STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 8180

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 Rutland Natural Gas Project	**)**
Phase 2 (ARNGP Phase 2)" to extend natural gas	**)**
Transmission facilities in Franklin and	**)**
Addison Counties, for service to the	**)**
Ticonderoga mill in New York, and	**)**
Construction of two Community Gate Stations	**)**
For distribution service in the towns of Cornwall	**)**
And Shoreham, Vermont	**)**

DIRECT TESTIMONY OF

JON D. ERICKSON, PH.D.

ON BEHALF OF

CONSERVATION LAW FOUNDATION

JUNE 13, 2014

Dr. Erickson's testimony addresses the greenhouse gas emission impacts, nonrenewable resource dependence, and economic risk of the proposed project.

Direct Testimony
of
Jon D. Erickson, PhD

Q1. Please state your name and occupation.

A1. My name is Jon D. Erickson, and I am Professor of Ecological Economics and the Interim Dean of the Rubenstein School of Environment and Natural Resources at the University of Vermont.

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. The focus of my education, teaching and work has been in ecological economics, including matters concerning climate change policy and greenhouse gas emissions.

I have published works on energy and climate change policy, land conservation, watershed planning, environmental public health, and the theory and practice of ecological economics. My research related to energy and greenhouse gas emissions began 20 years ago, published in peer-reviewed journals such as *Science*, *Climatic Change*, *Energy Policy*, *Ecological Economics*, *Contemporary Economic Policy*, and *World Development*. Current work related to Vermont's

energy future includes building a dynamic systems model of energy and greenhouse gas pathways for Vermont, funded by the National Science Foundation, and the development of the Vermont Genuine Progress Indicator with UVM's Gund Institute for Ecological Economics, as specified by Vermont Act 113.

I served as the Managing Director of UVM's Gund Institute for Ecological Economics from 2009-2012, am past President of the U.S. Society for Ecological Economics, past editor of the *Adirondack Journal of Environmental Studies*, past member of the Techical Advisory Committee for the Lake Champlain Basin Program, and currently serve on the Vermont Governor's Council on Energy and the Environment.

I have been a Fulbright Scholar at the Sokoine University of Agriculture in Tanzania; Visiting Professor at the University of Iceland, Pontificia Universidad Católica Madre y Maestra in the Dominican Republic, and Slovak University of Agriculture in Nitra; and was on the economics faculty at Rensselaer Polytechnic Institute before joining the University of Vermont in 2002.

I earned a Ph.D. and a M.S. degree in Natural Resource and Environmental Economics from Cornell University, and a B.S degree in Applied Economics and Business Management from Cornell University.

My Curriculum Vita is attached as Exhibit CLF-JDE-1.

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

A4. Yes. I testified in Docket no. 7970 the Phase 1 proceeding for the Vermont Gas Systems expansion.

Q5. Are you presenting any exhibits to support your testimony?

A5. I am presenting the following exhibits.

CLF-JDE-1 Curriculim Vita of Jon D. Erickson

Q6. Please summarize your testimony.

A6. My testimony addresses the long-term economic and environmental impacts of greenhouse gas emissions and nonrenewable energy dependence from the proposed Addison Rutland Natural Gas Project. I will also address the conflict between the Project and achieving the goals set forth in Vermont's Greenhouse Gas Reduction Targests and the 2011 Comprehensive Energy Plan.

Q7. Please explain why Vermont regulators should be concerned about greenhouse gas emissions.

A7. The Conference of the Parties (including the United States) to the United Nations Framework Convention on Climate Change (UNFCCC) is currently operating under the Copenhagen Accord, a non-binding agreement that recognizes that fundamental economic, social, and environmental risk posed by climate change, and that proposes immediate actions to keep temperature increases to below 2°C.

The Copenhagen Accord was built on the findings of the Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) that "Warming of the climate system is unequivocal" and that "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations." "Very likely" within the IPCC report means "the assessed likelihood, using expert judgment" is over 90%.

The more recent IPCC Fifth Assessment Report (AR5) released in 2013 assembled the most recent scientific evidence linking anthropogenic greenhouse gas emissions to a broad array of physical change in earth systems, including atmospheric, oceanic, cyrospheric (snow, river and lake ice, sea ice, glaciers, ice shelves and ice sheets, and frozen ground), and biogeochemical changes. The AR5 concluded: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased."

The main anthropogenic greenhouse gases (GHG) are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). While CO2 is the largest total contributor to anthropogenic warming, the greenhouse warming potential (GWP) estimated in the AR5 for CH4 and N20 are 86 and 268 times the impact of CO2 (based on molecular efficiency as a greenhouse gas and a 20-year atmospheric

lifetime). The AR5 concludes, "The atmospheric concentrations of the greenhouse gases carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) have all increased since 1750 due to human activity," and at 2011 levels have "exceeded the pre-industrial levels by about 40%, 150%, and 20%, respectively." The 2^{o}C threshold was set to match the scientific concensus from the Fourth IPCC report that limiting global warming to a 2^{o}C temperature rise would "prevent dangerous anthropogenic interference with the climate system," the stated objective of the UNFCCC. The AR5 reports a 0.85^{o}C warming that has already occured towards this threshold at 2011 atmospheric concentrations of 391 parts per million (ppm) CO2. The AR5 further finds that, "Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850," and that with medium confidence, "In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years."

Projecting into the future, the AR5 concludes that "Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system," and that, "Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions." Climate modeling research estimates that stabilising greenhouse gas concentrations at 450 ppm would result in a 50% likelihood of limiting global warming to 2°C. As of 2012, to stay within this concentration, an estimated 500 to 600 gigatons of CO2 can be emitted into the earth's atmosphere. At 2012 rates of global CO2 emissions

growth of approximately 3% per year, the global economy was on course to emit this additional 500 to 600 gigatons of CO2 in approximately 15 years.

Q8. What are the current commitments by the U.S. and the State of Vermont to reduce greenhouse gas emissions?

A8. Under the Copenhagen Accord, the U.S. has pledged to reduce GHG emissions to 17% below 2005 levels by the year 2020. Vermont's GHG reduction goals, codified in 10 V.S.A. § 578, are to reduce emissions below 1990 levels by 25 percent by 2012, 50 percent by 2028, and 75 percent by 2050. Vermont is well behind its 2012 goal. Part of the Vermont strategy to achieve these GHG reductions is to meet 90% of the State's total energy needs from renewable energy by 2050, as specificed in Vermont's 2011 Comprehensive Energy Plan.

Q9. Please explain how expanding natural gas infrastructure and use in the State will affect these GHG and renewable energy commitments.

A9. Natural gas is a nonrenewable, carbon-based fuel. Its extraction and delivery result in methane emissions to the atmosphere. Its use for heating, electricity, and transportation results in CO2 emissions to the atmosphere. Any expansion of the delivery of natural gas to customers in Vermont and New York has the potential to substitute for other nonrenewable, carbon-based fuels (such as fuel oil), but also has the potential to displace current and future uses of renewable energy (such as wood-based home heating or district heating, or renewable supplied heat pumps).

Analysis of displacement of oil must consider the full greenhouse warming potential of natural gas adoption (from extraction, to delivery, to use) in order to evaluate potential short-term progress to GHG goals. Also, substituting natural gas for heating oil or other nonrenewable fuels would not likely result in long-term GHG reductions. New gas infrastructure would likely result in considerable, long-term lock-in to natural gas use resulting in total GHG increases and nonrenewable energy dependence that is incompatible with long-term state policy. For example, moving households from oil to natural gas for home heating would likely delay the transition to renewable fuels due to the convenience of natural gas and the phemonemna of technology lock-in.

To evaluate against the State's GHG reduction goals, the Addison Rutland Natural Gas Project must be evaluated on the basis of *total, long-term* GHG emissions for the State under various scenarios of technology adoption and longevity, not the impact of replacement of *marginal, short-term* oil use at the household or business level. For home heating or industrial power use, relying on new natural gas infrastructure as a transition strategy by 2050 would require shifting from oil to natural gas to renewables within a 35 year time frame. The cost of conversions would preclude this. What is the likelihood of new natural gas users to remain in the system beyond this time horizon?

Finally, GHG benefits and reduced reliance on nonrenewable energy should not be limited to comparing one carbon-based fuel with another. As part of comprehensive energy planning, expansion of natural gas use in Vermont should

be evaluated against a shift directly to renewables, including wood-heating for homes and businesses, district heating with biomass, and electrical generation from a diversity of renewable sources. The failure to provide this analysis precludes determining that the proposed expansion reduces GHG emissions.

Q10. Please explain any risks to the State economy of expanding natural gas infrastructure.

A10. As an out-of-state, nonrenewable energy source, natural gas supplies and price are subject to regulation risk beyond State control and projected supply shortages in the coming decades. This past winter, the region experienced very high natural gas prices that are not reflected in the economic analysis for the Project, and demonstrate the volatility of fossil fuel prices and the economic problem for Vermont of expanding our reliance on natural gas. The likelihood of national and international regulations on CO2 emissions under current international agreements will lead to new charges and controls on carbon-based fuels, as evident by new U.S. regulations on coal-fired power plants. Beyond GHG-related risk, the extraction of natural gas supplies is using increasingly environmentally damaging procedures such as hydro-fracking, a practice that Vermont has banned within State borders. Environmental regulation in other States and Canadian Provinces poses a risk to the long-term stability of natural gas supplies.

The long-term economic risk of increasing reliance on carbon-based fuels is an increasing factor in business and community planning throughout the world. The

Addison Rutland Natural Gas Project exposes the Vermont economy and, in particular, new communities and businesses serviced in Addison County, New York and beyond to long-term supply, price, and regulatory risk.

Q11. Does this conclude your testimony at this time?

A11. Yes.