

**STATE OF NEW HAMPSHIRE
BEFORE THE PUBLIC UTILITIES COMMISSION**

**Docket No. DG 17-152
Liberty Utilities Least Cost Integrated Resource Plan**

DIRECT TESTIMONY OF

**ELIZABETH A. STANTON, PhD
ON BEHALF OF CONSERVATION LAW FOUNDATION**

APPLIED ECONOMICS CLINIC

SEPTEMBER 6, 2019

I. INTRODUCTION

Q: Please state your name, occupation, and business address.

A: My name is Elizabeth A. Stanton, Ph.D. I am the Director and Senior Economist of the Applied Economics Clinic, 1012 Massachusetts Avenue, Arlington MA 02476.

Q: On whose behalf are you testifying in this proceeding?

A: I am testifying on behalf of Conservation Law Foundation (CLF), 27 North Main Street Concord, NH 03301. CLF is a private, non-profit organization dedicated to protecting New England's environment for the benefit of all people.

Q: Dr. Stanton, what is your education and professional background?

A: I am the founder and Director of the Applied Economics Clinic, a non-profit consulting group and a long-term Visiting Scholar at the Global Development and Environment Institute at Tufts University. The Applied Economics Clinic ("the Clinic") provides expert testimony, analysis, modeling, policy briefs, and reports for public interest groups on the topics of energy, environment, consumer protection, and equity. The Clinic provides training to the next generation of expert technical witnesses and analysts through applied, on-the-job training to graduate students in related fields and works proactively to support diversity among both student workers and professional staff.

I am a researcher and analyst with more than 17 years of professional experience as a political and environmental economist. I have authored more than 150 reports, policy studies, white papers, journal articles, and book chapters on topics related to energy, the economy, and the environment.

My recent work includes Integrated Resource Plan (IRP) and Demand-Side Management (DSM) planning review, analysis and testimony of state climate laws as they relate to proposed capacity additions, and other issues related to consumer and environmental protection in the electric and natural gas sectors. I have submitted expert testimony and comments in state dockets in New Hampshire, Massachusetts, Vermont, Indiana, Illinois, Louisiana, and Minnesota as well as several federal dockets.

In my previous position as a Principal Economist at Synapse Energy Economics, I provided expert testimony in electric and natural gas sector dockets, and led studies examining environmental regulation, cost-benefit analyses, and the economics of energy efficiency and

renewable energy. Prior to joining Synapse, I was a Senior Economist with the Stockholm Environment Institute's (SEI) Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory (CBEI) model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense Fund, among others.

My articles have been published in *Ecological Economics*, *Climatic Change*, *Environmental and Resource Economics*, *Environmental Science & Technology*, and other journals. I have also published books, including *Climate Change and Global Equity* (Anthem Press, 2014) and *Climate Economics: The State of the Art* (Routledge, 2013), which I co-wrote with Frank Ackerman. I am also coauthor of *Environment for the People* (Political Economy Research Institute, 2005, with James K. Boyce) and coeditor of *Reclaiming Nature: Worldwide Strategies for Building Natural Assets* (Anthem Press, 2007, with Boyce and Sunita Narain).

I earned my Ph.D. in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, and the College of New Rochelle, among other colleges and universities. My curriculum vitae is attached to this testimony as EAS-Schedule 1.

A. OVERVIEW

Q: What is the purpose of your testimony?

A: My testimony addresses the need to evaluate the environmental impacts of new gas infrastructure in particular as it relates to climate change.

Q: What New Hampshire law guides the Commission's review of a utility's Least Cost Integrated Resource Plan (LCIRP)?

A: New Hampshire's least cost planning law states:

The general court declares that it shall be the energy policy of this state to meet the energy needs of the citizens and businesses of the state at the lowest reasonable cost while providing for the reliability and diversity of energy sources; to maximize the use of cost effective energy efficiency and other demand side resources; and to *protect the safety and health of the citizens, the physical environment of the state*, and the future supplies of resources, with consideration of the financial stability of the state's utilities

1 RSA 378:37 (emphasis added).

2 Regarding integrated resource plans, New Hampshire law states that they must include:

3 V. An assessment of plan integration and impact on state compliance with the Clean Air Act
4 of 1990, as amended, and other environmental laws that may impact a utility's assets or
5 customers.

6 VI. An assessment of the plan's long- and short-term environmental, economic, and energy
7 price and supply impact on the state.

8 RSA 378:38.

9 In evaluating utility integrated resource plans, New Hampshire law states:

10 In deciding whether or not to approve the utility's plan, the commission *shall consider potential*
11 *environmental, economic, and health-related impacts of each proposed option.*

12 And:

13 Where the commission determines the options have equivalent financial costs, equivalent
14 reliability, and equivalent environmental, economic, and health-related impacts, the following
15 order of energy policy priorities shall guide the commission's evaluation:

16 I. Energy efficiency and other demand-side management resources;

17 II. Renewable energy sources;

18 III. All other energy sources.

19 RSA 378:39.

20 **Q: How is climate change part of the required environmental review?**

21 A: Climate change is a type of environmental impact and therefore is a part of the required environment
22 review under these laws. Climate change includes a range of impacts to ecosystems, economy and
23 health that are reasonable to incorporate in any evaluation of utility plans or projects.

24 **Q: Does climate change affect New Hampshire?**

25 A: Yes, I discuss this in Section B below.

B. CLIMATE IMPACTS EXPECTED IN NEW HAMPSHIRE

Q: Is climate change expected to effect New Hampshire?

A: Yes, climate change is expected to have negative impacts on New Hampshire’s natural ecosystems, economy, and the health of its residents. Among many other sources, detailed geographic analysis published in 2017 by the U.S. Global Change Research Program (USGCRP)—a federal program mandated by the U.S. Congress—provides the most recent forecasts of climate damages expected in Northeast states (see Table 1).¹

Table 1. Impacts of Climate Change in New Hampshire²

Temperature
• 4°F to 5°F of additional annual average temperature increase is expected in New Hampshire by 2050 • Observed and projected increases in temperature are changing seasonality • The annual average temperature in New England has increased by about 3°F or more since 1901
Precipitation
• Observed and projected trend towards increases in rainfall intensity, exceeding similar increases elsewhere in the United States • Increases in total precipitation expected in winter and spring, little change expected in summer • In the worst case scenario (RCP8.5), monthly precipitation between December and April expected to be about 1 inch greater by the end of the century • Urban areas are at risk for displaced populations and damaged infrastructure due to extreme precipitation events and recurrent flooding
Ocean and Sea Level Rise
• Observed and projected increases in temperature, acidification, storm frequency and intensity • The warming trend in the ocean has been associated with fish migration northward and to greater depths • Sea level rise has amplified storm impacts on the coast, contributing to higher storm surges that reach further inland
Economy
• New England has a high occurrence of tourism and other natural resource-dependent industries like fishing, farming and forestry—putting livelihoods at greater risk from climate impacts • Much of the infrastructure in New England is old, including drainage and sewer systems, flood and storm protection infrastructure, transportation systems and power supply—climate-related disruptions will exacerbate existing age-related issues
Human Health
• Urban centers tend to have higher temperatures than surrounding regions, due to urban heat island effects • Heat-related illness and death are significant public health problems that are expected to worsen • The Northeast can expect approximately 650 additional premature deaths per year from extreme heat by 2050

¹ U.S. Global Change Research Program (USGCRP), available at https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

² Id.

1 **Q: What changes to temperature are expected in New Hampshire?**

2 **A:** By 2050, New Hampshire’s annual average temperatures are expected to be 4°F to 5°F higher
3 than today’s levels.

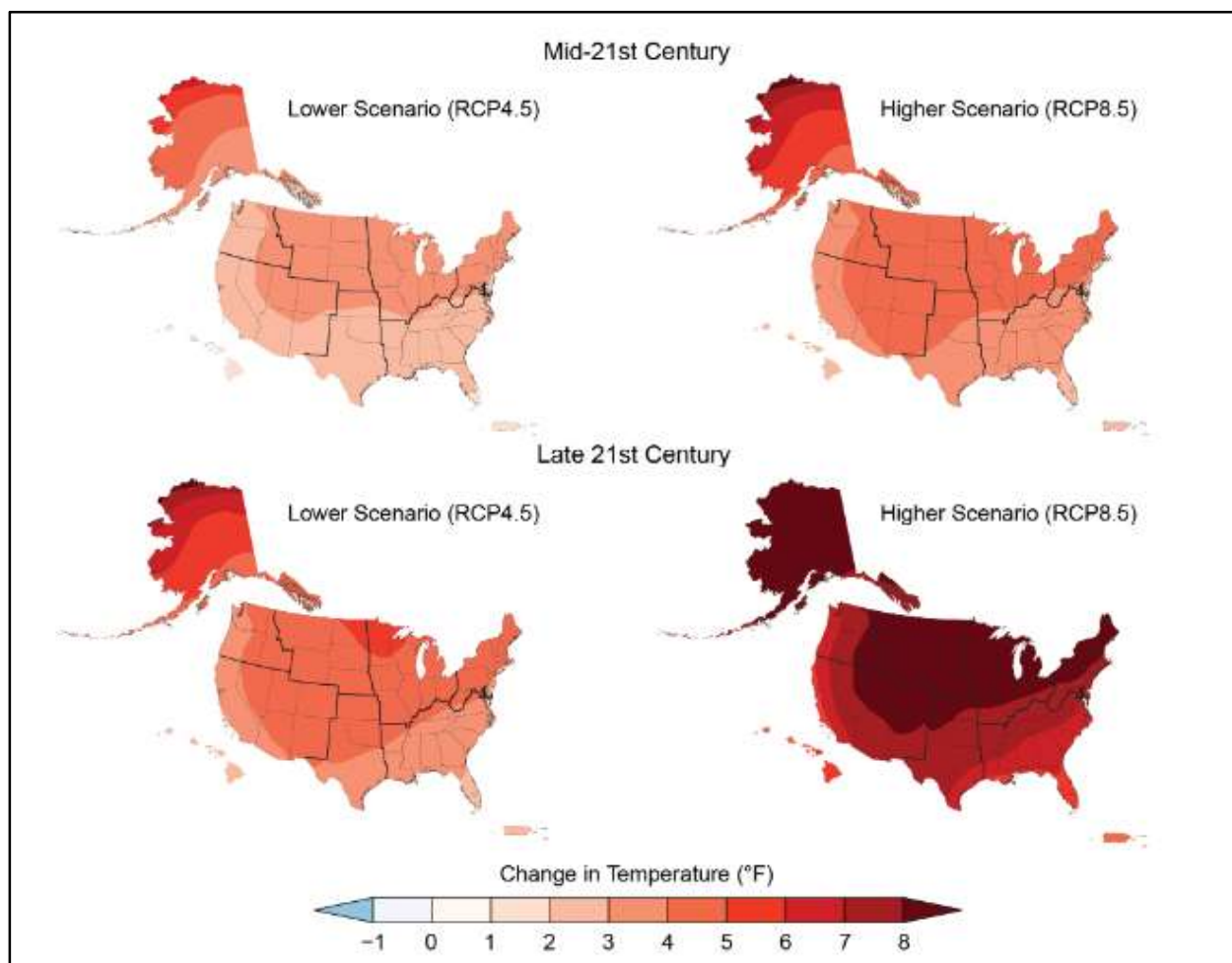
4 USGCRP presents probable temperature changes ranging from an optimistic case (called “RCP
5 4.5” in which global emissions rise only slightly over the next three decades and fall rapidly
6 starting in 2050) to a more pessimistic case (“RCP 8.5” in which global emissions continue to
7 rise at the same rapid pace as the previous two decades). For 2050, the expected range of
8 temperature increase is 4°F under the optimistic forecast up to more than 5°F under the more
9 pessimistic forecast).³ These temperature changes do not include the 3°F of temperature increase
10 that has already occurred, bringing New Hampshire’s current-day snowmelt 2-5 days earlier than
11 1960 at lower elevations and more than 10 days earlier at higher elevations.⁴

12 By 2100, New Hampshire’s annual average temperatures are expected to increase by 5°F to 8°F
13 from today’s levels (see Figure 1).

³ Id. at p. 42.

⁴ Id. at p. 681.

Figure 1. Projected Changes to Annual Average Temperatures from 2015 levels⁵



Q: Is the length of New Hampshire’s winter season expected to shrink with climate change?

A: Yes. According to the USGCRP report, from the current day to mid-century, New Hampshire’s winter season will shrink (and the “freeze-free” season will grow) by 2 to 3 weeks under the optimistic forecast, and up to 4 to 5 weeks under the more pessimistic forecast.⁶

Q: What changes to precipitation are expected in New Hampshire?

A: New Hampshire’s total December to April precipitation is expected to increase by 1 inch by 2050, with little change to summer rain levels.

⁵ Id., reproduced from USGCRP 2017 Figure 1.3.

⁶ Id. at p. 683.

1 **Q: What changes to sea level are expected in New Hampshire?**

2 **A:** By 2100, New Hampshire's sea levels are expected to rise 1-2 feet under the optimistic forecast,
3 and up to 5-6 feet under the more pessimistic forecast of global greenhouse gas emissions.⁷

4 **Q: Does climate change effect ocean temperatures?**

5 **A:** Yes, increased concentrations of greenhouse gases in the atmosphere also raises ocean
6 temperatures. In the last decade, the sea surface temperature above the Northeast Continental
7 Shelf has warmed four times faster than the long-term historical trend, and three times faster than
8 the global average ocean temperature increase.⁸

9 **Q: Does climate change effect the chemical balance of ocean water?**

10 **A:** Yes, increased concentrations of greenhouse gases in the atmosphere also change the pH balance
11 of ocean waters, making the ocean more acidic and making it more difficult for shell-forming
12 organisms (lobsters, scallops, crabs, oysters, clams, mussels) to survive. The USGCRP report
13 states that the coastal waters of the U.S. Northeast are particularly "sensitive to the effects of
14 ocean acidification."⁹

15 **Q: Are these climatic changes expected to impact on New Hampshire's economy?**

16 **A:** Yes. Climate change is expected to have negative impacts on New Hampshire's tourism, forestry,
17 farming, and fishing industries with shorter winters, rapid ecosystem changes and decreased
18 productivity in fisheries. Wetter Springs will make it difficult for farming to benefit from longer
19 growing seasons. According to the USGCRP report the ecosystems at the greatest risk in New
20 Hampshire are Alpine (high elevation), freshwater aquatic, and certain types of forests, which
21 have a difficult time adapting to shifting seasonality and rising temperatures.¹⁰

22 **Q: Are these climatic changes expected to impact on human health in New Hampshire?**

23 **A:** Yes. Climate change is expected to have negative impacts on human health in New Hampshire.
24 Threats to human health include extreme heat, storm flooding, and degradation of air and water
25 quality. More frequent heat waves will increase the numbers of emergency room visits and

⁷ Id. at p. 43.

⁸ Id. at p. 685.

⁹ Id. at p. 687.

¹⁰ Id. at p. 678-679.

premature deaths. Higher levels of ground-level ozone due to changing weather conditions also result in hospitalizations and deaths from asthma and related ailments.¹¹

Q: Has New Hampshire’s climate been changing more or less rapidly than the global average?

A: While global average temperatures have increased about 1.8°F from preindustrial levels, New England annual average temperatures have increased by 3°F.¹² The pace of New England’s sea level rise joins northern Alaska and the eastern Gulf Coast as the most rapid in the United States.

Q: Can global action to rapidly reduce greenhouse gas emissions slow climate change?

A: Yes, global action to rapidly reduce greenhouse gas emissions can slow—but not reverse—climate change. In a best-case scenario in which global greenhouse gas emissions begin to fall rapidly by 2020 (called “RCP 2.6”), New Hampshire’s annual average temperature would increase only an additional 1°F or less by 2050.¹³

C. NEW HAMPSHIRE AND GREENHOUSE GAS EMISSION REDUCTIONS

Q: What emissions reductions are necessary to limit further annual average temperature increases to 1°F in New Hampshire?

A: To limit New Hampshire’s future temperature increase to 1°F will require limiting future global average temperature increases to 0.8°F (not including the 1.8°F global increase that has already occurred, for a total of approximately 2.6°F from preindustrial times: this scenario is often referred to as “RCP 2.6”). In this best-case scenario, global emissions fall to half their current levels by 2040 and to zero net emissions by 2080.¹⁴

For New Hampshire this would mean that its 2015 greenhouse gas emissions (the latest year for which a state inventory is available) of 16 million metric tons (MMT) CO₂-equivalent (CO₂-e) (see Figure 2) must fall to 8 MMT by 2040 and 0 MMT by 2080.

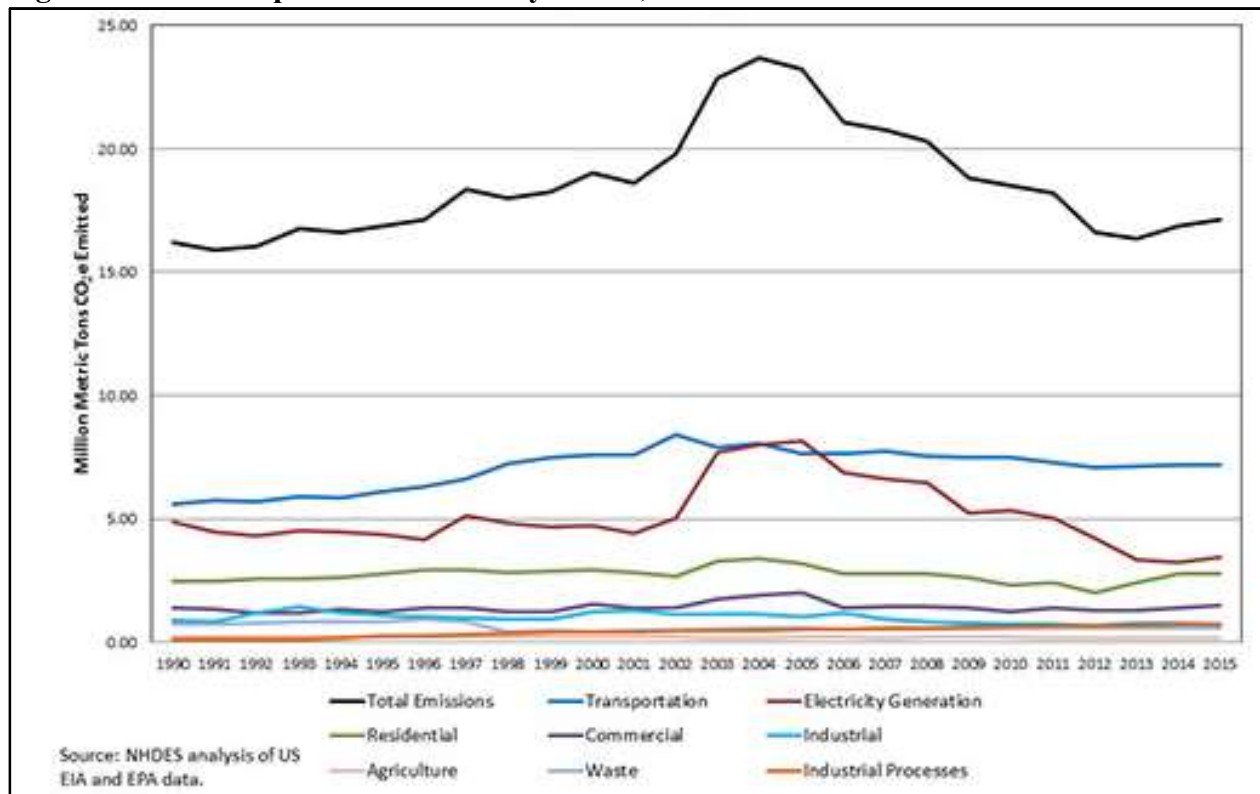
¹¹ Id. at p. 700.

¹² Global Warming of 1.5°C (IPCC 2018 SPM), available at https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf, p. 4.

¹³ IPCC SPM 2018 at p. 4, and NOAA State Climate Summaries: New Hampshire (NOAA 2019) <https://statesummaries.ncics.org/chapter/nh/>.

¹⁴ van Vuuren, Representative Concentration Pathways, 2011, available at https://unfccc.int/sites/default/files/2_vvuuren13sed2_amended.pdf.

Figure 2. New Hampshire Emissions by Sector, 1990-2015¹⁵



Q: What emission reductions are called for in New Hampshire’s 2009 Climate Action Plan?

A: New Hampshire’s 2009 Climate Action Plan sets greenhouse gas emission level targets of 12.7 MMT CO₂-3 in 2025 and 13.2 MMT in 2050.¹⁶ Assuming a steady pace of reductions between and beyond these dates, these targets would result in 2040 emissions of 13.0 MMT and 2080 emissions of 13.8 MMT.

Q: How do New Hampshire’s greenhouse gas emission reduction targets compare to the reductions necessary to limit future temperature increases to 1°F?

A: If the state implemented New Hampshire’s 2009 Climate Action Plan, the state’s 2040 emissions would be 26 percent lower than current-day emissions, compared to the 50 percent reduction worldwide necessary to limit future temperature increases to 1°F. Under the Climate Action Plan,

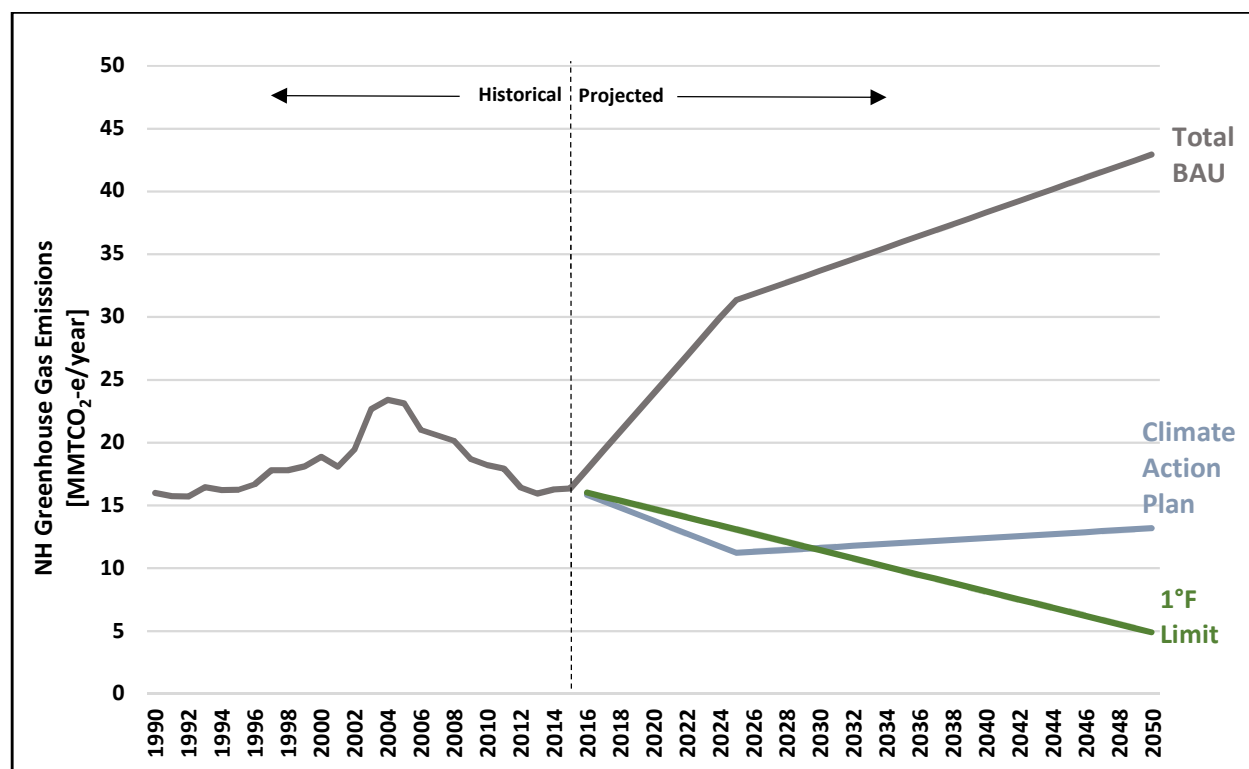
¹⁵ Reproduced from New Hampshire Department of Environmental Services, 2015. *New Hampshire Greenhouse Gas Emissions Inventory*. Available at: <https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/ghg-emissions.htm>.

¹⁶ NH Climate Action Plan, 2009, available at https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/nh_climate_action_plan.htm.

New Hampshire's emissions increase very gradually after 2025. To limit future temperature increases to 1°F, global emissions must begin to fall rapidly by 2020 and continue this decline until they reach zero net levels on or before 2080.

Without the emission reduction actions described in the Climate Action Plan, New Hampshire's emissions are expected to increase steadily, rising to 31 MMT CO₂-e in 2025 and 43 MMT in 2050.¹⁷ This pace of growth exceeds the most pessimistic global emissions growth (RCP 8.5) expected by U.S. and international sources (see Figure 3).¹⁸

Figure 3. New Hampshire Projected Emissions by Scenario¹⁹



¹⁷ Id. at p.16.

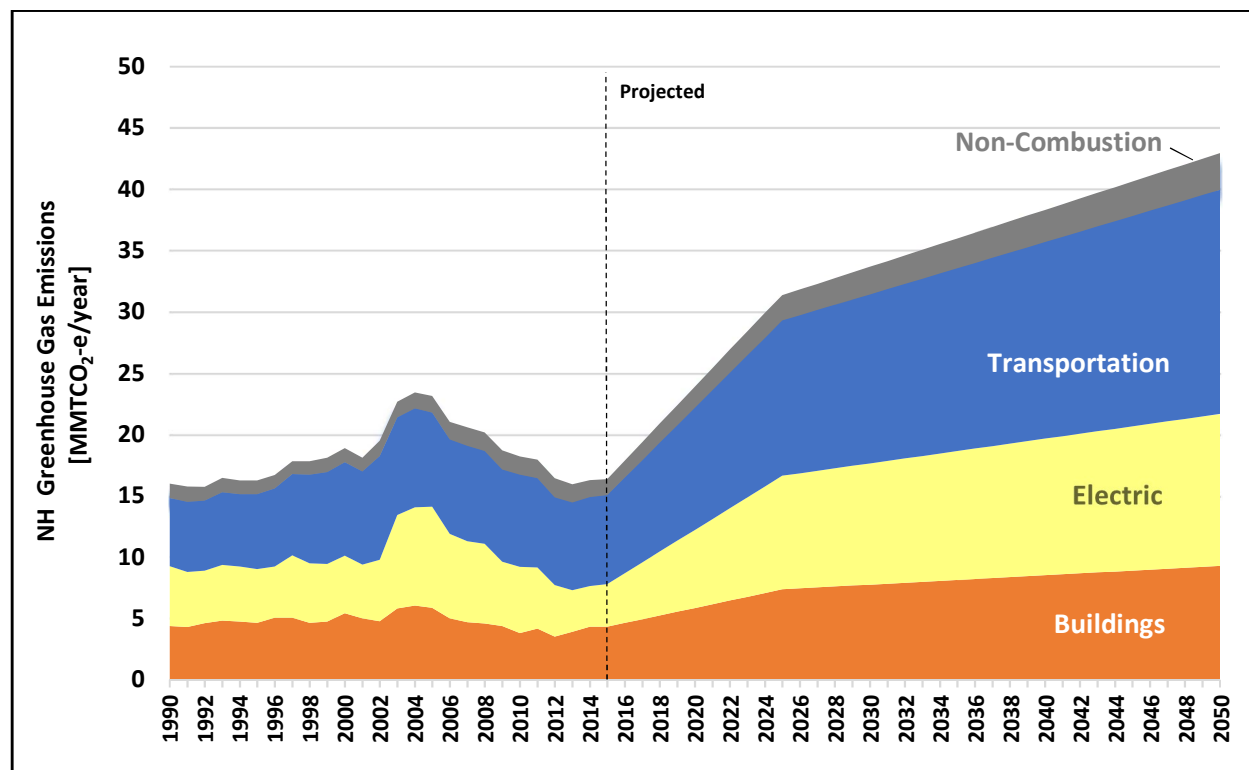
¹⁸ See van Vuuren at p.8.

¹⁹ NH DES 2015 NH Greenhouse Gas Emission Inventory, available at <https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/ghg-emissions.htm>, Figure 1.3, Table 2.1; NH DES 2015. NH GHG Emissions by Sector.

Q: What emissions are expected from the direct use of fuels in homes and businesses in New Hampshire?

A: According to NHDES, direct fuel use (not including electric generation) in New Hampshire's homes and business accounted for 4.3 MMT CO₂-e in 2015.²⁰ These emissions are expected to grow to 9.3 MTT by 2050 under a business-as-usual scenario without emission reduction policies (see "Buildings" in Figure 4).

Figure 4. New Hampshire Historical and Business-As-Usual Emissions by Sector²¹



²⁰ NH DES 2015 NH Greenhouse Gas Emission Inventory, available at <https://www.des.nh.gov/organization/divisions/air/tsb/tps/climate/ghg-emissions.htm>.

²¹ NH Climate Plan, 2009. Table 1.2, Figure 1.3; NH DES 2015. NH GHG Emissions by Sector.

D. EMISSIONS FROM GRANITE BRIDGE PIPELINE

Q: What greenhouse gas emissions come from building heating in Liberty’s service territory at present?

A: According to the testimony of Paul J. Hibbard in DG 17-152,²² 0.4 MMT CO₂-e is emitted annually from heating in the Liberty’s service territory.

Q: Do you agree with Liberty’s claims regarding the emissions impact from the addition of the Granite Bridge pipeline?

A: No. According to the testimony of Paul J. Hibbard in DG 17-152, Liberty claims that their customers’ greenhouse gas emissions from heating from sources other than gas would decline with the development of the Granite Bridge pipeline.²³ This expectation rests on the incorrect assumption that customers have two and only two heating choices: existing non-gas fossil fuels (fuel oil, propane) or new gas supplied by Granite Bridge.

Q: Is this a credible evaluation of the emissions impact?

A: No. Liberty’s evaluation fails to consider lower emission heating alternatives—such as heat pumps, and as CLF’s witness Chernick describes, it also fails to adequately consider demand side resources.

Q: Does Liberty’s claimed emission reduction take into account low-emission alternatives to current heating fuels?

A: No. By limiting heating alternatives to two (non-gas fossil fuels and new gas supplied by Granite Bridge), Liberty effectively “dials in” or “sets” an assumed emission reduction. Energy efficient electric heat pumps appear to supply a very limited share of heating needs in Liberty’s alternative to the Granite Bridge pipeline. Testimony submitted by Paul J. Hibbard describes this methodology and discusses the very low share of heat pumps Liberty has modeled in New Hampshire’s future heating mix.²⁴ This very low share is the “status quo” to which Granite Bridge is compared and includes 59 percent of customers heating with oil, 21 percent with propane, 11 percent with electric, and 5 percent with wood).

²² Hibbard Exhibit 2, Bates p.49.

²³ See id.

²⁴ See id. at p. 21.

Q: Is Liberty's claimed emission reduction correct?

A: Liberty's claimed emission reduction is not correct. The claimed emission reduction relies on electric heat pumps being either non-existent or infeasible—neither of which is the case. Electric heat pumps are a feasible, lower-emission alternative to non-gas fossil fuel or gas heating, as is discussed in Mr. Chernick's testimony.

Q: What is the correct emissions impact from Granite Bridge?

A: In comparison to the lowest emission heating alternative for Liberty's territory (conversion to electric heat pumps as discussed in Mr. Chernick's testimony), Granite Bridge increases emissions. Gas heating is less efficient and more emissions intensive than heating with sources such as electric heat pumps.

Q: Even if Liberty's claimed emissions reduction occurred, would it be sufficient to meet the pace of reductions needed to limit New Hampshire's future temperature rise to 1°F?

A: No, Even if a new gas pipeline resulted in the Company's projected reduction – which it does not – limiting New Hampshire's future temperature rise to 1°F will require a global emissions reduction of 50 percent by 2040 and 100 percent by 2080. Liberty evaluates Granite Bridge using an average life for the investment of 55 years, meaning that the pipeline's useful life extends into the 2060s or later.

Q: Can New Hampshire meet its share of emission reductions without reducing gas usage?

A: No. As Mr. Chernick's testimony notes, the proposed promotion and expansion of natural gas supply fails to advance economically prudent or environmentally sound energy investments.

E. LIMITATIONS FOR FUTURE GAS USE

Q: Can a global emission reduction of 50 percent by 2040 and 100 percent by 2080 be achieved in some way that does not require New Hampshire to meet these worldwide emission reductions?

A: The only way in which the global emission reduction necessary to limit New Hampshire's future temperature increase to 1°F (50 percent by 2040 and 100 percent by 2080) can be achieved without New Hampshire itself meeting these emission limits is for other states and countries to

1 exceed the limits. New Hampshire residents must either do their own share of emission
2 reductions or rely on others outside of the state to do it for them.

3 **Q: Does conversion to gas heating provide a path for New Hampshire to achieve the needed**
4 **emission reductions sufficient to limit New Hampshire's future temperature increase to 1°F**
5 **(50 percent by 2040 and 100 percent by 2080)?**

6 **A:** No. Even Liberty's testimony acknowledges that a reliance on gas that would extend into the
7 2060s. New Hampshire needs a portfolio of measures that reduce emissions by much more than
8 50 percent (so that the whole portfolio has an average reduction of 50 percent). Expanding gas
9 use for heating falls far short of this need. Building heating emission reductions must either do
10 their own share of emission reductions, or rely on other measures (outside of the building sector)
11 to do it for the sector.

12 **Q: In terms of climate change, has Liberty provided a least cost integrated resource plan that**
13 **reasonably addresses environmental and public health impacts?**

14 **A:** No. The evaluation fails to adequately address or assess the climate change impacts of the
15 Company's planned expansion of natural gas.

16 **Q: Does this conclude your testimony?**

17 **A:** Yes.

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PROFESSIONAL EXPERIENCE

Applied Economics Clinic, Somerville, MA. *Director and Senior Economist*, February 2017 – Present.

The Applied Economics Clinic provides technical expertise to public service organizations working on topics related to the environment, consumer rights, the energy sector, and community equity. Dr. Stanton is the Founder and Director of the Clinic (www.aeclinic.org).

Liz Stanton Consulting, Arlington, MA. *Independent Consultant*, August 2016 – January 2017.

Providing consulting services on the economics of energy, environment and equity.

Synapse Energy Economics Inc., Cambridge, MA. *Principal Economist*, 2012 – 2016.

Consulted on issues of energy economics, environmental impacts, climate change policy, and environmental externalities valuation.

Stockholm Environment Institute - U.S. Center, Somerville, MA. *Senior Economist*, 2010–2012; *Economist*, 2008 – 2009.

Wrote extensively for academic, policy, and general audiences, and directed studies for a wide range of government agencies, international organizations, and nonprofit groups.

Global Development and Environment Institute, Tufts University, Medford, MA. *Researcher*, 2006– 2007.

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Center for Popular Economics, University of Massachusetts-Amherst, Amherst, MA. *Program Director*, 2001 – 2003.

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AFFILIATIONS

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Senior Fellow, Visiting Scholar, 2007 – Present

PAPERS AND REPORTS

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