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# Quantifying the capacity value of natural gas efficiency in New England

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A B S T R A C T

Natural gas utilities in New England face increasing natural gas transmission system congestion and volatile spot gas prices. We observe that prevailing evaluation methods for natural gas efficiency programs value avoided firm pipeline capacity based on its total ('gross') cost. We propose, consistent with deregulated electricity markets, to value avoided firm pipeline capacity at its 'net' cost. Specifically, we account for revenues associated with selling excess capacity during periods when the firm capacity holder does not fully utilize its rights. Our evaluation of commercial building efficiency programs suggests that prevailing evaluation methods could over-estimate the value of efficiency programs when those programs are intended to offset new capacity investments (i.e., the utility is in need of additional firm capacity). The situation is more complex for a utility with sufficient firm pipeline capacity to meet forecast load (i.e., consumption). In this case, the prevailing evaluation methods have the potential to under- or over-estimate the value of efficiency programs. The value of avoided infrastructure investments is likely to vary with the specific circumstances of the utility and the expected revenues associated with short-term sales enabled by available capacity. In the future, we recommend that economic regulators of natural gas distribution utilities, the state public utility commissions (PUCs), value avoided infrastructure investments at the 'net' cost of the investment instead of the 'gross' cost.

## 1. Introduction

Natural gas price volatility, natural gas transmission pipeline congestion, wholesale electricity price spikes, and controversial pipeline expansion projects have contributed to New England customers paying higher natural gas and electricity prices than customers in neighboring states, despite increasing shale gas production in the U.S. In fact, spot natural gas prices in New England have become more volatile over the past several winters, and spot prices reached historic highs during the 2013–2014 winter (Energy Information Administration, 2014). While increasing the capacity of natural gas transmission pipelines across New England states could alleviate some of these constraints, these expansion projects remain controversial. Critics of expanding natural gas transmission pipelines cite concerns related to ecosystem protection, the impact of ratepayer funding of infrastructure projects, and the potential for prolonging society's dependence on fossil-based energy. Critics also point to the availability of clean energy substitutes (Environment Northeast, 2014).

Natural gas local distribution utilities (from here on, *natural gas utilities*) own large quantities of both 'long-haul' firm pipeline capacity from producing areas to New England, and 'short-haul' firm pipeline capacity within New England (Hornby et al., 2013). They are thus the primary firm capacity holders in the region. Firm capacity means the right to use a defined quantity of transport capacity on a given natural gas pipeline with legal guarantees that the capacity will be available (except under very extreme circumstances). While the primary responsibility of natural gas utilities is to serve their residential and commercial customers, natural gas utilities also serve electricity generators and other large consumers by providing transportation services (via the utility's pipeline infrastructure) or by reselling excess pipeline capacity in the marketplace. Electricity generators and other large consumers often rely on an assumption that firm capacity holders will not use all of their rights and will re-sell this capacity (ISO New England, 2012). The dependence of electricity generators on the excess capacity of natural gas utilities threatens the reliability of the electricity systems during periods that natural gas utilities consume all or nearly all of their firm pipeline capacity (ISO New England, 2012). Thus natural gas utilities, as both owners of firm capacity rights and suppliers of excess capacity to electricity generators, are key stakeholders in the larger New England energy system.

New England natural gas utilities are obligated to provide natural gas service to their core customers (i.e., most residential and small commercial customers) at regulated rates, subject to the just and reasonable standard. To meet this mandate, utilities use firm pipeline capacity during the summer to transport natural gas from producing regions into New England storage sites. During the winter, which is the

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**Table 1**
Natural gas efficiency programs in New England.

| State | 2013 | 2014 | 2015 |
|---|---|---|---|
| | *Total natural gas efficiency budget (million $)* | | |
| CT | 43.6 | 48.5 | 51.4 |
| MA | 168.4 | 174.6 | 180.1 |
| ME | – | 0.5 | 0.5 |
| NH | 6.3 | 7.1 | 6.7 |
| RI | 18.3 | 25.8 | 24.5 |
| Total | 236.6 | 256.5 | 263.2 |
| | *PUC accepted total lifetime savings estimate (MCF*)* | | |
| CT | 8,550,927 | 9,411,764 | 10,399,561 |
| MA | 31,277,136 | 31,277,136 | 31,277,136 |
| ME | – | 53,300 | 54,000 |
| NH | 1,781,409 | 1,897,430 | 2,036,173 |
| RI | 3,830,689 | 4,427,735 | 4,048,728 |
| Total | 45,440,161 | 47,067,364 | 47,815,598 |
| | *PUC accepted benefit-cost ratio (B/C)*** | | |
| CT | 0.83 | 0.87 | 0.87 |
| MA | 2.24 | 2.28 | 2.42 |
| ME | n/a | n/a | n/a |
| NH | 2.10 | 2.14 | 1.78 |
| RI | 2.14 | 1.87 | 2.23 |

Notes: Data from: (Connecticut Department of Energy and Environmental Protection, 2013; Efficiency Maine Trust, 2012; Mass Save, 2012a; New Hampshire electric and gas utilities, 2014, 2013; New Hampshire electric utilities, 2012; State of Rhode Island and Providence Plantations Public Utilities Commission, 2014, 2013, 2012). Maine did not estimate the cost-effectiveness of their natural gas efficiency programs due to the small total program budget (State of Maine Public Utilities Commission, 2013). Note: the cost per unit of natural gas savings is not the lifetime savings divided by the program budget because such an analysis would consider the consumer's increase in costs (e.g., marginal cost of the efficient equipment). *One 'MCF' equals one thousand cubic feet. **We report benefit-cost ratios for commercial and industrial programs since our research addresses commercial building efficiency programs.

high load season (due to heating), utilities rely on both firm pipeline capacity from producing regions and firm pipeline capacity from natural gas storage sites to meet load. Utilities will use off-system peaking resources to meet load during the highest load days of the year (approximately ten days each year (Hornby et al., 2013)). Off-system peaking resources are locally stored fuel supplies that do not require firm pipeline capacity to deliver them to customers, such as liquefied propane gas or liquefied natural gas (Hornby et al., 2013). All six New England states (Connecticut, Maine, Massachusetts, Rhode Island, New Hampshire, and Vermont) have laws, regulations, or policies that allow (or require) utilities to capture cost-effective energy efficiency in order to avoid natural gas system costs, including both fuel purchases capital investments in delivery infrastructure (for an overview of legislation, see Appendix, Tables 1–1). Energy efficiency programs can thus have a substitutive effect compared to conventional expenditures. To promote economic efficiency, state public utility commissions (PUCs) should require natural gas utilities to choose the least-cost resource portfolio. Table 1 shows that PUCs already rely on utility efficiency programs to offset the cost of procuring billions of cubic feet per year of natural gas annually.

A robust framework for valuing natural gas efficiency programs is critical given the scale of programs, in terms of both the natural gas savings and ratepayer expenditures. New England states have established a generic framework for evaluating efficiency programs and periodically reviewing these benefits. The Avoided Energy Supply Costs (AESC) report fills this role in New England (Hornby et al., 2013). The AESC report series is a collaborative effort among utilities, regulators, and consultants to estimate the avoided energy system costs when a utility implements an electricity or natural gas efficiency program; it is updated biannually and was published most recently in 2015 (Hornby et al., 2015). State public utility commissions (PUCs) direct utilities to use the results of these studies and standardized tests to ensure that only cost-effective programs are implemented (Connecticut General Assembly, n.d.; Efficiency Maine Trust, 2012; New Hampshire Public Utilities Commission, 2000; Rhode Island General Assembly, n.d.; The General Court of the Commonwealth of Massachusetts, 2008; Vermont General Assembly, n.d.). The PUCs in New England generally require that utilities estimate the energy savings of an efficiency program using Technical Resource Manuals (TRMs) (Efficiency Maine Trust, 2013; Efficiency Vermont, 2013; Hornby et al., 2013; Mass Save, 2012b; National Grid, 2014a; The United Illuminating Company and The Connecticut Light and Power Company, 2012). TRMs are documents that establish methods to estimate the energy savings of individual efficiency interventions and provide reference energy savings values for a wide variety of common efficiency interventions.

In this paper, we extend the current literature by considering both the reductions in firm pipeline capacity purchases and short-term excess capacity resale that result from reductions in natural gas consumption achieve by efficiency and discuss the implications of our analysis on natural gas efficiency programs in New England.

### 1.1. Problem statement and scenarios

When a utility implements a natural gas efficiency program, the utility potentially avoids the cost of purchased gas, system infrastructure, and pollution compliance measures over time as well as other less-tangible benefits (Hornby et al., 2013). In other words, efficiency avoids 'variable' system costs in the near term and 'fixed' system costs over time. The 2013 AESC report quantifies the variable and fixed cost savings of natural gas efficiency programs (Hornby et al., 2013). The primary variable cost avoided is the additional unit of purchased natural gas. Smaller avoided variable costs include the transmission costs associated with using a natural gas pipeline. Fixed costs that a utility avoids can include the costs of building or buying firm pipeline capacity to meet load, maintaining storage for meeting winter load, or maintaining peaking facilities to meet load above pipeline capacity on the highest load days (Hornby et al., 2011). The 2013 AESC report quantifies the value of efficiency by estimating the cost of firm pipeline capacity using utility data (Bay State Gas Company d/b/a Columbia Gas of Massachusetts, 2008; EnergyNorth Natural Gas, 2013; The Yankee Gas Services Company et al., 2013). The 2013 AESC report further recognizes that utilities sign long-term firm capacity contracts that incur monthly fees regardless of whether the capacity is utilized. Thus, in the short to medium terms, efficiency cannot avoid the cost of previously signed contracts for firm natural gas pipeline capacity. However, the prevailing evaluation methods do not account for utility revenues from the release and resale of excess firm capacity rights, which (depending on regulatory treatment) can offset utility revenue requirements (Hornby et al., 2013). The two scenarios below explore how the capacity value of natural gas efficiency programs may change when accounting for the reselling of excess firm pipeline capacity.

**Scenario 1: Utility has sufficient firm capacity**. *Efficiency programs reduce the use of pipeline capacity that the utility already owns.* An efficiency program will decrease load relative to the 'no efficiency' scenario. If, even absent the efficiency program, the utility does not need to purchase additional firm pipeline capacity to serve load, then efficiency programs are not likely to avoid firm pipeline investments (i.e., firm pipeline investments are unlikely to be made regardless of program implementation). In this scenario, firm pipeline costs may not decrease because the utility must continue to pay for its existing allocation of firm pipeline capacity (Boston Gas d/b/a National Grid, 2013; Connecticut Natural Gas Corporation, 2012; EnergyNorth Natural Gas, 2013). The 2013 AESC report assumes that existing firm capacity contract costs are sunk and that natural gas efficiency programs cause only small reductions in fixed capacity costs.

The 2013 AESC report does not contemplate that utilities resell excess capacity in the short-term markets and use the revenues to offset revenue requirements (Connecticut Public Utilities Regulatory