STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 8667

Petition of Vermont Gas Systems, Inc. for)
Renewable Natural Gas Program)

DIRECT TESTIMONY OF

DAVID G. HILL, PH.D.

ON BEHALF OF

CONSERVATION LAW FOUNDATION

JULY 7, 2016

Dr. Hill's testimony addresses the proposed savings and emissions reductions from Vermont Gas System's proposed voluntary renewable natural gas tariff, and recommends in the tariff's place a renewable natural gas content standard.

1

Direct Testimony
of
David G. Hill, Ph.D.

Q1. Please state your name and occupation.

A1. My name is David Hill, and I am the Distributed Resources Director and a Policy Fellow for the Vermont Energy Investment Corporation.

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

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

Q3. Please summarize your work experience and educational background.

A3. For the past eighteen years I have worked for the Vermont Energy Investment Corporation. Over the years, I have served as a Consultant, Managing Consultant, Director of Distributed Resources, and a VEIC Policy Fellow. My work has focused on program design and advocacy for clean energy solutions. I have extensive background in researching and analyzing the existing energy system and markets and developing strategies to advance energy efficiency, renewable energy, and the transformation of our energy economy. I was a founding Board member of Renewable Energy Vermont and have also served as a Board Member, Policy Committee Chair, and Chair of the Board for the American Solar Energy Society. Highlights of my work over the years that are relevant to the current docket include conducting technical, economic and achievable potential studies

for renewable energy and energy efficiency in New York 2003 and 2011. These studies included biomass resources and their potential to contribution to New York's building and electric sectors of the state's energy economy. I also have extensive experience with the design and implementation of renewable energy incentives, and renewable energy portfolio standards, and alternative compliance payments. This includes work for more than a decade each with the Long Island Power Authority, New Jersey's Clean Energy Program, and Vermont's Renewable Energy Resource Center, and the Solar and Small Wind Incentive program. Other work has included renewable assessments, advocacy and program design, and implementation support for Washington D.C., Alaska, Pennsylvania, and Arizona.

Prior to my work at VEIC, I was with the Tellus Institute and Stockholm Environment Institute Boston Center. I received my Ph.D. from the University of Pennsylvania in Energy Management and Policy Planning, where I also earned a Master's Degree in International Development and Appropriate Technology. My undergraduate degree is from Middlebury College in Political Science and Geography.

My resume is attached as Exhibit CLF-DH-1.

Q4. Have you previously testified before the Vermont Public Service Board ("the Board" or "PSB") or other regulatory proceedings?

A4. I have not previously testified before the Vermont Public Service Board. I have provided testimony in Public Utility Commission proceedings in Ontario (2005, Brampton and Hydro One Efficiency Plan Reviews on behalf of the Green Energy Coalition), and Maryland (more than a dozen occasions since 2011 on behalf of the Maryland Office of People's Counsel) and have participated in regulatory workshops and legislative committee hearings in Pennsylvania, New York, New Jersey, and Vermont.

Q5. Please describe your experience regarding utility regulation and natural gas.

A5. I have played a significant role in the planning and implementation of regulated utility energy efficiency and renewable energy programs in more than half a dozen states. This work includes preparing extensive program budgets and designs for regulatory commission approval, and review of utility-filed plans and implementation reports. In New Jersey, I worked for more than a decade supporting the market development of solar energy, while the state transitioned from up-front direct incentives to the market-based solar renewable energy credit (SREC) incentive structure. In the years the team that I led supported New Jersey, the program grew from 6 installations in the first year to more than 30,000 installed systems. I have extensive experience with the application and review of cost-effectiveness testing for renewable and energy efficiency portfolios, and for comprehensive potential studies and scenario modeling for efficiency and renewable resources.

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

A6. I am presenting the following exhibits

CLF-DH-1	Resume of David G. Hill, Ph.D.
CLF-DH-2	Vermont Natural Gas Consumption and Expenditures
CLF-DH-3	Natural Gas Annual Consumption and Proposed RNG Tariff Standard
CLF-DH-4	GMP Cow Power™ Production vs. Demand
CLF-DH-5	Illustrative Method for Net Emissions Reductions Calculations (flow chart)
CLF-DH-6	Illustrative Method for Net Emissions Reductions Calculations (spreadsheet)

Q7. Please summarize your testimony.

A7. Vermont Gas Systems (VGS) is proposing to implement a program that will enable its customers to voluntarily purchase renewable natural gas (RNG). This is partially in response to direction from the Board in Docket 7970 to develop a proposal to foster biomethane projects in Addison County (Murray, Docket 8667 April 1, 2016, p. 13, lines 7-9). I have several concerns with the proposed Renewable Natural Gas Program based on a voluntary tariff. These are: the levels of RNG targets, the proposed voluntary design for the program, and proposed emissions reductions. First, the objectives for this effort, in terms of the amount of renewable natural gas VGS will provide to consumers, is not significant as a

share of total consumption. The associated emissions reductions are also not on par with what is required to make progress toward the state's statutory renewable energy goals and the *Comprehensive Energy Plan* targets. Second, renewable natural gas and other strategies to reduce greenhouse gas emissions (particularly strategies for natural gas efficiency and reduction of leakage and fugitive emissions) should be core elements of the VGS portfolio. The costs and benefits from RNG and other emissions-reducing strategies should not be based on voluntary participation in premium renewable tariffs. Third, in Mr. Murray's testimony, VGS indicates the proposed level of 500,000 Mcf (thousand cubic feet) of RNG will avoid "significant carbon emissions in the state" (Murray, Supplemental Direct Testimony, Docket 8667, April 1, 2016, p. 5, lines 11-13). It is my opinion that this is misleading to market and policy discussions.

My testimony reviews the emissions reductions claimed, and compares these claims to actual statewide emissions. I also illustrate how a more rigorous analysis of net emissions reductions can be conducted. This illustration is followed by a discussion highlighting that RNG might well be a viable resource in Vermont, although more needs to be known regarding assumptions on avoided emissions, the available resource base, and the costs and benefits for end use and for integration into the overall energy system. Finally, I recommend that the Board direct VGS to revise its program plan, and implement a renewable content standard that has a more substantive impact. The renewable content standard should contain hard-wired consumer protection safety valves to protect natural

gas ratepayers if technical or other market factors prevent the delivery of a meaningful RNG portfolio.

Q8. Can you start by summarizing the RNG targets as proposed by VGS?

A8. The proposed voluntary tariff has a target of up to 500,000 Mcf over the first five years (Murray, October 23, 2015 testimony, p. 5, line 9; and April 1, 2016, p. 5, lines 11-13). Over a 5-year horizon, the VGS target is equivalent to an average annual RNG consumption of 100,000 Mcf / year.

Q9. How do the RNG targets compare to historic and anticipated future natural gas consumption?

A9. The proposed annual volumes of RNG should be considered in relation to historic and forward natural gas consumption volumes, and also in context of total dollar expenditures for natural gas. Exhibit CLF-DH-2 illustrates that from 2000 to 2014, the U.S. Energy Information Administration (EIA) reports natural gas consumption in the range of 8 to 12 billion cubic feet per year, with expenditures ranging between $60 and $120 million. Using 2013 EIA consumption data, the proposed volume of RNG is equivalent to 0.93 percent of the 10.7 billion cubic feet of total natural gas consumption. Looking forward, an average annual additional 893,892 Mcf of natural gas consumption per year is anticipated in association with the Addison Natural Gas Project. (Eileen Simollardes, testimony in Docket 7970, December 20, 2012, p. 5, and Exhibit EMS1). Adding the 2013 consumption (10.7 billion cubic feet) to the estimated additional 893,892 Mcf

from the Addison pipeline extension, the proposed RNG volumes represent 0.86 percent of annual system consumption. Exhibit CLF-DH-3 compares the proposed volumes of RNG to total annual system consumption (confirmed via sales as percent of volume response, in Murray to CLF: Exhibit A.CLF.VGS.1-5).

Q10. How do the proposed RNG volumes compare to state energy policy and planning targets?

A10. Using the calculation basis described in A8 and A9, after five years, the target volumes for RNG proposed by VGS represent between 0.93 percent and 0.76 percent of annual consumption. Attaining less than 1 percent of annual volumes from RNG as a resource, after 5 years of program activity, is not at a pace that is consistent with Vermont's legislative and planning targets for meeting energy needs with renewable energy or for reducing greenhouse gas emissions. For reference, the *Vermont Comprehensive Energy Plan's* vision is for the state to meet 90 percent of total energy needs from renewables by 2050. In statute, 10 V.S.A. §580(a) sets a goal to produce 25 percent of the energy consumed in the state from in-state renewable energy, including farms and forests. As the Board and VGS seek to implement strategies to contribute to the State's goals, the proposed savings of up to less than 1 percent of consumption at the end of five years is too modest to warrant the development and marketing of a separate tariff. It is my opinion that prior recommendations from the Vermont Department of Public Service, to develop quantified targets for RNG volumes at a much higher level than proposed, are appropriate.

Q11. Do you have any concerns or comments on the voluntary nature of the proposed RNG tariff?

A11. Yes, I do. In its Order of December 23, 2013, the Board ordered VGS to propose "a program to promote bio-methane project development" (Docket 7970, Order dated 12/23/2013, p. 147, item 11). In my opinion, a voluntary tariff falls short of being a program or strategy that promotes the increased use of RNG resources or supply. It is also my opinion that asking participants to voluntarily pay a premium for RNG content will produce only modest results, at best.

Q12. Are there useful lessons or observations that can be drawn from other voluntary tariff initiatives in Vermont?

A12. Yes, Exhibit CLF-DH-4 presents production and demand data from Green Mountain Power's Cow Power Program, another voluntary tariff program operating in Vermont. There are several trends in the data worth noting. First, most of the time there is a structural imbalance in supply and demand. In the first six years of the initiative, consumer demand trended higher than available production. Recently, this trend has reversed; production has been greater than demand. Although options such as banking supply, or offset purchases for managing the supply-and-demand imbalance, exist, a voluntary program is prone to a structural supply-and-demand imbalance. Second, Cow Power production has increased, indicating there are opportunities for on-farm biogas production, whereas the voluntary demand for the program has started to decline over the last

six years. This decline could be related to an increase in the renewable energy options available to consumers who might otherwise participate in the voluntary Cow Power offering.

Q13. Are there alternatives to a voluntary tariff that VGS could use to promote RNG development and supply?

A13. Yes. It is my opinion that a portfolio-wide RNG content target that increases at a pace consistent with state energy plan and policy goals should be implemented, instead of the proposed voluntary RNG tariff. Having a gradually increasing RNG volumetric target provides more consistent and stable support for the development of RNG projects and resources. In subsequent sections of my testimony, I further describe this recommendation for a portfolio-wide RNG content standard.

Q14. What estimates for greenhouse gas emissions reductions does VGS provide for the proposed RNG tariff?

A 14. The proposed RNG tariff does not contain any estimates of greenhouse gas emissions (GHG) reductions, but it does allude to the proposed program's potential for "avoiding significant carbon emissions in the state" (VGS, Description of the Renewable Natural Gas-Program Plan, p. 1).

Q15. What are the proposed GHG emissions reductions and methods?

A15. VGS reiterates that the proposed level of 500,000 Mcf of RNG will avoid "significant carbon emissions in the state" (Murray, Supplemental Direct

Testimony, Docket 8667, April 1, 2016, p. 5, lines 11-13). In earlier testimony, the estimated emissions reductions were quantified as being "over 36,000 tons of carbon emission in the state" (Murray, Prefiled Testimony, October 23, 2015, p. 5 lines 9-10).

Q16. Do you agree with Mr. Murray's characterization of this level of emissions reduction as being "significant"?

A16. First, it is my opinion that the calculations underlying Mr. Murray's estimate of 36,000 tons are not clearly described. It is also not clear whether Mr. Murray means these units are carbon dioxide equivalent (CO_{2e}) tons, or tons of carbon only. It is also not clear if this is the estimated total emissions reduction from the 500,000 Mcf to be provided over the 5-year period, or if it refers to estimated annual emissions reductions. In response to this question, I am assuming the estimated reductions are 36,000 tons of CO_{2e} annually. Total statewide emissions from the latest inventory are estimated to be 8.27 million metric tonnes of CO_{2e} in 2012 (Vermont Greenhouse Gas Emissions Inventory Update 1990-2012, Table 1, p. 3; link, if copied into URL search box: http://climatechange.vermont.gov/sites/climate/files/documents/Data/Vermont_GHG_Emissions_Inventory_Update_1990-2012_June-2015.pdf). The VGS estimate, when converted to metric tonnes, is equivalent to a reduction of 32,670 tonnes CO_{2e} annually. This accounts for 0.4 percent of statewide 2012 emissions. Although all progress toward emissions reductions is important and should be

encouraged, it is my opinion that Mr. Murray's statement that the proposed VGS reductions are significant is incorrect.

Q17. Do you have observations or recommendations related to calculating net emissions reductions from RNG?

A17. Yes. The calculation of net emissions for RNG is complicated. As Vermont continues to strive to reduce GHG emissions, it will be important to design and refine the methods for estimating emission reductions. I provide in Exhibit CLF-DH-5 an example of a flow chart and in Exhibit CLF-DH-6 an example of a spreadsheet for an approach to calculating the net emissions reductions from RNG.

Q18. What are the approach and basic steps for estimating the RNG net emissions impacts?

A18 The first step is to quantify the volume of RNG. This will typically be in Mcf. Next, entering this volume into an emissions reduction calculator from the U.S. Environmental Protection Agency (link to the methane calculator: https://www3.epa.gov/gasstar/tools/calculator.html) provides the tons of methane contained in this volume of RNG. The calculations must then consider the source material of the RNG. RNG derived from anaerobic digestion of manure is likely to be avoiding direct atmospheric emissions of methane. Direct emissions of methane to the atmosphere have a high global warming potential (a factor comparing emissions of various greenhouse gases directly to an equivalent mass

emission of carbon dioxide) and provide significant emission reductions. Landfill gas is another source for RNG identified by VGS in their plans. Due to regulations and market development, most landfills are required to have, or have elected to install, systems for methane capture and combustion. Although some landfill gas-sourced RNG might be avoiding direct methane emissions in a manner similar to the manure-derived RNG, it is reasonable to expect that much of the landfill gas-derived RNG would otherwise be captured and combusted, with or without an RNG program. (See 40 CFR 60.33c - Emission guidelines for municipal solid waste landfill emissions**.** http://www.ecfr.gov/cgi-bin/text-idx?SID=3c9c723efcf82c75d0015052aa93352f&mc=true&node=se40.7.60_133c&rgn=div8 and O. Reg. 232/98, s. 14 - Subsurface Migration of Landfill Gas and O. Reg. 232/98, s. 15 - Atmospheric Emissions of Landfill Gas https://www.ontario.ca/laws/regulation/980232#BK4). In most instances, RNG from sources that already have capture-and-combustion in place will result in no net reduction in emissions from the RNG. Therefore, the source of the RNG, and the portions of the landfill gas- and anaerobic digestion-derived RNG that are avoiding direct atmospheric methane emissions are important to estimate and quantify. The example provided in Exhibits CLF-DH-5 and CLF-DH-6 assumes 50 percent of the RNG volume is derived from anaerobic digesters, and the other 50 percent is derived from landfills. Further, all of the anaerobic RNG is assumed to avoid direct atmospheric methane emissions, and all of the landfill gas-derived RNG is assumed to come from facilities that would already be required to, or

have in place, capture-and-combustion. These are illustrative assumptions. Adjusting these assumptions to actual program planning or to implementation experience and the conditions for methane capture-and-combustion at the RNG sources will be important to help accurately estimate net emissions.

Q19. What is the next step in calculating the net emissions impacts of RNG?

A19 The carbon dioxide equivalent for avoided direct atmospheric release of methane needs to be based on the global warming potential (GWP) for methane. The GWP for methane has been updated by the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report (AR5; 2013; https://www.ipcc.ch/report/ar5/wg1/). The impact of methane emissions also depends on the time horizon for comparison. A higher comparative impact exists for shorter (20-year) comparisons, relative to time spans beyond 20 years. The example provided in Exhibit CLF-DH-6 estimates impacts based on methane GWP ranging from a low of 25 to 86, with the higher value based on the last updated AR5 value and a 20-year time horizon. At this stage, we have estimated the RNG impact from avoided methane emissions. However, since the methane that is not being released directly will be supplied as RNG to consumers and subsequently combusted, the CO_2 emissions for this combustion need to be subtracted from the emissions reductions associated with the avoided direct atmospheric methane emissions.

Q20. What are the results of your estimates on the net emissions reductions for RNG?

A20 Based on the VGS proposed average annual volume of 100,000 Mcf of RNG, and the method and assumptions outlined in A19, it is my opinion that net emissions reductions will range from 21,321 metric tonnes of CO_{2e} (using a GWP of 25 for methane) to 79,995 metric tonnes of CO_{2e} (using a GWP of 86 for methane). These in turn respectively represent 0.26 percent and 0.96 percent reductions in the total statewide emissions from the 2012 Greenhouse Gas Inventory cited in A16. Note that if all of the RNG comes from facilities that already have capture-and-combustion in place, there could be virtually zero net emissions impacts. On the other hand, if all of the RNG is coming from sources that would otherwise be directly releasing methane into the atmosphere, then the net impacts would be roughly twice as high, or close to 2 percent of statewide emissions, using the higher GWP values.

Q21. Is there experience or analysis from other jurisdictions, or from Vermont indicating that RNG has promise as a significant resource?

A21. Yes, there is a growing body of research, analysis, and experience suggesting that RNG can be a significant resource in future de-carbonized energy portfolios. The required resources and technologies exist, although commercial applications at scale are only just starting to emerge.

Q22. Can you provide some examples of potential studies and analysis for RNG?

Yes, I will briefly discuss recent work in Ontario and California, followed by a couple of examples specific to Vermont. Ontario's 5-year Climate Change Action Plan (2016-2020; https://www.ontario.ca/page/climate-change-action-plan) contains an action to introduce a renewable content requirement for natural gas and to provide supports for the use and development of renewable natural gas resources. The plan indicates that up to $100 million from cap-and-trade program proceeds will be made available to support RNG in the province during the next four years (www.applications.ene.gov.on.ca/ccap/products/CCAP_ENGLISH.pdf). I note that the Ontario initiative is based on the development of a renewable content requirement, along with identification of resources to support project and market development, as opposed to the voluntary tariff structure proposed by VGS. Also in Canada, the Canadian Gas Association has outlined targets for RNG content of 5 percent by 2025 and 10 percent by 2030 (http://www.cga.ca/news/).

Q23. What is the example of RNG potential analysis from California?

A23 In California, a study released in 2015 by Energy & Environment Economics examines the potential role for de-carbonized pipeline natural gas in meeting the state's long-term greenhouse gas reduction goals (https://ethree.com/documents/E3_Decarbonizing_Pipeline_01-27-2015.pdf). Executive Order S-3-05 sets a target for California to reduce GHG emissions by 80 percent, relative to 1990 levels, by 2050. Findings from this research indicate the technical pathways for de-carbonized natural gas to meet a significant

(approximately 40 percent) share of 2050 final energy demand already exist. They also indicate that the costs for developing the de-carbonized natural gas resource are roughly equivalent to an alternative scenario that meets overall greenhouse gas reduction targets via a path more dependent upon electrification. The study points out that several end uses, including industrial process heat and heavy-duty vehicles, might be better served via de-carbonized gas than through electrification. The RNG resource can also provide balancing and storage, by using periods with excess renewable electric generation to produce hydrogen via electrolysis, and synthetic natural gas production (with carbon capture from air or seawater) via power-to-gas conversions to create methane. The commercialization of available technologies, and the potential competition for and availability of, sustainable biomass resources in California are identified as areas of greatest potential risk along the de-carbonized natural gas development path.

Q24. What are the examples of analysis looking at higher levels of RNG potential in Vermont?

A24. An American Gas Foundation study in 2011 ("The Potential for Renewable Gas: Biogas Derived from Biomass Feedstocks and Upgraded to Pipeline Quality," http://www.gasfoundation.org/researchstudies/agf-renewable-gas-assessment-report-110901.pdf), by the Gas Technology Institute, estimated Vermont's potential, in an aggressive scenario with 15 percent to 75 percent of the available resource developed, of 4.5 million dekatherms per year from thermal gasification and anaerobic digestion. A dekatherm is equivalent to 1 Mcf, so the proposed

VGS voluntary tariff program target of 500,000 Mcf over five years is equivalent to 2 percent of the identified potential. The study estimated Vermont's potential for anaerobic digestion in the aggressive scenario to be 3.0 million dekatherms per year. This estimated potential for anaerobic digestion is equivalent to 28 percent of annual sales, based on 10.7 billion cubic feet of consumption in 2013.

The Vermont Department of Public Service, in testimony provided by Walter "TJ" Poor relating to Vermont Gas System's proposed Phase II pipeline construction, recommended an RNG standard starting at 1 percent of total demand in 2016, increasing by 1 percent annually, reaching 5 percent of total in-state demand by 2020, 15 percent by 2030, and 20 percent by 2035 (Department of Public Service, Walter Poor, Witness, Docket No. 8180, p. 3, lines 14-17).

Q25. Do you have any concerns over the potential resource and or costs associated with obtaining a higher RNG standard?

A25. Yes. Although the analyses cited above suggest that the viability of RNG in Vermont is worth exploring, there are also uncertainties on cost and ability to develop commercially viable projects at the scales anticipated. For example, access and proximity to existing pipeline infrastructure might be a limiting factor, and the number of projects that can support new pipeline extensions may be limited. Therefore, as discussed further below, I recommend a cost cap, such as an alternative compliance payment or alternative investment option be implemented along with any RNG content standard.

Q26. Do you have recommendations on how the proposed voluntary renewable natural gas voluntary should be modified?

A26. I recommend that the Board direct VGS to adopt an RNG content standard, providing all customers with an increasing share of RNG as part of their natural gas service. The RNG content standard should replace the proposed voluntary RNG tariff. I recommend the RNG content standard be set at a higher level than VGS has proposed for the voluntary target. I recommend the following RNG content standard be considered:

Illustrative RNG Content Target		Year 1	Year 2	Year 3	Year 4	Year 5	
RNG	Annual Incremental (Mcf)	100,000	125,000	125,000	125,000	150,000	**Total 5 year Volume**
	Annual Cumulative (Mcf)	100,000	225,000	350,000	475,000	625,000	1,775,000
	Annual Cumulative as % of 2013 consumption	0.93%	2.10%	3.27%	4.44%	5.84%	

My recommendation for the RNG content standard has a total 5-year impact of 1.775 million Mcf, or more than three and a half times the "up to 500,000 Mcf" target for the voluntary tariff as proposed by VGS. By Year 5, the proposed RNG content standard would represent roughly 5 percent of total annual sales, making it consistent with the RNG content requirement as proposed in the Department of Public Service Phase II Testimony as cited in A24.

Q27. Can you describe in general terms the potential costs for your recommended RNG content standard?

A27. Based on the VGS estimates of incremental RNG costs of $1.06 / ccf, the incremental cost for the proposed target could be expected to be $6.6 million by

Year 5. Referencing the Energy Information Administration data on expenditures and consumption I presented in Exhibit CLF-DH-2, $6.6 million is equivalent to 5.84 percent of 2013 expenditures. In Mr. Murray's prefiled testimony of October 23, 2015, he indicated that VGS customer research indicated that over 85 percent of customers indicated a willingness to pay 10 percent more for an RNG product (p. 5, lines 6-7).

Q28. Do you have further comments on how safeguards against excessive costs should be included in the RNG content target?

A28. Yes. I support the adoption of an alternative investment option that would enable VGS to limit costs for the program, if sufficient low-cost resources are not available to meet the RNG content standard. I suggest the alternative investment option level be based on current and expected market conditions, but also limit the exposure to no more than $10.60 / Mcf, which would be equivalent to the impact estimated under A27. In addition, I recommend that if sufficient RNG resources are not available to meet the content standard below the projected costs, then additional investments in energy efficiency (above and beyond other VGS obligations) could be used to make up any shortfall.

Q29. Do you have initial estimates of the greenhouse gas emissions reductions that would result from the RNG content standard that you are recommending?

A29. Yes, as I indicated in A17 through A20 above, estimating the net emissions reduction impacts from RNG is complicated and will depend upon the source of

the RNG. As part of adopting any RNG content standard, I recommend that appropriate methods and careful tracking and reporting of the net emissions reductions be adopted. With these as caveats, an initial estimate of the net emissions reductions from the RNG content standard I am recommending is that in Year 5 the proposed RNG content standard would result in net emissions reductions of between 1.69 percent and 6.06 percent of 2012 statewide emissions.

Q30. Can you comment on the RNG content standard you propose in relationship to Vermont's comprehensive energy plan and renewable energy targets?

A30. The RNG content target I recommend will result in renewable content for natural gas that is more than 5 percent after 5 years. Similar or greater savings and reductions in emissions should also be expected from energy efficiency, so the combined impacts from the portfolio would be approximately 10 percent after five years. This is the type of substantive progress in emissions reductions that are required to meet the state's goals. Compared to the target proposed for the voluntary RNG tariff proposed by VGS the RNG content standard I recommend is an increase by a factor of more than five times for the total volumes of RNG and the associated emission reductions. I think this level of increase is warranted and necessary. Considering the *Comprehensive Energy Plan* target of 90 percent of total energy from renewable resources by 2050, and the 25 percent target for in-state renewable energy production from farms and forest resources, the RNG content target I am proposing is, in my opinion, a minimum level of resource development that should be acceptable. It provides an attainable target that will be

a foundation for the further levels of market development that will be required if RNG is to play a part in Vermont's future clean energy mix.

Q31. Does this conclude your testimony at this time?

A31. Yes, it does.