty customers in Lebanon and Hanover to persuade them not to contract with pipeline gas.

Q15 How do you summarize your conclusions?

A15 All of the following are marketing problems for Liberty's proposed project:

- **It would be foolish on economic grounds for the majority of residential customers who are now oil users to switch to using natural gas, if they consider the cost of equipment conversion.**
- **Uncertainty about future gas price increases will further depress customer interest in natural gas.**
- **Without switching fuel, substantial heating cost savings can be secured by investment in energy efficiency, which pays for itself immediately.**
- **Renewable heating by heat pumps is comparable in cost to natural gas.**
- **The truth that natural gas is a non-renewable fuel that is as bad or worse for the environment as other fossil fuel choices is becoming more widely known, eroding the image that natural gas is better for the environment that had been created by an extensive publicity campaign.**
- **Motivated by public policy decisions in both Hanover and Lebanon to favor renewable energy use, more and more citizens are committing to influence potential gas pipeline customers not to become Liberty customers.**

- **Q16 Is this the end of your testimony?**
- **A16 Yes.**