UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

ALGONQUIN GAS TRANSMISSION, LLC ) DOCKET NUMBER: CP14-96

MOTION OF WEST ROXBURY INTERVENORS FOR A REHEARING

Now come a group of intervenors from the West Roxbury, adjacent neighborhoods of Boston and the Town of Dedham who, pursuant to Rule 713 of the Commission's Rules of Practice and Procedure, file this timely request for rehearing of the decision of the Federal Energy Regulatory Commission on March 3, 2015 to issue a certificate to Algonquin Gas Transmission, LLC (Algonquin). That certificate, pursuant to Section 7(c) of the Natural Gas Act, was issued to permit Algonquin to construct and operate the Algonquin Incremental Market (AIM) Project. As grounds therefor, the intervenors state:

Statement of the Facts

1. The Algonquin AIM Project consists of approximately 37.4 miles of pipeline and related facilities in New York, Connecticut and Massachusetts, and an additional 81,620 horsepower of compression at sites in New York, Connecticut and Rhode Island.\(^1\)

2. The Order Issuing the Certificate authorizes Algonquin, a wholly owned subsidiary of Spectra Energy Corporation, to “install approximately 4.1 miles of 16-inch-diameter pipeline and ad approximately 0.8 miles of 24-inch- diameter pipeline off its existing 1-4 System Lateral in Norfolk and Suffolk Counties, Massachusetts.”\(^2\) The geographic areas affected by this order include the Towns of Westwood and Dedham and the West Roxbury neighborhood of Boston.

---

\(^1\) Algonquin Gas Transmission LLC, Order Issuing Certificate and Approving Abandonment, 150 FERC ¶61,163 (March 3, 2015)(“Certificate Order”).

\(^2\) Order at page 2.
3. In addition, the FERC’s order authorizes Algonquin to “construct a new meter station at milepost (MP) 4.2 of the proposed West Roxbury Lateral to deliver natural gas to Boston Gas Company in Suffolk County, Massachusetts (West Roxbury Meter Station)” and “to modify 24 existing meter stations in New York, Connecticut, and Massachusetts.”³ “Algonquin estimates that the West Roxbury Lateral facilities will cost $95,293,105.”⁴

1. Community Profile and Impact

4. West Roxbury is a densely settled urban neighborhood in the southwest part of the City of Boston.⁵ The neighborhood encompasses 4.61 square miles, 4.56 of which consists of land and 0.5 of water. 30,246 residents live in the neighborhood, or approximately 4.9% of Boston’s total population of 617,594.⁶ 47.6% of the residents are male and 52.14 % female with 22.1% who are sixty years of age or older.⁷ There are 13,042 units of housing.⁸

5. Four Boston Public Elementary Schools - the Ludwig van Beethoven Elementary School, the William Ohrenberger School, the Joyce Kilmer K-8 School, and the Patrick Lyndon K-8 School - are located in West Roxbury, as is the West Roxbury Education Complex. The Joyce Kilmer School is the only majority white school located in the district. The minority enrollment

---

³ Order at page 4.

⁴ Order, at page 4, n.5.

⁵ “The proposed West Roxbury Lateral would be located in densely developed urban neighborhood.” Final EIS, at 2-19.

⁶ City of Boston Neighborhood Profile, Boston Redevelopment Authority.

⁷ U.S. Census Bureau and Boston Redevelopment Authority, American Community Survey, West Roxbury Neighborhood (May, 2013).

⁸ U.S. Census Bureau and Boston Redevelopment Authority, American Community Survey, West Roxbury Neighborhood (May, 2013).
in these schools range from a low of 39.7% at that school to 88% at the West Roxbury Education Complex.9

6. Two Catholic elementary schools, Holy Name Parish School and St. Theresa of Avila School, are located in West Roxbury.10 Catholic Memorial School, an all boys middle and high school, is located on Baker Street within blocks of the proposed West Roxbury Lateral pipeline.7

7. “The Roxbury Latin School is an independent boys’ private day school in the West Roxbury section of Boston, serving about 300 boys in grades seven through twelve (about 100 from the City of Boston. The school is open year-round, hosting several programs during the summer for students. The school’s academic and athletic facilities total about 120 acres. The West Roxbury Lateral would be located about 15 feet from the boundary of the school property along Centre Street.”11

8. “The St. Theresa of Avila School is a private Catholic school in the West Roxbury section of Boston serving 300 to 400 students age three to eighth grade commuting to the school from several surrounding parishes and towns. The St. Theresa of Avila Parish is located adjacent to the school and faces Centre Street. The West Roxbury Lateral terminates at an interconnection with National Grid’s facilities north of the intersection of Centre Street and Spring Street... about 295 feet southwest of the school and parish property.”12

---


10 Final EIS 4-170.

11 Final EIS 4-170.

12 Final EIS 4-170-171.
9. In addition, the proposed West Roxbury Lateral Pipeline would impact the Deutsches Altenheim, a facility that includes a 133 bed skilled nursing home facility, 62 assisted living residences, a 30 client adult day health program,[that] provides a full spectrum of care to seniors, from short-term rehabilitation, long-term care, outpatient rehabilitation, and a state-of-the-art Alzheimer's/memory care unit. It employs over 300 full time and part time staff. Located at 2220-2222 Centre Street in West Roxbury since 1914, Deutsches Altenheim shares boundaries with the Roxbury Latin School, a number of single-family residences, and a large open-pit quarry (the West Roxbury Crushed Stone Co.). The only access for staff, visitors, vendors, ambulances, and other emergency vehicles to our busy campus is by way of Centre Street, the proposed location of the new high-pressure natural gas pipeline.  

10. The vast majority of West Roxbury’s businesses are located on or near Centre Street in West Roxbury. In addition, Centre Street and Washington Street serve as vital traffic connectors that serve as conduits for the daily movement of commuters and goods from suburban towns to Boston proper.

11. “Construction of the AIM Project will result in temporary to short-term increases in traffic levels due to the construction workforce commuting to the project area, as well as the movement of construction vehicles and delivery of equipment and materials to the construction work area. In-street construction will also occur along the West Roxbury Lateral.”

12. “In-street construction will affect traffic in the project area along the West Roxbury

---

13 See Exhibit 1 attached hereto, a letter of concern sent by the nursing home’s Board of Trustees to Spectra’s local attorneys.

14 Order, at page 32.
Lateral in Massachusetts, and may affect on-street parking and use of sidewalks adjacent to the roadways.\textsuperscript{15}

13. “Similarly, the intersection of Spring Street and Centre Street generally operates acceptably throughout the day under existing conditions. During construction of the West Roxbury Lateral, however, the northbound Centre Street right-turn lane will be blocked off temporarily. This will be limited to only one phase of four traffic management phases planned for this location. Nonetheless, lengthy delays will occur on the northbound Centre Street approach to the intersection affected.”\textsuperscript{16}

14. “During pipeline construction within 0.25 mile of the area identified...impacts associated with increased traffic, noise and dust, as well as impacts on visual resources could occur; however, the impacts would be temporary and limited to the time of construction.”\textsuperscript{17}

15. “Construction of the AIM Project will occur within 50 feet of 332 residential structures and 94 non-residential structures. The majority of the residences identified are located along the West Roxbury Lateral, including many within 10 feet.”\textsuperscript{18}

16. “The West Roxbury Crushed Stone Quarry is located adjacent to the West Roxbury Lateral and West Roxbury Meter Station, along Grove Street from MPs 4.2 to 4.4 in West Roxbury, Massachusetts.”\textsuperscript{19}

\textsuperscript{15} Order, at page 32.

\textsuperscript{16} Order, at page 32.

\textsuperscript{17} Final EIS 4-154

\textsuperscript{18} Order, at page 27.

\textsuperscript{19} Order, at page 22.
17. “The proposed West Roxbury M&R Station would be sited on a wooded property located across the street from an active rock quarry. It would be bounded by residential properties to the north, south, and west and there is a residence immediately adjacent to the proposed facility off of Centre Street.”

18. “While the West Roxbury Lateral will require new permanent pipeline easements, the majority of the new pipeline will be located within streets or public property, and therefore will new pipeline easement on individual private properties. Most of the aboveground facilities associated with the project will modify existing facilities on properties owned by Algonquin.”


20. “The West Roxbury Lateral would cross the Mother Brook reservation along Washington Street and Post Lane in Dedham. The proposed pipeline would be installed within Washington Street and would pass above the culvert that carries Mother Brook under Washington Street.”

21. “Construction on Washington Street would temporarily disrupt access to Mary Draper Playground on Washington Street.”

---

20 Final EIS 4-174.
21 Order, at page 34.
22 Final EIS 4-28.
23 Final EIS 4-169.
24 Final EIS 4-168
2. Concerns Expressed by State and Local Agencies, Elected Officials and West Roxbury Residents

22. The Mayor of the City of Boston, members of the Boston City Council, and Massachusetts state and federally elected legislators have publicly expressed their concerns about the proposed West Roxbury Lateral to FERC.25

23. In addition, many West Roxbury residents and abutters to the proposed West Roxbury Lateral have attended public meetings, expressed their concerns in public comments on FERC’s docket in this proceeding and filed motions to intervene in this proceeding.

24. These residents have been joined by a number of West Roxbury neighborhood and civic organizations.

25. In general, the concerns of residents and abutters have focused on safety, environmental and health issues, along with traffic and quality of life concerns.26

26. Equally important, however, a number of commentators, residents and intervenors skeptics question whether Algonquin/Spectra - and the affiliated gas utilities that have an common economic interest in the construction of the West Roxbury Lateral - have, in fact, met their burden to show a need for the AIM project based upon existing and projected demand for natural gas.

27. Other residents and commenters have raised significant concerns about FERC’s anecdotal, piecemeal approach to natural gas regulation, and its inability to create a comprehensive, systematic set of policies that would uniformly address issues of natural gas

---

25 See the comments and responses from FERC entered on Docket CP14-96 and also Exhibit 2, Massachusetts Siting Board Reply To FERC, at page 8.

26 See, for example, Exhibit 3 attached hereto, transcript of a public hearing conducted by the Massachusetts DPU on December 3, 2014.
permitting, planning, and the environmental and human costs. The current feudal-like regulatory system and process enables gas companies and utilities, their shareholders’ demands, and their substantial financial, political and legal resources to drive the decision-making process in their best interests.

28. Finally, other commenters and critics challenge the lack of transparency, openness, and accountability of the Federal Energy Regulatory Agency and question whether FERC operates as an agency that actually promotes the public interest, as it is expected to do.\footnote{15 U.S. Code§ 719 (a) Necessity of regulation in public interest.}

**Statement of the Issues**

FERC’s order, if not reconsidered or stayed, will have profoundly deleterious effects upon the public safely, health and quality of life in West Roxbury, both in the short and long term, and will exacerbate existing environmental problems such as existing methane emissions caused by leaking natural gas all over the metropolitan Boston region. FERC’s authorization of a certificate that permits Algonquin to proceed with the AIM project and to construct the West Roxbury Lateral raises the following issues:

1. Did FERC fail to address issues of public safety in its order and in its final EIS?
2. Did FERC fail to address the full scope of environmental and health concerns in its order and final EIS?
3. Did FERC fail to address legal concerns under the Massachusetts Constitution posed by Algonquin’s proposed exercise of easements over existing public lands?
4. Did FERC abdicate its statutory responsibility to require that Algonquin Gas
Transmission, LLC show a compelling need for the proposed project based upon current and projected needs for Natural Gas?

5. Did FERC fail to discharge its statutory obligation to regulate in the public interest?

Argument

1. **FERC Has Failed to Seriously Address the Issue of Public Safety as It Affects the West Roxbury Community**

   The Energy Facilities Siting Board of the Commonwealth of Massachusetts, as early as September 29, 2014, expressed a number of public safety concerns to FERC after its review of the Draft Environmental Impact Statement prepared as part of Algonquin’s application.

   First, the Siting Board communicated concerns about the West Roxbury Lateral raised by the public that (a) that the pressure at the proposed West Roxbury metering and regulating station of 750 pounds per square inch was too high given the location of the station in a densely settled residential area; (b) that the shut-off time in case of accident (potentially 90 seconds) was too long; (c) that ten miles is too great a distance between shut-off valves; (d) that the Project requires gas pipeline welds that will eventually require inspection, and inspection of welds is too infrequent to ensure safety along gas pipeline routes; (e) that the safety of pipelines installed in streets with heavy trucking is questionable; and (f) that, in the event of a pipeline explosion, the estimated blast radius of 300 feet would also affect surrounding residences by the fire that accompanies an explosion at a natural gas pipeline. The Siting Board requested that FERC specifically address each of these safety concerns in its next EIS.  

---

28 Exhibit 2, Massachusetts Siting Board Reply To FERC, at page 4.
Second, the Siting Board also expressed concerns about the proximity of the proposed pipeline and its metering and regulating station, both of which would be located within feet of the West Roxbury quarry (“West Roxbury Crushed Stone”), an active quarry where blasting occurs on a regular basis. The Siting Board noted that Algonquin had provided a geotechnical review of the impact on the project of blasting activity at West Roxbury Crushed Stone. The consultant hired by Algonquin conceded that two existing water lines and one existing gas line are located between the proposed pipeline and West Roxbury Quarry. The Siting Board observed, however, that the report did not answer to the question whether blasting at the quarry had ever damaged these pipelines and emphasized that this information sought was essential and needed to be included in the next EIS.29

Third, since Algonquin’s proposed pipeline would pass along Centre Street adjacent to the West Roxbury quarry, the Siting Board reminded FERC and Algonquin of an act recently passed by the Massachusetts Legislature: Effective October 1, 2014, this law, the Siting Board stated, is directly relevant to operation of West Roxbury Crushed Stone and the alignment of the pipeline. Section 7 of Chapter 149 provides:

Notwithstanding any general or special law to the contrary, explosive material, as defined in 527 CMR 13.03, shall not be used to fire a blast in any blasting operation at a site primarily used as a source of mined products from the earth if such site is within 500 feet of a natural gas pipeline or metering and regulation station without written approval by the department of public utilities.

The Siting Board noted that the term “explosion” under 527 CMR 13.03 is broadly inclusive such that whatever the quarry uses for blasting would most likely qualify by definition as an explosive material for regulatory purposes. The Siting Board further noted that, although some portions of the quarry may lie outside the 500 foot radius established by Section 7, sections of the

---

29 Exhibit 2, Massachusetts Energy Siting Board Reply To FERC, at page 4.
proposed pipeline would come within 500 feet of the West Roxbury Crushed Stone property line, as does the Metering and Regulating Station (M&R station). The Siting Board emphasized that, although FERC was not bound by state law in this instance, the same was not true for the owners of the quarry, who are subject to the provisions of the Massachusetts law. 30

Finally, the Siting Board recommended that, in addition to a review of the quarry and pipeline safety concerns already noted, both FERC and Algonquin: “(1) analyze whether the planned siting of the pipeline and M&R station might result in a violation of Massachusetts Acts of 2014, Chapter 149, Section 7 by West Roxbury Crushed Stone in the course of its blasting operations; and (2) consider the physical safety consequences posed by such blasting activities, including the advisability of siting of the M&R station and any segments of the proposed pipeline within 500 feet of the Quarry property line. The Siting Board emphasizes that - regardless of whether the Project would result in the Quarry’s blasting activities violating Massachusetts Acts of 2014, Chapter 149, Section 7 – it is important to ensure that the Project is sited so that its location is consistent with the continued operation of the Quarry.”31

In its final Environmental Impact Statement, FERC dismissed the Siting Board’s first set of concerns about pipeline safety and the danger of a natural gas explosion in a densely settled urban neighborhood. Without any explanation, without citing any supporting data, and after apparently relying solely upon the assurances of Algonquin, FERC claimed that “The pipeline and aboveground facilities associated with the AIM Project would be designed, constructed, operated, and maintained to meet or exceed the Pipeline and Hazardous Materials Safety Administration’s Minimum Federal Safety Standards in 49 CFR 192 and other applicable federal standards.”

30 Exhibit 2, Massachusetts Siting Board Reply To FERC, at pages 6-7.
31 Exhibit 2, Massachusetts Siting Board Reply To FERC, at page 7.
and state regulations. The regulations include specifications for material selection and qualifications; minimum design requirements; and protection of the pipeline from internal, external, and atmospheric corrosion. By designing and operating the Project in accordance with the applicable standards, the Project would not result in significant increased public safety risk.”

Consistent with its unwillingness to explain the basis for the conclusions contained in its final EIS, FERC acknowledged that the West Roxbury Lateral terminated at an interconnection with National Grid’s facilities north of the intersection of Centre Street and Spring Street, about 295 feet southwest of the St. Theresa of Avila School and parish property but insisted that “The Project would not have any permanent impact on the school or parish” and that the project impact on St. Theresa of Avila School “would be temporary and limited to the period of active construction.”

In addition, although FERC conceded that the West Roxbury Lateral would be located about 15 feet from the boundary of Roxbury Latin School along Centre Street, and acknowledged that “users of the baseball field may experience temporary noise and visual impacts during the construction period,” it found that the West Roxbury Lateral “would not have any permanent impact on the school itself.”

---

32 Final EIS - ES 8.

33 Final EIS 4-170-171.

34 Final EIS ES-6. FERC did not require Algonquin to address the issue of whether it would occupy any of property of St. Theresa of Avila School, Roxbury Latin School, or any public school such as the Beethoven, Kilmer or Lyndon School during construction of the pipeline.

35 Final EIS 4-170.
FERC, despite the Siting Board’s requests, was equally unresponsive and evasive in addressing the Siting Board’s concerns about the public safety hazards posed by permitting Algonquin Gas Transmission to lay a 24 inch diameter pipeline with 750 psi of pressure in a heavily traveled street and building a Metering and Regulating Station and within feet of an active quarry where blasting still occurs on a daily basis. It claimed only that, “Prior to the Draft EIS, FERC considered several alternatives for the West Roxbury Lateral” and “We determined that none of the route or site alternatives or variations would offer environmental advantages over the project.”

FERC also accepted at face value the integrity and accuracy of the third-party consultant that Algonquin hired to justify its proposal to lay the pipeline and to build an M&R station next to an active quarry: “Algonquin also retained the services of a local third-party geotechnical consultant. Further blasting at the quarry would not damage the pipeline since it would be constructed five feet below grade.” Not surprisingly, the geo-environmental consultant - whose report Algonquin paid for - agreed with Algonquin and concluded that “the components of the M&R station would not be any more sensitive to vibration disturbance or damage than the underground pipeline; and that ground vibrations from blasting at the quarry would not be disruptive to or damaging to the M&R Station.”

Lastly, FERC dismissed the legal effect of M.G.L. c, 149 § 7, as cited by the Mass. Energy Facilities Siting Board, that prohibits any blasting or use of explosive materials within 500 feet of a natural gas pipeline or metering station. Its order did not mention the potential legal

---

36 Final EIS ES-10.

37 Final EIS 4-5.

38 Final EIS 4-6.
conflict caused by M.G.L. 149§ 7, or address the legal consequences that, if not resolved, would effectively amount to a condemnation of the quarry property. In its final EIS, FERC also declined to weigh into the obvious conflict and concluded that it needn’t address the issue since “There is already an existing natural gas pipeline (distribution line) closer to the quarry than the proposed AIM Project Facilities. Therefore, any conflict with quarry operations associated with this new project already exists. The AIM Project would not create any new conflict that the quarry does not already have to address.”

FERC’s attempts to minimize and to dismiss the Siting Board’s concerns about public safety expressly ignore the provisions of 49 CFR § 192.317 that have been promulgated to protect the public from hazards related to transportation of natural and other gas by pipelines. That federal regulation requires, first, that the “(a) The operator must take all practicable steps to protect each transmission line or main from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads. In addition, the operator must take all practicable steps to protect offshore pipelines from damage by mud slides, water currents, hurricanes, ship anchors, and fishing operations.”

Secondly, “(b) Each aboveground transmission line or main, not located offshore or in inland navigable water areas, must be protected from accidental damage by vehicular traffic or other similar causes, either by being placed at a safe distance from the traffic or by installing barricades.” It is difficult to comprehend how a 24 inch diameter pipeline with 750 psi of pressure, laid in a bed of dirt and gravel, subject to vagaries of heavy rain and shifting soil, beneath a heavily traveled thoroughfare, that passes within feet of an active quarry could possibly comply with the provisions of 49 CFR § 192.317.

---

39 Final EIS 4-6.
FERC’s seeming refusal to address the well-documented dangers posed by expanded natural gas pipelines has left residents and local officials perplexed and disappointed. A report prepared for Massachusetts Senator Markey, in July of 2013, warned that “Americans also remain at risk from gas Explosions and other safety hazards caused by leaky natural gas pipelines. From 2002 to 2012, almost 800 significant incidents on gas distribution pipelines, including several hundred explosions, killed 116 people, injured 465 others, and caused more than $800 million in property damage.”40

Joseph M. Lovett, a West Virginia environmental lawyer, in commenting on the proposed West Roxbury Lateral to the Boston Globe, agreed that West Roxbury residents have clear reason to be concerned. “The opportunity for accidents will always be there,’” Lovett said. “Natural gas lines fail all over the country.”

Lastly, according to an article in Energy Security, the threat of a terrorist attack on natural gas pipelines is very real.42 In its Order and in its Final EIS, FERC did not address this issue, nor did it require, as a condition of its permit, that Algonquin address this very real concern in a post 9-11 environment or to make contingency provisions.

Instead, in its Final EIS, FERC touts the economic benefits of the proposed Algonquin Gas Transmission Project and notes the large number of public services - including police and fire departments - along the proposed AIM project route.43 However, FERC’s oblique

43 Final EIS 4-182-183.
assurances of pipeline security and safety ring hollow. “Algonquin would operate and maintain the newly constructed pipeline facilities in the same manner as they currently operate and maintain their existing systems in compliance with PHMSA regulations provided in 49 CFR 192, the FERC guidance at 18 CFR 380.15, and the maintenance provisions in Algonquin’s E&SCP. Algonquin would add three full-time permanent workers for operation of the proposed and modified facilities.”

As the federal inspector and overseer for the safe operation of natural gas pipelines, PHMSA admits that it is one of the smallest agencies within the Department of Transportation, has a huge mission to oversee more than 2.6 million miles of our nation’s pipelines. Jeffrey Wiese, the nation's top oil and gas pipeline safety official, has publicly conceded that the regulatory process he oversees is "kind of dying." Wiese told several hundred oil and gas pipeline compliance officers that his agency, the Pipeline and Hazardous Materials Administration (PHMSA), has "very few tools to work with" in enforcing safety rules even after Congress in 2011 allowed it to impose higher fines on companies that cause major accidents. "Do I think I can hurt a major international corporation with a $2 million civil penalty? No," he said. 45

The fact that PHMSA’s inspection habits and enforcement abilities are questionable heightens the concerns West Roxbury and neighboring communities about the safety of the West Roxbury Lateral. Even if PHMSA is able to inspect the pipelines, it is not clear that the agency

---

44 Final EIS 2-41.

is able to enforce needed safety measures. This in turn leads to additional concerns about the
extent to which Spectra Energy will be held accountable over time for the safety of the pipeline.

Notwithstanding FERC’s assurances, which strike many as glib or perfunctory, the agency has failed to provide any answers to the question of what would happen in the event of a catastrophic gas explosion in West Roxbury? What would be the human, economic and environmental costs to West Roxbury, the City of Boston and to adjacent communities? How and in what ways would Algonquin Gas Transmission, LLC be held to account? And who, other than presumably the first responders, citizens and taxpayers of Boston and Massachusetts would be bear the burden of responding to such an event?

FERC’s seemingly utter indifference to the public safety issues posed by the construction and operation of a highly pressured natural gas pipeline passing through a densely settled urban neighborhood is unconscionable, inexplicable, reckless and irresponsible. It is also impossible to square this with its statutory responsibility under 15 U.S. Code§ 719(a) that “Federal regulation in matters relating to the transportation of natural gas and the sale thereof in interstate and foreign commerce is necessary in the public interest.”

2. **FERC Has Failed to Seriously Address Environmental and Health Concerns that Directly Affect West Roxbury in its Order and Final EIS**

FERC released its final Environmental Impact Statement on January 23, 2015. One day before an article appeared in the *Boston Globe* newspaper that described a study conducted by a group of scientists led by Harvard University researchers. The study documented that the amount of methane leaking from natural gas pipelines, storage facilities, and other sources in the Boston area was as much as three times greater than previously estimated - a loss that

---

contributed to the region’s high energy costs and adds potent greenhouse gases to the atmosphere. The authors of the study noted that the leaks would yield enough gas to heat as many as 200,000 homes a year and are valued at $90 million a year. 47

The Globe article reported that the study - the first of its kind to quantify methane emissions from natural gas leaks in an urban area - also suggested that regulators were substantially underestimating the amount of the nation’s methane emissions - and that methane is 20 times more powerful than carbon dioxide, meaning small amounts of the heat-trapping gas can have a significant impact on global warming.

“We were surprised to find that emissions are as high as they seem to be,” said Steven Wofsy, a lead author of the study and professor of atmospheric chemistry at Harvard’s School of Engineering and Applied Sciences. “Once we understand where they come from, we can find ways to reduce them in a cost-effective way.”

The study, published in the Proceedings of the National Academy of Sciences, relied on measurements from September 2012 to August 2013 taken by laser spectrometers at Copley Square, Boston University, Nahant, and the Harvard Forest in Petersham. The instruments found about 300,000 metric tons of natural gas leaks - about 2.7 percent of all natural gas delivered to the region. State and federal authorities had previously estimated that 1.1 percent of natural gas was being lost to leaks from a range of sources in the area, including homes, businesses, and electricity generation facilities.

According to the EPA, natural gas production and transportation systems were the second largest anthropogenic source of methane in the U.S. in 2012, accounting for approximately twenty three percent of national methane emissions. Production and transportation systems also

47 The Harvard study is attached hereto as Exhibit 5.
emit significant carbon dioxide, accounting for almost one percent of national emissions in 2012. In addition, the downstream combustion of natural gas in power plants and other applications releases carbon dioxide, nitrogen oxides, and other harmful air pollutants. 48

FERC, in its order and in its Final EIS, failed to acknowledge the polluting effects of methane in Boston caused by leaking gas lines and the adverse affects of methane gas as a known carcinogen detrimental to public health, although the existence of the methane leaks was widely reported in the media more than two years earlier - as was the underlying study led by Boston University scientists - who mapped and measured the underlying gas leaks.49 Rather than address the impact of this known environmental and public health hazard, FERC simply echoed the corporate mantra of Algonquin Gas Transmission, its corporate parent, Spectra, to assure the public that all was well and the adverse environmental impact of the AIM Project and its West Roxbury lateral component would be negligible.

Similarly, traffic, noise, concerns about congestion and the impact of the West Roxbury Lateral are barely mentioned in FERC’s order and in the Final EIS, and when, and if, discussed, minimized. “During pipeline construction within 0.25 mile of the area identified... impacts associated with increased traffic, noise and dust, as well as impacts on visual resources could occur; however, the impacts would be temporary and limited to the time of construction.”50

48 U.S. Environmental Protection Agency, “Clean Energy: Natural Gas” (last updated Sep. 25, 2013), (estimating that natural gas-fired power plants releases, on average, 1135 pounds of carbon dioxide and 1.7 pounds of nitrogen dioxide per MWh of electricity generated).

49 “Mapping urban pipeline leaks: Methane leaks across Boston,” Environmental Pollution, November, 2002. That underlying study is attached to this motion as Exhibit 6.

50 Final EIS 4-154.
Further, “Along the West Roxbury Lateral, the pipeline would primarily be placed within streets in the vicinity of residential and commercial areas. Algonquin would use the in-street construction method to install the pipeline within roadways. The work area would be isolated from road and pedestrian traffic, and traffic controls would be used to allow traffic to bypass the work area. No trenches would be left open overnight. *With the exception of the end of the pipe, which would be left exposed within the trench, the pipe trench would be backfilled at the end of the day*, and the open trench containing the exposed ends of the pipe would be plated. The work would be accomplished so that emergency vehicles would be able to pass and homeowners would be able to access their driveways. Algonquin has developed an acceptable Traffic Management Plan for the West Roxbury Lateral as well as acceptable site-specific residential construction plans for residences within 50 feet of the construction right-of-way (see sections 4.9.5 and 4.8.3, respectively).”  

Finally, “The proposed West Roxbury M&R Station would be sited on a wooded property located across the street from an active rock quarry. It would be bounded by residential properties to the north, south, and west and there is a residence immediately adjacent to the proposed facility off of Centre Street. Algonquin would maintain an existing wooded buffer along the entire western portion of the property as well as portions on the north and south sides of the site. Although maintaining a wooded buffer around the M&R station would provide substantive visual screening, the location of the site in a dense residential area could result in some visual impacts. Therefore, we recommend that: Prior to construction of the West Roxbury M&R Station, Algonquin should file with the Secretary, for review and written

---

51 Final EIS 4-275.
approval of the Director of OEP, a detailed site-specific landscaping plan for mitigation of visual impacts at the station.”

FERC has also accepted at face value Algonquin’s assurances that it could be trusted as a faithful steward of the environment and that there would be no detrimental effects upon existing bodies of water, wet lands or watershed protection areas in or near West Roxbury. Yet at the same time, FERC’s Final EIS acknowledged that “The West Roxbury Lateral would cross the Mother Brook reservation along Washington Street and Post Lane in Dedham. The proposed pipeline would be installed within Washington Street and would pass above the culvert that carries mother brook under Washington Street.”

“Mother Brook was originally dug in 1639 to deliver water from the Charles River to the Neponset River...the brook is now used as part of a flood-control system that diverts water from the Charles River to the Neponset River.”

Also, the Final EIS noted that “The West Roxbury Lateral crosses a portion of the Charles River Basin, a state-designated aquifer...” However, FERC assures us, “No wetlands would be affected in...Massachusetts.”

3. **FERC Has Failed to Seriously Address Legal Concerns under the Massachusetts Constitution Posed by Algonquin’s Proposed Exercise of Easements over Existing Public Lands**

The issue of access and the easements that Algonquin Gas Transmission, LLC proposes to exercise over existing public lands, including public roads and rights-of-way, also received

---

52 Final EIS 4-174.
53 Final EIS 4-169.
54 Final EIS 4-168.
55 Final EIS 4-28.
56 Final EIS 4-61.
scant attention from FERC. The Final EIS concedes that construction on Washington Street would cause temporarily disrupt access to Mary Draper Playground on Washington Street.\textsuperscript{57}

With respect to the West Roxbury Quarry Urban Wild, the Final EIS concluded: “The Project would have no direct impact on the urban wild lands. During the construction period, temporary visual and noise impacts on recreational users of the urban wild could occur but would be minor relative to the existing character of the area, due to the presence of the active quarry, the dense existing residential development in the area, and the fact that only a small, narrow portion of the urban wild is adjacent to the Project area.”\textsuperscript{58}

The Final EIS fails to appreciate the extent of legal issues that the proposed West Roxbury Lateral present when viewed within the context of environmental issues and public health. Article 97 to the Massachusetts Constitution was adopted, in relevant part, to guarantee the public “The right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose.” Article 97 further requires that “lands and easements taken or acquired for such purposes shall not be used for other purposes or otherwise disposed of except by laws enacted by a two thirds vote, taken by yeas and nays, of each branch of the general court.”

The interpretation of this constitutional provision has been broadly construed and arguably includes all easements on public lands, including public roads. “Land originally acquired for limited or specific pubic purposes is thus not to be excluded from the operation of

\textsuperscript{57} Final EIS 4-168.

\textsuperscript{58} Final EIS 4-170.
the two-thirds roll–call vote requirement for lack of express invocation of the more general purposes of Article 97.**59

The Final EIS adopted Algonquin Gas Transmission’s claim that it could identify only one possible Article 97 issue:“Algonquin has conducted a review of possible Article 97 lands crossed by the West Roxbury Lateral. Algonquin’s review suggests that Gonzalez Field in the Town of Dedham (see above) is subject to Article 97.**60 In point of fact, however, the proposed West Roxbury Lateral, in addition to interfering with the public’s access to identified public lands above, and their use and enjoyment by the public, would also require the Algonquin to convert the use of its existing easements along Washington and Centre Streets and West Roxbury from a low gas-pressure pipeline with 100 psi of pressure to a 24 inch diameter pipeline with 750 psi of pressure, which is arguably a new use. In addition, Algonquin/Spectra would require the grant of a new easement at the intersection of Spring and Centre Streets to enable its transmission facility to link up to that of National Grid (Boston Gas).

It is settled law that an easement is a taking and when granted may only be used for the original, specific use intended. Hence, the proposed use of existing easements on public lands and the proposed link at Spring and Centre Street, contrary to Algonquin’s denial, do raise Article 97 issues, especially where, as here, the public policies that inform the article are entirely consistent with existing federal environmental statutes that FERC is charged with enforcing.

Admittedly, the Natural Gas Act, 15 U.S.C. § 717(a) and (b), grants broad authority to FERC to regulate interstate pipelines and facilities, and has been held by federal courts to

---

59 See the Opinion of the Massachusetts Attorney General, 1-1-73 and Mahajan v. Department of Environmental Protection. 464 Mass. 604; 9844 N.E.2d 821; 201313 Mass. LEXIS 47 (2013). These documents are attached as Exhibits 7 and 8 to this motion.

60 Final EIS 4-171.
preempt state regulations that impact upon the location, construction, operation, and maintenance of natural gas pipeline.\textsuperscript{61} Nevertheless, a potential conflict exists between the guarantees of Article 97 and the extent of any preemption that Congress intended to grant under the Natural Gas Act exists. That conflict raises important and as yet unaddressed questions under the Tenth, Fifth and Fourteenth Amendments to the U.S. Constitution: (1) May a privately-owned corporation condemn or alienate public lands when, as here, the need for the project has not been clearly shown? (2) In addition, may a private, for-profit corporation Algonquin condemn private and public lands where FERC has not required that Algonquin guarantee that the gas that flows through the proposed West Roxbury Lateral - paid for by the rate-payers and consumers of Massachusetts - will not ultimately be liquified and shipped from Maine or from Halifax, Nova Scotia to Europe?\textsuperscript{62}

4. **FERC Has Abdicated Its Statutory Responsibility to Require that Algonquin Gas Transmission, LLC Show a Compelling Need for the Proposed Project Based upon Current and Projected Needs for Natural Gas**

The natural gas industry and their lobbyists appear have successfully persuaded the New England Governors, other public officials at large and FERC itself that, without the AIM Project, New England will suffer from a severe shortage of natural gas in the immediate or near future and that because of increasing demand, capacity must be increased significantly. This proposition is not supported by the existing evidence and it smacks of pure propaganda:

(1) As discussed above, two scientific studies show that the amount of methane

\textsuperscript{61} *Schneiderwind v. ANP Pipeline Co.*, 485 U.S. 293 (1988) and *ANR Pipeline v. Iowa State Commerce Comm’n*, 828 F.2d 465(8th Cir. 1987).

\textsuperscript{62} See Exhibit 9 attached hereto, a map that shows the integration on natural gas pipelines that will be created as a result of the West Roxbury lateral and the partnership of Spectra Energy, Eversource Energy and National Grid.
leaking from natural gas pipelines, storage facilities, and other sources in the Boston area was as much as three times greater than previously estimated - a loss that has contributed to the region’s high energy costs and adds potent greenhouse gases to the atmosphere. The article stated that the authors of the study noted that the leaks would be enough to heat as many as 200,000 homes a year with natural gas and that the value of gas lost was in excess of $90 million a year.63

(2) As the EPA reported, natural gas production and transportation systems were the second largest anthropogenic source of methane in the U.S. in 2012, accounting for approximately twenty three percent of national methane emissions. Production and transportation systems also emit significant carbon dioxide, and accounted for almost one percent of national emissions in 2012. In addition, the downstream combustion of natural gas in power plants and other applications releases carbon dioxide, nitrogen oxides, and other harmful air pollutants. 64

(3) As the study prepared for Senator Markey has observed, “American consumers are paying billions of dollars for natural gas that never reaches their homes, but instead leaks from aging distribution pipelines...Gas distribution companies in 2011 releasing 69 billion cubic feet of natural gas to the atmosphere, almost enough to meet the state of Maine’s gas needs for a year and equal to the annual carbon dioxide emissions of about six million automobiles. 65

63 “Mapping urban pipeline leaks: Methane leaks across Boston,” Environmental Pollution, November, 2002, attached to this motion as Exhibit 6 and “Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts.” Proceedings of the National Academy of Science, February 17, 2015, attached as Exhibit 5 to this motion for a rehearing.

64 U.S. Environmental Protection Agency, “Clean Energy: Natural Gas” (last updated Sep. 25, 2013), (estimating that natural gas -fired power plants releases, on average, 1135 pounds of carbon dioxide and 1.7 pounds of nitrogen dioxide per MWh of electricity generated).

FERC has uncritically accepted Algonquin’s evidence for the need for increased natural gas capacity, but has ignored other, independent economic studies other that have more carefully examined the relationship between capacity, gas leaks and existing use and demand. FERC has also neglected to consider other existing and available sources of natural gas such as liquified natural gas to meet existing and projected energy needs. In an article that appeared in the Boston Globe on March 23, 2015, Frank Katulak, chief executive of Distrigas, stated “We already have the infrastructure in place...We absolutely are an alternative to new pipelines. There’s no need for major changes or new fees to pay for new pipelines.” The article reported that Distrigas’ LNG terminal, located in Everett, Massachusetts, is running at about 50 percent capacity, despite a 60 percent increase in LNG shipments this year. A U.S. Energy Department graph that accompanied the article showed that between 2009 and 2014, LNG imports into the U.S. declined from 54.4 billion cubic feet to 8.0 billion feet.

Before it issued its Final EIS and its order, FERC also failed to consider the effect of alternative energy sources - such as solar and wind - upon future natural gas demand. A report released by the DOE in February of this year called into question the gas industry’s justification for increased pipeline construction: In its Key Finding 1, the DOE stated that, “Diverse sources of natural gas supply and demand will reduce the need for additional interstate natural gas pipeline infrastructure” and Key Finding 2 that “Higher utilization of existing interstate natural gas pipeline infrastructure will reduce the need for new pipelines. The U.S. Pipeline system is not

---

66 Jay Fitzgerald, “Pipeline opponents say LNG is underutilized.”

67 See Exhibit 10 attached hereto.
fully utilized because the flow patterns have evolved with changes in supply and demand.” 68

The primary responsibility of any public regulatory agency, given the evidence that shows pervasive gas leaks of billions of cubic feet of natural gas, would be to suspend all permits until the natural gas industry took steps to curb emissions and to replace aging pipelines. Instead, it appears that FERC has chosen rather than to rubber-stamp a proposal that increases gas-line capacity without considering other feasible measures that could satisfy existing and future demand. Because FERC ignored that responsibility, it also did not consider the positive impacts that conservation, and existing alternative sources of energy could have in the short-term while awaiting the development of more robust solar, wind, geothermal and kinetic technologies along with enhanced renewable battery-storage units.

The Commission’s failure to take into account the impact of the Atlantic Bridge project in its evaluation of the public convenience and necessity of the AIM project violates the Natural Gas Act and City of Pittsburgh v. FPA, 237 F.2d 741 (D.C. Cir. 1955), which holds that the Commission may not “close its eyes” to the impact that future expansion may have for the cost or need of the immediate proposal before the Commission.

Segmentation of the project is also incompatible with Commission’s Certificate Policy Statement, Certification of New Interstate Natural Gas Pipeline Facilities, 88 FERC ¶61,227 (1999) which requires the Commission to find a need for the project, and discourages overbuilding and duplication of facilities. Presently, PHMSA, on its website, reports that there are more than 2.2 million miles of natural gas pipelines that crisscross the United States. Without a comprehensive big picture view of the project as a whole, the Commission could not make the

required findings under the *Certificate Policy Statement*. Until and unless FERC adopts a systematic, comprehensive policy to address natural gas permitting as part of a nationwide, uniform system, it should revoke its certification and place the present Algonquin AIM Project on hold.

5. **FERC Has Failed To Discharge Its Statutory Obligation to Regulate in the Public Interest.**

FERC is legally required to exercise its regulatory authority under the Natural Gas Act in accordance with 15 U.S. Code § 719 (a) "Necessity of regulation in public interest” in which the U.S. States Congress “declared that the business of transporting and selling natural gas for ultimate distribution to the public is affected with a public interest, and that Federal regulation in matters relating to the transportation of natural gas and the sale thereof in interstate and foreign commerce is necessary in the public interest.”

From the outset, the administrative process that culminated in the instant certification order was flawed and lacked transparency. A January 5, 2015 letter to FERC from West Roxbury resident and the chairperson of West Roxbury Saves Energy, Rickie Harvey, aptly sums up the experiences of intervenors in this motion for a rehearing. Ms. Harvey stated, “We are writing in regard to Spectra's Algonquin Incremental Market (AIM) expansion project, docket #CP14-96-000, and in particular in regard to the portion of the AIM project designated as the West Roxbury Lateral.” The letter continued:

As the deadline for the Final Environmental Impact Statement approaches, we feel compelled to go on record with our objections to a process that has not been transparent and that has not considered adverse impacts to an existing residential neighborhood in locating a high-pressure transmission lateral as part of AIM. It also has not truly considered alternatives to the local supply requests. And, further, it has not taken into account the cumulative impacts of related projects.
In addition, our requests for health and safety information and/or reviews in regard to placing a high-pressure line and M&R station in a densely populated neighborhood and adjacent to an active, blasting quarry have gone unaddressed.

In conclusion, we believe that the AIM project requires further study and information prior to approval. However, if FERC feels it must approve the AIM project, then we request that you sever the West Roxbury Lateral, as it is not integral to the project and its sole purpose is to provide gas to one local distribution company without identifying reasonable alternatives.69

Ms. Harvey’s legitimate concerns about the lack of transparency, openness and FERC’s seeming rush to judgment were confirmed and underscored when, just one day before FERC issued its certification order, the Environmental Protection Agency issued its review of the Final EIS.70 The EPA raised a number of environmental issues that neither FERC nor Algonquin satisfactorily considered but, because FERC has issued its final order, without reconsideration, those concerns will not be addressed by the EPA, by FERC or by the public at large.

As part of its oversight and regulation of the natural gas permitting process, FERC is obliged to review all natural gas pipeline permit applications in conformity with all existing U.S. environmental laws and regulations and, if a permit application is found to be non-compliant, to deny certification. FERC has failed to do so in this proceeding.

The instant administrative proceeding shows that FERC adopted, uncritically and with little independent expert analysis or investigation, the assurances of Algonquin Gas Transmission and the natural gas lobby about the need and safety of the AIM Project. Algonquin Gas Transmission and its corporate parent- Spectra Energy Corporation - have been controlling the outcome of the instant permit process from the outset, although their combined environmental

69 See Exhibit 12 attached hereto.
70 See Exhibit 13 attached hereto.
track records show that these two entities are little better than serial offenders. According to the *Boston Globe*, U.S. Department of Transportation data shows that Spectra has amassed more than a $350,000 in fines for failure to inspect transmission lines; Spectra’s Texas Eastern Transmission LP company has been fined $361,900 since 2006; and Algonquin Gas Transmission LLC paid $154,000 in fines for failing to inspect transmission line valves, retain records of internal corrosion for five years, and check pressure regulating stations.

The contest between Algonquin Transmission and the public in this proceeding has pit the public at an extreme disadvantage, given the financial resources of Spectra and the natural gas lobby as a whole. Although the process that FERC oversees purports to ensure a kind of parity between the interests of those that benefit from the certification process - the natural gas industry and its shareholders - and the interests of citizens who are burdened, the contest is invariably unequal. One is reminded of the observation of Anatole France, “The law, in its majestic equality, forbids the rich as well as the poor to sleep under bridges, to beg in the streets, and to steal bread.”

FERC’s endorsement of the AIM Project and the West Roxbury Lateral Component, in light of the facts discussed above, is indefensible. In addition, its certification undermines the public’s confidence in the regulatory process and gives credence to the criticisms leveled by Robert Kennedy, Jr. and others who have suggested that FERC is little less than a rogue agency and a shill for the natural gas industry.

---

*The Vancouver Sun* in a February 21, 2015 article by Larry Pynn and Chad Skeleton described Spectra Energy as the province of British Columbia’s worst polluter.

Conclusion

The Federal Regulatory Agency, in order to ensure the integrity of its process, to assuage concerns about its independence and impartiality as a federal regulatory agency, and to protect the public interest, as charged, must, as a matter of law, and in the interests of fundamental justice and equal access to the law, reconsider its decision to issue a certification and allow a rehearing on the merits.

WHEREFORE, based upon above-stated concerns, these intervenors request that their motion for a rehearing be granted.

Respectfully submitted,

/s/ Paul Nevins
Paul L. Nevins, individually and as the attorney for the intervenors identified below

Certification of List of Intervenors Who Have Joined in this Motion

The undersigned certifies that he has been retained and requested to file this motion for a rehearing on behalf of the individuals and organizations listed below who have previously intervened in this administrative proceeding:

Matthew Butler
Charles River Spring Valley Neighborhood Association
Conservation Law Foundation
Foundation for a Green Future, Inc.
Rickie Harvey, Chair, West Roxbury Saves Energy
Virginia Hickey
Paul Horn
David Ludlow
Mary McMahon
Paul Nevins
Alexandra Shumway
Karen Weber

/s/ Paul L. Nevins
Paul L. Nevins
Certificate of Compliance

The undersigned hereby certifies that this document, filed through the E-filing system on April 2, 2015, will be sent electronically to the registered participants as identified on the notice of Electronic Filing.

/s/ Paul L. Nevins
Paul L. Nevins
Exhibit 1 to West Roxbury Motion for Rehearing: Nursing Home Concerns
March 11, 2015

Dear Mr. Bonsall,

We are writing on behalf of the Board of Directors of Deutsches Altenheim, Inc., with respect to the proposed West Roxbury lateral pipeline connection to the Algonquin Incremental Market (AIM) Project in New England. Deutsches Altenheim, a nonprofit organization, comprising a 133 bed skilled nursing home facility, 62 apartment assisted living residence, and 30 client adult day health program, provides a full spectrum of care to seniors, from short-term rehabilitation, long-term care, outpatient rehabilitation, to a state-of-the-art Alzheimer’s/memory care unit. We employ over 300 full time and part time staff. In addition, we often host civic, professional, or social events open to the public.

Located and operating at 2220-2222 Centre Street in West Roxbury since 1914, Deutsches Altenheim shares boundaries with the Roxbury Latin School, a number of single-family residences, and a large open-pit quarry (the West Roxbury Crushed Stone Co.). The only access for staff, visitors, vendors, ambulances, and other emergency vehicles to our busy campus is by way of Centre Street, the proposed location of the new high-pressure natural gas pipeline. While we take no position on the pros and cons of natural gas as an energy source or the need for more pipelines, the safety and wellbeing of our residents and staff is our top priority. We are convinced that the proposed West Roxbury lateral pipeline would increase the risk of a serious incident along Centre Street, especially given the routine blasting, excavation and high gross weight trucking at the nearby quarry. Any pipeline-related event, which would effectively block us from implementing our disaster evacuation plan, would have a tragic outcome.

The Board of Directors has the fiduciary responsibility to act in the best interest of our residents and staff. The Board members take this responsibility very seriously. We therefore oppose the location of the pipeline as currently proposed and urge Spectra to seek alternative routes.

Sincerely,

[Signatures]

Genevieve MacLellan, President
Board of Trustees

Gregory Karr, CEO

2222 Centre Street
West Roxbury, MA 02132-4097
Exhibit 2 to West Roxbury Motion for Rehearing: Siting Board Concerns
VIA ELECTRONIC FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Jon N. Bonsall, Esq.
Keegan Werlin, LLP
265 Franklin Street
Boston, MA 02110
COUNSEL TO ALGONQUIN GAS TRANSMISSION, LLC

Re: Algonquin Gas Transmission, LLC, Docket No. CP14-96-000

Dear Ms. Bose and Mr. Bonsall:

The Massachusetts Energy Facilities Siting Board (“Siting Board”) appreciates the opportunity to review and comment on the draft environmental impact statement (“Draft EIS”) prepared by the staff of the Federal Energy Regulatory Commission (“FERC”) for the Algonquin Incremental Market Project (“AIM Project” or “Project”). The Siting Board’s comments incorporate public concerns about the Project expressed in response to the Draft EIS in written comments and at a public forum. The Project, as proposed by Algonquin Gas Transmission, LLC (“Algonquin” or “Company”), would expand Algonquin’s existing pipeline system from an interconnection at Ramapo, New York to deliver up to an additional 342,000 dekatherms per day of natural gas transportation service to the Connecticut, Rhode Island, and Massachusetts markets.1 This letter addresses the Massachusetts portion of the AIM Project known as the West Roxbury Lateral (“WRL”).

1 The transportation path for the AIM Project encompasses a substantial portion of the Algonquin system from receipt points at Ramapo, New York, and Mahwah, New Jersey, near the western end of the system, to Everett, Massachusetts, near the eastern end.
I. INTRODUCTION

Algonquin is a wholly owned subsidiary of Spectra Energy (“Spectra”). With the AIM project, Algonquin seeks to expand its existing pipeline system in New York, Connecticut, Rhode Island, and Massachusetts. FERC is reviewing the AIM Project under its regulations in compliance with the Natural Gas Act (“NGA”) and the National Environmental Policy Act (“NEPA”).

The Siting Board is an independent board of the Commonwealth of Massachusetts with a statutory mission to ensure a “reliable energy supply for the Commonwealth with a minimum impact on the environment at the lowest possible cost.” G.L. c. 164, § 69H. The Siting Board is required by regulation in 980 C.M.R. § 7.07(9)(a) to intervene when an interstate natural gas pipeline company applies to FERC to construct or modify pipeline facilities within Massachusetts. FERC has allowed the Siting Board’s petition to intervene in the instant case, Algonquin Gas Transmission, LLC, Docket No. CP14-96-000.

In the pre-filing phase of the Project, the Siting Board conducted a site visit to the primary and the alternative pipeline routes and held its own public comment hearing regarding the WRL. In addition, the Board participated in FERC-facilitated teleconferences addressing the Massachusetts portion of the Project. In the Project filing phase, the Siting Board staff have monitored filings and public comments posted for the AIM Project on the FERC website. Most recently, Siting Board staff attended a September 8, 2014 meeting held by FERC in the WRL area to hear public comments on the Draft EIS.

II. PROPOSAL

The Project will include the construction of approximately 37.6 miles of pipeline facilities, modifications to six existing compressor stations (resulting in the addition of 81,620 horsepower of compression), modification to 24 existing metering and regulating (“M&R”) stations, and the construction of three new M&R stations. As a result of these changes, the maximum design capacity of the expanded Algonquin system will increase from approximately 2.6 billion cubic feet per day to 2.9 billion cubic feet per day.

The WRL includes installation of 4.9 miles of new pipeline in the towns of Westwood and Dedham and in the West Roxbury section of Boston. Of the 4.9-mile total, 4.09 miles of

---

2 The Siting Board previously submitted written comments during the pre-filing phase of this case on October 15, 2013, and on December 13, 2013. The October 15 letter addressed comments submitted on line and made at the FERC public scoping meeting held on October 3, 2013. The December 13 letter addressed twelve Draft Resource Reports filed pursuant to FERC regulations by Algonquin and included a summary of comments made at a public hearing on the AIM Project held December 3, 2013, by the Siting Board.
pipeline would be 16 inches in diameter and 0.81 miles would be 24 inches in diameter. Algonquin would also construct two new M&R stations in Massachusetts in connection with the AIM Project, one in West Roxbury and the other in Freetown (the Assonet M&R station). Modifications would be made to existing M&R stations located in Freetown, New Bedford, Middleborough, Brockton, Norwood, Needham, Wellesley, and Medford. The WRL would originate in Westwood and be sited within or near Route 1 (aka Providence Highway) in Dedham, and within or near Washington Street, Grove Street, and Centre Street in West Roxbury.

III. COMMENTS ON FERC’S DRAFT EIS

As required by regulation, FERC has distributed a Draft EIS for the AIM Project and anticipates issuing a Final EIS at the end of 2014. In connection with issuance of the Draft EIS FERC staff have also held public meetings in each of the four states along the Project route. The Siting Board staff have reviewed the Draft EIS and attended the associated public hearing held by FERC in Massachusetts on September 8, 2014. Comments at the public hearing focused on three broad areas of concern: (1) the safety of the Project; (2) alternatives to the Project; and (3) process issues related to planning for the Project. Potential traffic impacts of Project construction and impacts to commercial and residential areas were also subjects of considerable interest at the hearing. The following discussion summarizes public comments in Massachusetts on the Draft EIS and additional observation by the Siting Board, with particular focus on the WRL.

A. Pipeline Alignment and Traffic

The Siting Board agrees with comments by the legal representative for Legacy Place, a commercial center along the Project route and an intervenor in this proceeding. Counsel for Legacy Place notes that, although not indicated in the Draft EIS, Algonquin has shifted its pipeline alignment from the north side of Route 1 to the south side, the roadway where Algonquin would construct a significant segment of the WRL. The Siting Board joins Legacy Place in favoring this shift as a way to limit driveway crossings and disturbance to contaminated sub-soils along the roadway shoulder. If well planned, construction of the Project along this modified alignment would minimize traffic impacts. The Siting Board favors the pipeline alignment on the south side of Route 1, but reserves its final determination on this issue until additional information becomes available in the revised Draft EIS.\(^4\)

\(^3\) The length of the WRL has changed since distribution of Algonquin’s Draft Resource Reports, which listed the WRL as 4.9 miles long. The Draft EIS describes the WRL as 5.1 miles in length. Algonquin’s September 19, 2014 Supplemental Information (at 1) filing indicates that the total length of the WRL as currently planned is 4.9 miles.

\(^4\) As part of its review process, FERC responds to comments and/or revises the Draft EIS before issuing a Final EIS. The Siting Board asks that FERC make specifics of the identified Algonquin pipeline realignment available at its earliest possible convenience.
The Siting Board anticipates that planned nighttime construction in commercial areas along Route 1 will also contribute to minimizing traffic impacts. While the Siting Board supports nighttime construction in commercial areas, we recommend daytime construction off Route 1 in residential areas as overnight construction noise would be disruptive. The Company states that it will coordinate any work during peak traffic periods, 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m., with the Massachusetts Department of Transportation (“MassDOT”) and the communities of Westwood, Dedham, and/or West Roxbury. Given the necessity for daytime construction in residential areas, the Siting Board notes that it is imperative that the Company implement this coordination with MassDOT as planned.

Appendix G of the Draft EIS (the Traffic Management Plan) addresses rush hour traffic management and coordination of traffic management with local authorities. The Siting Board recommends that it also address construction crew parking.

B. Safety

With respect to safety, the proximity of the Project to various sensitive receptors is of concern in the community. The close proximity of the pipeline to Gonzalez Field in Dedham at the intersection of High Street and East Street has garnered particular attention, as has the installation depth of the pipeline. Both Algonquin and FERC have continued to examine pipeline routing at Gonzalez Field with a view to reducing Project impacts at this location. The Draft EIS included a realignment of the originally proposed pipeline route at Gonzalez Field.\(^5\) FERC required that Algonquin supply supplemental information for its pipeline at Gonzalez Field in the form of a site-specific construction plan to be filed prior to the end of the Draft EIS comment period. Algonquin recently (September 19) provided the supplemental information requested by FERC for Gonzalez Field; however, Algonquin’s filing described additional changes between the WRL at locations MP 2.42 to MP 2.67 (Gonzalez Field), raising the possibility that the current alignment is not the final one. The Siting Board further notes that the September 19\(^{th}\) filing did not entirely resolve safety concerns associated with the Gonzalez Field alignment of the pipeline.

The Siting Board therefore asks that FERC closely review any information on the Gonzalez Field pipeline segment that Algonquin submits subsequent to its September 19\(^{th}\) filing, as will the Siting Board. The Siting Board also urges FERC to require that, in burying pipelines through playing fields, the Company meet and exceed standard safety protocols for street installations of pipeline. The Company should examine the possibility of deeper-than-minimum

This will allow Siting Board review and comment on the realignment with sufficient time for incorporation of any resulting changes in the EIS.

\(^5\) See the Draft EIS at Table 3.5.4-1.
burial of pipeline and also undertake extra monitoring to maintain the integrity of in-field pipeline segments over the life of the Project.

Gonzalez Field, St. Teresa Parish, and The Roxbury Latin School are not the only sensitive receptors requiring special attention along the WRL. The Siting Board notes that Algonquin developed Residential Construction Plans ("RCPs") to address impacts on residences within 50 feet of the construction work areas and to inform affected landowners of proposed measures to minimize disruption. FERC, however, has found these plans to be unacceptable. Therefore, FERC has recommended that Algonquin provide revised RCPs that incorporate and address any comments received from affected landowners and also incorporate additional measures to minimize effects prior to construction.

The Siting Board is concerned that the 50 foot limit is inadequate. Rather, the Board requests that all owners of property within 250 feet of the construction work areas be consulted in connection with the drafting of the revised RCPs. The Siting Board further recommends that, upon receipt of Algonquin’s revised RCPs, that FERC confer with landowners of property located within 250 feet of the construction work areas as well as with Algonquin to ensure that the updated RCPs meet both landowner requests to the extent practicable and FERC specifications. The Siting Board further urges that FERC condition any RCP approval for the WRL with the requirement that Algonquin submit proof, following construction, that all residential areas are restored to preconstruction conditions or as specified in written landowner agreements.

Additional WRL-related safety issues raised by the public include: (1) that the pressure at the meter station (750 pounds per square inch) is too high given the location of the station in a residential area; (2) that shut-off time in case of accident (potentially 90 seconds) is too long; (3) that ten miles is too great a distance between shut-off valves; (4) that the Project requires gas pipeline welds that will eventually require inspection, and inspection of welds is too infrequent to ensure safety along gas pipeline routes; (5) that the safety of pipelines installed in streets with heavy trucking is questionable; and, (6) that in the event of a pipeline explosion, the estimated blast radius of 300 feet would also affect surrounding residences in the fire that accompanies an explosion at a natural gas pipeline. The Siting Board asks that the next version of the EIS specifically address each of these safety concerns.

The safety of pipeline construction near blasting at the West Roxbury Crushed Stone Quarry ("West Roxbury Crushed Stone" or "Quarry") is also at issue. A related concern is the proposed location across the street from the Quarry of a new M&R station. The siting of the pipeline and the M&R station near the Quarry is the subject of Section III.C, below.
C. Issues Related to West Roxbury Crushed Stone

1. General Issues

The planned route of the AIM pipeline along Centre Street exacerbates existing residential concern about the location of West Roxbury Crushed Stone and its blasting activities for gravel mining. Neighbors of the Quarry assert that blasting occurs frequently and has caused damage at their properties; they anticipate possible damage to the Algonquin pipeline as well. The proposed siting of the West Roxbury M&R station for the Project across the street from the Quarry only increases community misgivings about the proximity of the Quarry. Residents report that icy winter conditions have previously led to local traffic and commercial vehicles accessing the Quarry sliding out of control at this location. They worry about such accidents being even more dangerous given the proposed location of the M&R station.

The Siting Board notes that Algonquin has provided a geotechnical review of the impact on the Project of blasting activity at West Roxbury Crushed Stone. The report states that two existing water lines and one existing gas line are located between the proposed pipeline and West Roxbury Quarry. The report does not state, however, whether blasting at the Quarry has ever damaged these pipelines. Such information is essential and the Siting Board requests that it be included in the next version of the EIS.

The Siting Board also notes that public comments about West Roxbury Crushed Stone made in conjunction with review of the Draft EIS suggest that the Quarry may close in the near future. The Siting Board is interested in the likelihood that this closure will occur and the resultant potential impact on traffic flow associated with filling and/or closing the Quarry, and alternative siting options within the Quarry for the M&R station. Given this interest, the Siting Board asks that FERC require Algonquin to prepare an analysis that includes information on future plans for the Quarry, including a timeline for these plans, and any proposed repurposing of the site. As part of this analysis, Algonquin should indicate the activities involved in Quarry repurposing (e.g., filling in the Quarry) and how they would affect the Project pipeline and the M&R station.

Even if West Roxbury Crushed Stone is not closed in the near future, the Siting Board would welcome a review of the M&R station siting process to ensure that any preferred alternative to the proposed location is not overlooked. In addition, the Siting Board strongly recommends that FERC require that Algonquin meet with the owners of West Roxbury Crushed Stone and with nearby residents. The purpose of meeting would be to develop collaboratively a site-specific construction plan for the Quarry and M&R station location as well as a site-specific noise and vibration mitigation and management plan for the neighborhood.

2. Issues Specific to New Massachusetts Legislation

The Siting Board draws the attention of FERC and Algonquin to an act recently passed by the Massachusetts Legislature: Massachusetts Acts of 2014, Chapter 149. This new law,
effective as of October 1, 2014, appears directly relevant to operation of West Roxbury Crushed Stone and the alignment of the pipeline. Section 7 of Chapter 149 states:

Notwithstanding any general or special law to the contrary, explosive material, as defined in 527 CMR 13.03, shall not be used to fire a blast in any blasting operation at a site primarily used as a source of mined products from the earth if such site is within 500 feet of a natural gas pipeline or metering and regulation station without written approval by the department of public utilities.

The term “explosion” under 527 CMR 13.03 is broadly inclusive such that whatever the Quarry uses when blasting would most likely qualify by definition as an explosive material for regulatory purposes. The Siting Board notes that although some portions of the Quarry may lie outside the 500 foot radius established by Section 7, it is certainly the case that sections of the proposed pipeline come within 500 feet of the West Roxbury Crushed Stone property line, as does the M&R station. Although FERC is not bound by state law in this instance, the same is not true of the Quarry, to which the provisions of the referenced Massachusetts law are applicable.

The Siting Board recommends, in addition to review of Quarry and pipeline safety concerns already noted, that FERC and Algonquin: (1) analyze whether the planned siting of the pipeline and M&R station might result in a violation of Massachusetts Acts of 2014, Chapter 149, Section 7 by West Roxbury Crushed Stone in the course of its blasting operations; and (2) consider the physical safety consequences posed by such blasting activities, including the advisability of siting of the M&R station and any segments of the proposed pipeline within 500 feet of the Quarry property line. The Siting Board emphasizes that – regardless of whether the Project would result in the Quarry’s blasting activities violating Massachusetts Acts of 2014, Chapter 149, Section 7 – it is important to ensure that the Project is sited so that its location is consistent with the continued operation of the Quarry.

D. Visual Impacts

Visual impacts of the M&R station, though less controversial than other potential station impacts, may nonetheless warrant remedy. In the Draft EIS at 4-170, FERC concludes that the M&R station would have minimal visual impact based on Algonquin’s statement that it would maintain an existing wooded buffer on the entire west side of the M&R station site as well as along parts of the north and south sides of the parcel. There is, however, no evidence beyond Algonquin’s representation on which to base a conclusion as to the station’s likely visual impact. Algonquin has not yet provided a site plan or a landscaping plan for the M&R station, despite an earlier Siting Board request to obtain such documents.
E. Process Issues

1. Remarks on Process by Members of the Public

Process issues associated with the Draft EIS have also elicited public comment in Massachusetts. Concern about process was very evident at the September 8, 2014 FERC hearing on the Draft EIS. A number of speakers objected that the public hearing focused on the portion of the Project in Massachusetts only rather than on the Project in its entirety. The lack of design information for the M&R station across the street from West Roxbury Crushed Stone was a source of dissatisfaction as was the handling of public notification regarding the Project, public comment hearings, and the Draft EIS. A repeated observation was that the timing of the public comment hearing for the Draft EIS (on the evening before state primary elections) inhibited public participation. In connection with this scheduling issue, several individuals asked FERC to hold an additional public hearing and to extend the comment period on the Draft EIS for the WRL. Commenters suggested that having access to electric utility representatives and representatives of the Project together would be helpful. Many voiced criticism of the public outreach and participation process by Algonquin and FERC.

2. Remarks on Multiple Topics by Public Officials

Four public officials attended, or sent representatives to, the September 8, 2014 FERC public hearing. Henry Cohen represented Boston City Councilor Michelle Wu; Christopher Rusk represented Boston Mayor Martin Walsh. Officials attending the public hearing included Boston City Councilor Matthew O’Malley and Massachusetts State Representative Edward Coppinger.

- Councilor Wu’s comments, as relayed by Mr. Cohen, addressed the lack of notification, process, safety, and need for the project.

- Mayor Walsh’s comments, as relayed by Mr. Rusk, centered on the safety hazards presented by the pipeline and the diminished quality of life that would be caused by construction in heavily populated West Roxbury. Mr. Rusk also stated that Mayor Walsh had written to FERC to request that Monday night’s hearing be postponed because the next day, Tuesday, was primary day. As a consequence, many of the Commonwealth’s politicians and its most politically active citizens had other engagements on Monday night. Finally, Mayor Walsh requested that FERC hold another public meeting.

- Matthew O’Malley, the Boston City Councilor for the district that includes West Roxbury, asserted that the process of notification was inadequate, and he also requested that FERC hold another meeting.
Edward Coppinger, a state representative whose district includes all of West Roxbury, complained of inadequate notice of the proposed pipeline construction and he also requested that FERC hold another public meeting. In addition, Rep. Coppinger stated that when the Company consulted with the elected officials, he assumed that it would follow up by consulting with the general public. He was disappointed that the Company did not do so.

3. Additional Comments on Process

The Siting Board notes that Board of Selectmen and neighborhood meetings held by Algonquin approximately a week before FERC’s September 8 meeting on the Draft EIS provided initial exposure to the AIM Project for some residents. The Siting Board very much supports neighborhood meetings as a tool to inform residents and to collect their feedback on this and other Projects under FERC purview. The Siting Board recommends, however, that such meetings occur at an earlier stage of the process to improve the timing, quality, and completeness of communication between residents and Project developers.

IV. CLOSING COMMENTS

The Project has undergone significant development from the pre-filing stage to publication of the Draft EIS. The Siting Board appreciates the efforts of FERC staff and the Company to address comments submitted during the FERC Project pre-filing process by members of the Massachusetts public and by Siting Board staff. The Siting Board looks forward to examining the revision of the Draft EIS that incorporates the requests and comments above. The Siting Board will continue to monitor electronic filings in Algonquin Gas Transmission, LLC, Docket No. CP14-96-000 through FERC’s refinement of its Draft EIS and issuance of its Final EIS, anticipated in mid-December 2014.

Sincerely yours,

Robert J. Shea
Presiding Officer

cc: Mr. Douglas Sipe (FERC)
Ms. Maggie Suter (FERC)
Exhibit 3 to West Roxbury Motion for Rehearing: Public Hearing
December 13, 2013

Mark D. Marini, Secretary
Department of Public Utilities
One South Station, 5th Floor
Boston, MA 02110

Re: National Grid, D.P.U. 13-157

Dear Secretary Marini:

On behalf of Boston Gas Company and Colonial Gas Company d/b/a National Grid (the “Company”), please find enclosed the Company’s supplemental response to Record Request-DPU-2 filed on December 6, 2013.

Thank you for your attention to this matter.

Very truly yours,

John K. Habib

John K. Habib

Enclosures

Cc: Service List, D.P.U. 13-157
Record Request DPU-2 (Tr. at Vol. 1, p. 52)

If the Department wants to suggest any changes to the lateral project, will the AIM project be affected at all? In that context, please calculate the cost per dekatherm if the West Roxbury lateral were sized for 50,000/day.

Supplemental Response

Please find attached the December 3, 2013 public hearing transcript of the Massachusetts Energy Facilities Siting Board (“EFSB”) which includes public comment on the proposed West Roxbury Lateral (Attachment RR-DPU-2). The transcript includes comments addressed to the EFSB and the Federal Energy Regulatory Commission seeking to minimize the construction impacts associated with the West Roxbury Lateral, including traffic and congestion (see e.g. Attachment RR-DPU-2, at 24-25, 38). These comments reinforce the Company’s perspective that constructing the West Roxbury Lateral at the proposed size of 100,000 Dth/day now is preferable to constructing the Lateral at half that capacity now, and then having to construct new capacity in the near future along the same route, giving the permitting obstacles and environmental impacts that would be associated with constructing the Lateral in stages.

Original Response

The Precedent Agreement between Boston Gas and Algonquin addresses the expansion on the mainline and construction of the West Roxbury lateral on a fully integrated basis. The Company does not have the contractual right to unilaterally separate those two aspects of the overall project.

Pursuant to Section 7(b)(ii) of the Precedent Agreement (the “Agreement”), the Company’s obligations under the service agreements are subject to the Company’s receipt and acceptance, by December 1, 2013, of approval of the Massachusetts Department of Public Utilities. If this condition precedent is not satisfied, the Company has the right, pursuant to Section 9(b), to terminate the Agreement. If the Company, or any other Shipper of the Project terminates, Algonquin has the right to adjust the reservation rate, subject to a cap, for the remaining Shippers. The combined participation of Boston Gas and Colonial Gas is approximately one-third of the total Project volume, and such termination would presumably have a significant (upward) impact on allocation of costs to remaining Shippers of the Project.

1 The Company has requested that Algonquin extend the date set forth in Section 7(b)(ii) of the Agreement to February 1, 2014.
A decision to require National Grid to downsize the West Roxbury lateral would have significant cost impacts to customers in the future, particularly in comparison to the small amount of costs that would be eliminated by reducing the pipe size. The Company needs deliverability of 100,000 Dth per day into this area of the system over the next several years and will utilize 30,000 Dth per day upon the in-service date of the contract. The only reason that the 100,000 Dth per day will not be immediately leveraged for the benefit of the system on the in-service date is that there are certain infrastructure upgrades that must be installed on a sequenced basis to distribute the gas from the Lateral across the Boston Gas distribution system. These infrastructure upgrades cannot be completed unless and until the Lateral is in-service. From the point the Lateral is placed in-service, the Company will work to complete those upgrades on the distribution system so that access to the needed supplies (100,000 Dth per day) is achieved.

If only 50,000 Dth is constructed at this point, the Company will have to upgrade the facility within a short time of its installation. However, it is highly unlikely that there would be an opportunity to permit and relay new pipeline through the towns of Westwood, Dedham and West Roxbury once this project is completed. Even if such a project were permitted, the cost would be equivalent to installing a brand new lateral and likely would be much greater due to the fact there would be existing gas facilities in place. Therefore, it is unclear to the Company how it would meet the existing need in the system if this lateral is not constructed at this time with a sufficient pipe size.

If the West Roxbury lateral were sized for 50,000/day, the Company estimates that the cost differential would be in the range of $1.8 million in reduced pipeline and meter station costs, which represents a small fraction of the overall cost of the lateral (see Exh. EDA-JEA-2, at page 39 of 54 CONFIDENTIAL). The cost of meeting the need through a separate project at a later date would be many multiples of this amount, costing customers a much greater amount than it would if addressed at this point in time. Sizing the lateral to a maximum of 50,000 Dth per day is an extremely shortsighted proposition given this cost differential.

In addition, the reliability improvements that will be available as a result of the project will accrue as of the in-service date of the project because the West Roxbury Lateral will be interconnected with the Algonquin “I” system. Should there be operational issues on the Algonquin “J” system, delivering 38 percent of the gas to the Boston area, supplies can be diverted to the West Roxbury Lateral on the “I” system. Upon completion of the Algonquin AIM project, the Company will install additional distribution pipeline downstream of the West Roxbury delivery point to increase takeaway capacity and enable full utilization of the capacity of the lateral. This work...
needs to commence after the AIM project is completed to allow for proper coordination of the gas transmission and distribution work.
VOLUME A, PAGES 1-55

COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF PUBLIC UTILITIES

PF 13-16-000

PUBLIC HEARING, held at the Holiday Inn, 55 Ariadne Road, Dedham, Massachusetts, on Tuesday, December 3, 2013, commencing at 7:09 p.m., concerning

ALGONQUIN GAS TRANSMISSION, LLC

SITTING:
Robert Shea, Hearing Officer
Barbara Shapiro, Environmental Director
Enid Kumin, Economist
Maggie Suter, FERC

--------Reporter:  David A. Arsenault, RPR--------
Farmer Arsenault Brock LLC
50 Congress Street, Boston, MA 02109
617.728.4404

#### PROCEEDINGS -- 7:09 p.m.

**Mr. Shea:** Good evening. This is a public hearing held by the Massachusetts Energy Facilities Siting Board relating to a pre-filing proceeding at the Federal Energy Regulatory Commission, which is better known as FERC. The FERC docket number in this case is P, as in Peter, F as in Frank, 13-16. This pre-filing process was begun by Algonquin Gas Transmission, LLC and it relates to the Algonquin Incremental Market Project, also called the AIM project. The AIM project involves an expansion of Algonquin's existing pipeline system in New York, Connecticut, Rhode Island and Massachusetts. The portion of the AIM project to be constructed in Massachusetts consists of 4.9 miles of new pipeline that will be located in West Roxbury, Dedham and Westwood, as well as new meter stations in West Roxbury and Assonet. My name is Robert Shea. I have been designated as the hearing officer from the Massachusetts Energy Facilities Siting Board for this matter. With me this evening are -- to my immediate left is Barbara Shapiro, the environmental director of the Siting Board; to Barbara's left is Enid Kumin, who is an economist with the Siting Board. And then to my far left is Maggie Suter, a representative of FERC who has been kind enough to come up from Washington today. Representatives from Algonquin and Algonquin's attorneys are also here and many of them are seated in the front row to my left.

My opening remarks tonight are designed to provide a brief description of the Siting Board and its role in this particular case, to explain how individuals can be involved in the Board's process, and to establish some guidelines for tonight's public hearing. The Siting Board is an administrative agency of the Commonwealth of Massachusetts. The Siting Board consists of nine members. The board members include the Secretary of Energy and Environmental Affairs, who serves as a chairman; the Secretary of Housing and Economic Development; the Commissioner of the Department of Environmental Protection; the Commissioner of the Division of Energy Resources; two Commissioners from the Department of Public Utilities; and three public members who are appointed by the Governor. One of the principal functions of the Siting Board is to review proposals for the construction of new energy facilities in Massachusetts, including large power plants, electric transmission lines, natural gas pipelines and natural gas storage tanks. The Siting Board does not, however, have the authority to approve or disapprove interstate natural gas pipelines such as the one proposed by Algonquin in this case. Instead, such authority rests with FERC, which is located in Washington, D.C. The Siting Board is not a part of FERC. FERC is an agency of the federal government, and the Siting Board is a state agency. When an interstate natural gas pipeline company such as Algonquin applies to FERC to construct or modify facilities within Massachusetts, the Siting Board is required by its regulations to preserve the rights of interested citizens and residents of the Commonwealth by intervening in the FERC proceedings in any such application. The Siting Board is also required to hold a public informational hearing in the area where the proposed facility will be located. The interstate pipeline company must attend the hearing to address the questions and concerns of the public.

After the conclusion of the public hearing and an additional public comment period, the Siting Board will file written comments regarding the proposed project with FERC. The Siting Board's comments are intended to identify difficulties and problems with the project associated with environmental issues as required by the Siting Board's regulations. The Siting Board's comments to FERC will be based in part upon a review of the documents that Algonquin has filed with FERC in connection with this pre-filing proceeding, a site visit by the Siting Board staff along the proposed pipeline route, and also upon public comments and questions received by the Siting Board. The Siting Board encourages those attending the hearing tonight to comment on the potential environmental impacts of Algonquin's proposal, especially any specific concerns that you may have and any possible solutions or mitigation measures. In addition to comments received at tonight's hearing, the Siting Board will also accept written comments following this hearing. All comments regarding the AIM project must be received by the Siting Board.

2 (Pages 2 to 5)

<table>
<thead>
<tr>
<th>1</th>
<th>PROCEEDINGS -- 7:09 p.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Mr. Shea:</strong> Good evening. This is a public hearing held by the Massachusetts Energy Facilities Siting Board relating to a pre-filing proceeding at the Federal Energy Regulatory Commission, which is better known as FERC. The FERC docket number in this case is P, as in Peter, F as in Frank, 13-16. This pre-filing process was begun by Algonquin Gas Transmission, LLC and it relates to the Algonquin Incremental Market Project, also called the AIM project. The AIM project involves an expansion of Algonquin's existing pipeline system in New York, Connecticut, Rhode Island and Massachusetts. The portion of the AIM project to be constructed in Massachusetts consists of 4.9 miles of new pipeline that will be located in West Roxbury, Dedham and Westwood, as well as new meter stations in West Roxbury and Assonet. My name is Robert Shea. I have been designated as the hearing officer from the Massachusetts Energy Facilities Siting Board for this matter. With me this evening are -- to my immediate left is Barbara Shapiro, the environmental director of the Siting Board; to Barbara's left is Enid Kumin, who is an economist with the Siting Board. And then to my far left is Maggie Suter, a representative of FERC who has been kind enough to come up from Washington today. Representatives from Algonquin and Algonquin's attorneys are also here and many of them are seated in the front row to my left. My opening remarks tonight are designed to provide a brief description of the Siting Board and its role in this particular case, to explain how individuals can be involved in the Board's process, and to establish some guidelines for tonight's public hearing. The Siting Board is an administrative agency of the Commonwealth of Massachusetts. The Siting Board consists of nine members. The board members include the Secretary of Energy and Environmental Affairs, who serves as a chairman; the Secretary of Housing and Economic Development; the Commissioner of the Department of Environmental Protection; the Commissioner of the Division of Energy Resources; two Commissioners from the Department of Public Utilities; and three public members who are appointed by the Governor. One of the principal functions of the Siting Board is to review proposals for the construction of new energy facilities in Massachusetts, including large power plants, electric transmission lines, natural gas pipelines and natural gas storage tanks. The Siting Board does not, however, have the authority to approve or disapprove interstate natural gas pipelines such as the one proposed by Algonquin in this case. Instead, such authority rests with FERC, which is located in Washington, D.C. The Siting Board is not a part of FERC. FERC is an agency of the federal government, and the Siting Board is a state agency. When an interstate natural gas pipeline company such as Algonquin applies to FERC to construct or modify facilities within Massachusetts, the Siting Board is required by its regulations to preserve the rights of interested citizens and residents of the Commonwealth by intervening in the FERC proceedings in any such application. The Siting Board is also required to hold a public informational hearing in the area where the proposed facility will be located. The interstate pipeline company must attend the hearing to address the questions and concerns of the public.</td>
</tr>
</tbody>
</table>

<p>| 3 | Enid Kumin, who is an economist with the Siting Board. And then to my far left is Maggie Suter, a representative of FERC who has been kind enough to come up from Washington today. Representatives from Algonquin and Algonquin's attorneys are also here and many of them are seated in the front row to my left. My opening remarks tonight are designed to provide a brief description of the Siting Board and its role in this particular case, to explain how individuals can be involved in the Board's process, and to establish some guidelines for tonight's public hearing. The Siting Board is an administrative agency of the Commonwealth of Massachusetts. The Siting Board consists of nine members. The board members include the Secretary of Energy and Environmental Affairs, who serves as a chairman; the Secretary of Housing and Economic Development; the Commissioner of the Department of Environmental Protection; the Commissioner of the Division of Energy Resources; two Commissioners from the Department of Public Utilities; and three public members who are appointed by the Governor. One of the principal functions of the Siting Board is to review proposals for the construction of new energy facilities in Massachusetts, including large power plants, electric transmission lines, natural gas pipelines and natural gas storage tanks. The Siting Board does not, however, have the authority to approve or disapprove interstate natural gas pipelines such as the one proposed by Algonquin in this case. Instead, such authority rests with FERC, which is located in Washington, D.C. The Siting Board is not a part of FERC. FERC is an agency of the federal government, and the Siting Board is a state agency. When an interstate natural gas pipeline company such as Algonquin applies to FERC to construct or modify facilities within Massachusetts, the Siting Board is required by its regulations to preserve the rights of interested citizens and residents of the Commonwealth by intervening in the FERC proceedings in any such application. The Siting Board is also required to hold a public informational hearing in the area where the proposed facility will be located. The interstate pipeline company must attend the hearing to address the questions and concerns of the public. | 5 | After the conclusion of the public hearing and an additional public comment period, the Siting Board will file written comments regarding the proposed project with FERC. The Siting Board's comments are intended to identify difficulties and problems with the project associated with environmental issues as required by the Siting Board's regulations. The Siting Board's comments to FERC will be based in part upon a review of the documents that Algonquin has filed with FERC in connection with this pre-filing proceeding, a site visit by the Siting Board staff along the proposed pipeline route, and also upon public comments and questions received by the Siting Board. The Siting Board encourages those attending the hearing tonight to comment on the potential environmental impacts of Algonquin's proposal, especially any specific concerns that you may have and any possible solutions or mitigation measures. In addition to comments received at tonight's hearing, the Siting Board will also accept written comments following this hearing. All comments regarding the AIM project must be received |</p>
<table>
<thead>
<tr>
<th>Page</th>
<th>Text</th>
</tr>
</thead>
</table>
| 6    | by me no later than Monday, December 9, 2013 in order to be included in the comments that the Siting Board will file with FERC. At the back table there are several sheets of paper copies that contain my contact information. The same sheet also contains the regulations that dictate how the Siting Board proceeds in cases such as this one. So please feel free to go to the back table and take a copy of this document. It has my contact information and you will be able to send me written comments, if you want, or just if you have questions later on or you just want to keep in contact you will be able to contact me. I have a few more words about this evening's procedure. In a minute I will turn the microphone over to Maggie Suter from FERC who will explain the FERC process in more detail. Then Algonquin will present a description of the proposed project. That will be followed by questions and comments from the public. I will first call on state or local officials or their representatives who may be present. Then I will call on people in the order that they have signed the speakers list that is located in the back of the room. If you wish to speak and you have not had a chance to sign the speakers list, please do so at this time or at any time during the course of tonight's hearing. Finally, I would like to ask each person who speaks to state his or her name and address clearly and in particular to spell his or her last name. This hearing, including the statements made by members of the public, will be transcribed. We will use the remarks you make as recorded in the transcript to help us write our comments. At this point I will turn the hearing over to Maggie Suter from FERC. **MS. SUTER:** Good evening. My name is Maggie Suter. I am the project manager for the Algonquin Incremental Market or AIM project with Federal Energy Regulatory Commission with the Office of Energy Projects. I would like to thank Robert Shea and the Massachusetts Energy Facilities Siting Board for inviting FERC to participate in its process and speak in front of you all this evening. With me tonight is Jennifer Lee from Natural Resource Group, which is an environmental consulting firm who is helping us prepare the environmental impact statement for this project. Many of you may have spoken to me before or attended our scoping meeting a few months ago. I’m going to reiterate a bit of information about FERC and our process for you. FERC is an independent agency that regulates the interstate transmission of electricity, natural gas and oil. As a federal licensing agency the FERC has the responsibility under the National Environmental Policy Act, or NEPA, to consider the potential environmental impacts associated with the project which is under its consideration. With regard to Algonquin’s AIM project, the FERC is the lead federal agency for the NEPA review and the preparation of the EIS. We are currently meeting with other federal, state and local agencies to determine their NEPA responsibilities and their potential levels of involvement in the project and whether any agencies may wish to become cooperating agencies in preparation of the EIS. These issues generally focus on the potential for environmental effects but may also address construction issues, mitigation and the environmental review process. Many of you may have seen up at the front table, we have a flow chart for you which you can grab. This has been mailed out several times and we have had it at our meetings that we have had so far. I’m going to use this to guide us through the process this evening. Currently we are still near the beginning of our process. Although it looks like we are in the middle, it is still very early on. As Robert mentioned and as we talked about previously, we are in the pre-filing process which began on June 28, 2013. The purpose of the pre-filing process is to encourage the involvement by all interested stakeholders in a manner that allows for the early identification and resolution of environmental issues. That means that as of today no formal application has been filed with FERC. That means that FERC at this point cannot approve or deny anything because there is no actual application as of today. However, FERC along with other federal, state and local agency staffs have begun reviewing this project. Algonquin has requested the use of...
During our review of the project, we initiated a scoping period. The scoping or comment period ended on October 15, 2013. I’m going to note here that NEPA requires FERC to have a comment period. However, I’m going to note here that NEPA scoping or comment period. Our docket continues to remain open and comments and can continue to be filed with the FERC for further valuation. During our review of the project, we

As I mentioned, the pre-filing process allows for extra public input opportunities earlier on in Algonquin’s development of an application. On September 13th FERC issued a notice of intent, or NOI, to prepare an EIS for this project and initiated a scoping period. The scoping or comment period ended on October 15, 2013. I’m going to note here that NEPA requires FERC to have a comment period. However, the Commission’s pre-filing process allows FERC to continue to accept comments beyond the end of that period. Our docket continues to remain open and comments and can continue to be filed with the FERC for further valuation.

We will assemble information from a variety of sources, including Algonquin, the public, other state, federal and local agencies, and our own independent analysis and field work. This will include an examination of the proposed facility locations as well as alternative sites. We will assess the project’s effects on water bodies and wetlands, vegetation and wildlife, endangered species, cultural resources, soil, land use, air quality, and safety. We will analyze this information. And after an application is filed with FERC, we will prepare and issue a draft environmental impact statement or EIS. This draft EIS will be mailed to our entire mailing list for the project for public comment. During the 45-day comment period on the draft EIS, we will hold more public meetings to gather feedback on our analysis and findings. That’s this second red box on this flow chart, which is your next public input opportunity that FERC will hold. After making any necessary changes or additions to the draft EIS, a final EIS will again be mailed to the entire mailing list. I’m going to note here quickly that the mailing list for this project is quite large and undergoing constant revision. You can be added to our mailing list by providing us with your address and we will ensure that you are on our mailing list. If you have received a notice from us in the past, you are on our mailing list. It is very important that any comments you send, either electronically or by traditional mail, include our internal docket number for the project. As Robert mentioned earlier, that docket number is PF 13-16.

I would like to finish by explaining the roles of the FERC Commission and the FERC environmental staff. Up to five member Commissioners are responsible for making a determination on whether to issue a certificate of public convenience and necessity to the applicant for a specific project. In this case that is Algonquin for the AIM project. The EIS prepared by the FERC environmental staff, which I am a part of, describes the project facilities and associated environmental impacts, alternatives to the project, mitigation to avoid or reduce impacts, and conclusions and/or recommendations. The EIS is not a decision document. I’m going to say that one again. The EIS is not a decision document. It is being prepared to disclose to the public and to the Commission the environmental impact of constructing and operating the proposed project. When it is completed, the Commissioners will consider the environmental information in the EIS along with nonenvironmental issues, such as engineering, market and rates, in making its decision whether to approve or deny Algonquin’s request for a certificate. There is no review of FERC’s decision by the President or Congress, which maintains FERC independence as a regulatory agency and provides for fair and unbiased decisions. Thank you.

MR. SHEA: Thank you very much, Ms. Suter. I note that Algonquin has placed a very detailed series of maps and diagrams out there. I’ll call on Algonquin to make a presentation at this time.

MR. LUSKAY: Thank you, Robert. Good evening. My name is James Luskay. I’m the regional project director for Algonquin Gas, Spectra Energy.
I'm very pleased to be here. Thank you for the opportunity to address you this evening. Spectra Energy, Algonquin Gas has served customers and communities in North America for more than a century. The company develops and operates natural gas, liquid and crude oil pipelines. Additionally, the company gathers and processes natural gas, stores it and distributes it. Spectra Energy’s assets include Algonquin Gas Transmission, LLC or Algonquin, which is an interstate pipeline system which has been transporting up to 2.44 billion cubic feet per day of natural gas from major supply basins into New Jersey, New York and New England. The Algonquin system includes 1,120 miles of various size pipelines extending from Lambertville, New Jersey to New York, Connecticut, Rhode Island and Massachusetts. The system includes main lines, laterals and 35 miles of offshore pipeline from Weymouth to Beverly, Massachusetts, referred to as hub line. The Algonquin system interconnects with Spectra Energy’s Texas Eastern Transmission System in Lambertville, New Jersey, and with the Maritimes and Northeast pipeline, a majority owned by Spectra Energy Corporation in Beverly, Massachusetts. We also connect with the interstate pipeline infrastructure that allows us access to all major North American natural gas supply sources. By regulation, Algonquin is an open-access pipeline that must transport natural gas on a nondiscriminatory basis.

A little about the purpose and need for this project. As Robert has mentioned, currently Algonquin is participating in the Federal Energy Regulatory Commission or FERC’s pre-filing process for a proposed expansion called the Algonquin Incremental Market Project or AIM project. The AIM project will expand Algonquin’s existing pipeline system in order to transport an additional 342,000 decathems per day of natural gas from an interconnect at Ramapo, New York into the Northeast. The increased capacity offered by the AIM project will allow abundant domestically produced natural gas supplies to flow reliably into Northeast markets. These secure, cost-effective supplies will help meet the region’s current demand as well as future growth for clean-burning natural gas. Investment in new natural gas pipeline infrastructure, such as the AIM project, will lead to savings in energy costs. A report by the Concentric Energy Advisors concludes that the direct benefit of the New England infrastructure is estimated to range from approximately $243 to $313 million in annual cost savings. Open seasons were held in September through November of 2012 and in June of this year. An open season is a process where potential customers express interest in participating in pipeline expansion projects that will provide them with access to pipeline capacity. How much they request is based on their projected needs. The accumulation of all of the participating customer requirements is what determines the scope of the project and what facilities need to be built to serve their demand.

As the development of the project evolves, the volumes committed to by the customer and the resulting scope does change. Currently our scope, as previously mentioned, is 343,000 decathems per day. We have executed precedent agreements with the following Massachusetts local distribution companies: Northeast Utilities, which includes Yankee Gas Service in Connecticut as well as NSTAR Gas Company in New York; National Grid, which includes Narraganset, Colonial and Boston Gas; NiSource, which includes Bay State Gas Company and Middleborough Gas.

About our project schedule. In February and March of this year, we began contacting landowners and federal and state and local officials to begin to introduce the project and to start to gather feedback on proposed facilities and locations. With FERC’s approval, we began the pre-filing process in June. As part of the FERC process, agencies such as the Massachusetts Siting Board are involved in the review of the project as a participating agency. As part of the Massachusetts Energy Facilities Siting Board’s due diligence, they have requested this meeting this evening. From April to October there have been approximately 30 landowner informational meetings, open houses and FERC scoping meetings in New York, Connecticut, Rhode Island and Massachusetts. This is the fourth such meeting held in this area.
route is beginning, including opportunities to minimize impacts to the area. One area of attention is proposed in-street construction and subsequent traffic control.

Measures will be taken to develop sequence of construction activities and traffic management plans to minimize traffic and business interference to the extent feasible. This work is similar to recent successful projects such as the 2009 expansion of Algonquin’s J system in Somerville and Medford, Massachusetts as well as a recently completed project in New Jersey and New York. Preliminary planning discussions have already begun with Mass. DOT and the public works departments of Westwood, Dedham and Boston.

Blasting is another area of special attention, both for the construction of the new line and the meter station as well as ensuring the design accommodates the ongoing quarry blasting. Should blasting be necessary to install the proposed facilities, shots will be designed to minimize vibrations beyond the work area. Pre- and post-survey structure surveys will also be conducted as part of the blasting plan. A blasting specialty consultant will be engaged to evaluate the blasting activities at the quarry, and the information will be incorporated into the safe design of the pipeline and the meter station. Should contaminated soil or water be encountered during construction, it will be analyzed and characterized in order to be properly handled. Again, the procedures employed will be similar to those utilized in the recent J lateral work in Massachusetts as well as a recent project in New Jersey and New York.

In closing, we wish to thank landowners, public officials, regulatory agencies, including the Massachusetts Energy Facilities Siting Board, and FERC and other interested parties who have offered their guidance and input as we develop the AIM project. We are certain that the information we receive throughout the pre-filing process will help us design, construct and operate a safe, efficient and environmentally responsible expansion of the Algonquin system.

Thank you again for your time.

MR. SHEA: Thank you.

Let me first ask, are there any public meetings provide opportunities for people to learn more about the AIM project, let us know how the proposed facilities may impact them, and discuss how the impacts may be mitigated. We expect to complete the pre-filing process and submit a certificate application to FERC in February of 2014. We hope that FERC will issue a draft environmental impact statement, as has been mentioned, in July 2014 which will include comments received at this public meeting and throughout the scoping period.

We will ask that FERC approve the AIM project by January of 2015. This will allow us to begin construction in the second quarter of 2015. Construction will be scheduled over a two-year period to manage outages and minimize local impacts. We anticipate placing the AIM project fully into service in November of 2016.

A little bit about the project scope.

As the AIM projects move forward, we have revised facilities to align them with the needs of our customers. At this time the overall project we are proposing is to construct approximately 21.7 miles of various segments of main line primarily by removal and replacement or looping of existing lines; also, to construct approximately 15.3 miles of lateral pipeline either by removal, replacement or looping existing lines and expansion that also includes 4.8 miles of new 16-inch and 24-inch pipeline lateral.

We propose to add six new compressor units for a total of 72,240 additional horsepower at five existing Algonquin compressor stations, construct three new meter stations, and modify existing meter stations.

More specifically here in Massachusetts, we propose to construct 4.8 miles of new 16- and 24-inch-diameter lateral pipeline from Westwood to West Roxbury, Massachusetts; construct a new meter station in West Roxbury, Massachusetts; construct a new meter station in Assonet, Massachusetts; and make modifications to existing meter stations.

For the design and construction for the West Roxbury lateral, there are a few areas that have been recognized as requiring specific attention which have been raised at previous meetings through the FERC scoping comments and during our evaluation of the proposed route. The preliminary survey work is complete, and a more detailed evaluation of the

FARMER ARSENAULT BROCK LLC
22
officials who are here tonight who would like to
speak? No. Then let me take a look at the sign-up
sheet. The first person who signed up is Sanford
Matathia.

MR. MATATHIA: Thank you, Robert. My
name is Sanford, S a n f o r d, Matathia, M a t a t
h i a. I'm counsel at Rackemann Sawyer and Brewster
in Boston and representing National Amusements in
connection with their Legacy Place Showcase Cinema
and lifestyle retail center just on the other side
of Route 1 from here.

I would like to offer a handful of
comments tonight. I do not have prepared remarks,
so excuse me for that. However, I do have an
outline of bullet points which I can pass out to the
head table here and whoever else might care to have
one.

MR. SHEA: Thank you very much.

MR. MATATHIA: My first comment is
procedural. And I'll follow it with a couple of
substantive remarks or remarks on substantive
issues. The procedural issue is the observation
that this project is subject to environmental review
both at the federal level under NEPA, which has
already been described to you, as well as at the
state level, under MEPA, which has not yet been
mentioned. The thought here is that these two
processes at the federal and the state level come
together and be dovetailed and coordinated.

The suggestion is that the Facilities
Siting Board's comments which are being elicited
here tonight and which will be delivered to FERC
await and incorporate the comments which will be
given by the public, including state agencies, to
the MEPA unit in the environmental affairs office of
the Commonwealth and that those all get folded in
and passed through. The mechanism, if you will, to
enable that coordinated process to happen would be
to extend the deadline for comment here to the
Siting Board so that those comments are open until
the conclusion of the MEPA process on the ENF.

The further observation is that in
documents filed with FERC that the proponent has
indicated that they are filing the project with MEPA
in November. I don't believe that has happened as
yet. Assuming they do so in December, the comment
period would run through 20 days thereafter. We can
leave the procedural point there.

23
As for substance, the observation on
behalf of National Amusements and Legacy Place is
that a key impact of this project, however temporary
it may be, is with respect to traffic and roadway
congestion. The identity of issues of concern by
FERC to date in the NEPA environmental review
process does not yet include traffic, per se. There
was a list that was ticked off earlier this evening.
It did not include traffic. I do note that the
proponent's representative did identify that issue
or that concern as being voiced previously, and duly
noted. However, it is customary for NEPA as well as
MEPA to include traffic impact analysis in the
environmental review as a major area of impact and
concern. And I have outlined in the bullet-style
presentation handout a number of datapoints that we
believe must be brought to bear in order to see that
issue clearly and to deal with it effectively.

Those include getting average annual
daily traffic on Route 1 and connecting roadways;
getting monthly variations off of the average
annual; getting hourly variations, which fluctuate
wildly on Route 1 commensurate with commuter traffic
and retail traffic, consumer traffic and other
traffic, as well as looking at major intersecting
roads and turning movements on and off those roads,
all of which will be affected by construction in the
roadway.

The basic idea of collecting this
information is to analyze it and to identify the
severity and duration of traffic effects owing to
the construction of the project at different times
of the year and different times of the day, and to
identify those periods, those time periods both
seasonally and daily where construction will cause
the least possible traffic impact. That data and
that study and that analysis will enable the project
proponent to be well informed in the agency's
reviewing and guiding the project to effectively
point up the types of mitigation that would be
appropriate in order to minimize or avoid these type
effects.

Examples of what I’m talking about would
include the avoidance of construction during heavy
traffic congestion periods such as summer holiday
weekends, early school startup period and the
Thanksgiving period as well; to limit construction
to predominantly nighttime hours and to avoid lane
<table>
<thead>
<tr>
<th>Page 26</th>
<th>Page 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 closures during daytime hours, and to selectively</td>
<td>1 address the comments especially about extending the</td>
</tr>
<tr>
<td>2 use horizontal drilling across major driveways in</td>
<td>2 comment period? You don't have to address it.</td>
</tr>
<tr>
<td>3 order to avoid impeding traffic flow as well as</td>
<td>3 MS. SUTER: I can address what I can,</td>
</tr>
<tr>
<td>4 detailed -- traffic detail officers and other</td>
<td>4 but this is your comment period he was taking about.</td>
</tr>
<tr>
<td>5 customary traffic management measures.</td>
<td>5 MR. SHEA: But our comment period is set</td>
</tr>
<tr>
<td>6 One other point here is that traffic</td>
<td>6 on FERC's comment period. We require all comments</td>
</tr>
<tr>
<td>7 impacts can easily become exacerbated and multiplied</td>
<td>7 to be in by the 9th of December in order that we can</td>
</tr>
<tr>
<td>8 in the event that construction in these roadways</td>
<td>8 get them to FERC, so that we can summarize them and</td>
</tr>
<tr>
<td>9 proceeds with interruption or impediment or</td>
<td>9 get them to FERC by the 13th, and that's a FERC</td>
</tr>
<tr>
<td>10 encumbrance. One of the primary examples of this</td>
<td>10 deadline. We are working within the FERC framework.</td>
</tr>
<tr>
<td>11 which showed itself in connection with the Central</td>
<td>11 Mr. Luskay, do you want to address any</td>
</tr>
<tr>
<td>12 Artery project and also with the Legacy Place</td>
<td>12 of the issues that Mr. Matathia raised?</td>
</tr>
<tr>
<td>13 project is due to hazardous materials that</td>
<td>13 MR. LUSKAY: I'll not address but I</td>
</tr>
<tr>
<td>14 unfortunately dot the landscape in this vicinity due</td>
<td>14 appreciate the comments. I think that they are very</td>
</tr>
<tr>
<td>15 to historic activities.</td>
<td>15 important. Some of them we have heard before,</td>
</tr>
<tr>
<td>16 The resource reports that were filed by</td>
<td>16 certainly on traffic mitigation. That is a major</td>
</tr>
<tr>
<td>17 the project proponent indicate a whole cluster of</td>
<td>17 item that we need to focus on. We look forward to</td>
</tr>
<tr>
<td>18 contaminated sites along Elm Street and Route 1 as</td>
<td>18 working with your client and addressing what is</td>
</tr>
<tr>
<td>19 well as elsewhere. The potential for that</td>
<td>19 going to be least disruptive to business in that</td>
</tr>
<tr>
<td>20 contamination to bleed into the public right-of-way</td>
<td>20 area and also on contaminated materials. That is</td>
</tr>
<tr>
<td>21 is present. Some detail evaluation of that issue</td>
<td>21 something we do have extensive experience with, as I</td>
</tr>
<tr>
<td>22 needs to be made. It is not unusual to have that</td>
<td>22 mentioned in our J system expansion as well as our</td>
</tr>
<tr>
<td>23 evaluation be actual testing of sites along the</td>
<td>23 work recently done in New Jersey and New York. It</td>
</tr>
<tr>
<td>24 right-of-way; and with the benefit of the data</td>
<td>24 is something that unfortunately we do encounter</td>
</tr>
<tr>
<td></td>
<td>27</td>
</tr>
<tr>
<td>1 coming from that testing, to characterize the</td>
<td>28</td>
</tr>
<tr>
<td>2 right-of-way and actually to preclear it in advance</td>
<td>29</td>
</tr>
<tr>
<td>3 of construction for the pipeline itself so that when</td>
<td>30 quite often and do have to mitigate. Those are</td>
</tr>
<tr>
<td>4 you're laying the pipeline it can go smoothly and</td>
<td>31 going to be on the forefront as we move forward in</td>
</tr>
<tr>
<td>5 not be hung up, if you will, or bogged down by the</td>
<td>32 planning the project. Thank you for your comment.</td>
</tr>
<tr>
<td>6 presence of contamination, which itself is a</td>
<td>33 MS. SUTER: Just in response, although I</td>
</tr>
<tr>
<td>7 juggernaut sometimes to deal with. And obviously</td>
<td>34 didn't mention it the environmental impact statement</td>
</tr>
<tr>
<td>8 when, and when hazardous waste cleanup proceeds</td>
<td>35 or EIS will include a traffic analysis. We include</td>
</tr>
<tr>
<td>9 along the right-of-way that that in and of itself is</td>
<td>36 it as part of a socioeconomic analysis, that section</td>
</tr>
<tr>
<td>10 a construction activity and it too needs traffic</td>
<td>37 of the document. So there are a lot of areas,</td>
</tr>
<tr>
<td>11 mitigation along the lines that I previously</td>
<td>38 resource areas that will be addressed. That list</td>
</tr>
<tr>
<td>12 outlined.</td>
<td>39 that I mentioned was not an exhaustive list of</td>
</tr>
<tr>
<td>13 One last comment is that we think it is</td>
<td>40 everything. We address all comments that are</td>
</tr>
<tr>
<td>14 still appropriate, particularly at the early stage</td>
<td>41 brought up as part of our scoping analysis. So we</td>
</tr>
<tr>
<td>15 of project planning, to look at alternative</td>
<td>42 will address traffic.</td>
</tr>
<tr>
<td>16 alignments and to the extent there are routes that</td>
<td>43 MR. SHEA: Thank you, Ms. Suter.</td>
</tr>
<tr>
<td>17 avoid these issues and perhaps are not in</td>
<td>44 Mr. Matathia, do you have anything else</td>
</tr>
<tr>
<td>18 rights-of-way but instead are cross-country that</td>
<td>45 to add?</td>
</tr>
<tr>
<td>19 that should be considered.</td>
<td>46 MR. MATATHIA: The resource report filed</td>
</tr>
<tr>
<td>20 I appreciate your time and attention. I</td>
<td>47 by the proponent indicates that they do not expect</td>
</tr>
<tr>
<td>21 hope these comments are helpful and will be happy to</td>
<td>48 significant traffic impacts in connection with the</td>
</tr>
<tr>
<td>22 follow up as you might wish. Thank you.</td>
<td>49 project. I was wondering whether or not you would</td>
</tr>
<tr>
<td>23 MR. SHEA: Let me ask in response to</td>
<td>50 take that at face value or whether or not you would</td>
</tr>
<tr>
<td>24 Mr. Matathia's comment, Ms. Suter, do you want to</td>
<td>51 proceed with an analysis.</td>
</tr>
<tr>
<td></td>
<td>52 MS. SUTER: So right now, as we</td>
</tr>
<tr>
<td></td>
<td>53 mentioned with the pre-filing process, what the</td>
</tr>
</tbody>
</table>
### Colonial Gas Company d/b/a National Grid

**Boston Gas Company and**

**Attachment RR-DPU-2**

**D.P.U. 13-157**

**Page 9 of 24**

> I've made a sketch of it here -- in the 24 don't know if anybody has noticed these temporary repairs. I've noticed just recently, I and they are busting up the sidewalks and they do 21 in West Roxbury there's a lot of projects going on 20 and through Dedham, A couple of things. Driving around West 18 which I do every day, and through Dedham, which I do every day, and through Dedham, a little more lively than this group. MR. GOODE: You will enjoy that. It is 16 MR. LUSKAY: Yes, I am. MR. GOODE: You will enjoy that. It is a little more lively than this group. A couple of things. Driving around West Roxbury, which I do every day, and through Dedham, in West Roxbury there's a lot of projects going on and they are busting up the sidewalks and they do temporary repairs. I've noticed just recently, I don't know if anybody has noticed these temporary repairs -- I've made a sketch of it here -- in the property line.

### MR. LUSKAY

- That is correct. We do a preconstruction and post-construction noise survey, and we are required to meet noise requirements at the property line.

### MR. GOODE

- I went to the last meeting. I had a few other things to say.
- MS. SHAPIRO: I believe in the resource report there is an indication that you are going to do a noise analysis; is that correct?
MS. SHAPIRO: Could you explain a little more to Mr. Goode what a meter station is in that area, what decibels are associated with the size, if you know, or give some approximation?

MR. LUSKAY: Our requirement is 55 decibels at the property line we are required to meet. That would be the maximum noise at the edge of the property.

MS. SUTER: I'm going to jump in just quick. It is not the property line but at the noise sensitive area, at the home. But the regulation that FERC has, this is a FERC regulation that he's talking about, that applies to compressor stations unless Algonquin chooses or elects to have it apply to meter stations as well. However, we evaluate what the noise impact is at meter stations as well and we evaluate whether or not that noise level would be significant at the meter station. We've seen varying levels. We've seen locations where it is not audible at all. We have seen ones where it is audible and we have asked for recommended mitigation measures based on the projected noise levels. So you guys will do the noise analysis, which they have identified they are going to do a noise analysis. We'll take a look at that to see whether or not we believe mitigation is necessary, recognizing the residential nature of the location. In some cases it is the middle of cornfields and it is not necessary to add extra.

MR. GOODE: That's good to know it can be mitigated somehow. That's good. We talked about traffic.

The last thing. I know at the last meeting it was mentioned that there's a lot of rock blasting. West Roxbury Crushed Stone is also doing blasting. Does any of that get coordinated?

MR. LUSKAY: As far as coordinating with the quarry?

MR. GOODE: You are blasting down the street on Grove Street. Are you going to blast together?

MR. LUSKAY: We wouldn't want shots occurring at the same time. It seems to me we could coordinate so that we don't have shots going off at the same time.

MR. GOODE: Do you happen to know off the top of your head, the meter station that they are going to construct around West Roxbury Crushed Stone, is it on their property, on the street, is it way back?

MR. LUSKAY: It is set back and in a parcel is opposite the quarry in a vacant parcel.

MR. GOODE: I think that's about it. I look forward to seeing you at the meeting.

MR. LUSKAY: I look forward to it as well.

MR. SHEA: Thank you, Mr. Goode.

No one else has signed the speaker sign-up sheet as of the time I grabbed it. Anybody else that wants to speak? Please come up and take the podium.

MR. PROVIDAKES: George Providakes, Providakes, West Roxbury, 9 Mallkuar Road.

Several questions or observations as well. First, thanks for your comments regarding the Legacy Place issues and concerns. I would observe that commercial needs and residential needs are different. So in the commercial space, if you want to do the work at night, that's cool with me. In the residential space, I would rather you didn't because I want to sleep at night. So a heads-up on that and how you balance that.

The issue of traffic. I know that when I first came to West Roxbury, Center Street was not a very good street. And every time that darn gravel truck would go down Center Street it was so noisy that when I worked around my house I had to have ear protectors on. It was deafening. When they redid the street, that problem went away or they got better shock absorbers on the trucks. If you again come in and dig up the road and it is like that for how many months, it can be deafening as well. I would like attention paid to that.

The other thing is that Algonquin or whoever is going to provide information to FERC. FERC is going to look at it. If they have questions, they may ask questions. In turn they are going to get -- if they notice something they will bring it up. It strikes me that it would be prudent to check with other people who have gone through this in the area, like Legacy Place, and get their experience during the construction recently so that you actually have data to compare against what is being proposed or you may have sitting in a file.
MR. SHEA: Thank you so much for your question, Mr. Providakes. It was not entirely clear to me in the discussions. So what was planned. Therefore if the approved values are not met, they will go back and fix that. That was not entirely clear to me in the discussions. I think those cover most of the areas that caught my attention this time. Thank you. MR. SHEA: Thank you, Mr. Providakes. Anyone else who would like to speak? Please come up and take the podium. MR. PREVITERA: My name is Joe Previtera. I live at 16 Dean Street in Westwood. I’m chairman of the Westwood Conservation Commission. Barbara, you’re off the hook. Maybe it is more for counsel for Algonquin. Will you folks be filing NOIs with the local Conservation Commissions for this project? MR. TYRRELL: Mike Tyrrell with Spectra Energy. We are only required to file if we are in effect crossing resource areas. Right now we have completed our surveys. It looks like we will, based on some work at the golf course, be required to file with the Commission for that activity. That’s the only location where we will have buffer zone impacts. I believe at the end of the day they will likely have a crossing over a water body. The rest is we also have some buffer zone on impacts in Boston with respect to the meter station location. Beyond that, this is a pretty clean route. We only have I think three jurisdictional areas that we cross on the entire project here on the West Roxbury lateral. So we will, in fact, be filing with the con-com for that buffer zone impact, resource impact. MR. PREVITERA: Your name again? MR. TYRRELL: Mike Tyrrell, T y r r e l l. I. I’m with TRC Environmental for Spectra Energy. MR. PREVITERA: The other thing I had was, Mr. Matathia mentioned some contaminated areas. In reviewing the plans with my agent and with the plans that were shown out front, I did not see those. Are we talking about 21E contamination? MR. TYRRELL: I can address that. MR. PREVITERA: Are there any contaminated areas in Westwood? MR. TYRRELL: No. MR. PREVITERA: One quick thing. One thing we worked out with our DPW director in Westwood is the language -- Maggie, you may want to think about this -- there isn’t a lot you can do about the roadways. But the sidewalks -- and I know; my wife grew up in West Roxbury and we see the same thing in Westwood -- fortunately we are seeing more and more folks in electric wheelchairs able to get around our squares, to get around the villages. What we got with our DPW folks is to replace in kind. What I mean is that the wrong thing to do is to take the concrete sidewalk and then disrupt it and then put in the asphalt that you and I and everyone in this room knows within three months you have a 2-inch ditch to go through. It is a terrible inconvenience to people in the electric wheelchairs. From a sidewalk perspective, Joe, I would advocate for replace in kind. That’s my two cents. Thank you so much. MR. SHEA: Thank you so much for speaking. With respect to a point that was made by the last speaker, can I ask you about the maps -- the next to the last speaker. Is there any way that those can become public documents? I looked at them...
and they are more detailed than anything I've seen before.

MR. TYRRELL: Those are part of the FERC filing that was made. They are part of the public record today. They are part of that package. We can extract those and make them easier to get to. We can create a list if you would like. We would be happy to provide copies.

MS. SUTER: They are available on our website. They are large files and may not be the easiest to access. Any landowner should be able to contact the right-of-way agent. There should have been a phone number to contact Algonquin. You should be able to get the individual map for your location. If not, you also should put the filing and the maps in the public libraries. So there are multiple ways to access all the maps.

MR. PROVIDAKES: How many documents?

MS. SUTER: Quite a few maps.

MR. PROVIDAKES: How do I find it? Is there a search function that I can use?

MS. SUTER: The best way to get your individual one, we put out repeatedly Algonquin's hot line or phone number, an 800 number. You might have a local number for this area. One of you guys might identify what that phone number is. We might have it listed somewhere. You can call that phone number. Someone from Algonquin will contact you back and get you the individual map that you need.

MR. LUSKAY: We will get one printed out for you.

MR. PROVIDAKES: I can handle a big electronic file.

MR. SHEA: Ms. Suter, you did mention that certain things are available in the public domain. Could you talk for a second about how an individual can access the documents on FERC, the online system? I think it is very good but it is not necessarily very simple. There's a little bit of a wrinkle.

MS. SUTER: I understand. So anybody who wants to access information electronically through FERC's website, and anything that FERC issues, any comments that go on, anything that Algonquin files with us, everything goes on our website and is available for you to access. The way to do that is that you go to www.ferc.gov. In there is a tab, Documents and Filings. From there you should see eLibrary. You want to go to that tab and use -- there's a number of preferences. You can do a more advanced search or an entire docket search.

There are a couple of options for how you want to search. Within that you will want to use the docket number PF 13-16. You want to identify an appropriate date range. That's important to get right. I think it may set automatically to the past one or two months. If you want to see something from further back, you may want to set that appropriately. You can see and find anything that has been filed or is available.

There's other options also. There's something -- using that Documents and Filings tab, there is something called eSubscription. Using that you can create an account on FERC's website. You put in PF 13-16, and that means any time anybody files something on this docket, Algonquin, FERC, any agency or landowner will get an email that says so and so just filed something. You can click on a link to go to that. You will get an email any time something has been filed. It is a way to keep up with the information.

MR. PROVIDAKES: I get that email thing. In there there's one that came from Algonquin or Spectra that said we put the maps up here. Or it says we posted our CD of our thing, which is about three-terabyte size. Is there any specificity in that?

MS. SUTER: Our system will only allow you to upload up to a certain file size. Don't ask me what it is. I'm not a tech expert. They will have to break down a large file into components. When you click on the link, it will say there are multiple files on there and you can click a button on there to see all of the files under that particular filing. You have to start going through them. The maps are probably multiple files. You probably have to go through to get to the appropriate one.

It is not the easiest website to navigate. I have no control over that. This is just some of the options that are available to you. It is all on there and it is all publicly available to you. As we mentioned, it is out there at your local public library. You do have that option for anybody who wants to go there and access it.

MR. SHEA: Thank you very much.
<table>
<thead>
<tr>
<th>Page 46</th>
<th>Page 48</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>appreciate that. Let me ask now, is there anyone else who would like to speak? Mr. Goode?</td>
<td>EIS. We will marry those two documents together so that we don't have one document covering federal and one for state. The will run closely in parallel in the event we are required to submit an EIR with MEPA. That has already been discussed as well.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>MR. GOODE: I was curious if there was anybody from the local press here tonight? I don't know if they are invited. They always like to make sure that they are here.</td>
<td>MR. TYRRELL: Correct. By the time we formally file with FERC at the end of February, we will have been through the ENF stage with MEPA, and the determination of whether an EIR is required will be completed at that time, if an EIR is required.</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MR. SHEA: Someone from the local press was here when FERC had its meeting on October 3rd. But I don't know if anyone is here.</td>
<td>MR. TYRRELL: I think there is plenty of time there in order for the Secretary to issue the scope on the EIR at the end of the ENF period once we file. The FERC has got until the end of June or July before the EIS ever hits the street, so that's five months. The period in between in which any of the others might be looking at something is plenty of time.</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>MR. PREVITERA: Are they invited?</td>
<td>MR. MATATHIA: Both processes have similar steps almost identical. They initiate with a scope for filing which then determines whether or not an EIR or EIS is required, and the scope for that. And then the draft EIR -- file the EIS.</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>MR. SHEA: The notifications go out to abutters and to town and city officials, not specifically to members of the press unless they request to be invited.</td>
<td>What I'm asking is whether or not the state and federal processes will be in parallel or whether or not one is going to be stepping out ahead of the other, and to the extent the second one is</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>MR. MATATHIA: One final question. In order to inform the first procedural point that I had made in my remarks, I was wondering if the proponent can identify when they plan to file with MEPA so that you would know what the extension of your comment period through that proceeding would be.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>MR. TYRRELL: We are actively working on the ENF now. We are trying to marry up the ENF with our formal application being filed with FERC in February. We anticipate early for the ENF filing with MEPA.</td>
<td>MR. TYRRELL: I think that the plan would be that, that MEPA would issue the scope. And if they require an EIR, that scope would become part of the FERC's EIS. So again, we are working towards, for the benefit of everyone involved, a single NEPA/MEPA document.</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>MR. MATATHIA: So the ENF is married with the draft EIR or will it be?</td>
<td>MR. MATATHIA: So the ENF is married with the draft EIR or will it be?</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>MR. PREVITERA: Remember too, I think right now we barely triggered the requirement to file an ENF, given the length and the other statutory requirements. We voluntarily committed to filing an ENF with MEPA. That will march up with FERC's EIS document. We don't anticipate MEPA scoping us for anything beyond ENF at this stage. That's MEPA's decision, not ours. Right know the plan now is to file an ENF in early February. That will run its course and we'll go from there in determining whatever the Secretary decides.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>MR. SHEA: That's MEPA's decision, not ours. Right know the plan now is to file an ENF in early February. That will run its course and we'll go from there in determining whatever the Secretary decides.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>MR. MATATHIA: So the risk is that you do a federal EIR and then thereafter may have to do a state -- excuse me, a federal EIS and thereafter may have to do a state EIR.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>MR. TYRRELL: We have talked to MEPA and been successful at this before. In the event that the Secretary decides we need to prepare an EIR, we will expand FERC's EIS to cover any specific state requirements that aren't otherwise satisfied by that</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>the state-specific requirements, the expectation would be FERC is covering traffic, FERC is covering contamination, FERC is covering other environmental as well.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>MR. TYRRELL: I think that the plan would be that, that MEPA would issue the scope. And if they require an EIR, that scope would become part of the FERC's EIS. So again, we are working towards, for the benefit of everyone involved, a single NEPA/MEPA document.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>MR. MATATHIA: What I'm wondering about is whether the scopes will issue at the same time, assuming both processes are invoked.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>MR. MATATHIA: What I'm wondering about is whether the scopes will issue at the same time, assuming both processes are invoked.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>MR. SHEA: Someone from the local press was here when FERC had its meeting on October 3rd. But I don't know if anyone is here.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>MR. TYRRELL: Correct. By the time we formally file with FERC at the end of February, we will have been through the ENF stage with MEPA, and the determination of whether an EIR is required will be completed at that time, if an EIR is required.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>MR. TYRRELL: I think there is plenty of time there in order for the Secretary to issue the scope on the EIR at the end of the ENF period once we file. The FERC has got until the end of June or July before the EIS ever hits the street, so that's five months. The period in between in which any of the others might be looking at something is plenty of time.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>MR. PREVITERA: Remember too, I think right now we barely triggered the requirement to file an ENF, given the length and the other statutory requirements. We voluntarily committed to filing an ENF with MEPA. That will march up with FERC's EIS document. We don't anticipate MEPA scoping us for anything beyond ENF at this stage. That's MEPA's decision, not ours. Right know the plan now is to file an ENF in early February. That will run its course and we'll go from there in determining whatever the Secretary decides.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>MR. MATATHIA: So the risk is that you do a federal EIR and then thereafter may have to do a state -- excuse me, a federal EIS and thereafter may have to do a state EIR.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>MR. TYRRELL: We have talked to MEPA and been successful at this before. In the event that the Secretary decides we need to prepare an EIR, we will expand FERC's EIS to cover any specific state requirements that aren't otherwise satisfied by that</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>the state-specific requirements, the expectation would be FERC is covering traffic, FERC is covering contamination, FERC is covering other environmental as well.</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>MR. MATATHIA: What I'm wondering about is whether the scopes will issue at the same time, assuming both processes are invoked.</td>
<td></td>
</tr>
</tbody>
</table>
triggered it catches up.

MR. TYRRELL: My response is that they will be in parallel. That's the simplest answer.

We have navigated that before. If we have to navigate it, we will keep it in parallel for simplicity's sake.

MR. SHEA: Anyone else?

MR. DOYLE: My name is Ed Doyle, a resident of Dedham, Doyle. My concern is safety after this is constructed. I worked with gas over a long period of time, natural gas. I see these explosions in gas lines in Texas and other parts of the country. I looked at one a couple of months ago. They evacuated people to a mile and a half back from the site of the explosion.

I hope there's going to be an extensive evaluation after the pipeline is in. How soon can you shut that line down? Are we going to have evacuation routes? That road at times is completely covered with traffic for miles. How would you move those cars out of there if you had a leak? How soon could you move people out? How would you get people out of the area?

There is no possibility that you can guarantee a hundred percent that you won't have a leak. You are know that. Is there going to be a probability analysis of the leak? What's the possibilities of a leak? What's your history? A lot of the lines aren't in as heavily a populated area as this is going through in Dedham. The impact on Dedham from a safety point of view is going to be enormous. We have heavy trucks going over that road.

You are going to put the pipe down in. The road goes up and down. I heard your pipe is only 3 feet down. Are we going to fatigue those pipes? What's going to happen in 10 or 20 years? I'm not worried about 20 years from now but younger people are. I think this is a very unsafe thing you are doing in a very populated area. I hope when FERC does a safety analysis and they take that into account.

MR. SHEA: Thank you, Mr. Doyle.

Does anyone else want to speak? Let me just address one issue. As I said before, any comments, any written comments that you would like the Siting Board to consider must be filed with me no later than Monday, December 9th. And my contact information is on a sheet at the back of the room.

We don't have -- the reason that we need to stay to our schedule, and we can't alter it, is that we'll get the comments on Monday, April 9th. The comments have to be filed with the company, Algonquin, and FERC at the same time at the end of that week on the 13th. That's a FERC deadline. As people pointed out, we are still in the pre-filing process. No petition for approval of the project has been filed with FERC. At this point for the comments we are going to be submitting to FERC, we will summarize the comments that are made tonight, certainly. But if anyone wants to add some written comments, we will be happy to read them and see how we can incorporate them into our written comments to FERC. They have to be received by me by Monday, December 9th.

Since there are no other members of the public that wish to speak, I'll conclude. First I would like to thank everyone for coming. I know it is a weekday night. I appreciate your interest in what is going on. I would like to thank the company for making people available for answering questions. I especially thank Ms. Suter for coming up here from Washington, D.C. and my colleagues for coming in from Boston.

If you have any further questions, we'll be around for a few minutes after tonight's hearing. Thank you for attending. The meeting is now adjourned.

(8:24 p.m.)
<table>
<thead>
<tr>
<th>INDEX</th>
<th>54</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MR. SHEA</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>STATEMENTS</td>
</tr>
<tr>
<td>8</td>
<td>MS. SUTER</td>
</tr>
<tr>
<td>9</td>
<td>MR. LUSKAY</td>
</tr>
<tr>
<td>10</td>
<td>MR. MATATHIA</td>
</tr>
<tr>
<td>11</td>
<td>MR. GOODE</td>
</tr>
<tr>
<td>12</td>
<td>MR. PROVIDAKES</td>
</tr>
<tr>
<td>13</td>
<td>MR. PREVITERA</td>
</tr>
<tr>
<td>14</td>
<td>MR. TYRRELL</td>
</tr>
<tr>
<td>15</td>
<td>MR. DOYLE</td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CERTIFICATE</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I, David A. Arsenault, Registered Professional Reporter, and Certified Reporter in the Commonwealth of Massachusetts, #100693, do hereby certify that the foregoing record is a true and accurate transcript of my stenographic notes taken on December 3, 2013 in the above-captioned matter.</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

manager 7:15
manner 9:15
maps 13:19 38:17 20
41:22 42:16 17,19
45:2:14
march 17:9
maritime 15:1
market 2:10 7:16
13:10 15:15
markets 15:23
married 47:3
married 46:23 47:9
48:1
mass 20:13
massachusetts 1:2,7
2:3,14,15,21 3:15
4:3,13 7:19 14:19
14:21 15:3 17:1,15
17:17,23 19:11,14
19:15 16 20:11
21:10,14 55:6
matthia 22:4,5,6,19
28:12 29:15,17
40:16 46:15 47:3,16
48:6,16 49:5,16
54:10
matthias 27:24
materials 26:13 28:20
matter 2:22 55:9
maximum 34:7
mean 41:10
means 9:17,18 44:17
measures 5:20 20:5
26:5 34:22
mechanism 23:13
medford 20:10 38:3
meet 10:2 15:24 33:23
34:7
meeting 8:3,17 17:19
17:24 18:10 31:6,11
33:2 55:11 36:8
46:8 53:3
meetings 9:5 10:6
11:16 17:21 18:11
19:21
member 12:15
members 3:16,16,23
7:9 31:10 46:13
52:16
mention 29:5 43:10
mentioned 9:11 10:10
12:11 15:11 16:23
18:8 23:8 28:22
29:10,24 31:7 35:11
38:9,29 40:16
45:21 48:15
mepa 23:2,11,17,20
24:13 46:19 47:2,9
47:10,20 48:5,8,11
49:11,15
meapas 47:12
met 39:5
meter 2:17 19:9,10,14
19:16,17 20:18 21:4
34:2,15,16,18 36:1
40:5
metering 33:4
microphone 6:17
middle 9:10 35:5
middlebrough 17:7
mile 39:19 40:13
miller 50:14
miles 2:15 14:1,20
18:22 19:14,12
50:20
million 16:8
minimize 18:15 20:2,7
20:21 25:17
minute 6:16
minutes 53:2
mitigate 29:1
mitigated 18:4 35:8
mitigation 5:20 9:1
12:24 25:16 27:11
28:16 34:22 35:3
modifications 19:17
modify 4:15 19:9
monday 6:1 51:22
52:2,15
monthly 24:21
moises 8:3 37:12
41:13 44:9 48:24
50:14
move 18:19 29:2
50:20,22
movements 25:2
multiple 42:17 45:11
45:14
multiplied 26:7

nature 35:4
navigate 33:1 45:18
50:5
navigated 50:4
near 8:3 35:5
necessarily 43:15
necessary 11:21 20:20
35:3,6
necessity 12:18
need 15:10 16:18
28:17 30:17,21 43:5
47:22 51:24
needs 16:15 18:20
26:22 27:10 36:21
36:21
neighborhood 32:17
33:9 38:19
nepa 8:1,15,18 10:17
10:21 22:24 24:6,12
48:14 49:15
new 2:13,16,17 4:2
14:1,15,15,18,18
17:22 19:4,6,12,14
19:16 20:12,17
21:10 21:19,23:3
nice 38:11
night 31:11 36:23
37:1 52:19
nighttime 25:24
nine 3:15
nisourse 17:6
no 10:14
nois 39:17
noise 33:7,8,20,22,23
34:7,10,16,17,22,24
35:2 38:5,24 39:3
noisy 33:16 37:6
nondiscriminatory 15:9
nonenvironmental 13:9
north 14:4 15:6
northeast 15:2,19,22
17:2
note 10:17 11:24
note 17:3 24:9 32:18
nos 33:6
noted 24:12 32:8
notes 55:8
notice 10:13 12:6
37:18
noticed 31:6,22,23
32:15
notifications 46:11
november 16:10
18:17 23:21

nstar 17:4
number 2:3 12:10,12
24:16 42:13,24,24
43:1,24 44:2,6

O

o 22:6 36:17 50:9
observation 22:22
23:18 24:1
observations 36:18
observe 36:20
obviously 27:7 33:12
occurring 35:21
october 10:16 17:20
46:8
offer 22:12
offered 15:20 21:15
office 7:17 23:11
officer 1:14 2:20
officers 26:4
officials 6:22 17:10
21:13,22,14 46:12
36:14 20:2
oil 8:8 14:6
once 48:21
ones 43:20
ongoing 20:19
onlines 43:14
open 10:5,22 16:9,11
22:17 23:26
openness 15:7
opening 3:8 32:8
operate 21:19
operates 14:5
operating 13:6 14:12
opportunities 10:11
18:1 20:1
opportunity 10:9
11:19 14:2
opposed 39:3 49:7
opposite 36:6
option 45:22
options 44:4 45:19
order 6:2,24 15:17
21:7 24:17 25:17
26:3 28:7 46:16
48:20
outages 18:15
overview 22:15
outlined 24:15 27:12
overall 18:21
owing 25:7
owned 15:2

P

p 1:8 2:1,7 36:16 53:5

FARMER ARSENAULT BROCK LLC

22 54:10
24 33:11,13 53:5
240 19:7
243 16:7
24inch 19:4 38:13
24inchdiameter 19:13
26inch 33:13
28 9:13
2inch 41:14

3 1:8 19:1 51:10 55:9
30 17:21 31:12
31 54:11
313 16:7
342 15:17
343 16:23
35 14:20 31:12
36 54:12
39 54:13,14
3rd 46:8

4 2:15 19:4,12
44 14:13
440 1:24
45day 11:15

5 50 1:23 54:15
55 1:7 34:5

6 60 14:12
617 1:24

7 7 1:8 2:1 18:22 33:11
54:8
72 19:7
728 1:24

8 8 19:4,12 53:5
800 42:24

9 9 2:15 6:1 36:17
90 32:3
9th 28:7 51:22 52:3,15
Exhibit 4 to West Roxbury Motion for Rehearing: Senator Markey Study
America Pays for Gas Leaks

Natural Gas Pipeline Leaks Cost Consumers Billions

A report prepared for Sen. Edward J. Markey

Released: July X, 2013
This page intentionally left blank
American consumers are paying billions of dollars for natural gas that never reaches their homes, but instead leaks from aging distribution pipelines, contributing to climate change, threatening public health, and sometimes causing explosions. This report, which was prepared at the request of Sen. Edward J. Markey (D-MA), draws on data from a variety of sources to assess the impact of leaks and other “lost and unaccounted for” natural gas, using Massachusetts as a case study.

Gas distribution companies in 2011 reported releasing 69 billion cubic feet of natural gas to the atmosphere, almost enough to meet the state of Maine’s gas needs for a year and equal to the annual carbon dioxide emissions of about six million automobiles. Nonetheless, last year these companies replaced just 3 percent of their distribution mains made of cast iron or bare steel, which leak 18 times more gas than plastic pipes and 57 times more gas than protected steel. Gas companies have little incentive to replace these leaky pipes, which span about 91,000 miles across 46 states, because they are able to pass along the cost of lost gas to consumers. Nationally, consumers paid at least $20 billion from 2000-2011 for gas that was unaccounted for and never used, according to analysis performed for this report.

Natural gas has been touted as a cleaner alternative to coal for producing electricity, but its environmental benefits cannot be fully realized so long as distribution pipelines are leaking such enormous quantities of gas, which is primarily comprised of methane, a greenhouse gas that is at least 21 times more potent than carbon dioxide. Americans also remain at risk from gas explosions and other safety hazards caused by leaky natural gas pipelines. From 2002 to 2012, almost 800 significant incidents on gas distribution pipelines, including several hundred explosions, killed 116 people, injured 465 others, and caused more than $800 million in property damage.

---

1 The House Natural Resources Committee Democratic staff prepared the report at the request of Sen. Markey when he was serving as the senior ranking Democrat on the committee.
3 Distribution mains are a common gas source for multiple customers. Individual customers receive gas via service lines. In 2012, gas companies replaced 12 percent of their leak-prone service lines, according to PHMSA data.
5 Based on unaccounted for gas reported to EIA, multiplied by the average city gate price, and adjusted for inflation. An EIA official recommended we use the average city gate price because it reflects the price the distribution company paid for the gas from the transmission company.
7 There were 257 explosions from Mar. 2004 - Dec. 2012, according to data from PHMSA. PHMSA data before Feb. 2004 does not indicate whether significant incidents involved explosions. There were 191 significant incidents from Jan 2002 - Feb. 2004.
Gov. Deval Patrick’s administration has started to address this problem in Massachusetts, which is a nationally recognized leader among states in energy efficiency and reducing greenhouse gas emissions. In particular, the commonwealth’s Department of Public Utilities (DPU) recently launched incentive programs to encourage gas companies to replace leak-prone pipelines and operate more efficiently. The incentive programs are needed because gas companies in Massachusetts own and operate one of America’s oldest natural gas pipeline distribution systems, ranking sixth among state systems in the number of miles of main distribution pipelines made of cast iron or bare steel. These companies have replaced less than 4 percent of their leak-prone pipes per year while billing Massachusetts ratepayers an estimated $640 million to $1.5 billion from 2000-2011 for unaccounted for gas (see Table 3 on page 7).

The problem of leaky gas pipelines may be even worse than the data presented in this report suggests. Indeed, companies frequently report negative volumes of unaccounted for gas to various agencies—even though it’s physically impossible to dispose of more gas than enters a closed system. Federal and state regulators explained in interviews for this report that there isn’t a consistent methodology for calculating lost and unaccounted for gas, and data quality problems are common. The Massachusetts DPU has responded by requesting additional funds in its 2014 budget to hire a third-party consultant to review companies’ procedures for classifying leaks and calculating lost and unaccounted for gas.

Last year, 24.5 trillion cubic feet of natural gas was produced in the United States, up 4 trillion cubic feet since 2007. Sales of natural gas from federal lands were about 18 percent (4.3 tcf) of total U.S. sales in fiscal year 2012, including 3 trillion cubic feet produced onshore and 1.3 trillion cubic feet produced offshore.

---


trillion cubic feet produced offshore.14 Additionally, about 28 percent (85 tcf of 305 tcf) of U.S. proved reserves of dry natural gas are located on federal lands.15 Fixing leaky pipelines is important in making sure these newly abundant natural gas resources are put to responsible use and fully benefit the American people.

To address the problems identified in this report, Sen. Markey is drafting legislation that will push states and non-regulated utilities to accelerate replacement of high-risk, leaky pipelines and curtail the practice of passing along the costs of lost gas to consumers. The following section of the report uses Massachusetts as a case study to show why this legislation is necessary.

---

The price of leaked gas

By not replacing leaking pipelines, gas companies nationwide are charging ratepayers for gas that never reaches homes and is contributing to climate change, endangering public health,16 and risking explosions and other safety hazards. The problem is particularly acute in Massachusetts because of the advanced age of the commonwealth’s distribution system. Specifically, the data show:

- **Massachusetts ratepayers paid between $640 million to $1.5 billion from 2000-2011 for gas that never reached their homes and businesses.** At least 99 billion cubic feet of natural gas was “lost and unaccounted for” in Massachusetts from 2000-2011, according to data reported by utilities to the Massachusetts Department of Public Utilities (DPU). The cost of this unaccounted for gas—$640 million to $1.5 billion, according to calculations performed for this report17—was passed on to the commonwealth’s approximately 1.5 million residential, commercial and other customers (see Table 3 on page 7).18

Three companies, Boston Gas, Colonial Gas, and Nstar Gas, accounted for 80 percent of these passed-on costs from 2000-2011. As a group, Boston Gas customers paid the most, covering an estimated $352 to $781 million in unaccounted for gas costs, followed by Nstar Gas customers at $109 to $229 million, and Colonial Gas customers at $92 to $221 million. On a per customer basis, Westfield Gas & Electric customers paid the most (about $304 to $2,426 per customer) because of the company’s small customer base relative to its unaccounted for gas levels. Boston Gas, New England Gas, Nstar Gas and Essex Gas customers each paid over $370 to $875 on average in lost and unaccounted for gas costs from 2000-2011.

Table 2: Massachusetts Unaccounted for Gas, Emissions, and Significant Incidents on Natural Gas Systems

<table>
<thead>
<tr>
<th>Total Unaccounted for Gas from Massachusetts Natural Gas Distribution Systems from 2000-2011*</th>
<th>99 - 227 billion cubic feet of natural gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Reported Emissions from Massachusetts Natural Gas Distribution Systems from 2010 - 2011b</td>
<td>Equivalent to releasing between about 1 million and 1.3 million metric tons of CO₂</td>
</tr>
<tr>
<td>Significant Incidents on Massachusetts Natural Gas Distribution Systems from 2002-2012c</td>
<td>23 incidents / 24 injuries / $9,492,677 in property damage</td>
</tr>
</tbody>
</table>

* Source: Staff analysis of DPU Annual Reports. See notes under Table 3 on page 7 for our methodology. This value may not align with the national value provided in Table 1, because how companies calculate and report unaccounted for gas varies across states and agencies (see Table 1 on page 17).

b Source: Staff analysis of EIA data, Massachusetts Department of Environmental Protection (DEP) data, and U.S. Environmental Protection Agency emissions data, summarized in Table 4 on page 13. Unit conversions were performed using EPA’s methane conversion tool at [http://www.epa.gov/energy/methaneconversion/](http://www.epa.gov/energy/methaneconversion/).

c Source: PHMSA data, summarized in Table 5 on page 14.

---


17 See the notes under Table 3 on page 7 for information on our methodology.

18 The average number of customers as reported to the U.S. Energy Information Administration (EIA) for 2000-2011. The number of customers reported to EIA in 2011 was about 1.4 million.
Lost natural gas accounts for at least 45 percent of Massachusetts’ methane emissions for large, stationary facilities. Utilities serving Massachusetts reported releasing between 1.1 and 1.4 billion cubic feet of gas into the atmosphere in 2011, accounting for between 45 and 58 percent of the commonwealth’s methane emissions for large, stationary facilities, as reported to the Massachusetts Greenhouse Gas Registry (see Table 4 on page 13).

The three companies reporting the greatest emissions (Boston Gas, Nstar Gas, and Columbia Gas) were also the three companies that had the most leak-prone pipes in their distribution systems, as of 2012 (see Table 4 on page 13). In addition, researchers from Boston University and Duke University recently measured methane levels over 785 miles of Boston roads and found 3,356 leaks likely due to natural gas distribution pipelines.

State law requires Massachusetts to reduce greenhouse gas emissions to 25 percent below 1990 levels by 2020. Addressing gas leaks is especially important in meeting this goal because methane is such a potent heat-trapping gas, with at least 21 times the warming potential of carbon dioxide over a 100-year time horizon and as much as 72 times the warming potential over a 20-year horizon. By 2010, Massachusetts had already succeeded in reducing methane emissions from the natural gas distribution system by 14 percent below 1990 levels.

However, greater reductions are still possible by accelerating replacement of leaky pipes. Natural gas companies could reduce their emissions in Massachusetts to 25 percent below 1990 levels by replacing about 777 miles of cast iron mains (the most leak-prone pipe material), according to staff calculations.

---


20 Companies reported different amounts of methane lost or emitted per year to different agencies—largely due to differences in reporting methodologies. EIA does not require companies to follow a specific methodology for calculating natural gas losses, and in some cases, there is a substantial difference between the numbers reported to EIA and those reported to DEP and EPA.

21 According to the EPA, methane has a global warming potential of 21 for a hundred-year time horizon, compared to carbon dioxide’s global warming potential of 1. The International Panel on Climate Change (IPCC) and individual studies have assigned a higher global warming potential of 25 and 35 for hundred-year time horizons, respectively. For more information, see [http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).

22 Calculation is based on 2010 emissions levels reported in the Greenhouse Gas Inventory, [http://www.mass.gov/eea/docs/dep/air/climate/ghginv9012.xls](http://www.mass.gov/eea/docs/dep/air/climate/ghginv9012.xls).

23 Calculation is based on the 1990 emissions levels for the natural gas distribution system in the Massachusetts Greenhouse Gas Inventory, the emissions reductions reported as of 2010 in the Greenhouse Gas Inventory in 2010 and EPA’s emission rate for cast iron pipelines in 40 CFR Part 98, Subpart W.
Nationwide, the natural gas distribution system is the largest source of methane emissions, accounting for 19 percent of total emissions in 2011, according to the U.S. Environmental Protection Agency (EPA). EPA also found that recent reductions in U.S. methane emissions have been driven in part by replacing leak-prone pipelines in distribution systems.26

- **More significant pipeline incidents in Massachusetts involved cast iron or other high-risk pipes.** Incidents are four times more likely to occur on cast iron mains than mains made of other materials, according to an analysis of national pipeline incidents by the U.S Pipeline and Hazardous Materials Safety Administration (PHMSA).27

In Massachusetts, 57 percent of the significant incidents28 from 2002-2012—attributable to human error, leaks, natural forces, excavation damage, and a variety of other causes—occurred around segments of the distribution system utilizing cast iron or steel pipe (see Table 5 on page 14). One of these incidents, a gas explosion in July 2002 involving a corroded fitting on a steel pipe, leveled a home and killed two children in Hopkinton, Mass. Another powerful explosion occurred in Springfield, Mass., last November, as a result of human error after a worker from Columbia Gas of Massachusetts accidentally punctured a steel service line, which had been retrofitted with plastic, while responding to a call about a gas leak. The incident resulted in injuries to 17 people and $1.3 million in property damage, according PHMSA data.

Nationally, a number of recent killer pipeline explosions have been traced to aging, cast iron pipelines,29 including explosions in Austin, Texas, Philadelphia, and Allentown, Penn., where a gas main explosion in February 2011 resulted in five fatalities, three hospitalizations, and eight destroyed homes (see photo on page 3). Some of these accidents might have been prevented had gas companies performed timelier repair, rehabilitation and replacement of high-risk pipeline, such as cast iron and unprotected bare steel pipes, according to PHMSA.30 PHMSA warns that “public safety requires prompt action [by gas companies] to repair, remediate, and replace high-risk gas pipeline infrastructure.”


28 Significant Incidents are those incidents reported by pipeline operators to PHMSA when any of the following conditions are met: 1) Fatality or injury requiring in-patient hospitalization. 2) $50,000 or more in total costs, measured in 1984 dollars. 3) Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more. 4) Liquid releases resulting in an unintentional fire or explosion.


Table 3: Unaccounted for Gas Volumes and Estimated Cost by Company, 2000-2011, in 2012 dollars

<table>
<thead>
<tr>
<th>Company</th>
<th>Lower Bound&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Upper Bound&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Lower Bound&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Upper Bound&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unaccounted for Gas</td>
<td>Estimated Cost of Gas,</td>
<td>Average Cost of Gas</td>
<td>Estimated Cost of Gas,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackstone Gas</td>
<td>19,013</td>
<td>$82,400</td>
<td>$83</td>
<td>72,138</td>
</tr>
<tr>
<td>Boston Gas&lt;sup&gt;c&lt;/sup&gt;</td>
<td>54,938,203</td>
<td>$352,164,448</td>
<td>$604</td>
<td>117,874,912</td>
</tr>
<tr>
<td>Columbia Gas&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6,098,769</td>
<td>$39,557,300</td>
<td>$143</td>
<td>17,175,142</td>
</tr>
<tr>
<td>Colonial Gas&lt;sup&gt;e&lt;/sup&gt;</td>
<td>14,868,152</td>
<td>$91,740,162</td>
<td>$377</td>
<td>31,095,129</td>
</tr>
<tr>
<td>Essex Gas&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1,881,260</td>
<td>$12,801,477</td>
<td>$380</td>
<td>5,790,463</td>
</tr>
<tr>
<td>Fitchburg Gas &amp;</td>
<td>908,172</td>
<td>$5,905,935</td>
<td>$211</td>
<td>3,592,072</td>
</tr>
<tr>
<td>Electric&lt;sup&gt;d&lt;/sup&gt;</td>
<td>498,363</td>
<td>$2,914,285</td>
<td>$291</td>
<td>818,892</td>
</tr>
<tr>
<td>City of Holyoke&lt;sup&gt;d&lt;/sup&gt;</td>
<td>159,915</td>
<td>$757,985</td>
<td>$188</td>
<td>313,768</td>
</tr>
<tr>
<td>Middleborough</td>
<td>2,996,250</td>
<td>$19,585,719</td>
<td>$371</td>
<td>9,353,842</td>
</tr>
<tr>
<td>Gas &amp; Electric&lt;sup&gt;e&lt;/sup&gt;</td>
<td>15,118,577</td>
<td>$109,076,406</td>
<td>$427</td>
<td>33,554,316</td>
</tr>
<tr>
<td>New England Gas</td>
<td>75,498</td>
<td>$523,290</td>
<td>$88</td>
<td>547,872</td>
</tr>
<tr>
<td>Natar Gas</td>
<td>429,284</td>
<td>$1,816,422</td>
<td>$304</td>
<td>2,130,869</td>
</tr>
<tr>
<td>Total</td>
<td>99,294,819</td>
<td>$640,252,916</td>
<td>$273</td>
<td>227,154,754</td>
</tr>
</tbody>
</table>

Source: Staff Analysis of Massachusetts Department of Public Utilities (DPU) Annual Reports.

Notes: The transfer of gas costs onto rate payer is based on 200 Cam 6, [http://www.mass.gov/dpi/resource-library/PHMSA20111014_02%20NARUC.pdf](http://www.mass.gov/dpi/resource-library/PHMSA20111014_02%20NARUC.pdf) and [http://www.gas.uc/23Collection/Documents/Knowledge/CPLCA%20Mechanisms.doc](http://www.gas.uc/23Collection/Documents/Knowledge/CPLCA%20Mechanisms.doc). We calculated the cost of unaccounted for gas by multiplying the reported gas volumes by the NYMEX average futures price for that month, which are commonly used in cost of gas adjustments. We adjusted costs to 2012 dollars according to PHMSA’s methods for adjusting costs associated with pipeline accidents.

<sup>a</sup> Based on the yearly unaccounted for gas volumes reported to DPU, which include negative unaccounted for gas volumes on a monthly basis.

<sup>b</sup> Based on the positive monthly unaccounted for gas volumes reported to DPU and excludes negative unaccounted for gas volumes.

<sup>c</sup> Owned by National Grid. Of these, Essex Gas was merged into Boston Gas in 2010.

<sup>d</sup> Data were not available for all the years of our analysis. For the City of Holyoke, data were missing for 2006, 2005, 2004, 2003, 2002, and 2001. For Middleborough Gas & Electric, data were missing for 2006, 2005, and 2001. For Westfield Gas & Electric, data were missing for 2006. For the City of Wakefield, data were missing for 2005, 2004, 2002, and 2001.

<sup>e</sup> Columbia Gas is a subsidiary of NiSource.
The slow pace of fixing leaks

There are some federal and state incentives in place to accelerate the pace of infrastructure replacement. Massachusetts is one of several forward-looking states that have either established or are considering policies that create financial incentives for gas companies to repair or replace leaky infrastructure. Despite these incentives, gas distribution companies’ progress at replacing leak-prone pipeline remains slow. Specifically, the data show:

- **U.S. gas companies are replacing less than 5 percent of their leakiest pipes per year.** Cast iron and bare steel are the most leak-prone pipe materials, releasing 27.25 and 12.58 cubic feet of methane per hour, per mile, respectively, according to the EPA. PHMSA also lists these materials as high-risk pipeline infrastructure that is prone to failure. Nonetheless, last year gas companies nationwide replaced just 3 percent of their cast iron and bare steel distribution mains—pipes that connect transmission lines to service lines—with less leak-prone plastic pipes.

The Massachusetts gas distribution system—which is owned and operated by gas companies—ranks third among state distribution systems in the total number of miles of cast iron mains and second in the number of cast iron service lines (or “services”), which connect mains to customers. The distribution system ranks ninth and fourth in the number of miles of bare steel mains and services, respectively. Gas companies operating in Massachusetts, however, replaced just 4 percent of cast iron and bare steel pipes in 2012 (see Table 6 on page 16). Of these companies, Boston Gas replaced the most miles (99) and service lines (3,277) made of cast iron and bare steel in 2012. Since 2004, New England Gas has reduced its inventory of cast iron and bare steel pipeline the most, replacing 1,408 miles of leak-prone mains and 51,496 leak-prone services (Table 6).

- **Nationwide, there are few federal or state incentives to repair or replace leaky pipes or minimize lost gas.** Federal pipeline safety regulations require only “hazardous leaks” posing imminent threat to be repaired promptly, allowing non-hazardous leaks to go unrepaired. Gas companies are required to identify and classify leaks according to risk as part of their federally mandated Distribution Integrity Management Plans, but only five states require all non-hazardous leaks to be repaired within a certain timeframe.

---


32 Ibid, 30.

33 Companies may also retrofit bare steel pipelines with protective linings, which also have a lower emissions rate.

34 The ranking is based on PHMSA’s cast and wrought iron and bare steel pipeline inventory, available at:

http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp and


35 Both of these companies participate in Massachusetts’ targeted infrastructure replacement program.

36 49 CFR 192 Part 192.703(c). A hazardous leak represents an existing or probable hazard to people or property and requires immediate action until the conditions are no longer hazardous, according to PHMSA guidance.


The Massachusetts legislature is currently considering repair timeframes for all non-hazardous leaks.  

Thirty-three states, including Massachusetts, have infrastructure replacement programs targeting cast iron and bare steel pipelines that allow companies to recover costs for replacing their leak-prone pipelines. However, companies may have little incentive to use these programs to accelerate pipeline replacement so long as they can still pass costs on to customers for lost gas.

Only two states with infrastructure replacement programs, Pennsylvania and Texas, have established limits on the amount companies can charge customers for lost gas. Pennsylvania just took these actions, so the results are not in yet, but in Texas the results are dramatic. From 2010 to 2012, with four gas companies participating in infrastructure replacement programs, Texas gas companies reduced their inventory of leak-prone service lines by 55 percent (101,790 lines). In this same time period, gas companies in Massachusetts reduced their leak-prone service lines by just 4 percent (8,278 lines).

Notably, the Massachusetts legislature is also considering a cap on allowable unaccounted for gas, which could provide an additional financial incentive for gas companies to repair or replace leak-prone pipes.

- It’s hard to monitor company performance because data on unaccounted for gas is of such poor quality. Companies regularly report negative volumes of unaccounted for gas, and there can be substantial variance in the numbers reported across agencies (see Table 7 on page 18). Negative unaccounted for gas volumes indicate calculating or reporting errors because it’s physically impossible to dispose of more gas than enters a closed distribution system, according to a 2012 report prepared for the Pennsylvania Utility Commission. This report also noted that inconsistencies in methodologies across companies can inhibit regulators’ ability to monitor company performance over time.

According to federal and state officials, companies do not use a consistent methodology to calculate unaccounted for gas. Officials from PHMSA’s Office of Pipeline Safety explained in an interview for this report that the agency provides companies with a formula for calculating unaccounted for gas, as well as guidance about the types of adjustments that are appropriate to make; however, each company decides which adjustments to make and less sophisticated operators may not make basic adjustments,

---


40 New England Gas, Columbia Gas, and National Grid (MA)—which includes Boston Gas, Colonial Gas, and Essex Gas—all participate in Massachusetts’s targeted infrastructure replacement program. As noted above, New England Gas and Boston Gas replaced the most leak-prone pipeline.


42 Pennsylvania capped unaccounted for gas at 3 percent, to be phased in over time, and finalized its rule in 2013, (52 PA Code §59.111). Texas capped unaccounted for gas for distribution systems at 5 percent in 2002. 16 TX Admin. Code §7.5525.


such as adjusting volumes based on standard temperature pressure. In Massachusetts, the Department of Public Utilities requested additional funds in its 2014 budget to hire a third-party consultant to review companies’ procedures for classifying leaks and calculating lost and unaccounted for gas.

**Actions needed to accelerate pipeline replacement**

Despite slow progress to date, some state initiatives—like those established or proposed in Massachusetts—show promise and should be expanded to accelerate the repair or replacement of leak-prone pipelines. In particular:

- **States and non-regulated utilities such as municipal gas companies should adopt cost recovery programs for accelerated replacement of high-risk, leak-prone pipelines.** Companies typically cannot recover the costs of their infrastructure investments until the utility files for and receives such approval, which can be many months—and sometimes more than a year—after costs have been incurred. Cost recovery programs allow gas companies to recover the costs of infrastructure improvements on a timelier basis, which could provide more incentive for companies to replace their leaky pipelines. Ratepayers and the public may also benefit from these programs through increased safety, reductions in rates from decreased operations and maintenance and unaccounted for gas costs, and reduced greenhouse gas emissions, according to a recent analysis of such programs in New England.

Taking into account widely accepted assumptions from the EPA regarding the rate of gas leaks, global warming potential and the social cost of carbon, and including costs associated with replacing pipelines, Massachusetts residents stand to realize $156 million in net benefits over 10 years from the companies participating in the commonwealth’s infrastructure replacement program. One of these companies, Colonial Gas, increased their annual replacement rate of leak-prone pipeline by an average of 7 percent for

---


46 Ibid, 12.


48 Ibid, 12.


51 These reductions would help offset some, but not all, of the rate increase associated with replacing leak-prone infrastructure. For an example of how such a program might impact Massachusetts ratepayers, see the Attorney General’s comments in the National Grid petition for targeted infrastructure cost recovery, available at [http://www.env.state.ma.us/dpu/docs/gas/10-35/11310dpord.pdf](http://www.env.state.ma.us/dpu/docs/gas/10-35/11310dpord.pdf).

service lines and 13 percent for main lines during its two years in the program. The other companies participating in the cost recovery program—Boston Gas, New England Gas, and Colombia Gas—have not appreciably improved their replacement rates of leak-prone pipes. This suggests that additional financial incentives, such as those currently under consideration by the Massachusetts legislature, may be needed.51

In 2009, Secretary of Transportation Ray LaHood called on states to adopt and expand infrastructure replacement programs. Forty-six states have leak-prone pipelines and could benefit from such programs, but so far only 33 states, including Massachusetts,52 have answered LaHood’s call to action.

- **States and non-regulated utilities should establish timeframes for repairing non-hazardous gas leaks.** Gas companies are already required by federal regulation to identify, classify, and manage safety risks posed by leaks.53 Nonetheless, leaks that do not pose a safety risk may continue unabated. Just five states—Florida, Georgia, Kansas, Maine and Texas—have established firm timeframes for repairing all non-hazardous leaks, with timeframes ranging from 3 months to 36 months for the least hazardous leaks.54 As noted by the Conservation Law Foundation, this program may be having an effect, as Maine had one of the lowest lost gas rates in the country, according to data from the Energy Information Administration.55 The Massachusetts legislature is considering repair timeframes for all non-hazardous leaks.56

- **States and non-regulated utilities should adopt a standard definition and methodology for calculating unaccounted for gas.** Inconsistent data reported by companies inhibits regulators’ ability to perform oversight, according to the Pennsylvania Public Utility Commission and others.57 Furthermore, negative unaccounted for gas levels are indicative of calculating or reporting discrepancies, not actual gas volumes—and PHMSA does not allow companies to report negative values. To address this issue, the Pennsylvania Commission adopted a standard definition and methodology for unaccounted for gas, based in part on PHMSA’s definition.58 Other states with similar reporting issues should follow Pennsylvania’s lead. Massachusetts state regulators plan to study the issue.59

---

51 In the current legislative session, Massachusetts has at least two other innovative financing proposals for infrastructure replacement under consideration, including one—H. 2990 “An Act establishing natural gas infrastructure improvement financing”—specific to financing the repair of non-hazardous leaks.
52 Ibid, 51.
54 Ibid, 6.
55 Ibid, 6.
56 Ibid, 6.
57 Ibid, 57.
58 Ibid, 6.
61 Ibid, 57.
62 Ibid, 12.
• **States and non-regulated utilities should limit the ability of gas companies to recover costs for unaccounted for gas.** Limiting the amount of unaccounted for gas for which companies can charge would create a powerful financial incentive for gas companies to minimize emissions. As noted earlier, Pennsylvania and Texas are the only states that have set statewide caps on the percentages of gas for which companies can recover costs.60 In both states, companies can recover costs for no more than 5 percent of the unaccounted for gas, and Pennsylvania plans to lower that to 3 percent in coming years.61 In finalizing its plan earlier this year, the Pennsylvania Public Utility Commission stated that eliminating cost recovery for gas lost above the cap shifts the financial burden of lost gas from the ratepayer to the gas company. That approach appears to have worked in Texas, which reduced its inventory of leak-prone service lines by an impressive 55 percent over the last two years. As noted earlier, the Massachusetts legislature is considering a cap on allowable unaccounted for gas.62

To encourage action on these measures and build on Massachusetts’ efforts, Sen. Markey is currently drafting legislation amending the Public Utilities Regulatory Policy Act of 1978.

American consumers, businesses and communities now pay for gas they don’t receive and bear the risks of gas leaks they cannot repair. Gas distribution companies, on the other hand, have little reason to treat leaky pipelines as an urgent problem. They may even make money off of lost gas because they’re reimbursed whether it reaches the home or not. The Markey legislation will help make sure gas companies take responsibility and fix their leaks.

---

60 Pennsylvania and Texas are the only states with permanent, statewide caps in place. Other states may have temporary caps or company-specific caps in place.
61 Ibid, 28.
## Appendix

Table 4: Natural Gas Losses or Emissions as reported to the U.S. Energy Information Administration (EIA), the Massachusetts Department of Environmental Protection (DEP), and the U.S. Environmental Protection Agency (EPA), 2010-2011, in thousands of cubic feet (mcf)

<table>
<thead>
<tr>
<th>Company Name</th>
<th>2010 EIA (gas losses)</th>
<th>2010 DEP (emissions)</th>
<th>2011 EIA (gas losses)</th>
<th>2011 DEP (emissions)</th>
<th>2011 EPA (emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkshire Gas</td>
<td>68,702</td>
<td>40,954</td>
<td>45,434</td>
<td>40,706</td>
<td>-</td>
</tr>
<tr>
<td>Blackstone Gas</td>
<td>1,016</td>
<td>52</td>
<td>4,171</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Boston Gas</td>
<td>911,944</td>
<td>967,390</td>
<td>499,814</td>
<td>918,066</td>
<td>915,842</td>
</tr>
<tr>
<td>Colonial Gas</td>
<td>-</td>
<td>121,778</td>
<td>-</td>
<td>109,876</td>
<td>109,546</td>
</tr>
<tr>
<td>Columbia Gas</td>
<td>398,391</td>
<td>377,102</td>
<td>249,454</td>
<td>345,050</td>
<td>-</td>
</tr>
<tr>
<td>Essex Gas</td>
<td>40,680</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fitchburg Gas &amp; Electric</td>
<td>20,049</td>
<td>-</td>
<td>13,372</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>City of Holyoke</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Middleborough Gas &amp; Electric</td>
<td>5,116</td>
<td>19,387</td>
<td>3,358</td>
<td>8,086</td>
<td>3,934</td>
</tr>
<tr>
<td>New England Gas</td>
<td>43,310</td>
<td>-</td>
<td>27,857</td>
<td>-</td>
<td>202</td>
</tr>
<tr>
<td>Netar Gas</td>
<td>418,273</td>
<td>-</td>
<td>259,721</td>
<td>-</td>
<td>205,491</td>
</tr>
<tr>
<td>Wakefield Municipal Gas &amp; Lght</td>
<td>3,273</td>
<td>-</td>
<td>2,346</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Westfield Gas &amp; Electric</td>
<td>224</td>
<td>-</td>
<td>123</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,898,978</td>
<td>1,526,663</td>
<td>1,105,650</td>
<td>1,421,764</td>
<td>1,235,015</td>
</tr>
</tbody>
</table>


Notes: Natural gas companies began reporting GHG emissions to the Massachusetts DEP in 2010 and to EPA in 2011. According to an EPA official, differences in the emission amounts reported for individual companies are due to methodological differences between the General Reporting Protocol used as part of the Climate Registry and EPA's reporting requirements. For example, the EPA official said that the General Reporting Protocol in place for 2010 did not include different emissions factors specific to the type of pipe material used in the distribution system. In 2012, DEP amended its regulations so that companies which are also required to report GHG emissions to the U.S. EPA must use the same reporting methodology when they report to DEP.

The reporting thresholds for each agency are different. According to an EPA official, all companies are required to report natural gas losses. At the state level, companies are required to report emissions to DEP if they are (a) regulated under Title V of the U.S. Clean Air Act and 310 CMR 700 Appendix C, or (b) emit more than 5,000 short tons of CO2 equivalent. For federal GHG emissions reporting to EPA, companies are required to report if they emit more than 25,000 metric tons of GHGs annually.

Metric ton CO2 and CO2-equivalent values were converted to cubic feet using EPA’s online methane conversion tool, available at: http://www.epa.gov/energy/methaneconversiontool.
<table>
<thead>
<tr>
<th>Date</th>
<th>City</th>
<th>Operator</th>
<th>Cause</th>
<th>Injuries</th>
<th>Property Damage</th>
<th>Type of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/24/2002</td>
<td>Framingham</td>
<td>Nistar Gas</td>
<td>Excavation Damage</td>
<td>0</td>
<td>$186,437</td>
<td>Steel</td>
</tr>
<tr>
<td>02/13/2003</td>
<td>Turners Falls</td>
<td>Berkshire Gas</td>
<td>Other Cause</td>
<td>0</td>
<td>$550,330</td>
<td>Steel</td>
</tr>
<tr>
<td>11/21/2003</td>
<td>New Bedford</td>
<td>Nistar Gas</td>
<td>Other Cause</td>
<td>0</td>
<td>$391,348</td>
<td>No data reported</td>
</tr>
<tr>
<td>04/13/2004</td>
<td>Walpole</td>
<td>Columbia Gas</td>
<td>Other Cause</td>
<td>0</td>
<td>$182,281</td>
<td>Steel</td>
</tr>
<tr>
<td>04/06/2005</td>
<td>Boston</td>
<td>Boston Gas</td>
<td>Other Cause</td>
<td>1</td>
<td>$0</td>
<td>No data reported</td>
</tr>
<tr>
<td>11/09/2005</td>
<td>Lexington</td>
<td>Boston Gas</td>
<td>Other Cause</td>
<td>0</td>
<td>$1,661,938</td>
<td>No data reported</td>
</tr>
<tr>
<td>04/28/2006</td>
<td>Noodham</td>
<td>Nistar Gas</td>
<td>Unknown Cause</td>
<td>1</td>
<td>$22,285</td>
<td>Plastic</td>
</tr>
<tr>
<td>03/08/2007</td>
<td>Peabody</td>
<td>Boston Gas</td>
<td>Unknown Cause</td>
<td>0</td>
<td>$110,386</td>
<td>No data reported</td>
</tr>
<tr>
<td>05/17/2007</td>
<td>Wapole</td>
<td>Columbia Gas</td>
<td>Unknown Cause</td>
<td>1</td>
<td>$27,399</td>
<td>Plastic</td>
</tr>
<tr>
<td>09/10/2007</td>
<td>Easton</td>
<td>Columbia Gas</td>
<td>Unknown Cause</td>
<td>2</td>
<td>$2,208,346</td>
<td>Other</td>
</tr>
<tr>
<td>01/03/2008</td>
<td>Maynard</td>
<td>Nistar Gas</td>
<td>Unknown Cause</td>
<td>0</td>
<td>$161,597</td>
<td>Steel</td>
</tr>
<tr>
<td>01/25/2009</td>
<td>Gloucester</td>
<td>Boston Gas</td>
<td>Unknown Cause</td>
<td>1</td>
<td>$416,505</td>
<td>Cast iron (likely)</td>
</tr>
<tr>
<td>03/10/2009</td>
<td>West Barnstable</td>
<td>Colonial Gas</td>
<td>Unknown Cause</td>
<td>0</td>
<td>$364,442</td>
<td>Plastic</td>
</tr>
<tr>
<td>01/15/2010</td>
<td>Waltham</td>
<td>Boston Gas</td>
<td>Incorrect Operation</td>
<td>0</td>
<td>$510,449</td>
<td>Steel</td>
</tr>
<tr>
<td>01/25/2010</td>
<td>Reading</td>
<td>Boston Gas</td>
<td>Natural Force Damage</td>
<td>1</td>
<td>$255,224</td>
<td>Cast iron</td>
</tr>
<tr>
<td>01/23/2011</td>
<td>West Springfield</td>
<td>Columbia Gas</td>
<td>Other Cause</td>
<td>0</td>
<td>$104,409</td>
<td>Steel</td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>Pipeline Company</td>
<td>Other Outside Force Damage</td>
<td>Total Cost</td>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------</td>
<td>---------------------------</td>
<td>----------------------------</td>
<td>--------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>06/24/2012</td>
<td>Seelock</td>
<td>Columbia Gas</td>
<td>0</td>
<td>$315,400</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>11/09/2012</td>
<td>Fitchburg</td>
<td>Fitchburg Gas &amp; Electric Light</td>
<td>0</td>
<td>$110,000</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>11/23/2012</td>
<td>Springfield</td>
<td>Other Cause</td>
<td>17</td>
<td>$1,310,300</td>
<td>Plastic*</td>
<td></td>
</tr>
</tbody>
</table>

|               | Berkshire Gas         |                          | 0                          | $550,330     |          |
|               | Subtotal               |                          | 3                          | $3,060,938   |          |
|               | Boston Gas Subtotal    |                          | 0                          | $364,442     |          |
|               | Colonial Gas Subtotal  |                          | 6                          | $4,148,135   |          |
|               | Subtotal               |                          | 1                          | $110,000     |          |
| New England Gas Subtotal |                    |                          | 1                          | $1,258,832   |          |


* Significant incidents are those incidents reported by pipeline operators to PHMSA when any of the following conditions are met: 1) fatality or injury requiring in-patient hospitalization, 2) $50,000 or more in total costs, measured in 1984 dollars, 3) Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more, 4) Liquid releases resulting in an unintentional fire or explosion,

* Property damage is estimated as the sum of all public and private costs reported in the 30-day incident report. The costs for Incidents prior to 2012 are presented in 2012 dollars. Cost of Gas lost is indexed via the Energy Information Administration, Natural Gas City Gate Prices. All other costs are adjusted via the Bureau of Economic Analysis, Government Printing Office inflation values,

* The company did not officially report the type of pipeline material involved; however the wrongful death lawsuit filed by the parents of the victim implicated a corroded metal fitting as the source of the gas leak that led to the fatal explosion.

* The company did not officially report the type of pipeline material involved, however the incident report indicated that a piece of cast iron pipeline was identified at the incident scene.

* The company reported that the pipeline material was plastic. DPU officials clarified that the plastic pipeline had been inserted into an existing steel pipeline.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Leak-prone Pipeline Replaced Since 2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Leak-prone Pipeline Remaining in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkshire Gas - Main Miles</td>
<td>23</td>
<td>-2%</td>
<td>-73%</td>
<td>251%</td>
<td>-2%</td>
<td>-2%</td>
<td>-2%</td>
<td>-3%</td>
<td>-4%</td>
<td>115</td>
</tr>
<tr>
<td>Berkshire Gas - Service Lines</td>
<td>1,088</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-2%</td>
<td>-2%</td>
<td>-4%</td>
<td>-2%</td>
<td>-5%</td>
<td>3,864</td>
</tr>
<tr>
<td>Blackstone Gas - Main Miles</td>
<td>2</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Blackstone Gas - Service Lines</td>
<td>0</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Boston Gas - Main Miles&lt;sup&gt;a&lt;/sup&gt;</td>
<td>496</td>
<td>-1%</td>
<td>-2%</td>
<td>-1%</td>
<td>-1%</td>
<td>-2%</td>
<td>-3%</td>
<td>-2%</td>
<td>-3%</td>
<td>2,997</td>
</tr>
<tr>
<td>Boston Gas - Service Lines&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6,609</td>
<td>-2%</td>
<td>13%</td>
<td>-1%</td>
<td>-2%</td>
<td>-3%</td>
<td>-5%</td>
<td>-3%</td>
<td>-3%</td>
<td>90,523</td>
</tr>
<tr>
<td>Colonial Gas - Main Miles&lt;sup&gt;b&lt;/sup&gt;</td>
<td>189</td>
<td>-1%</td>
<td>-2%</td>
<td>-2%</td>
<td>-3%</td>
<td>-3%</td>
<td>-5%</td>
<td>-19%</td>
<td>-17%</td>
<td>253</td>
</tr>
<tr>
<td>Colonial Gas - Service Lines&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1,078</td>
<td>26%</td>
<td>1%</td>
<td>-6%</td>
<td>-8%</td>
<td>-6%</td>
<td>-3%</td>
<td>-10%</td>
<td>-10%</td>
<td>4,486</td>
</tr>
<tr>
<td>Columbia Gas - Main Miles&lt;sup&gt;c&lt;/sup&gt;</td>
<td>344</td>
<td>-5%</td>
<td>-5%</td>
<td>-4%</td>
<td>-4%</td>
<td>-3%</td>
<td>-2%</td>
<td>-4%</td>
<td>-4%</td>
<td>979</td>
</tr>
<tr>
<td>Columbia Gas - Service Lines&lt;sup&gt;d&lt;/sup&gt;</td>
<td>13,807</td>
<td>-3%</td>
<td>-4%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-4%</td>
<td>46,622</td>
</tr>
<tr>
<td>Essex Gas - Main Miles&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23</td>
<td>-2%</td>
<td>-4%</td>
<td>-1%</td>
<td>-1%</td>
<td>-3%</td>
<td>-6%</td>
<td>1%</td>
<td>-3%</td>
<td>111</td>
</tr>
<tr>
<td>Essex Gas - Service Lines&lt;sup&gt;b&lt;/sup&gt;</td>
<td>533</td>
<td>-1%</td>
<td>4%</td>
<td>-2%</td>
<td>-2%</td>
<td>-3%</td>
<td>-2%</td>
<td>-3%</td>
<td>-3%</td>
<td>4,433</td>
</tr>
<tr>
<td>Fitchburg Gas &amp; Electric - Main Miles&lt;sup&gt;e&lt;/sup&gt;</td>
<td>21</td>
<td>-83%</td>
<td>433%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
<td>-4%</td>
<td>66</td>
</tr>
<tr>
<td>Fitchburg Gas &amp; Electric - Service Lines&lt;sup&gt;e&lt;/sup&gt;</td>
<td>-490</td>
<td>-6%</td>
<td>-14%</td>
<td>-8%</td>
<td>-9%</td>
<td>-8%</td>
<td>119%</td>
<td>-6%</td>
<td>-6%</td>
<td>3,379</td>
</tr>
<tr>
<td>City of Holyoke Main Miles</td>
<td>6</td>
<td>0%</td>
<td>-2%</td>
<td>0%</td>
<td>-3%</td>
<td>-3%</td>
<td>0%</td>
<td>-2%</td>
<td>0%</td>
<td>58</td>
</tr>
<tr>
<td>City of Holyoke Service Lines</td>
<td>1,127</td>
<td>-2%</td>
<td>-4%</td>
<td>-2%</td>
<td>-2%</td>
<td>-5%</td>
<td>-3%</td>
<td>-7%</td>
<td>-10%</td>
<td>2,557</td>
</tr>
<tr>
<td>Service</td>
<td>Main Miles</td>
<td>National- Main Miles</td>
<td>National- Service Lines</td>
<td>National- Service</td>
<td>National- Main</td>
<td>National- Service</td>
<td>National- Main</td>
<td>National- Service</td>
<td>National- Main</td>
<td>National- Service</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
<td>---------------------</td>
<td>-------------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>NStar Gas Main Miles</td>
<td>145</td>
<td>-3%</td>
<td>-2%</td>
<td>-2%</td>
<td>-2%</td>
<td>-3%</td>
<td>-2%</td>
<td>-3%</td>
<td>-3%</td>
<td>-3%</td>
</tr>
<tr>
<td>Wakefield Municipal Gas &amp; Light Main Miles</td>
<td>11</td>
<td>-1%</td>
<td>-3%</td>
<td>-4%</td>
<td>-4%</td>
<td>-1%</td>
<td>-1%</td>
<td>-9%</td>
<td>-4%</td>
<td>-3%</td>
</tr>
<tr>
<td>Westfield Gas &amp; Electric Main Miles</td>
<td>15</td>
<td>-4%</td>
<td>-2%</td>
<td>-2%</td>
<td>-2%</td>
<td>-5%</td>
<td>-4%</td>
<td>-1%</td>
<td>-10%</td>
<td>42</td>
</tr>
<tr>
<td>Massachusetts - Main Miles</td>
<td>2,684</td>
<td>-3%</td>
<td>-20%</td>
<td>-0%</td>
<td>-2%</td>
<td>-2%</td>
<td>-3%</td>
<td>-3%</td>
<td>4%</td>
<td>5,571</td>
</tr>
<tr>
<td>Massachusetts - Service Lines</td>
<td>85,759</td>
<td>-2%</td>
<td>-18%</td>
<td>-2%</td>
<td>-3%</td>
<td>-4%</td>
<td>-3%</td>
<td>0%</td>
<td>-4%</td>
<td>194,328</td>
</tr>
<tr>
<td>National- Main Miles</td>
<td>20,844</td>
<td>-5%</td>
<td>-3%</td>
<td>-3%</td>
<td>-2%</td>
<td>-4%</td>
<td>3%</td>
<td>-4%</td>
<td>-3%</td>
<td>93,705</td>
</tr>
<tr>
<td>National- Service</td>
<td>2,036,032</td>
<td>-10%</td>
<td>4%</td>
<td>-2%</td>
<td>-2%</td>
<td>-4%</td>
<td>-3%</td>
<td>0%</td>
<td>-12%</td>
<td>2,588,279</td>
</tr>
</tbody>
</table>


Notes: According to PHMSA, changes in replacement rates are generally due to three factors: (1) pipeline replacement, (2) acquisition of or selling off part of a distribution pipeline, or (3) changes in pipeline classification due to updated information or reclassifying.

Owned by National Grid, Emera Gas was merged into Eversource Gas in 2010.

Participating in Massachusetts’ Targeted Infrastructure Replacement Program, Eversource Gas & Electric applied in 2011.

Columbia Gas is a subsidiary of NiSource.
Table 7: Unaccounted For Gas as reported to the U.S. Energy Information Administration (EIA), the Massachusetts Department of Public Utilities (DPU), and the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), 2000-2011, in thousands of cubic feet (mcf).

<table>
<thead>
<tr>
<th>Year</th>
<th>EIA</th>
<th>Berkshire Gas</th>
<th>EIA</th>
<th>Blackstone Gas</th>
<th>EIA</th>
<th>Boston Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PHMSAa</td>
<td>MA DPU</td>
<td>PHMSAa</td>
<td>MA DPU</td>
<td>PHMSAa</td>
</tr>
<tr>
<td>2000</td>
<td>120,978</td>
<td>63,692</td>
<td>168,984</td>
<td>(15,162)</td>
<td>1,272</td>
<td>(15,162)</td>
</tr>
<tr>
<td>2001</td>
<td>(154,150)</td>
<td>109,702</td>
<td>(77,929)</td>
<td>2,663</td>
<td>3,172</td>
<td>3,198</td>
</tr>
<tr>
<td>2002</td>
<td>(30,005)</td>
<td>73,381</td>
<td>38,868</td>
<td>0</td>
<td>1,353</td>
<td>3,914,559</td>
</tr>
<tr>
<td>2003</td>
<td>102,524</td>
<td>15,179</td>
<td>59,821</td>
<td>(9,910)</td>
<td>0</td>
<td>(10,257)</td>
</tr>
<tr>
<td>2004</td>
<td>139,696</td>
<td>23,282</td>
<td>84,457</td>
<td>0</td>
<td>3,126</td>
<td>349,109</td>
</tr>
<tr>
<td>2005</td>
<td>(55,099)</td>
<td>6,702</td>
<td>(19,904)</td>
<td>(1,048)</td>
<td>1,359</td>
<td>(1,048)</td>
</tr>
<tr>
<td>2006</td>
<td>(4,341)</td>
<td>14,205</td>
<td>(54,000)</td>
<td>1,502</td>
<td>1,508</td>
<td>1,502</td>
</tr>
<tr>
<td>2007</td>
<td>4,608</td>
<td>80</td>
<td>73,152</td>
<td>258</td>
<td>245</td>
<td>256</td>
</tr>
<tr>
<td>2008</td>
<td>(4,600)</td>
<td>0</td>
<td>39,820</td>
<td>424</td>
<td>42</td>
<td>1,117</td>
</tr>
<tr>
<td>2009</td>
<td>53,290</td>
<td>0</td>
<td>56,261</td>
<td>3,666</td>
<td>3,674</td>
<td>3,666</td>
</tr>
<tr>
<td>2010</td>
<td>(124,966)</td>
<td>0</td>
<td>(34,102)</td>
<td>(395)</td>
<td>612</td>
<td>621</td>
</tr>
<tr>
<td>2011</td>
<td>(204,783)</td>
<td>0</td>
<td>(122,974)</td>
<td>4,408</td>
<td>4,172</td>
<td>1,209,084</td>
</tr>
<tr>
<td>Year</td>
<td>EIA</td>
<td>PHMSA</td>
<td>MA DPU</td>
<td>EIA</td>
<td>PHMSA</td>
<td>MA DPU</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>2001</td>
<td>1,547,492</td>
<td>818,573</td>
<td>1,617,123</td>
<td>748,841</td>
<td>0</td>
<td>(299,313)</td>
</tr>
<tr>
<td>2002</td>
<td>1,017,066</td>
<td>646,801</td>
<td>1,066,732</td>
<td>(1,829,318)</td>
<td>171,874</td>
<td>(95,467)</td>
</tr>
<tr>
<td>2004</td>
<td>3,681,867</td>
<td>196,647</td>
<td>338,082</td>
<td>432,808</td>
<td>500,806</td>
<td>436,819</td>
</tr>
<tr>
<td>2005</td>
<td>(1,665,602)</td>
<td>460,716</td>
<td>1,378,895</td>
<td>141,385</td>
<td>350,591</td>
<td>168,940</td>
</tr>
<tr>
<td>2006</td>
<td>444,983</td>
<td>455,120</td>
<td>647,750</td>
<td>495,274</td>
<td>472,090</td>
<td>506,677</td>
</tr>
<tr>
<td>2007</td>
<td>(2,813,835)</td>
<td>962,352</td>
<td>1,160,167</td>
<td>422,819</td>
<td>239,207</td>
<td>431,702</td>
</tr>
<tr>
<td>2008</td>
<td>1,757,733</td>
<td>505,349</td>
<td>1,105,796</td>
<td>897,251</td>
<td>889,654</td>
<td>906,609</td>
</tr>
<tr>
<td>2009</td>
<td>3,803,689</td>
<td>509,276</td>
<td>2,109,285</td>
<td>914,520</td>
<td>775,345</td>
<td>951,102</td>
</tr>
<tr>
<td>2010</td>
<td>2,660,178</td>
<td>459,805</td>
<td>1,288,862</td>
<td>(366,512)</td>
<td>889,321</td>
<td>803,978</td>
</tr>
<tr>
<td>2011</td>
<td>(116,205)</td>
<td>630,792</td>
<td>271,059</td>
<td>273,855</td>
<td>730,366</td>
<td>544,244</td>
</tr>
<tr>
<td>Year</td>
<td>Fitchburg Gas &amp; Electric</td>
<td>New England Gas</td>
<td>Netar Gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------------------</td>
<td>----------------</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EIA</td>
<td>PHMSA*</td>
<td>MA DPU</td>
<td>EIA</td>
<td>PHMSA*</td>
<td>MA DPU</td>
</tr>
<tr>
<td>2000</td>
<td>64,340</td>
<td>17,284*</td>
<td>252,875</td>
<td>602,683</td>
<td>1,385,339*</td>
<td>539,117</td>
</tr>
<tr>
<td>2001</td>
<td>(5,504)</td>
<td>26,660</td>
<td>(117,568)</td>
<td>31,703</td>
<td>1,005,596</td>
<td>51,776</td>
</tr>
<tr>
<td>2002</td>
<td>40,314</td>
<td>86,104</td>
<td>162,640</td>
<td>349,369</td>
<td>297,360</td>
<td>430,622</td>
</tr>
<tr>
<td>2003</td>
<td>3,790</td>
<td>2,970</td>
<td>(164,846)</td>
<td>(1,646,155)</td>
<td>296,070</td>
<td>285,346</td>
</tr>
<tr>
<td>2004</td>
<td>4,690</td>
<td>2,572</td>
<td>(8,587)</td>
<td>(1,995,970)</td>
<td>242,633</td>
<td>385,839</td>
</tr>
<tr>
<td>2005</td>
<td>779</td>
<td>18,131</td>
<td>136,487</td>
<td>(455,114)</td>
<td>305,275</td>
<td>204,480</td>
</tr>
<tr>
<td>2006</td>
<td>2,334</td>
<td>40,719</td>
<td>190,397</td>
<td>(1,061,367)</td>
<td>228,572</td>
<td>183,237</td>
</tr>
<tr>
<td>2007</td>
<td>(4,014)</td>
<td>(16,227)</td>
<td>42,842</td>
<td>(641,455)</td>
<td>284,468</td>
<td>448,312</td>
</tr>
<tr>
<td>2008</td>
<td>75,680</td>
<td>32,584</td>
<td>4,254</td>
<td>(1,010,077)</td>
<td>210,260</td>
<td>133,218</td>
</tr>
<tr>
<td>2009</td>
<td>(302,625)</td>
<td>20,325</td>
<td>118,777</td>
<td>(874,917)</td>
<td>198,355</td>
<td>329,704</td>
</tr>
<tr>
<td>2010</td>
<td>63,964</td>
<td>15,283</td>
<td>(68,348)</td>
<td>(1,355,813)</td>
<td>140,535</td>
<td>26,596</td>
</tr>
<tr>
<td>2011</td>
<td>(20,415)</td>
<td>4,581</td>
<td>(42,142)</td>
<td>(1,477,340)</td>
<td>116,679</td>
<td>(4,163)</td>
</tr>
<tr>
<td>Year</td>
<td>City of Holyoke EIA</td>
<td>PHMSA</td>
<td>MA DPU</td>
<td>Middleborough Gas and Electric EIA</td>
<td>PHMSA</td>
<td>MA DPU</td>
</tr>
<tr>
<td>------</td>
<td>---------------------</td>
<td>-------</td>
<td>--------</td>
<td>-----------------------------------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>2000</td>
<td>26,252</td>
<td>11,076</td>
<td></td>
<td>9,604</td>
<td>2,426</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>404</td>
<td>403</td>
<td></td>
<td>5,388</td>
<td>1,815</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>65,469</td>
<td>26,759</td>
<td></td>
<td>33,798</td>
<td>18,404</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>88,471</td>
<td>26</td>
<td></td>
<td>26,219</td>
<td>27,329</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>100,409</td>
<td>21,310</td>
<td></td>
<td>22,558</td>
<td>23,269</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>7,846</td>
<td>3,256</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>39,185</td>
<td>(1,663)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>92,669</td>
<td>6,076</td>
<td>90,666</td>
<td>52,692</td>
<td>4,053</td>
<td>(9,606)</td>
</tr>
<tr>
<td>2008</td>
<td>92,041</td>
<td>84,155</td>
<td></td>
<td>(2,070)</td>
<td>8,871</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>(49,658)</td>
<td>161,684</td>
<td>163,870</td>
<td>28,763</td>
<td>36,704</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>46,100</td>
<td>74,063</td>
<td>103,923</td>
<td>22,072</td>
<td>20,813</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>51,876</td>
<td>103,358</td>
<td>55,346</td>
<td>4,381</td>
<td>8,515</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>EIA</td>
<td>PHMSA*</td>
<td>MA DPU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>34,191</td>
<td>31,397</td>
<td>98,687</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>7,404</td>
<td>54,448</td>
<td>24,890</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>35,730</td>
<td>47,617</td>
<td>63,304</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>(46,922)</td>
<td>52,623</td>
<td>37,398</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>26,659</td>
<td>43,856</td>
<td>82,085</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>(31,237)</td>
<td>28,761</td>
<td>10,465</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>53,718</td>
<td>16,603</td>
<td>-/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>50,401</td>
<td>37,698</td>
<td>112,455</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>(87,845)</td>
<td>33,429</td>
<td>(53,350)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>(79,530)</td>
<td>49,255</td>
<td>(55,449)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>(6,176)</td>
<td>12,682</td>
<td>(7,412)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>(44,794)</td>
<td>7,465</td>
<td>(45,652)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Energy Information Administration, EIA Form 178, "Annual Report of Natural and Supplemental Gas Supply and Disposition", Unaccounted for Gas Item, PHMSA, "Annual Gas Distribution Reports", Form 7100.1.1, Unaccounted for Gas Penalties, and Annual Reports filed with the Massachusetts DPU. The reporting timeframes are different for PHMSA versus EIA and DPU. Specifically, PHMSA requests data for the previous year through June 30 of the reporting year, while EIA and DPU request data for the previous calendar year.

* Unaccounted for Gas is reported annually to PHMSA as a percentage. Based on discussions with PHMSA officials, we calculated a volume of gas by multiplying that percentage by the amount of reported gas made and purchased for one year through June 30 of the reporting year, per the instructions in PHMSA’s Annual Gas Distribution Report Form 7100.1.1.

x Only partial year data were available, since annual reports from the Massachusetts DPU were not available for both of the years necessary to calculate the gas volume from the unaccounted for gas percentage reported to PHMSA.

x No data were available for this year, either because annual reports from the Massachusetts DPU were not available, or companies did not report data for this field to EIA.

x The percentage of unaccounted for gas reported to PHMSA is the same, however the volumes are different. Some of this variation may be due to differences in reporting timeframes (e.g., July 1 of the previous year-June 30 of the reporting year for PHMSA and calendar year for DPU).

x The percentage of unaccounted for gas reported to PHMSA was greater than that reported to DPU, however the PHMSA volume listed here is less than that listed for DPU. Some of this variation may be due to differences in reporting timeframes (e.g., July 1 of the previous year-June 30 of the reporting year for PHMSA and calendar year for DPU).

Notes: Boston Gas, Colonial Gas, and Essex Gas are subsidiaries of National Grid. Essex Gas was merged into Boston Gas in 2010.

Columbia Gas is a subsidiary of NiSource.
Exhibit 5 to West Roxbury Motion for Rehearing: Harvard Emissions Study
Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts

Kathryn Mckain\textsuperscript{a,b}, Adrian Down\textsuperscript{c,d}, Steve M. Raclit\textsuperscript{e,f}, John Budney\textsuperscript{g}, Lucy R. Hutyr\textsuperscript{a}, Cody Floerchinger\textsuperscript{g}, Scott C. Herndon\textsuperscript{a}, Thomas Nehkorn\textsuperscript{h}, Mark S. Zahniser\textsuperscript{i}, Robert B. Jackson\textsuperscript{c,d,i,k}, Nathan Phillips\textsuperscript{a}, and Steven C. Wofsy\textsuperscript{a,b}

\textsuperscript{a}School of Engineering and Applied Sciences and \textsuperscript{b}Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts 02138; \textsuperscript{c}Nicholas School of the Environment and \textsuperscript{d}Center on Global Change, Duke University, Durham, North Carolina 27708; \textsuperscript{e}Department of Earth and Environmental Science, Boston University, Boston, Massachusetts 02215; \textsuperscript{f}Department of Biology, Hofstra University, Hempstead, New York 11549; \textsuperscript{g}Aerodyne Research, Inc., Billerica, Massachusetts 01821; \textsuperscript{h}Atmospheric and Environmental Research, Inc., Lexington, Massachusetts 02421; and \textsuperscript{i}School of Earth Sciences, Stanford Woods Institute for the Environment, and \textsuperscript{j}Precourt Institute for Energy, Stanford University, Stanford, California 94305

Edited by A. R. Ravishankara, Colorado State University, Fort Collins, Colorado, and approved December 12, 2014 (received for review August 24, 2014)

Methane emissions from natural gas delivery and end use must be quantified to evaluate the environmental impacts of natural gas and to develop and assess the efficacy of emission reduction strategies. We report natural gas emission rates for 13 y in the urban region of Boston, using a comprehensive atmospheric measurement and modeling framework. Continuous methane observations from four stations are combined with a high-resolution transport model to quantify the regional average emission flux, 18.5 ± 3.7 (95% confidence interval) 9 10\textsuperscript{−3} m\textsuperscript{3} m\textsuperscript{−2} y\textsuperscript{−1}. Simultaneous observations of atmospheric ethane, compared with the ethane-to-methane ratio in the pipeline gas delivered to the region, demonstrate that natural gas accounted for ≈60–100% of methane emissions, depending on season. Using government statistics and geospatial data on natural gas use, we find the average fractional loss rate to the atmosphere from all downstream components of the natural gas system, including transmission, distribution, and end use, was 2.7 ± 0.6% in the Boston urban region, with little seasonal variability. This fraction is notably higher than the 1.1% implied by the most closely comparable emission inventory.

A
tmospheric methane (CH\textsubscript{4}) is an important greenhouse gas (1) and major contributor to elevated surface ozone concentrations worldwide (2). Current atmospheric CH\textsubscript{4} concentrations are 2.5 times greater than preindustrial levels due to anthropogenic emissions from both biological and fossil fuel sources. The growth rate of CH\textsubscript{4} in the atmosphere slowed beginning in the mid-1980s and plateaued in the mid-2000s, but growth has resumed since 2007. The factors responsible for the observed global increase and interannual trends, and the spatiotemporal distribution of sources, remains uncertain (3).

Losses of natural gas (NG) to the atmosphere are a significant component of anthropogenic CH\textsubscript{4} emissions (3), with important implications for resource use efficiency, worker and public safety, air pollution, and human health (4), and for the climate impact of NG as a large and growing source of energy. A major focus area of the US Climate Action Plan is reduction of CH\textsubscript{4} emissions (5), but implementation requires identification of dominant source types, locations, and magnitudes. A recent review and synthesis of CH\textsubscript{4} emission measurements in North America, spanning scales of individual components to the continent, found that inventory methods consistently underestimate CH\textsubscript{4} emissions, that fossil fuels are likely responsible for a large portion of the underestimate, and that significant fugitive emissions may be occurring from all segments of the NG system (6).

The present study quantifies CH\textsubscript{4} fluxes from NG in the urbanized region centered on Boston. Elevated CH\textsubscript{4} concentrations in urban environments have been documented around the world for decades (7) (SI Appendix, Table S1) and attributed to a variety of anthropogenic source types. Recent studies of urbanized regions in California, using diverse atmospheric observing and modeling approaches, consistently found that CH\textsubscript{4} emission rates were larger than those estimated by regional bottom-up inventories (8–12). In Boston, elevated CH\textsubscript{4} concentrations have been observed at street level and attributed to >3,000 NG pipeline leaks from antiquated infrastructure (13), but associated CH\textsubscript{4} emission rates were not quantitatively assessed.

In this study, we combine four key quantities in an atmospheric-based analytical framework: (i) atmospheric CH\textsubscript{4} enhancements above background (ΔCH\textsubscript{4}) were determined from measurements at a network of continuous monitoring stations, inside and outside the urban core (Fig. 1), for 12 mo in 2012–2013; (ii) the NG fraction of the observed ΔCH\textsubscript{4} was quantified for cool and warm seasons by measuring atmospheric ethane (C\textsubscript{2}H\textsubscript{6}), a tracer of thermogenic CH\textsubscript{4}, and comparing ratios of C\textsubscript{2}H\textsubscript{6} and CH\textsubscript{4} in the atmosphere and in the pipeline gas flowing through the region; (iii) total CH\textsubscript{4} emissions were derived from an atmospheric transport model, which quantitatively links surface fluxes with observed ΔCH\textsubscript{4} using assimilated meteorology; and (iv) the fraction of delivered NG lost to the atmosphere was estimated by comparing CH\textsubscript{4} emissions to spatially explicit data on NG consumption. The result encompasses NG losses from the entire urbanized region, including emissions from NG transmission, storage, distribution, end use, and liquefied NG importation.

Significance

Most recent analyses of the environmental impact of natural gas have focused on production, with very sparse information on emissions from distribution and end use. This study quantifies the full seasonal cycle of methane emissions and the fractional contribution of natural gas for the urbanized region centered on Boston. Emissions from natural gas are found to be two to three times larger than predicted by existing inventory methodologies and industry reports. Our findings suggest that natural-gas-consuming regions may be larger sources of methane to the atmosphere than is currently estimated and represent areas of significant resource loss.


The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

Freely available online through the PNAS open access option.

Data deposition: Archival datasets are available through the Boston Regional Atmospheric Measurement Network Datavente at dx.doi.org/10.7910/DVN/285855.

1To whom correspondence should be addressed. Email: kmckain@fas.harvard.edu.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1416261112/-/DCSupplemental.

www.pnas.org/cgi/doi/10.1073/pnas.1416261112

PNAS | February 17, 2015 | vol. 112 | no. 7 | 1941–1946
Methane concentrations in Boston were consistently elevated over background (Fig. 2 and SI Appendix, Figs. S1 and S2) and followed a distinct daily pattern (Fig. 3 A and C, and SI Appendix, Fig. S16), associated with growth and decay of the planetary boundary layer. Concentrations fluctuated over short timescales (SI Appendix, Fig. S1) due to small-scale atmospheric circulations and heterogeneous sources in the urban environment. Methane concentrations were higher in winter than the other seasons at both sites, but ΔCH₄ varied less with season (Fig. 2). The average annual afternoon values of ΔCH₄ at BU and COP were 45.9 (37.3, 58.5) ppb and 30.5 (23.6, 39.3) ppb, respectively (Fig. 2), reflecting different sampling altitudes (30 and 215 m, respectively; SI Appendix, Table S2). All errors reported throughout the paper are 95% confidence intervals. Uncertainties in ΔCH₄ (Fig. 2) were calculated through a bootstrap analysis that included background concentrations and afternoon hourly, daily, and seasonally averaged CH₄ measurements (SI Appendix, section S3.3).

Contribution of NG to Elevated CH₄ Concentrations

To quantify the fraction of the observed ΔCH₄ that was due to NG emissions, we compared ratios of C₂H₆ and CH₄ measured in the atmosphere and NG pipelines serving the region. Ethane is a significant component of NG, whereas microbial CH₄ sources, such as landfills, sewage, and wetlands, produce little or no C₂H₆ (15). Because Boston has no geologic CH₄ seeps, no oil and gas production or refining, and low rates of biomass burning, there are no known significant sources of C₂H₆ in the region other than NG.

Ethane concentrations were measured with a laser spectrometer (15) at BU for 3 mo in the fall and winter of 2012–13 and 1 mo in the late spring of 2014 (SI Appendix, Fig. S6). Covariances between atmospheric C₂H₆ and CH₄ observations were determined from the daily slopes of a linear model that minimizes χ² (16) of 5-min median afternoon data (Fig. 4 and SI Appendix, section S2.1). The median of the daily slopes of atmospheric C₂H₆ versus CH₄ was 2.6 (2.5, 2.8) % during the cool season and 1.6 (1.4, 1.7) % during the warm season, obtained from days with a coefficient of determination (R²) > 0.75 (~50% of the days). The average C₂H₆ and CH₄ ratios in the NG flowing into the region during the two atmospheric measurement periods was 2.7 ± 0.0% in the fall and winter of 2012–2013 and 2.4 ± 0.1% in the spring of 2014, determined from hourly gas quality data from the three main pipelines that serve the region (17, 18) (SI Appendix, Figs. S7 and S8, and section S2.2). The quotient of the C₂H₆ and CH₄ ratios in the atmosphere and pipeline demonstrates that NG contributed 98 (92, 105) and 67 (59, 72) % of the ΔCH₄ in Boston in the cool and warm seasons, respectively. This result is insensitive to assumptions about the relative contribution of the three pipelines that supply the region and
Methane enhancements were modeled at BU and COP with the Stochastic Time-Inverted Lagrangian Transport (STILT) model (19), coupled to the Weather Research and Forecasting (WRF) meso-scale meteorological model run at 1-km² grid resolution (WRF-STILT; ref. 20; SI Appendix, section S3.1). WRF-STILT generates footprints (with units ΔCH₄ per unit surface flux), which represent the sensitivity of each measurement point in space and time to upwind surface fluxes. Both urban measurement sites were sensitive to emissions from the greater Boston region, with COP sensitive to a larger area than BU due to its higher altitude (Fig. 1 and SI Appendix, Table S2).

A spatially resolved prior model of CH₄ emissions was constructed for the study region (SI Appendix, section S3.2.2, Fig. S12, and Table S4) and combined with WRF-STILT footprints to generate a set of simulated ΔCH₄ values for each hour at each measurement station. The emission inventory was scaled for each season to equalize mean afternoon (11–16 h EST) modeled and observed ΔCH₄, providing optimized CH₄ emission rates for the region. Detailed methods and results for the model framework, including details on the emissions error quantification and results from alternative methodological approaches, are given in SI Appendix, sections S3 and S4. Observation-model comparisons are shown in Fig. 3 and SI Appendix, Figs. S13 and S14.

The mean annual optimized emission rate for the study area was 18.5 ± 3.7 g CH₄ m⁻² yr⁻¹ from all sources (Fig. 5A). Seasonal variations of total CH₄ emissions were modest, with fluxes in spring and summer marginally higher than in fall at the 95% confidence level (Fig. 5A). The weak seasonality of observed ΔCH₄ (Fig. 2) and the CH₄ flux rate is consistent with the finding that most of the emissions are from thermogenic gas, rather than biological processes, which would likely depend more strongly on season (21, 22). When data from each urban site are analyzed independently, CH₄ emission results are not significantly different (SI Appendix, Fig. S4), despite the large differences in ΔCH₄ (Fig. 2) and modeled footprints (Fig. 1) between the two sites. This result provides strong support for the observation-model framework, which is further strengthened by the robustness of the emission result to adoption of different model frameworks (SI Appendix, sections S4.2–S4.3).

To assess the fraction of delivered NG emitted to the atmosphere, we constructed a spatially explicit estimate of NG consumption in the region (Fig. 6 and SI Appendix, section S3.2.1). Fractional loss rates for the region were obtained by multiplying optimized emissions by the fractional contribution of NG to the atmospheric signal, as indicated by the ethane tracer data, and dividing by the mean NG consumption in the region (Fig. 5A and B). The inferred mean annual NG loss rate in the study area was 2.7 ± 0.6% of the total delivered gas in 2012–2013, with little seasonal dependence (Fig. 5C). Uncertainties in the average loss rates were calculated by summing in quadrature the relative

---

**Fig. 3.** Observed and optimized modeled CH₄ at (A and B) COP and (C and D) BU for 1 yr. (A and C) Observed, modeled, and background CH₄ concentrations averaged by hour of the day. The horizontal hatched area shows the average range of possible background concentrations, derived from 5th to 95th percentiles of the background station data. The gray vertical shaded area indicates the afternoon model optimization period, 11–16 h EST (16-21 h UTC). (B and D) Modeled versus observed daily average afternoon CH₄ concentrations. The gray line is the one-to-one line.
errors for the average emissions, atmospheric NG fraction, and NG consumption terms (SI Appendix, section S3.2.1).

The modest seasonality of the inferred NG loss rate (Fig. 5C) is driven by the small seasonal variability in total NG consumption (Fig. 5B). Our analysis makes no assumptions about the relative contribution to emissions of specific NG-consuming sectors or emission processes (SI Appendix, section S3.2.1), which could individually have very different loss rates than the aggregate estimate generated by this study. Our finding that the regional average NG emission rate was seasonally invariant may indicate that it does not strongly depend on the seasonally varying components of the NG system, or could result from multiple compensating processes.

**Comparison with Atmospheric Studies and Inventories**

Two recent studies in Los Angeles covering ~2 mo provide the only previous atmosphere-based (“top-down”) estimates of emissions from NG in an urban area, 1–2% (0.7–3% when accounting for the error ranges) of total NG consumed in the basin (10, 11). However, attribution of CH₄ emissions to pipeline gas in Los Angeles is complicated by the presence of current and abandoned oil and gas wells, refinery operations, and natural CH₄ seeps, in addition to NG consumption. Other studies have estimated total CH₄ emission fluxes from a number of urban areas around the world (SI Appendix, Table S1), using atmospheric data-model frameworks of varying sophistication, but have not quantitatively attributed fluxes to NG. Our value for total CH₄ emissions in Boston is at the low end of the overall range of fluxes reported for other urban areas (SI Appendix, Table S1), suggesting that total CH₄ emission rates in Boston are not anomalous.

The US greenhouse gas (GHG) inventory (23) attributes 3,302 Gg of CH₄ emissions to NG transmission, storage, and distribution in 2012, equal to ~0.7% of the NG delivered to consumers (24). The key input data for NG distribution systems in the national inventory are emissions factors developed from industry measurements (25) and activity data on miles of pipeline by material and counts of metering and regulating stations, customer meters, and pipeline maintenance events and mishaps (23). Emissions of NG in our study area are equal to ~8% of US emissions attributed to distribution, transport, and storage, and ~23% of national emissions from distribution alone, a notably higher fraction than the ~3% of US residential and commercial

---

**Fig. 4.** Five-minute median atmospheric C₂H₆ and CH₄ measurement points at BU in fall and winter of 2012–2013 (black) and spring of 2014 (blue), χ² optimization lines fit to each day (light lines), average fit lines for both seasons from all days with R² > 0.75 (bold solid lines), and lines with slopes of pipeline C₂H₆/CH₄ (dashed lines).

**Fig. 5.** Seasonal and annual average (±95% confidence intervals) (A) optimized CH₄ emissions in total and from NG, (B) NG consumption by sector, and (C) NG loss rates, derived from CH₄ concentration observations from the BU and COP sites together. (B) Consumption categories are electric power, residential and commercial, and other, which is comprised of industrial, vehicle fuel, and pipeline and distribution use (SI Appendix, section S3.2.1).
gas consumed in the study region. More detailed comparison of our results for the Boston urban region to the US GHG inventory is not possible because the inventory is not spatially disaggregated.

Massachusetts has compiled a state GHG inventory (26) (SI Appendix, Table S4) using the same methods as the national inventory with state-level data, where available, and reports CH\textsubscript{4} emissions from NG systems equal to \(-1.1\)\% of NG consumed in the state. The larger loss fraction implied by the Massachusetts (~1.1\%) versus the national (~0.7\%) inventory is likely due to larger proportions of cast iron and bare steel pipelines (27), which have higher emission factors (23). Because most (68\%) of our study region lies in Massachusetts, and most (88\%) of the NG delivered in Massachusetts is consumed in the region, this value approximates the result that would be obtained by downscaling the national inventory to the study region. Our result for the NG loss fraction is approximately two to three times larger than that implied by the state inventory (although no uncertainty range is reported for the latter).

NG companies also report their GHG emissions and NG losses to public agencies. Methane emission and NG delivery data reported to both the US Environmental Protection Agency (28) and Massachusetts GHG Reporting Programs (29) show NG loss rates of 0.4–1.6\% among individual NG distribution companies in Massachusetts in 2012 and 2013, with an average of 0.6\%, weighted by delivered NG volumes. Data reported to the US Energy Information Administration (30) for “losses from leaks, damage, accidents, migration and/or blow down” indicate loss rates of 0–1.1\%, with a weighted average of 0.4\%, among Massachusetts NG distribution companies in 2012 and 2013.

Policy analyses of NG distribution emissions (31, 32) sometimes use reported quantities of “lost and unaccounted-for” (LAUF) gas, an accounting term and cost-recovery mechanism reported by utilities to public utility commissions. LAUF fractions reported by individual distribution companies in Massachusetts in 2012 and 2013 were 0–4.6\%, with a weighted average of 2.7\% (33). However, LAUF encompasses leaks, metering and accounting inaccuracies, and theft (34), and hence the relationship between LAUF and NG emissions is unknown.

**Deficiencies in Existing Estimates**

Several possible reasons may explain why existing methodologies predict lower CH\textsubscript{4} emissions from NG than we observe in the Boston urban region.

i) Not all emission sources are inventoried. The US and Massachusetts inventories (23, 26) do not include NG losses occurring downstream of customer meters, neither at large industrial facilities, nor in residential and commercial settings.

ii) Leak surveys are not comprehensive. Leak surveys (e.g., refs. 13 and 35) are based on detection of discrete, highly elevated atmospheric signals, expressed at accessible locations. Numerous small leaks can occur without posing a safety hazard while still contributing significantly to the total CH\textsubscript{4} source, and would require sensitive and accurate measurements for detection and quantification. Some NG leaks may be emerging in locations that are difficult to access (e.g., indoors, on private property, through sewers or subway tunnels) with conventional surveys.

iii) Sampling protocols used to calculate emission factors have significant limitations. Due to practical constraints, NG emission factors are calculated from very small samples relative to the population they are intended to represent, and measurements are obtained from short-duration, non-repeated campaigns in a limited number of locations (25). These limitations can lead to undersampling of infrequent, high-emission events (6). Measurement of emissions from individual components requires access to restricted, privately owned facilities, which could lead to sample bias (6), whether intentional or not. Inaccurate device and activity counts (6), and incomplete understanding of controlling variables, may lead to inappropriate extrapolation of emission factors in space and time. Data collected through new reporting requirements (36) may help address some of these limitations for particular devices and processes.

These issues arise from our fundamental lack of knowledge about the specific sources and processes responsible for the discrepancies found in this and other studies (6), and about the requirements for designing and testing a statistically rigorous accounting of emissions from the NG supply chain. Both high-emission events and diffuse low-emission sources need to be sampled continuously or repeatedly to gain understanding of the true distribution of NG emissions. In addition to emission data, improved quantification of the fractional NG loss rate requires the compilation and availability of more rigorous, standardized, and detailed data on NG flows. Datasets should be spatially explicit to facilitate collation of disparate datasets and analysis of specific areas. Closer cooperation in data sharing and synthesis and wide data dissemination are needed to better constrain CH\textsubscript{4} emissions from NG and to provide the information needed to reduce those emissions.

**Significance of Natural Gas Emissions**

This study used 1 y of atmospheric CH\textsubscript{4} measurements from a network of observing stations, a high-resolution modeling framework, atmospheric measurements of C\textsubscript{2}H\textsubscript{6}, a tracer for NG emissions, and statistics on NG composition and consumption to quantify the NG emission rate for the Boston urban area as 2.7 \pm 0.6\% (95\% confidence interval) of consumed NG, approximately two to three times higher than that given by the most applicable (state) GHG inventory. The total volume of emitted gas in the study area over 1 y was \sim 15 billion standard cubic feet (scf), valued conservatively at \sim $90 million [using 2012 and 2013 Massachusetts city gate prices (37)]], equal to \sim 6 scf person\textsuperscript{-1}d\textsuperscript{-1} [using the study area population of \sim 7.2 million (38)].

The US President’s Methane Strategy (5) for reducing downstream NG emissions describes state and utility programs to accelerate infrastructure replacement, but offers no new federal initiatives for the distribution sector (39). A new Massachusetts law (40) is intended to improve the classification, reporting, and repair of NG leaks. The current study provides an example of a measurement-model framework that can be used to evaluate the effectiveness of programs aimed at reducing NG distribution emissions. More detailed measurements and accounting,
following a more rigorous statistical design, are needed to fully characterize and prioritize the components, geographic areas, and supply chain sectors that are contributing to the most emissions. The full environmental benefits of using NG in place of other fossil fuels will only be realized through active measures to decrease direct losses to the atmosphere, including in receiving areas such as the Boston urbanized region.

ACKNOWLEDGMENTS. We thank Bruce Daube, Jasna Pittman, Bill Munger, Maryann Sargent, Elaine Gottlieb, Rachel Chang, Greg Santon, Robin Commane, Ben Lee, Brittan Bribier, Ryan McGovern, and Tara Yacovitch, for help with the measurements; Jennifer Hegarty, Markile Mountain, John Henderson, and the late Janusz Eluszkiewicz for their contributions to the WRF-STILT modeling; Conan Gately, Xiaoqiang Tang, and Robert Kaufmann for assisting with the customized emission inventory; George McNaughton, Deborah Warren, Brian Swett, and Joel Sparks for providing access to measurement sites; Robert Harris, Steven Hamborg, Brian Lamb, Thomas Ferrara, Peter Huybers, Melissa Welling, Mark de Figueiredo, Bill Irving, Sue Fleck, and Thomas Rogers, for helpful discussion; and the Barr Foundation for lending spectrometers. Funding for this study was provided by the TomKat Charitable Trust via the Harvard School of Engineering and Applied Science Dean’s Innovation Fund, Boston University College of the Arts and Sciences, the National Science Foundation through Major Research Instrumentation Award 1337512 and Collaborative Research Awards 1265614, 1302902, and 0948819; the National Aeronautics and Space Administration through the Earth and Space Science Graduate Research Fellowship NNX14AK87H, Interdisciplinary Science Award NNX12AM82G, Carbon Monitoring System Award NNX13CC02C, and Carbon Cycle Science Award NNX11AG47G; and the Environmental Defense Fund (EDF) Award 0146-10100, Funding for EDF’s methane research series was provided by Fiona and Stan Druckenmiller, the Heising-Simons Foundation, Bill and Susan Oberndorf, Betsy and Sam Reeves, the Robertson Foundation, the Alfred P. Sloan Foundation, the TomKat Charitable Trust, and The Walton Family Foundation.

Exhibit 6 to West Roxbury Motion for Rehearing: B.U. Gas Leak Study
Rapid communication

Mapping urban pipeline leaks: Methane leaks across Boston

Nathan G. Phillips a,*, Robert Ackley b, Eric R. Crosson c, Adrian Down d, Lucy R. Hutyra a, Max Bronfield a, Jonathan D. Karr d, Kaiguang Zhao d, Robert B. Jackson d

a Boston University, Department of Earth and Environment, 675 Commonwealth Avenue, Boston, MA 02215, USA
b Gas Safety, Inc., Southborough, MA 01772, USA
c Picarro, Inc., Santa Clara, CA 95054, USA
d Duke University, Nicholas School of the Environment and Center on Global Change, Durham, NC 27708, USA

A R T I C L E   I N F O

Article history:
Received 25 July 2012
Received in revised form 31 October 2012
Accepted 3 November 2012

Keywords:
Carbon isotopes
Infrastructure
Methane
Natural gas
Urban

A B S T R A C T

Natural gas is the largest source of anthropogenic emissions of methane (CH4) in the United States. To assess pipeline emissions across a major city, we mapped CH4 leaks across all 785 road miles in the city of Boston using a cavity-ring-down mobile CH4 analyzer. We identified 3356 CH4 leaks with concentrations exceeding up to 15 times the global background level. Separately, we measured δ13CCH4 isotopic signatures from a subset of these leaks. The δ13CCH4 signatures (mean = −42.8‰ ± 1.3‰, s.e., n = 32) strongly indicate a fossil fuel source rather than a biogenic source for most of the leaks; natural gas sampled across the city had average δ13CCH4 values of −36.8‰ (±0.7‰, s.e., n = 10), whereas CH4 collected from landfill sites, wetlands, and sewer systems had δ13CCH4 signatures ~20‰ lighter (μ = −57.8‰ ± 1.6‰, s.e., n = 8). Repairing leaky natural gas distribution systems will reduce greenhouse gas emissions, increase consumer health and safety, and save money.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

Methane (CH4) is a greenhouse gas more potent molecule for molecule than carbon dioxide (Shindell et al., 2012). In the United States, leaks of CH4 from natural gas extraction and pipeline transmission are the largest human-derived source of emissions (EPA, 2012). However, CH4 is not just a potent greenhouse gas; it also influences air quality and consumer health. CH4 reacts with NOx to catalyze ozone formation in urban areas (West et al., 2006). Incidents involving transmission and distribution pipelines for natural gas in the U. S. cause an average of 17 fatalities, 68 injuries, and $133 M in property damage each year (PHMSA, 2012). A natural gas pipeline explosion in San Bruno, CA, for instance, killed eight people and destroyed 38 homes in 2010. Detecting and reducing pipeline leaks of CH4 and other hydrocarbons in natural gas are critical for reducing greenhouse gas emissions, improving air quality and consumer safety, and saving consumers money (West et al., 2006; Han and Weng, 2011; Shindell et al., 2012; Alvarez et al., 2012).

To assess CH4 emissions in a major urban metropolis, we mapped CH4 emissions over the entire 785 centerline miles of Boston's streets. To evaluate the likely source of the street-level CH4 emissions, we also measured the δ13C−CH4 carbon isotope composition, which can differentiate between biogenic (e.g., landfill, wetland, sewer) and thermogenic (e.g., natural gas) sources (Schoell, 1980).

2. Materials and methods

We conducted 31 mobile surveys during the period 18 August, 2011–1 October, 2011, covering all 785 road miles within Boston’s city limits. We measured CH4 concentration ([CH4], ppm) using a mobile Picarro G2301 Cavity Ring-Down Spectrometer equipped with an A0491 Mobile Plume Mapping Kit (Picarro, Inc, Santa Clara, CA). This instrument was factory-calibrated on 15 August 2011, immediately prior to use in this study, and follow-up tests of the analyzer were made during 11–21 August, 2012, comparing analyzer output to a National Oceanic and Atmospheric Administration (NOAA) primary standard tank. In both pre- and post-checks, the analyzer output was found to be within 2.7 parts per billion of known [CH4] in standard tanks, three orders of magnitude below typical atmospheric concentrations. Spectrometer and mobile GPS data were recorded every 11 s. To correct for a short time lag between instantaneous GPS location and a delay in [CH4] measurement due to inlet tube length (~1 m), we used an auxiliary pump to increase tubing flow throughput to within 5 cm of the analyzer inlet; we also adjusted the time stamp on the [CH4] readings based on a 1-s delay observed between analyzer response to a standard CH4 source that we injected into the instrument while driving, and the apparent GPS location. We also checked the GPS-based locations of leaks with dozens of street-level sampling to confirm specific leak locations and the estimated sampling delay. Air was sampled through a 3.0 un Zefluor filter and Teflon tubing placed ~10 cm above road surface.

For our mobile survey data, we defined a "leak" as a unique, spatially contiguous group of [CH4] observations, all values of which exceed a concentration threshold of 2.50 ppm. This was used as a threshold because it corresponded to the 90th
percentile of the distribution of data from all road miles driven, and, relative to
global background, is ~37% above 2011 mean mixing ratios observed at Mauna Loa
(NOAA, 2012).

Independently of mobile street sampling of CH₄, we measured δ¹⁸CH₄ from
a subset of the leaks with a Picarro G2112i Cavity Ring-Down Spectrometer
(Croson, 2008). This instrument is calibrated monthly using isotopic standards from
Isotopic Instruments (Victoria, BC, Canada). The instrument was checked at least
once daily to ensure analyzer output was within 1σ of a tank of CH₄ with δ¹⁸CH₄
measured by a private lab (Isotech Labs, IL). Samples were collected in 1-L Tedlar
sampling bags with valve and septa fittings, manufactured by Environmental Supply
Company (Durham, NC). A Gas Sentry CGO-321 handheld gas detector (Rasecum-
Turner, MA) was used to identify the area of highest ambient CH₄ at each site
sampled for δ¹⁸CH₄. Sampling bags were pre-evacuated and filled at the area of
highest ambient concentration at the sampling site using a hand pump. δ¹⁸CH₄ was
analyzed using a Picarro G2112i with a sample hold time typically of a few days and
always less than two weeks.

At a subset of sampling sites (n = 12), we collected duplicate samples in glass
vials to assess potential leaking or fractionation by the Tedlar sampling bags. We also
sent duplicate samples from a different subset of sampling sites (n = 5) to a private
lab (Isotech Labs, IL) for independent δ¹⁸CH₄ analysis. These analyses suggest no
significant fractionation or bias either from the sampling bags or the Picarro G2112i
analyzer. Most samples were analyzed at less than the maximum hold time of two
weeks, at which bag diffusion could account for a 1.2σ drift in our measurements of
δ¹⁸CH₄.

We compared δ¹⁸CH₄ of these locations with samples taken from area landfills,
wetlands, and the Deer Island Water Treatment Facility. Sampling equipment and
procedures, as well as laboratory analyses, for landfill and wetland sites were similar
to those for δ¹⁸CH₄ sampling locations described above. Samples were collected from
three capped, inactive landfills (there are currently no active landfills in the Boston
area). At one former landfill site, samples were collected at approximately three
month intervals between September, 2011 and April, 2012. The δ¹⁸CH₄ signature of
the landfill was consistent over this period (±3.4σ s.e.). At all wetland sampling
sites, a plastic chamber (10 cm × 25 cm × 5 cm) connected to a sampling tube was
placed over the surface of exposed moist sediment or shallow (~5 cm) water.
Sediment below the chamber was disturbed gently before drawing air samples from
the headspace within the chamber. The sample from the Deer Island Treatment
Facility was drawn from the headspace of a sample bottle of anaerobic sludge,
collected onsite by Deer Island staff for daily monitoring of the facility’s anaerobic
sludge digesters.

3. Results and discussion

We identified 3356 CH₄ leaks (Figs. 1 and 2) exceeding 2.50 parts
per million. Surface concentrations corresponding to these leaks ranged up to 28.6 ppm, 14-times above a surface background
concentration of 2.07 ppm (the statistical mode of the entire
collection distribution). Across the city, 435 and 97 independent
leaks exceeded 5 and 10 ppm, respectively.

Based on their δ¹⁸CH₄ signatures, the CH₄ leaks strongly
resembled thermogenic rather than biogenic sources (Fig. 3).
Samples of natural gas from the gateway pipelines to Boston and
from other consumer outlets in the city were statistically
indistinguishable, with an average δ¹⁸CH₄ signature of −36.8‰ (±0.7‰
s.e., n = 10; ‰ vs. Vienna Pee Dee Belemnite). In contrast, CH₄
collected from landfill sites, wetlands, and sewer systems reflected a
greater fractionation from microbial activity and δ¹⁸CH₄ signatures
~20‰ lighter. Biogenic values ranged from −53.1‰ to
−64.5‰ (μ = −57.8‰ ± 1.6‰ s.e., n = 8) for samples collected in
four wetlands, three capped landfills, and the primary sewage
facility for the city, Deer Island Sewage Treatment Plant, which had
the heaviest sample observed for non-natural-gas sources
(−53.1‰). Our results for biogenic CH₄ carbon isotope signatures are
consistent with those of the δ¹⁸CH₄ signature of CH₄ from landfills (Bergamaschi et al., 1998; Borjesson et al., 2001) and
wetlands (Hornbrook et al., 2000).

Peaks of [CH₄] detected in the road surveys strongly reflected the
signature of natural gas rather than biogenic sources (Table 1). The
average δ¹⁸CH₄ value for peaks was −42.8‰ ± 3.3‰ (n = 32),
reflecting a dominant signal from natural gas, likely altered in some
cases by minor fractionation of natural gas traveling through soils and
by mixing with background air (δ¹⁸CH₄ = −47‰; Dlugokencky
et al., 2011). A minority of samples had δ¹⁸CH₄ more negative than

![Fig. 1. Upper Panel: Methane leaks (3356 yellow spikes > 2.5 ppm) mapped on Boston's 785 road miles (red) surveyed in this study. Lower Panel: Leaks around Beacon Hill and the Massachusetts State House. Sample values of methane concentrations (ppm) are shown for each panel. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)](image1)

![Fig. 2. Leak prevalence is associated with old cast iron pipes across ten Boston neighborhoods. (The combined line is the regression across all ten neighborhoods: P < 0.001; the green regression line (r² = 0.34; P = 0.08), which eliminates the influence of the leverage point [Dorchester neighborhood], has a slope and intercept indistinguishable (P > 0.10) from the combined regression.) (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)](image2)
Table 1
Locations and isotopic values from discrete street leak samples.

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
<th>$\delta^{13}$CH$_4$(‰ PDB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.3634</td>
<td>-71.0612</td>
<td>-53.959</td>
</tr>
<tr>
<td>42.3439</td>
<td>-71.2628</td>
<td>-47.898</td>
</tr>
<tr>
<td>42.3493</td>
<td>-71.2265</td>
<td>-57.590</td>
</tr>
<tr>
<td>42.3583</td>
<td>-71.1749</td>
<td>-40.818</td>
</tr>
<tr>
<td>42.3411</td>
<td>-71.2440</td>
<td>-37.323</td>
</tr>
<tr>
<td>42.3543</td>
<td>-71.2441</td>
<td>-38.241</td>
</tr>
<tr>
<td>42.3595</td>
<td>-71.1898</td>
<td>-39.412</td>
</tr>
<tr>
<td>42.3513</td>
<td>-71.2092</td>
<td>-41.978</td>
</tr>
<tr>
<td>42.3515</td>
<td>-71.2081</td>
<td>-39.531</td>
</tr>
<tr>
<td>42.3614</td>
<td>-71.2314</td>
<td>-41.796</td>
</tr>
<tr>
<td>42.3426</td>
<td>-71.1012</td>
<td>-44.100</td>
</tr>
<tr>
<td>42.3443</td>
<td>-71.0549</td>
<td>-41.848</td>
</tr>
<tr>
<td>42.3328</td>
<td>-71.0761</td>
<td>-37.516</td>
</tr>
<tr>
<td>42.3360</td>
<td>-71.0738</td>
<td>-46.414</td>
</tr>
<tr>
<td>42.3441</td>
<td>-71.0673</td>
<td>-45.490</td>
</tr>
<tr>
<td>42.3303</td>
<td>-71.0569</td>
<td>-37.476</td>
</tr>
<tr>
<td>42.3409</td>
<td>-71.0542</td>
<td>-40.029</td>
</tr>
<tr>
<td>42.3524</td>
<td>-71.0445</td>
<td>-43.127</td>
</tr>
<tr>
<td>42.3799</td>
<td>-71.0272</td>
<td>-48.182</td>
</tr>
<tr>
<td>42.3722</td>
<td>-71.0361</td>
<td>-57.693</td>
</tr>
<tr>
<td>42.3785</td>
<td>-71.0681</td>
<td>-48.429</td>
</tr>
<tr>
<td>42.3730</td>
<td>-71.0632</td>
<td>-37.471</td>
</tr>
<tr>
<td>42.3593</td>
<td>-71.0629</td>
<td>-42.689</td>
</tr>
<tr>
<td>42.3584</td>
<td>-71.0644</td>
<td>-52.033</td>
</tr>
<tr>
<td>42.3546</td>
<td>-71.1271</td>
<td>-47.241</td>
</tr>
<tr>
<td>42.2943</td>
<td>-71.1891</td>
<td>-52.028</td>
</tr>
<tr>
<td>42.2793</td>
<td>-71.1514</td>
<td>-37.648</td>
</tr>
<tr>
<td>42.2847</td>
<td>-71.1428</td>
<td>-32.467</td>
</tr>
<tr>
<td>42.3285</td>
<td>-71.0792</td>
<td>-28.251</td>
</tr>
<tr>
<td>42.3215</td>
<td>-71.0692</td>
<td>-36.214</td>
</tr>
<tr>
<td>42.3259</td>
<td>-71.0796</td>
<td>-30.662</td>
</tr>
<tr>
<td>42.3553</td>
<td>-71.0573</td>
<td>-43.836</td>
</tr>
</tbody>
</table>

Mean: \(-42.793\)
Standard error: \(1.259\)

Acknowledgments

The Barr Foundation, Conservation Law Foundation, Picarro, Inc., Duke University’s Center on Global Change and Nicholas School of the Environment, and Boston University’s Sustainable Neighborhood Laboratory and Center for Energy and Environmental Studies supported this research. Dr. Michael Delaney of the Massachusetts Water Resources Agency facilitated sewage influent sampling. Additional support was provided by the US National Science Foundation ULTRA-ex program (DEB 0948857). Shanna Cleveland, Adrien Finzi and Steven Wofsy provided helpful comments on the manuscript.

References


Exhibit 7 to West Roxbury Motion for Rehearing: Opinion of Attorney General
Opinion of the Attorney General Regarding the Disposition of Public Lands Under the “Clean Environment” Amendment to the Constitution of Massachusetts

Robert H. Quinn

Follow this and additional works at: http://lawdigitalcommons.bc.edu/ear

Part of the Environmental Law Commons

Recommended Citation

OPINION OF THE ATTORNEY GENERAL REGARDING
THE DISPOSITION OF PUBLIC LANDS UNDER THE
"CLEAN ENVIRONMENT" AMENDMENT TO THE
CONSTITUTION OF MASSACHUSETTS

By Robert H. Quinn*

In November, 1972, the voters of Massachusetts approved an amendment to the state constitution which established the right to a clean environment for every citizen.¹ Subsequently, the Massachusetts House of Representatives addressed several questions to me, as Attorney General, regarding those provisions in the amendment (Article 97) requiring that acts concerning the disposition of, or certain changes in, the use of public lands be approved by a two-thirds roll call vote of each branch of the Legislature.²

The questions were as follows.

1. Do the provisions of the last paragraph of Article XCVII of the Articles of the Amendments to the Constitution requiring a two-thirds vote by each branch of the general court, before a change can be made in the use or disposition of land and easements acquired for a purpose described in said Article, apply to all land and easements held for such a purpose regardless of the date of acquisition or, in the alternative, do they apply only to land and easements acquired for such purposes after the effective date of said Article of Amendments?

2. Does the disposition or change of use of land held for park purposes requires a two thirds vote, to be taken by the yeas and nays of each branch of the general court, as provided in Article XCVII of the Articles of the Amendments to the Constitution, or would a majority vote of each branch be sufficient for approval?

3. Do the words "natural resources" as used in the first paragraph of Article XCVII of the Articles of the Amendments to the Constitution include ocean, shellfish and inland fisheries; wild birds, including song and insectivorous birds; wild mammals and game; sea and fresh water fish of every description; forests and all uncultivated flora, together with public shade and ornamental trees and shrubs; land, soil and soil resources, lakes, ponds, streams, coastal, underground and surface waters; minerals and natural deposits, as formerly set out in the definition of
the words "natural resources" in paragraph two of section one of chapter twenty-one of the General Laws (of Massachusetts)?

4. Do the provisions of the fourth paragraph of Article XCVII of the Articles of the Amendments to the Constitution apply to any or all of the following means of disposition or change in use of land held for a public purpose: conveyance of land; long-term lease for inconsistent use; short-term lease, two years or less, for an inconsistent use; the granting or giving of an easement for an inconsistent use; or any agency action with regard to land under its control if an inconsistent use?

The proposed amendment to the Constitution was agreed to by the majority of the members of the Senate and the House of Representatives, in joint session, on August 5, 1969 and again on May 12, 1971, and became part of the Constitution by approval by the voters at the state election next following, on November 7, 1972. The full text of Article 97 is as follows:

ART. XCVII. Article XLIX of the Amendments to the Constitution is hereby annulled and the following is adopted in place thereof:—The people shall have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and aesthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose.

The general court shall have the power to enact legislation necessary or expedient to protect such rights.

In the furtherance of the foregoing powers, the general court shall have the power to provide for the taking, upon payment of just compensation therefor, or for the acquisition by purchase or otherwise, of lands and easements or such other interests therein as may be deemed necessary to accomplish these purposes.

Lands and easements taken or acquired for such purposes shall not be used for other purposes or otherwise disposed of except by laws enacted by a two thirds vote, taken by yeas and nays, of each branch of the general court.

I. QUESTION ONE

The first question of the House of Representatives asks, in effect, whether the two-thirds roll-call vote requirement is retroactive, to be applied to lands and easements acquired prior to the effective date of Article 97, November 7, 1972. For the reasons below, I answer in the affirmative.

The Legislature did not propose this Amendment nor was it approved by the voting public without a sense of history nor void of a
purpose worthy of a constitutional amendment. Examination of our constitutional history firmly establishes that the two-thirds roll-call vote requirement applies to public lands wherever taken or acquired.

Specifically, Article 97 annuls Article 49, in effect since November 5, 1918. Under that Article the Legislature was empowered to provide for the taking or acquisition of lands, easements and interests therein “for the purpose of securing and promoting the proper conservation, development, utilization and control” [of] “agricultural, mineral, forest, water and other natural resources of the commonwealth.” Although inclusion of the word “air” in this catalogue as it appears in Article 97 may make this new article slightly broader than the supplanted Article 49 as to purposes for which the Legislature may provide for the taking or acquisition of land, it is clear that land taken or acquired under the earlier Article over nearly fifty years is now to be subjected to the two-thirds vote requirement for changes in use or other dispositions. Indeed all land whenever taken or acquired is now subject to the new voting requirement. The original draftsmen of the Massachusetts Constitution prudently included in Article 10 of the Declaration of Rights a broad constitutional basis for the taking of private land to be applied to public uses, without limitation on what are “public uses.” By way of acts of the Legislature as well as through generous gifts of many citizens, the Commonwealth and Massachusetts cities and towns have acquired parkland and reservations. To claim that new Article 97 does not give the same care and protection for all these existing public lands as for lands acquired by the foresight of future legislators or the generosity of future citizens would ignore public purposes deemed important in Massachusetts laws since the beginning of the Commonwealth.

Moreover, if this amendment were only prospective in effect, it would be virtually meaningless. In Massachusetts, with a life commencing in the early 1600s and already cramped for land, it is most unlikely that the Legislature and the voters would choose to protect only those acres hereafter added to the many thousands already held for public purposes. The comment of the Massachusetts Supreme Judicial Court concerning the earlier Article 49 is applicable here: “It must be presumed that the convention proposed and the people approved and ratified the Forty-ninth Amendment with reference to the practical affairs of mankind and not as a mere theoretical announcement.”
II. QUESTION TWO

In its second question the House asks, in effect, whether the two-thirds roll-call vote requirement applies to land held for park purposes, as the term "park" is generally understood. My answer is in the affirmative, for the reasons below.

One major purpose of Article 97 is to ensure that the people shall have "the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment." The fulfillment of these rights is uniquely carried out by parkland acquisition. As the Supreme Judicial Court has declared:

The healthful and civilizing influence of parks in or near congested areas of population is of more than local interest and becomes a concern of the State under modern conditions. It relates not only to the public health in its narrow sense, but to broader considerations of exercise, refreshment, and enjoyment.4

A second major purpose of Article 97 is "the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources." Parkland protection can afford not only the conservation of forests, water and air but also a means of utilizing these resources in harmony with their conservation. Parkland can undeniably be said to be acquired for the purposes in Article 97 and is thus subject to the two-thirds roll-call requirement.

This question as to parks raises a further practical matter in regard to implementing Article 97 which warrants further discussion. The reasons the Legislature employs to explain its actions can be of countless levels of specificity or generality and land might conceivably be acquired for general recreation purposes or for very explicit uses such as the playing of baseball, the flying of kites, for evening strolls or for Sunday afternoon concerts. Undoubtedly, to the average man, such land would serve as a park but at even a more legalistic level it clearly can also be observed that such land was acquired, in the language of Article 97, because it was a "resource" which could best be "utilized" and "developed" by being "conserved" within a park. But it is not surprising that most land taken or acquired for public use is acquired under the specific terms of statutes which may not match verbatim the more general terms found in Article 10 of the Declaration of Rights of the Constitution or in Articles 39, 43, 49, 51 and 97 of the Amendments. Land originally acquired for limited or specific public purposes is thus not to
be excluded from the operation of the two-thirds roll-call vote requirement for lack of express invocation of the more general purposes of Article 97. Rather the scope of the Amendment is to be very broadly construed, not only because of the greater breadth in “public purpose”, changed from “public uses” appearing in Article 49, but also because Article 97 establishes that the protection to be afforded by the Amendment is not only of public uses but of certain express rights of the people.

Thus, all land, easements and interests therein are covered by Article 97 if taken or acquired for “the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources” as these terms are broadly construed. While small greens remaining as the result of constructing public highways may be excluded, it is suggested that parks, monuments, reservations, athletic fields, concert areas and playgrounds clearly qualify. Given the spirit of the Amendment and the duty of the Legislature, it would seem prudent to classify lands and easements taken or acquired for specific purposes not found verbatim in Article 97 as nevertheless subject to Article 97 if reasonable doubt exists concerning their actual status.

III. QUESTION THREE

The third question of the House asks, in effect, how the words “natural resources”, as appearing in Article 97, are to be defined.

Several statutes offer assistance to the Legislature, all without limiting what are “natural resources”. Massachusetts General Laws (M.G.L.) ch. 21, §1 defines “natural resources”, for the purposes of Department of Natural Resources jurisdiction, as including:

- ocean, shellfish and inland fisheries; wild birds, including song and insectivorous birds, wild mammals and game; sea and fresh water fish of every description; forests and all uncultivated flora, together with public shade and ornamental trees and shrubs; land, soil and soil resources, lakes, ponds, streams, coastal, underground and surface waters; minerals and natural deposits.

In addition, M.G.L. ch. 12, §11D, establishing a Division of Environmental Protection under the Attorney General, uses the words “natural resources” in such a way as to include air, water, “rivers, streams, flood plains, lakes, ponds or other surface or subsurface water resources” and “seashores, dunes, marine resources, wetlands, open spaces, natural areas, parks or historic districts or sites.” M.G.L. ch. 214, §10A, the so-called citizen-suit statute, con-
tains a recitation substantially identical. To these lists Article 97 would add only "agricultural" resources.

It is safe to say, as a consequence, that the term "natural resources" should be taken to signify at least these catalogued items. Public lands taken or acquired to conserve, develop or utilize any of these resources are thus subject to Article 97.

It is apparent that the Legislature has never sought to apply any limitation to the term "natural resources" but instead has viewed the term as an evolving one which should be expanded according to the needs of the time and the term was originally inserted in our Constitution for just that reason.\(^5\) The resources enumerated above should, therefore, be regarded as examples of and not delimiting what are "natural resources."

IV. QUESTION FOUR

The fourth question of the House requires a determination of the scope of activities which is intended by the words: "shall not be used for other purposes or otherwise disposed of."

The term "disposed" has never developed a precise legal meaning. As the Supreme Court has noted, "The word is nomen generalissimum, and standing by itself, without qualification, has no technical signification."\(^6\) The Supreme Court has indicated however, that "disposition" may include a lease.\(^7\) Other cases on unrelated subjects suggest that in Massachusetts the word "dispose" can include all forms of transfer no matter how complete or incomplete.\(^8\)

In this absence of precise legal meaning, Webster's Third New International Dictionary is helpful. "Dispose of" is defined as "to transfer into new hands or to the control of someone else." A change in physical or legal control would thus prove to be determinative.

I therefore conclude that the "dispositions" for which a two-thirds roll-call vote of each branch of the General Court is required include: transfers of legal or physical control between agencies of government, between political subdivisions, and between levels of government, of lands, easements and interests therein originally taken or acquired for the purposes stated in Article 97, and transfers from public ownership to private. Outright conveyance, takings by eminent domain, long-term and short-term leases of whatever length, the granting or taking of easements and all means of transfer or change of legal or physical control are thereby covered, without limitation and without regard to whether the transfer be for the same or different uses or consistent or inconsistent purposes.

This interpretation affords a more objective test, and is more
easily applied, than “used for other purposes.” Under Article 97 that standard must be applied by the Legislature, however, in circumstances which cannot be characterized as a disposition—that is, when a transfer or change in physical or legal control does not occur. A change of use within a governmental agency or within a political subdivision would serve as an apt example. Within any agency or political subdivision any land, easement or interest therein, if originally taken or acquired for the purposes stated in Article 97, may not be “used for other purposes” without the requisite two-thirds roll-call vote of each branch of the Legislature.

It may be helpful to note how Article 97 is to be read with the so-called doctrine of “prior public use,” application of which also turns on changes in use. That doctrine holds that

public lands devoted to one public use cannot be diverted to another inconsistent public use without plain and explicit legislation authorizing the diversion.9

The doctrine of “prior public use” is derived from many early cases which establish its applicability to transfers between corporations granted limited powers of the Commonwealth, such as eminent domain, and authority over water and railroad easements.10 The doctrine was also applied at an early date to transfers between such corporations and municipalities and counties.11

The doctrine of “prior public use” has in more modern times been applied to the following transfers between governmental agencies or political subdivisions: (1) a transfer between state agencies;12 (2) transfers between a state agency and a special state authority;13 (3) a transfer between a special state commission and special state authority;14 (4) transfers between municipalities;15 (5) transfers between state agencies and municipalities;16 (6) a transfer between a special state authority and a municipality;17 (7) a transfer between a state agency and a county;18 and (8) transfers between counties and municipalities.19

The doctrine has also been applied to the following changes of use of public lands within governmental agencies or within political subdivisions: (1) intra-agency uses;20 (2) intramunicipality uses;21 and (3) intracounty uses.22 The doctrine may also possibly reach de facto changes in use,23 and may be available to protect reservation land held by charitable corporations.24 In addition to these extensions of the doctrine, special statutory protections, codifying the doctrine of “prior public use”, are afforded local parkland and commons25 and public cemeteries.26

This is the background against which Article 97 was approved.
The doctrine of "prior public use" requires legislative action, by majority vote, to divert land from one public use to another inconsistent public use. As the scope of the doctrine discussed above indicates, the doctrine requires an act of the Legislature regardless of whether the land in question is held by the Commonwealth, its agencies, special authorities and commissions, political subdivisions or by certain corporations granted powers of the sovereign. And the doctrine applies regardless of whether the public use for which the land in question is held in a conservation purpose.

As to all such changes in use previously covered by the doctrine of "prior public use" the new Article 97 will only change the requisite vote of the Legislature from majority to two-thirds. Article 97 is designed to supplement, not supplant, the doctrine of "prior public use."

Article 97 will be of special significance, though, where the doctrine of "prior public use" has not yet been applied. For instance, legislation and a two-thirds roll-call vote of the Legislature will now, for the first time, be required even where a transfer of land or easement between governmental agencies, between political subdivisions, or between levels of government is made with no change in the use of the land, and even where a transfer is from public control to private.

Whether legislation pending before the General Court is subject to Article 97, or the doctrine of "prior public use," or both, it is recommended that the legislation meet the high standard of specificity set by the Supreme Judicial Court in a case involving the doctrine of "prior public use":

We think it is essential to the expression of plain and explicit authority to divert [public lands] to a new and inconsistent public use that the Legislature identify the land and that there appear in the legislation not only a statement of the new use but a statement or recital showing in some way legislative awareness of the existing public use. In short, the legislation should express not merely the public will for the new use but its willingness to surrender or forgo the existing use.27

Each piece of legislation which may be subject to Article 97 should, in addition, be drawn so as to identify the parties to any planned disposition of the land.

Conclusions

Article 97 of the Amendments to the Massachusetts Constitution establishes the right of the people to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, his-
totic and esthetic qualities of their environment. The protection of
the people in their right to the conservation, development and utiliza-
tion of the agricultural, mineral, forest, water, air and other natu-
ral resources is declared to be a public purpose. Lands, easements
and interests therein taken or acquired for such public purposes are
not to be disposed of or used for other purposes except by two-thirds
roll-call vote of both the Massachusetts Senate and House of Repre-
sentatives.

Answering the questions of the House of Representatives, I advise
that the two-thirds roll-call vote requirement of Article 97 applies
to all lands, easements and interests therein whenever taken or
acquired for Article 97 conservation, development or utilization pur-
oposes, even prior to the effective date of Article 97, November 7,
1972. The Amendment applies to land, easements and interests
therein held by the Commonwealth, or any of its agencies or politi-
cal subdivisions, such as cities, towns and counties.

I advise that “natural resources” given protection under Article
97 would include at the very least, without limitation: air, water,
wetlands, rivers, streams, lakes, ponds, coastal, underground and
surface waters, flood plains, seashores, dunes, marine resources,
ocean, shellfish and inland fisheries, wild birds including song and
insectivorous birds, wild mammals and game, sea and fresh water
fish of every description, forests and all uncultivated flora, together
with public shade and ornamental trees and shrubs, land, soil and
soil resources, minerals and natural deposits, agricultural resources,
open spaces, natural areas, and parks and historic districts or sites.

I advise that Article 97 requires a two-thirds roll-call vote of the
Massachusetts Senate and House of Representatives for all transfers
between agencies of government and between political subdivisions
of lands, easements or interests therein originally taken or acquired
for Article 97 purposes, and transfers of such land, easements or
interests therein from one level of government to another, or from
public ownership to private. This is so without regard to whether the
transfer be for the same or different uses or consistent or inconsist-
ent purposes. I so advise because such transfers are “dispositions”
under the terms of the new Amendment, and because “disposition”
includes any change of legal or physical control, including but not
limited to outright conveyance, eminent domain takings, long and
short-term leases of whatever length and the granting or taking of
easements.

I also advise that intra-agency changes in uses of land from Arti-
cle 97 purposes, although they are not “dispositions”, are similarly
subject to the two-thirds roll-call vote requirement.

Read against the background of the existing doctrine of “prior public use”, Article 97 will thus for the first time require legislation and a special vote of the Legislature even where a transfer of land between governmental agencies, between political subdivisions or between levels of government results in no change in the use of land, and even where a transfer is made from public control to private. I suggest that whether legislation pending before the General Court is subject to Article 97, or the doctrine of “prior public use”, or both, the very highest standard of specificity should be required of the draftsmen to assure that legislation clearly identifies the locus, the present public uses of the land, the new uses contemplated, if any, and the parties to any contemplated “disposition” of the land.

In short, Article 97 seeks to prevent government from ill-considered misuse or other disposition of public lands and interests held for conservation, development or utilization of natural resources. If land is misused a portion of the public’s natural resources may be forever lost, and no less so than by outright transfer. Article 97 thus provides a new range of protection for public lands far beyond existing law and much to the benefit of our natural resources and to the credit of our citizens.

Footnotes

*Attorney General, Commonwealth of Massachusetts.
1Article 97 of the Articles of Amendment, Constitution of Massachussetts.
2Mass. H. 6085 (1973); this article is an edited version of the letter which I sent to Hon. David M. Bartley, Speaker of the House of Representatives, on June 6, 1973, in response to those questions.
4Higginson v. Treasurer and School House Commissioners of Boston, 212 Mass. 583, 590 (1912); see also, Higginson v. Inhabitants of Nahant, 11 Allen 530, 536 (Mass. 1866).
6Phelps v. Harris, 101 U.S. 370, 381 (1880).

See, e.g., Boston and Albany Railroad Company v. City Council of Cambridge, 166 Mass. 224 (1896) (eminent domain taking of railroad land); Eldredge v. County Commissioners of Norfolk, 185 Mass. 186 (1904) (eminent domain taking of railroad easement); West Boston Bridge v. County Commissioners of Middlesex, 10 Pick. 270 (Mass. 1830) (eminent domain taking of turnpike land); and Inhabitants of Springfield v. Connecticut River Railroad Co., 4 Cush. 63 (1849) (eminent domain taking of a public way).


City of Boston v. Inhabitants of Brookline, 156 Mass. 172 (1892) (eminent domain taking of a water easement); Inhabitants of Quincy v. City of Boston, 148 Mass. 389 (1889) (eminent domain taking of a public way).


Abbott v. Commissioners of Dukes County, 357 Mass. 784 (1970) (Department of Natural Resources grant of navigation easement).

Town of Needham v. County Commissioners of Norfolk, 324 Mass. 293 (1949) (eminent domain taking of common and park lands); Inhabitants of Easthampton v. County Commissioners of Hampshire, 154 Mass. 424 (1891) (eminent domain taking of school lot).

Higginson v. Treasurer and School House Commissioners of Boston, 212 Mass. 583 (1912) (erecting a building on a public park); see, Kean v. Stetson, 5 Pick. 492 (1827) (road built adjoining a river).


M.G.L. ch. 45.

M.G.L. ch. 114, §§17, 41; as to changes in use of public lands held by municipalities or counties generally see, M.G.L. ch. 40 §15A; ch. 214, §3(11).

Exhibit 8 to West Roxbury Motion for Rehearing: Mahajan v. DPU
SANJOY MAHAJAN & others1 vs. DEPARTMENT OF ENVIRONMENTAL PROTECTION & another.2

1 Victor Brogna, Stephanie Hogue, David Kubiak, Mary McGee, Anne M. Pistorio, Thomas Schiavoni, Pasqua Scibelli, Robert Skole, and Patricia Thiboutot.
2 Boston Redevelopment Authority (BRA).

SJC-11134

SUPREME JUDICIAL COURT OF MASSACHUSETTS

464 Mass. 604; 984 N.E.2d 821; 2013 Mass. LEXIS 47

November 5, 2012, Argued
March 15, 2013, Decided

PRIOR HISTORY: [***1]

Suffolk. Civil action commenced in the Superior Court Department on February 26, 2010. The case was heard by Elizabeth M. Fahey, J., on motions for judgment on the pleadings. The Supreme Judicial Court granted an application for direct appellate review.

HEADNOTES


COUNSEL: Denise A. Chicoine for Boston Redevelopment Authority.

Annapurna Balakrishna, Assistant Attorney General, for Department of Environmental Protection.


The following submitted briefs for amici curiae:

Heather Maguire Hoffman for Shirley Kressel.

Thomas B. Bracken for The Sierra Club.


JUDGES: Present: Ireland, C.J., Spina, Cordy, Botsford, Gants, Duffly, & Lenk, JJ.

OPINION BY: CORDY

OPINION

[*605] [**823] CORDY, J. This action arises from the Department of Environmental Protection's (department's) issuance of a waterways license under G. L. c. 91 (chapter 91 license) to the Boston Redevelopment Authority (BRA) to redevelop a section of land owned by the BRA on the seaward end of Long Wharf (project site). The plaintiffs, ten residents of Boston's North End neighborhood, appealed the issuance of the chapter 91 license to the department's office of appeals and dispute resolution, and ultimately to a judge in the Superior Court, claiming the department acted unconstitutionally and beyond its statutory authority when it issued the chapter 91 license without
obtaining a two-thirds vote of the Legislature as required by art. 97 of the Amendments to the Massachusetts Constitution. On cross motions for judgment on the pleadings, the motion judge ordered declaratory relief and issued a writ of mandamus ordering the department to enforce art. 97. We granted the BRA's application for direct appellate review. We are presented with two principal questions: Whether the project site, which the BRA took by eminent domain for urban renewal purposes, is subject to art. 97; and if art. 97 does apply, whether the department may issue the chapter 91 license to the BRA without triggering the requirement of a two-thirds vote of the Legislature. We conclude that the project site is not subject to art. 97.

3 Article 97 of the Amendments to the Massachusetts Constitution, approved and ratified on November 7, 1972, superseded art. 49 of the Amendments, but preserved the right of the people to enjoy the natural resources of the Commonwealth. [***3] We refer to the provision as art. 97.

4 We acknowledge the amicus briefs submitted by Shirley Kressel and the Sierra Club, as well as the brief submitted by the Conservation Law Foundation, the Massachusetts Association of Conservation Commissions, the Nature Conservancy, and the Trustees of Reservations.

1. Background. a. The BRA and the 1964 urban renewal plan. [*606] The BRA is both a "redevelopment authority" under G. L. c. 121B, § 4, and an "urban renewal agency" under G. L. c. 121B, § 9. Additionally, it serves as the planning board for the city of Boston and monitors private development under G. L. c. 121A. See St. 1960, c. 652, §§ 12-14.


The BRA's urban renewal powers and duties are enumerated throughout G. L. c. 121B, particularly in § 11 and §§ 45-57A. The legislative goals of G. L. c. 121B are to "eliminate[e] decadent, substandard, or blighted [***4] open" areas and to promote sound [***824] community growth. G. L. c. 121B, § 45. See G. L. c. 121B, § 1 (defining decadent, substandard, and blighted open areas). The BRA is vested with the authority to effectuate the goals of urban renewal through land assembly, title confirmation, public financial assistance, and development and design controls, all of which enable the BRA to guide private sector development toward areas in need. See G. L. c. 121B, §§ 46-57A. Perhaps the most significant power granted to the BRA is the power of eminent domain, which G. L. c. 121B confers on the BRA as is "necessary or reasonably required to carry out the purposes of [c. 121B]." G. L. c. 121B, § 11 (d), such purposes being the elimination of "decadent, substandard or blighted open conditions." G. L. c. 121B, § 45.

6 General Laws c. 121B grants the power of eminent domain to urban renewal agencies and otherwise provides for the acquisition and disposition of land pursuant to the purposes of urban renewal. A number of statutory sections discuss this power. General Laws c. 121B, § 11, provides: "Each operating agency shall have the powers . . . (d) To take by eminent domain . . . any property, real or personal, [***5] or any interest therein, found by it to be necessary or reasonably required to carry out the purposes of this chapter."

General Laws c. 121B, § 45, provides:

"It is hereby declared . . . that the acquisition of property for the purpose of eliminating decadent, substandard, or blighted open conditions thereon and preventing recurrence of such conditions in the area, the removal of structures and improvement of sites, the disposition of the property for redevelopment incidental to the foregoing, [and] the exercise of powers by urban renewal agencies . . . are public uses and purposes for which public money may be expended and the power of eminent domain exercised . . . ."

General Laws c. 121B, § 47, provides:

"Notwithstanding any contrary provision of this chapter, an urban renewal agency may . . . take by eminent domain, as provided in clause (d) of section eleven . . . or acquire by purchase, lease, gift, bequest or grant, and hold, clear, repair, operate and, after having taken or acquired the same, dispose of land constituting the whole or any part or parts of any area which . . . it has determined to be a decadent, substandard or
Pursuant to the Downtown Waterfront-Faneuil Hall urban renewal plan, dated April 15, 1964 (1964 urban renewal plan), and an order of taking, dated June 4, 1970, which incorporated that plan, the BRA acquired the project site in 1970 as part of a larger taking by eminent domain of the Long Wharf area (1970 taking). In accordance with the legislative goals of G. L. c. 121B, the 1964 urban renewal plan provides in Section 201:

"The basic goal of urban renewal action in the Downtown Waterfront-Faneuil Hall Area is to stimulate and to facilitate development efforts in the area, by eliminating those severe conditions of blight, deterioration, obsolescence, traffic congestion and incompatible land uses which hinder private investment in new development without the aid of governmental action, in order to (1) revitalize a key portion of downtown Boston; (2) upgrade the pattern of land uses close by the North End residential community; (3) establish a functional connection between the area and its surrounding districts: the North End, the Government Center and the Financial District; and (4) provide an environment suitable to the needs of contemporary real estate development."

Section 202 of the Downtown Waterfront-Faneuil Hall urban renewal plan, dated April 15, 1964 (1964 urban renewal plan), also outlines several planning objectives, which are as follows:

"(1) To eliminate a pattern of land uses and blighting conditions which
(a) creates severe traffic congestion in the area;
(b) exerts a depressing effect on adjacent areas;
(c) inhibits the development of real property to its fullest economic potential.
(2) To eliminate obsolete and substandard building conditions which are a factor in spreading blight to adjacent areas.
(3) To prevent the further erosion of property values.
(4) To protect and strengthen the tax base of the city.
(5) To encourage productive and intensive use of land.
(6) To create opportunities for development of a downtown residential community offering a range of housing types and rentals.
(7) To provide sites suitable for the construction of efficient, economical buildings.
(8) To promote the preservation and enhancement of buildings in the Project Area which have architectural and historical significance.
(9) To create an environment which is conducive to the investment of funds in rehabilitation, conversion and general upgrading of property.
(10) To create an area with a mixture of land uses compatible with living, working and recreational opportunities.
(11) To create an area for the development of marine or marine-oriented activities designed to stimulate tourism and symbolize the importance of Boston's historic relationship to the sea.
(12) To provide for the efficient flow of traffic within and through the area.
(13) To improve streets and utilities and the landscaping of public areas.
(14) To provide public ways,
parks and plazas which encourage the pedestrian to enjoy the harbor and its activities.

"(15) To develop the area in such a way as to stimulate improvements in adjacent areas."

[*608] **825] b. The project site. The project site is a section of land at the eastern end of Long Wharf on which sits an open-air brick structure known as Long Wharf Pavilion. The BRA continues to hold and maintain Long Wharf, including the project site, pursuant to the 1964 urban renewal plan. Long Wharf is a designated national historic landmark, and is the site of water transportation, public transportation, hotels, retail establishments, and [*609] restaurants. It is also part of the Boston Harborwalk, a pedestrian walkway that lines the waterfront.

8 Although the 1964 urban renewal plan specified a forty-year effective period, the plan was amended in 2004 to be effective through April 30, 2015.

In 1983, the department permitted the Massachusetts Bay Transportation Authority to construct an emergency egress and ventilation shaft for the Blue Line subway tunnel, to be capped off by the structure now known as Long Wharf Pavilion. At the same time, the BRA undertook renovations to the plaza [***10] area surrounding the pavilion. The plaza measures approximately 33,000 square feet, is paved with granite flagstones, and features a large inlaid compass rose to the south of the pavilion. Other features include benches, public binoculars, and a flag pole. A segment of the Harborwalk lines the perimeter of the plaza. Although not discussed in much detail in the 1964 urban renewal plan, the plaza's current use is consistent with the plan's provision for an "observation platform" on Long Wharf.

9 The Department of Environmental Protection (department) was then referred to as the Department of Environmental Quality Engineering.

In addition to the 1964 urban renewal plan, the project site is also subject to Boston's Municipal Harbor Plan, which was approved in 1991 by the Secretary of the Executive Office of Environmental Affairs pursuant to 301 Code Mass. Regs. §§ 23.00 (2000) (municipal harbor plan). Among other objectives, the municipal harbor plan calls for the activation and revitalization of Boston's underutilized shoreline "by promoting growth through private investment [*826] that is appropriately designed, and is a balanced mix of uses that bring vitality to the waterfront and public [*11] benefits and amenities that are shared by all Boston residents." The municipal harbor plan was designed to complement waterways regulations that accompanied G. L. c. 91, already applicable to much of the waterfront area.

Considering the project site to be underutilized, the BRA proposed a plan in 2008 to redevelop it by enclosing and expanding the pavilion to accommodate a restaurant with outdoor seating, "takeout service," and a bar. Specifically, the BRA planned to expand the 3,430 square foot pavilion by 1,225 square feet. In addition to the restaurant, the proposed redevelopment includes shaded seating, restrooms, and several sets of binoculars, all available to the public independent of patronage of the restaurant. The proposed redevelopment is intended to allow year-round [*610] use of the pavilion and provide facilities and seating to the large number of pedestrians and water transit users who frequent the area.


The department granted the chapter 91 license to the BRA on September 17, 2008. The plaintiffs appealed. They argued that the proposed restaurant would create unnecessary noise and would damage public open space, parkland, and scenic quality. On January 29, 2010, the commissioner of the department issued a final decision affirming the issuance of the chapter 91 license. The plaintiffs appealed from that final decision to the Superior Court, seeking a declaratory judgment under G. L. c. 231A and a writ of mandamus under G. L. c. 249, § 5, ordering the department to enforce the requirements of art. 97 by seeking a two-thirds vote of the Legislature prior to issuing the license. The motion judge concluded that because the 1964 urban renewal plan aimed to create parkland, open space, and a [*611] means of utilizing and enjoying the harbor, it served art. 97 purposes and [***13] was therefore subject to art. 97. The judge further concluded that the issuance of the chapter 91 license constituted a transfer of legal control from the department to the BRA sufficient to effect a disposition, as well as a change in use of the land, both of which triggered the two-thirds vote requirement. Accordingly, the judge granted the plaintiffs' requested relief.

10 The standard for granting a waterways
license under G. L. c. 91 (chapter 91 license) for a nonwater dependent use (like the proposed restaurant) on filled tidelands is a finding by the department that the use "shall serve a proper public purpose and that said purpose shall provide a greater public benefit than public detriment to the rights of the public in said lands." G. L. c. 91, § 18.

The plaintiffs filed their appeal from the department's office of appeals and dispute resolution (OADR) on October 9, 2008, and at a prescreening conference on December 3, 2008, the parties established a list of issues for resolution. Those issues pertained only to the chapter 91 license and did not include the art. 97 issue. In a motion for summary decision filed on February 24, 2009, the plaintiffs [*14] raised the art. 97 issue for the first time. The BRA and the department countered by asserting that art. 97 is outside the department's express statutory authority. Based on that assertion, the OADR hearing officer (and, by adoption, the commissioner of the department) declined to consider the issue, and it was litigated for the first time in the Superior Court.

The plaintiffs also invoked G. L. c. 30A, § 14, arguing that the commissioner's decision was based on an error of law, and that issuance of the chapter 91 license was in contravention of G. L. c. 91 statutory and regulatory requirements. See note 10, supra. Because the judge disposed of the case on art. 97 grounds, she did not consider the plaintiffs' request for G. L. c. 30A review. Because the propriety of the chapter 91 license (apart from the potential art. 97 issue) was not reviewed in the Superior Court, it is not properly before us on appeal.

On appeal, the plaintiffs contend that the project site is subject to art. 97, and that the department's issuance of the chapter 91 license constituted a use or disposition triggering the two-thirds vote requirement. The BRA counters that art. 97 does not apply because the project [*15] site was not taken for art. 97 purposes. The department argues that it lacks the authority to interpret and apply art. 97, and that even if art. 97 did apply, the department's issuance of the chapter 91 license did not constitute a use or disposition triggering the vote requirement. Both defendants argue that the motion judge improperly voided the chapter 91 license through declaratory and mandamus relief.

2. Discussion. a. Applicability of art. 97. Article 97 was approved and ratified on November 7, 1972, superseding art. 49 of the Amendments. See note 3, supra. It provides, in pertinent part, as follows:

"The people shall have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose.

"The general court shall have the power to enact legislation necessary or expedient to protect such rights.

[*612] " . . .

"Lands and easements taken or acquired for such purposes shall not be used for [*16] other purposes or otherwise disposed of except by laws enacted by a two-thirds vote, taken by yeas and nays, of each branch of the general court." (Emphases added.)

The principal issue in this case concerns whether the project site, which the BRA took by eminent domain in 1970, was "taken" for art. 97 purposes. See Selectmen of Hanson v. Lindsay, 444 Mass. 502, 504-506, 829 N.E.2d 1105 (2005) (in order for art. 97 vote requirement to apply, land must have been taken or acquired for art. 97 purposes). Article 97 clearly states that its purposes are "the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources." In contrast, land taken for urban renewal purposes is generally understood to be taken "for the purpose of eliminating decadent, substandard or blighted open conditions." G. L. c. 121B, § 45. See Aaron v. Boston Redev. Auth., 66 Mass. App. Ct. 804, 807, 808, 810, 850 N.E.2d 1105 (2006) (in context of claim for prescriptive easement, land taken by BRA for urban renewal purposes held for "other public purpose," not conservation). Although as a practical matter, certain aspects of an urban renewal plan may accomplish goals similar to those outlined in [*17] rt. 97, the overarching purpose for which [*828] the land is taken is distinct from art. 97 purposes.

With that distinction in mind, the issue is whether the project site can nonetheless be characterized as having been "taken or acquired for [art. 97] purposes." Reported cases interpreting art. 97 are scarce. In concluding that the project site was taken for art. 97 purposes, the motion judge relied heavily on the June 6, 1973, opinion of then Attorney General Robert Quinn. See Rep. A.G., Pub. Doc. No. 12, at 139 (1973) (Quinn Opinion). Using the Quinn Opinion for guidance, she identified certain aims or objectives referenced in the
1964 urban renewal plan, including the creation of public ways, parks, open space, and plazas, and a means of utilizing and enjoying the harbor. Because those aims were consistent with the purposes of art. 97, the judge concluded that the project site, which realizes them, was taken for art. 97 purposes and is therefore subject to the two-thirds [*613] vote requirement. Not surprisingly, the plaintiffs rely extensively on the Quinn Opinion in their arguments before this court.

The Quinn Opinion was issued in response to a general inquiry from the Speaker of the House [***18] of Representatives regarding the applicability of art. 97, and was rendered without reference to any particular set of facts. Although the Quinn Opinion is entitled to careful judicial consideration on the question of the scope of art. 97 and the intent of its drafters, see Opinions of the Justices, 383 Mass. 895, 918, 424 N.E.2d 1092 (1981), citing Rep. A.G., Pub. Doc. No. 12, at 141 (concluding art. 97 applies retroactively), its interpretation of art. 97 is not binding in its particulars, and we are hesitant to afford it too much weight due to the generalized nature of the inquiry and the hypothetical nature of the response." See A.J. Cella, Administrative Law and Practice § 20, at 70-75 (1986) (discussing legal effect of opinions of the Attorney General).

13 It is highly unusual for an opinion of the Attorney General to be rendered on a hypothetical basis. See A.J. Cella, Administrative Law and Practice § 20, at 69 n.2 (1986) (Cella). Opinions of the Attorney General are rendered pursuant to G. L. c. 12, § 3, which provides for the rendering of legal advice by the Attorney General to State "departments, officers, and commissions" in matters relating to their official duties. Cella, supra at 69. [***19] "Opinions of the Attorney General are rendered solely upon factual situations which actually confront a given state department or agency, and not upon hypothetical questions or general requests for information." Id. at 69 n.2, citing Rep. A.G., Pub. Doc. No. 12, 114 (1967). An advisory opinion of the Attorney General "is entitled to careful judicial consideration and is generally regarded as highly persuasive." Cella, supra at 74 & n.37. However:

"[I]t is clear that the courts retain the power to determine for themselves on a case by case basis whether or not, and if so, to what extent, the courts agree or disagree with an advisory opinion of the Attorney General as to the proper interpretation of some issue of law."

Id. at 75.

The Quinn Opinion suggests a more expansive reading of art. 97 than we afford it today, and it may reasonably be read to support the plaintiffs' argument that the project site is subject to art. 97. We disagree with the Quinn Opinion to the extent it suggests that the vast majority of land taken for any public purpose may become subject to art. 97 if the taking or use even incidentally promotes the "conservation, development and utilization of the . . . forest, [***20] water and air," Rep. A.G., Pub. [*614] Doc. No. 12, at 142, or that the land simply displays some attributes of art. 97 land generally." Id. at 143. We also do not [**829] agree that the relatively imprecise language of art. 97 warrants [*615] an interpretation as broad as the Quinn Opinion would afford it, particularly in light of the practical consequences that would result from such an expansive application, as well as the ability of a narrower interpretation to serve adequately the stated goals of art. 97.

14 Unconstrained by a particular set of facts, the then Attorney General, in Rep. A.G., Pub. Doc. No. 12 (1973) (Quinn Opinion) paints a broad picture of the scope of art. 97. In response to the question, "Does the disposition or change of use of land held for park purposes require a two thirds vote . . . as provided in [art. 97], or would a majority vote of each branch be sufficient for approval?" the Quinn Opinion answered, "Yes," and then went on to suggest that the actual use, appearance, or attributes of a piece of land may be better evidence of the purpose for which it was taken or acquired than the language of the instrument effectuating the acquisition. Id. at 143. Its most expansive language [***21] reads:

"Th[e] question as to [the applicability of art. 97 to] parks raises a further practical matter in regard to implementing Article 97 which warrants further discussion. The reasons the Legislature employs to explain its actions can be of countless levels of specificity or generality and land might conceivably be acquired for general recreation purposes or for very explicit uses such as the playing of baseball, the flying of kites, for evening strolls or for Sunday afternoon concerts. Undoubtedly, to the average man, such land would serve as a park but at even a more legalistic level
it clearly can also be observed that such land was acquired, in the language of Article 97, because it was a 'resource' which could best be 'utilized' and 'developed' by being 'conserved' within a park. But it is not surprising that most land taken or acquired for public use is acquired under the specific terms of statutes which may not match verbatim the more general terms found in Article 10 of the Declaration of Rights of the Constitution or in Articles 39, 43, 49, 51 and 97 of the Amendments. Land originally acquired for limited or specified public purposes is thus not to be excluded from the operation [***22] of the two-thirds roll-call vote requirement for lack of express invocation of the more general purposes of Article 97. Rather the scope of the Amendment is to be very broadly construed, not only because of the greater breadth in 'public purpose,' changed from 'public uses' appearing in Article 49, but also because Article 97 establishes that the protection to be afforded by the Amendment is not only of public uses but of certain express rights of the people.

"Thus, all land, easements and interests therein are covered by Article 97 if taken or acquired for 'the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources' as these terms are broadly construed. While small greens remaining as the result of constructing public highways may be excluded, it is suggested that parks, monuments, reservations, athletic fields, concert areas and playgrounds clearly qualify. Given the spirit of the Amendment and the duty of the General Court, it would seem prudent to classify lands and easements taken or acquired for specific purposes not found verbatim in Article 97 as nevertheless subject [***23] to Article 97 if reasonable doubt exists concerning their actual status." (Emphases added.)

Id. at 142-143.

The critical question to be answered is not whether the use of the land incidentally serves purposes consistent with art. 97, or whether the land displays some attributes of art. 97 land, but whether the land was taken for those purposes, or subsequent to the taking was designated for those purposes in a manner sufficient to invoke the protection of art. 97. See Selectmen of Hanson v. Lindsay, 444 Mass. 502, 508-509, 829 N.E.2d 1105 (2005) (art. 97 protections may arise where subsequent to taking for purposes other than art. 97, land is "specifically designated" for art. 97 purpose by deed or other recorded restriction). See also Toro v. Mayor of Revere, 9 Mass. App. Ct. 871, 872, 401 N.E.2d 853 (1980) (applicability of art. 97 hinged on whether land had in fact been conveyed "to the conservation commission . . . to maintain and preserve it for the use of the public for conservation purposes"). In this case, while it can be argued that the project site displays some of the attributes of [***830] a park and serves the purpose of the utilization of natural resources -- in that it promotes access to the waterfront and the [***24] sea -- this specific use is incidental to the overarching purpose of urban renewal for which the land including the project site was originally taken. Cf. Benevolent & Protective Order of Elks, Lodge No. 65 v. Planning Bd. of Lawrence, 403 Mass. 531, 551-552, 531 N.E.2d 1233 (1988), citing Papadinis v. Somerville, 331 Mass. 627, 632, 121 N.E.2d 714 (1954) (any benefit from disposition to private redeveloper of land taken for urban renewal purposes is "incidental to the main purpose of the plan, which is the elimination of a substandard, decadent, or blighted open area").

15 As the motion judge noted, a bronze plaque located on the plaza designates the area as "Long Wharf Park," and the BRA's owned-land database identifies the area at the end of Long Wharf as a "park."

In Selectmen of Hanson v. Lindsay, supra, we held that a [*616] town meeting vote to designate for conservation purposes land that had originally been taken for tax purposes did not subject that land to art. 97 protections absent recordation of a restriction on the title. Without the execution or recordation of a deed containing the conservation restriction, the land "never became specifically designated for conservation purposes in the first instance" and accordingly [***25] "was not held for a specific purpose" under art. 97, so "compliance with the provisions of art. 97 . . . was not
required." *Id. at 508-509.* This was true despite the clear intent of the town meeting members to hold the property for conservation purposes. *Id. at 505.* As the plain language of art. 97 indicates, for land to be subject to the two-thirds vote requirement on disposition or use for other purposes, it must be "taken or acquired for [the] purpose" of protecting interests covered by art. 97. In *Selectmen of Hanson v. Lindsay*, supra at 508-509, where the property had indisputably been acquired as a tax forfeiture and held as general corporate property, the town had to deed the land to itself for conservation purposes -- or record an equivalent restriction on the deed -- in order for art. 97 to apply to subsequent dispositions or use for other purposes. Here, where the land at issue is but a small part of a much larger taking effectuated for the purposes of urban renewal, it is difficult to identify a "specific purpose" for which the project site was acquired or held that would clearly bring it within the protection of art. 97." See *id. at 509.*

16 We do not conclude that land taken [***26] pursuant to an urban renewal plan is automatically immune from art. 97. See note 19, infra.

Because the spirit of art. 97 is derived from the related doctrine of "prior public use," cases applying that doctrine inform our analysis. See Rep. A.G., Pub. Doc. No. 12, at 146 (prior public use doctrine "background against which [art. 97] was approved"). See also Rep. A.G., Pub. Doc. No. 14, 131 (1980) ("language of Article 97 must be read in conjunction with the judicially developed doctrine of 'prior public use'"). The prior public use doctrine holds that "public lands devoted to one public use cannot be diverted to another inconsistent public use without plain and explicit legislation authorizing the diversion." *Robbins v. Department of Pub. Works*, 355 Mass. 328, 330, 244 N.E.2d 577 (1969). See [*617] *Brookline v. Metropolitan Dist. Comm'n*, 357 Mass. 435, 440, 258 N.E.2d 284 (1970), and cases cited. However, that doctrine is only applicable "to those lands which are in fact 'devoted to one public use'" (emphasis added). [*831] *Muir v. Leominster*, 2 Mass. App. Ct. 587, 591, 317 N.E.2d 212 (1974), quoting *Robbins v. Department of Pub. Works*, supra. In the Muir case, the Appeals Court held the prior public use doctrine inapplicable to the sale for commercial [***27] purposes of a parcel of land, where that parcel had been conveyed to a city as a gift with no limitation on its use but was in fact used for thirty years as a playground and for other recreational purposes. *Muir v. Leominster*, supra at 588-589, 591 ("[i]n this case there had been neither prior legislative authorization of a taking for a particular purpose nor a prior public or private grant restricted to a particular purpose").

Here, as the motion judge highlighted, the 1964 urban renewal plan enumerates, among its listed planning and design objectives, certain objectives that are consistent with art. 97 purposes. The 1964 urban renewal plan also contains vague descriptions of the project site and Long Wharf generally that are consistent with its current use as an open space." Most significantly, § 202 of the 1964 urban renewal plan, entitled "Planning Objectives," states as one of its fifteen objectives, the objective "+[t]o provide public ways, parks and plazas which encourage the pedestrian to enjoy the harbor and its activities." In addition, in § 203, entitled "General Design Principles," the plan lists several design principles, including:

"3. To provide maximum opportunity for [***28] pedestrian access to the water's edge.

"4. To establish an orderly sequence and hierarchy of open spaces and views for both the pedestrian and the motorist.

"5. To establish a relationship between buildings, open [***618] spaces and public ways which provides maximum protection to the pedestrian during unfavorable weather conditions."

17 Section 204(1)(f) of the 1964 urban renewal plan, under the heading "Sub-Area Design Objectives," identifies a "developmental characteristic[" of the plan as: "The preservation or redevelopment of wharves which retain the historic tradition of fingers out into the harbor and create active and intimate water inlets. Long Wharf is to retain its historic position as the farthest projection of land into the harbor, and will become an observation platform."

By definition, *G. L. c. 121B* vests in the BRA the authority to take or acquire "decadent, substandard or blighted open area[s]" for the purpose of eliminating those undesirable conditions (emphasis added). See *G. L. c. 121B §§ 11, 45, 47*. However, it does not follow that, where a comprehensive urban renewal plan calls for some areas of a taking to be left open -- without a more specific and particularized invocation [***29] of art. 97 purposes unique to those areas that effectively designates those areas as separate and apart from the rest of the taking -- a two-thirds vote of the Legislature is required for any subsequent change in use or disposition of those open areas. Nor do we find sufficient to invoke art. 97 protection the fact that a comprehensive urban renewal plan may identify, among other objectives, some objectives that are consistent with art. 97 purposes, or where certain areas taken pursuant to that plan ultimately
display some attributes of art. 97 land. A contrary rule would be particularly nonsensical where the proposed change in use or disposition that would purportedly trigger the two-thirds vote is made in furtherance of the goals of the particular urban renewal plan and is otherwise appropriate.

Given the overarching purpose of the 1964 urban renewal plan to eliminate urban blight through the comprehensive redevelopment of the waterfront area, including its revitalization through the development of mixed uses and amenities, it cannot be said that the retention of certain open spaces, like the project site, is sufficiently indicative of an art. 97 purpose as to trigger a two-thirds vote of the Legislature should the BRA wish to slightly revise the use of certain spaces in a manner consistent with the objectives of the original urban renewal plan. The fact that the 1964 Urban Renewal Plan (which covered a large section of downtown Boston) provided in general terms for open spaces and pedestrian access to the water's edge is itself insufficient to invoke protections for parts of the original taking that ultimately serve those general purposes. The single, fleeting reference in the 1964 urban renewal plan to an "observation platform" on Long Wharf similarly fails to adequately invoke the specific purposes of art. 97.

18 Section 1101 of the 1964 urban renewal plan provides for modification of the plan, stating:

"The Urban Renewal Plan may be modified at any time by the Boston Redevelopment Authority provided that, if the general requirements, controls, or restrictions applicable to any part of the Project Area shall be modified after the lease or sale of such part, the modification is consented to by the Developer or Developers of such part or their successors and assigns. Where proposed modifications will substantially or materially alter or change the Plan, the modifications must be approved by the Boston City Council and the State Division of Urban and Industrial Renewal." Although a modification clause certainly cannot serve as a unilateral bar to the application of art. 97, the provision for modification demonstrates the often fluid purposes for which land is taken pursuant to an urban renewal plan.

Nevertheless, we disagree with the BRA's contention that it cannot possibly take land for art. 97 purposes pursuant to its urban renewal powers under G. L. c. 121B. The purposes served by urban renewal and by art. 97 are not mutually exclusive. Certainly, for the BRA to take land by eminent domain, it must exist in a "decadent, substandard, or blighted" condition. However, where an urban renewal plan accompanying a taking clearly demonstrates a specific intent to reserve particular, well-defined areas of that taking for art. 97 purposes, the BRA conceivably may take land for such purposes while remaining within its statutory authority. The recording of a restriction on the use of land subsequent to a taking may also place land within the protections of art. 97. See Selectmen of Hanson v. Lindsay, 444 Mass. 502, 504-506, 829 N.E.2d 1105 (2005). Furthermore, we disagree with the BRA that the language of an order of taking is necessarily determinative of the applicability of art. 97. Under certain circumstances not present here, the ultimate use to which the land is put may provide the best evidence of the purposes of the taking, notwithstanding the language of the original order of taking or accompanying urban renewal plan. See Quinn Opinion, supra at 142-143.

19 We note, for example, that relying on the Quinn Opinion, the office of the Attorney General concluded in a December 16, 1997, letter to the BRA director that City Hall Plaza in Boston was subject to art. 97 and a two-thirds vote of the Legislature was required to approve the construction of a hotel and parking garage on the site. The Attorney General's letter relied primarily on the language of the Government Center urban renewal plan, which specifically stated that the site of City Hall Plaza "shall be devoted to public open space," as well as the BRA's description of the Plaza at the unveiling of the plan in 1963:

"The strong focal point of the Government Center will be the new City Hall and the Government Center Plaza. Comparable as a monumental public space to the most famous squares in Europe . . . (the) City Hall and the new plaza together will be comparable in function and relationship to the town meeting house and common in an old-time New England village" (emphasis in original).
b. Occurrence of triggering condition. Even if art. 97 did apply to the project site, the issue would remain whether the department's issuance of the chapter 91 license constituted a disposition or change in use of the land triggering the two-thirds vote requirement. Although not necessary to our holding, we briefly address the issue.

The answer to this question depends on whether the chapter 91 license is in fact a mere license, or if it is more properly characterized as an easement. Although the granting of an easement over art. 97 land constitutes a disposition triggering the two-thirds vote requirement, a disposition of any lesser property interest does not. See Opinions of the Justices, 383 Mass. 895, 919, 424 N.E.2d 1092 (1981) (relinquishment by Commonwealth of any vestigial property interests in tidelands other than "lands and easements" would not trigger art. 97 voting requirement); Miller v. Commissioner of the Dep't of Envtl. Mgt., 23 Mass. App. Ct. 968, 969-970, 503 N.E.2d 666 (1987) (department's issuance [***34] of revocable one-year permit to operate ski area did not trigger two-thirds vote under art. 97).

General Laws c. 91, § 15, states that "the grant of a license" under that chapter "shall not convey a property right."[20] The [***621] BRA owns the project site, and accordingly, the BRA's right to lease the Long Wharf Pavilion to a restaurant operator derives not from the chapter 91 license, but from the fact that the BRA owns the land. The chapter 91 license merely certifies that the planned use, including the lease, complies with G. L. c. 91 and accompanying department regulations. It does not, as the motion judge concluded, transfer from the department to the BRA "an extent of legal control over the land at issue."[21] Any disposition triggering the [***834] art. 97 voting requirement would need to be granted by the BRA -- as would be the case with the lease to the restaurant operator -- not to the BRA.

20 In support of their argument that the chapter 91 license confers a property right on the BRA, the plaintiffs point out that the license is not revocable at will but only for noncompliance, lasts thirty years, runs with the land, and must be recorded to be valid. In addition, any revocation of the chapter [***35] 91 license is considered a taking that requires just compensation for "valuable structures, fillings, enclosures, uses or other improvements built, made or continued in compliance with said authorization or license." G. L. c. 91, § 15.

Furthermore, G. L. c. 91, § 15, provides:

"A license issued pursuant to this chapter is hereby made a mortgageable interest lawful for investment by any banking association, trust company, savings bank, cooperative bank, investment company, insurance company, executor, trustee, or other fiduciary, and any other person who is now or may hereafter be authorized to invest in any mortgage or other obligation of a similar nature."

We conclude that, while the aforementioned characteristics of the chapter 91 license acknowledge the economic value of the license, they do not make the license "tantamount to an easement," because the department has no property interest in the project site over which to grant an easement.

21 In concluding that the department's issuance of the chapter 91 license constituted a disposition of the land, the motion judge relied on language from the Quinn Opinion, supra at 144, stating that "all means of transfers or change of legal or [***36] physical control are thereby covered, without limitation." First, the notion that any change of legal or physical control no matter how small constitutes a disposition for art. 97 purposes conflicts with our opinion in Opinions of the Justices, 383 Mass. 895, 918, 424 N.E.2d 1092 (1981), issued after the Quinn Opinion, and with the Appeals Court's holding in Miller v. Commissioner of the Dep't of Envtl. Mgt., 23 Mass. App. Ct. 968, 969-970, 503 N.E.2d 666 (1987). Second, and perhaps more important, in issuing the chapter 91 license, the department has not transferred legal control over the project site. As the agency charged with enforcing G. L. c. 91, the department has no affirmative legal control over the project site; it is merely vested with the authority to ensure that uses that implicate G. L. c. 91 conform with its requirements and the accompanying regulations.

The chapter 91 license itself is "granted upon the express condition that any and all other applicable authorizations . . . shall be secured by the Licensee prior to the commencement of any activity or use authorized pursuant to this License" (emphasis in original). The license also states that it is "granted subject to all applicable Federal, State, [***37] County, and Municipal laws, ordinances and regulations." Even if, arguendo, the chapter 91 license created a property right, the right it created is a contingent [622] future interest and would not trigger the voting requirement until the interest vests on obtaining all necessary approvals.

Nor does the issuance of the chapter 91 license...
constitute a "use[] for other purposes" that would trigger the legislative vote. For lands to which art. 97 does apply, art. 97 legislative approval is likely just one of the many approvals a project proponent will need to acquire in order to proceed with the project. These approvals are issued by various State and local regulatory agencies and are largely independent of one another, yet all are necessary to proceed with the project. It would make little practical sense to condition the application for one such approval, in this case the chapter 91 license, on the successful application for another approval. The chapter 91 license facilitates the change in use in the same way the zoning variances and other necessary approvals do. A project proponent like the BRA could conceivably obtain the necessary approvals to change the use of land and, for myriad reasons, [***38] never follow through on the planned use. Article 97 requires a two-thirds vote of the Legislature prior to an actual change in use, not mere preparations for that change.

3. Conclusion. For the reasons discussed, we conclude that art. 97 does not apply to the project site and, therefore, a two-thirds vote of the Legislature is not required to approve the planned redevelopment. Because the motion judge did not review the issuance of the chapter 91 license pursuant to G. L. c. 30A, § 14, we remand the case to the Superior Court for proceedings consistent with this opinion. 22

22 We note, however, that with art. 97 inapplicable and relief in the form of mandamus therefore inappropriate, we have serious doubts whether the plaintiffs can demonstrate standing to otherwise challenge the chapter 91 license. The department's hearing officer concluded that the plaintiffs did not have standing because they failed to demonstrate that the issuance of the license may cause them to "suffer an injury in fact, which is different either in kind or magnitude from that suffered by the general public which is within the scope of the public interest protected by [G. L. c. 91]." See 310 Code Mass. Regs. § 9.02. [***39] In her final decision, the commissioner declined to adopt the hearing officer's finding of a lack of standing because of her conclusion that the plaintiffs' challenge failed on the merits.

So ordered.
Exhibit 9 to West Roxbury Motion for Rehearing: Eversource Map
Access Northeast

Exhibit 10 to West Roxbury Motion for Rehearing: LNG Article from Boston Globe
Gas Imports for US

Source: Energy Department

Jan. 2009
26.9 pb

Jan. 2010
56.4 pb

December 2014
8 pb

60 Billion Cubic Feet
Exhibit 11 to West Roxbury Motion for Rehearing: DOE Study
Natural Gas Infrastructure Implications of Increased Demand from the Electric Power Sector

February 2015
# Table of Contents

Executive Summary ........................................................................................................... v

1. Introduction ...................................................................................................................... 1
   1.1 Purpose of This Study ................................................................................................. 1
   1.2 Recent Developments in the U.S. Natural Gas Sector ............................................. 2
   1.3 Economics of Natural Gas Transmission .............................................................. 3
   1.4 Institutional Considerations .................................................................................... 4

2. Model Description, Limitations, and Scenarios ............................................................ 7
   2.1 Model Description .................................................................................................... 7
   2.2 Modeling Limitations .............................................................................................. 8
   2.3 Description of Scenarios ....................................................................................... 10

3. Model Results ................................................................................................................. 13
   3.1 Natural Gas Demand ............................................................................................. 13
   3.2 Natural Gas Supply ............................................................................................... 17
   3.3 Natural Gas Prices ................................................................................................. 18
   3.4 Natural Gas Transmission ...................................................................................... 20
   3.5 Expenditures on Natural Gas Transmission Infrastructure .................................. 26

4. Conclusion ..................................................................................................................... 31

Appendix A. Additional Figures ....................................................................................... 33
   Appendix A.1 Map of Electric Power Sector Natural Gas Demand Regions .............. 33
   Appendix A.2 Map of Lower 48 States Shale Plays .................................................... 34
   Appendix A.3 Map of Natural Gas Pipeline Expansion Regions ................................ 35

Appendix B. Electric Power Sector Results .................................................................... 37
Executive Summary

The natural gas sector in the United States has been fundamentally transformed by technological advancements in horizontal drilling and hydraulic fracturing that have enabled the economic extraction of natural gas from shale formations. This breakthrough has, in turn, unlocked new, geographically diverse natural gas resources that are unprecedented in size.

The availability of abundant, low-cost natural gas has increased demand for natural gas from multiple end-use sectors. In the electric power sector, which is currently the largest consumer of natural gas in the United States, the record-low natural gas prices during the month of April 2012 drove generation from natural gas to virtually match that of coal. While coal has regained some of its market share because of gradually rising natural gas prices, the combination of favorable economics and the lower conventional air pollution and greenhouse gas emissions associated with natural gas relative to other fossil fuels is likely to contribute to expanded use of natural gas in the electric power sector in the future.

However, increased use of natural gas in the electric power sector also presents some potential challenges. Unlike other fossil fuels, natural gas cannot typically be stored on-site and must be delivered as it is consumed. Because adequate natural gas infrastructure is a key component of electric system reliability in many regions, it is important to understand the implications of greater natural gas demand for the infrastructure required to deliver natural gas to end users, including electric generators.

The purpose of this study is to understand the potential infrastructure needs of the U.S. interstate natural gas pipeline transmission system under several future natural gas demand scenarios. Specifically, three scenarios were developed: a reference scenario and two scenarios with increased electric sector natural gas demand. Both increased demand scenarios—an Intermediate Demand Case and a High Demand Case—are based on a simple, illustrative national carbon policy applied to the electric power sector (not based on any real or proposed policy) that drives increased electric sector natural gas use. The Intermediate and High Demand Cases differ only in their underlying assumptions about coal-fired power plant retirements. In particular, the High Demand Case, which assumes greater coal-fired power plant retirements, is intended to be an upper-bound test case on natural gas consumption in the electric power sector.¹

To perform this analysis, the U.S. Department of Energy commissioned Deloitte MarketPoint to examine these scenarios in its North American Integrated Model (NAIM), which simultaneously models the electric power and the natural gas sectors.

¹ For a more detailed description of the scenarios considered in this analysis, see Section 2.3 Description of Scenarios.
The key findings of this analysis are the following:

**Key Finding 1: Diverse sources of natural gas supply and demand will reduce the need for additional interstate natural gas pipeline infrastructure.** The combination of a geographic shift in regional natural gas production—largely due to the expanded production of natural gas from shale formations—and growth in natural gas demand is projected to require expanded natural gas pipeline capacity. However, the rate of pipeline capacity expansion in the scenarios considered by this analysis is lower than the historical rate of natural gas pipeline capacity expansion. Pipeline capacity additions in the cases considered here are projected to be 38–42 billion cubic feet per day (Bcf/d) between 2015 and 2030. In comparison, between 1998 and 2013, nearly 127 Bcf/d of pipeline capacity was added in the United States. Because projected natural gas production and demand are geographically diverse, the need for additional interstate natural gas pipeline infrastructure is lower than would be expected if the increased production or demand were concentrated in a particular region. Furthermore, recent pipeline capacity additions that were placed in service between 2007 and the present in order to realign the U.S. natural gas transmission system with changing supply and demand conditions driven by increases in shale gas production are likely to reduce the need for future pipeline infrastructure.

**Key Finding 2: Higher utilization of existing interstate natural gas pipeline infrastructure will reduce the need for new pipelines.** The U.S. pipeline system is not fully utilized because flow patterns have evolved with changes in supply and demand. Increased demand for natural gas in the scenarios considered by this analysis does not lead to larger increases in pipeline capacity because, in some regions, available existing pipeline capacity is projected to be used before expanding existing pipelines or building new capacity. Given the cost of building new pipelines, finding alternative routes that utilize available existing pipeline capacity is often less costly than expanding pipeline capacity. While seasonality of demand requires pipelines to accommodate peak natural gas demand, the incremental demand from new base load natural gas generation in the scenarios considered in this analysis tends to be relatively uniform across the year. It is easier to accommodate this relatively uniform incremental natural gas demand on existing pipelines than it would be to accommodate demand that coincides more strongly with peak demand.

**Key Finding 3: Incremental interstate natural gas pipeline infrastructure needs in a future with an illustrative national carbon policy are projected to be modest relative to the Reference Case.** While a future carbon policy may significantly increase natural gas demand from the electric power sector, the projected incremental increase in natural gas pipeline capacity additions is modest relative to the Reference Case. In the Intermediate Demand Case, an incremental 1.4 Bcf/d (about 4% of total Reference Case capacity additions of 38 Bcf/d) of additional pipeline capacity above Reference Case levels is projected to be built. Similarly, in the High Demand Case, an incremental 3.9 Bcf/d (10% of total Reference Case capacity additions of 38 Bcf/d) of additional pipeline capacity above Reference Case levels is projected to be built. These relatively modest incremental additions follow from the system characteristics described previously and from the pipeline infrastructure attributes of the sources of incremental natural gas supply across the cases.
Key Finding 4: While there are constraints to siting new interstate natural gas pipeline infrastructure, the projected pipeline capacity additions in this study are lower than past additions that have accommodated such constraints. Siting energy infrastructure in the United States is a complex, multi-jurisdictional, and multidimensional process, with no two projects facing the same set of issues. While these barriers present potential challenges to expanding U.S. natural gas infrastructure, the Federal Energy Regulatory Commission (FERC) has authorities to facilitate siting of natural gas pipeline infrastructure. Similarly, while there are a number of institutional and other barriers to siting infrastructure and coordinating the natural gas and electric systems, there are multiple processes underway to address these issues. In addition, the projected pipeline capacity additions in this study (ranging from 38 to 42 Bcf/d across the cases from 2015 to 2030) are lower than past additions (127 Bcf/d of pipeline capacity was added from 1998 to 2013) that have accommodated siting constraints. However, if siting energy infrastructure becomes more or less challenging in the future, the level of effort needed to site the pipeline capacity additions projected in this analysis could increase or decrease.
1. Introduction

1.1 Purpose of This Study

Over the past decade, natural gas production in the United States has undergone a revolution. The combination of hydraulic fracturing and horizontal drilling technology has allowed economic access to enormous quantities of natural gas from shale formations. As a result, in 2013, the United States became the world’s largest producer of hydrocarbons.² This development has had and will likely continue to have significant consequences for the broader economy. The impact of abundant, low-cost natural gas is particularly important in the electric power sector. During the month of April 2012, electricity generation from natural gas-fired plants virtually matched generation from coal-fired plants.³ While coal has regained some of its market share because of gradually rising natural gas prices, growth in natural gas generation is projected to continue in the future.⁴

Increased use of natural gas in electric generation presents some potential challenges. While coal can typically be stored on-site at power plants, natural gas must be delivered as it is used.⁵ Because adequate natural gas infrastructure is a key component of electric system reliability in many regions, it is important to understand the implications of greater natural gas demand for the infrastructure required to deliver natural gas to end users, including electric generators.

The United States has more than 217,000 miles of interstate natural gas pipelines to deliver natural gas from producing regions to end users.⁶ However, the continued development of natural gas from shale formations, which tend to be situated outside of traditional natural gas producing regions, will require new pipeline infrastructure and/or the repurposing of existing infrastructure.

The purpose of this study is to understand the potential infrastructure needs of the natural gas pipeline system under several future natural gas demand scenarios. Specifically, three scenarios were developed: a reference scenario and two scenarios with increased electric sector natural gas demand. Both increased demand scenarios—an Intermediate Demand Case and a High Demand Case—apply a simple, illustrative carbon policy to the U.S. electric power sector (not based on any real or proposed policy) that drives increased electric sector natural gas use. These cases differ only in their underlying

⁵ Some natural gas power plants also have the ability to operate on alternatives to pipeline-delivered natural gas, such as fuel oil and local stores of liquefied natural gas (LNG) or liquefied petroleum gas (LPG). In addition, note that potential deliverability challenges for coal have also been documented. For example, see: U.S. Energy Information Administration, “Coal stockpiles at coal-fired power plants smaller than in recent years,” Today in Energy, November 14, 2014, accessed November 12, 2014, http://www.eia.gov/todayinenergy/detail.cfm?id=18711.
assumptions about coal-fired power plant retirements. In particular, the High Demand Case, which assumes greater coal-fired power plant retirements, is intended to be an upper-bound test case on natural gas consumption in the electric power sector.

1.2 Recent Developments in the U.S. Natural Gas Sector

The United States has an extensive natural gas infrastructure that efficiently produces, stores, and transports natural gas from producing fields to end users. The United States is the largest consumer of natural gas in the world, and with the recent growth in shale gas production, the United States is also now the world’s largest natural gas producer.7 As shown in Figure 1, pipelines originate in supply regions and transport natural gas to major market regions as well as to smaller markets throughout the country. While most pipelines are relatively short (several hundred miles or less), some major transmission pipelines stretch over a thousand miles. For example, the Transcontinental (Transco) pipeline, connecting Texas and Louisiana supplies to Mid-Atlantic markets, and the Rockies Express (REX) pipeline, connecting Colorado and Wyoming supplies to Ohio and eastern markets, are both about 1,700 miles long.

![Figure 1: U.S. Natural Gas Pipeline System](image)

Because pipelines are not moved once they are built, new pipelines or modifications to existing pipelines are required when production in a supply basin grows and reaches pipeline takeaway capacity constraints out of the region, or when demand in a market area grows to exceed the pipeline system

---


8 U.S. Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System.
capacity to deliver into the region. For example, during the previous decade, rapid growth in Rockies
natural gas production gave rise to the REX pipeline, which transports natural gas produced in the region
to markets in the East. Similarly, rapid natural gas demand growth in Florida prompted construction of
the Gulfstream pipeline and numerous expansions of the Florida Gas Transmission pipeline so that
natural gas produced in the Gulf region could be delivered to consumers in Florida.

The most prolific shale gas basin in the United States is the Marcellus, with the prime fields located in
Pennsylvania and West Virginia. The growth in Marcellus shale gas production has had a major impact
on the flow of natural gas throughout the United States. Natural gas that was once imported from other
states into eastern markets has been increasingly displaced by Marcellus production. While pipeline
capacity connecting Marcellus producing fields to either natural gas markets or interconnections to
existing pipelines has been added, some natural gas production has yet to be connected, because
pipeline takeaway capacity is still limited.

1.3 Economics of Natural Gas Transmission

New natural gas pipeline development is driven by market supply and demand, which expresses itself in
the form of basis differential, or the difference in natural gas prices between two locations or “hubs.”
Basis differentials provide an incentive for prospective pipeline shippers (the party that wants to
transport natural gas) to request that a pipeline company (the party that develops and/or owns the
pipeline, often referred to as the “operator”) construct new pipeline capacity and enter into long-term
contracts for firm pipeline transportation service sufficient to enable the pipeline operator to proceed
with the project.⁹ Effectively, such an agreement enables the operator to have confidence that a
significant share of the project’s development, construction, financing, and operating costs will be
recoverable from shippers. Once a new natural gas pipeline is constructed, the shipper can rely on its
contract for firm transportation service to capture the resulting basis differential.¹⁰ Basis differentials,
and how the captured revenues compare to the cost of constructing pipelines, largely determine how
much and in which locations pipeline capacity is likely to be added.¹¹

---

⁹ Shippers may be gas marketers or other entities, such as local distribution companies that contract for transportation service in order to gain access to supply to serve retail customers. Also, pipeline operators typically do not own upstream natural gas assets but instead generate revenue by offering pipeline capacity to shippers. In 1992, the Federal Energy Regulatory Commission issued Order Number 636, “Restructuring of Interstate Natural Gas Pipeline Services (Final Rule).” Order Number 636 fundamentally altered the manner in which pipeline operators conducted business by requiring pipeline companies to sell natural gas transportation, storage, and other services separately (often referred to as “ unbundling”), and enabled all participants in the U.S. natural gas market to buy, sell, or trade natural gas with any other market participant. For more details, see [http://www.ferc.gov/legal/maj-ord-rep/land-docs/restruct.asp](http://www.ferc.gov/legal/maj-ord-rep/land-docs/restruct.asp). Note also that natural gas may be contracted on a firm, or uninterruptible, basis. Firm transportation service is backed by an agreement that typically binds both parties to the agreement to either deliver or receive the quantity of natural gas specified in the agreement. Firm service has priority over interruptible service and cannot be curtailed during periods of high demand.

¹⁰ Note also that while requests for firm transportation service by shippers effectively drive new pipeline expansion, these shippers may make available transportation service to others in the secondary or resale markets once the pipeline is fully constructed and operating.

¹¹ Changes in other sectors, such as electricity, may further change the supply and demand conditions within natural gas markets. These changes may, in turn, affect basis differentials and the resulting incentives for natural gas pipeline infrastructure development.
The cost of constructing pipelines can be significant. For example, the 1,698-mile-long REX pipeline, which has a capacity of 1.8 billion cubic feet per day (Bcf/d), cost approximately $5 billion to construct.\textsuperscript{12} In order for the economics of the pipeline to be favorable, the natural gas flowing through the pipeline must generate sufficient revenue over its operating lifetime to justify the upfront capital investment.

Revenue and/or cost recovery for pipeline shippers depends on the demand for natural gas, which is highly seasonal, particularly in the East. Moreover, pipeline shippers sometimes capture high value for short durations, often during peak periods, when increased demand, coupled with transmission constraints, causes basis differentials to rise. For example, the “polar vortex,” which occurred during the winter of 2013–2014 and plunged the Mid-Atlantic, Northeast, and Southeast into a deep freeze, highlights how pipeline transmission constraints can cause price spikes in transmission-constrained markets. In fact, even during normal years in regions served by limited pipeline capacity, significant transmission constraints can last for weeks. However, while price spikes and temporary transmission constraints associated with extreme weather events can have significant impacts on natural gas consumers, a price spike may or may not provide sufficient revenue to justify additional infrastructure investment.

\subsection*{1.4 Institutional Considerations}

Siting energy infrastructure in the United States is a complex, multi-jurisdictional, and multidimensional process, with no two projects facing the same set of issues. While these barriers present potential challenges to expanding U.S. natural gas infrastructure, the Federal Energy Regulatory Commission (FERC) has authorities to facilitate siting of natural gas pipeline infrastructure. Specifically, under the Natural Gas Act (NGA), FERC has authority to regulate the interstate transmission and certain sales for resale of natural gas.\textsuperscript{13} Central to resolving siting and cost allocation issues, FERC also possesses authority to grant the right of eminent domain for the construction of pipelines, and under Section 7 of the NGA, FERC can issue a certificate of public convenience and necessity to allow pipeline operators to recover expenses associated with pipeline construction and operation.

The combination of technical change, fundamental economic drivers, and related institutional considerations explain the history of pipeline capacity additions in the United States. Figure 2 depicts total U.S. pipeline capacity additions and construction expenditures by year in which pipelines were or are expected to be placed in service.\textsuperscript{16} There has been significant investment in new interstate pipeline capacity over the last 18 years for which data are available, with more than 133 Bcf/d of capacity additions and $65 billion in capital expenditures. The pipeline expenditures in Figure 2 do not follow a smooth path over time; major projects, such as the REX pipeline, which placed sections of the pipeline into service in 2008 and 2009, result in total expenditures for a particular year that exceed the long-run


\textsuperscript{16} The data in Figure 2 reflect both the capacity and cost associated with constructing new pipelines as well as adding capacity to existing pipelines. In addition, the data account for the capacity and cost associated with reversing flows in existing pipelines.
average. Recent growth in natural gas production from shale formations has spurred new growth in pipeline construction because many large shale deposits are located outside of regions with a history of natural gas production and therefore lack the associated infrastructure. As such, the majority of expenditures for pipelines placed in service from 2010 through 2013 were for projects designed to transport shale gas.

Figure 2: Interstate Pipeline Capacity Additions and Capital Expenditures by Year in Service

---

2. Model Description, Limitations, and Scenarios

2.1 Model Description
This study uses the Deloitte MarketPoint North American Integrated Model (NAIM) to analyze the interaction between electric power and natural gas markets in North America.\(^\text{16}\) NAIM includes detailed and comprehensive electricity and natural gas market models. Each sectoral model includes disaggregated representations of supply, infrastructure, and demand by geographic region within North America. These two sectoral models are then integrated both geographically and temporally to produce a comprehensive and self-consistent set of results across both markets.

NAIM applies microeconomic theory to solve for market-clearing prices and quantities simultaneously across multiple markets, multiple commodities, and multiple time steps. It performs fundamental market analysis of supply and demand within each region and their dynamic interactions. The model uses monthly time steps over a 30-year time horizon, but the electricity model further disaggregates the monthly time steps to more accurately represent load duration curves in each region.

On the natural gas side of NAIM, the model represents natural gas producer decisions regarding the timing and quantity of reserves to add, given producers’ resource endowments, the cost to bring production online, and anticipated forward prices. Within the model, there are about 40 natural gas supply regions in the United States. The model uses depletable resource economics to compute a resource production schedule that maximizes profit, given endogenously projected wellhead prices. Under this approach, today’s drilling affects tomorrow’s natural gas prices and, conversely, expectations about tomorrow’s natural gas prices affect today’s drilling.

NAIM also represents the existing interstate pipeline system by pipeline segment. The model builds additional pipeline capacity when it is economic, given the computed supply-demand dynamics as well as infrastructure constraints and costs. Specifically, the model builds pipeline capacity if the basis differential across a new pipeline would be large enough to cover pipeline variable costs and recovery of upfront capital costs for expansion, while providing a sufficient rate of return. That is, the volume of natural gas flows over time must deliver sufficient after-tax margins to justify the cost of expansion.

The model input that determines the cost of expansion is the overnight capital cost.\(^\text{17}\) Estimates of capital cost are derived from the cost of actual pipeline projects. For example, a 1 Bcf/d pipeline expansion that costs $500 million would have a capital cost of $1.37 per million cubic feet (Mcf) of

\(^{16}\) For more details on the Deloitte MarketPoint North American Integrated Model, see: Deloitte MarketPoint, Deloitte MarketPoint, 2011, [http://www.deloitte.com/assets/Com- UnitedStates/Local%20Assets/Documents/us_er_marketpoint_marketbuilder011411.PDF](http://www.deloitte.com/assets/Com-UnitedStates/Local%20Assets/Documents/us_er_marketpoint_marketbuilder011411.PDF). The results are solely for informational purposes and are not intended to be predictions of events or future outcomes. Deloitte MarketPoint is not, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services to any person. Deloitte MarketPoint shall not be responsible for any loss sustained by any person who uses or relies on this publication.

\(^{17}\) The overnight capital cost is the cost at which a unit could be constructed, assuming that the entire process from planning through completion could be accomplished in a single day. It does not include related financing costs (cost of capital) and does not reflect potential changes in cost over the actual period during which the capacity would be constructed.
annual transmission capacity. The cost of each additional Mcf of expansion for a specific pipeline segment is assumed to be constant in the model.\textsuperscript{18}

To represent natural gas demand for the residential, commercial and industrial sectors, the model applies growth rates by sector and region derived from the U.S. Energy Information Administration’s (EIA’s) Annual Energy Outlook 2014 (AEO 2014) Reference Case to historical state-level demand data. Demand for natural gas from these sectors is assumed to be responsive to changes in natural gas prices over time. Demand for natural gas from the electric power sector is determined endogenously by NAIM, which computes fuel use based on competition between different types of power generation.

More specifically, on the electricity side of NAIM, the model contains a representation of the North American electricity system, including electric generation assets, bulk transmission between regions, and load patterns. NAIM projects prices, generation mix, associated fuel use, and environmental emissions for North American power markets. The geographic scope encompasses all areas under the jurisdiction of the North American Electric Reliability Corporation (NERC), which includes portions of Canada and Northern Baja Mexico, as well as all of the lower 48 United States.\textsuperscript{19} Within NAIM there are a total of 76 electricity balancing regions.

Electric generating capacity additions are largely endogenous, with some planned and other capacity additions specified exogenously, while all capacity retirements are specified exogenously. NAIM uses technology cost and performance assumptions similar to those assumed in EIA’s AEO 2014 Reference Case. Electric transmission capacity additions are specified exogenously, and NAIM’s total electric load projection is based on the AEO 2014 Reference Case.\textsuperscript{20}

Finally, the representation of inter-commodity linkages allows the model to project how an illustrative national carbon policy might affect each regional electricity market, which in turn affects the natural gas market. Integrating the markets for natural gas and electricity within the model is important because future U.S. natural gas demand growth is projected to be largely driven by the electric power sector.

### 2.2 Modeling Limitations

This analysis assumes rational economic behavior with perfect foresight, but a variety of barriers may lead to outcomes that differ from those projected by this analysis. Real-world markets may overbuild or underbuild infrastructure in anticipation of future demand and prices. For example, by 2006, FERC had received 43 applications to construct new U.S. liquefied natural gas (LNG) import terminals, and a total of 11 facilities were ultimately built in anticipation of a large increase in LNG imports that never

\textsuperscript{18} The model also accounts for the costs associated with adding capacity to existing pipelines through expansions and looping (adding a new pipeline running parallel to an existing pipeline). In addition, the model accounts for the costs associated with reversing flows in existing pipelines. For example, in June 2014, a portion of the Rockies Express Pipeline, which was originally constructed to bring natural gas from the Rocky Mountain region to eastern markets, was reconfigured to allow natural gas produced in the Marcellus and Utica shale basins to be transported to midwestern markets. See U.S. Energy Information Administration, “First westbound natural gas flows begin on Rockies Express Pipeline,” Today in Energy, June 18, 2014, accessed October 22, 2014, http://www.eia.gov/todayinenergy/detail.cfm?id=16751.

\textsuperscript{19} For details, see Appendix A.1 Map of Electric Power Sector Natural Gas Demand Regions.

materialized. The approach taken in this study does not try to anticipate suboptimal actions. While real-world markets do not always perfectly align supply and demand, it is difficult to determine a credible way to anticipate potential future market disequilibrium.

In addition, interstate pipeline capacity additions in the model are presumed to use the most efficient routing, regardless of ownership. Full access to pipeline segments is assumed for both the utilization of existing capacity and future capacity additions. As such, the model is limited in its ability to account for the potential cost of barriers facing many interstate natural gas pipeline projects, including siting and permitting challenges as well as cost allocation and cost recovery issues.

As discussed later in this report, the amount of new interstate natural gas pipeline capacity projected in the scenarios considered in this analysis between 2015 and 2030 (38–42 Bcf/d) is considerably lower than the amount of new capacity added for the historical period between 1998 and 2013 (127 Bcf/d). Because this historical capacity was constructed in a market and regulatory environment prone to the siting, permitting, and cost recovery issues described previously, it is reasonable to conclude that a smaller amount of total capacity (such as that projected in the Reference Case, Intermediate Demand Case, and High Demand Case) could be constructed in the future in a similar market and regulatory environment. However, if siting energy infrastructure becomes more or less challenging in the future, the level of effort needed to site the pipeline capacity additions projected in this analysis could increase or decrease.

Moreover, in the near term, all three scenarios in this analysis project relatively modest interstate pipeline capacity additions (2.2–2.7 Bcf/d annually between 2015 and 2020). Increased production from shale and other geographically diverse sources of natural gas as well as geographic diversity in the sources of natural gas demand have significantly reduced the need for additional construction of interstate natural gas pipeline infrastructure. Projected near-term pipeline capacity additions are smaller than the annual average additions over the last five years for which data are available (8.8 Bcf/d annually between 2009 and 2013) and also smaller than the average annual capacity additions reported

---


as planned for the years 2014–2016 by EIA (5.1 Bcf/d annually).\textsuperscript{23} Taken together, these comparisons suggest that the rate of near-term and medium-term pipeline capacity expansion projected by this analysis is consistent with the rate of both historical and planned capacity expansion.

Projections in this study are also limited by the spatial and temporal resolution of the model. The monthly time resolution in the model may not identify interstate pipeline constraints that reflect peak demand days or shorter time intervals. Moreover, these projections will not capture most future intrastate pipeline capacity additions (as opposed to interstate pipeline capacity additions). Increased natural gas demand will likely also require new, smaller pipelines (known as laterals) to connect new electric power sector generation. Laterals are difficult to represent because they depend on the precise locations of any new electric generating capacity that is built. Similarly, the model represents the pipeline gathering system as part of an integrated natural gas gathering and processing system within each basin, so natural gas gathering pipeline additions are not explicitly modeled. However, these limitations are not likely to affect the conclusions about interstate natural gas pipeline infrastructure.

Finally, the model computes optimal natural gas storage dispatch based on projected monthly prices and storage operating parameters. The model does not endogenously determine future storage capacity, and storage capacity is held constant in the model.\textsuperscript{24} This study also does not address how greater natural gas demand may affect the need for high-deliverability storage, which becomes important at time scales shorter than the monthly time resolution of the model, and is often used by natural gas electric power generators. However, none of these assumptions is likely to affect the conclusions about interstate natural gas pipeline infrastructure. In fact, the lack of natural gas storage additions in this study could place more pressure on the natural gas transmission system than would be the case if storage expansion were explicitly represented, consistent with the intention to create an upper-bound test case.

2.3 Description of Scenarios

In order to analyze the potential impact of increased demand from the electric power sector, this report examines three scenarios: a “Reference Case” with no national carbon policy, an “Intermediate Demand Case” with an illustrative national carbon policy applied to the electric power sector, and a “High Demand Case” with an illustrative national carbon policy applied to the electric power sector and accelerated coal-fired power plant retirements. The cases are described in Figure 3.

\textsuperscript{23} Planned projects include projects that have been publicly announced, projects that have applied for or have received FERC approval, and projects that are under construction.

<table>
<thead>
<tr>
<th>Case Name</th>
<th>Case Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reference Case</td>
<td>Reference Case with no national carbon policy</td>
</tr>
<tr>
<td>2. Intermediate Demand Case</td>
<td>Nationally uniform carbon policy (illustrative) applied to the Reference Case</td>
</tr>
<tr>
<td>3. High Demand Case</td>
<td>Nationally uniform carbon policy (illustrative) applied to the Reference Case, with accelerated coal-fired power plant retirements</td>
</tr>
</tbody>
</table>

Figure 3: Cases Analyzed

The Reference Case does not include an illustrative national carbon policy, but it does include existing state renewable energy portfolio standards as well as regional greenhouse gas emissions policies, such as the Regional Greenhouse Gas Initiative (RGGI) in the Northeast and Mid-Atlantic and the California Global Warming Solutions Act (AB32). In the Reference Case, approximately 25 gigawatts (GW) of coal capacity are retired after 2014. These retirements have been publicly announced and are imposed exogenously in the model.

In the increased demand cases, an illustrative carbon policy was applied nationally beginning in the year 2020 at a price of about $32 (2012$) per metric ton of CO₂, increasing at a rate of 5% per year in real terms. This pathway matches EIA’s AEO 2014 $25 Carbon Price side case from 2020 onwards. This illustrative national carbon policy is not intended to represent any actual or proposed policy, but instead is used as a means to drive growth in electric power sector natural gas demand, and consequently in natural gas infrastructure.

In the Intermediate Demand Case, coal-fired power plant retirements are assumed to follow the trajectory in the Reference Case. In other words, no additional retirements beyond those already announced occur. However, in such a policy scenario, coal-fired power plants for which no announcements have been made to date could in fact retire prior to 2030, which in turn would require additional generation from other sources, including natural gas.

To analyze this, a High Demand Case was also modeled. In this case, all coal-fired power plants that lacked scrubber-type emissions controls as of the first quarter of 2014 are assumed to retire in 2017. This assumption results in an incremental reduction of 104 GW of coal-fired capacity beyond the 25 GW of capacity that retires in the Reference and Intermediate Demand Cases. Just as some units that have not yet publicly announced a decision to retire may in fact eventually retire, it is likely that some uncontrolled units will be economic to retrofit and will continue to operate after 2017.

This analysis focuses specifically on the sensitivity of the interstate natural gas pipeline infrastructure to varying levels of electric power sector natural gas demand. Additional scenarios would be needed to characterize a broader range of possible natural gas futures. For example, future work might consider alternative natural gas supply assumptions (such as the size of the natural gas resource base or the rate of technology advances that affect drilling cost and/or drilling productivity) that could result in natural

---

25 Existing federal production tax credits and investment tax credits for renewable energy sources are assumed to be expired in all of the cases considered in this analysis.
gas supply that is higher or lower than Reference Case levels. Similarly, future work might consider scenarios in which energy efficiency or conservation is significantly deployed to meet end-user demand, or scenarios with alternative assumptions about future industrial or transportation natural gas demand.
3. Model Results

3.1 Natural Gas Demand

In the Reference Case, total U.S. natural gas demand is projected to grow steadily and reach about 76 Bcf/d by 2030, an 18% increase from 2015 levels.\(^{26}\) Reference Case demand in 2030 is close to EIA’s AEO 2014 Reference Case level of approximately 80 Bcf/d.\(^{27}\) Figure 4 shows natural gas demand by sector in the Reference Case.

![Figure 4: Reference Case Total U.S. Natural Gas Demand by Sector, 2015 to 2030](image)

One of the implications of increased natural gas production from shale formations is that the United States is now an attractive source of LNG for global buyers. The Reference Case projects about 5.1 Bcf/d of U.S. LNG exports by 2020.\(^{28}\) The volume of U.S. LNG exports in the model is determined by Deloitte MarketPoint’s World Gas Model, which computes the competitiveness of U.S. LNG exports in global markets based on projections of the domestic price of natural gas, the cost of building LNG liquefaction terminals, the cost of transportation and liquefaction, and the price and demand for natural gas in foreign markets.\(^{29}\) Given these conditions, the model determines whether the capital investment would be recovered. The model’s estimate of LNG export volumes is based purely on underlying economics.

---

\(^{26}\) The model output presented in Figure 4 does not include natural gas used at the production site, volumes used in processing, pipeline use and losses, or natural gas exports.


\(^{29}\) For more details on the Deloitte MarketPoint World Gas Model, see: Deloitte MarketPoint, [Deloitte MarketPoint](http://www.deloitte.com/assets/Icom-UnitedStates/Local%20Assets/Documents/us_er_marketpoint_marketbuilder011411.PDF).
and does not capture purchase decisions of LNG consumers who are willing to pay above market prices in order to diversify their LNG acquisition portfolios.\textsuperscript{30}

In general, under an illustrative national carbon policy, a shift away from more carbon-intensive generation such as coal to lower-carbon generation such as natural gas and to zero-carbon options such as nuclear, renewables, and energy efficiency would be expected. Because this study examines the impacts of an illustrative national carbon policy on the natural gas pipeline system, this section will focus on the impact of these two scenarios on electric power sector natural gas demand. See Appendix B. Electric Power Sector Results for additional electric power sector results.

Figure 5 compares electric power sector natural gas demand across the cases. In the Intermediate Demand Case, electric power sector natural gas demand increases by about 7.5 Bcf/d (about 25\%) in 2030 relative to the Reference Case. In the High Demand Case, electric power sector natural gas demand increases by about 14 Bcf/d (about 46\%) in 2030 relative to the Reference Case.\textsuperscript{31}

Figure 6 shows electric power sector natural gas demand by region in the Reference Case (for a description of regions, see Appendix A.1 Map of Electric Power Sector Natural Gas Demand Regions).

\textsuperscript{30} In order to test the sensitivity to alternative assumptions about U.S. LNG export volumes, an additional case was run with approximately 10 Bcf/d of LNG exports by 2022. The pipeline capacity additions projected in this case are not significantly different from those projected in the Reference Case.

\textsuperscript{31} These increases are equivalent to 10\% and 18\%, respectively, of total natural gas demand in 2030 in the Reference Case.
The incremental change in electric power sector natural gas demand between the Intermediate Demand Case and the Reference Case is shown in Figure 7. Positive values are increases relative to the Reference Case, while negative values are decreases. The electric power sector natural gas demand results are consistent with the electric power sector generation results presented in Appendix B. Electric Power Sector Results. Nearly all regions see an increase in electric power sector natural gas demand once the illustrative national carbon policy is applied in 2020, as natural gas-fired generation replaces generation from coal-fired units. However, regions in which coal-fired generation is replaced with a greater amount of renewable power, such as MRO and SPP, do not demand as much incremental natural gas as other regions.
Figure 8 shows the change in electric power sector natural gas demand in the High Demand Case relative to the Reference Case. In this modeling framework, the greater number of coal plant retirements assumed in this scenario results in greater natural gas-fired generation and, in turn, greater natural gas demand in the electric power sector. This increase in natural gas demand also begins earlier, reflecting the assumption about the timing of coal-fired power plant retirements.

In the WECC (excluding CA) region, power sector natural gas demand declines in the Intermediate Demand Case (Figure 7) but increases in the High Demand Case (Figure 8) relative to the Reference Case. In the Reference Case, WECC (excluding CA) exports electricity to California. However, the application of the illustrative national carbon policy in the Intermediate Demand Case increases the costs to operate fossil generation in the WECC (excluding CA) region. In light of these higher costs, the WECC (excluding CA) region exports less electricity to California, and fossil generation—and, in turn, power sector natural gas demand—in the WECC (excluding CA) region declines relative to the Reference Case (Figure 7). Natural gas power generation increases in California to replace decreasing imports of power from the WECC (excluding CA) region. The greater number of coal-fired power plant retirements assumed in the High Demand Case requires replacement energy to be made up by natural gas-fired generation in the WECC (excluding CA) region. This effect works in the opposite direction as the prior one, resulting in greater WECC (excluding CA) power sector natural gas demand in the High Demand Case relative to the Reference Case (Figure 8).

![Figure 8: High Demand Case Electric Power Sector Natural Gas Demand Relative to the Reference Case, 2015 to 2030](image-url)
3.2 Natural Gas Supply
Growing demand for natural gas leads to a significant increase in the supply of natural gas. In the Reference Case, total natural gas production is projected to grow by 37% from 2015 to 2030, increasing from approximately 71 Bcf/d in 2015 to nearly 98 Bcf/d in 2030 (Figure 9). Reference Case natural gas supply in 2030 is comparable to EIA’s AEO 2014 Reference Case level of approximately 94 Bcf/d. The Reference Case projection also shows a continued increase in shale gas production over the projection period. With the most significant contribution coming from the Marcellus basin, total U.S. shale gas production is projected to reach about 70 Bcf/d by 2030 and to become the dominant source of U.S. natural gas supply (for a description of the production regions, see Appendix A.2 Map of Lower 48 States Shale Plays).

![Figure 9: Reference Case Natural Gas Production by Production Region, 2015 to 2030](image)

In response to the increased use of natural gas for power generation in the Intermediate and High Demand Cases, U.S. natural gas production is projected to increase by 6%–10% over Reference Case levels in 2030. The majority of production is projected to come from shale gas basins, as shown in Figure 10. The remainder, totaling 38% of total natural gas supply in both the Intermediate Demand Case and the High Demand Case, includes conventional natural gas, offshore natural gas, associated gas, coalbed methane, and tight gas. Just as in the Reference Case, shale gas production in the Intermediate Demand Case is spread across multiple regions. While the volumes of natural gas supplied are larger in the High Demand Case, the geographic distribution of that supply is similar.

---

32 In any given year, natural gas production is greater than natural gas demand plus net exports because of fuel used or lost in all stages of natural gas production, transmission, distribution, and storage.
34 “Tight gas” is natural gas found in low-permeability sandstones and carbonate reservoirs. The rock layers that hold the natural gas are very dense, preventing easy flow of natural gas.
Interestingly, while the Marcellus region is the largest source of shale gas production in the Reference Case, it is not the largest incremental source, relative to the Reference Case, of projected future natural gas production in the Intermediate and High Demand Cases. Instead, the largest source of incremental shale gas production in these cases is the Haynesville basin, which is situated in East Texas and Northwest Louisiana. This result follows from the underlying resource economics of the shale plays represented in the model. As the lowest-cost Marcellus resources are depleted over the course of the Reference Case projection, only higher-cost Marcellus supplies remain available for incremental production in the increased demand cases. Incremental Marcellus production is also likely to require additional infrastructure to bring production to market, diminishing the attractiveness of Marcellus production relative to other basins. In addition, the Haynesville is well positioned to supply natural gas to southern electricity markets, which account for a significant share of the increase in demand from the U.S. electric power sector in the Intermediate and High Demand Cases (Figure 7 and Figure 8).

3.3 Natural Gas Prices

The United States is estimated to hold about 2,400 trillion cubic feet (Tcf) of technically recoverable natural gas in shale formations, equivalent to approximately 100 years of supply at present levels of demand. The large shale gas resource potential has effectively made the long-run natural gas supply curve more elastic, and as a result, long-run natural gas demand changes are less likely to result in major price impacts.

---

In the Reference Case, U.S. natural gas prices are among the lowest compared to other industrialized countries throughout the forecast period. Figure 11 shows historical prices through 2010 as well as the projected price at Henry Hub in the Reference Case.\textsuperscript{36} Advancements in the technology used to produce natural gas from shale formations, coupled with the global recession, caused natural gas prices to fall sharply from 2009 to 2012. In the Reference Case, natural gas prices slowly rebound and rise throughout the projection period at levels that are sufficient to incentivize production from marginal sources of natural gas supply. Henry Hub natural gas prices in the Reference Case are similar to prices in EIA’s AEO 2014 Reference Case. In 2030, Reference Case Henry Hub prices are projected to be $6.16/million British thermal units (MMBtu), while EIA’s AEO 2014 Reference Case prices are projected to be $6.03/MMBtu.\textsuperscript{37}

\textsuperscript{36} The projection begins in 2011 in order to calibrate the model.


Figure 12 shows average prices from 2015 to 2030 across the cases for selected major regional natural gas markets and hubs. In the Intermediate Demand Case, growing demand for natural gas results in an average increase in Henry Hub prices of $0.19/MMBtu (or about 4%) from 2015 to 2030 relative to the Reference Case. In the High Demand Case, the average increase in Henry Hub prices is about $0.53/MMBtu (or about 10%) from 2015 to 2030 relative to the Reference Case. The largest price impact in these cases is in Massachusetts, which is far downstream in regional pipeline flows.

![Figure 12: Average Natural Gas Prices by Location across the Cases, 2015 to 2030](image)

3.4 Natural Gas Transmission

**Reference Case**

In the Reference Case, the combination of a geographic shift in regional natural gas production—largely due to the expanded development of natural gas from shale formations—and growth in natural gas demand is projected to require more interstate natural gas pipeline capacity.

Figure 13 shows the historical and planned capacity additions from 1996 to 2016, along with the projected pipeline capacity additions between 2015 and 2030 in the Reference Case. Pipeline capacity additions in the Reference Case are projected to be 38 Bcf/d between 2015 and 2030. In comparison, between 1998 and 2013, nearly 127 Bcf/d of pipeline capacity was added in the United States.

Continued integration of shale gas production from the Marcellus basin, which is the largest producing basin in the Reference Case projection, is a key driver of future pipeline capacity additions in the Reference Case. Shale gas produced from the Marcellus is both lower in cost and situated geographically closer to end-user demand in the eastern United States. As a result, more than half of the 38 Bcf/d of interstate pipeline capacity additions in the Reference Case are associated with further integrating Marcellus natural gas production into U.S. natural gas markets.

Even with the significance of the Marcellus, projected natural gas production and demand are geographically diverse, so the need for additional interstate natural gas pipeline infrastructure is lower than would be
expected if the increased production or demand were concentrated in a particular region. Furthermore, pipeline capacity additions that were placed in service between 2007 and the present in order to realign the U.S. natural gas transmission system with changing supply and demand conditions driven by increases in shale gas production are projected to reduce the need for future pipeline infrastructure.

Figure 13: Historical, Planned, and Projected U.S. Interstate Pipeline Capacity Additions, 1996 to 2030

Another reason that pipeline capacity additions in the Reference Case are not greater is that, in many regions, existing pipeline capacity is not fully utilized during many parts of the year. Average capacity utilization between 1998 and 2013 was 54%.\textsuperscript{40} For comparison, projected pipeline utilization for the top 200 pipeline segments by projected flow volume in the Reference Case in 2030 is 57%.\textsuperscript{41} Given the cost of building new pipelines, finding alternative routes utilizing available capacity on existing pipelines is often less costly than expanding pipeline capacity.\textsuperscript{42} This response is more likely when incremental natural gas demand does not strongly coincide with peak natural gas demand, which is true in the Reference Case, because the incremental demand is largely driven by increases in base load natural gas generation in the electric power sector.

Figure 14 shows the regional distribution of projected pipeline capacity additions between 2015 and 2030 (for more detail on the regions, see Appendix A.3 Map of Natural Gas Pipeline Expansion Regions). In the Marcellus, growth in natural gas production is projected to require additional expansion of pipeline takeaway capacity from the region. In total, an estimated 8.4 Bcf/d of additional pipeline capacity will be needed to integrate Marcellus production with regional markets and interstate pipelines (shown as “Within Marcellus” in Figure 14). Growing Marcellus natural gas production is projected to dominate the Mid-Atlantic natural gas market. Not only will natural gas from the Marcellus displace flows from other regions, but it will also be exported to other parts of the country. A portion of the growth in Marcellus natural gas production is projected to serve northeastern markets and will require 3.2 Bcf/d of incremental pipeline capacity (shown as “Mid-Atlantic to North” in Figure 14).\textsuperscript{43}


\textsuperscript{41} This value represents annual average utilization for the top 200 segments in the model. Projected pipeline utilization in any given region or at any given time may be higher or lower than the average values reported here, depending on seasonal patterns of natural gas demand and regional natural gas system characteristics. In addition, annual pipeline utilization will be well below 100% for most pipelines because of the seasonality of natural gas flows. A pipeline might operate near full capacity during peak seasons but will operate at much lower levels during off-peak seasons.

\textsuperscript{42} As discussed in Section 1.3 Economics of Natural Gas Transmission, pipeline expansions are driven by basis differential, which means that new pipelines may be constructed even when existing capacity is available to perform the same transportation service, provided that the anticipated revenue can justify the investment and operating costs.

\textsuperscript{43} The construction of a planned 1.7 Bcf/d expansion to the Transco Pipeline, which will serve markets in the Northeast, is exogenously specified to be in service in 2018 in the model.
Growth in the Marcellus and in the Utica is also projected to reverse flows that historically have come from west and south of the region. In the Reference Case, the model projects 4.4 Bcf/d will reverse flow from Ohio to Indiana (included within the total for “Mid-Atlantic to West” in Figure 14). Other expansions are projected to increase flows from Pennsylvania and West Virginia to Ohio, bringing total Mid-Atlantic to West expansion to 7.6 Bcf/d. Flow reversal is also projected southward out of the Marcellus to serve markets in the Southeast. Pipelines that currently bring natural gas from the Gulf region to the north are projected to reverse flow so that Marcellus production can serve the Virginia and Carolinas markets (included within the total for “Mid-Atlantic to South” in Figure 14). As a result of the projected expansions, Virginia is almost completely served by Marcellus production. However, pipeline reversals do not go any farther south beyond the Carolinas because Gulf production is able to maintain hold of southern markets.

In addition, Midcontinent, Rockies, and Gulf production, which is largely displaced from eastern markets, is increasingly transported to the Midwest and is projected to require 3.6 Bcf/d of capacity (shown as “Midcontinent, Rockies, and Gulf to Midwest” in Figure 14). The greater quantity of natural gas from the Midcontinent, Rockies, and Gulf region, as well as from the Marcellus and Utica, that serves midwestern markets, in turn, leads to a greater amount of natural gas that is available for export to Canada. As a result, export pipelines from the Midwest to Canada are projected to expand by 2.2 Bcf/d (shown as “Exports to Canada” in Figure 14). Finally, as production increases in the San Juan and Permian basins,

---

more pipeline capacity is projected to be added to allow natural gas produced in the Rockies and in the Permian basin to increase its share of California and western markets (shown as “San Juan/Permian to West” in Figure 14).

**Intermediate and High Demand Cases**

In the Intermediate Demand Case, electric power sector natural gas demand increases by 7.5 Bcf/d in 2030 compared to the Reference Case. This is a 25% increase relative to Reference Case electric power sector natural gas demand and a 10% increase relative to total Reference Case natural gas demand. The impact on natural gas production is lower, at 6.1 Bcf/d (6%) over Reference Case levels in 2030. Higher U.S. natural gas demand results in lower U.S. pipeline exports to Canada, which in turn reduces the need for additional U.S. natural gas production.\(^45\) Moreover, only a relatively modest 1.4 Bcf/d (about 4% of the total Reference Case capacity additions of 38 Bcf/d) of additional pipeline capacity beyond Reference Case levels is projected to be built by 2030. As in the Reference Case, because incremental natural gas production and demand are broadly distributed, and because utilization of some existing pipelines can be increased, the need for additional natural gas infrastructure is reduced.\(^46\)

In the High Demand Case, electric power sector natural gas demand is projected to increase by about 14 Bcf/d over Reference Case levels in 2030. This is a 46% increase relative to Reference Case electric power sector natural gas demand and an 18% increase relative to total Reference Case natural gas demand. This increase in demand results in a 10 Bcf/d (10%) increase in U.S. natural gas production relative to the Reference Case in 2030. Just as in the Intermediate Demand Case, reductions in natural gas pipeline exports account for the difference between natural gas production and demand. With the increase in natural gas demand in the High Demand Case, an incremental 3.9 Bcf/d (approximately 10% of the total Reference Case capacity additions of 38 Bcf/d) of additional pipeline capacity above Reference Case levels is projected to be built by 2030. Just as in the Reference and Intermediate Demand Cases, the wide geographic distribution of both natural gas production and demand and the ability to increase utilization of some existing pipelines reduce the need for additional interstate natural gas pipeline infrastructure. Projected pipeline utilization for the top 200 pipeline segments by projected flow volume in the model in 2030 rises to 60% in the Intermediate Demand Case and 61% in the High Demand Case, compared to 57% in the Reference Case.

Finally, to further understand the reasons for the modest incremental infrastructure needs in the Intermediate and High Demand Cases, it is necessary to consider the incremental sources of supply in

---

\(^45\) In the Intermediate and High Demand Cases, U.S. LNG export levels are unchanged from the Reference Case level of 5.1 Bcf/d. In order to test the sensitivity to alternative assumptions about U.S. LNG export volumes, an additional case was run that coupled the High Demand Case assumptions with approximately 10 Bcf/d of LNG exports by 2022. The total pipeline capacity additions projected in this case are not significantly different from those projected in the High Demand Case.

\(^46\) Just as in the Reference Case, incremental demand in the increased demand cases largely follows from increases in natural gas-fired electric power generation primarily designed to serve base load electricity demand. As a result, incremental natural gas demand in these cases is relatively uniform over the course of a year, compared to total natural gas demand in the Reference Case, which exhibits a stronger seasonal pattern. It is easier to accommodate this relatively uniform incremental natural gas demand on existing pipelines than it would be to accommodate demand that coincided more strongly with peak demand.
these cases relative to the Reference Case. As discussed previously, while the Marcellus is the largest source of shale gas production in the Reference Case, driving more than half of the total pipeline capacity additions in the Reference Case, the Haynesville basin is the largest source of incremental shale gas supply in the Intermediate and High Demand Cases, relative to the Reference Case. Compared to the Marcellus, increased production of shale gas in the Haynesville basin requires little or no additional interstate pipeline capacity in order to access markets, because the region has a history of natural gas production and is already well served by interstate natural gas pipelines. However, even if the incremental natural gas supply in the Intermediate or High Demand Cases were to come from another basin with a history of natural gas production, the additional infrastructure requirements would be unlikely to affect the conclusions about infrastructure needs relative to historical experience.

Figure 15, which compares the incremental regional pipeline capacity additions in the Intermediate and High Demand Cases to those in the Reference Case, demonstrates that the regional incremental capacity additions (and subtractions) are comparatively small, relative to the level of capacity additions in the Reference Case (shown in gray). However, there are some modest changes in regional capacity additions between the cases.

![Figure 15: Incremental Interstate Pipeline Capacity Additions in the Intermediate Demand (blue) and High Demand (red) Cases Compared to the Reference Case (gray), 2015 to 2030](image)

In both increased demand cases, greater natural gas demand within the Mid-Atlantic and southeastern regions results in regionally produced natural gas remaining within the region or being sent to

---

47 The gray bars are identical to Figure 14, which shows Reference Case pipeline capacity additions between 2015 and 2030. The blue and red bars show the incremental changes in additions relative to the Reference Case over the same period in the Intermediate Demand and High Demand Cases, respectively. Total additions in these cases over the period can therefore be found by summing the gray and blue and gray and red bars, respectively.
southeastern markets (shown as “Within Marcellus” and “Mid-Atlantic to South” in Figure 15). Furthermore, in both increased demand cases, the demand for natural gas in midwestern markets (and the resulting tendency to send natural gas westward) is lower than the demand in the Mid-Atlantic (and the resulting tendency to use such supplies within the region), so the 7.6 Bcf/d of projected capacity expansions in the Reference Case (shown as “Mid-Atlantic to West” in Figure 15) is reduced by 3.5 Bcf/d in the Intermediate Demand Case and by 2.9 Bcf/d in the High Demand Case. Given the increased demand for natural gas in the Southeast, the tendency to send natural gas northward to midwestern markets is lower than the tendency to use Gulf production in the Southeast, so fewer pipeline capacity expansions are projected into the Midwest from the Gulf in the Intermediate and High Demand Cases than in the Reference Case (shown as “Midcontinent, Rockies, and Gulf to Midwest” in Figure 15).

In both increased demand cases, more pipeline capacity additions are projected relative to Reference Case levels within the West as well as westward from the San Juan and Permian basins to meet growing demand for natural gas in California and western markets (shown as “Within Western States” and “San Juan/Permian to West” in Figure 15). While there are not any coal-fired power plants to displace in California, natural gas demand increases because of reduced imports of electricity and the resulting higher utilization of in-state natural gas-fired power plants.

Finally, compared to the Reference Case, which projects 2.2 Bcf/d of pipeline capacity additions to support U.S. exports to Canada, the Intermediate Demand Case projects 0.5 Bcf/d fewer capacity additions, while the High Demand Case projects 1.0 Bcf/d fewer capacity additions (shown as “Exports to Canada” in Figure 15). These reductions in export volumes follow from the increasing demand for natural gas in the United States relative to Canada, driven by the growing demand from the U.S. electric power sector.

3.5 Expenditures on Natural Gas Transmission Infrastructure

The projected capital expenditures required to construct, expand, and modify interstate pipeline infrastructure described in the previous section are shown in Figure 16. Total capital expenditures on pipeline capacity expansion in the Reference Case are projected to be about $42 billion between 2015 and 2030. In comparison, between 1998 and 2013, pipeline capacity expenditures totaled more than $63 billion.\(^{48}\) In the Intermediate Demand Case, the incremental capital expenditures are projected to be about $0.6 billion, 1.3% higher than the Reference Case, and in the High Demand Case, the incremental capital expenditures are projected to be about $2.8 billion, 6.5% higher than the Reference Case.\(^{49}\)

---

\(^{48}\) While projected costs are lower than historical costs (over a similar time period), the difference in expenditures is not as large as the difference in pipeline capacity additions between history and the model projection. The distance associated with the pipeline capacity additions in the model projection is comparable to (but lower than) the distance associated with historical pipeline capacity additions. Because project costs reflect, in part, the distance associated with new pipelines, the projected expenditures are closer to (but still lower than) historical expenditures.

\(^{49}\) As noted previously, the model does not include the cost of expanding natural gas gathering and processing systems. As such, the projected capacity expansions are limited to the granularity of the pipeline system representation in the model. Because demand is mostly represented at the state level, intrastate pipeline capacity is only partially represented in the model.
Figure 16: Historical, Planned, and Projected Capital Expenditures on U.S. Interstate Pipeline Capacity, 1996 to 2030\(^{50}\)

---

Projected regional pipeline capital expenditures are displayed in Figure 17. The largest interstate pipeline capital expenditures in the Reference Case are projected to be in the Marcellus to construct pipeline takeaway capacity. In the Intermediate and High Demand Cases (Figure 18), expenditures to expand Marcellus takeaway capacity and to transport natural gas southward increase relative to the Reference Case. Furthermore, in these cases, expenditures to transport Marcellus production westward and Midcontinent, Rockies, and Gulf production northward decline relative to the Reference Case, consistent with the changes in pipeline capacity additions between the cases (Figure 15). Finally, in both cases, expenditures to bring Rockies and southwestern natural gas into and around California increase compared to Reference Case levels (shown as “Within Western States” and “San Juan/Permian to West” in Figure 18), also consistent with the changes in pipeline capacity additions between the cases.
Figure 18: Incremental Projected Pipeline Capital Expenditures in the Intermediate Demand (blue) and High Demand (red) Cases Compared to the Reference Case (gray), 2015 to 2030\(^5\)

---

\(^5\) The gray bars are identical to Figure 17, which shows Reference Case pipeline capital expenditures between 2015 and 2030. The blue and red bars show the incremental changes in expenditures relative to the Reference Case over the same period in the Intermediate Demand and High Demand Cases, respectively. Total expenditures in these cases over the period can therefore be found by summing the gray and blue and gray and red bars, respectively.
4. Conclusion

This study concludes that, under scenarios in which natural gas demand from the electric power sector increases, the incremental increase in interstate natural gas pipeline expansion and associated investment is modest, relative to historical capacity additions. The projected rate of interstate pipeline capacity expansion in the scenarios considered in this analysis is lower than the rate of historical capacity additions over the past 15 years and is consistent with information currently available on planned capacity additions over the next 3 years. In the scenarios considered here, 38–42 Bcf/d of new and expanded interstate pipeline capacity is projected to be constructed between 2015 and 2030, compared to nearly 127 Bcf/d of pipeline capacity added in the United States between 1998 and 2013.

Similarly, capital expenditures on new interstate pipelines in the scenarios considered here are projected to be significantly less than the capital expenditures associated with infrastructure expansion over the last 15 years. The scenarios in this analysis project $42 billion to $45 billion in capital expenditures on new, expanded, and modified interstate pipeline capacity between 2015 and 2030, while pipeline capacity expenditures totaled more than $63 billion between 1998 and 2013.

The results of this study are consistent with a recent report prepared by ICF International for the Interstate Natural Gas Association of America (INGAA) Foundation.\(^{52}\) Average annual expenditures on interstate natural gas pipeline infrastructure range from $2.6 billion to $2.8 billion across the cases considered in this analysis between 2015 and 2030. The INGAA study, which utilizes a different set of input assumptions and projection methodologies, projects annual expenditures that range between $2.7 billion and $4.0 billion across the cases considered in its analysis.\(^{53}\)

Two primary factors mitigate the need for additional interstate natural gas pipeline infrastructure and related capital expenditures in these scenarios. First, the growth in both natural gas demand from electricity generation and natural gas production is broadly distributed rather than geographically concentrated, reducing potential interstate pipeline capacity constraints as well as the need for new interstate pipelines. Second, increasing utilization of capacity that is not fully utilized in existing interstate natural gas pipelines, re-routing natural gas flows, and expanding existing pipeline capacity are potentially lower-cost alternatives to building new infrastructure and can accommodate a significant increase in natural gas flows.\(^{54}\)

While the conclusions about interstate pipeline additions and capital expenditures are likely to be robust to a range of alternative assumptions, additional research could further inform discussions about natural gas infrastructure needs and related natural gas system issues. Such research might consider representation of shorter time intervals (such as peak days or peak hours), the role of seasonal and high-

---


\(^{53}\) Ibid., p. 26.

\(^{54}\) As discussed in Section 1.3 Economics of Natural Gas Transmission, pipeline expansions are driven by basis differential, which means that new pipelines may be constructed even when existing capacity is available to perform the same transportation service, provided that the anticipated revenue can justify the investment and operating costs.
deliverability natural gas storage, and more granular regional and local segmentation of natural gas markets to pinpoint areas where future investment may be needed. In addition, a variety of other supply and demand cases might be considered, including cases that represent alternative industrial demand, transportation demand, or export futures, as well as alternative natural gas supply assumptions.
Appendix A. Additional Figures

Appendix A.1 Map of Electric Power Sector Natural Gas Demand Regions

![NERC Regions Map](image)

<table>
<thead>
<tr>
<th>Region Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRCC</td>
<td>Florida Reliability Coordinating Council</td>
</tr>
<tr>
<td>MRO</td>
<td>Midwest Reliability Organization</td>
</tr>
<tr>
<td>NPCC</td>
<td>Northeast Power Coordinating Council</td>
</tr>
<tr>
<td>RFC</td>
<td>ReliabilityFirst Corporation</td>
</tr>
<tr>
<td>SERC</td>
<td>SERC Reliability Corporation</td>
</tr>
<tr>
<td>SPP</td>
<td>Southwest Power Pool</td>
</tr>
<tr>
<td>TRE</td>
<td>Texas Reliability Entity</td>
</tr>
<tr>
<td>WECC</td>
<td>Western Electricity Coordinating Council</td>
</tr>
</tbody>
</table>

Figure 19: Map of North American Electric Reliability Corporation (NERC) Regions

---

Appendix A.2 Map of Lower 48 States Shale Plays

![Map of Lower 48 States Shale Plays](image)

<table>
<thead>
<tr>
<th>Model Region</th>
<th>Producing Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Shale</td>
<td>All conventional, associated, offshore, tight, and coalbed methane production</td>
</tr>
<tr>
<td>Eagle Ford</td>
<td>Eagle Ford shale basin</td>
</tr>
<tr>
<td>Haynesville</td>
<td>Haynesville shale basin</td>
</tr>
<tr>
<td>Marcellus</td>
<td>Marcellus shale basin</td>
</tr>
<tr>
<td>Midcontinent Shales</td>
<td>Fayetteville, Woodford, and Arkoma shale basins</td>
</tr>
<tr>
<td>Utica</td>
<td>Utica shale basin</td>
</tr>
<tr>
<td>Other Shales</td>
<td>Barnett, Permian, Niobrara, and all other shale basins</td>
</tr>
</tbody>
</table>

Figure 20: Map of Lower 48 States Shale Plays

---

Appendix A.3 Map of Natural Gas Pipeline Expansion Regions

Figure 21: Map of Natural Gas Pipeline Expansion Regions

Note: Figure does not represent actual or projected physical natural gas infrastructure.

57 Regions that are not included in this figure are not projected to have pipeline capacity additions. Pipeline capacity additions from the Bakken region are not reported with the regional pipeline expansion results, because Bakken region wet natural gas production is represented in the model as natural gas liquids processing that is delivered to the Chicago market via the Alliance Pipeline. LNG exports are also not reported with the regional pipeline expansion results.
Appendix B. Electric Power Sector Results

Figure 22 shows the projected generation by fuel in the Reference Case. In this case, the majority of electricity generation is supplied by coal- and natural gas-fired generation, along with generation from nuclear and renewable energy sources. Coal-fired generation decreases by 2% from 2015 to 2030, while natural gas-fired generation increases substantially, by approximately 33% over the same period. Non-hydro renewable generation grows by approximately 76% between 2015 and 2030, but the absolute increase is slightly less than half of the increase from natural gas-fired sources.

Figure 22: Electric Sector Generation by Fuel in the Reference Case, 2015 to 2030\(^{58}\)

Regional natural gas-fired generation is shown in Figure 23. While the WECC (excluding CA) region is expected to experience the largest relative increase in natural gas-fired generation during the forecast period (a 106% increase and absolute growth of 112 terawatt-hours [TWh]), the Southeast (SERC and FRCC) is expected to see the largest absolute increase in natural gas-fired generation (a 31% increase and absolute growth of 137 TWh).\(^{59}\) Part of the increase in natural gas-fired generation in these regions stems from a decrease in coal-fired capacity; both WECC (excluding CA) and the Southeast (i.e., SERC and FRCC) have large coal-fired fleets with a significant number of announced retirements.

---

\(^{58}\) The label “Imports” represents U.S. imports of electricity generated in Canada.

\(^{59}\) For a map of the regions mentioned here, see Appendix A.1 Map of Electric Power Sector Natural Gas Demand Regions.
Figure 23: Natural Gas-Fired Generation by Region in the Reference Case, 2015 to 2030

Figure 24 shows the shift in generation in the Intermediate and High Demand Cases relative to the Reference Case. The dominant source of replacement generation for coal in both cases is natural gas-fired generation. Non-hydro renewables make up the balance, with a small contribution from cross-border imports from Canada (shown as “Imports”).

In the High Demand Case, all coal-fired power plants that lacked scrubber-type emissions controls as of the first quarter of 2014 (the most recent data that were available prior to publication of this report) are assumed to retire in 2017. Consequently, the electric power sector responds in two steps: first, in 2017, when the coal-fired capacity is retired, and then again in 2020, when the illustrative national carbon policy begins to affect dispatch. The reduction in coal-fired capacity assumed in the High Demand Case drives a larger shift from coal to natural gas, renewables, and imports.
Figure 24: Change in Generation in the Intermediate Demand and High Demand Cases Relative to the Reference Case, 2015 to 2030

The label “imports” represents U.S. imports of electricity generated in Canada.
Exhibit 12 to West Roxbury Motion for Rehearing: Harvey letter
Docket #CP14-96-000

January 21, 2015


Dear Commissioners of FERC and Elected Officials:

We are writing in regard to Spectra's Algonquin Incremental Market (AIM) expansion project, docket #CP14-96-000, and in particular in regard to the portion of the AIM project designated as the West Roxbury Lateral.

As the deadline for the Final Environmental Impact Statement approaches, we feel compelled to go on record with our objections to a process that has not been transparent and that has not considered adverse impacts to an existing residential neighborhood in locating a high-pressure transmission lateral as part of AIM. It also has not truly considered alternatives to the local supply requests. And, further, it has not taken into account the cumulative impacts of related projects.

In addition, our requests for health and safety information and/or reviews in regard to placing a high-pressure line and M&R station in a densely populated neighborhood and adjacent to an active, blasting quarry have gone unaddressed.

In conclusion, we believe that the AIM project requires further study and information prior to approval. However, if FERC feels it must approve the AIM project, then we request that you sever the West Roxbury Lateral, as it is not integral to the project and its sole purpose is to provide gas to one local distribution company without identifying reasonable alternatives.

Thank you for addressing our concerns and for your assistance.

Respectfully,

Rickie Harvey
Chair of the Steering Committee of West Roxbury Saves Energy
Exhibit 13 to West Roxbury Motion for Rehearing: EPA Post EIS Concerns
March 2, 2015

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

RE: Algonquin Incremental Market Project (AIM Project), FERC Docket No. CP14-96-000,
CEQ # 20150025

Dear Secretary Bose:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA),
and Section 309 of the Clean Air Act, we have reviewed the Final Environmental Impact
Statement (FEIS) for Algonquin’s Incremental Market gas pipeline and related facilities in New
York, Connecticut, Rhode Island and Massachusetts.

The proposed Algonquin project includes construction and operation of 37.6 miles of natural gas
pipeline and associated infrastructure in New York, Connecticut, Rhode Island and
Massachusetts. Seventy percent of the work entails replacement of existing pipelines with larger
capacity pipe, and the balance of the work is associated with the installation of new pipeline
including a new mainline, a loop and a lateral. The project also includes upgrades to existing
compressor stations in New York, Connecticut, and Rhode Island.

As described in both the DEIS and FEIS, the majority of the proposed project entails
replacement of an existing pipeline with larger pipe to increase capacity. EPA has actively
participated as a cooperating agency throughout the FERC review process by offering detailed
scoping comments on the project, comments on the interagency review draft of FERC’s
Administrative Draft Environmental Impact Statement (ADEIS), comments on the DEIS and
observations on the Administrative Draft of the Final Environmental Impact Statement (AFEIS).
EPA appreciated the brief opportunity to coordinate with FERC in advance of the publication of
the FEIS as it provided an opportunity to more fully explain our comments on the DEIS. In
addition to the comments on the FEIS provided here, EPA remains willing to work with FERC
on this project in the future with a focus on the efficacy of project mitigation measures to address
impacts.

Our previous comments on the DEIS focused on impacts to wetlands, drinking water,
groundwater supply, greenhouse gas emissions, environmental justice communities, and air
quality (during construction and operation of the pipeline). Generally, the responses provided to
the majority of our DEIS comments are informative and helpful. The attachment to this letter
highlights several areas where more could be done to characterize and address project impacts. EPA also notes that on December 18, 2014, The Council on Environmental Quality (CEQ) published a draft guidance for public comment directing how Federal agencies should consider the effects of GHG emissions and climate change in NEPA reviews. EPA looks forward to working with FERC on other upcoming actions with the guidance in mind.

Please feel free to contact me or Timothy Timmermann of the Office of Environmental Review at 617/918-1025 if you wish to discuss these comments further.

Sincerely,

[Signature]

H. Curtis Spalding
Regional Administrator

Enclosure
Detailed Comments – Algonquin Incremental Market Project FEIS

Wetland Issues

EPA appreciates the responses provided to address wetland characterization, impact and mitigation issues we raised in response to the DEIS. We believe the information advances the discussion on these issues and will help support the ongoing review of the project under Section 404 of the Clean Water Act. Nevertheless, we note several outstanding concerns based on our review of the FEIS.

- EPA continues to believe that placing fill in wetlands is a direct impact. For example, backfilling trenches within new right of way (ROW) is considered a direct impact, which may result in either permanent or temporary impacts depending upon whether the resource is fully restored to its previous condition. We note that the FEIS was updated to itemize new ROW impacts. Also, we consider any permanent conversion of wetland type within the existing alignment as a permanent impact; for example, if project activities were to require expansion of permanently maintained areas into previously restored forested wetland areas. We intend to continue to participate in discussions regarding restoration and mitigation as part of the Corps Section 404 permit process for the project.

- EPA continues to recognize the placement of temporary construction mats, timber rip rap, etc. in wetlands, even though deployed as mitigative measures, as temporary wetland impacts that should be considered in the calculation of the total wetland impacts for the project. We are confident that this impact will be addressed in the Corps’ Section 404 permitting for the project.

- EPA’s comments on the FEIS requested additional analysis to determine if horizontal directional drilling (HDD) could be implemented to help reduce project impacts at stream crossing locations. We note that Algonquin has revised the project design to incorporate HDD at the Susqetonscut Brook (B13-ELR-S5B) crossing. EPA supports this approach, which will avoid and minimize impacts to the stream and adjacent wetlands.

- EPA believes that additional information is needed to understand the potential for impacts to streams from blasting and to determine the most appropriate mitigation measures for those impacts. It remains unclear whether the recommendation for providing blasting schedules for only designated coldwater fisheries and streams greater than 10 feet wide, along with the other measures described in the FEIS, is sufficiently protective of stream resources. The FEIS identified two streams - Susqetonscut Brook and the Unnamed Tributary to Stony Brook - as streams requiring time of year restrictions on blasting, and noted that additional restrictions may be required on a site-specific basis. EPA intends to work with the Corps and Connecticut Department of Energy & Environmental Protection (DEEP) to determine whether additional mitigation measures for blasting impacts are necessary for other streams in the project corridor.
We encourage FERC to be mindful of these issues as it works to develop final conditions and mitigation measures for the project certificate. Close interagency coordination will remain important to help successfully address these issues as the project continues through the FERC and Corps’ Section 404 permitting processes.

### Air Quality

EPA’s comments during scoping, in response to the ADEIS and the DEIS, strongly recommended a commitment from Algonquin and a corresponding certificate condition by FERC to require specific measures during construction to help reduce and minimize air quality impacts. Our comments noted that these measures are not complicated to implement and they benefit residents in the project corridor during construction. The FEIS reports that, “Algonquin has committed to using ultra low sulfur diesel and best available technology on non-road engines where feasible.” As of 2014 ultra-low sulfur diesel fuel is required for non-road applications. Despite the applicant’s pledge, the lack of a FERC condition requiring the use of this technology provides little incentive and gives no certainty that these measures will be utilized for the project. We continue to encourage FERC to do more to reduce diesel emissions from the construction portion of the project, especially in populated areas, through the addition of a specific condition requiring these mitigation measures in the project certificate.

### Enhanced Community Coordination

The FEIS response to comments section regarding Environmental Justice issues notes the commitment by Algonquin to prepare additional “fact sheets in Spanish to be posted on the Project website and to prepare notices regarding public meetings and, in the future, notices regarding construction information in Spanish for the identified Environmental Justice communities.” Algonquin’s willingness to enhance their community coordination for the balance of the project should be applauded. The commitment is the result of successful coordination between EPA and Algonquin during the EIS review process. EPA values the proponent’s pledge to improve and enhance the communication with Spanish speaking populations in the project area. Better communication, regardless of whether the project will result in significant impacts to any particular community, and regardless of the language spoken in that community, is an important component of a successful project.

While we do not question the applicant’s willingness to do more to communicate with the communities affected by the proposed project, EPA encourages FERC to make the requirement for community specific, language appropriate outreach a condition of project approval for this and other future projects. We disagree with the statement in the FEIS that “there is no need or requirement for additional measures, beyond those already proposed, to mitigate an impact that is not significant.” The need for effective, targeted communication with the host communities exists regardless of the potential for impact, or the need for mitigation (in EJ and non-EJ communities alike). Language barriers can and should be overcome so that the public understands the potential for project impacts during construction and operation of the project and can effectively communicate with both FERC and the project applicant as appropriate. EPA looks forward to learning how FERC will incorporate the applicant’s willingness to enhance project communication into the project authorization.
Greenhouse Gas Emissions

EPA notes and agrees with FERC staff acknowledgment that “disparate sources of greenhouse gas (GHG) emissions individually contribute to the global climate change issue.” As noted in our comments on the DEIS, we continue to believe that FERC should avoid the comparison of project related GHG emissions to those associated with an entire region. The goal of the analysis should not be to make emissions seemingly more or less significant; rather, it should be to disclose the emissions from the project in a manner that allows for an informed discussion of the emissions and measures that can be taken to address them.

EPA appreciates the information provided in the FEIS regarding Algonquin’s best management practices to minimize fugitive methane emissions and we encourage FERC to adopt those (applicant supported) measures as a condition of the project approval.

Cumulative/Indirect Effects

EPA continues to believe that the EIS should have more fully considered the potential for increased gas production associated with the development of project related pipeline capacity. In addition, we note that the FEIS discussion continues to make reference to gas extraction occurring more than 10 miles from the proposed project location as a rationale for limiting the discussion of cumulative impacts. Geographic proximity is not in and of itself the standard for NEPA’s requirement to consider impacts that have a reasonably close causal relationship to the proposed federal action.

We also continue to recommend that FERC consider relevant studies regarding methane leaks and emissions. With regard to EPA regulations concerning methane emissions from natural gas processing and transmission sources, please note that EPA is planning to issue a proposed rule later this year that will set standards for emissions from these sources (see “FACT SHEET: Administration Takes Steps Forward on Climate Action Plan by Announcing Actions to Cut Methane Emissions,” 1/14/2015, http://yosemite.epa.gov/opa/admpress.nsf/6424ac1ca800aabh85257359003f5337/8af2a9bcb2fd9d4f85257dcd0052a8fb!OpenDocument). The link above provides information regarding EPA white papers that address various technical issues in the construction of gas pipelines. These papers may be helpful in developing estimated methane emissions from the entire project, as well as providing a basis for developing mitigation measures.