White Paper
Natural Gas in the New England Region:
Implications for Offshore Wind Generation and Fuel Diversity

The United States has seen unprecedented growth in the demand for natural gas across all sectors of the economy at a time when industry groups and regulators are concerned about the natural gas industry's ability to meet current requirements. The issue is not limited to any one facet of the natural gas markets, nor is it easily addressed by capital improvements in any one sector. End user markets that are located further away from supply basins are more heavily impacted by the price volatility that is created by the supply/demand imbalance. New England is one distant market that has experienced drastic price volatility due to commodity shortages, inadequate pipeline infrastructure and a significant increase in the development of natural gas fired electrical generation over the past few years. To alleviate New England's volatile energy market and reduce its over reliance on natural gas, the region needs to pursue an energy policy that is focused on fuel diversity. Increased use of renewable energy will enable New England to diversify the region's energy portfolio, thereby increasing electric reliability and lowering energy costs by utilizing local resources in the generation of electricity.

The U.S. Department of Energy has publicly discussed the potential for natural gas shortages facing the nation and the significant impact that various sectors of our economy face from such shortages. Within the past few months, the nation has seen stocks of natural gas in underground storage reach unusually low levels due to a combination of cold weather in parts of the country and declines in both domestic production and net imports. Price volatility of natural gas during this past winter has also been unprecedented.

In a report dated September 25, 2003, the National Petroleum Council (NPC) stated that "North America is moving to a period in its history in which it will no longer be self-reliant in meeting its growing natural gas need; production from traditional U.S. and Canadian basins has plateaued… The solution is a balanced portfolio that includes increased energy efficiency and conservation; alternate energy sources … including renewables."

The NPC report addressed the federal government's growing concerns about the adequacy of natural gas supplies to meet the strong demand for natural gas given that, as an environmentally preferred fuel, natural gas supplies approximately 25% of U.S. energy. [1] The report suggested that the government policies encourage the use of natural gas, but have not fully addressed the need for additional natural gas supplies. The NPC anticipated that North American producing areas will provide about 75 percent of the long term U.S. natural gas needs. Correspondingly, about 25 percent of future U.S. natural gas demand will have to come from new non-North American sources of natural gas in the form of liquid natural gas (LNG) projects.

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[1] Energy Information Administration, Annual Energy Outlook 2004 with projections to 2025, Page 89; House Committee on Energy and Commerce, Transcript #108-26, June 10, 2003, Page 1.

Likewise, Secretary of Energy, Spencer Abraham, in a letter dated July 17, 2003, proclaimed that "the Nation's stocks of natural gas in underground storage are unusually low due to weather factors and declines in both domestic production and new imports." Secretary Abraham stressed that the President's National Energy Policy emphasizes the need for a diverse energy mix to strengthen our energy security.

A tightening of the supply of natural gas has come at the same time that current demand has grown considerably across many sectors of the region's economy. New England is particularly vulnerable to constraints in natural gas supply issues because the region has no indigenous supply of natural gas. New England obtains its natural gas through a complex pipeline infrastructure that delivers the commodity from external sources such as the Gulf region of the U.S. and Canada. However, the New England pipeline capacity is marginally adequate and is quickly becoming overburdened because the pipeline system was designed to supply industrial and heating uses, and now also supplies fuel for 41% of New England's electricity needs. Therefore, New England's supply methodology creates a volatile market whereby natural gas prices are among the most expensive in the country.

Natural gas is a deregulated commodity which is bought and sold freely in the market place. Supplies of natural gas are delivered from the well-head by a highly interconnected web of interstate natural gas pipelines extending throughout the country. The establishment of market centers and hubs is a rather recent development in the natural gas marketplace. They evolved, beginning in the late 1980s, as an outgrowth of gas market restructuring and the execution of the Federal Energy Regulatory Commission's (FERC) Order 636 issued in 1992. Order 636 mandated that interstate natural gas pipeline companies transform themselves from buyers and sellers of natural gas to strictly gas transporters.

Historically, most natural gas flowed into New England from Texas and the Gulf of Mexico through the Mid-Atlantic States. Over the past few years there has been an increase in pipeline capacity in an effort to increase the deliverability of Canadian gas into the New England market through greater interconnections and new pipelines.[2] Since 1990, New England has added over 300,000 natural gas customers, an increase of 15%, and consumption has risen steadily, from approximately 400 Bcf in 1990 to over 700 Bcf.[3] Presently, natural gas provides approximately 18% of New England's energy needs and serves 2.3 million households and businesses.[4] The fastest growing sector for natural gas consumption is in electric generation. However, the demand for natural gas in the electric sector is stressing both the supply of natural gas in the region and the reliability of the transportation of the gas to generating facilities during periods of peak winter demand. According to the U.S. Energy Information Administration (EIA), the electrical generating sector is currently, and in the future will remain, the largest end-use gas-consuming sector in the region. Therefore, we can

[2] FERC staff analysis of natural gas consumption and pipeline capacity in New England and the Mid-Atlantic State. December, 1999, page 2.
[3] Northeast Gas Association http: www.northeastgas.org/industryInfo/marketInfo.cfm?s=Market%20Trends
[4] New England Gas Infrastructure, Staff Report of the Federal Energy Regulatory Commission, December 2003, Page 2

anticipate problems with natural gas reliability in the future due to supply shortages as well as limitations in peak pipeline capacity.

The benefits of natural gas that have made it the preferred utility fuel for the electric generating industry have been realized with the recent development of cleaner burning generating facilities with more flexible operating parameters. However, with increases in natural gas consumption and constraints on supply, many areas of the U.S., particularly New England, are becoming over reliant on this precious commodity. This fundamental shift in the natural gas supply/demand balance has resulted in higher prices and increased volatility over the past couple of years. In light of increasing risk associated with the nation's supply of natural gas, it may be in the public's best interest to support renewable energy projects that could contribute to reducing the fuel supply requirement and price volatility risks.

SUPPLY:

The depletion rates of the North American natural gas resource base has increased steadily since 1990. This is occurring as older, larger reservoirs are replaced by less prolific, shorter lived natural gas reservoirs. Although the U.S. is the most heavily drilled province in the world, since 1977 the U.S. has had an average net reduction in domestic reserves of 1,013 bcf per year.[5] The New England Region is particularly vulnerable to depleting natural gas stocks because New England has no indigenous fossil energy resources and relies on the energy it consumes to be shipped or piped to the region. Because of New England's remoteness from natural gas producing basins and storage areas, and the higher pipeline costs, New England experiences some of the most expensive delivered natural gas prices in the country.

Historically, Canada has been a reliable and cost effective source of natural gas for the United States. However, new natural gas additions to reserves from exploratory drilling have been declining. On the eastern coast of Canada, the gas reserves in the Sable Island have been reduced and new exploration has been disappointing. Net imports of natural gas from Canada are projected to peak at 3.7 trillion cubic feet in 2010, then decline gradually to 2.6 trillion cubic feet in 2025.[6] Canada has a diminished ability to sell natural gas to the U.S. because Canada is using more natural gas to meet their domestic commitment to combat global warming and other environmental issues associated with producing electricity from fossil fuels. Additionally, a large block of Canadian natural gas has been allocated to supply drilling and exploration equipment for oil recovery. The most recent discoveries in new Canadian reserves are in the higher frontiers, similar to our own reserves in Alaska's Prudhoe Bay. Although the adequacy of the reserves has yet to be quantified, the remoteness of these reserves most likely renders them uneconomic to recover unless natural gas prices rise significantly above current levels.

Liquefied Natural Gas (LNG) is the form that natural gas takes when it is cooled to temperatures below minus 260°F. As a liquid, natural gas occupies only 1/600th the volume

[5] EIA, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2002 Annual Report, Table 15
[6] Energy Information Administration

of its gaseous state and is more efficiently stored and shipped. When LNG is warmed, it regassifies and can be used for the same purposes as conventional natural gas. While LNG has historically made up a small part of U.S. natural gas supplies, rising gas prices and the possibility of domestic shortages are sharply increasing LNG demand. At the same time, environmental and safety concerns and cost have limited the number of LNG terminals and imports of LNG.

LNG is imported from various international sources including Trinidad and Tobago and Algeria.[7] One of the four receiving points for LNG in the contiguous U.S. is located near Boston and is owned by Distrigas of Massachusetts LLC (Distrigas).[8] It is delivered by ship to the Distrigas terminal at Everett, Massachusetts. The Distrigas facility has a 3.5 Bcf capacity that is crucial for sustaining inner Boston and other parts of the region through overland cryogenic trucks that infuse invaluable storage as discussed above.[9] At the Distrigas facility the LNG is either re-gassified for distribution as natural gas within the pipeline system or trucked as LNG to storage sites. There are 46 liquefaction and satellite LNG storage tanks located throughout New England with a total combined storage of 15 billion cubic feet.

There are currently three additional LNG facilities under consideration in Fall River, Rhode Island and Maine. However, the development of additional LNG infrastructure is not a short term solution because such facilities are developed at a higher cost, have longer lead times, and face major barriers to development, including environmental and safety concerns. The Coast Guard is the lead Federal agency for U.S. maritime security.[10] Given the New England facility's location within a densely populated area and the exposed route that the tankers must navigate through Boston Harbor, the security cost to deliver LNG to the facility are estimated to be $80,000 per shipments, exclusive of any expense to the facility owner.[11]

According to Tractebel, the Belgian company which owns the Distrigas terminal, it "serves most of the gas utilities in New England and key power producers" altogether meeting "between 15% to 20% of New England's annual gas demand."[12] Therefore, a loss of LNG from Distrigas during the winter heating season would impair both gas and electric energy security regionally. For example, the Mystic electric generating units 8 and 9 (combined 1400 MW[13]) are solely dependant on LNG, a condition that is shared by no other

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[7] According to EIA, in 2002, LNG imports to the U.S. originated primarily in Trinidad (66%), Qatar (15%), and Algeria (12%). The remaining 7% of U.S. LNG imports came from Nigeria, Oman, Malaysia, and Brunei.

[8] Everett, Massachusetts; Lake Charles, Louisiana; Cove Point Maryland; Elba Island, Georgia. There are additional facilities for U.S. imports located in Penuelas, Puerto Rico and Kenai, Alaska.

[9] Levitan & Associates, Natural Gas and Fuel Diversity Concerns in New England and the Boston Metropolitan Electric Load Pocket, Page 52, July1, 2003

[10] Fritelli, John F., Congressional Research Service. Port and Maritime Security. RL31733. Washington, DC. May 20, 2003.

[11] Parnfomak, Paul W., Congressional Research Service. Liquefied Natural Gas Infrastructure Security: Background and Issues for Congress. Washington, DC. September 9, 2003

[12] Tractebel, press release June 17, 2003

[13] Maximum summer claimed capability for 2003 per ISO-New England CELT Report: http://www.iso-

electric generating facility in the U.S. or Canada. Therefore, LNG imports are extremely important for NE reliability, but are obtained at a higher price than other sources of natural gas.[14]

PIPELINE INFRASTRUCTURE:

Because New England has no indigenous sources of natural gas, the region is reliant on an intricate pipeline infrastructure to deliver gas from four separate sources; eastern and south-central United States, western Canada, Sable Island in eastern Canada, and from one of four liquefied natural gas import terminals within the contiguous U.S.[15] According to FERC's December 2003 New England Natural Gas Infrastructure report:

> Any delay in the construction of planned infrastructure or underestimates of demand during December through February could result in insufficient capacity to meet demands. During these peak demand months, interstate pipelines in New England are fully loaded.

Currently there are no major projects pending for New England. In fact, after a boom in natural gas pipeline construction, the number of new pipeline projects appears to be slowing. Interstate natural gas pipelines are rarely built on speculation. In order for pipelines to obtain the financing needed to expand the infrastructure to meet future transportation needs, pipeline developers will need to financially secure commitments on the demand side. However, the financial health of the electric generation sector does not present itself as a viable counterparty to meet the lending requirements for project development. Over the last 2-years, the merchant power sector has lost more that $100 billion in market capitalization.[16] Three companies generating electricity in New England have filed for bankruptcy protection in 2003 (NRG, Mirant, PG&E) and other companies' credit ratings have fallen below investment grade. The financial weakness of the merchant generating sector, along with an overall slowdown in the economy, comes at a time when the Interstate Natural Gas Association of America has estimated that between $60 and $70 billion in new pipeline investment will be required over the next 12 to 15 years in order to meet the demands of the natural gas market. Additional investments are speculative at best considering the underlying financial risk associated with fossil-fired generating capacity and will be further complicated by declining natural gas reserves.

STORAGE:

New England's reliance on natural gas between many economic sectors, along with extreme changes in weather patterns that cause drastic fluctuation in demand, has created a strong need for storage facilities to prevent imbalances in the pipeline system and price

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ne.com/Historical_Data/CELT_Report/2003_CELT_Report/

[14] Energy Information Administration; Assumptions to the Energy Outlook 2004, Page 92.

[15] New England Gas Infrastructure, Staff Report of the Federal Energy Regulatory Commission, December 2003, Page 2

[16] Ken Silverstein, Re-Fueling the Merchant Energy Sector, February 4, 2004

volatility created by sudden supply imbalances. However, New England has no underground natural gas storage and relies on bulk underground storage in New York and Pennsylvania to augment supplies. For New England customers to have access to the gas in underground storage in New York or Pennsylvania, capacity must be available on interstate pipelines to carry the natural gas from storage to New England.

Interstate pipelines operating at or near full capacity between the storage fields and New England limit access to gas in underground storage. From December through February, when interstate pipelines are fully loaded with natural gas to serve the high demand heating season, many New England customers must rely on marginal above ground storage located within New England, pipeline imports and imported LNG to meet demand. Given the limited amount of pipeline capacity, unless storage facilities have reserved sufficient pipeline capacity to complete injections or extractions, they must compete with customers seeking to use pipeline capacity for other immediate demand purposes, such as fueling electric generators, residential heating or industrial uses. In order to maintain such a strong reliance on natural gas as the preferable fuel to drive the economic engine, the Edison Electric Institute has called for the further development of storage facilities to balance gas supply and demand. In a deregulated market such as we generally have in the New England Region, the investment capital to build and operate additional storage capacity will have to be provided from new charges or it is unlikely that meaningful capacity will get built.

DEMAND:

In 1999, New England's dependence on natural gas for electric energy generation had increased to 16% from less than 1% in 1980. Today the region's dependence on natural gas for electric energy production has exceeded 41% and is expected to account for 49% of New England's electric energy by 2010.[17] Nationwide, reliance on natural gas for the generation of electricity accounts for 19% of total electric generation.[18] However, natural gas accounts for 88% of the new electric capacity built in the last 10 years.[19] Because the fastest growing sector for natural gas use through 2010 will be power generation, electricity prices will continue to be substantially influenced by the cost of natural gas.

Dependence on natural gas will vary within the region as a result of greater constraints in pipeline capacity within certain sub-regions.[20] For instance, natural gas reliance in the Boston sub-area is forecast to reach 80% by 2010, leaving the Boston area critically dependant on the availability of LNG from Distrigas.[21] The rapid proliferation of

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[17] Levitan & Associates, Natural Gas and Fuel Diversity Concerns in New England and the Boston Metropolitan Electric Load Pocket, Page 11, July1, 2003.
[18] Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy, National Petroleum Council, September 25, 2003, page 17
[19] Prepared statement of Edison Electric Institute to the House Committee on Energy and Commerce, June 10, 2003.
[20] NEPOOL is divided into thirteen sub-areas.
[21] Levitan & Associates, Natural Gas and Fuel Diversity Concerns in New England and the Boston Metropolitan Electric Load Pocket, Page 7, July 1, 2003.

natural gas as the regions fastest growing fuel sector source was detailed in ISO New England's report in the summer of 2003 which stated:

> Fundamental concerns about the adequacy of the natural gas resource base in North America, as well as the adequacy of the transportation infrastructure to ship natural gas from where it is produced or stored to the market center in New England, raises concern for the burgeoning gas use for electricity production in New England. Lacking a well diversified fuel portfolio for bulk power production, minor fluctuations in gas supply or transportation availability have the potential to be far more disruptive in New England than would otherwise be the case.

Over reliance on natural gas is not unique to the energy industry. Price volatility is further exacerbated by competition from other sectors of the economy. Strong economic growth during the late 1980's and through out the 1990's boosted housing sales and new home construction, leading the number of residential natural gas customers to grow from 48 million in 1987 to 60 million in 2001.[22] From 1991 to 1999, two-thirds of the single-family new homes and 57 percent of the new multifamily buildings constructed were heated with natural gas. As the decade progressed, the share of gas-heated new homes nationwide increased from 60 to 70 percent.[23]

Additionally, the industrial sector derives 40% of its primary energy from natural gas.[24] U.S. industries have become increasingly dependent on natural gas based technologies because of their lower capital costs, improved air emissions performance and the fact that they require less land and are less intrusive than other fossil fuel applications. Industrial natural gas use is projected to grow 1.5 percent annually through 2025 when the annual total natural gas consumption will reach 10.6 quadrillion Btu.[25]

The industrial sector's reliance on natural gas has created uneasiness among the nation's leaders. In testimony before the Committee on Energy and Commerce, Federal Reserve Chairman Alan Greenspan stated that:

> The updrift and volatility of the spot price for gas have put significant segments of the North American gas-using industry in a weakened competitive position. Unless this competitive weakness is addressed, new investment in these technologies will flag... The perceived tightening of long-term demand/supply balances is beginning to price some industrial demand out of the market.

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[22] FERC, New England Gas Infrastructure, Docket No. PL04-01-000, Page 2, December 2003.

[23] U.S. Department of Housing and Urban Development and U.S. Department of Commerce, Characteristics of New Housing, C25, Table 10 (various issues).

[24] Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy, National Petroleum Council, September 25, 2003, pages 17 and 35.

[25] Energy Information Administration, Annual Energy Outlook 2004 with projections to 2025, Page 45

The current structure of the electricity market and the forecasted increases in electric demand have created an unsustainable momentum upon which to manage future economic growth. Total U.S. electricity demand grew 31% from 1990 to 2002, and is projected to grow by 1.9 percent per year through 2025.[26] Total demand for natural gas is projected to increase at an average annual rate of 1.8 percent between 2001 and 2025, primarily because of rapid growth in demand for electricity generation.[27] In analyzing the country's future sources of natural gas through 2025, the Energy Information Administration predicts that

> LNG imports, Alaskan production, and lower 48 production from non-conventional sources are not expected to increase sufficiently to offset the impacts of resource depletion and increased demand.

There has already been a fundamental shift in the natural gas supply/demand balance that has created an overall tightening of the market and led in recent years to higher gas prices and price volatility.[28] The market's diminishing ability to absorb changes in lower supply or higher demand has created significant swings in energy prices that have had dramatic impacts at the regional level within the past months. This situation has manifested itself in the New England electricity market through increased electricity costs and reduced reliability.

CASE STUDY: JAN. 14-16, 2004

According to ISO New England, the integrity of New England's electricity market was tested by extreme weather conditions from January 14-16, 2003. (Exhibit I) On January 14th temperatures dropped to as low as 7°F in the Boston and Hartford regions and the peak electricity demand in NEPOOL reached 22,450 MW, [29] approximately 400 MW above forecasted demand. Typical New England winter usage ranges from 17,000 MW to 19,000 MW.[30] At 10:00A.M. on January 14th, ISO-NE recalled the 2,760 MW of generation that had been granted the right to remain off-line for an economic outage, however, only 1/3 of the natural gas fired generators were able to make it back online. ISO-NE informed electric generators that a capacity shortage existed and requested additional capacity, briefed regulators about the emergency conditions and issued a press release requesting that customers conserve energy. The bitterly cold weather increased demand for natural gas across all economic sectors and caused the price of wholesale natural gas to increase to $63.23/Mmbtu and the corresponding electricity prices climbed to $375/MWh ($.375per kilowatt hour wholesale price).[31] ISO-New England said that gas supply issues, coupled with

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[26] Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy, National Petroleum Council, September 25, 2003, page 33; Energy Information Administration, Annual Energy Outlook 2004 with projections to 2025, Page 50.

[27] Energy Information Administration, Annual Energy Outlook 2004 with projections to 2025, Page 70.

[28] Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy, National Petroleum Council, September 25, 2003, page 26.

[29] According to ISO-NE the previous record demand was 21,535 set in January of 2003.

[30] Power Daily Northeast, January 15, 2004, Page 1.

[31] Power Daily Northeast, January 15, 2004, Eastern Market Report, Page 5.

high demand, led to the generation constraints. They further indicated that residential and commercial customers receive priority for gas service over the electric generation sector.[32]

During the January 14-16, 2004 period of natural gas shortage, the Cape Wind project, if it had been fully constructed and was online, would have made a significant contribution to the power supply and reliability of the regional grid. Exhibit II is presented to illustrate the hour by hour production that would have been delivered to the grid during the three day period of shortage. Over the three days, the project would have delivered 25,596 megawatt hours of power and would have averaged 396 megawatts per hour.

In terms of avoided natural gas use, the average efficiency of natural gas units operating during the winter cold period is about 7,200 BTU's of natural gas per kilowatt of electricity produced with natural gas at 1000 BTU/SCF.[33] At 7200 BTU per Kw hr, there would be 138.9 kilowatt hours of electricity produced per million BTUs. Correspondingly, it takes 7.2 million BTUs to produce a 1 megawatt hour[34] of electricity (1,000 kW x 7,200/1,000,000). Therefore, at peak production capacity Cape Wind would have produced 454 Megawatts per hour, which would save an equivalent of 3.268 million SCF per hour.[35]

During the three day period of shortage, Cape Wind production would have been equal to 7.1995 million BTUs per megawatt hour multiplied by 25,596 megawatt hours produced or the equivalent of 184.25 million SCF of natural gas. According to the American Gas Association, the average house in New England uses about 89,000 SCF and 26,000 SCF for space heating (furnace) and water heater, respectively. <u>Therefore, the three day savings of 184.25 million SCF of natural gas that could have been realized with Cape Wind's electricity production would have been sufficient to provide natural gas for heating and hot water for over 1,600 homes for a year</u>.

CASE STUDY: APRIL, 2003 THROUGH MARCH, 2004

Using the same average efficiency of natural gas units of 7,200 BTU's of natural gas per kilowatt of electricity produced with natural gas at 1000 BTU/SCF, Cape Wind production for the twelve month period of April, 2003 through March, 2004 would have been equal to 7.2 million BTUs per megawatt hour multiplied by 1,691,261 megawatt hours produced or the equivalent of 12.1 billion SCF of natural gas (Exhibit III). Again, according to the American Gas Association, the average house in New England uses about 89,000 SCF and 26,000 SCF for space heating (furnace) and water heater, respectively. Therefore, the twelve month savings of 12.1 billion SCF of natural gas that could have been realized with Cape Wind's electricity production would have been sufficient to provide natural gas for heating and hot water for over 105,000 homes for a year.

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[32] Power Daily Northeast, January 15, 2004, Page 4.
[33] 1000 SCF of natural gas would equal a million BTU.
[34] 1,000 KW hr = 1 MWhr
[35] (7.1995 million BTU's per megawatt hour times 454 megawatts of production = 3,268.6 MMBTU or 3,268,600 SCF per hour)

CONCLUSION:

The culmination of events that caused the constraint in generating capacity in New England in January of 2004, are likely to be increasingly encountered in the future as supply capability declines unevenly in the future. The use of renewable energy to generate electricity can play a significant role in offsetting price volatility in electric generation by providing a natural hedge against fuel supply restraint and natural gas cost volatility. In contrast to the volatility of natural gas prices, renewable resources provide a stable cost of electric generation and provide a suitable structure for a long term, fixed price contract.

Additionally, as renewable generation increases, the demand for natural gas in the electric generation sector is reduced and this lower demand frees up this finite resource for other sectors of the economy. Lower demand should put downward pressure on natural gas prices overall and result in an economic benefit to consumers in both the electricity and natural gas end-user markets. The electric industry has called for greater fuel diversity to alleviate over reliance on limited fuel sources in an effort to reduce electricity prices. In a 2003 prepared statement submitted to the House Committee on Energy and Commerce, the Edison Electric Institute and its Alliance of Energy Suppliers stated that:

> ……from the perspective of the electric power industry, which is searching for ways to continue the production of low-cost electricity essential for the United States to compete in a global economy, one of the most important long term solutions is for Congress and the President to make sure that federal policies assure that an adequate and diverse fuel supply is available for the generation of electricity. Fuel diversity means that coal, nuclear, hydro, wind, solar, natural gas - and other fuel sources as they become available - can continue to be used by generators of electricity to mitigate price or supply risk in any one source... the broader the selection of technologies and fuels available to the generator, the better for all classes of customer.

Any advancements in New England's energy infrastructure that increases the diversity of fuel sources has benefits beyond the market for the commodity itself. Therefore, it is incumbent upon the electric industry participants, market regulators and political leaders to promote policies that encourage the development of sources of electric generation from diverse fuel sources. With New England experiencing record peaks in electricity demand, rising electric costs and unhealthy air quality alerts, it is a concern that delays in the permitting of proposed projects will impede the development of renewable energy proposals that are critical to the creation of a sustainable energy future. New England's energy outlook could benefit significantly by utilizing our ocean resources in combination with current renewable energy technologies to address our growing energy needs. This in turn will help to combat global warming, polluting emissions and environmental degradation, energy price volatility and fuel supply constraints.

Exhibit I

Electric & Gas Wholesale Initiative
Workshop # 1
March 19, 2004

"New England Power System Operations
Under Extreme Winter Conditions
January 14-16, 2004"

Stephen G. Whitley
Senior Vice President & COO

Topics

- Initial Conditions
- Sequence of Events – January 13 -16, 2004
- ISO-NE Actions to Protect New England
- Conclusions
- Actions Planned

2

Background – Initial Conditions

1. Previous all-time New England winter peak established January 22, 2003 at 21,533 MW
2. We have added almost 10,000 MW of new generating capacity to the New England system in the last 3 years – nearly all is gas-fired.
3. 38% of New England's generating fleet is now gas-fired (versus 12% in 1998)

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Background – Initial Conditions, *Con't.*

4. First winter cold snap – January 7, 8 & 9, 2004
   a) Temperatures were in the 6-10°F range
   b) Peak demand 21,409 MW on Friday, January 9, 2004
   c) Minimal generating unit availability problems – gas-fired or otherwise
   a) Surplus capacity above reserve requirements was 2,900 MW across the peak
   a) "Economic outages" averaged 755 MW across the period
5. Conditions forecast for January 12-16, 2004 similar to those experienced over January 7, 8 & 9, but colder temperatures expected by end of the week.

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Sequence of Events

1. **<u>January 13 (Tuesday) Day-Ahead Forecast for January 14 (Wednesday)</u>**
   a) Temperatures: 8°F/ 5°F in Boston and Hartford
   b) Projected demand for January 14: 22,075 MW
   c) Projected surplus for January 14: 580 MW above operating reserve and replacement reserve requirements
   d) 2,760 MW of units had been granted "Economic Outage/OP# 5" status for January 14 because adequate surplus was projected to be available

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Sequence of Events, *Con't*

2. **<u>Conditions Change Overnight – January 14</u>**
   a) 822 MW of expected generating capacity became unavailable overnight January 13 into January 14 (507 MW gas-fired and 315 MW other fuels)
   a) At 10:00 a.m. on January 14, due to the forecast for a capacity deficiency, ISO-NE canceled all previously approved economic outages and ordered all such units back on line
   b) Some adjacent Control Areas reported insufficient reserves – but NYISO reported that it could support New England with 600 MW
   c) ISO-NE alerted all power system personnel (under Master/Satellite Procedure # 2) at noon of a potential capacity deficiency forecast for that evening
   d) At 4:30 p.m., ISO – NE briefed New England regulators and government officials about the power supply situation
   e) ISO-NE issued a press release at 5:00 p.m. requesting conservation for the cold-wave period

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Sequence of Events, *Con't*

MWs Out of Service At Peak Hour (hour ending 1800) – January 14

Type	Forced Outage	Reductions in Capability of Online Units	Total
Gas	6,200	850	7,050
Coal	415	15	430
Nuclear	0	12	12
Oil	918	164	1082
Hydro	5	257	262
Other	30	113	143
Economic Outage	0	0	0
Subtotal	7,568	1,411	8,979

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Sequence of Events, *Con't*

4. **January 14 (Wed.) Day-Ahead Forecast for January 15 (Thurs.)**
   a) Temperatures: 5°F/ 3°F in Boston and Hartford with very high winds
   b) Projected demand for January 15: 22,525 MW
   c) Projected surplus for January 15: 1,568 MW above operating and replacement reserve requirement, but figure was ***very questionable***
   d) No new economic outages were requested or granted for January 15 or 16

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Sequence of Events, *Con't*

5. Conditions Change Overnight – January 15

a) Over 2,000 MW of generating capacity became unavailable overnight (January 14 into the 15); conditions highly volatile during the night

b) About 410 MW of generation previously on forced outage became available

c) At 10:00 a.m., IOS – NE briefed New England regulators and government officials

d) At 10:30 a.m., ISO-NE met with the Master/Satellite Heads to discuss the situation and the potential of staffing field substations, in light of imminent, extremely unpredictable conditions:

- to quickly respond to equipment problems; and,
- to enable manual curtailment and restoration of customer load, if necessary

e) New York dual-fired units converted from gas to oil in the afternoon

f) At 1:30 p.m., ISO-NE asked Master/Satellite Heads to arrange for transmission owners to staff the substations across the evening peak

g) At 4:30 p.m., briefed New England regulators and government officials

h) At 7:20 p.m., issued a press release warning the public of the situation and the precautionary measures that were being taken

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Sequence of Events, *Con't*

6. Conditions Across Evening Peak - January 15 (Thurs.)

a) Temperatures: 5°F/ 5°F in Boston and Hartford

b) Actual peak demand: 22,733 MW

c) Actual surplus at peak hour: +717 MW

d) NYISO supplied up to 1,100 MW to New England during the period

7. January 15 (Thurs.) Day-Ahead Forecast for January 16 (Fri.)

a) Temperatures: -9°F/ -9°F in Boston and Hartford with very high winds

b) Projected demand for January 16: 21,600 MW (morning peak); 22,800 MW (evening peak)

c) Surplus: 0 MW (morning peak); 700 MW (evening peak) projected, but was ***very questionable***

d) No new economic outages were requested or granted for January 16

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Sequence of Events *Con't*

8. **Conditions Across Evening Peak -- January 16 (Fri.)**
   a) Temperatures: 11ºF/12ºF in Boston and Hartford
   b) Actual Peak Demand: 21,885 MW
   c) Actual Surplus: +2,184 MW
   d) Many schools/colleges were closed or delayed opening due to the cold
   e) Key Canadian interface in VT -- Phase I Highgate interconnection -- was lost (200 MW) at 2:00 a.m. January 16 due to transformer problems in Canada. VT transmission system significantly weakened. Interconnection restored at 4:00 p.m.
   f) At 10:00 a.m., ISO – NE briefed New England regulators and government officials
   g) Temperatures moderated during the day on January 16
   h) Availability of generating resources significantly improved
   i) Power supply conditions remained stable
   j) M/S #2 procedure ended January 17 at 11:00 a.m.

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Winter Cold Snap Summary

MWs Out of Service At Peak Hour– January 9, 14, 15 16

	Jan. 9	Jan. 14	Jan. 15	Jan 16
Peak Demand	21,409	22,450	22,733	21,885
Unit Types OOS				
Gas	2,806	7,050	6,075	4,590
Coal	166	430	344	166
Nuclear	12	12	12	16
Oil	306	1,082	1,520	1,177
Hydro	339	262	312	277
Other	177	143	106	111
Economic Outage	755	0	0	0
MWs OOS	3,806	8,979	8,369	6,337
Surplus	2,900	(108)	717	2,184

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ISO-NE Actions to Protect New England

- Ordered on generating units – to provide reserves
- Recalled units from "economic outage" status
- Requested voluntary conservation from public
- Requested participants to arrange Emergency Energy Transactions (imports)
- Coordinated with New York to make better use of New York to New England transmission capability
- Issued notifications under demand response program

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ISO-NE Actions to Protect New England

- Implemented Master/Satellite Procedure # 2 to alert power system personnel of impending capacity deficiency
- Returned transmission facilities to service on January 14 that had been in a maintenance outage
- "Postured" hydro pumped storage and other generation during OP4 to maintain required operating reserve
- Implemented OP4 Actions 1 and 6
- Coordinated with NYISO and satellites in developing plan to import energy over 1385 Cable from Long Island to protect SW CT
- Requested staffing of substations as precautionary measure, based on lessons learned from August 14 blackout in Midwest/Northeast
- Coordinated with NPCC/NERC and adjacent Control Areas
- Kept regulators and public informed

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Conclusions

- Keeping the electricity flowing is essential to public health and safety during extreme cold weather events [-10°F and 45 mph winds]
- Integrity of the bulk power system must be protected to prevent widespread collapse
- Gas unit availability was the critical factor during the Jan 2004 "Cold Snap Event"

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Actions Planned

1. Reviewed spring outage schedule to ensure increased reliability for balance of winter
2. Complete review of Cold Snap Operations
   - Operations Events
   - Market Monitoring
3. Develop process to identify problems and develop solutions on a collaborative basis w/NEPOOL, State officials, and Gas Industry

"Electric & Gas Wholesale Initiative"

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