STATE OF VERMONT
PUBLIC SERVICE BOARD

Petition of Vermont Gas Systems, Inc., requesting a Certificate of Public Good pursuant to 30 V.S.A. §, authorizing the construction of the "Addison Natural Gas Project" consisting 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	)))))))))))	Docket No. 7970

REBUTTAL TESTIMONY OF
WALTER (TJ) POOR

ON BEHALF OF THE
VERMONT DEPARTMENT OF PUBLIC SERVICE

AUGUST 14, 2013

Summary: Mr. Poor compares and evaluates the lifecycle greenhouse gas analyses presented by Conservation Law Foundation ("CLF") and Vermont Gas Systems, Inc. ("VGS"). Using these analyses to establish a reasonable range of lifecycle greenhouse gas costs/benefits associated with the Addison Natural Gas Project ("ANGP" or "Project"), Mr. Poor addresses the lifecycle economic impacts of the Project, including consideration of the amount and value of lifecycle greenhouse gas emissions impacts. Mr. Poor introduces the key input parameters of the lifecycle economic analysis conducted by the Department, and introduces the testimony of George Nagle who explains the structure of the economic model.

Rebuttal Testimony
of
Walter (TJ) Poor

Q. Please state your name and title.

A. My name is Walter Poor and my position is as a Utilities Economic Analyst at the Vermont Department of Public Service ("Department").

Q. Are you the same Walter "TJ" Poor who previously testified in this Docket?

A. Yes.

<u>SUMMARY</u>

Q. Please describe the purpose and the structure of your testimony.

A. The purpose of my testimony is to compare and evaluate the lifecycle greenhouse gas analyses presented by Conservation Law Foundation ("CLF") and Vermont Gas Systems, Inc. ("VGS"). Using these analyses to establish a reasonable range of lifecycle greenhouse gas costs/benefits associated with the Addison Natural Gas Project ("ANGP" or "Project"), I then address the lifecycle economic impacts of the Project, including consideration of the amount and value of lifecycle greenhouse gas emissions. I introduce the key input parameters of the lifecycle economic analysis, including costs and benefits associated with greenhouse gas impacts, conducted by the Department, and introduce the testimony of George Nagle who explains the structure of the economic model.

Q. Please identify any witnesses that will submit prefiled testimony on behalf of the Department for the first time in this proceeding, as well as the scope of their testimony.

A. George Nagle will provide testimony with regard to the structure and results of the economic impact analysis.

REVIEW OF LIFECYCLE GREENHOUSE GAS ANALYSES

Q. Why did you review the greenhouse gas analyses provided by VGS and CLF?

A. I reviewed these analyses in order to determine a reasonable range of greenhouse gas costs and/or benefits that are associated with the Project. I then applied the same economic value of carbon dioxide equivalent emissions that was used by both CLF and VGS to the range in order to put the value into economic terms. The resulting range is then added to the results of the economic model (discussed by George Nagle) to assess whether there is a need for the Project and whether it is likely to result in an economic benefit to the state.

Q. Have you conducted a full lifecycle greenhouse gas analysis of the Project?

A. No.

Q. Why not?

A. Such analyses are extremely complex and even when completed, they rely on a myriad assumptions and projections that may or may not turn out to be accurate. Furthermore, I have neither the resources nor the independent expertise to conduct a full lifecycle greenhouse gas analysis of the Project from the ground up. Therefore, I am relying on the greenhouse gas analyses conducted by VGS and CLF to set the parameters for the reasonable range of greenhouse gas emissions that should be associated with the Project.

Q. Please describe the manner in which you analyzed the greenhouse gas studies provided by VGS and CLF.

A. I have reviewed the study conducted by Dr. Stanton on behalf of CLF and the study conducted by Mr. Bluestein on behalf of VGS. Importantly, neither one of these studies represents a full lifecycle greenhouse gas analysis of the Project. Moreover, the studies are constructed differently—relying on different assumptions and comparing different scenarios. My analysis is intended to describe the two studies and identify the key differences between them and their respective shortcomings. Correcting certain assumptions and shortcomings, I present a revised analysis that incorporates aspects of both VGS's and CLF's analyses, thereby providing a more comprehensive review of the Project. The purpose of my analysis, through the two scenarios described below, is to establish a reasonable range of greenhouse gas impacts that can be used in calculating the economic impact of and need for the Project.

Q. Please characterize the estimates of greenhouse gas emissions impacts from the Project estimated by Dr. Stanton on behalf of CLF.

A. Dr. Stanton compared the emissions from the combustion of natural gas MMBtu and the upstream emissions associated with methane leaks from natural gas transportation and production projected to be sold as a result of the Project to the simple combustion emissions of fuel oil and propane that was estimated to otherwise be utilized. This was done using the estimates of new sales associated with the Project, compared to the MMBtu it displaces.

Q. Do you have any concerns with the use of Dr. Stanton's methodology to evaluate greenhouse gas emissions impacts from the Project?

A. Yes. Dr. Stanton did not appropriately model the impacts of lifecycle greenhouse gas emissions from the Project because she compared lifecycle greenhouse gas emissions from natural gas to only a portion of the lifecycle for other fuels. In addition, estimates of methane leakages and other upstream emissions are uncertain. A range of potential greenhouse gas impacts under various assumptions would provide a clearer picture of the actual impacts of the Project. With all other assumptions equal, Dr. Stanton's methodology places an undue bias against the Project. I have a further concern with the value used for the density of methane, as described below.

Q. Please characterize the estimates of greenhouse gas emissions impacts from the Project estimated by Mr. Bluestein on behalf of VGS.

A. Mr. Bluestein provides a comparison of natural gas lifecycle emissions to fuel oil and biofuel, concluding that lifecycle emissions from natural gas are less than that of both fuel oil and biofuel. He did not provide an analysis of the lifecycle emissions of propane.

Q. Do you have any concerns with the use of Mr. Bluestein's methodology to evaluate greenhouse gas emissions impacts from the Project?

A. Mr. Bluestein did not provide estimates of greenhouse gas emissions impacts from the Project. In addition, in general, estimates of methane leakages and other upstream emissions are uncertain. A range of potential greenhouse gas impacts under various assumptions would provide a clearer picture of the actual impacts of the Project.

Q. Do either of the two analyses evaluate the full lifecycle greenhouse gas impacts of the Project?

A. No. The two analyses each incorporate portions of a full lifecycle analysis, but neither presents the full picture. While Dr. Stanton's analysis accounts for the upstream methane leakages from natural gas, it does not account for other upstream emissions from natural gas (although these are likely to be much smaller). More importantly, it does not present a comparable picture for the upstream impacts of fuel oil and propane. Similarly, while Mr. Bluestein's analysis provides a lifecycle comparison of natural gas to fuel oil and biofuel, it does not address propane, nor does it specifically analyze the impacts of the Project relative to alternatives it may displace. Instead, Mr. Bluestein presents a more generic analysis of how the heating fuels compared vary in terms of lifecycle greenhouse gas emissions. Thus, neither of the two analyses provide an apples to apples comparison of the proposed Project relative to the fuels it is projected to displace.

Q. Please characterize the major differences between Mr. Bluestein's and Dr. Stanton's analyses.

A. As noted above, Dr. Stanton compared lifecycle natural gas emissions attributable to the Project to emissions from fuel oil and propane it is projected to displace only at the burner tip, while Mr. Bluestein compared the lifecycle emissions of fuel oil and biofuel to natural gas. The other major difference is in the assumption used for the density of methane. Dr. Stanton used a value for the density of methane of 77.5 lb/ft^3 calculated by taking the average gas density at "normal" conditions (42 lb/ft^3) and at boiling point (113 lb/ft^3) (A.PET:CLF.1-52). Mr. Bluestein used a value for the density of methane at "normal" conditions of 42 lb/ft^3. (Bluestein Rebuttal p.9 ln 12). This conversion factor is critical in order to translate volumetric sales information into mass for understanding carbon equivalent emissions impacts.

Q. In your opinion, what methane density should be used to calculate the greenhouse gas impact attributable to upstream methane leakage?

A. The density at normal conditions, or 42 lb/ft^3.

Q. On what are you basing this opinion?

A. The Code of Federal Regulations, at 40 C.F.R §90.233 describes the requirements for reporting greenhouse gas emissions (GHG) under the Environmental Protection Agency's Greenhouse Gas Reporting Program. Subpart W applies to petroleum and natural gas systems. Provision *v) GHG mass emissions* is relevant. It describes the formula for calculating GHG mass emissions in carbon dioxide equivalent – I've reproduced the language from provision *v* below. (Available at http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=d80b076a220f010c01a2210dd5d44039&rgn=div8&view=text&node=40:22.0.1.1.3.23.1.4&idno=40.)

> v) *GHG mass emissions.* Calculate GHG mass emissions in carbon dioxide equivalent by converting the GHG volumetric emissions at standard conditions into mass emissions using Equation W-36 of this section.
>
> $$Mass_i = E_{s,i} \cdot \rho_i \cdot GWP \cdot 10^{-3} \qquad \text{(Eq. W-36)}$$
>
> Where:
>
> $Mass_i$ = GHG_i (either CH_4, CO_2, or N_2O) mass emissions in metric tons CO_2 e.
>
> $E_{s,i}$ = GHG_i (either CH_4, CO_2, or N_2O) volumetric emissions at standard conditions, in cubic feet.
>
> P_i = Density of GHG_i. Use 0.0526 kg/ft³ for CO_2 and N_2O, and 0.0192 kg/ft³ for CH_4 at 60 °F and 14.7 psia.
>
> GWP = Global warming potential, 1 for CO_2, 21 for CH_4, and 310 for N_2O.

The density of GHG recommended to convert from volumetric metric to mass metric is 0.192 lb/ft^3. Using a conversion factor of 2.2 lbs/kg results in a factor of .042 lb/ft^3. To convert to lb/MCF, multiply by 1000 to get 42 lbs/MCF to put into the same units as Dr. Stanton's analysis.

Q. Have you calculated the lifecycle emissions impacts from the Project using 42 lbs/MCF as the density conversion?

A. Not specifically. Instead, I have updated Dr. Stanton's analysis contained in Exhibit CLF-EAS-07 to utilize 42 lbs/MCF as the density conversion factor (provided as Exhibit-DPS-WP-01). I also conducted an additional analysis that updated Exhibit CLF-EAS-07 to not only utilize 42 lbs/MCF as the density conversion, but also to include upstream emissions from fuel oil as estimated by Mr. Bluestein. See Exhibit-DPS-WP-02. This second analysis is intended to partially correct for the fact that Dr. Stanton's analysis considers the upstream impacts of natural gas but does not consider the similar upstream impacts for fuel oil or propane. The comparison that results is not a full lifecycle analysis comparing the lifecycle emissions of the proposed Project to the lifecycle emissions of the fuel oil and propane it is projected to displace, however it provides a useful consideration of the Project's impact on greenhouse gas emissions.

Both DPS-WP-01 and DPS-WP-02 utilize and update Exhibit CLF-EAS-07. Substantively, DPS-WP-01 changes only the value used for the density of methane, on the "Single Year without IP" tab. It also makes a correction to lines 29 and 30 of the "Temporal without IP" tab. The values on line 29 and 30 were not used elsewhere in the analysis, but sum the total cumulative emissions impacts. Most other unused tabs were deleted.

DPS-WP-02 builds upon DPS-WP-01, adding a new line 11 in the "Temporal without IP" tab where upstream fuel oil emissions are calculated. The assumptions used for this calculation are described below and can be found at the top of that tab.

Q. How did you apply the upstream emissions of fuel oil in DPS-WP-02?

A. To apply the upstream emissions to the CLF-EAS-07 original spreadsheet, I:

- Utilized the upstream emissions value of 13.4kg CO2e/MMBtu calculated by Mr. Bluestein in Exhibit Reb. JB-2
- Converted to lbs using the ratio 2.2 lbs/kg
- Multiplied resulting lbs CO2e/MMBtu by the estimated gas sales for fuel oil (assuming 1 MCF=1 MMBtu).
- Added the resulting change in lbs CO2e to the total CO2e estimated by Dr. Stanton.

Q. Why did you structure your analyses using the structure of Dr. Stanton's analysis?

A. I based my analysis on Dr. Stanton's because it is the only analysis conducted in the case that is structured to compare the greenhouse gas impacts of the Project to the alternative. While the inputs have been challenged, the structure of the analysis has not been disputed by the Petitioner in the case. Dr. Stanton's analysis was based in large part on assumptions from VGS's initial analysis, as presented in the testimony of Eileen Simollardes and Exh. Petitioner EMS-1. My purpose in further revising Dr. Stanton's analysis is to stay within the basic methodology used by both CLF and VGS while correcting only those portions that I believe to be incorrect.

Q. Why is the analysis presented in DPS-WP-01 and DPS-WP-02 useful in considering the Project's impact on greenhouse gas emissions relative to the alternatives it replaces?

A. This analysis provides a range of emissions impacts that may result from the Project. While neither of these values is likely to be correct, it is likely that the impacts would fall somewhere within the range. DPS-WP-01 essentially adopts Dr. Stanton's analysis, correcting only the density value of methane. It does not include any upstream emissions from fuel oil or propane, which I believe are essential to generating an apples-to-apples comparison of the Project's greenhouse gas emissions and the greenhouse gas emissions generated by the fuels that will be replaced by the Project. However, I think it is important to present this analysis, because it is conceivable that leakage rates could be greater than the 3% assumed by Dr. Stanton. Accordingly, DPS-WP-01 provides an estimate of greenhouse gas emissions on the high side of the range.

DPS-WP-02, which includes upstream emissions from fuel oil (but not propane), is a better estimate of greenhouse gas emissions from the Project. By correcting the methane density calculation and incorporating upstream emissions from fuel oil, DPS-WP-02 provides a better comparison of Project's greenhouse gas emissions as compared to the status quo.

Q. Please describe the results of the two calculations.

A. The two calculations both show that the Project reduces emissions relative to fuel oil and propane that VGS projects to replace. Table 1 summarizes the results.

Table 1: Emissions Impacts Calculated in Exhibits DPS-WP-01 and DPS-WP-02

Case	20 year cumulative Impact (tons/CO2e)	100 Year Cumulative Impact (tons/CO2e)
DPS-WP-01 (Adj Density only)	(388,980)	(9,054,002)
DPS-WP-02 Adj Density + VGS estimate upstream fuel oil	(2,219,601)	(57,050,409)

Q. Did you analyze how your revised emissions estimates affect the estimated net benefits of the Project overall?

A. Yes. Generally, the positive economic benefits associated with my revised emissions estimates increase the net economic benefit of the Project relative to the fuel oil and propane alternatives. Utilizing the $80/ton CO2e value for emissions that is utilized for energy efficiency cost-effectiveness screening in Vermont, and which was also used by both Vermont Gas and CLF in their analyses, the societal economic impact of the change in emissions under the two scenarios is described in Table 2.

Table 2: Economic Impact of Change in Emissions

Case	20 Year cumulative economic impact	100 Year cumulative economic impact
PSD-WP-01 (Adj Density only)	$2,320,620	$4,703,173
PSD-WP-02 Adj Density + VGS estimate upstream fuel oil	$13,328,958	$29,146,824

Obviously, if the value used to quantify economic impact of changes in emissions were higher, then the estimates of lifetime economic benefits would be higher. Similarly, the benefits would be lower if a lower value were to be placed on greenhouse gas emissions.

Q. Did you measure the economic impact associated with greenhouse gas emissions estimates at varying discount rates?

A. No. The benefits or costs associated with greenhouse gas emissions accrue to society in general, rather than to the utility or a particular group of customers. The societal discount rate is based on a societal perspective on the time value of money in which society as a whole has less strong time preference than does any individual. Three percent is used as it roughly tracks long-term United States Treasury rates and is consistent with the discount rate utilized by the Public Service Board in energy efficiency cost-effectiveness screening.

Q. Did you analyze the impacts on greenhouse gas emissions from the Project in a scenario that also includes the likely impact of VGS energy efficiency programs?

A. Not quantitatively. VGS's energy efficiency programs would serve to improve the emissions profile of the Project significantly. Even under the more conservative estimate of greenhouse gas emissions impacts set forth in DPS-WP-01, the proposed Project provides an emissions benefit. It is not necessary to explicitly estimate these impacts because any added efficiency would only serve to provide an additional reduction in greenhouse gas emissions.

Economic Impact

Q. Did the Department analyze the impact on the economic value of the Project to Vermont, including these economic impacts?

A. Yes. In order to evaluate the total economic value of the Project to Vermont, including the impact associated with changes in greenhouse gas emissions, the Department conducted an independent economic analysis, above and beyond the review conducted by Mr. Kumar and presented in his testimony in this case. The Department's analysis quantified both the impact of the Project costs relative to estimated direct customer fuel price benefits and indirect economic impacts that would result in Vermont. Mr. Nagle provides testimony on behalf of the Department regarding the structure and results of the economic impact analysis. I then quantified the estimated economic impact of the change in greenhouse gas emissions associated with the Project as described above, and added those values to the result of the Vermont economic analysis.

Q. Did the Department's economic analysis estimate only the impacts of the proposed Project versus the status quo, or did the Department consider other scenarios?

A. The Department's economic analysis also considered the impacts of the following alternative scenarios: (1) the proposed Project including efficiency programs, and (2) the economic impacts of industrial customers choosing to convert to Liquefied Natural Gas ("LNG") or Compressed Natural Gas ("CNG"). In the LNG and CNG scenarios, it was assumed that the proposed Project would not be constructed.

Q. Are the results of the Department's economic analysis directly comparable to the VGS analysis?

A. No. As described in Mr. Nagle's testimony, the VGS economic analysis emphasized the direct fuel cost benefits of the Project, and asserted there would be positive indirect economic impacts associated with the fuel savings. The Department's analysis modified a number of VGS assumptions and quantified both the direct and indirect economic impacts. In addition, the Department's analysis used updated fuel price estimates from the Energy Information Administration's 2013 Annual Energy Outlook (VGS had used 2012 as that was what was available at the time of VGS's initial filing).

Q. Please summarize the Department's estimate of the economic impact of the Project.

A. Table 3 below summarizes the estimate of the economic impacts of the Project relative to fuel oil and propane it projects to displace. The impacts are summarized and presented at three different discount rates: 3%, 7.69%, and 9.75%.

Table 3: Overall Net Economic Impact of Proposed Project

	GDP (NPV millions $2012)		
Discount Rate	3.00%	7.69%	9.75%
VGS baseline	$89.79	$60.35	$52.09
VGS+Efficiency	$140.57	$86.96	$72.40
Industrial LNG	$82.26	$47.76	$38.37
Industrial CNG	$80.79	$47.21	$38.04

Table 3 shows that the Project provides significant net benefits to Vermont, even before the economic impacts of greenhouse gas emissions are quantified. The net benefits of the Project without accounting for efficiency are similar to the LNG and CNG scenarios. When the impacts of VGS energy efficiency impacts are quantified, the Project has significantly greater net benefits to Vermont than the LNG or CNG scenarios.

Q. In Table 3, you did not explicitly add the economic impacts of greenhouse gas emissions. Why?

A. The range of economic greenhouse gas emissions impacts would be additive to the totals in the VGS baseline scenario shown in Table 3. They do not apply to the LNG and CNG scenarios considered. As described above, the economic impacts for the efficiency scenario were not quantified, but would provide a further significant increase in net benefits. Because the benefits are large and all point in the same direction, it is sufficient to address them qualitatively.

Q. What conclusions should be drawn from the Department's analysis?

A. The Project, as proposed, provides significant net benefits to Vermont. Once the impacts from energy efficiency programs are included into the analysis, the proposed Project will provide net benefits significantly greater than the other options analyzed. This result supports my position that VGS should be very aggressive in securing energy efficiency savings from new customers – including providing energy efficiency services either prior to or at the time of customer conversion.

Q. What conclusions should not be drawn from the Department's analysis?

A. As I mentioned above, the Department did not conduct its own independent lifecycle greenhouse gas analysis. My purpose has never been to provide a single number or set of numbers that represents the authoritative greenhouse gas impact of the Project. Rather, my goal is to provide a reasonable range of greenhouse gas impacts that can be attributed to the Project, and thereafter to put that number in the overall economic context of the Project.

Moreover, I did not attempt to estimate or capture other environmental costs in the analysis, such as costs associated with impact on wetlands or certain species of flora/fauna, or mitigating such impact. I do not have the expertise to generate such cost estimates, and would therefore defer to others to do so. Any such relevant environmental costs should be included when considering the overall impact of the proposed Project. To the extent such costs are generated, the economic model described by Mr. Nagle is capable of incorporating them into the overall economic impact of the Project.

Q. Please describe the inputs utilized for the various scenarios analyzed.

A. Mr. Nagle will testify to the inputs associated with the different scenarios. However, because I have significant experience associated with Vermont's energy efficiency programs and was deeply involved in the recent work of the Thermal Efficiency Task Force, I will describe the assumptions utilized for the energy efficiency scenario.

10 V.S.A § 581 sets the goals that the average MMBtu efficiency gains in all residential units receiving thermal efficiency services be 25% in the residential sector and significantly reduce fuel costs in all buildings. Consistent with this goal, the Department's analysis assumes a 25% reduction in fuel usage across all new customers. For the residential and commercial sector (proposed VGS firm customers), the cost/MMBtu saved directly utilized assumptions developed by the Thermal Efficiency Task Force. For the commercial sector, the Department model assumed cost of the energy efficiency measures was the average of the historical VGS cost/MMBtu and the Efficiency Vermont ("EVT") cost/MMBtu as provided to the Task Force. The average was higher than the VGS cost in the Task Force model. This adjustment was made to account for deeper savings being achieved in the commercial sector – resulting in increased overall cost. All costs/MMBtu include incentive costs, program costs, and any customer costs (i.e. total installed measure plus non-incentive program costs). In order to simplify the model, savings were assumed to occur immediately for new customers.

Q. Did you quantify the emissions impact, and the economic impact associated with those emissions, from the LNG and CNG scenarios?

A. No. I considered the emissions impact from the LNG and CNG scenarios qualitatively. Both fuels have the same combustion emissions/MMBtu as piped natural gas. However the upstream emissions from the use of LNG and CNG will be higher than that for natural gas supplied via pipeline due to added steps in the process to get the fuel to the customer. In the case of LNG, the fuel needs to be liquefied and then regasified. These processes consume fuel and require methane to be vented. In Vermont, the LNG then needs to be trucked to the end use. In the case of CNG, the gas needs to be compressed and decompressed, and similarly needs to be trucked to the end use (although not quite as far). Thus, the overall economic benefits modeled by Mr. Nagle from LNG and CNG would be reduced due to increased greenhouse gas emissions from these sources. Because the net benefits associated with the pipeline were greater than the net benefits associated with the LNG and CNG scenarios, adding the economic impacts of emissions would only increase the Project's comparative advantage. This advantage is extended significantly once energy efficiency impacts are included.

Q. Are there other considerations associated with the LNG and CNG scenarios not addressed by Mr. Nagle?

A. As noted by Mr. Nagle, the LNG scenarios assume all of the projected sales to industrial customers are served by LNG. However, the industrial customers that project to receive service are not all contiguous – thus more infrastructure investment may be necessary to install LNG than what was assumed. This would reduce the net benefits associated with the LNG scenario.

Finally, it should be noted that the LNG and CNG alternatives lessen the possibility for utilizing bio-methane as a renewable gas resource.

Q. Can you summarize your conclusions with regard to the emissions and economic impacts associated with the Project?

A. The economic analysis, including costs associated with greenhouse gas emissions, completed by the Department shows that the proposed Project provides significant net benefits to Vermont compared to the alternatives of fuel oil and propane consumption (the "status quo") and the use of either CNG or LNG by industrial customers. There are no alternatives that have been analyzed that are likely to provide net benefits to Vermont greater than the proposed Project. As noted above, the overall Project impact should consider costs associated with any relevant environmental impacts.

In addition, the Department expects that the Project will result in less greenhouse gas emissions than would otherwise result from fuel oil and propane use or the CNG and LNG alternatives.

Q. Does this conclude your testimony?

A. Yes.