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The Proposed Broadwater LNG Import Terminal
An Analysis and Assessment of Alternatives

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I. Introduction and Executive Summary

This research was undertaken at the request of Save the Sound[1] to identify and evaluate potential alternatives to the proposed Broadwater Liquefied Natural Gas (LNG) import terminal in Long Island Sound to meet the long-term energy needs of the New York and Connecticut markets.

Having carefully reviewed the project documentation put forth by Broadwater, we find that they have failed to identify any compelling local or regional need for the proposed project that would justify the impact that this project would have on the environmental, economic, recreational and historical value of Long Island Sound. Our own research, detailed in this report, suggests that the project is not well suited to local or regional gas supply needs, and that several supply and demand management alternatives exist which would better serve the region. This being the case, the burden of proof falls on the project proponents to detail the need they propose to address and to show why it can best be met through the proposed LNG import terminal. This requirement has yet to be met.

While it is clear that domestic production of natural gas is strained relative to growing demand nationwide, this does not mean that a base load, supply-side project such as the Broadwater LNG facility, located in Long Island Sound, is the right approach for meeting the needs of New York and Connecticut. In particular, we find that:

- There is no evidence that the regional market requires a base load gas supply facility capable of providing an additional one billion cubic feet per day (bcf/d) of natural gas to meet its immediate or long-term needs. More pressing may be an infrastructure or other investment to address potential supply deficiencies during peak winter heating periods. However, the studies prepared by Broadwater Energy do not substantiate even this requirement for the region;

- Other, environmentally preferable approaches to resolving any anticipated peak load supply shortfall would provide economically and socially preferable alternatives to any perceived supply deficiency. Such approaches include increased development and use of local storage facilities; investments in energy efficiency, renewable energy, and demand-side resources; expanded use of combined heat and power technology; and repowering of existing gas-fired power plants to increase fuel efficiency;

- Even if additional base load sources of natural gas are ultimately required to balance regional demand, Broadwater is not the most promising source of supply. The Bear Head and Canaport LNG import terminals in eastern Canada, for example, are expected to begin receiving deliveries and transporting gas to the northeast United States through the upgraded Maritimes and Northeast pipeline as

[1] Save the Sound (http://www.savethesound.org) is a program of the Connecticut Fund for the Environment (CFE; http://www.cfenv.org) dedicated to the restoration, protection, and appreciation of Long Island Sound and its watershed through advocacy, education and research.

soon as 2008. The total incremental volume of gas that could be delivered through these new and upgraded facilities will be 1.5 bcf per day, and these supplies will be available at least two years earlier than Broadwater could begin operations. These facilities, which are already under construction, are among a number of supply and demand alternatives which do not threaten the integrity of a national environmental treasure[2]. They have not been given sufficient attention in the discussions over Broadwater.

- The proposition that LNG will represent an abundant and inexpensive source of natural gas is not supported by the existing and projected dynamics of the global LNG market.

II. Broadwater project description

As proposed[3], the Broadwater floating LNG import, storage and re-gasification terminal would be moored in Long Island Sound, approximately 9 miles from Long Island and just over 10 miles from the closest point in Connecticut, at a depth of approximately 90 feet. The facility, which is designed to have a base import capacity of 1.0 bcf/d (billion cubic feet per day) of natural gas, would connect via a dedicated hookup into the existing Iroquois pipeline under Long Island Sound. The proposed facility would re-gasify all imported LNG within the facility and deliver gas supplies directly into the interconnected pipeline system. Unlike the Distrigas terminal in Everett, Massachusetts, which is an onshore facility, the Broadwater facility would not be capable of providing gas in liquefied form for local storage purposes.

For perspective, total annual imports from Canada to the U.S. are about 3.1 trillion cubic feet (averaging 8.5 bcf/d) and the peak day gas deliveries for New York City[4] were just over three bcf in 2003, with the daily average delivered volume of just under two bcf. Thus the proposed LNG terminal, if built, would represent a significant expansion of gas supply infrastructure to New York, to the Northeast and to the domestic US gas market as a whole.

III. Broadwater "need" assessment is misleading

According to Broadwater Energy,[5] the primary target markets for the project are "Long Island, New York City, New York City metropolitan area and Connecticut." This region, together with New England, are on the downstream end of two "long-haul" pipeline systems which start from producing regions near the Gulf of Mexico and in Canada. This

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[2] Long Island Sound was designated an "Estuary of National Significance" under §320 of the Clean Water Act in 1988.

[3] This description is based on the Broadwater "Resource Report No.1: General Project Description" of May, 2005.

[4] New York City Energy Policy Task Force, *New York City Energy Policy: An Electricity Resource Roadmap* January, 2004.

[5] Broadwater Energy, Ltd., 2004, *Broadwater Project Description*. Available at http://www.broadwaterenergy.com/

limits the ability of the transcontinental pipelines to deliver high volumes of gas to these downstream markets under peak conditions, and causes the local gas price to reflect high transportation costs (basis differentials) relative to most other areas of the United States.

It is useful to clarify the notion of an "upstream" end and a "downstream" end for gas pipelines, with gas moving from upstream to downstream. When gas pipelines are constrained, such that incremental gas cannot be transported in the direction of flow, it is still possible to effectively reach an upstream market with gas which is injected in the pipeline on the downstream end. This is done by satisfying demand downstream with the additional gas supply, thus freeing up gas upstream for another user. Thus there is additional value to supplying gas at the downstream end of the pipeline relative to injecting it upstream in the traditional supply regions. It is this additional value which Broadwater presumably hopes to capture by securing a location in Long Island Sound, and indeed it is this value that is coveted (and it is this service provided) by *any* of the numerous proposals for LNG import terminals in the northeast United States and eastern Canada.

There is no dispute that on a national basis, demand for natural gas has been growing while domestic production from conventional sources has struggled to keep pace. However, this does not mean that a major LNG import terminal in Long Island Sound, with all of the social and environmental costs it would entail, is required to meet local gas demand. In fact, the Broadwater Energy documentation does not substantiate any particular requirement for additional natural gas supplies in the target region, nor do they make any specific claim that the Broadwater project would lower prices or dampen price volatility in this market. These benefits are left as an implication. In this sense Broadwater has not satisfied their burden of proof that the project would have local or regional benefits to justify the local costs.

Our research shows that the target region has and will continue to have ample natural gas import capacity to supply the regional demand for most days of the year. If there are any import capacity shortfalls, they would only materialize during peak demand periods during the winter heating season, due to the strong seasonality of gas use. The seasonal pattern of pipeline utilization in New England is illustrated in Figure 1.

The winter-peaking behavior illustrated in Figure 1 is due to the seasonality of residential and some commercial demand, which is extremely difficult, costly, and dangerous to curtail. On the other hand, natural gas demand for power generation and industrial applications is relatively constant throughout the year, and may also be replaceable with other fuels if gas is unavailable or too costly. Because of this, companies that deliver gas directly to retail consumers generally contract for pipeline capacity on a firm basis and use local storage facilities to store either LNG or natural gas vapor to meet peak demand. Gas-fired generators are more likely to purchase gas at a lower cost on a non-firm basis. If a shortfall were to occur, retail gas providers would likely get their supplies first and generators would be fueled to the extent that additional supplies were available.

In New England, there is concern that as the generation share of natural gas-fired plants increases, the reliability of the electric system will be compromised during peak heating days by delivery constraints on natural gas. These potential peak-day gas shortages do not appear to be a current concern in New York. While the New York market is expected to add at least 4,000 MW of gas-fired generation over the next five years,[6] this is unlikely to lead to a comparable level of natural gas dependence and risk. Some of the older generating units whose output will be displaced by this new generation of highly-efficient, gas-fired combined cycle units are older gas-fired steam units, and the newer units will be able to produce up to 50% more electricity for the same amount of fuel.[7]

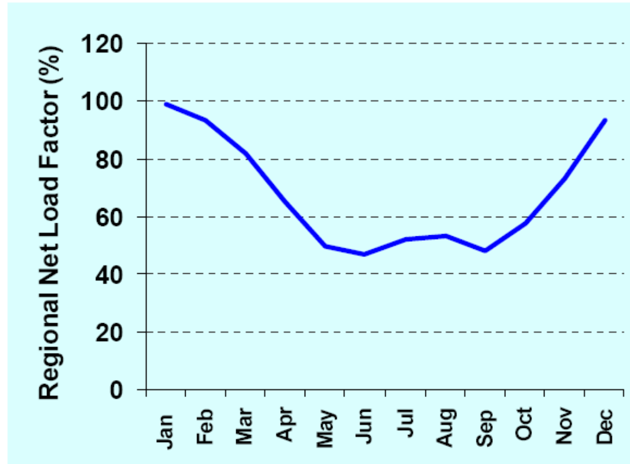

Figure 1. Monthly average interstate pipeline utilization rate in New England. From New England Governors Conference, 2005, based on data from FERC. The pattern of pipeline utilization in New York would be expected to exhibit similar seasonality.

New York and Connecticut have a number of socially and economically beneficial options for controlling gas consumption, as outlined later in this report. These include increased application of well-established energy efficiency practices, expanded use of renewable energy, investment in highly efficient combined heat and power (CHP) operations, and re-powering of existing gas-fired power plants to produce significantly more power for the same amount of fuel. Finally, both New York's participation in the RGGI cap-and-trade greenhouse gas initiative,[8] and the rapidly increasing cost of gas and oil above what is reflected in the Broadwater studies, means that energy efficiency and conservation approaches are becoming increasingly attractive and cost-effective for meeting the region's future energy needs. Because of the abundant opportunities to meet these needs without additional fuel use, and because the natural gas supply to the region is not constrained for most hours of the year, the Broadwater project cannot be justified on the basis of the needs of this market.

Finally, we find that other incremental sources of natural gas supply which can reach the regional market are already under development, and will begin to provide gas substantially before the Broadwater facility could be brought on line. The most likely near-term source of additional gas supply is the upgraded Maritimes and Northeast (M&N) pipeline,[9] which will deliver gas from at least two LNG import terminals already under construction in eastern Canada. As discussed later in this report, these terminals are

[6] New York City Energy Policy Task Force, 2004.

[7] New York State Energy Plan, June, 2002.

[8] http://www.rggi.org/

[9] www.mnp-usa.com.

expected to deliver gas beginning in 2008, around the same time that the Phase IV upgrade to the M&N pipeline will enable it to deliver the additional gas to the region. Other proposed LNG import facilities in the northeast United States, and/or expansions of existing facilities, are also likely to begin delivering gas at least as early as Broadwater could do so. Almost all of these facilities are downstream of the New York and Connecticut markets.

The Broadwater terminal would have a base import capacity of 1.0 bcf/d, and the project documents consider alternatives only to the extent that these alternatives are capable of providing this same quantity of natural gas to the region. This line of reasoning is specious; nowhere in these documents or in any other study is a requirement for this quantity of natural gas substantiated for the target market. The Broadwater project is designed to serve a much broader market, financially if not physically. The primary attraction of locating an import terminal in Long Island Sound is not that it addresses the supply requirements of the local market. It is that by injecting gas in this downstream position in the pipeline system, the facility would have access to high-priced gas markets anywhere in the eastern United States.

Summary: *Is there a natural gas supply shortfall in New York and Connecticut?*

The *Broadwater Resource Report No.1: General Project Description* (May, 2005) asserts, in a section entitled "Purpose and Need," that the target market is facing "a projected critical period over the next 10 to 15 years in meeting the anticipated energy needs of consumers." However, the report proceeds to discuss natural gas supply and demand only on a national level. While we do not disagree that the national supply infrastructure is stressed, we have found no studies which project such a shortage *in the target region* which would justify a large, base load project such as Broadwater. We were unable to find any studies which provide specific forecasts of even a shortfall in meeting peak demand in this region.

The most cost effective and environmentally beneficial approach to managing natural gas demand growth involves increased efficiency of fuel use and efforts to reduce demand for both gas and electricity. Because of the significant societal costs of the Broadwater project and the significant social benefits of energy efficiency, renewable energy, and demand-side alternatives, these alternatives should be given much greater consideration. In addition, other sources of gas supply which will be able to meet the region's peaking needs are likely to come on line well before Broadwater could begin deliveries.

The potential for energy efficiency and demand reduction for managing natural gas demand, and a discussion of alternative sources of supply, are the subjects of the next sections of this report.

IV. Managing Growth in Natural Gas Demand

Many environmental groups, consumer groups and research organizations, including Synapse[10], have highlighted the importance of renewable energy and energy efficiency to reduce natural gas demand, reduce emissions of pollutants, and control prices and price volatility.[11] Perhaps the most fully-developed approach is to reduce reliance on fossil-fuel based electric generation. Because gas-fired electricity generation is the fastest growing sector of demand for natural gas (Figure 2), and because gas-burning generators are generally "on the margin" in the northeastern United States, saving electricity is an effective means of saving gas. Similarly, expanded use of renewable energy sources will displace generation from gas-fired sources, also easing pressure on gas supplies.

These approaches have a number of ancillary benefits, such as reduction of NOx, SOx and CO_2 emissions, reduction in the need for new gas infrastructure and the creation of local jobs. A recent study conducted by the Regulatory Assistance Project and Synapse presents an example of how these benefits can be estimated.[12]

As prices have risen to record high levels during the past few years, efficiency measures which may have been marginally cost effective in the past have become extremely attractive on an economic basis—perhaps half the cost per kWh saved compared to the market price of electricity. Several states, including Connecticut, have been reevaluating existing policies or implementing new policies to promote natural gas energy efficiency measures.[13]

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[10] Several examples are available at http://www.synapse-energy.com/publications.htm/. See also reports by the Union of Concerned Scientists, at http://www.ucsusa.org/clean_energy/.

[11] See R. Wiser, M. Bolinger, and M. Clair, January 2005, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency*; D. York and M. Kushler, 2004, *Tapping Our Hidden Reserves: America's Exemplary Natural Gas Energy Efficiency Programs*, a Report presented at the 2004 ACEEE Summer Study on Energy Efficiency in Buildings; W. Steinhurst, September 2004, Testimony of William Steinhurst Senior Consultant Synapse Energy Economics, Inc. On Behalf of Citizens Action Coalition, Inc.: Case No. 42598 Before the Indiana Utility Regulatory Commission; M. Bolinger, R. Grace, D. Smith, and R. Wiser, May 2003, *Using Wind Power to Hedge Volatile Electricity Prices for Commercial and Industrial Customers in New York*, prepared for the New York State Energy Research & Development Authority; National Petroleum Council, 2003, *Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy*, Washington, D.C.

[12] Regulatory Assistance Project and Synapse Energy Economics, , Electricity Energy Efficiency and Renewable Energy in New England: An Assessment of Existing Policies and Prospects for the Future, May 2005.

[13] See a summary of recent development in Northeast prepared by NEEP (Northeast Energy Efficiency Partnership) at http://www.neep.org/policy_and_outreach/Natural_Gas_EE.pdf ; and F. Coito and M. Rufo, 2003a, *California Statewide Residential sector Energy Efficiency Potential Study, Final Report, Volume 1 of 2 Main Report*: KEMA-XENERGY Inc.; and F. Coito and M. Rufo, 2003b, *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study, Final Report, Volume 1 of 2 Main Report*: KEMA-XENERGY Inc.

Other ways that improved gas utilization can be achieved include improved and expanded use of combined heat and power technology (CHP, also known as cogeneration,) and re-powering of existing gas-fired electric power plants. Natural gas burning CHP reduces overall natural gas consumption by providing both power and heat on-site, at a fuel efficiency rate of more than 80%. The increased deployment of CHP in New York and Connecticut could reduce natural gas consumption at both generation and end-user levels by reducing the need to purchase electricity from the grid, and by using "waste" heat for heating needs at consumers' premises. Re-powering existing electric generators can improve the fuel efficiency of existing gas-fired generators by 30% or more.

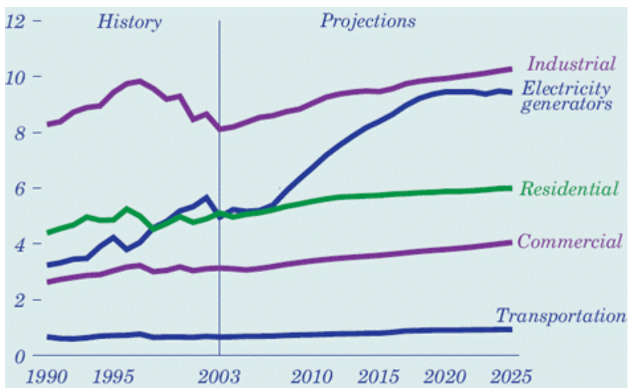

Figure 2. Historical and projected US gas demand by sector, in trillion cubic feet. From AEO 2005. Because electricity generation is a large and fast-growing sector of demand, renewable energy and electricity demand management are effective ways of limiting gas demand.

We have reviewed a range of studies exploring the potential for each of these approaches to reduce gas demand in New York and Connecticut. Based on our assessment of the potential for cost-effective energy efficiency and renewable energy initiatives, we find that roughly 75% of the anticipated growth in regional gas demand over the next decade can be eliminated through these approaches alone. Together with other gas-saving options, such as gas demand-side management, expanded use of combined heat and power operations, and re-powering of existing power plants, these measures can eliminate or even reverse the trend toward increasing gas use.

This potential is illustrated in Figure 3. On the left is the combined increase in demand in New York and Connecticut as projected by the U.S. Department of Energy in the Annual Energy Outlook for 2005.[14] On the right is a compilation of likely gas savings associated with full implementation of renewable energy and energy efficiency statutes and goals in New York and Connecticut, which have not been taken into account in the AEO forecast. Also shown in this column are the impacts of measures such as expanded use of CHP, and repowering of existing gas burning plants to improve their efficiency. These measures are much more likely to be undertaken given the current gas price outlook, as fuel prices and futures are much higher today than those assumed in the AEO 2005 model.

[14] http://www.eia.doe.gov/oiaf/archive/aeo05/index.html.

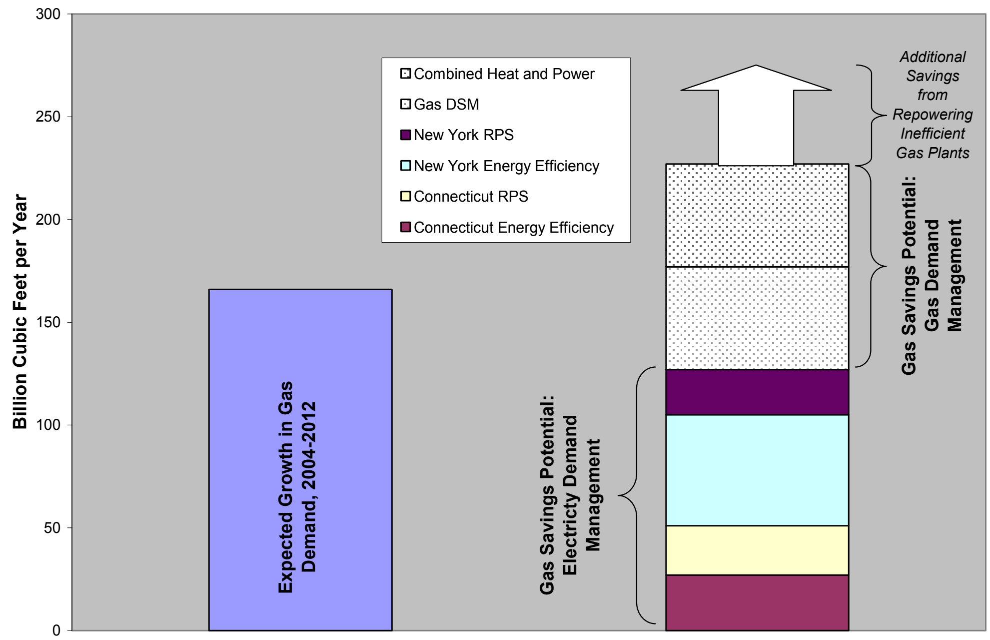

Figure 3. Projected increase in natural gas demand in New York and Connecticut through 2012, compared to estimated 2012 potential savings from cost-effective electric and gas demand management programs relative to business as usual.

What Figure 3 shows is that if these measures are taken into account, gas demand would not be expected to grow relative to its current level by 2012. In fact, the region may be using less gas in 2012 than today, in response to both forward-thinking state initiatives, and the elevated cost of natural gas. The specific components of this demand reduction are detailed in Appendix A to this report.

Summary: *Can natural gas demand growth in New York and Connecticut be met with demand side management?*

Natural gas use in New York and Connecticut can be reduced through management of both electricity and natural gas demand, through implementation of renewable energy generation goals, through expanded use of combined heat and power and through improving the efficiency of existing generating plants. On the electric side, both demand management and increased reliance on renewable sources are effective ways to save gas because gas-burning power plants are often "on the margin" in this region. This means that these particular plants are the ones that will run less in response to decreased load on the system.

We find that full implementation of renewable portfolio standards in New York and Connecticut will save approximately 52 bcf of gas each year, and that electric energy efficiency initiatives could save an additional 81 bcf at very low cost compared to the cost of energy. Together these measures alone would offset roughly 75% of the expected gas demand growth in the region through 2012. When supplemented by gas DSM, expanded use of combined heat and power, and repowering of existing power plants, these measures represent more than enough potential savings to offset all anticipated demand growth over the next decade.

V. Supply alternatives

As noted earlier in this report, it is not clear that New York and Connecticut are facing a natural gas supply shortfall at all, nor has such a shortage been substantiated in Broadwater's project descriptions. It is more likely that some infrastructure investments may be required to help manage peak demand for a few days during the winter heating season. In this case, the best alternative may be investment in peaking facilities—local LNG storage facilities which can augment peak day supply without adding to load on the interstate pipeline system. This approach is widely used in New England to meet peak demand levels that exceed the real-time import capacity of the system.

However, it is useful to explore whether the proposed Broadwater facility is an appropriate option if it turns out that additional sources of supply are needed. This may be the case if gas demand grows more rapidly than we expect, or if supplies from existing domestic sources becomes constrained for any reason.

We find that there are alternative supply options that are better suited to meeting this potential need than the proposed Broadwater facility, that do not present the same adverse impact on the region. As shown in Figure 4, there are a large number of LNG import terminals that have been proposed throughout the United States, as well as several sites which have been identified as "potential" sites by project sponsors. Ten to twelve projects have been proposed in the northeastern U.S. and eastern Canada,[15] any of which would free up supplies that could serve New York and Connecticut. Many of these projects would have much lower social costs than would a new, experimental import terminal in Long Island Sound.

[15] The precise number of active proposals changes frequently as new projects are initiated and/or abandoned. A current list and other related information may be found at http://www.ferc.gov/industries/lng.asp.

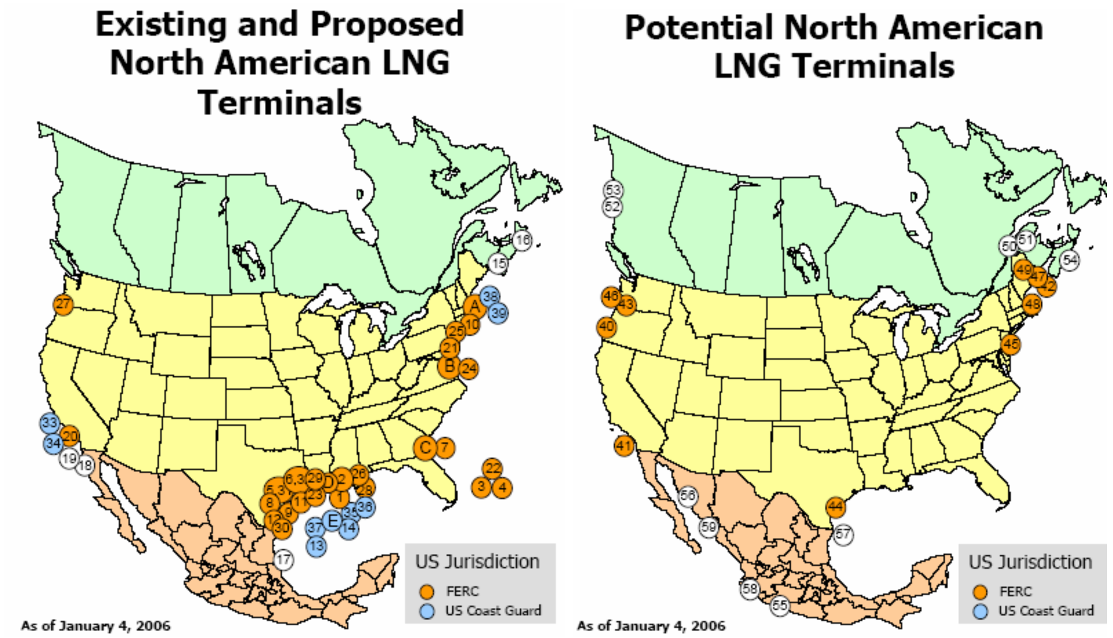

Figure 4. Existing and proposed LNG terminals in the United States, as of January 4, 2005. *Source: Existing and proposed:* ***http://www.ferc.gov/industries/lng/indus-act/exist-prop-lng.pdf****;* *Potential sites:* ***http://www.ferc.gov/industries/lng/indus-act/horizon-lng.pdf***.

The most likely near-term supply-side alternative is represented by the ongoing construction of two LNG import terminals in Eastern Canada, combined with the Phase IV expansion of the Maritimes and Northeast (M&N) pipeline from the Sable Island region into the northeast United States,[16] shown in Figure 5. The import terminals are the Bear Head (Anadarko) LNG import terminal under construction in Nova Scotia, and the Canaport (Irving Oil) LNG import terminal under construction in St. John, New Brunswick. Both are expected to begin deliveries in 2008. The M&N pipeline currently carries 0.5 bcf/d of gas from Nova Scotia and Sable Island, and is expected to be upgraded in carrying capacity by an additional 1.5 bcf per day by 2008 to coincide with the onset of gas deliveries to the two new LNG terminals[17]. M&N has the benefit of being connected to the "downstream" end of the U.S. pipeline system in Dracut, Massachusetts. As discussed earlier in this report, injecting gas into the downstream end of the interconnected pipeline system significantly increases deliverability all along the pipeline, including into the New York and Connecticut markets.

The Phase IV expansion of this system requires investments in additional compressors to increase the flow capacity of the pipeline by an additional 1.5 bcf/d, but does not generally require construction of new pipeline. This is a significant cost advantage compared to other pipeline expansion alternatives that might reach the target market.

[16] http://www.mnp-usa.com/.

[17] See Maritimes and Northeast Pipeline Notice of Intent for the Phase IV expansion filed with FERC December 2005, Docket No. PF05-17-000. http://www.mnp-usa.com/ferc_notice_of_intent.pdf.

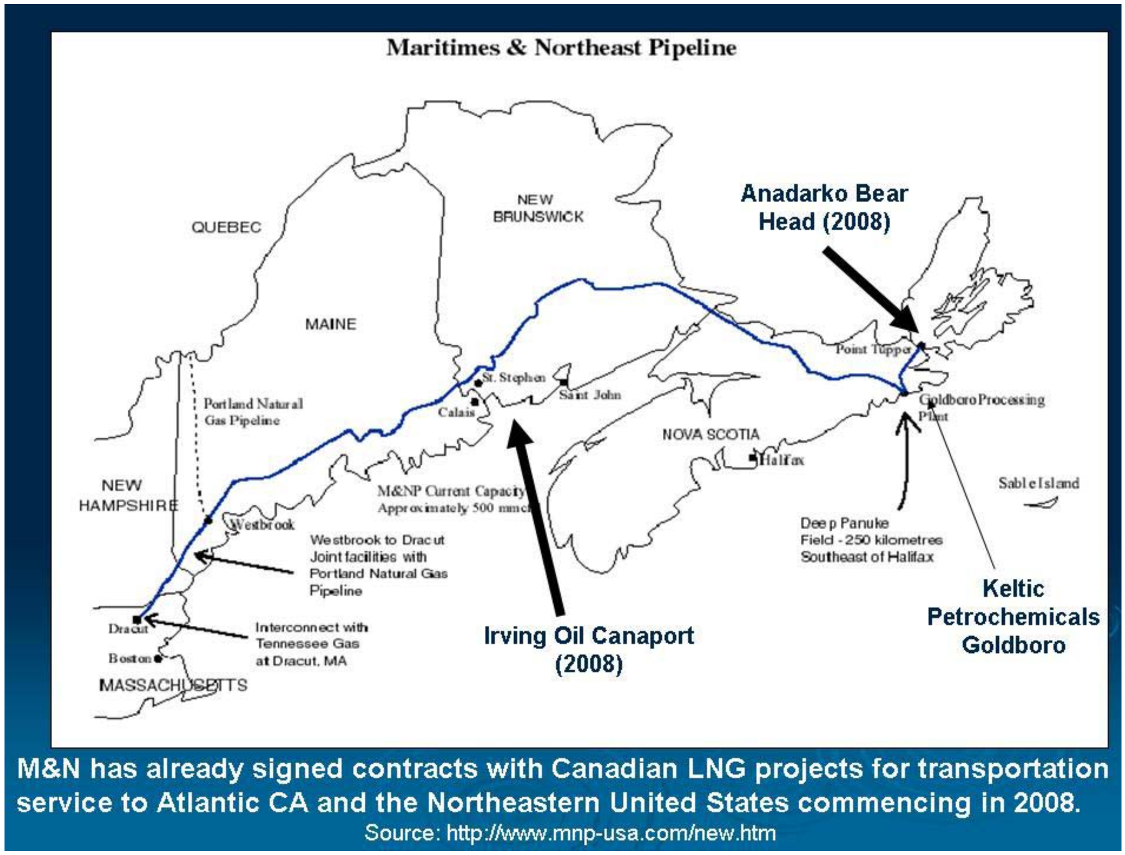

Figure 5. LNG terminals under construction and their connection to the Maritimes and Northeast pipeline, which will increase capacity by 1.5 bcf/d under the Phase IV expansion. Both the expanded pipeline and the import terminals are expected to be in service in 2008, at least two years before the Broadwater project could begin deliveries.

Another cost advantage for the eastern Canadian alternative is that LNG could reach these terminals at significantly lower transportation cost than would be incurred reaching Eastern U.S. locations, such as Long Island Sound. This is because Eastern Canada is significantly closer to most LNG producing regions in the world, and transportation costs are directly related to transport distance.

We conclude that the M&N pipeline expansion, combined with the LNG import terminals currently under construction in eastern Canada, are more viable and more appropriate supply-side options than the Broadwater project for increasing availability of natural gas in the New York State and Connecticut. These facilities are already under construction and require minimal additional infrastructure to increase delivery capability into the region. They are located on the downstream end of the pipeline system and can thus make gas available anywhere in the broader region. They can obtain gas at a lower transportation cost than would be possible in Long Island Sound, and they do not threaten a fragile and vital natural resource.

Summary: *Is Broadwater the only option for additional natural gas supplies in New York and Connecticut?*

There are a number of options for bringing additional natural gas supplies into the New York and Connecticut Region, including up to a dozen proposed LNG terminals in New England and eastern Canada. Most notably, two LNG sites currently under construction in Eastern Canada can and will serve this market through the M&N pipeline system, which is expected to be upgraded to carry an additional 1.5 billion cubic feet of gas per day into the northeast United States as early as 2008. This is at least two years before Broadwater could begin deliveries.

VI. Is LNG an abundant and inexpensive source of natural gas?

One commonly expressed argument for developing natural gas import capability in the United States is that global supplies are abundant and inexpensive relative to domestic sources of gas. For example, the Broadwater *Project Description* discusses the benefits of lower energy costs for the State of New York, implying (but not actually asserting) that an LNG import terminal would lead to lower energy costs for the state. While it is true that global natural gas supplies are much more abundant than U.S. supplies, and that the production costs associated with these supplies can be much lower, it is unlikely that much or any of this economic benefit will be passed through to consumers. There are a number of reasons why this is the case:

- While the global supply of gas is abundant, the capital investments required for production, transport, liquefaction, and shipping represent a significant hurdle that will slow the availability of global sources;
- Gas demand is growing in a large number of countries around the world, many of which will inevitably depend on the global LNG market due to limited or nonexistent indigenous resources;
- Natural gas prices are generally higher in markets such as Europe and Japan than in the United States, while transportation costs to these markets are generally lower. This places these importers at a competitive advantage over their American counterparts in obtaining supplies;
- Importers of natural gas into the deregulated U.S. gas market will sell their supplies at the prevailing domestic market price, whatever their cost of supply; and
- The small number of high-volume exporting countries may form a cartel to maintain high global LNG prices.

According to a 2003 overview of the global LNG market produce by the U.S. Department of Energy,[18] the global natural gas liquefaction capacity in 2003 was about 6,500 bcf/yr, with about half in the Pacific basin (primarily Indonesia, Malaysia, Australia and Brunei), a third in the Atlantic basin (Algeria, Nigeria and Trinidad & Tobago) and the remainder in the Middle East (Qatar, Oman and the UAE). The world's largest importer was and remains Japan which, with a re-gasification capacity of 9,200 bcf/yr in 2003, alone had more import capacity than the rest of the world had export capacity. Japan is dependent on LNG for approximately 12% of its energy needs. South Korea has the world's second largest re-gasification capacity at about 2,000 bcf/yr, followed by the United States with 1,200 bcf/yr capacity.

While some of the currently exporting countries are expected to increase their liquefaction capacity in the next several years, much of the growth in LNG supplies is likely to come from new exporters such as Egypt, Russia, and Norway. Another major player could be Iran, with the world's second largest proven gas reserves. On the import side, the United Kingdom, China and India were all building their first import terminals as of the 2003 report. In the United States, which currently has four LNG import terminals with a combined peak capacity of about 1,200 bcf/yr, imports to these existing terminals have doubled since 2000, and approximately 40 new import terminals have been proposed (Figure 4). Thus while production capacity is growing, it is being far outstripped by the growth in import capacity and demand worldwide.

One effect of the rapidly growing and globalizing LNG market is increased price competition among importers. For example, during the summer of 2005, U.S. imports decreased from the previous year despite much higher gas prices. This appears to have been largely due to poor hydropower availability in Spain, driving up European natural gas prices and making Europe a more attractive market than the United States for suppliers.[19] In addition, the LNG market has evolved toward increased flexibility and shorter-term contracts, or long-term contracts with limited price protection with pricing terms pegged to petroleum market indicators. In this situation, with most import terminals operating below capacity, supplies will be available only to the highest bidders. As the EIA report states:

> Costs of liquefaction, shipping, and re-gasification have declined over time, lowering costs to producers. Since the LNG market is primarily driven by long-term contracts with pricing mechanisms pegged to petroleum products, however, lower operating costs do not necessarily translate into lower LNG prices, at least in the short term.[20]

The industrialized world's nearly insatiable thirst for energy, combined with the small number of gas-rich exporting countries, has led to a situation in which an OPEC-like cartel could have a major impact on world gas prices. In fact, according to a recent article

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[18] Energy Information Agency, US Department of Energy, *The Global Liquefied Natural Gas Market: Status and Outlook* December, 2003. http://www.eia.doe.gov/oiaf/analysispaper/global/index.html.

[19] Dow Jones Newswire, "Global LNG Crunch Forcing US Into Bidding War", November 23, 2005.

[20] Energy Information Agency, op. cit., p. 32.

in the New York Times,[21] thirteen gas rich nations including Qatar, Iran, Egypt, Nigeria and Venezuela have already formed an organization called the Gas Exporting Countries Forum and set up a liaison office in Doha, Qatar. In the oil sector, the international price of oil dominates the domestic U.S. trading price, extending OPEC's influence and increasing costs to American consumers and industry. This same specter may haunt the future U.S. gas market as imported LNG plays an increasingly significant role.

Summary: *Will LNG mean cheaper gas for consumers?*

In the United States alone, about 40 LNG import facilities have been proposed and are in various stages of permitting. While only a small fraction of these will ever go into operation, it will still represent an enormous jump in the global exposure for what has traditionally been primarily a domestic market. But the United States is not the only country with a fast-growing appetite for natural gas as a clean, flexible energy source; many countries around the world are pursuing LNG imports to fuel their growing energy demand. As a result, global import capacity is growing much faster than sources of supply, leading to an intense competition for supplies that is driving up prices.

While it is true that global natural gas supplies are plentiful, there are numerous obstacles that must be overcome and substantial capital investment to be made before this gas can serve needs in the United States. Because there is a relatively small number of producers, and because the political and economic conditions in many potentially producing regions are not conducive to efficient infrastructure development, this abundant raw gas is unlikely to translate into savings for consumers.

VII. Conclusions

A review of the available data does not substantiate any near-term requirement for additional, base load sources of supply in the New York and Connecticut markets; nor have the studies provided by Broadwater made this case. While growth in North American production has been outstripped by growth in demand in recent years, there does not appear to be any specific need for additional base load capacity which will feed directly into this regional market. To the extent that infrastructure investments are required to meet local demand, it can best be directed toward increasing local storage capacity, so that peak winter demand can be met with a greater margin of safety using existing pipeline infrastructure.

We find that implementation of existing renewable portfolio standards in New York and Connecticut, combined with cost-effective energy efficiency and DSM initiatives, can neutralize or even reverse any anticipated growth in natural gas demand over the coming decade. Displacement of gas-fired electricity generation alone, through investments in energy efficiency and renewable energy sources, could eliminate roughly 75% of the projected natural gas demand growth until 2012. Other measures, such as gas demand

[21] "Demand for Natural Gas Brings Big Import Plans, and Objections," New York Times, June 15, 2005.

management, expanded use of combined heat and power, and repowering of aging gas-fired generators could more than offset the rest.

In addition, the region can look forward to increased access to gas imports regardless of need due to the high gas prices in the northeast US markets. Among the dozen or so proposed LNG import terminals on the east coast of North America, there are many that do not raise the local environmental concerns that accompany the Broadwater proposal and that would just as effectively serve this market. Most notable are the two LNG terminals already under construction in Eastern Canada, coupled with the Phase IV upgrade of the Maritimes and Northeast pipeline to serve the northeast U.S. markets. Because these facilities would be located "downstream" of the load centers in New England, they will free up gas supplies and increase deliverability throughout the region.

We find that imported LNG holds little promise as an inexpensive source of supply for the region; we would expect only minimal price benefits for consumers, if any. Demand for LNG is growing rapidly in markets around the world including Western Europe, China, and India, as well as in the United States. Global demand is poised to outpace available global supply for the foreseeable future, and the benefits of inexpensive production abroad are unlikely to accrue to consumers in the United States. In addition, the small number of producers controlling sources of supply raises concern that cartel behavior may serve to keep prices artificially high.

Many aspects of this analysis have required extrapolation from available data to make judgments about supply and demand in the target market. For example, we were unable to find any sources which detailed the adequacy of gas supplies for the New York region specifically. We have extrapolated from a variety of studies on the efficacy of demand side alternatives in both the gas and electric sectors to try to estimate the likely savings in New York and Connecticut, knowing that all markets have unique characteristics that render such assessments somewhat uncertain. What we do know with certainty is that there is great potential for moderating demand growth throughout the United States, and experience shows that much can be done at a significantly lower cost than the cost of augmenting supply. We also know that several options for additional supply are available, many of them without the long-term damage to environmental, economic and recreational resources that Broadwater would impose on Long Island Sound. Both supply and demand alternatives have been discussed in this report.

The Broadwater proponents have not made a convincing case that the project is required for regional energy needs. They retain the burden of proof that this project, with all of its associated impacts, is necessary to assure adequate natural gas supplies for the region. They have failed to demonstrate that the proposed facility represents a better alternative for the northeast United States than demand management, increased use of peaking facilities, and reliance on other proposed LNG import terminals and pipeline expansion projects. They have not shown that it would result in cost savings for consumers in the region. In short, they have not shown that this project, which risks compromising the vital and irreplaceable resource of Long Island Sound, presents commensurate regional benefits.

Appendix A

Demand reduction through renewable energy and energy efficiency

The New York Renewable Portfolio Standard (RPS) Order provides for production of 25% of New York's energy from renewable sources by 2013.[22] Assuming this target would be reached through incremental additions each year, we assumed that 24.3% of total retail load would be served by renewable sources in 2012, representing an increment of 8,466 GWh,[23] over 2004 levels. However, for comparison with existing forecasts of gas use, we did not include any renewable energy projects which are already taken into account in the AEO 2005 forecast; this reduced our incremental renewable energy estimate to 6,638 GWh in 2012 over 2004 levels.

The Connecticut RPS currently sets renewable energy targets at 7% of the total retail sales in 2010. The Connecticut Climate Change Action Plan proposes to increase this percentage annually by 1% after 2010.[24] We estimated the incremental renewable energy production for 2012 (relative to 2004) by applying the RPS targets, plus 2%, to the most recent electricity demand forecast estimated by the ISO-New England.[25] The electricity demand in 2012 is 39,430 GWh is again adjusted downward to 34,964 GWh in order to reflect the aggressive energy efficiency measures considered in our analysis. This demand is further adjusted downward to 32,866 GWh by excluding the estimated demand by publicly-owned utilities that are not subject to the State RPS.[26] As a result, we assume Connecticut RPS would produce roughly 9% of this, or 3,000 GWh of incremental renewable energy in 2012 relative to 2004. The AEO 2005 forecast does not include any new renewable energy generation in Connecticut between the years 2004 and 2012.

For energy efficiency potential in New York, we applied the least-cost achievable energy efficiency measures as described in a recent NYSERDA study.[27] This achievable

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[22] New York Public Service Commission, September 2004, Order Regarding Retail Renewable Portfolio Standard: CASE 03-E-0188 - Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard.

[23] This estimate is based on a load forecast which takes into account all energy efficiency measures identified in this study.

[24] The Governor's Steering Committee on Climate Change, 2005, *Connecticut Climate Change Action Plan 2005,* sets goals for voluntary green marketing programs and government's green procurement policy. However, as these estimates are still under development we did not use these in our study.

[25] ISO-New England, 2005, *CELT report 2005*, available at http://www.iso-ne.org/.

[26] The share of retail sales by publicly-owned utility is approximately 6% in Connecticut in 2003 according to EIA. See EIA, Electric Sales and Revenue 2003, available at http://www.eia.doe.gov/cneaf/electricity/esr/esr_tabs.html. This percentage is applied to our analysis in order to identify the applicable amount of retail sales under Connecticut RPS.

[27] Optimal Energy, Inc., ACEEE, Vermont Energy Investment Corporation, and Christine T. Donovan Associates, 2003, *Energy Efficiency and Renewable Energy Resource Development Potential in New York State*, prepared for New York State Energy Research and Development Authority (NYSERDA), August 2003.

potential takes into consideration market barriers to efficiency and renewable energy development, and the costs of market intervention strategies to overcome those barriers, while achieving green-house gas emissions reduction goals set by the 2002 State Energy Plan for the years 2010 and 2020. The levelized lifetime costs of the measures selected under this scenario are less than $0.03/kWh, or less than half the cost of electricity at today's prices.

For Connecticut, we used estimates of potential savings for energy efficiency measures from a recent study prepared for the Energy Conservation Management Board (ECMB) of Connecticut.[28] This study evaluated the maximum achievable, cost-effective potential savings from energy efficiency measures and practices in Connecticut and the Southwest Connecticut region up to 2012.[29] For the purposes of this study we used the maximum achievable, cost-effective measures, which pass the Total Resource Cost test.[30]

Published estimates of the reductions in electricity use associated with energy efficiency and renewable energy production rarely directly estimate the associated savings in natural gas. We estimate the associated natural gas savings by applying both a region-specific natural gas displacement ratio, and a representative marginal heat rate for natural gas-fired generation.[31] We used the natural gas displacement ratio of approximately 78% for Connecticut, consistent with estimates by ISO-NE of the share of natural gas in the marginal generation fuel mix in 2003.[32] For New York we obtained an estimated displacement ratio of 43% from the 2004 New York RPS Order.[33] For the marginal heat rate of natural gas plants, we applied ISO-NE's assumption of 7,800 Btu/kWh for Connecticut,[34] and we applied 7,950 Btu/kWh for New York.[35] The marginal heat rate can be thought of as the amount of gas that would be burned or saved if one more or one

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[28] GDS Associates, Inc. and Quantum Consulting, June 2004, *Independent Assessment of Conservation and Energy Efficiency Potential for Connecticut and the Southwest Connecticut Region: Final Report For the Connecticut ECMB*.

[29] The Governor's Steering Committee on Climate Change, *Connecticut Climate Change Action Plan 2005,* sets goals for voluntary green marketing programs and government's green procurement policy. However, as these estimates are still under development we did not use these in our study.

[30] The costs include all the expenditures by the utility and the customers. The benefits include all the avoided utility costs, plus any other cost savings for the customer such as avoided water costs, avoided oil cost, reduced operations and maintenance costs to the customer, or non-energy benefits to low-income customers. Note that the Total Resource Cost test typically excludes hard to estimate benefits such as environmental benefits, and economic development benefits.

[31] The gas savings associated with each MWh electricity reduction depends on the generation fuel mix on the margin in a given region. The more natural gas is used for generation among marginal generation fuel mix, the higher the displacement ratio. In addition, the gas savings depend on the efficiency of a typical gas-fired generating plant in the region, represented by the marginal heat rate.

[32] This figure was used for ISO-NE, 2004, *2003 NEPOOL Marginal Emission Rate Analysis.*

[33] New York Public Service Commission, September 2004, *Order Regarding Retail Renewable Portfolio Standard*: CASE 03-E-0188 - Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard (RPS order)

[34] ISO-NE, 2004, *2003 NEPOOL Marginal Emission Rate Analysis*.

[35] New York RPS order. This value is suggested for 2013, but we believe it is a reasonable approximation for more near-term projections as well.

fewer kilowatt of electricity were required, respectively, assuming a gas-burning electric power plant is being adjusted to follow the load.

Table 1 provides our estimates of natural gas consumption reduction through renewable energy and electric energy efficiency measures for New York and Connecticut[36]. New York has the potential to generate almost 8,500 GWh of renewable energy and to save over 16,000 GWh through electric efficiency measures in 2012. These two measures combined would save over 80 bcf of natural gas each year.

Connecticut has the potential to generate roughly 3,000 GWh of renewable energy and to save an additional 4,500 GWh through electric efficiency measures in 2012, which translates into natural gas savings of about 44 bcf of gas per year. Thus, the potential incremental savings from energy efficiency and renewable energy in New York and Connecticut combined is almost 120 bcf of natural gas per year by 2012.

It is instructive to compare these savings of 120 bcf per year, due solely to expected renewable energy development and readily achievable electric energy efficiency, to the projected growth in natural gas demand during the same period (see Figure 3 in the main body of this report.) The Energy Information Agency of the Department of Energy's most recent projections, published in the Annual Energy Outlook 2005, projects growth in natural gas demand in the Mid-Atlantic region (including New York) and in the New England region (including Connecticut). We applied the projected natural gas consumption growth rates in the two regions between 2004 and 2012, 1.64% for New York and 1.77% for Connecticut. In 2004, New York consumed approximately 970 bcf and Connecticut 163 bcf,[37] so the combined incremental natural gas consumption may be estimated at 160 bcf (141 bcf for New York and 18 bcf for Connecticut) in 2012 relative to 2004. (As noted above, AEO 2005 accounts for very limited new renewable energy development based on state RPS. Our projection of potential *additional* renewable energy only includes projects which are not already included in the AEO forecast.) Thus the 120 bcf of savings is roughly 75% of the expected 160 bcf incremental demand for gas in 2012 relative to 2004. For another perspective, these estimated savings represent the amount of gas that the Broadwater facility would deliver each year if it operated at a 33% overall capacity factor.

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[36] In calculating the combined impact of RPS and energy efficiency measures, the total potential impact is less than the sum of the two because decreased load reduces the required renewable production in MWh under RPS. This effect is taken into account in the results shown here.

[37] EIA, *Natural Gas Monthly*, October, 2005.

Table 1. Potential 2012 gas savings associated with Renewable Energy and Energy Efficiency in New York and Connecticut

	Generation Savings (GWh)	NG savings (bcf per year)
New York		
Renewable Energy†	6,638	22
Electric Efficiency††	16,116	54
Connecticut		
Renewable Energy*	2958	18
Electric Efficiency**	4,466	27
Total		120

†New renewable generation due to state RPS, exclusive of incremental renewable energy in AEO 2005 forecasts, converted to gas savings using 43% displacement ratio and heat rate of 7950 Btu/kWh, with these assumptions derived from New York RPS study.
††Electricity savings estimate from NYSERDA study converted to gas savings using 43% displacement ratio and heat rate of 7950 Btu/kWh
* New renewable generation due to RPS converted to gas savings using 78% displacement ratio and heat rate of 7800 Btu/kWh
**Electricity savings from ECMB (2004) converted to gas savings using 78% displacement ratio and heat rate of 7800 Btu/kWh

Natural gas efficiency measures and combined heat and power

In addition to electricity use reductions, natural gas energy efficiency measures and expanded combined heat and power (CHP) operations will contribute to the overall reduction of natural gas consumption in New York and Connecticut. One study by the American Council for an Energy Efficient Economy (ACEEE) provides an excellent summary of costs and performance of 32 gas demand side management (DSM) programs across the United States.[38] The lifetime cost of conserved energy for seven of those programs ranged from $0.72 to $8.21 per thousand cubic feet, with an average of $3.90. Even the high end of these cost estimates is only a fraction of the natural gas prices for the residential sector in New York and Connecticut over the past few years, which ranged from $10 to $14 per thousand cubic feet.[39] We estimate that the region could save almost 60 billion cubic feet of gas per year through gas DSM, and between 20 billion and 50 billion cubic feet per year through the expanded use of CHP by 2012.

Connecticut is considering a proposal to mandate a 3% surcharge on natural gas to fund natural gas conservation programs. According to the Climate Change Action Plan 2005, this program is expected to provide approximately $29 million per year for DSM activities.[40] According to the conservative estimate in the Climate Change Action Plan,

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[38] D. York and M. Kushler, 2004, *Tapping Our Hidden Reserves: America's Exemplary Natural Gas Energy Efficiency Programs*, a Report presented at the 2004 ACEEE Summer Study on Energy Efficiency in Buildings.

[39] EIA, Natural gas price data at http://tonto.eia.doe.gov/dnav/ng/ng_pri_top.asp. Current and projected natural gas prices would be significantly higher than this range.

[40] The Governor's Steering Committee on Climate Change, January 2005, *Connecticut Climate Change Action Plan 2005*.

Connecticut can achieve gas savings at a cost of $29 per thousand cubic feet saved; because these are investments in energy efficiency, an investment of $29 in one year continues to produce savings in subsequent years up to the lifetime of the efficiency measure (approximately 12-15 years). Thus, if the budget remains at $29 million until 2012, Connecticut's conservation program would provide a savings of 7 bcf each year by the end of this period.

New York does not currently have a funding mechanism for natural gas conservation program. However, a current regulatory proceeding on system benefit charge programs (Case 05-M-0090) proposes a system benefit charge program for natural gas conservation measures. If this is adopted, New York could potentially save a significantly larger amount of natural gas than Connecticut, given that the annual natural gas consumption in New York is seven times greater than that in Connecticut.[41]

In addition to these DSM opportunities, both New York and Connecticut could make broader use of combined heat and power (CHP) to reduce natural gas consumption at both central generation and end-user levels. CHP reduces the need to purchase electricity from the grid and takes advantage of waste heat for industrial and indoor heating purposes.

A study conducted by Energy and Environmental Analysis, Inc. (EEA) provides insight into available natural gas use reduction through the increased deployment of CHP.[42] EEA first estimated the technical potential of new CHP in the Northeast (including New York State), Texas, and California, and then estimated penetration rates (or achievable potentials) of CHP by applying reasonable market penetration rates developed for different types and sizes of CHP. For the Northeast, the study identified a technical potential of 17,373 MW and assumed penetration of 4,238 MW. By adjusting these savings for gas consumption required for new CHP, they found that achievable potential CHP penetration in the Northeast US would reduce overall natural gas consumption by 78 billion cubic feet per year.

These savings can be scaled by estimates of achievable potential CHP penetration for New York and Connecticut to suggest the available savings in these states. According to a 2002 study for NYSERDA,[43] New York has an achievable CHP potential of between 760 and 2,200 MW of CHP by 2012. This would save between 14 and 40 bcf per year. Similarly, a recent study by the Institute for Sustainable Energy[44] found that Connecticut

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[41] EIA, Natural gas consumption data at http://tonto.eia.doe.gov/dnav/ng/ng_cons_top.asp .

[42] Energy and Environmental Analysis Inc., October 2003, *Natural Gas Impacts of Increased CHP*, prepared for U.S. Combined Heat and Power Association.

[43] Energy Nexus Group, Onsite Energy Corporation, and Pace Energy Project, October 2002, *Combined Heat and Power Market Potential for New York State: Final Report*, prepared for New York State Energy Research and Development Authority. Some of the potential CHP have been already installed since 2002 when the study was conducted. However, given the difficulty to identify the additions between 2002 to present, we did not attempt to subtract any CHP capacity from the study's estimates.

[44] Institute for Sustainable Energy, March 2004, *Distributed Generation Market Potential: 2004 Update/ Connecticut and Southwest Connecticut.*

has an achievable CHP potential of approximately 290 MW under a base case and 580 MW under an accelerated case, leading to savings of between 5 to 11 bcf per year.

Table 2 presents the results of our survey on the potential of natural gas savings through natural gas efficiency and CHP measures. The total savings from these measures could result in roughly 75 to 107 bcf in 2012. Combining these impacts with the impacts from renewable energy and electric efficiency initiatives would save between 155 and 185 bcf per year in 2012, more than offseting the expected natural gas consumption growth.

Table 2. Potential of Natural Gas Efficiency and Combined Heat and Power

	CHP Capacity (MW)	Gas Savings (bcf per year)
New York		
Natural Gas Efficiency		49
CHP	760 - 2200	14 – 40
Connecticut		
Natural Gas Efficiency		7
CHP	290 - 580	5 – 11
Total		75 – 107

Repowering of existing gas-fired generation

Future natural gas demand also can be reduced significantly by the repowering of existing, aging gas-fired power plants. In general, repowering a generating facility means replacing the plant's old and inefficient equipment with a newer, combined cycle unit. In practice, this can be done in at least two ways: 1) by actually rebuilding and replacing part or all of an existing power plant or 2) by closing down an existing power plant and building a replacement unit next to it.

Repowering older power plants can provide a number of important environmental and electric system reliability benefits: reduced consumption of natural gas due to lower facility heat rates, which lead to significantly more efficient fuel use; large reductions in NO_X and SO_2 emissions both overall and in terms of emissions per MWH of electricity; improved plant availability; lower plant operating and maintenance costs; and up to 98% reductions in water intake and related fish impacts. In terms of natural gas usage, a modern combined-cycle plant can use one-third less gas than an old-technology gas-fired power plant to produce the same amount of electricity.

A number of repowering projects have been completed in New York State in recent years. Consolidated Edison repowered its East River Plant and PSEG New York has repowered the Bethlehem Energy Center outside Albany. These two projects added 1,100 MW of new efficient combined cycle capacity to the electric system, representing a net increase of 500 MW of generating capacity.

It is difficult to estimate the total number of gas-fired power plants that could be economically repowered in New York and Connecticut, and it requires another complex analysis to estimate the resulting gas savings because of the changes in overall system dispatch that would result. A study prepared by Synapse in 2004 found that almost 175 bcf of gas per year could be saved by repowering aging power plants in California.[45] It is reasonable to assume that similarly significant savings could be attained in New York, which has a large number of aging and inefficient power plants.

The combined effect of electric energy efficiency, gas DSM, expanded combined heat and power, and repowering of existing plants is compared to projected gas demand growth in Figure 3 of this report. While the potential impact of some of these measures (particularly re-powering) remains uncertain, it is clear that this represents a cost-effective and environmentally benign way to offset gas demand growth in New York and Connecticut.

The following annotated bibliography lists the underlying data and literature sources used in this analysis.

<u>Annotated bibliography on demand reduction alternatives in the study region</u>

New York

1. Optimal Energy, Inc., ACEEE, Vermont Energy Investment Corporation, and Christine T. Donovan Associates, 2003, *Energy Efficiency and Renewable Energy Resource Development Potential in New York State*, prepared for New York State Energy Research and Development Authority, August 2003.

   This study investigates regional and state-wide potentials of energy efficiency and renewable energy in New York State in order to meet the State's greenhouse gas emission targets. The study examined the potentials over three time horizons: five years (through 2007), 10 years (through 2012), and 20 years (through 2022). The types of potentials examined are technical, economical, and achievable, least-cost potentials. The levelized cost of the measures selected under the least-cost, achievable potentials are below three cents/kWh over lifetime of the measures. We used the least-cost achievable potential of energy efficiency for our study. We did not use the potential of renewable energy from this study since the focus of the potential in this study is to identify a portfolio of the least-cost resources which precluded several types of renewable energy such as solar panel and fuel cell.

2. New York State Department of Public Service, New York State Energy Research & Development Authority, Sustainable Energy Advantage, LLC, and La Capra

[45]Synapse staff, "Comments of Synapse Energy Economics on the California Natural Gas Utilities' Phase 1 Proposals," prepared for Ratepayers for Affordable Clean Energy as comments on CPUC Rulemaking 01-01-025, March, 2004.

Associates, February 2004, *New York Renewable Portfolio Standard Cost Study Report II: Volume A*: Case 03-E-0188.

3. New York Public Service Commission, September 2004, *Order Regarding Retail Renewable Portfolio Standard*: CASE 03-E-0188 - Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard

   This order adopted a renewable portfolio standard in New York. The order provides detailed design of the RPS and numerous data regarding impacts of RPS including projected amount of renewable energy based on the target and cost-benefits of the policy. One of the benefits it estimated is natural gas fuel usage reduction through RPS.

4. Potomac Economics, LTD, June 2005, *Estimated Market Effects of the New York Renewable Portfolio Standard*, prepared for New York Independent System Operator.

5. Long Island Offshore Wind Initiative, at http://www.lioffshorewindenergy.org/index.html

Connecticut

1. GDS Associates, Inc. and Quantum Consulting, June 2004, *Independent Assessment of Conservation and Energy Efficiency Potential for Connecticut and the Southwest Connecticut Region: Final Report For the Connecticut ECMB*.

   This study (refers to ECMB potential study) estimates technical and maximum achievable potential of energy efficiency measures and practices in Connecticut and the Southwest Connecticut region toward 2012.

2. The Governor's Steering Committee on Climate Change, January 2005, *Connecticut Climate Change Action Plan 2005*.

   This report was submitted to the General Assembly, fulfilling the requirements of PA 04-252. The report sets numerous policies for all sectors in order to reduce greenhouse gas emissions to 1990 levels by the year 2010 and an additional 10% below that by the year 2020.

3. Dereck K. Murrow, February 2005, Testimony of Dereck K. Murrow On Behalf of Environmental Northeast: Docket No. 04-10-02, DPUC Review of the Connecticut Gas Utilities Forecast of Demand and Supply and Conservation 2005-2009, submitted on February 17, 2005.

4. Connecticut Siting Council, 2005, Connecticut Siting Council Review of the Ten-Year Forecast of Connecticut Electric Loads and Resources: Draft Report

   This report provides the most recent forecast of electric loads toward 2012 for Connecticut. We used this data to estimate the amount of renewable energy generation required under Connecticut's Renewable Portfolio Standard.

Both Connecticut and New York

1. Energy and Environmental Analysis Inc., October 2003, *Natural Gas Impacts of Increased CHP*, prepared for U.S. Combined Heat and Power Association.

   This study investigated the extent to which the potential of additional combined heat and power (CHP) to reduce the overall natural gas consumption in three regions: Northeast including New York, Texas, and California. The data for Northeast is significantly useful for our study to estimate natural gas reduction in Connecticut and New York through the increased deployment of CHP.

Non-State Specific

1. Ryan Wiser, Mark Bolinger, and Matt St. Clair, January 2005, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency*

   This study compares over a dozen of RPS studies and some natural gas DSM studies and examine impacts of RPS and DSM on natural gas demand and prices. Based on this investigation, the study provides recommendations for national and regional level studies on the impact of RPS and DSM on natural gas regarding the appropriate level of (1) natural gas displacement ratio, (2) natural gas heat rate, (3) inverse price elasticity of supply, (4) regional multipliers, and (5) benefits in $/MWh of demand savings by RPS and DSM programs. This study is significantly useful to examine our assumptions.

2. D. York and M. Kushler, 2004, *Tapping Our Hidden Reserves: America's Exemplary Natural Gas Energy Efficiency Programs*, a Report presented at the 2004 ACEEE Summer Study on Energy Efficiency in Buildings

   ACEEE surveyed 50 states regarding natural gas energy conservation programs and policies, and also examined over 30 exemplary natural gas energy efficiency programs across the U.S. The latter study is especially useful in that it presented several important information regarding the costs and performance of those programs. Particularly interesting is annual program spending and cost of conserved energy.

3. William Steinhurst, September 2004, *Testimony of William Steinhurst Senior Consultant Synapse Energy Economics, Inc. On Behalf of Citizens Action*

Coalition, Inc.: Case No. 42598 Before the Indiana Utility Regulatory Commission.

This is Synapse's testimony on behalf of Citizens Action Coalition, Inc, to the Indiana Utility Regulatory Commission. We explored the theory and practices of natural gas and electric energy conservation programs across the U.S., and proposed to Vectren Energy Delivery of Indiana the design of natural gas DSM programs and the appropriate level of DSM budget.

4. IndEco and Navigant consulting, April 2004, *DSM in North American gas utilities*

5. M. Kushler, D. York, and P. Wite, 2003, *Responding to the Natural Gas Crisis: America's Best Natural Gas Energy Efficiency Programs*. Washington, D.C., American Council for an Energy-Efficient Economy

6. Optimal Energy, Inc, May 2005, *Economically Achievable Energy Efficiency Potential in New England*, prepared for Northeast Energy Efficiency Partnership, Inc.