CONSERVATION LAW FOUNDATION – CLEAN WATER ACTION –
ENVIRONMENTAL LEAGUE OF MASSACHUSETTS – ENERGY CONSUMERS ALLIANCE OF NEW ENGLAND
HEALTH CARE WITHOUT HARM

June 18, 2013

Senator Benjamin Downing
Senate Chair, Joint Committee on Telecommunications
Utilities and Energy
The State House, Room 413-F
Boston, MA 02133

Representative John Keenan
House Chair, Joint Committee on Telecommunications
Utilities and Energy
The State House, Room 473-B
Boston, MA 02133

Dear Chairman Keenan, Chairman Downing, and Honorable Members of the Committee:

Conservation Law Foundation, Clean Water Action, Environmental League of Massachusetts, Energy Consumers Alliance of New England, and Health Care Without Harm are pleased to provide this testimony in support of House Bill 2933 and portions of Senate Bill 1580, the passage of which would take a crucial step toward protecting the public safety, health, economy, and environment of the Commonwealth of Massachusetts from the inefficiencies and dangers of natural gas leaks. At this time, wealso urge the members of this committee not to favorably report out H. 2950 and H. 2962 because they include provisions that would prematurely move forward with proposals to expand natural gas infrastructure without first addressing the failings of the existing system.

The Threats Posed by Natural Gas Leaks

Natural gas leaks pose a triple threat to the Commonwealth. They create serious risks for public safety, jeopardize our climate change mandates, and take money directly from natural gas customers' pockets. The public safety threat is chilling. This winter, a natural gas leak caused an explosion in Fitchburg that destroyed a building and displaced three nearby families.[1] An explosion in Springfield last year injured eighteen people and significantly damaged 12 buildings,[2] and a woman was killed by an explosion in Somerset in 2009.[3] During the public

[1] Craig S. Semon, *Gas leaks blamed for Fitchburg explosion; 3 families displaced*, NEWSTELEGRAM.COM (Feb. 6, 2013), http://www.telegram.com/article/20130206/NEWS/130209761/0.
[2] Ryan Walsh et al., *Several hurt, none killed in massive downtown gas explosion*, 22NEWS WWLP.COM (Nov. 26, 2012), http://www.wwlp.com/dpp/news/local/hampden/downtown-intersection-blocked-off-due-to-apparent-gas-leak.

hearing on these bills, the Committee heard testimony from Wayne Sargent, who was inside his Gloucester home on January 25, 2009 when a gas leak from a cast iron main installed in 1922 caused an explosion that completely destroyed his home and injured him.[4] This leak had not been detected even though the gas company had responded to multiple odor calls and leaks on the same section of pipeline from as early as December 26, 2008 through January 2009.[5] Outdated natural gas distribution pipes and unrepaired or undetected leaks represent thousands of literal ticking time bombs throughout the Commonwealth.

Natural gas distribution system leaks also contribute to significant emissions of methane, a potent greenhouse gas. CLF reported the drastic extent of these emissions in a 2012 white paper.[6] Methane emissions from gas leaks, reported to the Massachusetts Department of Public Utilities ("DPU") as lost and unaccounted for gas by gas distribution companies, sent up to 3.6 million metric tons of CO_2-equivalent methane into the atmosphere in 2010.[7] Developing a more accurate inventory of and eliminating this source of climate-warming methane is critical to achieving the mandates of the Global Warming Solutions Act ("GWSA") and fully accounting for the climate impacts of natural gas. To that end, we were very pleased to hear Secretary Sullivan announce at the public hearing that the DPU plans to engage an independent contractor to conduct an analysis of the emissions from leaks. We fully support this step as necessary and critical to this issue.

In addition to the public safety and environmental risks, natural gas leaks have a substantial economic impact on the Commonwealth's ratepayers and are directly at odds with the Commonwealth's nation-leading programs to conserve natural gas. The end consumers of natural gas pay for all of the gas purchased by distribution companies from gas producers, regardless of the amount of gas that is lost to leaks (or other causes) on the way to consumers' homes and businesses. This is a direct financial loss to the Commonwealth's natural gas consumers, totaling $38.8 million annually.[8] The impact of these leaks is especially substantial when considered in comparison to the amount of natural gas conserved through Massachusetts' natural gas energy efficiency programs. In 2010, the program administrators for the natural gas efficiency programs reported savings of 1,097 million cubic feet of natural gas ("MMcf") at a cost of $62.4 million.[9] These savings were estimated to produce benefits of over $204 million. Nonetheless, during the

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[3] John Moss, *One woman killed in house explosion*, THE HERALD NEWS (Feb. 20, 2009), http://www.heraldnews.com/news/x1802692367/Unofficial-reports-House-leveled-in-explosion#axzz2VTIAMwBh

[4] Testimony of Wayne Sargent before the Joint Committee on Telecommunications, Utilities, & Energy (June 11, 2013) (The incident report containing Mr. Sargent's account of the harrowing incident is *available at* http://www.mass.gov/eea/docs/dpu/pipeline/incident-reports/1-25-09-gloucester.pdf , 3-4, 7-9).

[5] *Id*. at 9-10.

[6] SHANNA CLEVELAND, CLF, INTO THIN AIR: HOW LEAKING NATURAL GAS INFRASTRUCTURE IS HARMING OUR ENVIRONMENT AND WASTING A VALUABLE RESOURCE (2012), *available at* http://www.clf.org/intothinair/.

[7] *Id*. at 13.

[8] *Id*.

[9] *Id*. at 9, 23 (The actual savings of the natural gas energy efficiency programs for 2010 amounted to 11,245,671 therms (which converts to 1,097 MMcf). Actual program costs were reported at $62,473,787). *See* ENERGY EFFICIENCY ADVISORY COUNCIL, 2010 ANNUAL REPORTS FOR ELECTRIC AND GAS ENERGY EFFICIENCY PROGRAMS (Sept. 15, 2011), *available at* http://www.ma-eeac.org/Docs/3.1_Council%20Meeting%20Minutes/2011%20Minutes/9.20.11/2010AnnualReports-SummaryElec&Gas_EEACconsult9-15-11f.pdf.

same time frame, Massachusetts gas companies reported losing 1,725 MMcf of natural gas through leaks.[10] Massachusetts cannot afford to let these leaks go unaddressed. The risks are simply too great, and the economic and environmental costs are too high. Further, any attempts to reduce greenhouse gas emissions by switching to natural gas will be substantially undermined as long as the existing system continues to leak.

Specific Provisions that Will Effectively Address the Issues

The current system of ad hoc pipeline replacement, which only mandates that leaking pipes be repaired or replaced when they become "hazardous," leaves thousands of dangerous and costly leaks unaddressed.[11] The leak classification and action provisions of H. 2933 and portions of S. 1580 are the best-suited to deal with this crucial issue.

Classification and Timeline for Repair

Clear, uniform classification of differing levels of leaks in order to prioritize aggressive repair and replacement of leaking pipe is vital to addressing leaks. H. 2933 establishes a uniform system for grading three classes of leaks which closely mirrors current industry standards: Grade 1, Grade 2, and Grade 3.

- Grade 1, which generally covers leaks deemed "hazardous" under the current system, includes the additional safeguards of immediate reporting to local police and fire departments, and the explicit mandate to act continuously and immediately to eliminate the hazard or source of the leak.

- Grade 2 leaks, leaks that are probable future Grade 1 leaks (hazards to persons or property) are required to be reevaluated at least every three months, and repaired or cleared no later than 12 months from classification. Given the potential for Grade 2 leaks to escalate into Grade 1 hazards, enhanced monitoring and a strict timeline for repair is imminently reasonable. Other legislative proposals set less stringent requirements for monitoring and repair of Grade 2 leaks and are thus insufficient.

- Grade 3 leaks, those that are expected to remain non-hazardous, are generally to be evaluated at least every 12 months until the leak is eliminated, but under certain conditions are to be upgraded for scheduled repair. These provisions establish an appropriate balance by limiting the use of resources to address Grade 3 leaks to situations where demonstrated damages or costs that would otherwise be borne by municipalities or the public can be remedied. The bill also provides for targeted preemptive upgrading of certain Grade 3 leaks that have the most

[10] *See* CLEVELAND, *supra* note 6, at 9, 23 (This figure is based upon a conversion of the total amount of methane emissions as a result of leaks from the distribution system as reported to the Massachusetts Department of Environmental Protection by the local distribution companies, attached as Exhibit 1. For 2010, this figure amounted to 33,227 metric tons (which converts to 1,725 MMcf)).
[11] *Id*. at 14.

> potential to become Grade 2 leaks, including: those that could migrate substantially with frost conditions; situations where multiple leaks are identified in densely populated locations such as business or residential areas; and school zones.

Recordkeeping and Reporting

The impact of even an aggressive leak repair scheme will be diluted without comprehensive recordkeeping and reporting requirements. H. 2933 requires records of location, classification dates, and repair status for all three grades of leaks reported quadrennially to the DPU. Utilities already keep track of this information, and providing the reports to the DPU should not impose a significant additional burden, but it will provide the DPU, municipalities, and public safety officials with important information.

In addition, Sections 1-5 of S. 1580 establish requirements that would provide more accurate information for regulators, the companies, and customers. Section 1 would increase transparency by requiring distribution companies to provide a report that details not only the percentage of lost gas, but also information about actions taken to reduce lost gas. S. 1580 would also require the DPU to establish a performance benchmark for lost and unaccounted for gas to provide utilities with an incentive to reduce losses on the system. S. 1580 also tackles the issue of meter inaccuracy to ensure that customers, companies and the DPU have better data to inform decisionmaking.

Increased Surveys

The expansive network of gas distribution pipelines in the Commonwealth and the personnel limits of gas companies mean that any effective gas leaks bill must prioritize surveying areas particularly vulnerable or at risk. H. 2933 requires surveys at the very least for leaks where trees are discovered to be damaged due to leaks, whenever any commonwealth or municipal roadwork is done over gas pipelines, and at least every 12 months in school zones.[12] In addition, cast iron pipelines are required to be surveyed during specified winter temperature conditions that place the pipes at the highest risk of damage.[13]

Coordination with Municipalities

H. 2933 will require coordination with municipalities, from pipe surveys during any road work to ongoing communication with police and fire departments. However, H. 2933 includes crucial benefits for municipalities even beyond the most immediate reduction in safety risks, including mandating scheduled repair of Grade 3 leaks that result in continued visits by local firefighters and producing quadrennial reports of identified gas leaks available to municipal safety officials.

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[12] *See* H. 2933 § 144(c).
[13] *See id*. at § 144(e) (It is worth noting that each of the explosions referenced above occurred during late fall or winter).

Concerns with Specific Provisions in H. 2950 and S. 1580

There are two distinct major objectives that natural gas leak regulation should seek to implement. The first is ongoing assessment of leaks, and the second is actual replacement of leak-prone pipe with more reliable materials. The combination of H. 2933's classification and reporting requirements, discussed above, and an expansion of current DPU policies is the most efficient way to address both objectives. Provisions of other bills under consideration that attempt to address these objectives would be either less beneficial or actively harmful to the achievement of efficient gas leak monitoring and pipeline replacement.

Under traditional DPU practice, distribution companies are only allowed to recover the costs and a reasonable rate of return on outdated or broken pipeline replacements through a new rate case before the DPU. As a result, the company must carry the capital costs and loan payments on their own books until the new rate is approved. Other capital investments may have a better return than replacement of existing pipelines, or uncertainty regarding the scope of cost recovery for replacing pipeline can negatively affect a company's decision about moving forward with major pipeline replacement projects.[14]

The DPU has taken steps to address this problem for three local distribution companies ("LDCs") thus far, allowing capital recovery of pipeline replacement costs annually rather than solely in rate cases.[15] These programs have established requirements for the amount of pipeline that must be replaced. In addition, the approach provides ratepayers with significant net benefits.[16] The existing accelerated replacement programs, implemented via Targeted Infrastructure Replacement Factors ("TIRFs"), are company-specific and dependent on the existing inventory, service territory and capital requirements presented by the utilities in a rate case. Although the proposed language of H. 2950 clearly intends to improve the operation of existing TIRFs, the DPU has been working with utilities to modify and expand TIRFs as necessary on a case-by-case basis, and this issue is best left with the expertise of the DPU.

Pipeline replacement is and should remain a normal business expenditure for gas distribution companies, and the DPU is taking action to ensure that replaced pipe is prioritized in the companies' capital expenditure considerations. It would be counterproductive and harmful to the programs that currently depend on funds from Chapter 25, Section 19 to redirect energy efficiency revenues to pay for pipeline replacements outside this framework. Energy efficiency revenues in Massachusetts are currently directed toward programs such as Mass Save, which reduce utility bills and decrease demand on the power grid, thereby cutting greenhouse gas emissions. Residential efficiency programs allow for low-to-moderate income families otherwise unable to pursue increased home comfort to weatherize their home and save much needed capital. Likewise, business efficiency programs provide crucial cost and emissions reductions that empower local entrepreneurs to thrive in a competitive market. Funding directed at

[14] *See* CLEVELAND, *supra* note 6, at 11.
[15] *Id.*
[16] CRAIG AUBUCHON & PAUL HIBBARD, THE ANALYSIS GROUP, SUMMARY OF BENEFITS AND COSTS RELATED TO SELECT TARGETED INFRASTRUCTURE REPLACEMENT PROGRAMS (Jan. 2013), *available at* http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Benefits_Costs_TIRF_Jan2013.pdf (The Analysis Group has reported significant monetized net benefits of MA's TIRF program).

efficiency is estimated to have three to four dollars benefit for every dollar spent. Rather than divert efficiency funds we should pursue 21st-century infrastructure through the existing DPU process so as to maximize the economic and environmental benefits and meet legally mandated greenhouse gas reductions.

Under no circumstances should system benefit charge dollars currently allocated to efficiency be diverted to gas infrastructure maintenance or expansion. The utilities should continue to invest in all cost-effective energy efficiency AND meet their obligations to provide safe and reliable pipelines.

Legislation supporting expansion of natural gas infrastructure is premature

We strongly oppose the provisions of H. 2950 and H. 2962 that could increase the burdens of natural gas infrastructure expansion on ratepayers. This legislation provides incentives for expansion at significant cost to ratepayers under the dubious assumption that natural gas prices will remain at their current relative levels indefinitely when the one constant for natural gas prices has been, and remains, volatility.[17] These provisions also fail to consider whether such an expansion of natural gas service can be consistent with the mandates of the GWSA to reduce greenhouse gas emissions by 25% below 1990 levels by 2020 and by 80% below 1990 levels by 2050. To the extent that natural gas companies see a current or future economic benefit to expanding to serve additional customers, the companies should be required to provide and the potential customers should be required to take the economic risk of expansion on themselves. Finally, expansion should not move forward until recent concerns over system reliability and the need for additional coordination of the electricity and gas markets have been resolved.

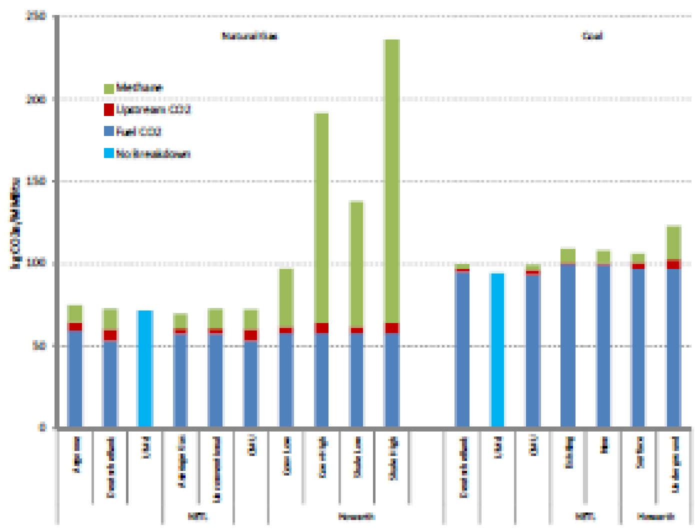
Some of our organizations have supported alternatives to standard ratemaking practices such as the current accelerated replacement programs for pipelines, as administered by the DPU. We do not recommend developing such alternative mechanisms for pipeline expansion. The accelerated replacement programs are valuable and necessary not only because they increase public safety by replacing leak-prone pipe, but also because they provide benefits to ratepayers immediately and continuously by reducing the lost and unaccounted for gas—a charge that is passed on to ratepayers regardless of whether that gas was delivered and usable to customers or lost in gas leaks.[18] In addition, the operations and maintenance expenses that would have been passed on to customers to repair leaks on these older pipelines are subtracted from the total cost of the TIRF. So ratepayers see multiple benefits from these programs in the form of reduced costs that would have otherwise been passed on to them. These programs were intended to counteract the Averch-Johnson effect which can sometimes deter regulated companies from making capital investments to replace infrastructure. Capital expansion projects, however, are already attractive to shareholders because they increase revenues and the capital costs are added

[17] One clear example of this is the most recent charts from the Energy Information Administration's Short-Term Energy Outlook regarding potential prices of natural gas available at http://www.eia.gov/forecasts/steo/images/Fig4.png.
[18] *See* CLEVELAND, *supra* note 6, at 12.

to the rate base. That is one of the reasons that the costs of lost expansion are not included in the existing accelerated replacement programs.

Equally important is the question of whether such an expansion of natural gas use in the Commonwealth can be compatible with the mandates of the GWSA. Although natural gas is less greenhouse gas intensive than coal or oil when it is combusted, recent studies have demonstrated that unless the issue of fugitive emissions (from leaks, venting, flaring and other events) is addressed, natural gas can actually result in higher greenhouse gas emissions than coal on a life cycle basis.[19] For example, in a 2012 study that ICF International conducted for the City of New York, ICF assessed recent analyses of the impacts of fugitive emissions on the life cycle greenhouse gas emissions from natural gas versus coal.[20] As the chart below shows, the amount of fugitive emissions can negate the potential climate benefits of shifting from coal to natural gas for the generation of electricity.[21]

Exhibit 6-2: Comparison of Recent Studies of Life-Cycle Emissions from Natural Gas and Coal (kg CO_2e/MMBtu)



Source: Cited studies and ICF Analysis.

CLF's recent whitepaper highlighted the impacts of leaks from the distribution system, as explained above. Likewise, any climate benefit that could be attributed to converting from oil to natural gas for heating would need to be evaluated to determine the impacts of fugitive emissions, such as leaks. CLF submitted expert testimony in an expansion proceeding before the Vermont Public Service Board to show just how important an assessment of fugitive emissions is

[19]Ramón A. Alvarez et al., *Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure*, 109 PROC. NAT'L ACAD. SCI. 6435, 6435-40 (2012), *available at* http://www.pnas.org/content/109/17/6435; James Bradbury et al., *Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems* (World Res. Inst., Working Paper, 2013), *available at* http://www.wri.org/publication/clearing-the-air.

[20]ICF INTERNATIONAL, ASSESSMENT OF NEW YORK CITY NATURAL GAS MARKET FUNDAMENTALS AND LIFE CYCLE FUEL EMISSIONS (Aug. 2012), *available at* http://www.nyc.gov/html/om/pdf/2012/icf_natural_gas_study.pdf.

[21] *Id.* at 44.

to developing an accurate measure of climate impacts.[22] Moving to expand the natural gas system without first reducing the leaks and inefficiencies of the existing system is premature, and doing so without first assessing the greenhouse gas impacts in the context of the short, medium, and long-term mandates of the GWSA is contrary to the statutory requirements and puts customers at risk of being saddled with stranded costs.

Infrastructure investments create long-term impacts. Once pipeline is in the ground, it may continue in use for 50 or 60 years or longer, as current pipeline inventories in Massachusetts demonstrate. This means that when the Commonwealth makes decisions about infrastructure, it must consider not only where a particular investment falls on the carbon curve now, but how it will measure up in 2030, 2040, and 2050. Unless the Commonwealth engages in that analysis prior to building new infrastructure, it will find itself locked in to investments that are inconsistent with the mandates of the GWSA and inconsistent with protecting ratepayers from imprudent expenditures that result in stranded costs.

Finally, expanding the current use of natural gas will have an impact on electric system reliability. The Federal Energy Regulatory Commission ("FERC"), the New England States Committee on Electricity ("NESCOE"), and the Independent System Operator of New England ("ISO-NE") have all acknowledged that the region's increasing dependence on natural gas fired electric generation may pose risks to system reliability.[23] Multiple stakeholders, including CLF, are engaged at the regional level to propose market-based solutions to ensure system reliability during periods of high seasonal demand, stressed system conditions, and other contingencies associated with natural gas supply/transportation system infrastructure. Massachusetts should not expand natural gas infrastructure without examining the potential reliability impacts on the system and the interplay with the solutions that are currently being developed by ISO-NE under FERC oversight.

Therefore, we urge the Committee to leave determinations about expansion to specific proposals by the DPU in the context of an adjudicated rate case where they can be fully evaluated to determine whether they are warranted, whether they are consistent with the mandates of the GWSA, and whether they include appropriate cost allocation.

Conclusion

The aging natural gas distribution system in Massachusetts poses real public safety, environmental, and economic threats to Massachusetts and its residents. Multiple steps need to be taken to ensure that the infrastructure that carries natural gas to homes, businesses, and institutions to heat and power the Commonwealth does so safely and efficiently. The Department of Public Utilities, Department of Energy Resources and Executive Office of Energy and Environmental Affairs have already begun taking many of those steps in coordination with the

[22] *See* Direct Testimony of Elizabeth A. Stanton on behalf of Conservation Law Foundation, No. 7970 (June 14, 2013), attached as Exhibit 2.

[23] *See* Letter from Ann Berwick, Chair, Massachusetts Department of Public Utilities, President, New England States Committee on Electricity, to Federal Energy Regulatory Commission (Aug. 23, 2012) (FERC Docket No. AD-12-12-000); ISO NEW ENGLAND, 2013 REGIONAL ENERGY OUTLOOK (Jan. 21, 2013), *available at* http://www.iso-ne.com/committees/comm_wkgrps/strategic_planning_discussion/materials/2013_reo.pdf.

local distribution companies. Establishing uniform leak classifications, timelines for repair and reporting requirements while also developing more accurate information about the sources and amounts of lost and unaccounted for gas are the most effective legislative actions that can be taken to address this issue, and we urge the Committee to favorably report out H. 2933 and the portions of S. 1580 referenced above to implement such measures. However, moving forward with the portions of H. 2950 and H. 2962 regarding accelerated replacement programs and potential expansion of the natural gas system are premature, and we recommend that the Committee leave these issues to the capable regulators at the Department of Public Utilities to ensure a robust, transparent, and public review that addresses the issues of compatibility with the GWSA, reliability, and cost allocation.

Thank you for the opportunity to submit these comments.

Please do not hesitate to contact us if you have any questions regarding the foregoing.

Sincerely,

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Encls.

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

Natural Gas Facility CH4 emissions

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
ALGONQUIN GAS TRANSMISSION LLC	SPEC	Fugitive emissions	16.844	Pipeline and meter station fugitive emissions
		Blowdown emissions	42.64	
		Vented Emissions	14.8	
		Algonquin Gas Transmission LLC Total	**74.284**	
BELLINGHAM COGENERATION	Nort	Natural Gas Pipeline Fugitive Emissions	0.31	
		Bellingham Cogeneration Total	**0.31**	
BERKSHIRE GAS COMPANY	BERK	pipeline distribution network	788.78	
		Berkshire Gas Company Total	**788.78**	
BOSTON GAS COMPANY	NATI	Above ground meter and regulators at custody transfe	39.78	For 2010 we used API Compendium emission factors for these Custody Transfer City Gate Stations. 1.17 CH4 tonnes/station/yr and 0.03 CO2 tonnes/station/yr. These are currently being used by National Grid and the gas industry to estimate GHG emissions from City Gate Stations. EPA has devised a new method in Subpart W that will be used in 2011.
		Above ground meters and regulators at non-custody t	270.68	For 2010 we used API Compendium emission factors for these Non-Custody Transfer Stations. 4.04 CH4 tonnes/station/yr and 0.12 CO2 tonnes/station/yr. These are currently being used by National Grid and the gas industry to estimate GHG emissions from Non-Custody Transfer Stations. EPA has devised a new method in Subpart W that will be used in 2011
		Below ground meter and regulators and vault equipm	8.46	For 2010 we used EPA Subpart W emission factors for these Below Grade M&R stations. This total is the from the three types of Below Grade M&R stations listed in Subpart W. The calculations is simply a station count multiplied by an emission factor. This willbe the same case in 2011

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
		Pipeline mains equipment leaks	14050.22	For 2010 we used the pipe types listed in Subpart W and the emission factors listed in Table W-7. The calculation is simply miles of pipe multiplied by pipe type specific emission factor, converted to mass emissions.
		Service line equipment leaks	4262.82	
		Boston Gas Company Total	**18631.96**	
CITY GATE STATION	WES	Fugitive Gas Emissions	4.97	
		City Gate Station Total	**4.97**	
COLONIAL GAS COMPANY	NATI	Above ground meter and regulators at custody transf	9.36	For 2010 we used API Compendium emission factors for these Custody Transfer City Gate Stations. 1.17 CH4 tonnes/station/yr and 0.03 CO2 tonnes/station/yr. These are currently being used by National Grid and the gas industry to estimate GHG emissions from City Gate Stations. EPA has devised a new method in Subpart W that will be used in 2011
		Above ground meters and regulators at non-custody t	72.72	For 2010 we used API Compendium emission factors for these Non-Custody Transfer Stations. 4.04 CH4 tonnes/station/yr and 0.12 CO2 tonnes/station/yr. These are currently being used by National Grid and the gas industry to estimate GHG emissions from Non-Custody Transfer Stations. EPA has devised a new method in Subpart W that will be used in 2011
		Below ground meter and regulators and vault equipm	1.56	For 2010 we used EPA Subpart W emission factors for these Below Grade M&R stations. This total is the from the three types of Below Grade M&R stations listed in Subpart W. The calculations is simply a station count multiplied by an emission factor. This will be the same case in 2011.

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
		Pipeline mains equipment leaks	1690.13	For 2010 we used the pipe types listed in Subpart W and the emission factors listed in Table W-7. The calculation is simply miles of pipe multiplied by pipe type specific emission factor, converted to mass emissions. The value provided is the total of the four types of pipe.
		Service line equipment leaks	571.67	
		Colonial Gas Company Total	**2345.44**	
COLUMBIA GAS OF MASSACHUSETTS	COLU	Fugitive_AG_M&R	222.2237	API Compendium /Table 6-7 (emission factor)
		Fugitive_BG_M&R_100-300	1.923	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_BG_M&R_<100	2.2664	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_BG_M&R_>300	0.6799	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Cast Iron Miles	3672.3903	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Copper Services	2.936	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Plastic Miles	323.226	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Plastic Services	25.0669	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Protected Steel Miles	126.217	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Protected Steel Services	171.747	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Unprotected Steel Miles	817.824	EPA MRR /Subpart W /Table W-7(emission factors)
		Fugitive_Unprotected Steel Services	1786.6548	EPA MRR /Subpart W /Table W-7(emission factors)
		Venting_Ludlow	109.85	Density of Methane = 0.0196 kg/scf
		Columbia Gas of Massachusetts Total	**7263.005**	
EL PASO CHARLTON STATION	TENI	Compressor Station Fugitives	59.21	Emissions (metric tons) = EF (lb/facility) * (actual CH4 mol%/default CH4 mol%)*(1 metric ton/2204.6 lb)
		264-C-01 (Pressurized)	76.518	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		264-C-02 (Pressurized	76.518	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
		Station Blowdowns	14.5308	falsely labeled as process emissions; CO2)*(1/2204.6) Emissions (metric tons) = blowdown vol*1000*(CH4mol%/100)*(1/379.3)*(CH4)*(1/2204.6)
		El Paso Charlton Station Total	**226.7768**	
EL PASO MENDON STATION	TENI	266A-A-01 (Pressurized)	23.637	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		266A-A-01 (Unpressurized)	193.848	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		266A-A-02 (Pressurized)	13.952	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		266A-A-02 (Unpressurized)	229.362	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		266A-B-01 (Pressurized)	76.507	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		Compressor Station Fugitives	59.2	Emissions (metric tons) = EF (lb/facility) * (actual CH4 mol%/default CH4 mol%)*(1 metric ton/2204.6 lb)

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
		Station Blowdowns	5.7158	falsely labeled as process emissions; CO2)*(1/2204.6) Emissions (metric tons) = blowdown vol*1000*(CH4mol%/100)*(1/379.3)*(CH4)*(1/2204.6)
		El Paso Mendon Total	**602.2218**	
EL PASO ENERGY STATION	TENI	267-A-01 (Pressurized)	0.294	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-A-01 (Unpressurized)	280.08	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-A-02 (Pressurized)	0.027	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-A-02 (Unpressurized)	281.06	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-A-03 (Pressurized)	1.851	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-A-03 (Unpressurized)	274.371	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
		267-B-01 (Pressurized)	1.917	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-B-01 (Unpressurized)	274.13	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-B-02 (Pressurized)	2.283	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		267-B-02 (Unpressurized)	35.07	described as compressor fugitives; Emission (tons)= EF(lb/hr-component) * Activity Data (hr) * Correction Factor * (1 metric ton/2204.6lb) * Component Count
		Compressor Station Fugitives	59.33	Emissions (metric tons) = EF (lb/facility) * (actual CH4 mol%/default CH4 mol%)*(1 metric ton/2204.6 lb)
		Station Blowdowns	0.0883	falsely labeled as process emissions; CO2)*(1/2204.6) Emissions (metric tons) = blowdown vol*1000*(CH4mol%/100)*(1/379.3)*(CH4)*(1/2204.6)
		El Paso Energy Total	**1210.5013**	
MIDDLEBOROUGH GAS & ELECTRIC GAS DIVISION OFFIC	MID	Natural Gas Distribution System	373.4	EPA GHG Equivalencies Calculator Gas Chromatograph CH4 96.3%
		Middleborough Gas & Electric Gas Division Office Total	**373.4**	
MUELLER ROAD GAS CONTROL	CITY	LNG Storage	0.02	
		Natural Gas Distribution	511.29	
		Mueller Road Gas Control Total	**511.31**	
NSTAR GAS	NSTA	NSTAR Gas FAcility ID 1193487	4198.24	
		NSTAR Gas Total	**4198.24**	

Exhibit 1: CH4 Emissions reported to the MassDEP by the local distribution company, 2010

FACILITY	ENTI	SOURCE	QUANTITY (metric tons of CH4	DESCRIPTION/NOTES
TENNESSEE GAS PIPLELINE CO (WORCESTER)	TENI	M&R Fugitives	76.5962	Emissions (metric tons) = M&R Station Count * EF (lb/station) * (actual CH4 mol%/default CH4 mol%)*(1 metric ton/2204.6 lb)
		Pipeline Blowdowns	168.7822	"pipeline blowdowns" was falsely noted as process - scope 1; Emissions (metric tons) = blowdown vol *1000*(CH4 mol%/100) *(1/379.3) *(MW)
		Pipeline Fugitives	4.1587	Emissions (metric tons) = EF (lb/mile)*pipeline length (mile) * (actual CH4 mol%/default CH4 mol%)*(1 metric ton/2204.6 lb)
		Tennessee Gas Pipeline Co (Worcester) Total	**249.5371**	
		TOTAL CH4 FUGITIVES OF ALL FACILITIES	**36,480.74**	

Exhibit 2: Stanton Direct Testimony

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.

[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	$1.4\text{x}10^{-5}$	1	1	1
Methane	CH_4	$3.7\text{x}10^{-4}$	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

[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 <u>decreases</u> 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 <u>increase</u> by 176,000 short tons over 20 years (compared to a 292,000 short ton <u>reduction</u> 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.