STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 7970

Petition of Vermont Gas Systems, Inc. for	**)**
a certificate of public good, pursuant to	**)**
30 V.S.A. § 248, authorizing the construction	**)**
of approximately 43 miles of new natural gas	**)**
transmission pipeline in Chittenden and Addison	**)**
Counties, approximately 5 miles of new	**)**
distribution mainlines in Addison County,	**)**
together with three new gate stations in Williston,	**)**
New Haven and Middlebury, Vermont	**)**

DIRECT TESTIMONY OF

ELIZABETH A. STANTON, PH.D.

ON BEHALF OF

CONSERVATION LAW FOUNDATION

JUNE 14, 2013

Dr. Stanton's testimony identifies serious shortcomings regarding the climate change impacts of the proposed project: Ms. Simollardes calculations of the emission impact of the Addison Natural Gas Project fail to include methane, and fail to account for the life cycle emissions of the project. Dr. Stanton demonstrates that Ms. Simollardes' assumptions are inaccurate and presents corrected calculations showing that net emissions would, in fact, increase from the proposed expansion. She also describes the effect that making such corrections has on the environmental outlook of this project, discusses opportunities to use thermal efficiency improvements to mitigate or offset increased emissions, and explains the proposed Addison Pipeline expansion's expected effect on Vermont's ability to meet the goals of its Comprehensive Energy Plan.

Direct Testimony
of
Elizabeth A. Stanton, PhD

Q1. Please state your name and occupation.

A1. My name is Elizabeth A. Stanton, and I am a Consultant with Synapse Energy Economics (Synapse).

Q2. On whose behalf did you prepare this direct testimony?

A2. I prepared this testimony on behalf of the Conservation Law Foundation.

Q3. Please describe Synapse Energy Economics.

A3. Synapse Energy Economics ("Synapse") is a research and consulting firm specializing in energy and environmental issues, including electric generation, transmission and distribution system reliability, ratemaking and rate design, electric industry restructuring and market power, electricity market prices, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power.

Q4. Please summarize your work experience and educational background.

A4. I am a Senior Associate at Synapse, where my work focuses primarily on the economic impacts of climate and other environmental policies.

Prior to joining Synapse in 2012, I was a senior economist with the Stockholm Environment Institute's Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory model and on water issues and climate change in the western U.S. I have led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense.

I have co-authored dozens of reports on topics including the cost of inaction on climate change; the economics of emissions-reduction targets; and the balance of science, policy, and equity in global climate protection. My academic articles have been published in Ecological Economics, Renewable Resources Journal, Environmental Science & Technology, and other journals. My book publications include *Climate Economics: The State of the Art* (Routledge, 2012), co-authored with Frank Ackerman; *Environment for the People* (Political Economy Research Institute, 2005, co-authored with James K. Boyce); and *Reclaiming Nature: Worldwide Strategies for Building Natural Assets* (Anthem Press, 2007) co-edited with Boyce and Sunita Narain.

I am a research fellow at the Global Development and Environment Institute (GDAE) of Tufts University and serve on the Climate Taskforce of Economics for Equity and Environment (the E3 Network). I previously served at the University of Massachusetts-Amherst as an editor and researcher for the Political Economy Research Institute, and as program director of the Center for Popular Economics.

I earned my PhD in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, the College of New Rochelle, Fitchburg State College, The School for International Training, and a joint program of Castleton State College and the Southeast Vermont Community Learning Collaborative. My resume is attached as Exhibit CLF-EAS-1.

Q5. Have you previously testified before the Vermont Public Service Board?

A5. No.

Q6. Are you presenting any exhibits to support your testimony?

A6. I am presenting the following exhibits.

CLF-EAS-1 Resume of Elizabeth Stanton, PhD

CLF-EAS-2 Attachment A.CLF.VGS.2-3.1

CLF-EAS-3 Attachment A.CLF.VGS.2-3.2

CLF-EAS-4 A.PSD:VGS.2-34a; see also Q.ANR:VGS.2-61 through 2-64

CLF-EAS-5 1997 EPA Report: Harrison, M. R., Shires, T. M., Wessels, J. K., & Cowgill, R. M. (1997). Methane Emissions from the Natural Gas Industry. Research Triangle Park: United States Environmental Protection Agency.

CLF-EAS-6 WRI Report: Bradbury, J., Obeiter, M., Draucker, L., Stevens, A., & Wang, W. (2013). Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems. Washington, DC: World Resources Institute.

CLF-EAS-7 Synapse Excel Based Calculations

CLF-EAS-8 A.CLF:VGS.2-1

CLF-EAS-9 REDACTED Attachment A.ANRVGS.RTP.1-3 (Simollardes) "Redacted – with IP 20 year response"

CLF-EAS-10 Vermont Thermal Efficiency Task Force Report

CLF-EAS-11 Vermont Comprehensive Energy Plan Overview

Q7. Please summarize your testimony.

A7. My testimony identifies serious shortcomings regarding the climate change impacts of the proposed project: Ms. Simollardes calculations of the emission impact of the Addison Natural Gas Project fail to include methane, and fail to account for the life cycle emissions of the project. I demonstrate that Ms. Simollardes' assumptions are inaccurate and present corrected calculations showing that net emissions would, in fact, increase from the proposed expansion. I also describe the effect that making such corrections has on the environmental outlook of this project, discuss opportunities to use thermal efficiency improvements to mitigate or offset increased emissions, and explain the proposed Addison Pipeline expansion's expected effect on Vermont's ability to meet the goals of its Comprehensive Energy Plan.

Q8. How is your testimony organized?

A8. My findings are presented in the following order:

I. The implicit assumption that the Addison Pipeline expansion will not result in methane emissions is unreasonable.

II. Correcting Ms. Simollardes' assumptions yields a significantly different conclusion regarding the environmental outlook of this project.

III. Opportunities to reduce emissions from the Addison Pipeline expansion and prevent associated environmental damages.

IV. The Addison Pipeline expansion hinders Vermont's ability to achieve Vermont's 2050 energy goals.

I. THE IMPLICIT ASSUMPTION THAT THE ADDISON PIPELINE EXPANSION WILL NOT RESULT IN METHANE EMISSIONS IS UNREASONABLE.

Q9. Please explain how Ms. Simollardes calculates the emissions presented in her prefiled testimony (VGS ANGP Simollardes PFT [12-20-12])?

A9. Ms. Simollardes uses simple spreadsheet calculations to estimate emissions based on the amount of fuel oil and propane natural gas that the Addison Pipeline expansion is expected to displace in a given year [see Attachment A.CLF.VGS.2-3.1 and Attachment A.CLF.VGS.2-3.2 attached as Exhibits CLF-EAS-2 and CLF-EAS-3]. Based on these calculations she asserts that "The Project promotes the general good of the state by…reducing greenhouse gas emissions ("GHGs") by a total of almost 300,000 tons over [the next 20 years]"(VGS ANGP Simollardes

PFT [12-20-12], p.2, lines 13-15) without including possible supply to the International Paper's Ticonderoga Mill.

In her spreadsheets, Ms. Simollardes uses typical emissions rates from combustion of each of the fuels to compare carbon dioxide (CO_2) emissions with and without the expansion. Because natural gas can produce the same amount of energy as fuel oil and propane while producing less CO_2, she asserts that the expansion will result in a net reduction in CO_2 emissions.

Q10. What does Ms. Simollardes assume regarding methane emissions from the Addison Pipeline project?

A10. Ms. Simollardes implicitly assumes that there will be no increase in methane emissions associated with the expansion of the Addison Pipeline. She states that "Vermont Gas has not historically calculated methane as a GHG as compared to carbon dioxide"(A.PSD:VGS.2-34a; see also Q.ANR:VGS.2-61 through 2-64 attached as Exhibit CLF-EAS-4). In the spreadsheets estimating the greenhouse gas emissions of the Addison Pipeline project, Ms. Simollardes does not include any calculation of methane emissions (see Attachment A.CLF.VGS.2-3.1 and Attachment A.CLF.VGS.2-3.2 attached as Exhibits CLF-EAS-2 and CLF-EAS-3).

Q11. Do you find this to be a reasonable assumption?

A11. No.

Q12. What do you find to be unreasonable about this assumption?

A12. Achieving zero methane emissions is contrary to industry experience regarding the technical feasibility and physical limitations that exist in natural gas systems. EPA's 1997 seminal analysis of "Methane Emissions from the Natural Gas Industry" is attached as Exhibit CLF-EAS-5. For this study, EPA used tracer elements to track where leaks occur and how much methane leaks during each phase of the natural gas life cycle. The study concluded that increased methane emissions should be expected as natural gas production expands, and presented an initial estimate of those emissions.

Subsequent studies have confirmed these findings. For an overview of recent literature see the April 2013 report from the World Resources Institute (Bradbury, J., Obeiter, M., Draucker, L., Stevens, A., & Wang, W. (2013). *Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems.* Washington, DC: World Resources Institute) attached as Exhibit CLF-EAS-6.

Even with rigorous maintenance and technical advancements to prevent leaks, it is unreasonable to assume that no methane will leak from the system at some point during the natural gas life cycle from drilling to end user.

Q13. Is methane an important contributer to greenhouse-gas emissions?

A13. Yes. As discussed below, methane is actually a more potent greenhouse gas than CO_2 by a factor of 25.

Q14. What do you mean by "natural gas life cycle"?

A14. The natural gas life cycle is the set of all processes related to the use of natural gas from its extraction, processing, and distribution, to its end-use combustion. Life-cycle analyses are studies that determine the upstream and downstream consequences of a particular product or service used by consumers.

Q15. Can you provide examples of published life-cycle analyses for natural gas?

A15. Yes. I reviewed the results of four life-cycle analyses of natural gas published in the last two years. They are:

1) Howarth, R. W., Santoro, R., & Ingraffea, A. (2011). *Methane and greenhouse-gas footprint of natural gas from shale formations.* Springer Netherlands.
2) Burnham, A., J. Han, C.E. Clark, M. Wang, J.B. Dunn, and I.P. Rivera. (2011). "Life cycle greenhouse gas emissions of shale gas, natural gas, coal, and petroleum." Environmental Science and Technology. doi: 10.1021/es201942m.
3) Weber, C., and C. Clavin. (2012). "Life Cycle Carbon Footprint of Shale Gas: Review of Evidence and Implications." Environmental Science and Technology. doi:10.1021/es300375n.
4) Logan, J., G. Heath, J. Macknick, E. Paranhos, W. Boyd, and K. Carlson. (2012). "Natural Gas and the Transformation of the U.S. Energy Sector: Electricity." NREL Technical Report-6A50-55538.

These reports were summarized and analyzed in an April 2013 report from the World Resources Institute (WRI) (Bradbury, J., Obeiter, M., Draucker, L., Stevens, A., & Wang, W. (2013). *Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems.* Washington, DC: World Resources Institute, attached as Exhibit CLF-EAS-6). Each of these studies specifically looked at methane leaks from the natural gas industry over the total life cycle of natural gas and concluded that methane leaks will inevitably occur in its extraction, processing, distribution, and combustion.

The WRI report concluded that "Fugitive methane emissions from natural gas systems represent a significant source of global warming pollution in the U.S. Reductions in methane emission are urgently needed as part of the broader effort to slow the rate of global temperature rise."(p.2) The figure below reproduces WRI Table 1, showing life-cycle methane leak rate estimates for natural gas (given in percentages of total system gas flow).

Table 1 | Life Cycle Methane Leakage Rate Estimates for Natural Gas from Onshore Conventional and Shale Gas Sources

	CONVENTIONAL ONSHORE	RANGE		SHALE / UNCONVENTIONAL	RANGE	
		LOW	HIGH		LOW	HIGH
Burnham	2.75	0.97	5.47	2.01	0.71	5.23
Howarth	3.85	1.70	6.00	5.75	3.60	7.90
Weber	2.80	1.20	4.70	2.42	0.90	5.20
Logan	–	–	–	1.30	0.80	2.80

According to the WRI summary report, estimates of life-cycle natural gas leak rates range from 2.75 to 3.85 percent for conventional on-shore extraction and 1.30 to 5.75 percent for shale or unconventional extraction.

II. CORRECTING MS. SIMOLLARDES ASSUMPTIONS YIELDS A SIGNIFICANTLY DIFFERENT CONCLUSION REGARDING THE ENVIRONMENTAL OUTLOOK OF THIS PROJECT.

Q16. Were you able to estimate the amount of methane that will be emitted as a result of the Addison Pipeline expansion?

A16. Yes. I created a spreadsheet model to account for methane leaks from the project (attached as Exhibit CLF-EAS-7). In this model, I use a methane "leak rate" from the natural gas life cycle of 3.0 percent, which is the average of the conventional and unconventional estimates in the four studies reviewed in the WRI report (Exhibit CLF-EAS-6).

Q17. What is a methane "leak rate"?

A17. Leak rate is the amount of methane that is lost (or "leaks") from the natural gas system as a percentage of the amount of natural gas that goes through the system on a <u>production</u> basis. If the life-cycle leak rate of natural gas is 3 percent, then for every 100 thousand cubic feet (Mcf[1]) of natural gas <u>consumed</u>, approximately 3 percent—calculated as leak rate/(1-leak rate)—is leaked from the system into the environment.

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[1] 1 Mcf = 1,000 cubic feet of natural gas.

Q18. How did you incorporate the methane leak rate into Ms. Simollardes' emissions calculations for the scenario that does not include supply to the Ticonderoga Mill?

A18. I began by replicating Ms. Simollardes calculations—for the scenario that does not include supply to the Ticonderoga Mill—of the single-year CO_2 emissions for 2016 (see Attachment A.CLF.VGS.2-3.1 attached as Exhibit CLF-EAS-2) and her 20-year projection of CO_2 emissions from 2015 to 2034 (see Attachment A.CLF.VGS.2-3.2 attached as Exhibit CLF-EAS-3). In Exhibit CLF-EAS-7, I extend and correct Ms.Simollardes calculations by accounting for methane leaks associated with natural gas, in addition to CO_2 emissions, by converting methane to its CO_2-equivalent using a 100-year global warming potential.

My calculations can be compared directly to those of Ms. Simollardes. With the exception of the addition of methane emissions, I follow all of Ms. Simollardes' assumptions including how much natural gas would be required to replace propane and fuel oil in a scenario that does not include supply to the Ticonderoga Mill.

Q19. How did you estimate methane emissions from the Addison Pipeline expansion?

A19. I multiplied Ms. Simollardes' projected new natural gas supply (without supply to the Ticonderoga Mill) on an Mcf per year basis by 1) a methane leak rate from the natural gas life cycle of 3.0 percent, which (as described above) is the average of the conventional and unconventional leakage estimates in the four studies reviewed in the WRI report (Exhibit CLF-EAS-6), and 2) the density of methane (lbs/Mcf). The result is an estimate of the pounds of methane emitted each year. I then converted these pounds of methane to CO_2-equivalents using the 100-year global warming potential of methane.

Q20. On what basis did you choose the 100-year time scale for the global warming potential of methane?

A20. In 2007, the Intergovernmental Panel on Climate Change released their Third Assessment Report which is currently the standard for global warming potential factors.[2] Here I include a table which lists global warming potentials using three different time horizons.

Global Warming Potential for CO_2 and CH_4 from the IPCC Third Assessment Report			**Global Warming Potential for Given Time Horizon**		
Industrial Designation or Common Name	**Chemical Formula**	**Radiative Efficiency ($W\ m^{-2}\ ppb^{-1}$)**	**20-yr**	**100-yr**	**500-yr**
Carbon dioxide	CO_2	$1.4x10^{-5}$	1	1	1
Methane	CH_4	$3.7x10^{-4}$	72	25	7.6

This table reports the global warming potential of methane as compared to CO_2 by weight. Over the first 20-years after emission to the atmosphere, each pound of

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[2] Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

methane has a 72 times greater impact on global warming than a pound of CO_2. Methane's global warming potential drops to 25 times the impact of CO_2 on a100-year time horizon, and to 7.6 times the impact of CO_2 on a 500-year time horizon.

The infrastructure developed for the Addison Pipeline expansion is expected to remain in operation for "well over 50 years" (see A.CLF:VGS.2-1 attached as Exhibit CLF-EAS-8). For this reason, the 100-year global warming potential for methane appears to be the most appropriate choice for this analysis.

Q21. How would the emissions that you have estimated change if you instead used the 20-year global warming potential?

A21. Changing this assumption to the 20-year global warming potential would result in projected emissions that were nearly three times higher than estimates based on the 100-year global warming potential.

Q22. What were the results of your corrections to the emissions calculations for the single-year analysis for 2016 for the scenario that excludes supply to the Ticonderoga Mill?

A22. By correcting Ms. Simollardes' calculations for the scenario that excludes supply to the Ticonderoga Mill to include the effect of methane leaks, I found that the 2016 net CO_2-equivalent (CO_2-e) emissions from the Addison Pipeline expansion would be higher than the levels she projected by approximately 21,000 short tons CO_2-e per year. As a result of this correction, Ms. Simollardes' estimate of a 13,000 short ton <u>reduction</u> should be revised to an expected 8,100 short ton <u>net</u>

increase in emissions from the project per year. The table shown here summarizes these annual emission results for 2016:

2016 Annual Totals from Average Leak Rate (no supply to Ticonderoga Mill)				
Simollardes $C0_2$ Emission Change	(25,875,586)	lbs	(12,938)	short tons
Corrected CO_2e Emission Change	16,230,747	lbs	8,115	short tons
Simollardes Overestimate	42,106,333	lbs	21,053	short tons

Q23. Would your conclusion regarding the emissions impact of the project hold if the leak rate of methane were less than 3 percent?

A23. Yes. To investigate this question in my spreadsheet model, I calculated the minimum leak rate necessary to net out all projected CO_2 emission benefits from the project, such that any larger leak rate would result in a net emissions increase (Exhibit CLF-EAS-7).

Holding all other assumptions constant, a methane leak rate of 1.9 percent would result in methane emissions with a CO_2-equivalance equal to the expected CO_2 emission reductions that Ms. Simollardes projects would result from the Addison Pipeline expansion. In other words, with this very low rate of leakage, the project would have a neutral global warming impact. At any leak rate greater than 1.9 percent, the project would increase Vermont's contribution to global warming.

Q24. Is it reasonable to expect that the project's leak rate will be 1.9 percent or greater?

A24. The leak rates cited in the WRI report (Exhibit CLF-EAS-6) range from 2.75 to 3.85 percent for conventional on-shore extraction and 1.30 to 5.75 percent for shale or unconventional extraction. The average estimate is 3.0 percent. While the leak rate specific to the Addison Pipeline expansion has not, to my knowledge, been projected, it seems reasonable to conclude that its leak rate would reach or exceed 1.9 percent, and could certainly be much higher.

Q25. Did you make any assumptions regarding methane leaks from the fuel oil or propane?

A25. Yes. I used the same assumption followed in the four life-cycle analyses reviewed in the World Resources Institute report (Exhibit CLF-EAS-6)and the 1997 EPA analysis (Exhibit CLF-EAS-5). Each of these reports implicitly assumes that methane leaks from fuel oil and propane are negligible.

Q26. Did you perform any additional corrections to Ms. Simollardes analysis of the scenario without supply to the Ticonderoga Mill?

A26. Yes. I made the same corrections to Ms. Simollardes' 20-year projection of the scenario with supply to the Ticonderoga Mill as I did to her single-year analysis fo 2016, and I extended her calculations to estimate emission impacts over a 100-year period (Exhibit CLF-EAS-7).

Over a 100-year period, the Addison Pipeline expansion would add a cumulative 981,000 short tons CO_2-e to Vermont's contribution to global warming. Using the same $80 per short ton cost and 3 percent discount rate employed by Ms. Simollardes (see Attachment A.CLF.VGS.2-3.2 attached as Exhibit CLF-EAS-3), I estimate that the net present cost of these emission <u>increases</u> would be $11 million in 2015 dollars over 20 years or $25 million over 100 years. Ms. Simollardes estimates a $18 million benefit from emission decreases over 20 years—a $29 million overestimate relative to my corrected calculations.

Q27. Did you make any additional assumptions in this multi-year analysis of the scenario without supply to the Ticonderoga Mill?

A27. Yes, I made one additional assumption. Ms.Simollardes' workpapers (Attachment A.CLF.VGS.2-3.1 and Attachment A.CLF.VGS.2-3.2 attached as Exhibits CLF-EAS-2 and CLF-EAS-3) only report projections of natural gas use through 2034. For Years 21-100 in the scenario without supply to the Ticonderoga Mill, I assumed that the project's natural gas usage was unchanged from Year 20. This conservative assumption, together with a leak rate that is assumed to remain constant throughout the lifetime of the Addison Pipeline, likely underestimates future methane leaks.

Cumulative emissions increase by 176,000 short tons over 20 years (compared to a 292,000 short ton reduction calculated by Ms. Simollardes in Exhibit CLF-EAS-3) and 981,000 short tons over 100 years. These results are shown in the table below:

Cumulative 20- and 100-Year Changes (no supply to Ticonderoga Mill)		
Cumulative Change in Emissions	**20-Year**	**100-Year**
CO_2 (short tons)	(292,378)	(1,546,641)
CH_4 (short tons)	18,755	101,121
CO_2e (short tons)	176,492	981,382
Simollardes NPV Calculation	**20-Year**	**100-Year**
NPV in Year 1	$ 17,665,633	$ 39,267,886
Corrected NPV Calculation	**20-Year**	**100-Year**
NPV in Year 1	$ (10,649,569)	$ (24,512,240)

Q28. Did you repeat these calculations for the scenario in which natural gas is supplied to International Paper's Ticonderoga Mill?

A28. Yes. In the scenario in which natural gas is supplied to Ticonderoga Mill the results of my corrections were as follows (Exhibit CLF-EAS-7):

In 2016, CO_2-e emissions increased by 185 million short tons (compared to a 26 million short ton reduction in Ms. Simolardes calculations in REDACTED Attachment A.ANRVGS.RTP.1-3 (Simollardes) "Redacted – with IP 20 year response" attached as Exhibit CLF-EAS-9).

From 2015 to 2034, 20-year cumulative CO_2-e emissions increased by 541,000 short tons (compared to a 1.3 million short ton decrease using the same methodology that Ms. Simollardes uses in Exhibit CLF-EAS-2).

From 2015 to 2114, 100-year cumulative CO_2-e emissions increased by 3.1 million short tons (compared to a 6.5 million short ton decrease using the same methodology that Ms. Simollardes uses in Exhibit CLF-EAS-2). The table below presents these results:

Cumulative 20- and 100-Year Changes (with supply to Ticonderoga Mill)		
Cumulative Change in Emissions	**20-Year**	**100-Year**
CO_2 (short tons)	(1,226,765)	(6,463,970)
CH_4 (short tons)	70,716	381,012
CO_2e (short tons)	541,143	3,061,319
Simollardes NPV Calculation	**20-Year**	**100-Year**
NPV in Year 1	$ 73,974,046	$ 164,174,819
Corrected NPV Calculation	**20-Year**	**100-Year**
NPV in Year 1	$ (32,593,236)	$ (75,998,408)

Q29. Did you make any additional assumptions in order to estimate emissions for the scenario that includes supply to the Ticonderoga Mill?

A29. Yes. Ms. Simollardes presents fuel conversion and total natural gas sales assumptions for 2016 and 2034 in REDACTED Attachment A.ANRVGS.RTP.1-3 (Simollardes) “Redacted – with IP 20 year response” attached as Exhibit CLF-EAS-9), but does not present a time series of these values for Years 1 through 100 in her analysis. I assumed that in this scenario supply to the Ticonderoga Mill would: 1) begin in 2016; 2) follow a linear trend in between Years 2 and 20; and 3) would remain constant at Year 20 levels through Year 100.

Q30. How would you summarize the effect of your corrections to Ms. Simollardes' calculations on the projected emissions impact of the Addison Pipeline expansion project?

A30. My correction to Ms. Simollardes' estimates changes her projected emission reduction associated with the Addison Pipeline expansion to a net emission increase. Based on these calculations, the expansion does not appear to provide Ms. Simllardes claimed environmental benefits and, in fact, will increase Vermont's contribution to global warming. Using the same $80 per short ton cost and 3 percent discount rate employed by Ms. Simollardes, the corrections I have made demonstrate that in the scenario that includes supply to Ticonderoga Mill, where the methodology presented by Ms. Simollardes (Exhibit CLF-EAS-2) projects a net present value benefit of $74 million over 20 years from reduced CO_2 emissions, my calculations show a net present value cost of $33 million over 20 years. Over a 100-year period, the net present value cost of these emission increases would amount to $76 million in 2015 dollars.

III. OPPORTUNITIES TO REDUCE EMISSIONS FROM THE ADDISON PIPELINE EXPANSION AND PREVENT ASSOCIATED ENVIRONMENTAL DAMAGES.

Q31. Have you identified any opportunities to reduce emissions impact from the Addison Pipeline expansion?

A31. Ms. Simollardes' stated emission reductions and environmental benefits (VGS ANGP Simollardes PFT [12-20-12] , p.2, lines 13-15) could be achieved by making Vermont's overall fuel consumption (including natural gas, fuel oil and propane) more efficient (that is, it would have to deliver the same amount of energy using less fuel).

The Vermont Thermal Efficiency Task Force completed its work and reported to the Vermont Legislature in January 2013. The summary of the Task Force Report (Exhibit CLF-EAS-10 p.ES-1) states:

> In 2010, Vermonters paid over $600 million to import fossil based heating fuels; most of this money leaves the Vermont economy. Despite the fact that the average Vermont home today uses about half as much heating oil as compared to the early 1970's, Vermonter's 2010 fuel bill was nearly twice as much as it was a decade earlier, and prices are expected to continue to rise. These price increases will affect both homes and businesses. Comprehensive and rapid weatherization of Vermont's buildings will bring two significant benefits to homes and businesses: (1)

> Vermonters will be less vulnerable to volatility in the fuel market and to effects from dramatic weather fluctuations, and (2) more money will stay within the Vermont economy. At current fuel prices, thermal efficiency investments in a home can bring average savings of approximately $1,000 per year over the lifetime of the investment. The value of these savings increases as fuel prices rise.

The summary of the Task Force Report goes on to state:

> Each new public dollar invested would secure $6.18 in direct fuel price benefits over the life of the measures installed. Overall, Gross State Product, including indirect and other interactive effects of the recommended new spending and savings on the total economy, increases $1.47 for every $1 invested.(p.4)

> In addition to the monetized benefits described previously, investments in thermal efficiency will increase the comfort, health, and safety of Vermont families and businesses, and save over 6.8 million tons of carbon dioxide equivalent emissions from entering the atmosphere, which is equivalent emissions from entering the atmosphere, which is equivalent to the annual CO_2 emissions of 1.7 coal fired power plants, or removing 1.26 million passenger vehibles from the roads for one year.(p.ES-2)

The findings in the Task Force Report are based on projected public investments over seven years totaling just over $267 million (Exhibit CLF-EAS-10 on p. ES-7).

Investment of a substantial portion of the expected $200 million savings in energy bills from the Addison Pipeline expansion (VGS ANGP Simollardes PFT [12-20-12], p.2, lines 13) in the thermal efficiency efforts contemplated in the task force report would be one way to offset the increased emissions from the expansion.

IV. THE ADDISON PIPELINE EXPANSION WILL MAKE IT MORE DIFFICULT TO ACHIEVE VERMONT'S 2050 ENERGY GOALS.

Q32. Are you familiar with Vermont's Comprehensive Energy Plan and its 2050 renewable energy goals?

A32. Yes. The Vermont CEP specifies a goal of having 90 percent of Vermont's energy come from renewable sources by 2050 (Vermont Comprehensive Energy Plan Overview attached as Exhibit CLF-EAS-11).

Q33. What, if any, impact will the Addison project have on obtaining our 2050 goal?

A33. The Addison Pipeline expansion will make it more difficult to achieve this goal. A central purpose of the CEP and its 2050 goal is to reduce Vermont's contribution to anthropogenic global climate change. Conversion from fuel oil and propane to natural gas results in a net increase in greenhouse gas emissions and represents a step in the opposite direction of the CEP goal.

Q34. Does this conclude your testimony at this time?

A34. Yes.