STATE OF VERMONT
PUBLIC SERVICE BOARD

Petition of Vermont Gas Systems, Inc., for a certificate of public good, pursuant to 30 V.S.A. § 248 , authorizing the construction of the "Addison Natural Gas Project Phase 1"	))))	Docket 7970

Prefiled Rebuttal Testimony of Chris Neme

Submitted on Behalf of
Vermont Public Interest Research Group (VPIRG) and Kristin Lyons

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Summary: Mr. Neme responds to the testimony of Department of Public Service witness Asa Hopkins, Ph.D. Using the data from Hopkins Exhibit C, Mr. Neme corrects the table on fuel-price comparisons in Dr. Hopkins' Exhibit A (p. 3). Using additional information regarding heating system distribution losses of which Dr. Hopkins was unaware, Mr. Neme further corrects Exhibit B. The end result is that, even at today's energy prices, cold climate heat pumps cost less per unit of heat provided than the average conversion to natural gas. That advantage is forecast to grow even larger in the future.

Q: What is the purpose of your rebuttal testimony?

A: I respond to the testimony and exhibits of Dr. Hopkins. When I read his testimony and exhibits, I saw that there were substantial inconsistencies between the assumptions used in the fuel-price comparisons in the table on page 3 of Exhibit A and the assumptions used by Dr. Hopkins in his analysis of the pipeline's economic impacts in Exhibit C. I also saw that the table on page 3 of Exhibit A appears to omit an important factor in comparing heating system efficiency.

Q: **What inconsistency did you find between Dr. Hopkins' Exhibit A and Dr. Hopkins' Exhibit C?**

A: In Exhibit C (p. 10 of 25), where Dr. Hopkins documents the heating equipment efficiency assumptions he uses in his economic assessment of the proposed pipeline, it is clear that his analysis assumes that for conversions to natural gas in which the heating system is not replaced (i.e. using a conversion burner) the heating equipment efficiency would remain at 85%; for conversions to natural gas in which new gas heating equipment is installed, he assumes an average efficiency of 92%. Exhibit C (p. 10) also suggests that Dr. Hopkins assumes 61% of gas conversions will retain existing heating equipment and 39% will install new gas heating equipment. That would imply a weighted average initial gas equipment efficiency of 88%. However, in Exhibit A, where Dr. Hopkins compares the current cost per Btu of gas heat and cold climate air source heat pump heat, he appears to focus on the high efficiency case in which gas heating equipment has a much higher efficiency of 95%.

In Exhibit C (p. 13 of 25), Dr. Hopkins also clearly assumes that the average cold climate heat pump would have an efficiency of 270% (i.e. a coefficient of performance of 2.7). That

assumption is based on the same "meta-study" (i.e. review of several dozen other studies and related documents) that I reference in my evidence. However, in Exhibit A, the assumed cold climate heat pump efficiency is a much lower 240%.

These differences are important. When I substitute Dr. Hopkins' Exhibit C assumptions regarding heating equipment efficiency for those in his Exhibit A, the average cost per unit of gas heat resulting from a natural gas conversion ($16.41 per MMBtu) is actually slightly higher than the average cost for a cold climate heat pump ($16.28 per MMBtu). This is shown in my attached Exhibit A, which corrects Dr. Hopkin's Exhibit A. Moreover, that is at today's (actually April 2015's) fuel prices. As noted in my testimony, gas prices are projected to grow faster than electricity prices in each of the next three decades, meaning that the slight advantage that cold climate heat pumps have today will grow over time.

Q: **What is the important factor in comparing heating system efficiency that you find to be omitted from Exhibit A, page 3?**

A: Exhibit A appears to only reflect the impact of heating *equipment* efficiency on the ultimate cost per unit of heat delivered. It does not appear to take into account that there is typically a second source of energy loss in fossil-fuel fired home heating systems: distribution system losses. For example, in forced-air heating systems, there are both conductive losses and direct leaks from ductwork into unconditioned spaces. Though they tend to be much smaller, hydronic (water-based) heating systems also experience distribution losses. I estimate that the average fossil-fuel heated Vermont home has heating distribution system losses of between 7% and 8%. In contrast, ductless heat pumps have no distribution system losses.

My estimate of 7% to 8% fossil-fuel heating distribution losses is based on standard assumptions

used for energy ratings of buildings.[1] Those assumptions range from 0% to 5% losses for hydronic heating systems and from 12% to 20% losses for forced air heating systems. The bottom ends of the ranges (i.e. low losses) are for homes in which the entire heating system is in conditioned space; the high ends of the ranges are for homes in which distribution system components are in unconditioned spaces. Based on a recent Vermont study, there are approximately two boilers (hydronic systems) for every one furnace (forced-air system) in the state and approximately 60% of heating systems can be assumed to be in unconditioned spaces.[2] When I further adjust the Dr. Hopkins' Exhibit A table to reflect the impact of distribution system losses, the average cost per MMBtu of gas increases to $17.76, or about 9% more than the cost of a cold climate heat pump ($16.28). Again, that is at today's (April 2015's) fuel prices. Gas prices are projected to grow faster than electricity prices in each of the next three decades, meaning that the advantage that cold climate heat pumps have today will grow over time.

Q: Does that conclude your testimony?

A: Yes.

1 Residential Energy Services Network, "Mortgage Industry National Home Energy Rating Systems Standards", 2013. http://www.resnet.us/standards/RESNET_Mortgage_Industry_National_HERS_Standards.pdf

2 NMR Group et al., "Vermont Single-Family Existing Homes Overall Report, Final", submitted to the Vermont Public Service Department, 6/13/2013.