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OLR BACKGROUNDER: NATURAL GAS IN THE ELECTRIC POWER MARKET

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QUANTIFYING THE ISSUE

Natural gas is measured in cubic feet, a measurement that equals the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor.

A British thermal unit (BTU) is the standard measurement of heat energy. One BTU raises the temperature of one pound of water by one degree Fahrenheit at sea level.

One cubic foot of natural gas contains approximately 1,000 BTUs of energy.

Electricity consumed over time is measured in kilowatt-hours (kWh). 1000 cubic feet of natural gas can generate 127 kilowatt-hours of electricity (depending on the efficiency of the generator).

The average U.S. home consumed 903 kWh per month in 2012.

ISSUE

This report discusses the relationship between the natural gas and electricity markets in New England, particularly in light of constraints on the interstate pipeline system.

SUMMARY

Over the past decade, technological advances in drilling techniques have brought substantially more gas to market in North America, resulting in larger quantities of natural gas and lower natural gas prices. At the same time, an increasing amount of New England's electricity comes from natural gas. Many coal and oil plants have retired or indicated they will retire in the near future, and gas-powered power plants are expected to replace them. From 2009 to 2013, these factors lowered electricity prices in New England.

Interstate gas transmission lines, however, have not expanded in proportion to this increase in supply and demand. Gas-powered power plants generally purchase natural gas through intermittent (or interruptible) contracts, and transmission pipelines generally expand based on firm commitments. During episodes of extreme cold weather, when heating customers have high demand for natural gas, gas-powered plants risk losing access to their supply.

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When this happens, more expensive generation fuel (e.g., coal or oil) is used. This causes price volatility and spikes, which can increase the price of electricity over time.

Several groups have proposed or taken various actions to address the issues arising from natural gas in the electricity market. Proposals include changes to the wholesale electricity market rules, new funding mechanisms for pipeline expansions, increased energy efficiency, and alternative energy sources.

INCREASED RELIANCE ON NATURAL GAS

Supply of domestic natural gas

Much of the increase in supply of natural gas across the United States is due to technological advances in drilling techniques, including hydraulic fracturing or fracking, that allow the harvest of natural gas from organic shale formations (i.e., shale gas). Shale gas as a percentage of all U.S. natural gas production has grown from 3% in 2005 to 45% in 2013. As a result of this increase, natural gas prices have decreased over this time period relative to other fuels. Electricity prices also decreased—the standard service offer in Connecticut decreased from over 12 cents per kilowatt hour in 2009 to less than 8 cents per kilowatt hour in 2013.

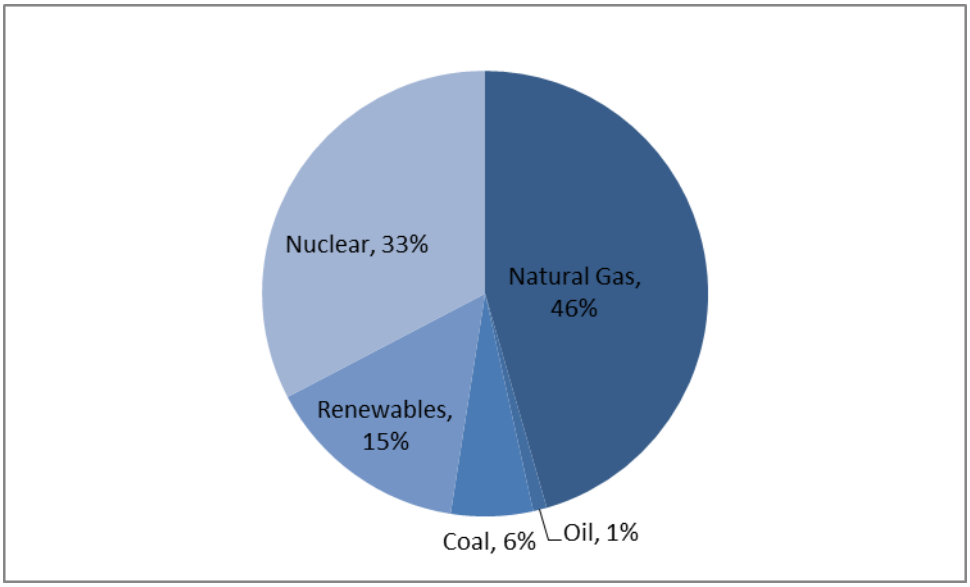
Plant Retirements and Changing Generation Mix

As natural gas has become cheaper, the region's electric generation fleet has become more reliant on it. Over the past few years, several large coal and oil power plants have retired or announced plans to retire in the next few years. Also, the Vermont Yankee nuclear plant has announced plans to close by the end of this year. Factors driving these retirements include the advanced age of the plants, increased environmental regulations, and the current price disadvantage when compared to natural gas. Because coal and oil plants are now normally more expensive to operate than natural gas plants, they typically only operate when natural gas is unavailable or experiencing price increases or shocks that raise its price above oil or coal.

The Independent System Operator (ISO)-New England oversees this system, administering energy markets that establish a wholesale market price for electricity. In 2013, 46% of electricity produced in New England came from power plants fueled by natural gas (see Figure 1). Those who wish to connect power plants to the regional power system must submit their proposals to ISO-New England. Among generator proposals submitted as of January 2014, over half are natural gas, and most of the remaining proposals are for wind generation. Though not every

proposal is developed, the submitted proposals show the potential mix of new power plants in the region.

Figure 1: Regional Electric Energy Production (2013)



Source: ISO-New England

Natural Gas in Other Markets

An estimated 32% of Connecticut residents use natural gas to heat their homes, according to U.S. Census data. Connecticut's Comprehensive Energy Strategy calls for increased natural gas use for heating and the Public Utilities Regulatory Authority (PURA) approved an expansion plan proposed by the local distribution companies (LDC) in 2013. The plan promotes the conversion of households from heating oil to natural gas and facilitates extensions of service lines and mains to these new customers. As of October 31, 2014, according to PURA staff, 15,940 customers have converted to natural gas since PURA approved the natural gas expansion plan.

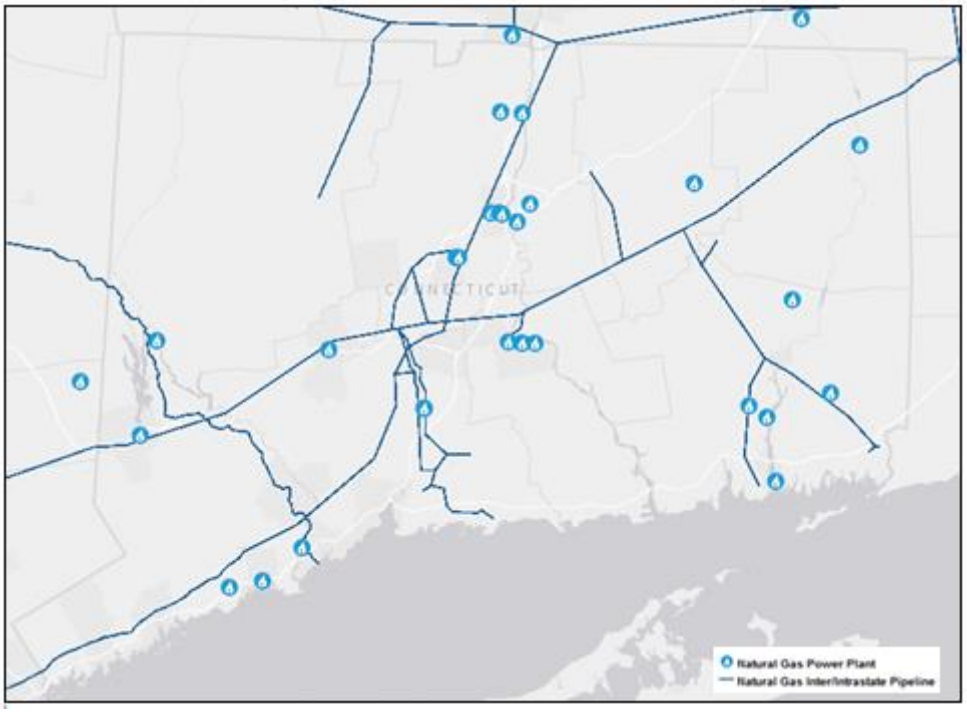
NATURAL GAS PIPELINES

Pipelines Explained

Natural gas from wells, storage facilities, offshore drilling platforms, and imports is transported through gathering pipelines to gas processing and treatment plants. Once treated, the natural gas moves through transmission lines categorized as interstate if they cross one or more states, or intrastate if they operate only within one state's boundaries. Natural gas comes to Connecticut via three interstate pipeline systems: the Algonquin, the Iroquois, and the Tennessee.

Connecticut's natural gas resources are so minimal that they are highly unlikely to be developed, and the New England region is not geologically able to store natural gas underground. Thus, the three interstate transmission pipelines transport Connecticut's main supply of natural gas. Generally, natural gas in transmission lines is pumped to the local gas distribution system (i.e., service lines and mains), large industrial customers, and power plants. Figure 2 shows natural gas infrastructure in Connecticut, including the three interstate pipelines and natural gas power plants throughout the state.

Figure 2: Connecticut's Natural Gas Infrastructure



Source: EIA

Intermittent versus Firm Contracts

Generally, LDCs and other natural gas suppliers purchase capacity on the pipelines under firm contracts. Their orders must be filled regardless of market or weather conditions.

In contrast, power plants purchase less expensive pipeline capacity for natural gas under intermittent (i.e., non-firm) contracts. Their supply orders can be delayed or cancelled if orders from other firm customers need to be filled, such as LDC orders. Generally, transmission pipelines are built and expanded to accommodate their firm obligations throughout the year, which is largely why increased demand in the electric power market has not led to a proportional expansion of pipeline capacity.

In summer months, when demand for natural gas as a heating fuel is low, the pipelines can accommodate both firm and intermittent contracts and power plants can easily get natural gas. In the winter, however, demand for natural gas as a heating fuel is high and those contracts have a higher priority than the intermittent contracts of power plants.

During the last year's "polar vortex", the cold weather event from January 6 to January 8, many natural gas power plants around the country were unable to get natural gas due to curtailments or interruptions to their deliveries. For more information on impacts of the polar vortex on electricity, see the North American Electric Reliability Corporation's Polar Vortex Review.

PRICE IMPLICATIONS

When demand rises and supply is constrained, price increases. Price spikes in wholesale electricity costs during colder months show the close relationship between natural gas and electricity: when natural gas fuels over half of the region's electricity generation and natural gas prices spike during cold weather, the price of electricity also spikes. Also, when gas power plants are unable to obtain fuel to run, the wholesale market must rely on more expensive sources (e.g., coal or oil) at a premium price.

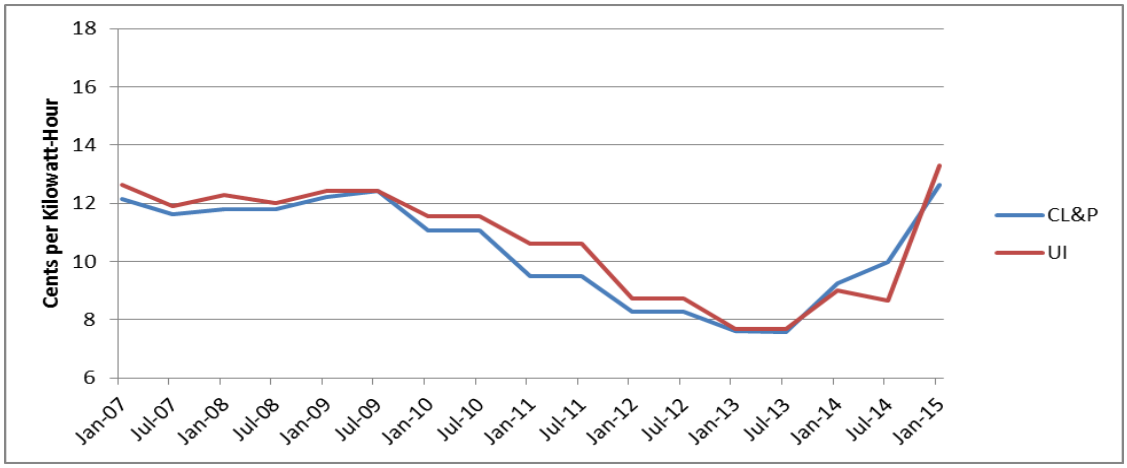
These prices are not paid directly by Connecticut residents or businesses. Rather, ISO-New England establishes the price for electric energy purchases and sales at specific locations throughout New England. Energy suppliers and electricity companies pay various rates throughout the year to acquire energy. Last winter, many customers of retail suppliers with short-term variable rates experienced drastic price increases, partly in response to these trends.

In contrast, Connecticut's electricity companies - Connecticut Light and Power (CL&P) and United Illuminating (UI) - purchase electricity and pass the cost directly to residential and small commercial customers through the standard service rate as required by state law (CGS § 16-244c). Standard service rates do not fluctuate as drastically with the weather; rather they represent a blended rate of purchases that the companies make in small increments at different time periods. PURA approves their purchases in advance, and then the companies adjust the standard service rate every six months to account for any change in price (without making a profit).

While customers on the standard service rate are somewhat protected from weather-driven price volatility, they are not immune to the upward pressure the price spikes put on the price generally. According to EIA, for the first six months of 2014, the day-ahead wholesale power price in the region averaged 45% higher

than the average wholesale price during the same period last year. Both companies have recently raised their standard service rates. Figure 3 shows standard service rates for both companies since 2007.

Figure 3: Standard Service Rates Since 2007



Source: EnergizeCT

RECENT POLICY CHANGES AND PROPOSALS

ISO-New England Policy Changes

ISO-New England has made several recent policy changes to address issues related to the role of natural gas in the electricity market. In addition to the Real-Time Energy Market, which coordinates the dispatch of generation and other resources to meet the demand for electricity and other requirements, ISO-New England also administers the Day Ahead Energy Market, which allows market participants to secure prices for electric energy the day before the operating day and hedge against price fluctuations in real time. In both markets, beginning in December 2014, the power plants will be able to submit offers on schedules that more closely accommodate the price volatility of the natural gas market.

ISO-New England is also developing a pay-for-performance mechanism in their Forward Capacity Market, the market to ensure the sufficiency of installed capacity (e.g., power generation) to meet future regional demand. Such a mechanism would strengthen financial incentives for power plants to make necessary investments to perform when the grid is stressed (i.e., when demand for electricity is high and supply is low or costly). For more information on these changes, see ISO-New England's 2014 Regional System Plan.

Last winter, ISO-New England also implemented special measures (a "winter reliability program") to ease pressure on the grid during periods of cold weather. Among other things, the program encourages oil and dual-fuel generators to keep more oil supplies on hand. The Federal Energy Regulatory Commission (FERC) has approved a similar program for this winter.

Company Pipeline Expansion Proposals

Pipeline companies have proposed several pipeline expansion or modification projects now in various stages of development. Generally, companies only go forward with plans to expand pipelines when LDCs and other customers enter into firm long-term commitments. FERC regulates the location, construction, and operation of interstate pipelines. The energy companies cannot begin construction until FERC issues a certificate allowing them to do so. According to FERC, for large pipelines, the application process takes from one to two years. Table 1 lists some of the pipeline proposals in the region and includes the company, a project description, the planned in-service date, and a FERC docket number when available.

Table 1: Pipeline Proposals

Companies	*Project Description*	*Planned In-Service Date*
Iroquois	The Wright Interconnect Project would connect the proposed Constitution Pipeline to the Iroquois pipeline system. The project has received a final environmental impact statement from FERC (FERC docket CP13-499).	December 2015 or January 2016
	The South-to-North Project would reverse the direction of the flow in the Iroquois system.	November 2016
Kinder Morgan	The Northeast Energy Direct Project would add some new pipeline and loop existing pipeline in the Tennessee pipeline system.	November 2018
	The Connecticut Expansion Project would also loop pipeline along the Tennessee pipeline system in locations in Connecticut, Massachusetts, and New York (FERC docket CP14-529).	November 2016
Spectra Energy	The Algonquin Incremental Market Project would expand the pipeline capacity of the interstate Algonquin pipeline. The project is currently under regulatory review (FERC docket CP14-96-000).	November 2016
	The Atlantic Bridge Project would expand the Algonquin pipeline and the Maritimes & Northeast pipeline.	November 2017 or later
Spectra Energy and Northeast Utilities	The Access Northeast Project would also expand the Algonquin pipeline and the Maritimes & Northeast pipeline, with the potential to customize some services to serve electric generators.	November 2018
Williams, Cabot Oil and Gas, Piedmont Natural Gas, and WGL Holdings	The Constitution Pipeline would connect natural gas supplies in Pennsylvania with the Iroquois and Tennessee interstate pipelines. FERC has issued a final environmental review for the project (FERC docket CP13-499).	Late 2015 or early 2016

Source: Company Websites

NESCOE Proposal

The New England States Committee on Electricity (NESCOE) is a stakeholder group representing the collective interests of the region's six governors on regional electricity matters. In December 2013, the governors announced that they would work together through NESCOE to advance a regional energy infrastructure initiative to diversify the region's energy supply portfolio while ensuring that the New England states share the benefits and costs of transmission and pipeline investments. After soliciting assistance from ISO-New England and comments from various stakeholders, NESCOE presented a proposal that included a tariff mechanism to fund additional pipeline capacity through a charge to electricity customers.

In July 2014, the Massachusetts legislature declined to act on legislation believed by NESCOE to be necessary for continuing this effort. As of September, Massachusetts is conducting a state-level study and other state officials in the region continue to discuss regional policies. Documents related to NESCOE's regional infrastructure initiative are available here.

Pipeline Alternatives Assessment

The Acadia Center (a clean energy advocacy organization formerly known as Environment Northeast) responded to NESCOE's analysis, which included a low-demand scenario in which no large scale energy infrastructure would be necessary or cost-effective. They argued that reducing gas demand across the region, through increased energy efficiency and other measures, would diminish reliance on natural gas for electric generation, and listed several alternative sources, noting that more analysis is needed. Their response is available here.

EIPC Study

The Eastern Interconnection is the larger power grid stretching from central Canada to the east coast and includes all of New England. The Eastern Interconnection Planning Collaborative (EIPC) is an effort by various stakeholders including regional planning authorities (i.e., ISO-New England and other regional independent system operators), power companies, and other stakeholders, to model the impact of various policy changes on the grid. EIPC is conducting the "Gas-Electric System Interface Study" to

1. develop a baseline of the electric and natural gas systems, including their planning, operation, and interactions;

2. analyze the adequacy of the gas system to satisfy generation needs in the future;

3. identify contingencies on the gas and electric systems that could negatively affect each system; and

4. compare the benefits and risks of dual-fuel capability for generation compared with expanding gas system infrastructure.

The study, funded by the U.S. Department of Energy, is still in progress, but its reports and other documents are available here.

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