From: MLearner [mailto:mzlearner@gmail.com]
Sent: Sunday, February 28, 2016 6:20 PM
To: Monroe, Pamela
Subject: Re: SEC Site 300 rules

I, like many others, have reviewed the current Site 300 rules and the provisions specified in the Request for Comment and found them to be inadequate. I know that many comments, suggestions, supporting documents, and informative literature have been forwarded for your review and I trust they will be carefully considered and included in your new regulations. I would like to comment on the responsibilities inherent in this process as well as regulation topics. The NHSEC has a unique opportunity to put in place up-to-date regulations governing the siting of gas transmission pipelines and their accompanying appurtenances. I hope this task is given the time and attention it deserves.

Given the importance of this process I request that additional time be allowed for the public to enlist the aid of medical, public health, engineering, geologic, hydrologic, legal, scientific, etc experts to formulate and craft relevant critical reports so that appropriate regulations can be suggested. Despite the 25 January 2016 date of the request, the public did not receive the request until 11 February 2016. I request that the deadline for submission be extended well beyond 29 February 2016 to give the municipalities and members of the public a reasonable opportunity to contribute to this process. Once comments have been included, I assume a public hearing will be scheduled to further review and refine NH regulations.

As are all residents of NH, I am impacted to some degree every decision that degrades the landscape, resources, finances and public health of NH. Preserving our beautiful living environment, which includes ensuring the continuation of life-sustaining renewable sources of potable water, clean air, and a healthy, regenerating ecosystem for future generations should be a primary function and obligation of our energy infrastructure regulatory commission.

Current FERC regulations regarding the siting of gas transmission pipelines are several decades old and were written well before HVHF was used for gas extraction. Therefore regulations regarding the toxic emissions and byproducts of this technology were not anticipated. The current FERC EIS lacks a Comprehensive Health Impact Assessment, and avoids considering the short and long term impacts that transmission pipeline construction and operation has on public health. Public health and public interest are inextricably bound. The water debacle of Flint Michigan is an extreme and tragic example of the problems that can arise when public health impacts are divorced from public interest determinations; common sense says that public interest includes a myriad of issues beyond promised short term financial savings.

FERC employees were heard to say at scoping meetings in NH that [they] are aware that new, currently operating compressor stations helping the transmission of fracked gas from shale plays are making nearby residents ill, and data from towns near fracking fields in CO, UT and PA are beginning to document the longer term negative effects people experience from ongoing exposure to the toxic emissions from the transmission of fracked gas.

There are currently several massive high pressure HVHF transmission pipelines proposed for New England. Unfortunately the dysfunction and contentiousness of the US Congress makes it unlikely that necessary legislation designed to modernize FERC's siting regulations, which could address these documented problems, will be forthcoming in the foreseeable future. Therefore, it is imperative that NH, which will be operating under a new, untested siting process, draft relevant up-to-date siting regulations, rather than defaulting to FERC's out-of-date siting criteria. NH has both an **opportunity** and an **obligation** to draft and put into place up-to-date regulations that protect public health. 21st century construction methods and techniques, operational issues, toxic byproducts and their impacts on public

health must be part of the calculus. Of utmost importance in NH regulations is the inclusion of a **Comprehensive Health Impact Assessment (CHIA).** (See below)

Fracking and its byproducts have the potential to be the **lead** and **asbestos** of our time. Our society continues to pay externalized costs that stem from their use decades ago. We might prevent inevitable future damage already known to be caused by the toxic chemicals and VOCs in gas emissions by enacting preventive regulations based on data we already have. I strongly encourage the SEC to adopt a **CHIA** as an essential component of every high pressure gas transmission pipeline application. Documentation explaining the rationale for and categories to be included in a CHIA is included.

Additionally, due to an eroded sense of trust in regulatory agencies at all levels of government, it is imperative that regulatory commissions acknowledge -via public statements - that they understand and accept the public health consequences of their decision making, should siting approval be granted. "Acceptable" health risks and other externalized costs to NH citizens, such as no/slow growth, decreased property values, shift in school aged populations within school districts, loss of schools, loss of population, loss of business, potential demise of viable towns, increased health care costs, etc. should be anticipated and quantified, and impacted residents should participate in planning mitigation "remedies."

I suggest one additional criterion for SEC consideration; **proportionality** pertaining to length of use vs amount of potential destruction to lives, property and resources. Just as the last century ushered in industrial change, our 21st century is ushering in technological advances for a clean energy age. Energy storage and potential generation sources are in various stages of research and development. Even the military is investing heavily in clean energy research; the question is WHICH TECHNOLOGIES will prove best, and WHEN the new technologies become adoptable for public use, not IF.

Does it make sense to invest heavily in last century technologies and energy sources, knowing they may not even be in widespread use in 15 years? Third world countries that had no land line telephone wire infrastructure in the 20th century have better cell phone service today than we do, because there was no corporate or civic investment in last century's infrastructure to protect. Investing in a massive high pressure transmission gas pipeline and encouraging the proliferation of gas power plants is like investing in a home theater system that shows DVDs but has no streaming capability, just because it's a "deal." There's a reason it's discounted; it is already obsolete! NH should plan ahead, maintain the fossil fuel energy infrastructure already in place as a bridge, tweaking it minimally as necessary, and look toward the future.

Thank you for considering my comments.

Marilyn Learner
Hollis NH

CHIA White Paper-NH

http://www.ncsl.org/research/environment-and-natural-resources/an-analysis-of-state-health-impact-assessment-legislation635411896.aspx

Governor's Pipeline Infrastructure Task Force (PITF) Report, dated February 2016, the Pennsylvania Department of Environmental Protection Pipeline Infrastructure Task Force http://files.dep.state.pa.us/ProgramIntegration/PITF/PITF%20Report%20Final.pdf

A Brief Review of Compressor Stations, dated November 2015, by the Southwest Pennsylvania Environmental Health Project http://www.environmentalhealthproject.org/wp-content/uploads/2014/05/A-Brief-Review-of-Compressor-Stations-.pdf

Summary on Compressor Stations and Health Impacts, dated 24 February 2015, by the Southwest Pennsylvania Environmental Health Project http://www.environmentalhealthproject.org/wp-content/uploads/2012/03/Compressor-station-emissions-and-health-impacts-02.24.2015.pdf

Topics to be addressed:

1. Public and Private Drinking Water Wells

a. Avoidance of aquifers that are used for public and private drinking wells
b. Identify impacts of blasting on groundwater for public and private drinking wells
c. Require hydrogeological studies to support application
d. Identify impacts and risks associated with hydrostatic testing
e. Identify impacts of air pollution from surface facilities (compressor engines, compressor blowdowns, condensate tanks, storage tanks, truck loading racks, glycol dehydration units, amine units, separators, fugitive emission sources, etc.) on dug wells
f. Testing and monitoring of public and private wells prior to construction (baseline) and periodically post construction; test for flow as well as contaminates (i.e., arsenic, radon, benzene, VOCs, etc.)

2. Public Health and Safety

a. Current state (baseline) of the impacted Town's Emergency Management, Fire Department and Police Department capabilities
b. Identify risks of proximity to high-tension electrical wires and other ignition sources; avoid EMI
c. Identify Emergency Response Plans; training and equipment; ability of Town's to respond to wildfires and other disasters; Mutual Aid impacts, etc.
d. Identify security requirements and associated risks
e. Identify system shut-down procedures; identify risks associated with road structure and conditions, terrain, weather, etc.
f. Require highest quality of pipe, considering health and safety impacts, not only population density
g. Use and management of dangerous substances; major hazards assessment and management; pollution prevention; solid and chemical waste management
h. Avoid steep-slopes; identify risks due to erosion, pipe cleaning and maintenance, etc.
i. Current state (baseline) of roads and public right of ways; impacts to roads for logging, construction and maintenance activities
j. Require road bonds prior to construction
k. Audits and inspections during operations

3. Air Pollution

a. Require a Comprehensive Health Impact Assessment
b. Require surface facilities (compressor engines, compressor blowdowns, condensate tanks, storage tanks, truck loading racks, glycol dehydration units, amine units, separators, fugitive emission sources, etc.) to be constructed to control emissions and prevent air pollution
c. Identify impacts to people, business, schools, local farms, surface waters, etc.
d. Twelve months of air monitoring prior to operation to establish current state (baseline)
e. Constant testing and monitoring for air pollution
f. Guidelines for levels of pollutants that shuts down the surface facility
g. Soil testing and monitoring to identify local conditions (baseline) and periodically after operation

4. Noise, Vibration and Light Pollution

a. Identify current local conditions (baseline)
b. Identify impacts to people, business, local farms, etc.

c. Requirements of local ordinances
d. Identify risks to homes, businesses and farms

5. Socioeconomic

a. Assessment of Baseline Social, Economic and Environmental conditions
b. Identify impacts to property values and abatement impacts on Town revenue
c. Identify impacts to local businesses
d. Identify local Master Plans; address impacts to Town planning and development
e. Require independent study of local economic impacts due to effects of project on Public and Private Drinking Wells, Public Health and Safety, Air Pollution, Noise and Light Pollution, Aesthetics and Deforestation, Threatened and Endangered Species, etc.
f. Require local resource taxes be paid by the applicant to include Timber Tax, Excavation Taxes, Local Permitting Fees, Change of Use (e.g., Current Use), etc.
g. Avoid disproportionate impact on low income and disadvantaged or vulnerable groups

6. Land Use, Recreation and Aesthetics

a. Identify impacts and risks
b. Identify impacts due to deforestation
c. Avoid land with current conservation easement or with non-development deed restrictions
d. Protect cultural property and heritage
7. Threatened and Endangered Species
a. Avoid Endangered, Threatened and Species of Special Concerns
b. Avoid Highest Ranked Wildlife Habitat

8. Alternatives

a. Identify and consider feasible environmentally and socially preferable alternative locations
b. Avoid use of Eminent Domain or condemnation
c. Consider efficient production, delivery and use of energy
d. No build option
e. Minimal/as needed expansion of existing transmission infrastructure

The Role of Comprehensive Health Impact Assessment in Evaluating Infrastructure for Natural Gas Transport
A White Paper prepared by an *ad hoc* working group
(20 February 2016)

Executive Summary

This white paper provides an overview of four critical issues regarding the role of comprehensive health impact assessment (CHIA) in review of applications for permits and certificates concerning natural gas transport infrastructure proposals. Section I outlines the essential features of CHIA and the value it adds to the review process. Section II documents the increasing need for CHIA given recent developments in the installation, operation, monitoring, and researching of natural gas transportation infrastructure. Section III covers incorporating CHIA into review procedures. Section IV proposes particular approaches to CHIA at various points in the application and review process and in the federal environmental impact assessment process.

I. What is a CHIA

A. Purpose

A comprehensive health impact assessment ("CHIA") is an in-depth and systematic approach to health impact assessment that uses "an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program or project on the health of a population and the distribution of those effects within the population. "[1] A CHIA provides recommendations on minimizing, monitoring, and managing those effects.

CHIAs inform decision-making by identifying and prospectively evaluating potential effects on human health of a development proposal and its alternatives, aiming specifically at predicting how development induces unintended changes in health determinants and resulting changes in health outcomes. After considering multiple factors, a CHIA informs decision-making about whether to proceed with a proposed activity and if so, offers recommendations to address health-related gaps in data, to minimize risks and maximize benefits, and to establish a monitoring framework. A CHIA can be performed at many different levels of policymaking and regulation.

Intimately related to environmental impacts, the objective of a CHIA can, and should, be incorporated into an environmental impact statement ("EIS") but very often, is not. As a result, the typical EIS:

- Does not consider the human health impacts of the project; and when it does, the analysis is narrow
- Does not encompass human health in the "description of the affected environment." As a result, there are no baseline rates of potentially impacted health problems, no identification of drivers of those problems, no "consequences of the alternatives" in terms of human health -- direct, indirect, or cumulative health risks are not systematically identified or analyzed
- Does not review pertinent medical research and public health studies
- Rarely involves health experts and officials
- Rarely proposes the "no action" alternative or mitigation measures to protect and promote health

[1] North American HIA Practice Standards Working Group, "Minimum Elements and Practice Standards for Health Impact Assessment (Version 3, September 2014)," found at http://hiasociety.org/wp-content/uploads/2013/11/HIA-Practice-Standards-September-2014.pdf.

Further, the typical regulatory agency approach estimates the total short-term and long-term emissions directly sent into air or water by the project under consideration. Estimated total emissions are then compared with Federal or State standards for "acceptable" emissions.[2] If the estimated levels fall below critical thresholds, the project is assessed as having a non-significant health impact. This approach is inadequate. For example, the following are but three examples of impacts that the typical approach presently does not include:

- Emission spikes. Regulatory agencies measure emissions in terms of averages taken over numerous short (for example, one hour or less) or long-term intervals (for example one or more days). Recent studies have found that these averages do not reveal the occurrence of very high levels of "peak" emissions that may occur at irregular intervals. These peaks may have serious adverse health impacts that are not captured by averaging over longer periods of time. A comprehensive assessment performed according to public health professional standards would capture information on peak emissions and their consequent health implications.
- Dynamic evolution of emissions. Regulatory agencies take a very local and static view of toxic emissions, assessing them in isolation from each other and only at the time and place immediately adjacent to their source. Many if not most standards are based on single chemical emission, while under most circumstances it is a mixture of different chemicals that are emitted. In addition, any single emission can disperse widely, evolve, and combine with other emissions and atmospheric conditions and become reabsorbed into distant water and soil. Only a comprehensive health assessment can properly evaluate the full range of emission impacts.
- Downstream and upstream impacts. Regulatory agencies restrict their assessment of impacts to the operations of the project in question. However, pipeline impacts extend far beyond pipeline operations. Pipelines are a "midstream" structure, placed between the start-point of gas well production sites and the endpoint of commercial or residential consumption. Adding a pipeline has the impact of expanding both production and consumption; and many studies have reported that the endpoint use of pipeline-provided gas in residential stoves has adverse impacts on respiratory function. Only the CHIA component of an environmental impact assessment would, correctly, view this as a pipeline impact.

The above examples are not exhaustive. The issue of vulnerable sub-populations (such as people with pre-existing asthmatic conditions) is not routinely addressed by regulatory agencies, but is a key CHIA element.

As an integral component of an EIS, the CHIA must be completed before any final decisions are made by the regulators, and, must inform such decisions. Unlike the other components of an EIS, which focus on estimating and evaluating the increase in environmental stressors (*e.g.*, air, water and soil contamination; population movement; *etc*.) and then on articulating means and methods to eliminate adverse environmental impacts to the maximum extent practicable, the CHIA component is specifically designed to consider and evaluate potential *human health* impacts by identifying the potential pathways for such stressors to harm human health, quantifying the cumulative risks posed by such stressors, and recommending necessary mitigation. The goal of the CHIA component of an EIS, then, is to maximize

[2] In fact, the Department's rationale in rejecting recommendations in the Algonquin Incremental Market Project to conduct an independent air emissions baseline assessment and health impact study consistent with the resolutions adopted by many municipalities within the New York portion of the AIM Project reflects precisely this approach: "Neither … is required in order for the NYSDEC to issue the Title V air permit modifications because the AIM Project complies with all applicable federal and state regulations, which have been established to protect public health and safety." "New York State Department of Environmental Conservation Response to Public Comments: Algonquin Incremental Market Project, May 2015," which may be found at: http://www.spectraenergy.com/content/documents/Projects/AIM/NYSDEC_Response_Public_Comments_AIM%20Project_%20May%202015_DEC%20website_7625736_1-c.PDF.

preservation of the health of individuals and to minimize negative health impacts. The CHIA component therefore focuses specifically on health outcomes linked to potential exposures, including respiratory, cardiovascular, oncologic, dermatologic, reproductive, developmental, neurological, psychiatric, substance abuse, emerging infectious disease and injury/motor vehicle related impacts, with a special emphasis on vulnerable and general populations in the community. The CHIA component gives special attention to vulnerable populations, such as subpopulations of low socioeconomic status, racial and ethnic minorities, infants and youth, pregnant women, the elderly, the infirm, and industrial workers, because such populations must be protected from levels of exposure that might be judged "on average" to be of insignificant adverse impact. The CHIA component is also well-designed to evaluate both cumulative impacts and site-specific factors (such as local geography and meteorological conditions) that may predominate in determining whether human health will be adversely impacted by an action.

B. The Steps in the CHIA Process[3]

The first two steps determine the tools to be used in the following four.

1. Screening –determines what policy/regulatory requirements would the CHIA inform. Identify lead(s) and partners
2. Scoping – develops the framework for the CHIA component; identifies the important possible health effects, affected populations, and available evidence. Identifies budget. Includes the following steps/tools:
   - Literature search and gathering of opinions from medical and public health experts, scientists, and engineers, as well as economists and sociologists
   - Identify stakeholders and their information needs
   - Identify and prioritize stressors which might lead to health impacts
   - Identify the boundaries of the potential impact
   - Specify budget
   - Use the above information to identify methods and tools for data collection
3. Assessing risks and benefits – analyzes baseline conditions and predicts potential effects
4. Developing recommendations – develops human health-based recommendations and a feasible plan for implementing them
5. Reporting – produces the text to be included in the EIS, disseminates the EIS to decision-makers, the public, and other stakeholders
6. Monitoring and evaluating – determines the extent to which inclusion of CHIA in the EIS added value to it, identifies the obstacles to research, and monitors outcomes of implementing decision

II. The need to include CHIAs into environmental impact assessments of the natural gas transport infrastructure is increasingly significant

Incorporating a CHIA into an environmental assessment of a proposed natural gas transport infrastructure project or a proposed policy relating to natural gas transport infrastructure is essential since the CHIA component informs decision-making by, among other things, identifying potential risks and benefits of the proposal and making recommendations to minimize risks, maximize benefits, address data gaps, and establish a monitoring framework.

A. Increased understanding of releases and their human health effects

[3] Derived from Figure S-1 (p. 7) in National Research Council (2011), "Improving Health in the United States: The Role of Health Impact Assessment by Committee on Health Impact Assessment", found at http://www.nap.edu/download.php?record_id=13229.

Setting aside the known impacts on the natural environment of anthropogenic releases of methane, the primary component of the mix of fuel gases commonly known as "natural gas"[4] – which alone should give cause to question the desirability of expanding natural gas transport infrastructure[5] -- gases and condensate[6] in natural gas transport infrastructure have known human health effects. Recent studies show that those releases occur in quantities greater than had been previously estimated and in patterns that pose risk to human health. The need for incorporation of CHIA into environmental impact assessments of natural gas infrastructure projects thus becomes that much more important.

1. Releases

Recent research documents the prevalence of leaks in each component of the natural gas extraction, processing, and transport infrastructure system. As but a few examples:

- According to USEPA, 92.1 percent of methane emissions in the United States natural gas industry come from fugitive emissions (62.1 percent of the total) and vented emissions (30 percent of the total),[7] with total United States natural gas industry methane emissions accounting for 19 to 21 percent of anthropogenic methane emissions.[8] Additionally, "In the largest, most comprehensive study ever conducted on methane emissions from natural gas gathering facilities and processing plants, researchers led by Colorado State University found that 0.47 percent of the methane produced domestically is lost during gathering and processing operations. According to the study, methane emissions from gathering systems are equivalent to 30 percent of overall methane emissions in the current U.S. greenhouse gas inventory. The majority of these methane emissions were attributed to normal operations of gathering facilities."[9]
- "A Colorado State University-led research team … completed the most comprehensive field study to date of the amount of methane being emitted at the nation's natural gas transmission and storage infrastructure. [Based on 2012 data,] researchers detected methane emissions at compressor stations that were both operating and idle. Estimates based on on-site measurements indicate about 30 percent of aggregate emissions were from facilities where all compressors were idle. … Without the two super emitters, average methane emissions recorded during the study

[4] "Natural gas is composed primarily of methane, but may also contain ethane, propane and heavier hydrocarbons. Small quantities of nitrogen, oxygen, carbon dioxide, sulfur compounds, and water may also be found in natural gas." http://www.beg.utexas.edu/energyecon/lng/LNG_introduction_07.php.

[5] USEPA considers methane to be a major greenhouse gas: "Pound for pound, the comparative impact of CH4 on climate change is more than 25 times greater than CO2 over a 100-year period." http://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html. To address the issue of reducing anthropogenic releases of methane into the atmosphere, that agency recently issued a series of regulations and requests for information on emissions occurring at various stages of natural gas extraction, processing, and transportation. *See* http://www3.epa.gov/airquality/oilandgas/actions.html.

[6] In the context of this White Paper, "condensate" means liquids -- hydrocarbon liquids and water -- that condensed out of the natural gas stream and particulate matter formed during natural gas contact with the materials that coat the inside of the natural gas pipeline.

[7] USEPA, "Estimate of Methane Emissions from the U.S. Natural Gas Industry," Table 2, posted September 15, 2015 and found at http://www3.epa.gov/ttn/chief/ap42/ch14/related/methane.pdf.

[8] *Ibid*., at "5.0: Conclusions." According to USEPA, methane emissions from oil extraction activities and from natural gas extraction, transportation, and distribution activities account for nearly 30 percent of total United States anthropogenic methane emission sources. USEPA news release dated August 18, 2015, "EPA Proposes New Commonsense Measures to Cut Methane Emissions from the Oil and Gas Sector/Proposal Cuts GHG Emissions, Reduces Smog-Forming Air Pollution and Provides Certainty for Industry," found at http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/e5f2425e2e668a2b85257ea5005176fa!opendocument.

[9] http://source.colostate.edu/researchers-measure-methane-lost-in-natural-gas-operations/. The study itself, A. Marchese et al., "Methane Emissions from United States Natural Gas Gathering and Processing," Environ. Sci. Technol. 2015, 49, 10718−10727, may be found at http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b02275.

were higher than the Greenhouse Gas Reporting program, but comparable to or lower than the Environmental Protection Agency's Greenhouse Gas Inventory estimate. When the super emitters are included, then the study-average emission factors could exceed both EPA estimates."[10] A follow-up analysis of the data "found that the total amount of methane emitted into the atmosphere from the transmission and storage sector is not statistically different from the emissions reported in the Environmental Protection Agency's 2012 Greenhouse Gas Inventory[11] for the sector[, which] ... estimated emissions between 1,680 to 2,690 Gg/yr (mean of 2,071 Gg/yr). The study estimates that total methane emissions from the transmission and storage sector resulted in the loss of 0.28% to 0.45% (mean of 0.35%) of the methane transported in 2012."[12] This new information, combined with other data acquired from other studies, led USEPA last week to announce its re-evaluation of its inventory.[13]

- A Harvard University study of natural gas leaks from the Boston area's natural gas infrastructure published in January 2015 showed that natural gas is leaking from that infrastructure at rates two to three times higher than previous government estimates, with an overall leak rate of 2.1 percent to 3.3 percent.[14]

Additionally, at present, planned releases of large volumes of transported fuel gases into the atmosphere (commonly known as "blowdown events") are an integral component of routine pipeline infrastructure operations.[15]

The above, and other, studies and analyses led USEPA last year to propose regulations that tighten requirements intended to reduce methane emissions from the natural gas transport infrastructure system.[16]

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[10] http://source.colostate.edu/csu-study-measures-methane-emissions-natural-gas-transmission-storage-sites/. The report, R. Subramanian *et al*., "Methane Emissions from Natural Gas Compressor Stations in the Transmission and Storage Sector: Measurements and Comparisons with the EPA Greenhouse Gas Reporting Program Protocol," Environ. Sci. Technol. 2015, 49, 3252−3261, may be found at http://pubs.acs.org/doi/pdfplus/10.1021/es5060258.

[11] USEPA's Greenhouse Gas Inventory is one of the federal agency's two programs that track methane from the natural gas infrastructure system.

[12] http://source.colostate.edu/results-of-second-methane-emissions-study-published/. The study, D. Zimmerle *et al*., Methane Emissions from the Natural Gas Transmission and Storage System in the United States," Environ. Sci. Technol. 2015, 49, 9374−9383, may be found at http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b01669.

[13] USEPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: Revisions under Consideration for Natural Gas Transmission and Storage Emissions January 2016)," posted January 20, 2016, and found at http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport/DRAFT%20Proposed%20Revisions%20to%20NG%20Transmission%20Storage%20Segment%20Emissions_2016-01-20.pdf.

[14] K. McKain *et al*., "Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts," Proceedings of the National Academy of Sciences, 112: 1941-1946 (February 17, 2015), which may be found at http://www.pnas.org/content/112/7/1941.full.pdf.

[15] *See* Argonne National Laboratory, "Natural Gas Pipeline Technology Overview," (2007), p.45. This report may be found at http://corridoreis.anl.gov/documents/docs/technical/apt_61034_evs_tm_08_5.pdf. *See also* "Infrastructure" in Concerned Health Professional of New York, "Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction), Third Edition (October 2015)", found at http://concernedhealthny.org/wp-content/uploads/2012/11/PSR-CHPNY-Compendium-3.0.pdf.

[16] USEPA news release dated August 18, 2015, "EPA Proposes New Commonsense Measures to Cut Methane Emissions from the Oil and Gas Sector/Proposal Cuts GHG Emissions, Reduces Smog-Forming Air Pollution and Provides Certainty for Industry," found at http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/e5f2425e2e668a2b85257ea5005176fa!opendocument. *See also* [Natural Gas STAR Annual Implementation Workshop, Pittsburgh, Pennsylvania, November 18, 2015, "Directed Inspection and Maintenance for Transmission Compressor Station Leak Reduction: Program Focus Supported by Subpart W Data," found at http://www3.epa.gov/gasstar/documents/workshops/2015_AIW/19mccarthypugh.pdf.

These releases, occurring through spills, leaks, and intended releases, pose threats to the environment and human health ranging from impacts on forests and wetlands to exposure to radiation, gas, and hazardous condensate.

The push to build new natural gas transport infrastructure appears to be having a materially adverse impact on pipeline safety:

- According to a 2015 Pipeline Safety Trust analysis of federal data, new pipelines are failing at a rate on par with gas transmission lines installed before the 1940s. Carl Weimer, director of the Pipeline Safety Trust, told attendees at a National Association of Pipeline Safety Representatives annual meeting in Tempe, Arizona, "The new pipelines are failing even worse than the oldest pipelines." The Trust looked at the annual average number of incidents per 10,000 miles of onshore transmission lines over 2005-2013 based on when the pipelines were installed, as reported to PHMSA and found a "bathtub curve" with high points on the ends and low points in the middle, indicating that the oldest pipes and the newest pipes had the highest rates of incidents.
- Robert Miller, chairman of the National Association of Pipeline Safety Representatives said in a September 1, 2015 interview that while more emphasis has been placed on construction inspections, "If it's brand new, if it's all new materials, if everybody was doing their job correctly, why would we have an uptick in … failures?" Miller, who is also the Arizona Corporation Commission's pipeline safety section supervisor, said, "You can only attribute that, in my personal opinion, to poor construction practices or maybe not enough quality control, quality assurance programs out there to catch these problems before those pipelines go into service."
- Robert Hall, director of the NTSB's Office of Railroad, Pipeline and Hazardous Materials Investigations, noted in a September 1, 2015 interview that the "bathtub curve phenomenon" is well established among industries working through the struggles of new technology, but he agreed that the rapid construction of pipelines in the United States is likely a contributing factor to "people … out there possibly taking shortcuts or not being as diligent" as they would be if the pace of construction were less fervent."[17]

Pipeline ruptures occur even in newly constructed pipelines. As but one example: a 20 foot by 20 foot rupture occurred in January 2015 in a buried 42 inch pipeline in Missouri that went fully online in November 2009.[18] Reductions in staffing at regulatory agencies make oversight and timely correction of deficiencies more difficult.

2. Human health effects

Experience in other states across the country shows that a decision to allow further expansion of natural gas infrastructure to allow transport of natural gas extracted by means of high volume hydraulic fracture technology ("HVHF") has the potential to result in significant substantive effects on human health, particularly effects that could be avoidable, involuntary, adverse, and irreversible. Numerous members of the medical community have affirmed this conclusion.[19]

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[17] http://www.napsr.org/SiteAssets/mediainfo/SNL%20Sept%209%202015%20BathTub%20Curve%20Construction%20Practices.pdf. USEPA's 2015 rulemaking proposals intended to reduce methane emissions from natural gas infrastructure may have the beneficial consequence of providing an enforceable adjunct in New York State to PHMSA's pipeline safety program in the form of NYSDEC's Air Resources program.

[18] "Pipeline Ruptures Near Pike 43", The People's Tribune, February 3, 2015, found at http://thepeoplestribune.com/?author=2 .

[19] In support of an HIA on HVHF, in October 2011, 250 physicians and medical professionals wrote a letter calling for a comprehensive public health impact assessment on HVHF.

The Medical Society of the State of New York adopted Position Statement 260.904 "Protecting Public Health from Natural Gas Infrastructure" in May, 2015, which states that the Society recognizes the potential impact on human health and environment associated with natural gas infrastructure and supports governmental assessment

Residents living near shale gas operations have reported health issues ranging from dizziness, sinus disorders, bronchitis, and other respiratory symptoms to depression, nausea, fatigue, headaches, anxiety, difficulty concentrating, and cancer. A Colorado School of Public Health study released in March 2012 found that cancer risks were 66 percent higher for residents living less than half a mile from oil and gas wells than for those living farther away, with benzene being the major contributor to the increased risk. While these studies primarily relate to gas extraction activity consequences, some research has included consideration of pipelines and compressor stations.[20] Health impacts may occur in these situations even when conventional means of monitoring air quality do not universally document actionable levels of specific toxins. In essence, the human beings who, and farm and domestic animals

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of the health and environmental risks that are associated with natural gas pipelines. The Position Statement may be found at http://www.mssny.org/MSSNY/About_MSSNY/Position_Statements/HTML-Position_Statements-2.aspx#260000.

In June 2015, the American Medical Association adopted a similar policy (number: H-135.930): "Protecting Public Health from Natural Gas Infrastructure," found at https://searchpf.ama-assn.org/SearchML/searchDetails.action?uri=%2FAMADoc%2Fhod.xml-0-297.xml which states, "Our AMA recognizes the potential impact on human health associated with natural gas infrastructure and supports legislation that would require a comprehensive Health Impact Assessment regarding the health risks that may be associated with natural gas pipelines."

[20] *See*, *e.g.*,

- D. Brown *et al*., "Understanding exposure from natural gas drilling puts current air standards to the test," *Reviews in Environmental Health* 2014: 29(4):277-92, the abstract for which may be found at http://www.ncbi.nlm.nih.gov/pubmed/24690938.
- Southwest Pennsylvania Environmental Health Project, "Summary of Minisink Monitoring Results" found at http://www.environmentalhealthproject.org/wp-content/uploads/2015/06/Summary-of-Minisink-Results.Public.pdf (documented episodic spikes in air pollutants emanating from this compressor station, which became operational in 2013, corresponded with waxing and waning self-reported health symptoms among 35 residents in eight families living within a mile of the compressor. Six of 12 children suffered from nosebleeds); and W Gillingham *et al*., "Toxic Air Emissions During a Compressor Station Blowdown at Hancock New York" (submitted for publication).
- In comments to the Federal Energy Regulatory Commission, New York's Madison County Health Department reviewed the literature on compressor station emissions and expressed concerns about associated health impacts, including documented correlations between health problems and residential proximity to compressor stations. It also reviewed health outcomes associated with exposures to chemicals known to be released from compressor stations, including volatile organic compounds, carbonyls and aldehydes, aromatics, and particulate matter. In addition, gas from fracking operations transiting through compressor stations carries gaseous radon. The Health Department noted a troubling lack of information on the intensity, frequency, and duration of emission peaks that occur during the blowdowns and large venting episodes that are a normal part of compressor operations. https://www.madisoncounty.ny.gov/sites/default/files/publicinformation/madison_county_doh_comments_-_docket_no._cp14-497-000.pdf
- A research team led by David O. Carpenter at University at Albany found high levels of formaldehyde near 14 compressor stations in three states. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4216869/. In Arkansas, Pennsylvania, and Wyoming, formaldehyde levels near compressor stations exceeded health-based risk levels. Other hazardous air pollutants detected near compressor stations in this study were benzene and hexane.
- Southwest Pennsylvania Environmental Health Project's (2015, February 24) "Summary on compressor stations and health impacts," found at http://www.environmentalhealthproject.org/wp-content/uploads/2012/03/Compressor-station-emissions-and-health-impacts-02.24.2015.pdf, describes impacts that are based upon the researchers' first-hand experience with health impacts in southwest Pennsylvania. It also describes the results of other studies conducted by the Pennsylvania Department of Environmental Protection, by the Texas Commission on Environmental Quality, consultants for Dish, Texas, and by Earthworks, a not-for-profit organization, and by other organizations, identifying the various pollutants emitted during compressor station operations.

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that, are becoming ill are serving as "bioassays," revealing the presence of toxins or combinations of toxins that are difficult or impractical to measure in other ways. Thus, instead of measuring environmental contaminants as an indicator of or surrogate for human health impacts, in this setting it may be more accurate and more efficient to measure human health indicators directly as the primary "outcome measures" of possible contaminants. Moreover, it must be kept in mind that (a) leaks occur in the infrastructure used to transport gas extracted from HVHF gas wells and (b) standard procedure for planned and unplanned pipeline evacuation events is simply to release into the air the fuel gas contained in the pipeline.

Further, research has also shown that even minute amounts of endocrine disrupting chemicals commonly used in fossil fuel operations may impact humans, particularly children and the unborn, a concern not currently addressed. Such chemicals include many of the additives used in fracking procedures, as well as many of the volatile aromatic compounds (such as "BTEX": benzene, toluene, ethylene, and xylene) that travel with methane and other components of natural gas.

Other factors that confirm that a CHIA would add value to the decision-making process are the presence of broad stakeholder concerns about the decision's health effects, the potential for unequally distributed impacts, the potential for the CHIA to recommend and result in timely changes to various proposals, and the likely availability of resources and technical capacity to conduct the CHIA.

A. Precedent for fossil fuel CHIAs

A CHIA covering natural gas transport infrastructure operations should be undertaken in order to assess the risks to human health that the transport infrastructure already poses and the cumulative and site-specific human health risks that additional infrastructure development will be anticipated to bring about. The timing of such an assessment will be discussed later in this paper.

There is established precedent for preparing HIAs to evaluate the impacts of high volume hydraulic fracturing (HVHF) and other fossil fuel operations. For example:

- In 2007, a health impact assessment was performed for the Bureau of Land Management and Minerals Management Service for oil and gas development proposals on Alaska's North Slope. This assessment led to new requirements for air quality analysis and monitoring of any oil related contaminants in subsistence foods, along with more worker education. It also identified significant public health impacts not normally examined in the context of an environmental review, including risks from increased traffic accidents, drug trafficking, and infectious diseases.[21]
- In 2010, a draft health impact assessment was completed in Garfield County, Colorado for proposed natural gas development in Battlement Mesa.[22] The draft assessment concluded "that [the] health of the Battlement Mesa residents will most likely be affected by chemical exposures, accidents or emergencies resulting from industry operations and stress related community changes." The researchers went on to recommend a set of mitigation measures to reduce the health threats to local residents. The Battlement Mesa assessment clearly

[21] *See* A. Dannenberg *et al*., "Use of Health Impact Assessment in the U.S.: 27 Case Studies, 1999–2007," *American Journal of Preventive Medicine*, 2008;34(3):241–256, which may be found at www.cdc.gov/healthyplaces/publications/AJPM_HIAcasestudies_March2008.pdf. *See also* R. Bhatia and A. Wernham, "Integrating Human Health into Environmental Impact Assessment: An Unrealized Opportunity for Environmental Health and Justice," which may be found at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2516559/#b70-ehp0116-000991.

[22] The draft report may be found at http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx

demonstrates the feasibility and utility of health impact assessments for evaluating risks to the health of local residents from HVHF and horizontal drilling operations.

- In September 2014, the City of Hermosa Beach, California released its report covering its health impact assessment of the E&B oil well drilling and production project proposed to be undertaken in the city.[23] While the assessment concluded that when considered by itself, the project under review is expected not to cause more than nuisance health impacts to the general population, it provided monitoring recommendations for the city to consider, including a community liaison committee to address resident's active concerns about project activities; a follow-up community health assessment to identify if some groups are disproportionately impacted by project activities; and a quality of life survey to establish baseline conditions in Hermosa Beach, and to monitor health status changes during the project.
- On December 17, 2014, the New York State Department of Health (NYSDOH) released its review of the health impacts of HVHF. This 186-page document served as the foundation for NYDEC's determination not to issue permits for high volume hydraulic fracturing. [24] While NYSDOH did not employ a formal CHIA to reach its conclusions, it "identified environmental problems associated with fracking that could contribute to adverse public health impacts. Among them: air pollution (particulate matter, ozone, diesel exhaust, and volatile organic compounds) that could affect respiratory health; drinking water contamination from underground migration of methane and/or fracking chemicals associated with faulty well construction or seismic activity; drinking water contamination from inadequate water treatment of fracking waste or from surface spills of fracking chemicals or wastewater; earthquakes and the creation of fissures; increased vehicle traffic; increased noise; increased demand for housing and medical care; and public health problems related to climate change impacts from methane and other greenhouse gas emissions into the atmosphere."[25] NYSDOH concluded that "there are significant uncertainties about the kinds of adverse health outcomes that may be associated with [HVHF], the likelihood of the occurrence of adverse health outcomes and the effectiveness of some of the mitigation measures in reducing or preventing environmental impacts which could adversely affect public health."[26] The contributions of the NYSDOH's thorough review of the health and science literature were pivotal in NYSDEC's determination under SEQRA that HVHF should not proceed in New York State.

III. Incorporating CHIAs into the environmental impact assessment of a natural gas infrastructure project

1. In enacting the National Environmental Policy Act of 1969, as amended,[27] Congress declared a national policy "which will prevent or eliminate damage to the environment and biosphere and stimulate

[23] The report, entitled, " Health Impact Assessment: E&B Oil Drilling and Production Project," may be found at: http://www.slideshare.net/StopHermosaBeachOil/final-health-impact-assessment-2014

[24] New York State Department of Health, "A public health review of high volume hydraulic fracturing for shale gas development, December 17, 2014." The report may be found at http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf.

[25] Concerned Health Professional of New York, "Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction), Third Edition (October 2015)", found at http://concernedhealthny.org/wp-content/uploads/2012/11/PSR-CHPNY-Compendium-3.0.pdf, at page 74.

[26] New York State Department of Health, "A public health review of high volume hydraulic fracturing for shale gas development, December 17, 2014." The report may be found at http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf.

[27] Pub. L. 91-190, 42 U.S.C. 4321 *et seq*.

the health and welfare of man." In order to carry out that policy, the federal government must "use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may … assure for all Americans safe [and] … healthful … surroundings; [and to] attain the widest range of beneficial uses of the environment without … risk to health or safety."[28] The environmental assessment process contained in the Act is a systematic interdisciplinary approach "intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment."[29] Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment.

2. "Environment" in the NEPA context encompasses the human environment, which is interpreted comprehensively "to include the natural and physical environment and the relationship of people with that environment. (See the definition of 'effects' (Sec. 1508.8[, which defines 'effects' to include effects on, among others, *health, whether direct, indirect, or cumulative*].) This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment."[30]

3. Typically there is no information pertaining to, or discussion of, specific potential health impacts or vulnerable subpopulations in the usual NEPA-mandated EIS that either the state or federal agencies undertake or require of an applicant. This serious deficiency in the existing process of evaluating the environmental impact of a proposed project results in current environmental assessments covering natural gas transport infrastructure projects containing no references to peer-reviewed literature on health effects near such infrastructure despite there being several determinants of health impacts that should be studied – and would be in the CHIA component of an EIS relating to that infrastructure. Those determinants include:

- Baseline health of population and prevalence of relevant diseases
- Identity and location of vulnerable populations and high-risk groups (*e.g.*, communities with low socioeconomic status, racial and ethnic minorities, women of childbearing age, infants, youth, elderly, and people with pre-existing or latent health conditions) and areas of particular concern (*e.g.*, sites near residences, schools, camps, recreational facilities, nursing homes, hospitals, agricultural regions, areas of sensitive geographical characteristics, such as wetlands and natural wildlife preserves, and sites likely to concentrate contaminants)
- Pathways of exposure: all potential pathways that link the activity to health, direct, indirect and cumulative (*e.g.*, risks of multiple chemical exposures; accident risk, diet/subsistence factors; strain on services; and social changes such as violence and crime)
- Modeling of, for instance, air impacts, local and distant
- Review of scientific information and research on health impacts of compressor stations, metering stations, regulating stations and pigging facilities and other infrastructure associated with transported natural gas, including Colorado research on negative health impacts from HVHF-related air pollution
- Input from local population and county and regional health departments
- Worker health included as part of the community health evaluation
- A literature search and expert opinions from the medical and public health community and from other experts

[28] 42 USC 4331(b).
[29] 40 CFR 1500.1(c).
[30] 40 CFR 1508.14.

The CHIA component also provides recommendations for health-based mitigation. For instance, in the case of air impacts, recommendations could include best control practices near particularly vulnerable communities that may drive enhanced mitigation measures, development of site-specific monitoring and adaptive management based on local meteorological conditions and population vulnerability, and/or alternative siting or avoidance of some areas altogether. With respect to water impacts, health-based mitigation could include identification and monitoring of sensitive receptors and addressing unique pathways such as subsistence consumption.

The failure to evaluate and attempt to mitigate potential health impacts associated with natural gas transport infrastructure can result in a number of negative outcomes for states, including more illness and disability and decreased productivity; increased cost to insurers, business owners and the state for health care; social instability; loss of community support; and particularly adverse effects for those who are poor, already ill, underserved or otherwise vulnerable.

IV. Proposal for a CHIA on Natural Gas Transport Infrastructure Development

A. Project Description

The proposed CHIA component of an EIS covering natural gas transport infrastructure will assess the potential health impacts of that infrastructure and will inform decision-making about permitting and development of permit conditions encompassing needed health-based mitigation. (At higher policy levels, a CHIA could inform new legislation or regulations related to energy policy and delivery options, including consideration of the comparative health benefits of most forms of renewable energy, including the positive impact of renewable alternatives on climate stability, with its associated health benefits.) Unlike the non-human health related components of the EIS, the CHIA component will give special attention to how the infrastructure may affect vulnerable populations and to what mitigation is needed to protect such groups. The potential health impacts that should be examined through the systematic approach of a CHIA include, but are not limited to, those potentially resulting from or relating to:

- air pollution
- water contamination
- soil contamination
- exposure to endocrine-disrupting and other chemicals
- waste management
- radiation exposure
- spills, accidents
- road safety
- social concerns such as housing, community character, schools, substance abuse and infectious diseases
- economic issues such as employment, home value, health costs, loss of productivity
- health infrastructure including availability of insurance
- justice concerns such as vulnerable populations and equality
- synergistic and cumulative effects of multiple stressors

The CHIA component will lead to recommendations for health-based mitigation (including the potential denial of permits or imposition of permit limitations), additional or new regulations, education programs, monitoring, and further study and potentially risk assessment(s).

B. Implementing the CHIA in the EIS process

Two major issues arise when considering how to incorporate CHIA into the environmental review of an interstate natural gas transport infrastructure project: (a) what geographical extent does the CHIA cover and (b) at what stage in the permit application review process is the project?

CHIA needs a baseline condition against which a project's particular incremental and cumulative impacts can be assessed; and the area whose information will be used to articulate that condition.

Where an applicant is in the project review process drives how CHIA may be addressed. For example,

- Before the EIS process gets underway, there is the opportunity to develop the baseline condition with assistance from other agencies, and to issue guidance that incorporates CHIA into the requirements for an acceptable environmental assessment of a project.
- Respecting applications pending before the FERC as of the date of this White Paper that have not yet been declared "complete" for processing purposes, FERC could inform the applicant that an acceptable environmental assessment for the project would include a CHIA component fulfilling requirements that are provided to the applicant, with the CHIA component encompassing a description of the baseline condition and an assessment of the incremental and cumulative human health impacts that the project is anticipated to generate. In consultation with other impartial agencies, FERC could also identify the qualifications of those who would undertake the CHIA components of the environmental assessment.
- Respecting applications pending before FERC as of the date of this White Paper that have already been declared "complete" for processing purposes, FERC could inform the applicant of the need for it to supplement the environmental assessment by expanding that assessment to encompass a CHIA. The difference between this situation and the situation described immediately above is, in this case, the need to have the supplementation completed before expiration of the time period set forth in federal law for consideration of the application in question in order to have the CHIA's assessment have any impact on agency decision-making on the application.

References and Notes:

1 North American HIA Practice Standards Working Group, "Minimum Elements and Practice Standards for Health Impact Assessment (Version 3, September 2014)," found at http://hiasociety.org/wp-content/uploads/2013/11/HIA-Practice-Standards-September-2014.pdf.

2 Derived from Figure S-1 (p. 7) in National Research Council (2011), "Improving Health in the United States: The Role of Health Impact Assessment by Committee on Health Impact Assessment", found at http://www.nap.edu/download.php?record_id=13229

3 "Natural gas is composed primarily of methane, but may also contain ethane, propane and heavier hydrocarbons. Small quantities of nitrogen, oxygen, carbon dioxide, sulfur compounds, and water may also be found in natural gas." http://www.beg.utexas.edu/energyecon/lng/LNG_introduction_07.php.

4 USEPA considers methane to be a major greenhouse gas: "Pound for pound, the comparative impact of CH4 on climate change is more than 25 times greater than CO2 over a 100-year period." http://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html. To address the issue of reducing anthropogenic releases of methane into the atmosphere, that agency recently issued a series of regulations and requests for information on emissions occurring at various stages of natural gas extraction, processing, and transportation. *See* http://www3.epa.gov/airquality/oilandgas/actions.html.

5 In the context of this White Paper, "condensate" means liquids -- hydrocarbon liquids and water -- that condensed out of the natural gas stream and particulate matter formed during natural gas contact with the materials that coat the inside of the natural gas pipeline.

6 USEPA, "Estimate of Methane Emissions from the U.S. Natural Gas Industry," Table 2, posted September 15, 2015 and found at http://www3.epa.gov/ttn/chief/ap42/ch14/related/methane.pdf.

7 *Ibid*., at "5.0: Conclusions." According to USEPA, methane emissions from oil extraction activities and from natural gas extraction, transportation, and distribution activities account for nearly 30 percent of total United States anthropogenic methane emission sources. USEPA news release dated August 18, 2015, "EPA Proposes New Commonsense Measures to Cut Methane Emissions from the Oil and Gas Sector/Proposal Cuts GHG Emissions, Reduces Smog-Forming Air Pollution and Provides Certainty for Industry," found at http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/e5f2425e2e668a2b85257ea5005176fa!opendocument.

10 http://source.colostate.edu/researchers-measure-methane-lost-in-natural-gas-operations/. The study itself, A. Marchese et al., "Methane Emissions from United States Natural Gas Gathering and Processing," Environ. Sci. Technol. 2015, 49, 10718−10727, may be found at http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b02275.

11 http://source.colostate.edu/csu-study-measures-methane-emissions-natural-gas-transmission-storage-sites/. The report, R. Subramanian *et al*., "Methane Emissions from Natural Gas Compressor Stations in the Transmission and Storage Sector: Measurements and Comparisons with the EPA Greenhouse Gas Reporting Program Protocol," Environ. Sci. Technol. 2015, 49, 3252−3261, may be found at http://pubs.acs.org/doi/pdfplus/10.1021/es5060258.

12 USEPA's Greenhouse Gas Inventory is one of the federal agency's two programs that track methane from the natural gas infrastructure system.

13.http://source.colostate.edu/results-of-second-methane-emissions-study-published/. The study, D. Zimmerle *et al*., Methane Emissions from the Natural Gas Transmission and Storage System in the United States," Environ. Sci. Technol. 2015, 49, 9374−9383, may be found at http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b01669.

14.USEPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: Revisions under Consideration for Natural Gas Transmission and Storage Emissions January 2016)," posted January 20, 2016, and found at http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport/DRAFT%20Proposed%20Revisions%20to%20NG%20Transmission%20Storage%20Segment%20Emissions_2016-01-20.pdf.

15 K. McKain *et al*., "Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts," Proceedings of the National Academy of Sciences, 112: 1941-1946 (February 17, 2015), which may be found at http://www.pnas.org/content/112/7/1941.full.pdf.

16 *See* Argonne National Laboratory, "Natural Gas Pipeline Technology Overview," (2007), p.45. This report may be found at http://corridoreis.anl.gov/documents/docs/technical/apt_61034_evs_tm_08_5.pdf. *See also* "Infrastructure" in Concerned Health Professional of New York, "Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction), Third Edition (October 2015)", found at http://concernedhealthny.org/wp-content/uploads/2012/11/PSR-CHPNY-Compendium-3.0.pdf.

17 USEPA news release dated August 18, 2015, "EPA Proposes New Commonsense Measures to Cut Methane Emissions from the Oil and Gas Sector/Proposal Cuts GHG Emissions, Reduces Smog-Forming Air Pollution and Provides Certainty for Industry," found at http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/e5f2425e2e668a2b85257ea5005176fa!opendocument. *See also* [Natural Gas STAR Annual Implementation Workshop, Pittsburgh, Pennsylvania, November 18, 2015, "Directed Inspection and Maintenance for Transmission Compressor Station Leak Reduction: Program Focus Supported by Subpart W Data," found at http://www3.epa.gov/gasstar/documents/workshops/2015_AIW/19mccarthypugh.pdf.

18 http://www.napsr.org/SiteAssets/mediainfo/SNL%20Sept%209%202015%20BathTub%20Curve%20Construction%20Practices.pdf. USEPA's 2015 rulemaking proposals intended to reduce methane emissions from natural gas infrastructure may have the beneficial consequence of providing an enforceable adjunct in New York State to PHMSA's pipeline safety program in the form of NYSDEC's Air Resources program.

19 “Pipeline Ruptures Near Pike 43”, The People’s Tribune, February 3, 2015, found at http://thepeoplestribune.com/?author=2 .

20 In support of an HIA on HVHF, in October 2011, 250 physicians and medical professionals wrote a letter calling for a comprehensive public health impact assessment on HVHF.

The Medical Society of the State of New York adopted Position Statement 260.904 “Protecting Public Health from Natural Gas Infrastructure” in May, 2015, which states that the Society recognizes the potential impact on human health and environment associated with natural gas infrastructure and supports governmental assessment of the health and environmental risks that are associated with natural gas pipelines. The Position Statement may be found at http://www.mssny.org/MSSNY/About_MSSNY/Position_Statements/HTML-Position_Statements-2.aspx#260000.

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- A research team led by David O. Carpenter at University at Albany found high levels of formaldehyde near 14 compressor stations in three states. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4216869/. In Arkansas, Pennsylvania, and Wyoming, formaldehyde. levels near compressor stations exceeded health-based risk levels. Other hazardous air pollutants detected near compressor stations in this study were benzene and hexane.
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22 *See* A. Dannenberg *et al*., “Use of Health Impact Assessment in the U.S.: 27 Case Studies, 1999–2007,” *American Journal of Preventive Medicine*, 2008; 34(3):241–256, which may be found

at www.cdc.gov/healthyplaces/publications/AJPM_HIAcasestudies_March2008.pdf. *See also* R. Bhatia and A. Wernham, "Integrating Human Health into Environmental Impact Assessment: An Unrealized Opportunity for Environmental Health and Justice," which may be found at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2516559/#b70-ehp0116-000991.

23 The draft report may be found at http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx

24 The report, entitled, "Health Impact Assessment: E&B Oil Drilling and Production Project," may be found at: http://www.slideshare.net/StopHermosaBeachOil/final-health-impact-assessment-2014

25 New York State Department of Health, "A public health review of high volume hydraulic fracturing for shale gas development, December 17, 2014." The report may be found at http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

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27 New York State Department of Health, "A public health review of high volume hydraulic fracturing for shale gas development, December 17, 2014." The report may be found at http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf