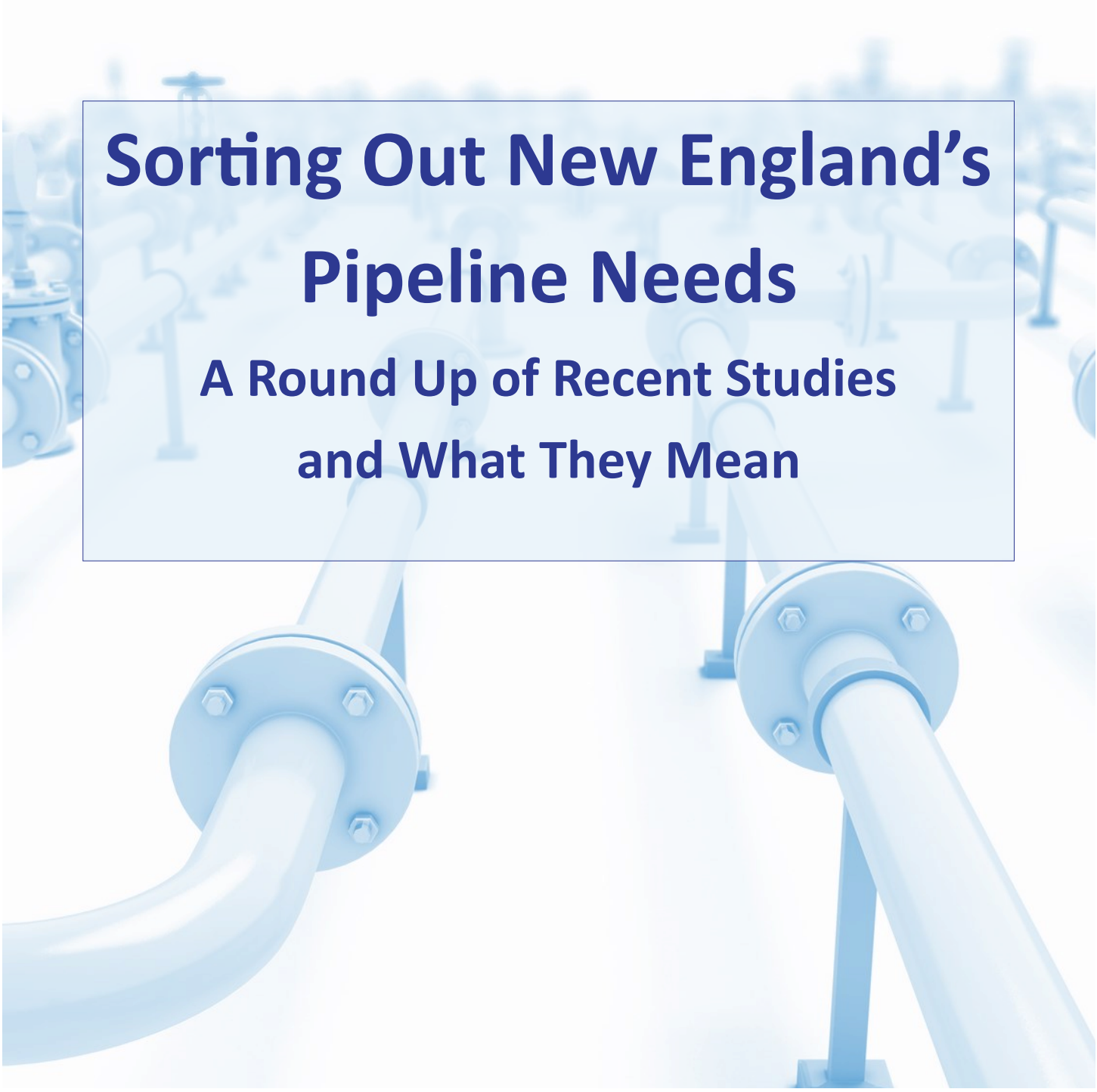

Sorting Out New England's Pipeline Needs

A Round Up of Recent Studies and What They Mean

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EXECUTIVE SUMMARY: THREE PIPELINE REPORTS IN 2015

New England's growing dependence on natural gas has had some in the region worrying about supply constraints. In fact, concerns about natural gas supply and the impacts of proposed new pipelines prompted no fewer than three separate studies on the issue last year. In 2015, three consulting firms released separate reports for different clients analyzing the need for incremental natural gas pipeline in New England through 2030. The three distinctly different approaches to the studies have the potential to create uncertainty for those trying to compare the results. To address this confusion, Synapse reviewed the main differences in the methods and inputs for each of the three studies. We present them here, along with their results and key findings.

New England Pipeline Reports Released in 2015	Link
Synapse for MassDOER: *Massachusetts Low Gas Demand Analysis: Final Report.* January 2015. Synapse Energy Economics, Inc., on behalf of Massachusetts Department of Energy Resources.	*http://synapse-energy.com/sites/default/files/Massachusetts%20Low%20Demand%20Final%20Report.pdf*
ICF for Kinder Morgan: *New England Energy Market Outlook*. September 2015. ICF International, on behalf of Kinder Morgan, Inc.	*http://www.kindermorgan.com/content/docs/NED_CapacityOutlook.pdf*
Analysis Group for MassAG: *Power System Reliability in New England*. November 2015. Analysis Group, Inc., on behalf of Massachusetts Office of the Attorney General.	*http://www.mass.gov/ago/docs/energy-utilities/reros-study-final.pdf*

Overall, we find the key takeaways from the Synapse study performed on behalf of MassDOER to be consistent with the most recent of these studies, released by the Analysis Group on behalf of MassAG. We also find that several issues of critical importance to an assessment of pipeline need are largely ignored in ICF's study on behalf of Kinder Morgan:

- Additional natural gas pipeline may be an obstacle to compliance with state and federal climate policies.
- The existence of current natural gas infrastructure expansion projects and the availability of liquefied natural gas (LNG) have a large impact on results. The extremes of the 2015 winter season substantially altered findings about LNG price and supply in New England.
- Energy efficiency investments are the cheapest way to reduce the amount of electricity needed at peak times, when high electricity demand is most likely to create supply problems. None of the studies satisfactorily investigated the real potential for ambitious energy efficiency savings in Massachusetts and throughout New England.
- Anticipated growth rates for non-electric natural gas demand and electric sales are key drivers in determining future natural gas infrastructure requirements.

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CLEARING UP THE CONFUSION

As New England increases its dependence on natural gas for heating and electric generation, questions have arisen about whether there will be adequate pipeline infrastructure to support yet more natural gas use. As a result, since January 2015, three separate reports have assessed the need for incremental natural gas pipeline in New England through 2030. Given that each report used distinctly different study approaches, inputs, and methodologies, and found different—and sometimes conflicting—results, Synapse reviewed each report to reduce confusion for stakeholders in the region, and to assess what each report's findings mean in terms of meeting state climate goals.

Each report examined the question of whether more pipeline was "needed" in the sense of whether the New England region will require more pipeline in future years to meet electric-sector reliability. Authors of each of the three reports went about their studies in markedly different ways. They made different assumptions, used a different methodology, and found different answers to the question of whether the New England region will require more pipeline in future years to meet electric-sector reliability, how incremental pipeline could impact costs in the region, and how incremental pipeline could help or hinder environmental goals. Table 1 compares the key inputs, general methodology, study scope, and main findings for each report. Each of the following sections discusses these differences in greater detail.

Table 1. Summary of approaches and findings of recent studies

	Synapse for MassDOER	ICF for Kinder Morgan	Analysis Group for MassAG
Study Approach	Examined general need for incremental pipeline in Massachusetts, compared costs of building a pipeline to alternate strategies to a new pipeline determined by Massachusetts DOER, and evaluated compliance with emission reduction goals in Massachusetts.	Examined a specific pipeline proposal, compared costs to a future with no new pipeline	Examined general need for incremental pipeline in New England, compared costs of building a pipeline versus alternate strategies, and evaluated compliance with emission reduction goals in all New England states.
Geographic Area	New England is modeled; analysis focuses on Massachusetts	New England	New England
Main Findings	Incremental pipeline is needed in all modeled scenarios. Scenarios in which alternate strategies are implemented alongside incremental pipeline are more expensive than a base case with just pipeline. No modeled scenarios are compliant with emission reduction goals.	The specific pipeline proposal analyzed results in cost savings compared to a future without the pipeline	New pipeline is not needed in base case and all other scenarios but two in which ISO-NE's winter reliability program is halted and no other actions are taken. Strategies with expanded energy efficiency programs and firm contracts over existing Canadian transmission lines lead to cost savings compared to both the base case and a pipeline case, and near emission reduction goals.

In comparing the three studies, we found the following:

- Additional natural gas pipeline may be an obstacle to compliance with state and federal climate policies.
- The existence of current natural gas infrastructure expansion projects and the availability of liquefied natural gas (LNG) have a large impact on results. The extremes of the 2015 winter season substantially altered findings about LNG price and supply in New England.
- Energy efficiency investments are the cheapest way to reduce the amount of electricity needed at peak times, when high electricity demand is most likely to create supply problems. None of the studies satisfactorily investigated the real potential for ambitious energy efficiency savings in Massachusetts and throughout New England.
- Anticipated growth rates for non-electric natural gas demand and electric sales are key drivers in determining future natural gas infrastructure requirements.

*None of the studies satisfactorily investigated the real potential for ambitious **energy efficiency savings** in Massachusetts and throughout New England.*

The assumptions the authors made about these factors were largely responsible for the studies' outcomes on the question of whether or not incremental natural gas infrastructure will be needed. Another notable finding was how differently the studies treated the implied net costs associated with a new pipeline. Synapse's analysis did not examine any scenario without a pipeline and, therefore, does not allow a cost comparison. ICF's analysis for Kinder Morgan found that new pipeline capacity is not necessary for regional electric or heating reliability, but would reduce energy costs. In stark contrast, Analysis Group found the opposite: a no-new-pipeline future was the most cost-effective.

Asking Different Questions Results in Different Answers

Each report takes a different approach to answering the question of whether incremental natural gas pipelines are needed to meet electric-system reliability. These approaches include different ways of framing the initial question, the examination of different numbers of scenarios and sensitivities, and various methods of integrating non-electric-sector demand.

Note that unlike both the ICF report and the Analysis Group report, the Synapse analysis was conducted prior to winter 2015 and does not include any data or inputs on natural gas supply, demand, or pricing for this time period.

Synapse for MassDOER

The January 2015 Synapse report commissioned by the Massachusetts Department of Environmental Resources (DOER) is framed by two questions:

- What is the current demand for and capacity to supply natural gas in Massachusetts?
- If all technologically and economically feasible alternative energy resources are utilized, is any additional natural gas infrastructure needed, and if so, how much?

Synapse's report did not evaluate any specific pipeline proposal, but addressed the more general question of whether any new incremental pipeline was needed.

Synapse analyzed two main scenarios requested by DOER: (a) one "base case" scenario, representing a business-as-usual future with existing policies and (b) a "low energy demand case" in which the maximum feasible amount of additional alternative resources is utilized before any incremental pipeline is built. The definition of feasibility was selected by DOER as a proxy for resources that are technically and practically achievable in Massachusetts for a given year, and are estimated to have net costs below the threshold of economic viability (which is itself set by the estimated cost of incremental pipeline). Synapse assessed each of these scenarios for the sensitivity of its resulting need for incremental pipeline to variations in two uncertain future outcomes: the price of natural gas, and the construction of a new 2,400 MW transmission line from Canada—with an associated increase in electricity imports.

Within each scenario, Synapse forecasted demand for natural gas in both the electric sector and non-electric sectors (i.e., water heating, heating for buildings, industrial) at an annual level and during a peak winter hour for each year between 2015 and 2030. Synapse then examined annual peak hours to determine whether a shortage in natural gas supplies existed. The Synapse report modeled business-as-usual non-electric and electric gas demand for the five non-Massachusetts states in New England. Natural gas shortages were only evaluated for Massachusetts; imbalances between natural gas supply and demand in other states was not examined in this study.

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The Synapse report assumed gas demand for heating in Massachusetts grows by 0.8 percent per year between 2015-2030 before accounting for end-use gas energy efficiency programs, or a growth rate of -0.2 percent per year during the same period if these reduction measures and efficiency savings are accounted for. The Synapse report based its assumption of electric retail sales in Massachusetts on the ISO-NE's 2014 CELT report.[1] It used a projected electric sales growth of 1.0 percent per year absent any energy efficiency, 0.1 percent per year with low levels of energy efficiency, and -0.2 percent per year with high levels of energy efficiency (i.e., its "Low Demand" scenario). Note that the Synapse analysis

[1] ISO New England. 2014. *2014 CELT Report.* Available at http://www.iso-ne.com/system-planning/system-plans-studies/celt.

was conducted prior to January through March 2015 and does not include any data on natural gas supply, demand, or pricing for this time period.

The Synapse analysis assumed that the Algonquin Incremental Market (AIM) project, an expansion of pipeline in New England, would be complete in 2017 and that new pipeline would be required if demand for natural gas exceeded 95 percent of existing pipeline capacity in the peak hour.

The Synapse analysis for DOER yields values for annual and peak hour gas demand (and gas shortages), annual heating and electric-sector costs, and annual CO_2 emissions.

ICF for Kinder Morgan

The September 2015 ICF report commissioned by Kinder Morgan examined the question of need differently than Synapse and Analysis Group. Rather than posing a question on whether incremental pipeline is needed for electric system reliability, ICF evaluated the impacts of one specific pipeline proposal: a new 1.3 billion cubic feet per day (Bcf/d) pipeline known as the "Northeast Energy Direct" project, or "NED," in New England. The proposed NED pipeline would be operated by Kinder Morgan, be in service by November 2018, and transport natural gas from upstate New York to Dracut, Massachusetts—largely through existing right-of-ways in Massachusetts and New Hampshire.

Rather than posing a question on whether incremental pipeline is needed for electric system reliability, ICF evaluated the impacts of one specific pipeline proposal.

This study evaluated the expected impact of the NED pipeline in terms of two key outcomes: (1) the average monthly natural gas and electric prices that would occur both with and without the NED pipeline, and (2) the cost savings from avoided natural gas price volatility that could be achieved as a result of the pipeline. The ICF report analyzed costs from 2020 through 2035 under two different weather conditions: a "normal" winter season and a "design" winter season that represented a "worst-case" scenario for natural gas non-electric and electric demand. In the ICF analysis, non-electric gas demand for heating grows by 2.7 percent per year from 2015-2018 and 1.3 percent per year from 2018 through 2035 in all scenarios. ICF also assumed that future electric retail sales, net of energy efficiency, would grow by 0.8 percent per year through 2035.

Like the Synapse analysis, the ICF report also assumes that the AIM project will be online in future years, and that a second pipeline expansion project, the Kinder Morgan Connecticut Expansion (TGP CT), project will also be online. ICF reports that in a recent historically cold winter (2013-2014), daily utilization factors on existing pipelines averaged 90 percent and on occasion exceeded 95 percent. ICF notes that wholesale power prices can spike and can be more volatile when daily utilization factors exceed 75 percent.

Analysis Group for MassAG

The November 2015 Analysis Group study commissioned by the Massachusetts Attorney General's office used a set of framing questions to organize its analysis:

- Could the region experience peak winter periods when the electric system may not be able to reliably meet peak electric demand?

- If any such periods are identified, what practical options (e.g., new pipeline infrastructure and alternate strategies) are available to maintain power system reliability?

This study also examined the effect of these "practical options" on costs, greenhouse gas emission reductions, and other key outcomes. Like Synapse's report for DOER, Analysis Group did not look at any specific pipeline proposals, but instead compared projections through 2030 of peak heating and electric-system demand for natural gas against the current supply conditions to determine whether any shortages would exist in future years. The Analysis Group study assumes demand for gas heating will grow by 1.4 percent per year throughout its study period of 2016 to 2030. The Analysis Group report relied on electric load forecasts for New England in ISO-NE's CELT 2015 report, projecting sales increase 1.0 percent per year over the study period, absent any energy efficiency. Analysis Group estimated future levels of energy efficiency for Massachusetts using the 2016-2018 Three-Year Plans filed by Massachusetts Program Administrators, which closely resemble the levels of energy efficiency used in Synapse's "Low Demand" scenario.

Like Synapse's report for DOER, Analysis Group's scenarios were designed to shed light on the need for new pipeline capacity in the future, the cost implications of new pipeline, and the emissions impacts of building new pipeline versus the alternatives. Unlike Synapse's study, the Analysis Group report examined natural gas needs for the New England region as a whole, instead of focusing on Massachusetts. The different scenarios modeled in the Analysis Group report include:

- A "base case" featuring no new infrastructure improvements, with a "severe winter" modeled for heating demand and an assumption that electricity imports over existing transmission lines from Canada would not be available in future years.

- Three scenarios testing the sensitivity to the base case of future events in which backup oil is not available at gas power generating units capable of burning dual fuels: (a) oil was not available for use at dual-fuel units, (b) new gas units were built only as single-fuel (i.e., could not use oil to produce electricity), and (c) and a situation in which both events occur simultaneously. Several additional scenarios and sensitivities examining (d) the implementation of firm contracts for ship-delivered LNG, (e) the construction of new, incremental pipeline, (f) the implementation of expanded energy efficiency and demand response programs, (g) the implementation of expanded efficiency and demand response programs alongside firm contracts for electricity imports over existing transmission lines from Canada, (h) the implementation of expanded efficiency and demand response programs alongside firm contracts for imports over new transmission lines from Canada, and (i) the model's sensitivity to variations in the quantity and timing of pipeline and transmission additions.

Note that some assumptions used in Analysis Group's sensitivities—such as electricity imports over existing transmission lines from Canada not being available in future years, or new gas units built as single-fuel only—tend to favor a positive assessment of pipeline need. Indeed, the Analysis Group report states explicitly on page 2 of its executive summary its intention to "carry out [its] analysis from a

conservative reliability planning perspective—namely, with every judgment and assumption we err on the side of overstating the need for electricity generation, and understating the level of resources available to meet that need."

The Analysis Group report assumes that both the AIM project and TGP CT project will be online in the future and that a third pipeline expansion project, the Atlantic Bridge project, will also be in place. The Analysis Group report does not assume future utilization rates or input utilization thresholds for incremental future pipeline. Instead, it uses the historical relationship between pipeline utilization and gas prices to forecast future natural gas prices. The report then uses those expected natural gas prices as inputs into each scenario to determine the overall costs or savings associated with each modeled future.

Comparison of growth rates

One of the critical differences between these studies are their authors' basic assumptions regarding the annual growth forecasts associated with non-electric (i.e., heating, industrial, and water heating) natural gas demand and the annual growth forecasts associated with electric retail sales for each report.

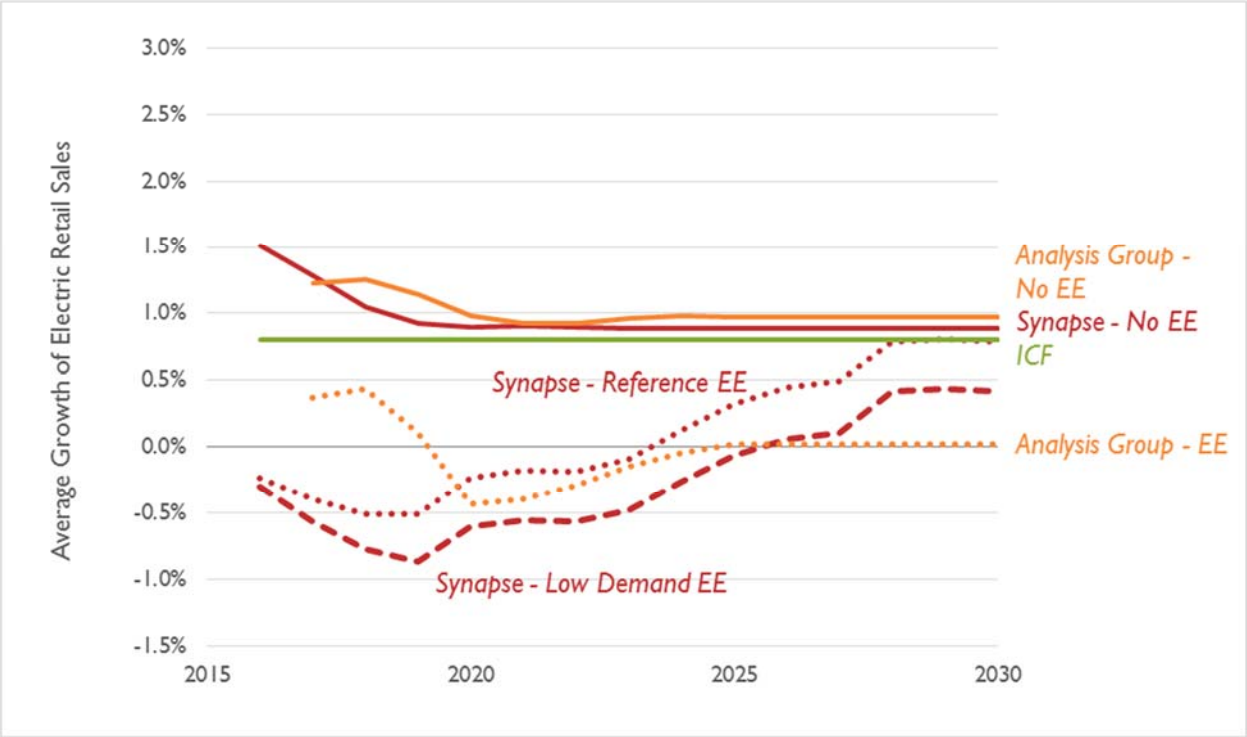
One of the critical differences between these studies are their authors' basic assumptions regarding the annual growth forecasts associated with non-electric natural gas demand and the annual growth forecasts associated with electric retail sales for each report.

Figure 1 shows average growth in demand over time; it is possible that in each analysis, slightly varying growth rates were used in specific years. In general, higher growth rates for non-electric natural gas demand would make it more difficult to meet electricity reliability in future years without making changes to the existing system. In the Synapse report, growth rates of non-electric demand for natural gas were available for three cases: one without energy efficiency ("EE"); one with a reference, or "business-as-usual," level of energy efficiency; and a third with "low demand" or high levels of energy efficiency. It is unclear whether the growth rates reported for the Analysis Group and ICF reports are net of energy efficiency.

Figure 1. Annual growth of non-electric natural gas demand

As with non-electric demand growth rates, higher growth rates for electricity sales would make it more difficult to meet electricity reliability in future years without making changes to the existing system. Figure 2 shows the rate of growth in electric sales assumed in all three studies including three different growth rate trends for electric sales in the Synapse report: one without any energy efficiency ("EE"); one showing a reference, or "business-as-usual," level of energy efficiency; and a third showing "low demand" or high levels of energy efficiency. This figure also shows two growth rate trends for electric sales in the Analysis Group report: one growth rate with energy efficiency, and one without. The ICF study does not state whether its assumed electric sales growth rate is or is not net of energy efficiency.

Figure 2. Annual growth of electric retail sales

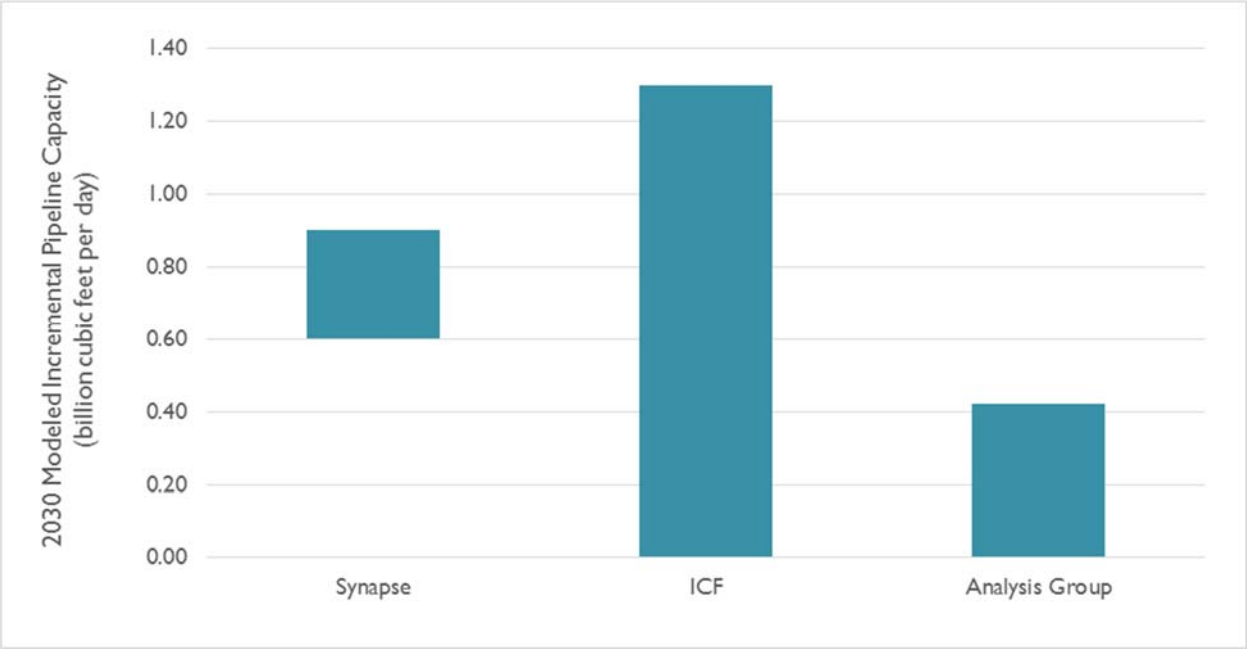


To put these forecasted growth rates in context: According to data from the Energy Information Administration (EIA), New England's electricity sales grew -0.7 percent annually between 2010 and 2014. EIA's Annual Energy Outlook (AEO) 2015 Reference Case with no incremental energy efficiency projects the region's electricity sales growth for 2015-2030 will be 0.2 percent each year on average.

MAIN FINDINGS: PIPELINE NEED DEPENDS ON KEY ASSUMPTIONS

Because of the different methodologies and inputs used, each report came to different conclusions about the need for new pipeline in the region for reliability purposes. Figure 3 summarizes these findings for 2030. Pipeline capacity was modeled as in input in the ICF analysis. In the Synapse analysis, each scenario required a different level of incremental pipeline by 2030, represented here as a range across scenarios. The Analysis Group report, in the most stressed scenario, identified a 0.42 Bcf/day deficiency; this deficiency is diminished or non-existent in all other scenarios.

Figure 3. Modeled incremental pipeline capacity for 2030



Synapse for MassDOER

Synapse's report found that in each scenario chosen by MassDOER, a natural gas shortfall in Massachusetts' heating and electric system was identified beginning in 2015. Because of the time required to construct incremental pipeline, Synapse assumed that for 2015-2019, gas prices would reflect an out-of-balance market. Depending on the scenario, Synapse's report found that, beginning in 2019, the natural gas shortage could be met by a new pipeline supplying 0.6 to 0.9 Bcf/day.

The report discussed a number of key caveats to its methods and assumptions:

- First, none of the scenarios analyzed required compliance with Massachusetts' Global Warming Solution Act (GWSA); indeed, no scenarios modeled in the Synapse report met compliance with the 2020 GWSA requirement and only two scenarios met compliance with the expected 2030 GWSA target.[2]
- Second, the Winter Reliability Program, recently put in place by the New England Independent System Operator (ISO-NE) was assumed to be available to help decrease the need for natural gas through the use of backup oil only through the winter of 2018.
- Finally, firm contracts for ship-delivered LNG, which were assumed in the Analysis Group study, were assumed to be uneconomic in the New England region, and therefore unavailable throughout the 2015 to 2030 study period.

[2] Synapse's report describes that, after accounting for projected emissions reductions in other sectors, combined emissions from the electric, buildings, and industrial sectors must be under 23.3 million metric tons in 2020 or 18.7 million metric tons in 2030 in order to meet compliance with the MA GWSA legislation.

Each scenario modeled in this study required incremental pipeline. This study found that between 2015 and 2030, a scenario that includes 2,400 MW of incremental Canadian transmission increases costs by $840 million (on a net present value basis) compared to the base case. Scenarios in which significant incremental pipeline is avoided using (a) strategies such as energy efficiency and renewables or (b) energy efficiency and renewables in conjunction with a 2,400 MW Canadian transmission line increase costs by $1,433 million to $2,157 million in net present value compared to the base case in which no new alternative strategies to a pipeline are implemented.

None of the scenarios analyzed required compliance with Massachusetts' Global Warming Solution Act.

ICF for Kinder Morgan

Depending on the year, ICF's report for Kinder Morgan on the proposed NED pipeline found that a new 1.3 Bcf/day pipeline, costing $400 million per year, would yield a net annual benefit of $2.1 billion to $2.4 billion to electric ratepayers between 2019 and 2028.

ICF concludes that if New England generators were to pursue a future without building new gas pipeline, 12 million MWh of electricity would be generated by oil-fired generation instead of natural gas. According to ICF, this would result in an increase of 5.6 million tons of CO_2 above 2012 levels by 2020. While ICF's report does not identify whether its scenarios are compliant with the federal Clean Power Plan, the Massachusetts GWSA, or other state-specific emissions reduction targets, it does assume compliance with the Northeast's Regional Greenhouse Gas Initiative (RGGI).[3] Because RGGI caps are more lenient than Massachusetts' GWSA, and other similar state targets, it is likely that the scenarios in the ICF Report are non-compliant with the GWSA.

ICF also found that if its proposed pipeline project had existed in the 2013-2014 winter, reducing load factors below 75 percent (to ranges of 55-64 percent), the new pipeline would have reduced expenditures on wholesale electricity by $3.7 billion.

[3] Note that the MA GWSA and other analogous state laws are the most stringent CO_2 reduction goals, followed by RGGI, followed by the federal Clean Power Plan.

Analysis Group for MassAG

Analysis Group's report for MassAG found that:

- Even in a base case with severe weather conditions and unavailable imports from Canada, ISO-NE's current winter reliability programs would be sufficient for maintaining electric system reliability through 2030 without any new pipeline.
- If the electric system were stressed by removing the expected dual-fuel capability, there would be a natural gas shortage starting in 2024, with a maximum shortage of about 2,500 MW on-peak in 2029 and 2030.

In addition, Analysis Group found that there are many types of investments which could avoid the shortage without building a new pipeline. These include firm contracts for ship-delivered LNG, extensive energy efficiency and demand response programs, and firm contracts alongside either existing or new transmission lines from Canada. Importantly, scenarios that included new energy efficiency and demand response programs were cost savers compared to both the base case and a case in which incremental pipeline was built (see Table 2).

Analysis Group found that there are many types of investments which could avoid the shortage without building a new pipeline.

Table 2. Solutions featuring cost savings in the Analysis Group Report (annualized dollars, 2015 $ million)

	Energy Efficiency and Demand Response	Energy Efficiency and Demand Response + Firm Import along existing transmission
Savings compared to base case	$146	$98
Savings compared to incremental pipeline scenario	$85	$37

Analysis Group also found that a scenario featuring an incremental pipeline was inadequate for achieving New England states' emissions targets. This study found that only scenarios featuring efficiency, demand response, and firm imports from Canada could achieve New England's climate goals, although even in those scenarios these goals are not achieved in every year of the study.