# Expanding Natural Gas Service to Multifamily Buildings

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# EXECUTIVE SUMMARY

## Background

This report stems from an American Gas Foundation project to identify the barriers, benefits and solutions associated with expanding natural gas service in America's multifamily markets, driven by a combination of factors:

- The growing importance of multifamily housing in many markets around the country;
- Continuing challenges faced by natural gas utilities in seeking to expand service to new and existing multifamily buildings;
- The technical, economic, and environmental benefits derived from utilizing natural gas service in multifamily buildings; and
- Recent innovations in technology, program design, and marketing that have enabled some gas utilities to gain market share in their multifamily markets.

The report is organized around three main facets of expanding multifamily natural gas service:

- **Barriers:** assessing the nature, impact, and potential solution strategies to key technical, economic, physical, market, regulatory and other barriers to expanding natural gas service in multifamily buildings.
- **Benefits:** quantifying the energy, environmental, economic and other benefits of natural gas service, at the technology, building, and national levels.
- **Solutions:** defining and illustrating the policy, program, and other solutions that gas utilities and their allies can use to reduce barriers and promote benefits to expand natural gas service in multifamily markets.

## Key factors in multifamily markets

In the past decade, multifamily construction has risen from less than 25% to one-third or more of newly-built residential dwelling units, making multifamily markets significantly more important for policymakers seeking cost-effective and low-emission energy solutions, and for utilities seeking to retain or expand market share. The report documents these trends; it also shows that multifamily markets are not monolithic: market segmentation is increasingly important in seeking to match technology solutions with market needs. The table below summarizes the main market segments examined in this report.

| Multifamily Market Segmentation Map | | |
|---|---|---|
| **Ownership** | Rented | Owned |
| **Income** | Affordable | Market Rate |
| **Building cycle** | New construction | Retrofit |
| **Construction type** | High-rise | Low-rise |
| **Demographics** | Baby Boomers | Millennials |

## Barriers to expanded natural gas service

The report examines technology, policy, economic, and market barriers to expanding natural gas service in multifamily markets. These are summarized in bullet form below.

*Technology Barriers*

- **Technical efficiency limits of gas vs. other fuels**. Despite major advances in gas end-use technologies in recent decades, today's energy rating methods often show gas technologies as less efficient than other fuel technologies. The table below illustrates typical gas vs. electric space heating and water heating comparisons.

| Water Heating | Gas | | Electric | | | |
|---|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | NAECA Min. | Heat Pump Water Heater | | |
| Energy Factor | 0.62 | 0.67 | 0.92 | 2.00* | 0.95* | [Increased Space Heating]** |
| Annual input (Therms for gas; kWh for electric) | 151 | 136 | 2,685 | 686 | 748 | 328 |
| Site Consumption (MMBTU) | 15.1 | 13.6 | 9.2 | 6.0 | | |
| Source Consumption (MMBTU) | 16.6 | 15.0 | 28.9 | 19.0 | | |
| Annual Water Heating Required (output in Btu) | 9,385,422 | 9,385,422 | 9,385,422 | 9,385,422 | | |
| Total Annual Water Heating Cost ($) | $191 | $171 | $342 | $224 | | |

- ***Energy Factor for the heat pump water heaters is 2.00 based on the referenced test procedure, but falls to 0.95 in conditions where electric resistance heat is used as backup. Btu and cost estimates are based on EF 2.00; but they would increase to the extent that electric resistance backup is used.
- ****When installed in conditioned space, heat pump water heaters increase space heating loads by pumping heat from indoor air into the water tank.

| Space Heating | Gas | | | Electric | |
|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR South | ENERGY STAR North | NAECA Min. | ENERGY STAR ASHP |
| AFUE/HSPF | 80% | 90% | 95% | 7.7 | 8.5 |
| Annual input (Therms for gas; kWh for electric) | 132 | 117 | 111 | 1,583 | 1,399 |
| Site Consumption (MMBTU) | 13.2 | 11.7 | 11.1 | 5.4 | 4.8 |
| Source Consumption (MMBTU) | 14.5 | 12.9 | 12.24 | 17.1 | 15.1 |
| Annual Fuel Cost | $166 | $147 | $140 | $202 | $178 |

**Note:** the calculations behind these tables are based on national-average climate conditions in Climate Zone 4, equivalent to Washington Dulles Airport weather data. In some regions, heating loads may be significantly higher or lower, which would affect the absolute values of the table numbers as well as the relative consumption levels of water heating vs. space heating systems.

- **Physical constraints on gas technologies**. Depending on the building type and situation, it can be challenging to find space for supply pipe chases, air intake and venting systems, mechanical closets, etc. needed to support gas systems; this challenge is typically much greater in retrofit situations. By contrast, electric technologies such as mini-split or through-the-wall heat pumps can be installed relatively easily in a wide variety of

architectural configurations. Even if gas service is technically feasible, it can reduce rentable space, and be viewed as economically undesirable. Also, in some climates matching HVAC equipment sizing to heating and cooling loads can create mismatch conditions that add to the challenges of gas service.

### *Policy Barriers*

- **Building codes.** The energy rating methods used in codes can disadvantage natural gas technologies, and other code provisions can limit or eliminate gas technologies outright.
- **Utility metering and ratemaking policies.** State and local policies that affect the use master metering vs. individual dwelling unit metering, and policies that encourage or discourage revenue decoupling and revenue growth linked to customer meter counts, can have strong effects on utilities' ability to pursue gas service extension goals.
- **Environmental and energy policies.** From climate change and air quality regulations to zero-energy building definitional policies, national, state, and local energy and environmental policies can have strong effects on utilities' ability to extend natural gas service.

### *Economic Barriers*

Perhaps the most persistent barrier to gas service is the market perception of lower first costs for electric technologies, which tends to favor single-fuel, all-electric designs. Total construction costs can often be lower using one utility service instead of two; and because builders focus on keeping first costs low, this fundamental is hard to counter.

### *Market Structure Barriers*

- **The split-incentive barrier.** Also known as the principal-agent problem, this barrier stems from the fact that building owners and builders bear the capital costs of energy service technologies, but occupants bear the longer-term operating costs. The owner or builder's incentive is to keep first costs low; the occupant wants to keep total costs, including energy costs low. Because so much of U.S. multifamily markets are rented rather than owned, this barrier is especially challenging in multifamily.
- **Information barriers.** Like many end-use markets, multifamily markets are plagued by lack of awareness and technical knowledge in key audiences that keeps the benefits of natural gas service from being recognized and realized. For example: developers may not be fully aware of the consumer demand for gas service; designers may not have access to concrete data on the performance and other benefits of gas end-use technologies; and local gas distribution company staff may not have the tools and resources they need to educate key audiences.

The report defines and documents the impact of such barriers, and goes on to outline potential solutions, which are developed further in the solutions section of the report.

## Benefits of expanded gas service

### *Reduced source energy consumption and energy bills*

The table above comparing gas and electric technologies tells a two-part story: (1) gas technologies can appear less efficient on a site-Btu basis, and (2) gas technologies are often more efficient on a source-Btu basis, and can also provide lower operating costs. If these source-Btu

and energy cost benefits were applied across all or part of the U.S. multifamily building stock, the nationwide benefits could be substantial:

- Multifamily unit occupants could realize $2.2 billion in reduced annual energy bills, or about 6% of total energy expenditures for multifamily units nationwide.
- On a source Btu basis, gas conversions would reduce total national energy consumption by 182 Trillion Btu, which is in the range of 6% of total multifamily energy usage.
- Nationwide $CO_2$ emissions would be reduced by more than 20 million tons.[1]

Taking a narrower, "lost opportunity" look at this data, focusing on EIA RECS data for multifamily buildings constructed in the 2000-2009 decade, the multifamily units built during this time period that chose not to utilize natural gas service:

- Consume about 25 trillion more Btu per year;
- Incur $302 million more in in annual energy bills; and
- Account for an additional 2.75 million tons of $CO_2$ emissions.

### *Reduced emissions of air pollutants and greenhouse gases*

Depending on the characteristics of comparative fuel and system choices, gas service can reduce emissions at the building site and energy supply system levels. The table below illustrates the relative air pollutant emissions for the technologies shown above. For carbon dioxide, NAECA-minimum gas water heating equipment emits just over half the annual emissions of a NAECA-minimum electric water heater. Gas space heating equipment emits 20% less carbon dioxide than minimum-standard electric heat pumps.

| Water Heating | Gas | | Electric | | |
|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | NAECA Min. | Heat Pump Water Heater | |
| Energy Factor | 0.62 | 0.67 | 0.92 | 2.0 | 0.95 |
| tons $CO_2$ Emissions | 0.8030 | 0.7220 | 1.5007 | 0.9848 | |
| tons $SO_2$ Emissions | 0.0000040 | 0.0000036 | 0.0032 | 0.0021 | |
| tons $No_x$ Emissions | 0.0006 | 0.0006 | 0.0014 | 0.0009 | |

| Space Heating | Gas | | | Electric | | |
|---|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | ENERGY STAR | Electric Res. | NAECA Min. | ENERGY STAR |
| AFUE/HSPF | 80% | 90% | 95% | 98% | 7.7 | 8.5 |
| tons $CO_2$ Emissions | 0.6980 | 0.6204 | 0.5803 | 1.9127 | 0.8851 | 0.7820 |
| tons $SO_2$ Emissions | 0.0000035 | 0.0000031 | 0.0000029 | 0.0041 | 0.0019 | 0.0017 |
| tons $No_x$ Emissions | 0.0005 | 0.0005 | 0.0005 | 0.0017 | 0.0008 | 0.0007 |

**Note:** the calculations behind these tables are based on national-average climate conditions in Climate Zone 4, equivalent to Washington Dulles Airport weather data. In some regions, heating loads may be significantly higher or lower, which would affect the absolute values of the table numbers as well as the relative consumption levels of water heating vs. space heating systems.

[1] These emission impacts are based on national impacts across the residential sector; those calculations differ somewhat from the emissions analysis in the report tables, which build up emissions impacts based on comparisons of specific water heating and space heating technologies.

The Benefits section of the report includes three case studies of the benefits of gas technologies in multifamily buildings, with detailed information on the technologies analyzed, building characteristics, energy performance including energy bill impacts, and other benefits.

## Solutions for expanding natural gas service to multifamily buildings

This part of the report highlights successful examples of natural gas industry efforts to enable the expansion of natural gas service in multi-family buildings through energy efficiency, fuel conversion, policy actions, and other initiatives. It describes gas industry marketing and energy efficiency efforts, public policy initiatives, and nonprofit and technical society initiatives.

### *High-performance natural gas technologies*

The report briefly touches on key technologies that show greatest promise in multifamily applications, including combination hot water and space heating systems, small-capacity heating systems, and Renewable Natural Gas (RNG) and other low-emission gas supply technologies. This section also describes metering solutions that gas utilities are applying in the field to enable various gas service strategies.

### *Marketing Initiatives*

Gas utilities have innovated in service areas around the country to foster incentives, technology solutions, and data documentation efforts that support marketing efforts. This report contains detailed case studies from the following companies:

- Atlanta Gas Light
- Atmos Energy
- CenterPoint Energy
- Con Edison
- PSEG
- Washington Gas Light

The report also provides information on natural gas energy efficiency programs, focusing on ways that these programs can support utility goals for expanding gas service to multifamily buildings.

From these case studies, and other input provided by the project steering committee, the report identified a number of best-practice features that give utility programs the needed elements for success. These include:

- **Staffing.** To be able to reach multifamily markets effectively, initial indications are that a utility should maintain a team of people with a mix of sales, technical, and management skills to support outreach, engagement, technical assistance, and project management support. A competent and responsive team is key to getting access to a deep engagement with developers, design teams, and contractors to help shape energy technology choices.

- **Codes and standards.** Companies should consider assigning a staff person to work with state and local code officials and processes if they do not already have one assigned, both to influence code provisions at the adoption phase, and to obtain favorable interpretations for specific projects or applications.
- **Technical resources.** Utilities should consider developing libraries of key data, including construction cost and operating cost data for gas vs. other energy technologies, documentation of case studies of successful gas installations, contact information for contractors, equipment distributors, and other trade allies, so that marketing staff have concrete information at their fingertips.
- **Incentives.** In some states, regulatory action has enabled gas utilities to offer gas service installation incentives subject to approved economic tests. This can create a powerful tool to support marketing and influence individual project decisions.

Other solution areas include federal, state, and local policy initiatives, and nonprofit technical and professional society activities. While too many and diverse to detail in this executive summary, there are many arenas in which gas industry engagement can support expanded natural gas service to multifamily markets.

# INTRODUCTION

This report summarizes the results of an American Gas Foundation project to identify the barriers, benefits and solutions associated with expanding natural gas service in America's multifamily markets. The project stems from a combination of factors:

- The growing importance of multifamily housing in many markets around the country;
- Continuing challenges faced by natural gas utilities in seeking to expand service to new and existing multifamily buildings;
- The technical, economic, and environmental benefits derived from utilizing natural gas service in multifamily buildings; and
- Recent innovations in technology, program design, and marketing that have enabled some gas utilities to gain market share in their multifamily markets.

## Organization of the report

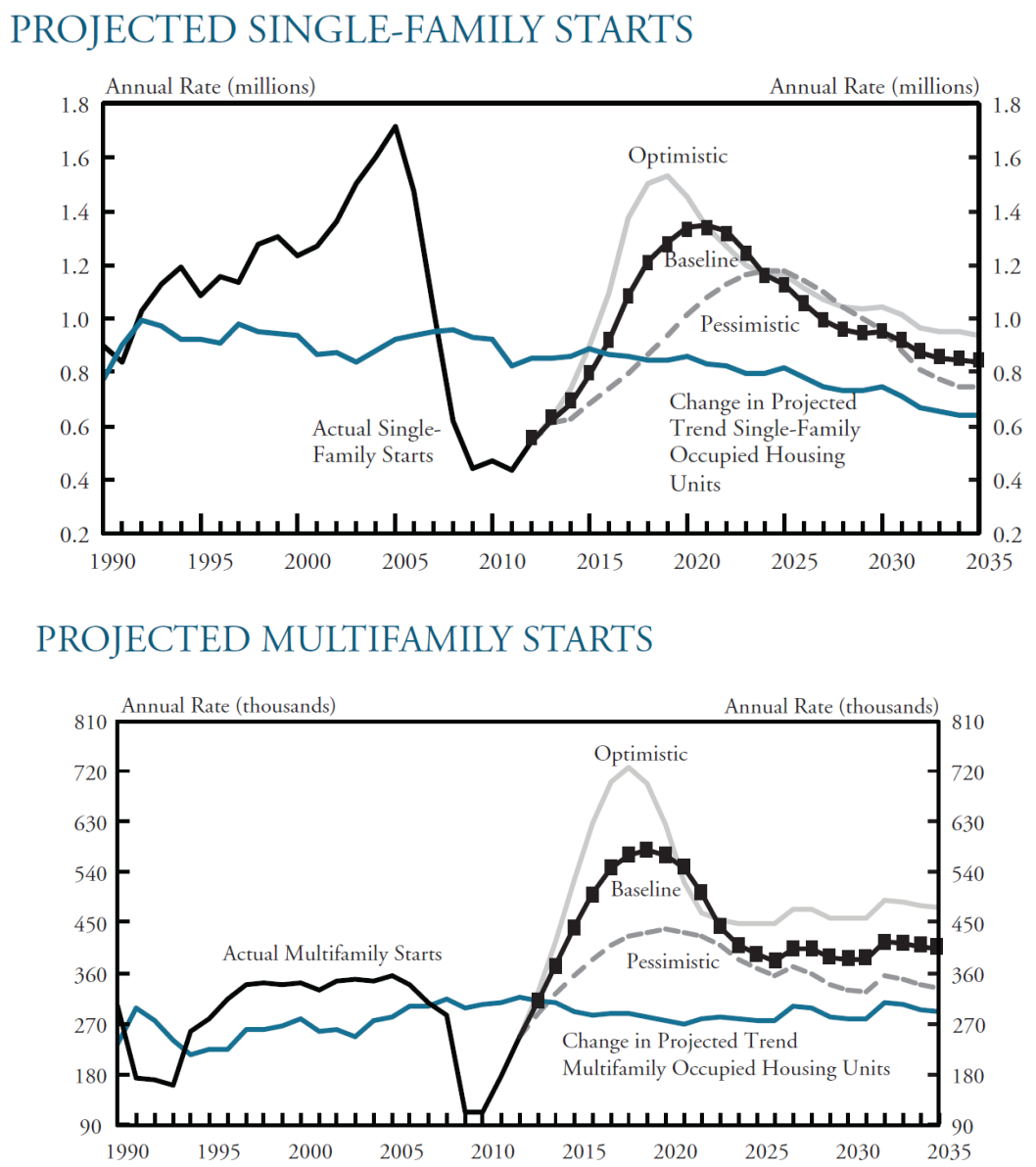
This report is organized in three main sections:

- **Barriers:** assessing the nature, impact, and potential solution strategies to key technical, economic, physical, market, regulatory and other barriers to expanding natural gas service in multifamily buildings.
- **Benefits:** quantifying the energy, environmental, economic and other benefits of natural gas service, at the technology, building, and national levels.
- **Solutions:** defining and illustrating the policy, program, and other solutions that gas utilities and their allies can use to reduce barriers and promote benefits to expand natural gas service in multifamily markets.

## The growing importance of multifamily housing

Multifamily construction has grown rapidly in market share, especially since the housing slump that began in the 2008 timeframe, and is projected to sustain a sharply high share of new housing construction over the next 20 years. Exhibit 1 illustrates historical trends and future projections for single-family and multifamily housing. These charts show that for the two decades prior to 2010, multifamily housing accounted for less than 25% of new residential construction. Since 2008, multifamily construction has accounted for about one-third of new construction, and the forecasted levels project this market share to continue for the next two decades. These figures will vary greatly from market to market: for example, more heavily urbanized service areas with higher densities are likely to see higher multifamily market shares. In any case, multifamily housing appears likely to be a much larger force in America's housing markets for years to come.

**Exhibit 1: Historical and Projected Single-Family and Multifamily Construction**




Source: *The Demographic Shift from Single-Family to Multifamily Housing*. Jordan Rappaport, Senior Economist, Federal Reserve Bank of Kansas City. www.kansascityfed.org.

## Key segments of the multifamily market

Because the multifamily marketplace is diverse and complex, there is no "one size fits all" approach to expanding natural gas service that works in all parts of the market. To help break down the complexity and diversity, this section provides basic market segmentation information. While not exhaustive in nature, it draws out some of the dimensions that determine key market segments, which helps focus strategies to reach the most promising segments. This section addresses five dimensions, as shown in the table below, as those most relevant to defining key

segments. While clearly a limited segmentation approach, it captures the principal segments of interest to most natural gas utilities.

| Market Segmentation Map | | |
|---|---|---|
| **Ownership** | Rented | Owned |
| **Income** | Affordable | Market Rate |
| **Building cycle** | New construction | Retrofit |
| **Construction type** | High-rise | Low-rise |
| **Demographics** | Baby Boomers | Millennials |

This table format is used in the case studies that appear later in this report, with the relevant segment choices highlighted as appropriate to each individual case study.

**Rented vs. owned**. Rental apartment segments present different challenges and opportunities than do owner-occupied segment such as condominiums. In rental markets, the "split-incentive barrier" that causes building owners to focus primarily on initial capital costs rather than tenant energy bills is more pronounced than in owner-occupied markets; in the latter, prospective owners are more likely to consider long-term operating costs, and can be more amenable to retrofit improvements that reduce energy costs. In rental housing, tenancy is generally short, and tenants may not focus as much on energy costs as a major issue.

Rental units account for the great majority of American multifamily dwelling units; Exhibit 2 shows that in 2011, multifamily units were 87% renter-occupied, a mirror image of the 87% of single-family units that are owner-occupied. Moreover, rentals are growing in market share, especially in the last decade when the financial crisis drove major changes in mortgage lending that have forced millions of households out of homeownership via foreclosure, and have also made qualifying for home-purchase loans more difficult. In Exhibit 3, data from Harvard's Joint Center for Housing Studies estimates that rental markets have grown by about 1 million per year in this decade, and are projected to grow by 4-4.7 million by 2023.

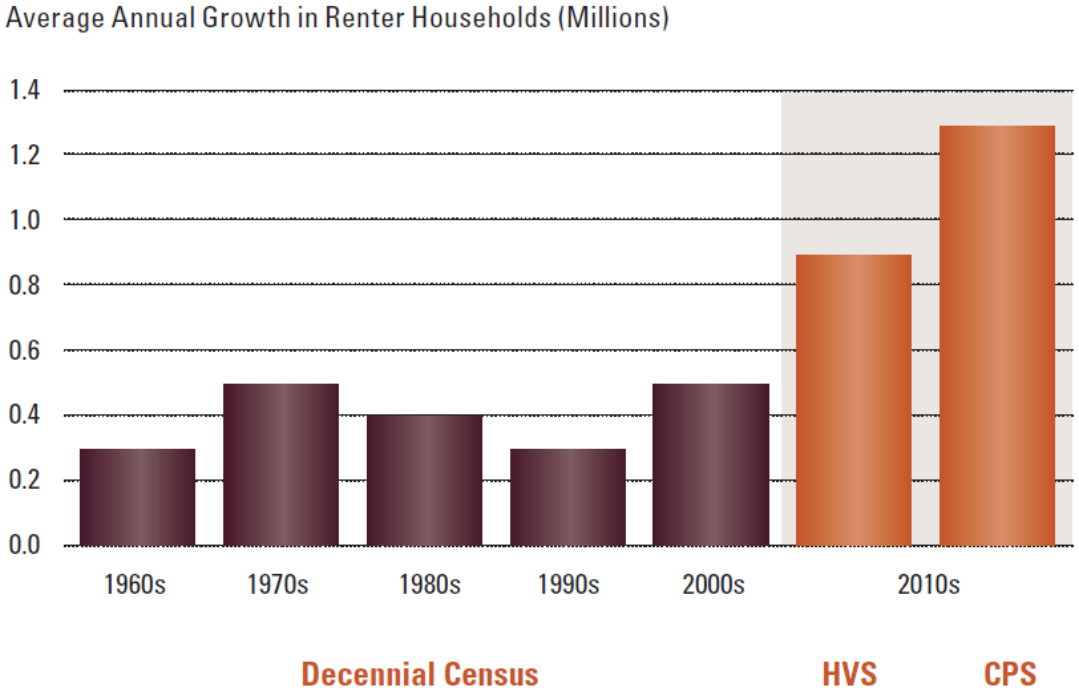
**Exhibit 2. Owner- vs. Renter-Occupied Housing Units**

| Type of Housing Units | Owner-Occupied & Renter-Occupied | | | | |
|---|---|---|---|---|---|
| | **Total** | **Owner-occupied** | **Renter-occupied** | **% Owner-occupied** | **% Renter-occupied** |
| **Total Housing Stock** | **114,908,000** | **76,092,000** | **38,815,000** | **66%** | **34%** |
| **Single-family** | **80,505,000** | **66,752,000** | **13,753,000** | **83%** | **17%** |
| Single-family – detached | 73,761,000 | 62,662,000 | 11,099,000 | 85% | 15% |
| Single-family – attached | 6,744,000 | 4,090,000 | 2,654,000 | 61% | 39% |
| **Multi-family** | **27,213,000** | **3,662,000** | **23,550,000** | **13%** | **87%** |
| 2 to 4 units | 8,956,000 | 1,419,000 | 7,537,000 | 16% | 84% |
| 5 to 9 units | 5,410,000 | 583,000 | 4,827,000 | 11% | 89% |
| 10 to 19 units | 5,032,000 | 518,000 | 4,514,000 | 10% | 90% |
| 20 to 49 units | 3,665,000 | 408,000 | 3,257,000 | 11% | 89% |
| 50 or more units | 4,150,000 | 734,000 | 3,415,000 | 18% | 82% |

| | | | | | |
|---|---|---|---|---|---|
| Manufactured/mobile home or trailer | 7,190,000 | 5,678,000 | 1,512,000 | **79%** | **21%** |

Source: ICF tabulation of 2011 American Housing Survey

**Exhibit 3. Joint Center for Housing Studies Estimates of Rental Market Growth**




Note: Renter growth in 2013 in the HVS was calculated by averaging the number of renters in the first and second quarters of the year and subtracting the average number of renters in the first and second quarters of 2012.

Source: JCHS tabulations of US Census Bureau, Decennial Censuses, Current Population Surveys (CPS), and Housing Vacancy Surveys (HVS).

This data suggests that rental markets are and will continue to be the largest and fastest-growing segment of the multifamily market.

**Affordable vs. market-rate**. Affordable housing is defined for the purposes of this study to mean buildings, dwelling units, or occupants that receive financial assistance from federal, state, or local housing programs. Determining the percentage of multifamily housing units occupied by participants in all forms of housing assistance programs is challenging, as comprehensive data is not available to address all facets of this question.

Available data (2003 vintage) summarized in Exhibits 4 and 5 illustrate selected aspects of this question. Exhibit 4 illustrates the distribution of HUD-assisted tenants by housing type; it shows that while multifamily units account for only one-quarter of total U.S. housing units, they account for more than two-thirds of HUD-assisted tenanted units. Note that this data does not include other housing assistance programs administered at the state or local levels, including the Low Income Housing Tax Credit program described below.

**Exhibit 4. Distribution of HUD-Assisted Renters in Multifamily vs. Single-Family Units**

| Type of Housing Units - Occupied Units | HUD-Assisted Renters | | | All Income-Eligible Renters |
|---|---|---|---|---|
| | Tenants in Public Housing (%) | Voucher Recipients (%) | Tenants in Privately-Owned Housing (%) | |
| **Total Housing Stock** | **100%** | **100%** | **100%** | **100.0%** |
| **Single-family** | **12%** | **34%** | **28%** | **28%** |
| Single-family - detached | 4% | 26% | 20% | 20% |
| Single-family - attached | 8% | 8% | 7% | 7% |
| **Multi-family** | **88%** | **66%** | **72%** | **72%** |
| 2 to 4 units | 23% | 24% | 22% | 22% |
| 5 to 9 units | 13% | 15% | 15% | 15% |
| 10 to 49 units | 19% | 19% | 20% | 20% |
| 50 or more units | 33% | 7% | 11% | 11% |

Source: *Characteristics of HUD-Assisted Renters and Their Units in 2003*

Exhibit 5 shows the absolute numbers of HUD housing assistance recipients, and illustrates the gap between households eligible for housing assistance and those receiving it. It shows that HUD-assisted units in 2003 accounted for only about 13% of total renter households nationwide. Of the 34 million U.S. households that rented in 2003, about half were income-eligible for federal housing assistance. However, only about 4 million households, about 25% of those eligible, actually received federal assistance through HUD programs, leaving over 12 million households eligible but not served by federal programs. Data trends indicate that this gap has been widening.

**Exhibit 5. Housing Assistance Eligibility and Recipients**

| Renter Eligibility for Housing Assistance and Recipients by Type | | |
|---|---|---|
| **Total Renter Households** | **33,604,000** | **100%** |
| **Income Eligible Households** | **16,577,000** | **49%** |
| All Assisted Renter Households | 4,280,000 | 13% |
| Tenants in Public Housing | 1,064,000 | 3% |
| Voucher Recipients | 1,800,000 | 5% |
| Tenants in Privately Own Housing | 1,385,000 | 4% |
| Eligible Unassigned Renter Households | 12,297,000 | 37% |
| Worst Case Needs Households | 5,116,000 | 15% |
| **Other Rented Households** | **17,027,000** | **51%** |

Source: ICF tabulation of *Characteristics of HUD-Assisted Renters and Their Units in 2003*

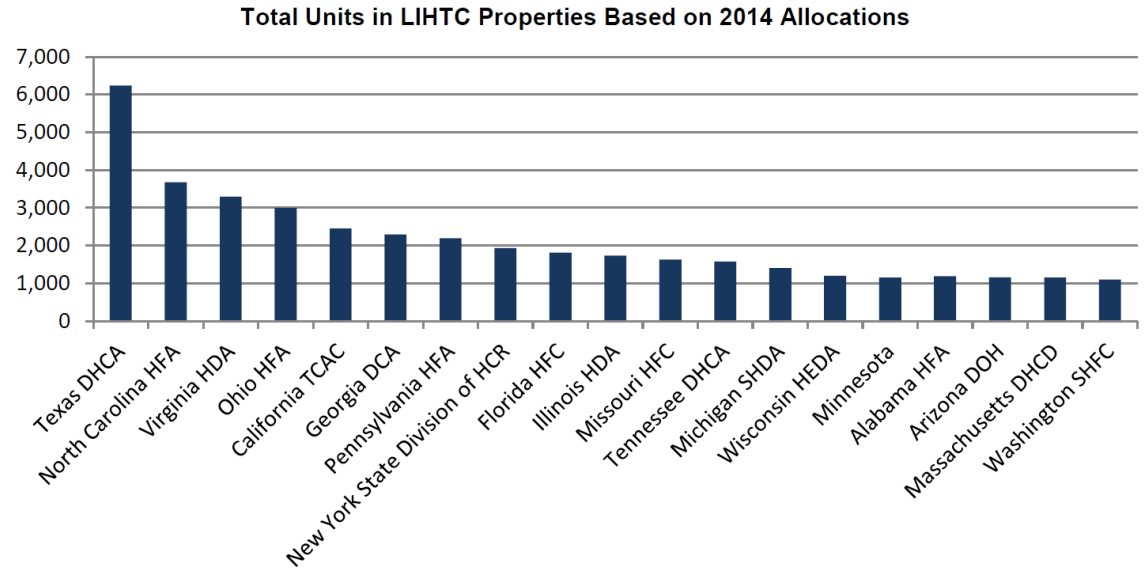
The Low-Income Housing Tax Credit (LIHTC) has emerged in the last three decades as an important resource for creating affordable housing in the United States. According to HUD's LIHTC database, more than 43,000 projects and 2.78 million housing units were placed in service between 1987 and 2014 using the LIHTC incentive. Created by the Tax Reform Act of 1986, the LIHTC program gives state and local LIHTC-allocating agencies the equivalent of nearly $8 billion in annual budget authority to issue tax credits for the acquisition, rehabilitation, or new construction of rental housing targeted to lower-income households. A list of these agencies and contact information can be found at http://lihtc.huduser.gov/agency_list.htm.

The LIHTC program is administered by the Internal Revenue Service; states have a fixed number of LIHTC credits to allocate annually. For 2014, the amount used to determine each state's LIHTC ceiling was the greater of $2.30 multiplied by the state population or a minimum of $2.68 million. The LIHTC creates potentially attractive income tax credits to investors; the structuring of such projects, however, is complex, and can vary greatly depending on state administration rules and other factors.

Exhibits 6 and 7 summarize selected LIHC data. Exhibit 6 shows LIHC data for the 19 states that created 1,000 or more housing units using the LIHC in 2014. States vary in their rules for LIHTC administration, their overall level of engagement in affordable housing, and in other housing programs that may be combined with the LIHTC; this helps explain the somewhat irregular pattern shown in Exhibit 6, where LIHTC "production" is not directly proportional to population, as the IRS formula might suggest.

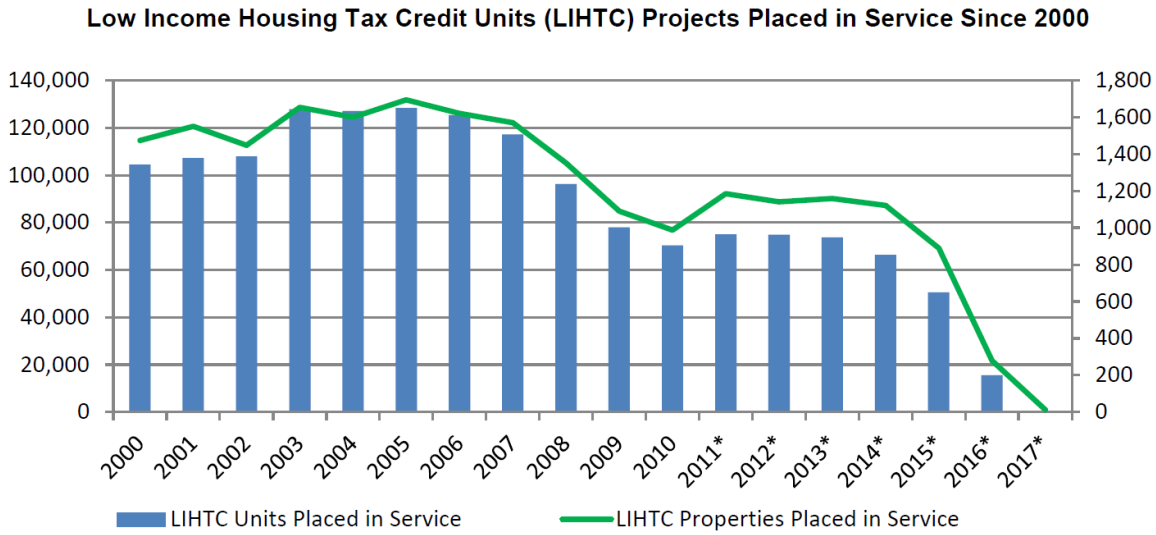
Exhibit 7 shows the trend in units placed in service through the LIHTC credit program since 2000. Total units placed in service annually have fallen since their peak in the last decade, along with overall housing development levels. The projected data trend is misleadingly negative; Fannie Mae and other analysts expect recent LIHTC units to continue at the recent 80,000-unit annual pace for the near future. With the overall growth in multifamily construction, however, LIHTC units may account for a smaller overall segment of the market that existed prior to the financial crisis. The data indicate that LIHTC units accounting for about a third of multifamily units created in the last decade; but in this decade, it appears that LIHTC units may account for about one-fifth of new multifamily units.

**Exhibit 6. Fannie Mae 2014 Estimates of Tax Credit-Supported Housing Units**




Source: Fannie Mae *Multifamily Market Commentary*. March 2015.

**Exhibit 7. Fannie Mae Trend Analysis of LIHTC Housing**




Source: Fannie Mae *Multifamily Market Commentary*. March 2015.
*Projected data

**Existing buildings vs. new construction**. While the existing stock represents the vast majority of the addressable market in a given year, new construction offers unique opportunities that can merit added focus. Market data shown above indicates that while multifamily construction may add some 400,000 units annually to the stock in the coming years, compared to the existing stock (approaching 30 million units) new construction adds only a little over 1% to the stock in a typical year.

However, new construction may also represent a key "lost opportunity" market, in that gas service is almost always more feasible and less expensive to incorporate at the design and construction stage than to add as a retrofit measure later in the building life cycle. Also, given the split-incentive barrier discussed later in this report, which focuses developer/designer/builder attention on minimizing the capital cost of construction, it is especially important to focus on the design and construction phase to make the case for gas service. Depending on the regulatory context and the technical and financial resources available to gas utilities, new construction markets may offer a unique and compelling opportunity to extend gas service more widely in multifamily markets.

Gas service can also be extended, retained, or expanded in retrofit situations, such as properties undergoing sale, refinancing, or renovation. At these points, owners/developers/designers may be willing to take a broader look at capital and operating costs; the operating cost advantages of natural gas, elaborated later in this report, can often be promoted effectively in such situations. This report documents case studies of successful gas distribution utility engagement in both retrofit and new construction markets.

**High-rise vs. low-rise construction**. While building codes and market practices differ from market to market on what is considered high-rise construction, the breakpoint generally tends to come at around four stories. At or above that height level, construction typically shifts from wood framing to concrete-and-steel construction, which can create additional barriers to natural gas service, especially in retrofit situations. With wood framing, it is typically easier to place service piping, venting, and other gas infrastructure, as wall and floor penetrations, construction or expansion of chases, and other construction details can be addressed more flexibly. Also, low-rise wood-frame construction often accommodates utility services at the building periphery or unit-by-unit, which can facilitate gas service with lower costs for pipe runs and related infrastructure.

With high-rise concrete and steel framing, physical barriers and related limits can constrict the options for gas service. For example, in typical high-rise core-and-shell construction, utility service risers tend to be clustered in the building's service core, along with elevators. This means that gas service piping and other gas infrastructure may need to be run from the core out to the periphery of the building for each dwelling unit, adding to construction costs. In some markets, glass curtain wall has become the norm for exterior walls; this can severely limit options for gas venting as well as placing of gas equipment. In earlier designs, dwelling units would often come with utility closets located at or near the exterior wall, sometimes integrated with a balcony design; this approach doesn't work in curtain-wall construction, and forces gas service and equipment locations elsewhere in the unit and in the overall building design.

**Demographics**. It can be important to segment multifamily occupants by age, income, ethnicity, and other demographic factors. Different demographic groups value different things in their constellation of needs and preferences, so understanding what drives a given demographic in terms of their preferences and attitudes toward energy services can help identify the most receptive market segments for gas service expansion.

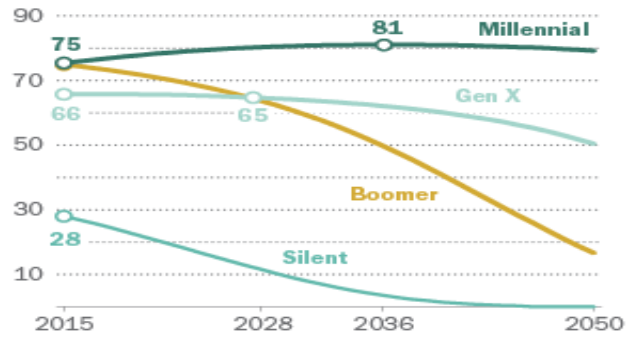
While demographic segmentation can be "sliced" many ways (the Census Bureau's projections identify 42 demographic segments based on gender and age alone), this study isolates two key demographic segments as particularly important: millennials, defined as those 18-34 in 2015, and the Baby Boomer generation, defined as those aged 51-69 in 2015. Millennials have now surpassed Baby Boomers as the nation's largest living generation, according to Census Bureau estimates; Millennials now number 75.4 million, surpassing the 74.9 million Baby Boomers as of 2015.

Exhibit 8 illustrates the demographic shift that is underway; millennials will continue to grow in total number for the next 20 years, and become the dominant generation in somewhat the way Baby Boomers were 20 years ago. Examining this graphic, one might be led to think that Baby Boomers are rapidly becoming irrelevant as a market segment, given the rapid projected decline in absolute numbers. However, a key trend not shown in this graphic is Baby Boomers' shift from single-family to multi-family housing; as the Boomers age and their children leave home, more and more are choosing multifamily living, for downsizing and cost savings purposes. At the other end of the demographic curve, millennials are entering the housing market; many are choosing to rent, be it because of the difficulty of qualifying for mortgages, unwillingness to commit to long-term residency, or other factors. Both demographics are driving the increase in demand for multifamily housing.

**Exhibit 8.**

**Projected population by generation**

*In millions*




Note: Millennials refers to the population ages 18 to 34 as of 2015.
Source: Pew Research Center tabulations of U.S. Census Bureau population projections released December 2014 and 2015 population estimates

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## BARRIERS TO EXPANDING NATURAL GAS SERVICE IN MULTIFAMILY MARKETS

This section categorizes barriers by type under the section headers below. For each barrier, it then examines the definition, scale, and potential solution strategies.

### Technology Barriers

*Technical efficiency limits of gas vs. other fuel technologies*

**Definition.** In recent decades, gas industry R&D efforts produced innovations such as condensing furnaces, gas-engine heat pumps, and advanced thermally-activated cooling technologies. However, electric technologies have also advanced, and in some cases have been able to make further gains based on improved mechanical engineering, materials, and controls. In certain climate zones, electric technology advances have enabled these technologies to show efficiencies superior to those of alternative gas technologies.

Exhibit 9 illustrates some basic comparisons between gas and electric technologies. The examples in these tables are based on a typical multifamily dwelling unit in average U.S. climate conditions.

In the water heating table, it is noteworthy that both electric options show higher efficiency ratings and lower site Btu consumption than the gas options. However, on a source Btu basis, both gas technologies use less energy; and in terms of annual energy costs, both gas options cost less to operate. In the space heating table, the electric heat pumps show lower site Btu usage, but their source Btu usage and annual operating costs are higher than all of the gas options.

**Exhibit 9: Gas-Electric Technology Efficiency and Cost Comparisons**

| Water Heating | Gas | | Electric | | | |
|---|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | NAECA Min. | Heat Pump Water Heater | | |
| Energy Factor | 0.62 | 0.67 | 0.92 | 2.00* | 0.95* | [Increased Space Heating]** |
| Annual input (Therms for gas; kWh for electric) | 151 | 136 | 2,685 | 686 | 748 | 328 |
| Site MMBTU | 15.1 | 13.6 | 9.2 | 6.0 | | |
| Source MMBTU | 16.6 | 15.0 | 28.9 | 19.0 | | |
| Annual Water Heating Required (output in Btu) | 9,385,422 | 9,385,422 | 9,385,422 | 9,385,422 | | |
| Total Annual Water Heating Cost ($) | $191 | $171 | $342 | $224 | | |

*Energy Factor for the heat pump water heaters is 2.00 based on the referenced test procedure, but falls to 0.95 in conditions where electric resistance heat is used as backup. Btu and cost estimates are based on EF 2.00; but they would increase to the extent that electric resistance backup is used.

**When installed in conditioned space, heat pump water heaters increase space heating loads by pumping heat from indoor air into the water tank.

| Space Heating | Gas | | | Electric | |
|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR South | ENERGY STAR North | NAECA Min. | ENERGY STAR ASHP |
| AFUE/HSPF | 80% | 90% | 95% | 7.7 | 8.5 |
| Annual input (Therms for gas; kWh for electric) | 132 | 117 | 111 | 1,583 | 1,399 |
| Site MMBTU | 13.2 | 11.7 | 11.1 | 5.4 | 4.8 |
| Source MMBTU | 14.5 | 12.9 | 12.24 | 17.1 | 15.1 |
| Annual Fuel Cost | $166 | $147 | $140 | $202 | $178 |

**Note:** the calculations behind these tables are based on national-average climate conditions in Climate Zone 4, equivalent to Washington Dulles Airport weather data. In some regions, heating loads may be significantly higher or lower, which would affect the absolute values of the table numbers as well as the relative consumption levels of water heating vs. space heating systems.

Key assumptions in the tables above:

- 1,200 square foot multifamily unit, 2 bedrooms/1 bath
    - Average of all exterior exposure configurations (e.g. top floor end unit, mid floor middle unit, etc.)
- EIA 2015 national average costs of $1.259/Therm and $0.1273/kWh
- Source to site energy ratio of 3.16 for electricity and 1.1 for gas (per U.S. EPA eGRID 2012)
- 2009 IECC Climate Zone 4 only; mid-continent, "average" climate with heating and cooling loads
- For comparison purposes, ENERGY STAR Space Heating analysis does not include savings typically associated with increased SEER
- 40 gallon hot water tank (electric water heaters are typically larger than 40 gallons, and use more energy on an annual basis, making this comparison conservative)

A key related issue in this area is the test procedures and rating methods used to assign efficiencies to such technologies. Typically, such methods use a site-energy basis for calculations; use of source energy as the basis typically flips the differences between gas and electric technologies because source methods account for losses across the electricity system. While the gas industry has made progress in bringing source-energy calculation methods into some policy analyses, the preponderance of core engineering efficiency rating methods used in the marketplace remain site-based. Operating cost has been used as a proxy value for source efficiency in some forums, such as the ASHRAE Standard 90.1 Energy Cost Budget compliance path, and the IECC performance based compliance path.

**Impact**. This barrier can have a strong influence on designer, builder, contractor, and consumer choices in some markets. Site-energy ratings that favor electric technologies, coupled with efficiency gains, can make it hard for gas technologies to compete. Coupled with other barriers, such as the first-cost advantages that can accrue to builders to use electric technologies in a

single-utility-service design approach (see below), efficiency barriers can exert powerful influences on designers, builders, buyers and others in the construction and renovation industries.

**Solution Strategies**. Solutions than can reduce technology barriers include:

- **Technology development.** Gas industry efforts through the Gas Technology Institute (GTI) and the Energy Solutions Center (ESC), the U.S. Department of Energy (DOE), manufacturers, and others could accelerate efforts to commercialize competitive technologies in key end use markets.
- **Rating method advocacy.** Sustained efforts to modify test procedures for key technologies, through ASHRAE, ASTM, DOE and related forums could be productive.
- **Design tools.** Providing architects, engineers, builders, developers and contractors user-friendly, flexible design tools that compare gas and electric technologies across a wider set of variables than nominal site-energy rating methods could give gas technologies a better chance of full consideration in the design/project development process.
- **Incentive and technical assistance programs.** Gas utilities can offer incentives and technical assistance to encourage efficient gas designs in programs that go beyond energy code minimums. It can be especially important to provide sound technical support for installing and maintaining advanced technologies, so that designers, contractors, owners, managers, and operators are knowledgeable and confident in their continued use.

  For any of these potential solutions, outreach, educational and training efforts aimed at key audiences can be important to create the awareness of the issues and the solutions needed to shift market players' thinking and decision-making.

### *Physical constraints on installing gas technologies in some building types or designs*

**Definition.** Physical constraints are less of a technical issue in new construction, in that designs can allow for supply pipe chases, air intake and venting systems, mechanical closets, etc. needed to support gas systems. In retrofit situations, however, such constraints can be significant: finding routes for supply piping, intake/ventilation ducting, space in mechanical closets, and similar issues can be challenging. By contrast, electric technologies such as mini-split or through-the-wall heat pumps can be installed relatively easily in a wide variety of architectural configurations.

Even in new construction, however, physical constraints can create indirect barriers that show up in cost terms. If, for example, gas technologies require added or expanded pipe chases, take away rentable space for intake/venting systems, or require larger mechanical closets, developers may see negative financial implications in loss of rentable space, even when consumers express a preference for gas.

Physical and technical constraints can also come into play in markets where heating loads and cooling loads are significantly mismatched. In warmer climates, for example, heating loads can be so low that it becomes difficult to match the heating and cooling coil sizes in the air handling unit that provides conditioned air to the dwelling unit. And even if the sizing issue can be addressed, this mismatch can reduce the efficiency of the gas technology's performance.

**Impact.** Physical constraints tend to show up as larger barriers in retrofit markets than in new construction.

**Solution strategies.** Physical constraints can be challenging to address, especially in existing buildings with space limitations. Options for overcoming these barriers include:

- **Industry innovation** focused on making gas systems more compact, developing modular retrofit kits, etc. Examples include tankless gas water heaters with the burner also supplying a space heating coil in the HVAC air handling unit; this technology eliminates a second vent, and eliminates electric heating. Such solutions can reduce the size and cost of the building electric service; this effect has been observed by natural gas utilities whose cases studies appear later in this report.
- **Continued advocacy in national codes and standards arenas** such as the National Fuel Gas Code and International Fuel Gas Code to support code changes to recognize new safe fuel gas appliances and systems.
- **Working with voluntary green building programs.** Some voluntary programs have specifications that discourage gas usage, through specifications such as requiring all combustion appliances to use sealed-combustion technology; somewhat analogous to codes advocacy, and working with these programs to enable wide use of gas technologies can help open these growing markets.
- **Training and technical support** for contractors to educate and train them on new ways to build gas systems into existing and new buildings compactly and cost-effectively.
- **Incentive and technical assistance programs.** Gas utilities can offer incentives and technical assistance to encourage efficient gas designs in programs that go beyond energy code minimums.

## Policy Barriers

### *Building codes*

**Definition.** Building codes can shape the ultimate choice of energy type in many ways. Outside the U.S., especially in the developing world, building codes often do not require energy services to be provided as part of building construction, other than basic electric wiring and service connection. Such choices are typically left up to the market, and energy services are often provided after construction. In such cases, piped gas service is rarely installed after construction; since electric service is typically present wherever grid access exists, the default choice is to install electric devices. While this is not typical of U.S. markets, it does illustrate the "single service" bias that can distort energy markets in favor of electricity.

In the U.S., building codes may set specific technical requirements for energy service equipment and systems, but they do not typically require a specific type of energy service to be connected for a building to get an occupancy permit. These policies vary by state and local jurisdictions, but overall the choice of energy service type is typically made through market forces. Details within code documents, however, can affect the competitiveness of gas vs. other fuels. For example:

- Codes using performance-based compliance methods typically refer back to the energy rating and equipment test methods described above. Depending on the end use and technology choices, these methods can cause gas technologies to be rated as nominally less efficient than electric technologies, even if they show superior performance using other rating methods or on the basis of operating costs.

- Specific provisions of building, fuel gas and electrical codes can affect the relative technical feasibility and cost of competitive energy services. For example, today's condensing furnace technologies can be installed with PVC venting systems through sidewalls, which could reduce total installation costs in new construction multi-family buildings. However, in retrofit situations, if the existing non-condensing gas furnace shares a common venting system with a gas, water heater, replacing the furnace with condensing technology, or with a heat pump, can "orphan" the water heater, which typically requires a costly new vent system to be installed for the water heater. Such situations can cause the water heater to be converted to electricity to avoid the venting cost. In addition, sidewall venting constraints for condensing furnaces could also add significant costs and even prevent the installation of condensing furnaces in some homes/buildings.

**IECC Performance Path**

The simulated performance alternative contained in Section 405 of the 2015 IECC uses annual energy cost as the basis for compliance. However, equipment efficiencies in these systems can't be credited for compliance (i.e. the fuel type and efficiency level in the proposed design must be the same as the reference design). This precludes fuel switching for the purposes of showing annual energy cost advantages. So even if, as Exhibit 1 illustrates, gas technologies show lower annual operating costs, those advantages cannot be used against electric technologies in the compliance calculations.

The IECC performance path does offer an exception available that permits source energy to be substituted for annual energy cost. A site-to-source ratio of 3.16 for electricity and 1.1 for all other energy sources is used. No direct comparison/compliance path is available for using site energy consumption alone. However, as explained above, fuel switching or efficiency improvements cannot be used as compliance options. In summary, the IECC performance path does not allow natural gas operating cost advantages to be applied in a code compliance context.

Beyond what's contained in official code documents at the national or state levels, local building officials typically retain the power to interpret codes as their professional judgment and traditional practice indicate. For example, code officials may require gas stove shutoff valves to be directly accessible, increasing the installation cost of such appliances.

**Impact.** Building codes rarely by themselves force shifts in market behavior, and thus typically have less of an impact than other policies or market forces, but because model codes and underlying rating methods can be modified through industry advocacy, codes can be productive area of focus.

**Solution strategies.** Codes can be shaped through stakeholder intervention, at the national level through code development processes managed by the International Code Council and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and through technical committees and related processes run by the American Society for Testing and Materials (ASTM), the Residential Energy Services Network (RESNET), and other American National Standards Institute (ANSI)-compliant organizations. And because code interpretations are typically a local matter, working closely with local code officials to ensure that interpretations do not hamper gas technology applications can also be important.

Another option is to use codes as baselines for voluntary incentive and technical assistance programs. ENERGY STAR, green building, and other above-code programs can be engaged in partnerships with local distribution companies to promote efficient gas technologies. This reinforces the need for effective engagement in the field in local markets with a tailored mix of outreach, education, and technical assistance.

Because voluntary programs can exert strong influence on building practices and fuel choices in some markets, working with such program sponsors to ensure that their specifications and practices provide for fair treatment of gas technologies can help level the playing field in such markets. For example, New Jersey Natural Gas works closely with the U.S. Department of Energy on the use of DOE's Home Energy Score software on such issues.

### *Utility metering and ratemaking policies*

**Definition.** State law and utility commission regulations can determine the type and level of utility service metering in multifamily buildings. Some states have effectively banned master metering in new multifamily building construction, such that each tenant unit has its own utility service meter and account. Others have moved to require or encourage sub-metering of tenant units; such sub-meters may not involve individual utility accounts, but they do provide for individual tenant unit billing. More detail on state policy actions on utility metering can be found in Appendix A.

In some states, utility commissions have permitted electric rate structures that promote the use of electric heat and/or all-electric buildings. Such tariffs typically discount rates during the heating season, or provide year-round rate discounts for all-electric buildings. Coupled with other rate design elements such as declining-block rates, these tariffs tend to promote electricity usage at the expense of natural gas. Such tariffs tend to be more prevalent in warmer-climate states, where gas heating's advantages are less prominent, electric cooling is more ubiquitous, making the all-electric case easier.

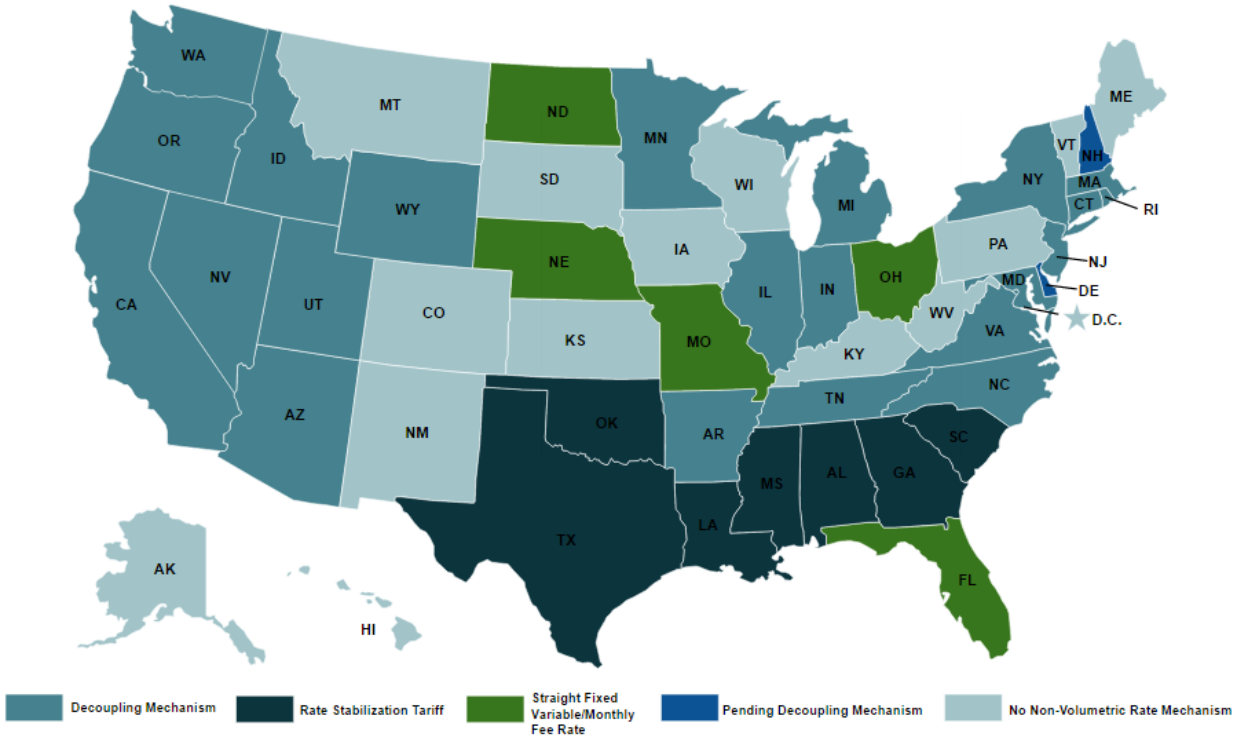
**Impact.** Several studies indicate that the direct feedback effect of individual tenant utility billing can have significant impacts on energy usage.[2] Because individual tenant metering has been shown to encourage energy-efficient behaviors, states and localities are encouraging individual metering in various ways. The effect on the gas industry is indirect, but can be powerful; when master metering is permitted, centralized, efficient gas technologies for space and water heating can be a cost competitive option in some multifamily markets. But the technical feasibility and cost of sub-metering energy services from such central systems to individual tenant units can disadvantage this option.

Individual metering can be a benefit to gas utilities operating under revenue-stability ratemaking practices (non-volumetric rates), where the policy structure is designed to keep revenues stable on a per-customer basis. These policies include decoupling, straight-fixed variable rate designs and rate stabilization plans. In such markets, adding customer meter accounts can support total revenue and earnings growth. In states without such non-volumetric ratemaking practices,

[2] Executive Office of the President. 2011. *Sub-metering of Building Energy and Water Usage: Analysis And Recommendations of the Subcommittee On Buildings Technology Research And Development*. https://www.whitehouse.gov/sites/default/files/microsites/ostp/submetering_of_building_energy_and_water_usage.pdf

however, individual metering may not provide the same financial benefit. Exhibit 10 maps state non-volumetric ratemaking policies.

**Exhibit 10: State Non-Volumetric Ratemaking Policies**

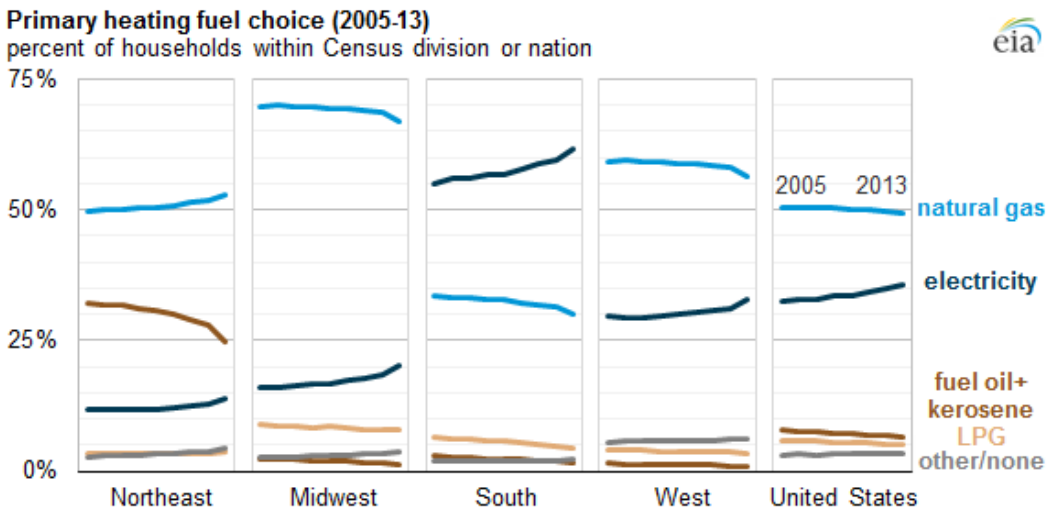



Source: American Gas Association

Apart from ratemaking practices, individual metering tends to focus design strategies on compact, low-cost energy service technologies. On the electric side, resistance heating, packaged terminal air conditioning (PTAC) and similar through-the-wall heat pumps, and unvented electric water heaters can become very attractive to developers, especially when unit costs are multiplied by large numbers of dwelling units. By contrast, installing gas piping, venting, and related system elements along with electricity service into each unit can create significant first cost premiums, regardless of occupant preferences or lifecycle performance or cost. As a result, developers and design teams frequently choose the lowest-first-cost path, with the result of making the building all-electric.

On the ratemaking side, in warmer-climate states promotional electric rate structures have helped build dominant market shares for electric heat and all-electric buildings in some markets. Once these buildings are constructed, retrofit strategies for bringing gas service into such buildings are very challenging. Exhibit 11 illustrates recent regional trends in gas vs. electric heating fuel choices.

**Exhibit 11**




**Source:** U.S. Energy Information Administration, based on Census Bureau American Community Survey

**Solution strategies.** Addressing this barrier directly is challenging, in that states and localities are unlikely to amend individual-unit metering policies without overwhelming evidence of the benefits and broad support from stakeholders. Major stakeholders, notably building owners and managers, are typically content to allow responsibilities for energy issues to fall to occupants, including billing and payment, and depending on unit ownership structures, equipment maintenance.

Strategies that the gas industry could use to address this barrier could include:

- **Articulating and documenting the resiliency and reliability** dimensions of dual utility service. Gas-supplied buildings can remain more habitable under electricity service outage conditions; depending on specific equipment and system configurations, gas can keep heating, water heating, and cooking services available during outage conditions, which can have life safety benefits under severe weather conditions.
- **Articulating and documenting the benefits of metering policies** for gas service. Both master-metering and individual-metering strategies can benefit customers and utilities, depending on the regulatory context and the specific needs of building designers and owners. These strategies could lead some jurisdictions to amend or interpret their regulations to better support customer and utility goals.
- **Working with utility commissions and intervener groups** to support ratemaking policy changes that help level the playing field between electric and gas retail rates.

### *Environmental and energy policies*

**Definition.** While natural gas can be advantaged in some policies, such as the Clean Power Plan, those advantages tend to apply more in power generation markets than in end use markets. Other policies tend to push markets away from gas; for example, policies aimed at zero energy buildings tend to favor all-electric building energy systems. One of the overarching themes

evolving in the climate policy arena is that, despite natural gas' advantages over other fossil fuels, the goal is to drive the carbon intensity of the power sector to minimal levels via renewable energy and storage technologies, and to shift end uses to efficient electric technologies.

**Impact.** Impacts of these policies can be hard to measure directly, but at the same time can exert major influence on gas end use markets over time. If the overarching message is that gas and other fossil fuels must be phased out to reach climate policy goals that places a blanket of downward pressure on gas usage.

**Solution strategies.** Options for overcoming environmental policy biases towards natural gas include:

- **Educating stakeholders** on the value of gas in zero-energy building solutions. This can help counter the notion that to get to carbon neutrality, all fossil energy use must be eliminated. The Department of Energy's recently-released definition of Net Zero-Energy buildings uses this language: *An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.*[3] The use of the source energy term in DOE's definition can help gas compete for inclusion in zero-energy designs, to the extent that natural gas end-use technologies can be shown to be more cost effective in achieving zero-energy building status.
- **Articulating the resiliency benefits of gas service.** Gas service can also be linked to the emerging resiliency theme that comes up in utility planning, climate policy, and similar arenas. To the extent that gas technologies can continue to operate during electricity grid outages, with the understanding that many technologies depend on electricity for the system to function, gas service can be sold on that basis. For example, natural gas CHP systems, gas cooking appliances and, conventional water heating equipment, and CHP technologies can operate during grid outages.
- **Articulating and documenting the GHG emissions benefits** of converting end uses to gas. Most policymakers, and especially utility commissions, have shied away from directly advocating one fuel over another; commission approvals of promotional electric rates in warmer states have typically been justified on marginal cost of service basis. There is, however, a climate policy argument to be made for substituting natural gas for electricity in certain end uses; in some power markets, adding a million Btu of gas usage in high-efficiency furnace load can back out two to three million Btu of fossil fuel at the generation level, with a marked net decrease in total GHG emissions. Additionally, efforts are underway to reduce the carbon content of natural gas and related gas products, including
    - **Renewable Natural Gas**, which produces methane from renewable sources such as municipal landfills or agricultural wastes;
    - **Power to Gas technologies**, which use electricity to separate hydrogen and oxygen from water via electrolysis and then formulate gas products; and

[3] National Institute of Building Sciences. 2015. *A Common Definition of Zero Energy Buildings*. Prepared for the U.S. Department of Energy.
http://energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf

- **Combined Cycle Sequestration and Utilization technologies (CCS&U)**, which create gas products through chemical processing of high-carbon fuels such as coal, separate out and sequester the $CO_2$, and utilize the gas products for power generation.

## Economic Barriers

### *Market-based issues*

**Definition.** The fundamentals of current multifamily markets often favor single-fuel, all-electric designs. It is fundamentally cheaper to install one utility service instead of two; for builders focused on low first costs, which is predominantly the case given the market structure barriers described below, this fundamental is hard to counter. In the U.S. today, electric utility service is a given in new multifamily construction; this makes it an uphill fight for gas to be included in building designs. This barrier tends to be more significant in lower-end markets, but can appear in almost any new construction market.

Given the technical and materials issues associated with installing gas service, including piping, joints, valves, the larger relative size requirements for gas vs. electric chases/conduits, gas service typically costs more than electric service, depending on the specifics of the service design. This is generally true in new construction; in retrofit situations, this effect can be heightened, in that utility service closets, chases, and other features could require significant modification to add gas service to the building.

Aside from the issues associated with extending utility services into the building to individual units, the relative cost of natural gas end-use equipment and systems versus those using other energy types can create additional barriers. An all-electric building using PTACs/through-the-wall heat pumps and apartment size resistance water heaters can be built relatively cheaply, with little impact of rentable space. Gas systems, however, can require added closet space, plus space for air intake and exhaust ducting, plus air distribution ducts; these elements add direct cost, and also take away rentable space.

**Impact.** These barriers directly contribute to the loss of market share that natural gas has experienced in most markets in recent years, as described above.

**Solution strategies.** Gas service retains core values in many market segments: affordable, clean, and comfortable. Consumers continue to prefer gas in key end uses like heating and cooking, and with recent declines in natural gas market prices, the perception of affordability is enhanced. The gas industry can leverage these core values to help level the playing field in key markets by:

- **Working with manufacturers, contractors, and local distribution companies** to innovate in making gas service and end-use technologies more cost-effective to install;
- **Developing education and marketing campaigns** for the designer and builder communities to help reinforce the core values of gas service, point out recent gas technology advances, and connect these communities with experts and resources to support gas design strategies. Along similar lines, developing "market pull" initiatives to build demand for gas service among renter/buyer customer segments can help increase market awareness and market share.

- **Developing design tools and related resources** for local-market outreach, education, and technical assistance efforts to help multifamily design professionals understand the benefits and technologies associated with gas service.

## Market Structure Barriers

### *The split-incentive/principal-agent barrier*

**Definition.** In classical economics, the principal-agent problem occurs when the "agent" (in this case, a builder or landlord) fails to act in the long-term interest of the "principal" (in this case, a tenant or other occupant who pays the energy bills). Often referred to as the split-incentive barrier, in that the builder/landlord's interest is typically to minimize capital costs in the near term, and the occupant's incentive is to minimize energy bills, this barrier can significantly affect wide swaths of residential energy end-use markets.[4]

In subsidized housing markets, public agency involvement can introduce an additional "split" into this kind of barrier. For example, when HUD subsidizes rental payments and utility costs, this can create additional challenges in aligning the interests of the agency, the owner, and the tenant. While some progress has been made through HUD in partnership with local housing organizations, the challenge generally remains to be addressed.

A related version of this barrier can occur in large organizations, as structural issues between departments such as facility management, procurement, and finance. Since much of the multifamily building stock, especially buildings of 50+ units, in the U.S. is owned and/or managed by such large organizations, such barriers can apply as well.

**Impact.** The IEA study cited above found that principal-agent barriers affect some 30% of total U.S. residential energy use. That estimate included both single-family and multifamily markets; it is arguable that considered separately, the multifamily market could be even more extensively affected.

To the extent that natural gas solutions entail higher initial capital costs, even if their lifecycle costs and monthly net costs are lower, gas service can be subject to this kind of barrier in similar proportions.

**Solution strategies.** Overcoming the split-incentive barrier can involve such strategies as:

- **Educating and providing technical assistance** to designers, developers, builders and contractors on the benefits of natural gas service and end-use technologies.
- **Offering incentives for efficient gas designs.** These can take the form of design assistance payments, cash incentives for specific technologies, or both.
- **Supporting energy rating and disclosure policies** that convey the benefits of natural gas to consumers, creating added market demand for gas service in multifamily markets.

[4] International Energy Agency. 2007. *Mind the Gap: Quantifying Principal-Agent Problems in Energy Efficiency.* https://www.iea.org/publications/freepublications/publication/mind_the_gap.pdf

- **Advocating metering policies and technology solutions.** These can vary dramatically depending on the state regulatory climate and the utility's business goals. In many states, master-metering is not allowed in new construction, and conversion to individual-unit metering is a public policy goal for regulators as well as a business goal for utilities.

### *Information Barriers*

**Definition.** This barrier type, which tends to overlay the more specific barriers defined above, includes the lack of awareness and technical knowledge in key audiences such as building operators, tenants, developers, and policymakers that keeps the benefits of natural gas service from being recognized and realized. For example: developers may not be fully aware of the consumer demand for gas service; designers may not have access to concrete data on the performance and other benefits of gas end-use technologies; and local gas distribution company staff may not have the tools and resources they need to educate key audiences.

**Impact.** Information barriers are as pervasive as the multifamily building market is vast. There are more than 27 million multifamily buildings in the U.S., with hundreds of thousands more built each year. While there are no well-defined metrics for information barriers, it is safe to say that they affect the gas industry's ability to reach most of the U.S. multifamily market.

**Solution strategies.** Information barriers have concrete solutions, even though deploying information strategies is challenging in such large and complex markets, and in an information-overload culture. Solutions include:

- **Developing informational materials.** This is an element of many solution sets to multiple barriers; the gas industry needs credible, useful information packaged in materials that each audience can use. Given the solid base of information already available through gas industry efforts, an assessment and gap analysis could be helpful in targeting incremental efforts.
- **Launching information campaigns.** As with any set of informational materials, the key is to deliver useful information into the right hands at the right time. The gas industry can target key audiences, both at the national level and in local markets.

# DOCUMENTING THE BENEFITS OF EXPANDED NATURAL GAS SERVICE

This section summarizes the major energy, environmental, economic, and other benefits that gas technologies offer in the multifamily building sector. It includes estimates of benefits at the individual technology level as well as at the national level. In addition to provide calculated estimates of benefits from gas technologies in comparison with electric technologies in cases where they have been documented, it provides case studies of gas technology applications in specific multifamily buildings.

## Reduced source energy consumption and energy bills

Where gas end-use technology is more efficient on a total full-fuel-cycle (FFC) basis, natural gas-fueled systems would reduce total national energy consumption. Exhibit 12 illustrates the impacts of gas water heating and space heating technologies on source energy consumption on a unit basis, using typical energy performance and utility cost data for representative technologies. It shows that natural gas space heating and hot water technologies can typically outperform electric technologies on both source-Btu and annual energy cost bases.

**Exhibit 12: Per-Unit Benefits of Gas vs. Electric Space Heating and Water Heating Technologies**

| Water Heating | Gas | | Electric | | | |
|---|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | NAECA Min. | Heat Pump Water Heater | | |
| Energy Factor | 0.62 | 0.67 | 0.92 | 2.00* | 0.95* | [Increased Space Heating]** |
| Annual input (Therms for gas; kWh for electric) | 151 | 136 | 2,685 | 686 | 748 | 328 |
| Site MMBTU | 15.1 | 13.6 | 9.2 | 6.0 | | |
| Source MMBTU | 16.6 | 15.0 | 28.9 | 19.0 | | |
| Annual Water Heating Required (output in Btu) | 9,385,422 | 9,385,422 | 9,385,422 | 9,385,422 | | |
| Total Annual Water Heating Cost ($) | $191 | $171 | $342 | $224 | | |

*Energy Factor for the heat pump water heaters is 2.00 based on the referenced test procedure, but falls to 0.95 in conditions where electric resistance heat is used as backup. Btu and cost estimates are based on EF 2.00; but they would increase to the extent that electric resistance backup is used.

**When installed in conditioned space, heat pump water heaters increase space heating loads by pumping heat from indoor air into the water tank.

| Space Heating | Gas | | | Electric | |
|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR South | ENERGY STAR North | NAECA Min. | ENERGY STAR ASHP |
| AFUE/HSPF | 80% | 90% | 95% | 7.7 | 8.5 |
| Annual input (Therms for gas; kWh for electric) | 132 | 117 | 111 | 1,583 | 1,399 |

| | | | | | |
|---|---|---|---|---|---|
| Site MMBTU | 13.2 | 11.7 | 11.1 | 5.4 | 4.8 |
| Source MMBTU | 14.5 | 12.9 | 12.24 | 17.1 | 15.1 |
| Annual Fuel Cost | $166 | $147 | $140 | $202 | $178 |

**Note:** the calculations behind these tables are based on national-average climate conditions in Climate Zone 4, equivalent to Washington Dulles Airport weather data. In some regions, heating loads may be significantly higher or lower, which would affect the absolute values of the table numbers as well as the relative consumption levels of water heating vs. space heating systems.

### *Nationwide potential energy and cost benefits*

If these source-Btu and energy cost benefits were applied across all or part of the U.S. multifamily building stock, the nationwide benefits could be substantial:

- Multifamily unit occupants could realize $2.2 billion in reduced annual energy bills, or about 6% of total energy expenditures for multifamily units nationwide.
- On a source Btu basis, gas conversions would reduce total national energy consumption by 182 Trillion Btu, which is in the range of 6% of total multifamily energy usage.
- Nationwide $CO_2$ emissions would be reduced by more than 20 million tons.[5]

These estimated benefits represent and upper-limit, first-order estimate of maximum potential. Realizing these benefits fully across the nation's multifamily housing units is unlikely, as not all buildings may be amenable to gas conversions based on physical limitations, cost issues, and the host of market barriers that has inhibited the needed investments. On the other hand, these estimated benefits are based on comparing NAECA-minimum gas and electric technologies; in many retrofit situations, gas would be replacing older and less-efficient electric technologies. In such cases, the benefits would be larger. See Appendix B for a more detailed tabular presentation of this information.

This simplified analysis was conducted because there are relatively few detailed studies on the total potential benefits of natural gas end use conversion, as most state utility commissions do not officially support policies along those lines. One study conducted for the Maryland Energy Administration did assess the technical, economic, and achievable potential for converting electric end-use technologies to natural gas.[6] This analysis found that on a technical potential basis, that is substituting natural gas for all technically feasible electric end uses in the residential and commercial sector, total electricity sales in the state could be reduced by almost 5%. An achievable potential subset of this estimate, which takes into account cost-effectiveness and market barriers, narrows the potential to less than 1% of electricity sales. However, this study is not directly comparable to this section's limited indicative assessment, because it does not take

[5] These emission impacts are based on national impacts across the residential sector; those calculations differ somewhat from the emissions analysis in the report tables, which build up emissions impacts based on comparisons of specific water heating and space heating technologies.

[6] GDS Associates. 2012. *Natural Gas Fuel Switching Potential in Maryland.* Prepared for the Maryland Energy Administration.

into account the net effects of increased gas use weighed against reduced electricity use. A net-effects analysis would reduce the total savings potential in the Maryland study.

### *Nationwide potential benefits in recent construction*

It is also instructive to look more specifically at the "lost opportunity" segment of the multifamily market by focusing on the benefits associated with recent construction. Narrowing these nationwide potential estimates to the multifamily building stock that has been built most recently, using EIA RECS data for buildings constructed in the 2000-2009 decade, the Multi-Family units built during this time period that chose not to utilize natural gas service:

- Consume approximately 25 Trillion more source Btu per year;
- Incur $302 million more in in annual energy bills representing about 6% of total energy expenditures for multifamily units nationwide; and
- Account for an additional 2.75 million tons of $CO_2$ emissions.

## Reduced emissions of air pollutants and greenhouse gases

Depending on the characteristics of comparative fuel and system choices, gas service can reduce emissions at the building site and energy supply system levels. Applying standard national average emission factors to the basic gas and electric space heating and water heating technology characteristics shown in Exhibit 12, Exhibit 13 illustrates the relative air pollutant emissions of these technologies. For carbon dioxide, NAECA-minimum gas water heating equipment emits just over one-half the annual emissions of a NAECA-minimum electric water heater. Gas space heating equipment emits 20% less carbon dioxide than minimum-standard electric heat pumps.

**Exhibit 13: Air Pollutant Emissions Impacts of Gas vs. Electric Technologies**

| Water Heating | Gas | | Electric | | |
|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | NAECA Min. | Heat Pump Water Heater | |
| Energy Factor | 0.62 | 0.67 | 0.92 | 2.0 | 0.95 |
| tons $CO_2$ Emissions | 0.8030 | 0.7220 | 1.5007 | 0.9848 | |
| tons $SO_2$ Emissions | 0.0000040 | 0.0000036 | 0.0032 | 0.0021 | |
| tons $No_x$ Emissions | 0.0006 | 0.0006 | 0.0014 | 0.0009 | |
| | | | | | |
| | | | | | |

| Space Heating | Gas | | | Electric | | |
|---|---|---|---|---|---|---|
| | NAECA Min. | ENERGY STAR | ENERGY STAR | Electric Res. | NAECA Min. | ENERGY STAR |
| AFUE/HSPF | 80% | 90% | 95% | 98% | 7.7 | 8.5 |
| tons $CO_2$ Emissions | 0.6980 | 0.6204 | 0.5803 | 1.9127 | 0.8851 | 0.7820 |
| tons $SO_2$ Emissions | 0.0000035 | 0.0000031 | 0.0000029 | 0.0041 | 0.0019 | 0.0017 |
| tons $No_x$ Emissions | 0.0005 | 0.0005 | 0.0005 | 0.0017 | 0.0008 | 0.0007 |

**Assumptions:**

Electricity emission factors from US10 Data, eGRID 9th edition Version 1.0

Natural gas emissions data from:

- NOx SO2 http://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf
- CO2 http://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf

**Note:** the calculations behind these tables are based on national-average climate conditions in Climate Zone 4, equivalent to Washington Dulles Airport weather data. In some regions, heating loads may be significantly higher or

lower, which would affect the absolute values of the table numbers as well as the relative consumption levels of water heating vs. space heating systems.

Applying these relative annual emissions to the multifamily market totals discussed above and detailed in Appendix B indicates that if the nation's multifamily markets were to convert all space heating and water heating systems to natural gas, the nation would benefit from over 20 million tons of $CO_2$ emission reductions. This is more than 2% of the total $CO_2$ emissions that would be reduced from the nation's existing electric generating units under the requirements of EPA's Clean Power Plan. As with all of the estimates in Appendix B, these are simplified calculations that do not take into account variations in system types and efficiencies, differences in building characteristics, climate factors, physical limits on gas applications, or other barriers. A complete benefits analysis would be considerably more complex.

## Analytics tools for estimating benefits

Analytics tools can be very helpful in estimating the benefits of efficient gas technologies in retrofit and new construction projects. One such tool is EZ Retrofit, developed by Stewards of Affordable Housing for the Future (SAHF); EZ Retrofit was used in the project case studies described later in this section of the report. More information on EZ Retrofit can be found in Appendix C.

## Qualitative benefits

In addition to the quantifiable benefits shown above, efficient gas technologies, especially when combined with sound building science and building performance practices. Examples include:

- **Improved comfort and health.** Gas heating can provide improved comfort compared to some electric heating system types, by providing warmer supply air temperatures and faster response times. Gas can also be part of a healthy-home definition, if packaged such that the home as a whole and gas appliances are properly ventilated.
- **Improved building value.** Buildings that are equipped with modern, high-efficiency energy systems fueled by natural gas can gain market value at resale if marketed as clean, efficient, and economical. For example, a survey of real estate professionals conducted by Utility Pipeline, Ltd. (UPL) showed that homes connected to natural gas enjoy an average appreciation in property resale value of 5% to 10% over similar homes without gas service.[7] UGI in Pennsylvania cites a National Association of Home Builders analysis that shows a 4% value increase for home served by natural gas. [8]

## Case studies

To illustrate the benefits of multifamily gas service in concrete terms, this section includes three case studies of multifamily buildings using advanced gas technologies. The following pages contain additional detail on these case studies:

[7] http://www.utilitypipelineltd.com/frequently-asked-questions#Property
[8] http://www.ugienergylink.com/change-natural-gas-increase-home-value/

- Energy Solutions Center study of gas vs. electric technologies in a 10-story prototypical multifamily building in an “average” (St. Louis) climate zone.
- SAHF/EZ Retrofit case study of the 107-unit Columbia Court building in Belleville, MI
- SAHF/EZ Retrofit case study of the 77-unit Parkside Manor building in Pittsburgh, PA

**Energy Solutions Center (ESC) Case Study**
**Vertical Subdivisions/Mechanical Systems**
**Analysis of Construction Cost and Annual Utility Cost**

| Market Segmentation Map | | |
|---|---|---|
| **Ownership** | **Rented** | **Owned** |
| **Income** | **Affordable** | **Market Rate** |
| **Building cycle** | **New construction** | Retrofit |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** This case study compares the capital and operating costs of seven heating/cooling/hot water mechanical systems for a prototypical mid-rise apartment building in a typical (St. Louis) climate zone. Five options use natural gas for both space heating and domestic water heating; two use electricity. The air-source heat pump system, is used as the "baseline" scenario for the report's primary cost analysis. The study's results show that *natural gas technologies outperform the electric baseline system in terms of operating costs.* However, capital cost comparisons tend to favor the heat pump solution, especially when heating and cooling system costs are combined.

**Background:** The study was conducted by Entech Engineering, and commissioned by the Energy Solutions Center.

**Features**: Since natural gas cooling isn't part of the technology options analyzed in the study (almost all options use electric-powered DX air conditioning), the study focuses primarily on comparing natural gas and electricity for space heating and domestic water heating. It compares construction cost and annual utility cost among system types. All seven system types were simulated in the same prototype building: a 10-story, multi-family complex based in St. Louis, Missouri (climate zone 4A). The utility rates (natural gas and electricity) were also taken from 2013 St. Louis data.

**Benefits**: Focusing on the most pertinent/noteworthy data from the ESC study, results for four systems (the electric heat pump baseline and three gas options) are tabulated below.

| **Space Heating / Water Heating** | **Baseline System:** Air-source heat pump | **System 1:** Central Boiler & Chiller | **System 2:** Combination Boiler & Packaged DX | **System 3:** Packaged NG Furnace with DX Cooling |
|---|---|---|---|---|
| AFUE / Energy Factor | 3.2 COP | 90 / 0.9* | 80 / 0.82 | 85 / 0.8* |
| Annual input (Therms) | 3,084 kWh | 202 | 216 | 192 |
| Site MMBTU | 10.5 | 20.2 | 21.6 | 19.2 |

| | | | | |
|---|---|---|---|---|
| Source MMBTU | 33.2 | 22.3 | 23.7 | 21.1 |
| Annual Fuel Cost per unit/apartment | $301 | $189 | $201 | $179 |

*EF not explicitly mentioned in case study. Data instead taken from mechanical efficiency of water heater (%).
*Values listed represent heating consumption only

The data in this table indicate that *System 3 (standard efficiency gas furnace with self-contained direct expansion cooling[9]) provides the lowest annual operating costs of any of the options.*

***Space heating.*** The results indicate that for space heating, the natural gas systems yield lower utility costs than the electric heat pump baseline. The study does concede, however, that "considerations of first cost often outweigh systems which are capable of performing at lower annual operating cost and significantly lower Source Energy Use Intensity (EUI)." And because builders pay the capital costs of the HVAC system as a whole, and focus primarily on capital costs rather than operating costs, "few options would un-seat the low-cost [baseline heat pump] without outside financial drivers, such as grants and incentives for energy efficiency and/or specific types."

This finding reflects a common field experience: *while natural gas technologies typically show lower source-Btu consumption and operating costs, first-cost premiums often impede their competitiveness in the marketplace.*

***Domestic water heating.*** The study shows even greater operating cost benefits for natural gas domestic water heating technology solutions. It demonstrates operating cost advantages that show natural gas hot water systems providing hot water at one-third the cost of their electric counterparts. Even if electric technologies were used for heating and cooling, the study finds that *"the cost associated with providing an otherwise all-electric building with gas-fired domestic hot water…would yield a per unit annual savings of around $200 and might provide the best overall system performance for the tenant."*

**Resources:** Detailed analysis information, as well as schematics and technical specifications for the mechanical equipment are outlined in the appendices of the case study.
The full study, titled *Energy Solutions Center Vertical Subdivision—Mechanical Systems Analysis of Construction Cost and Annual Utility Cost*, can accessed by contacting the Energy Solutions Center. See below for contact information.

**Contact information**:
Energy Solutions Center
400 N. Capitol St.
Washington, DC 20001
202-824-7152
www.escenter.org

[9] also referred to as Option 5 in the ESC report

## Case Study – Columbia Court

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | **Affordable** | Market Rate |
| **Building cycle** | New construction | **Retrofit** |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** Columbia Court is a 6-story multifamily building in Belleville, Michigan. EZ Retrofit, an energy benchmarking and audit tool, was used to identify appropriate energy efficiency opportunities in the property. As part of the building energy retrofit, inefficient boilers and water heaters were replaced with high-efficiency systems. The improvements are estimated to reduce building annual gas usage by 5,113 therms and annual utility costs by $7,965.

**Background:** This case study demonstrates the use of EZ Retrofit, a free, easy-to-use energy savings analysis tool designed to assist multi-family property owners/managers in identifying and prioritizing effective energy and water efficiency retrofit opportunities. Stewards of Affordable Housing for the Future (SAHF) developed the EZ Retrofit Tool with contractors ICF International and Bright Power, Inc. under a grant from the U.S. Department of Housing and Urban Development's Energy Innovation Fund.

**Features:** This 6-story multifamily building in Belleville, Michigan was originally constructed in 1986. The building has 107 units – 27 studios, and 80 one-bedrooms. The property is heated by hot-water fan coils installed in each apartment. The hot water loop serving the fan coils is heated by five gas-fired atmospheric boilers. Domestic hot water is provided by two dedicated gas-fired hot water heaters.

*275 West Columbia Ave, Belleville MI*

**Benefits:** EZ Retrofit was used to compare the existing systems with high-efficiency natural gas heating and hot water options. The tables below compare the existing and efficient systems in terms of energy performance and estimated annual savings.

| Space Heating | Existing System | Efficient System | Savings |
|---|---|---|---|
| AFUE | 0.75 | 0.94 | - |
| Annual input (Therms) | 16,719 | 13,339 | 3,380 |
| Site MMBTU | 1,672 | 1,334 | 338 |
| Source MMBTU | 1,839 | 1,467 | 372 |
| Annual Fuel Cost | $26,048 | $20,783 | $5,265 |

| Water Heating | Existing System | Efficient System | Savings |
|---|---|---|---|
| Energy Factor | 0.47 | 0.96 | - |
| Annual input (Therms) | 7,958 | 6,225 | 1,733 |
| Site MMBTU | 796 | 623 | 173 |
| Source MMBTU | 875 | 685 | 191 |
| Annual Fuel Cost | $12,399 | $9,699 | $2,700 |

The total heating and hot water savings of $7,965 average almost $75 per dwelling unit.

**Resources:** The EZ Retrofit tool can be obtained free from the SAHF website at http://www.sahfnet.org/ezretrofit.html.

**Contact Information:**

Eric Walker
Director, Affordable Housing Development
National Church Residences
EWalker@nationalchurchresidences.org
Direct: 614-273-3734
Cell: 614-403-7558

## Case Study – Parkside Manor

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | **Affordable** | Market Rate |
| **Building cycle** | New construction | **Retrofit** |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** Parkside Manor is an 8-story multifamily building located in Pittsburgh, Pennsylvania. EZ Retrofit, a Microsoft Excel-based Benchmarking and Audit tool, was used to identify appropriate energy efficiency opportunities in the property. As part of the building energy retrofit, inefficient boilers that were used for Domestic Hot Water (DHW) and space heating were replaced with high-efficiency boilers. The improvements are estimated to reduce the building annual gas usage by 5,955 therms and the annual utility cost by $11,838.

**Background:** This case study demonstrates the use of EZ Retrofit, a free, easy-to-use energy savings analysis tool designed to assist multi-family property owners/managers in identifying and prioritizing effective energy and water efficiency retrofit opportunities. Stewards of Affordable Housing for the Future (SAHF) developed the EZ Retrofit Tool with contractors ICF International and Bright Power, Inc. under a grant from the U.S. Department of Housing and Urban Development's Energy Innovation Fund.

**Features:** The 8-story multifamily building in in Pittsburgh, Pennsylvania was originally constructed in 1982. The building has 77 units – all of which are one-bedrooms. The dwelling units are supplied heating via four (4) central gas fired water boilers that work in conjunction with individual wall mounted Whalen units located in each dwelling unit. The boilers and Whalen units are original to the date of construction (1982). Domestic hot water (DHW) is provided by two gas-fired dedicated hot water boilers.


*1306 Brookline Boulevard, Pittsburgh, PA*

**Benefits:** The tables below compare existing and efficient systems in terms of energy performance as well as estimated energy cost savings.

| Space Heating | Existing System | Efficient System | Savings |
|---|---|---|---|
| AFUE | 0.68 | 0.94 | - |
| Annual input (Therms) | 16,272 | 11,772 | 4,501 |
| Site MMBTU | 1,627 | 1,177 | 450 |
| Source MMBTU* | 1,790 | 1,295 | 495 |
| Annual Fuel Cost | $32,350 | $23,402 | $8,948 |

| Water Heating | Existing System | Efficient System | Savings |
|---|---|---|---|
| Energy Factor | 0.47 | 0.96 | - |
| Annual input (Therms) | 6,608 | 5,154 | 1,454 |
| Site MMBTU | 661 | 515 | 145 |
| Source MMBTU* | 727 | 567 | 160 |
| Annual Fuel Cost | $13,136 | $10,246 | $2,890 |

*The source to site energy ratio of 1.1 for gas (per U.S. EPA eGRID 2012).
Total energy cost savings of $11,838 average $154 per dwelling unit.

**Resources:** The EZ Retrofit tool can be obtained free from the SAHF website at http://www.sahfnet.org/ezretrofit.html.

**Contact information:**

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# DEVELOPING THE SOLUTIONS FOR EXPANDING NATURAL GAS SERVICE TO MULTIFAMILY BUILDINGS

This section highlights successful examples of natural gas industry efforts to enable the expansion of natural gas service in multi-family buildings through energy efficiency, fuel conversion, policy actions, and other initiatives. It describes three areas in which gas industry initiatives could be most fruitful: gas industry marketing and energy efficiency efforts, public policy initiatives, and nonprofit and technical society initiatives.

## High-performance natural gas technologies

Over the past several decades, industry and public research and development efforts have helped bring to market high-efficiency, cost-effective gas technologies that can make gas service more practical and cost-competitive for multifamily applications. Among the most promising technology options available in today's market are:

- **Combination hot water and space heating**. The most typical application of this technology solution today is to combine a tankless gas water heater with the heating coil in an air handling unit. Because the water heater burner is designed for high capacity to serve instantaneous hot water loads, it can also provide enough energy for multi-family unit heating loads in some climate. The application typically includes a hot water line from the tankless unit to the main air handling unit to serve the heating coil. This design is not only high-efficiency, it saves crucial floor space by avoiding the need for a hot water storage tank while keeping the heating function within the space footprint of the air handler. Several gas utilities have worked with multifamily developers and contractors to install this application.
- **Small-capacity heating systems.** A few manufacturers have developed low-Btu-output furnaces designed to fit within the small footprints associated with multifamily units. Some models are also designed to fit within or connect easily to packaged HVAC designs in multifamily application. These systems can make natural gas more competitive in multifamily HVAC system designs.[10]
- **Renewable Natural Gas (RNG)**. Biomass-based gas is becoming a commercially-available commodity in some markets; produced from municipal, commercial, agricultural, or forestry waste streams, RNG can be used in applications that place a premium on low-emission, net-zero, or other varieties of "green" building and technology strategies. Natural gas utilities have found that in many markets, there are typically leading builders and designers who want to be identified as "green leaders" and will invest in high-performance, low-emission technologies to support that goal. RNG and other low-carbon, gas-based energy technologies, including the Power to Gas and CCS&U technologies described earlier in this report, can help support gas utility efforts to expand gas service in multifamily markets.

Gaining market share for leading-edge technologies like these can involve challenges. These can include local designers and contractors who are not familiar with these technologies, and will

[10] For more information, contact the Energy Solutions Center at http://www.energysolutionscenter.org/, or the Gas Technology Institute at http://www.gastechnology.org/Pages/default.aspx

either not consider them or will price them high to manage perceived risks. They can also include the limited technical and marketing support that small/emerging manufacturers can provide; this can exacerbate the contractor/designer challenge. Major manufacturers tend to follow the market, and will typically wait until a technology has gained a certain market share before putting their resources into similar models.

Addressing these challenges involves working with manufacturers using natural gas utility staff with technical skills and marketing resources to extend manufacturer partner resources into specific markets. It can also involve cultivating leading developers, designers, and contractors in the local market to change the mind-set that had kept such high-performance technologies out of serious contention. Several gas utilities have shown that getting just a few leaders of this kind engaged can rapidly change local market dynamics, and can help build market share for high-performance gas technologies.

**Metering solutions**. As discussed earlier, the trend toward individual metering of utility service to individual multifamily dwelling units continues to push industry efforts toward technical solutions based on individual metering. In many cases, individual metering also supports utility business goals in terms of expanding customer counts and revenue potential. However, in some markets and building configurations, individual-unit gas revenue metering may not be feasible for technical and other reasons. In such cases, solutions can include:

- **Btu meters**. These typically involve a flow meter (e.g. to measure water flow) and a temperature sensor (to measure Btu content).
- **Master revenue metering with unit check metering**. In some buildings, owners will install their own sub-metering (also known as check-metering) to allocate energy usage and costs to tenants/unit owners.
- **Refrigerant flow metering**. In cases where units receive HVAC refrigerant from a central system, meters can be used to measure refrigerant flow to the dwelling unit as a proxy measure of energy usage.
- **Cold water metering**. Some multifamily buildings use cold water flow as a proxy for energy usage, applying a formula to estimate water heating energy usage.

Meter locations (and also service piping locations) have also been a challenge for gas utilities, especially when installing individual unit meters in a multifamily complex where space and/or aesthetics limit options. Gas utilities have innovated with meter and service piping placement solutions that include:

- Rooftop meter banks;
- Parking garage meter banks;
- Landscaped meter banks;
- Meter rooms on each floor of a high-rise building; and
- Service pipe easements, sometimes involving payments to building owners, to secure safe and legal pipe locations and access.

## Natural gas utility initiatives

Some gas utilities have succeeded in gaining market share in new construction and existing building markets through various program and policy activities. Drawing on ICF's own client

experience, Foundation recommendations, and literature review, we have identified a number of these exemplary initiatives that could help gas utilities expand natural gas service in multifamily markets. These initiatives fall in two main categories: marketing programs and efficiency programs. Marketing programs tend to be company-funded efforts, whereas efficiency programs tend to be ratepayer-funded; efficiency programs also tend to be more directly subject to utility commission regulatory oversight, though some marketing activities are also enabled or constrained by commission policies and actions.

### *Marketing Initiatives*

Gas utilities have innovated in service areas around the country to foster incentives, technology solutions, and data documentation efforts that support marketing efforts. This report contains detailed case studies from the following companies:

- Washington Gas Light
- Atlanta Gas Light
- Atmos Energy
- CenterPoint Energy
- Con Edison
- PSEG

These case studies are found at the end of this section.

**Best practices.** Based on information gleaned from gas utility experience around the country, this study has begun to define a basic set of best practices utilities should consider in developing their multifamily marketing efforts. These include:

- **Staffing.** To be able to reach multifamily markets effectively, initial indications are that a utility should maintain a team of people with a mix of sales, technical, and management skills to support outreach, engagement, technical assistance, and project management support. A competent and responsive team is key to getting access to a deep engagement with developers, design teams, and contractors to help shape energy technology choices.
- **Codes and standards.** Companies should consider assigning a staff person to work with state and local code officials and processes if they do not already have one assigned, both to influence code provisions as the adoption phase, and to obtain favorable interpretations for specific projects or applications.
- **Technical resources.** Utilities should consider developing libraries of key data, including construction cost and operating cost data for gas vs. other energy technologies, documentation of case studies of successful gas installations, contact information for contractors, equipment distributors, and other trade allies, so that marketing staff have concrete information at their fingertips.
- **Incentives.** In some states, regulatory action has enabled gas utilities to offer gas service installation incentives subject to approved economic tests. This can create a powerful tool to support marketing and influence individual project decisions. Appendix D provides more information on such incentives.

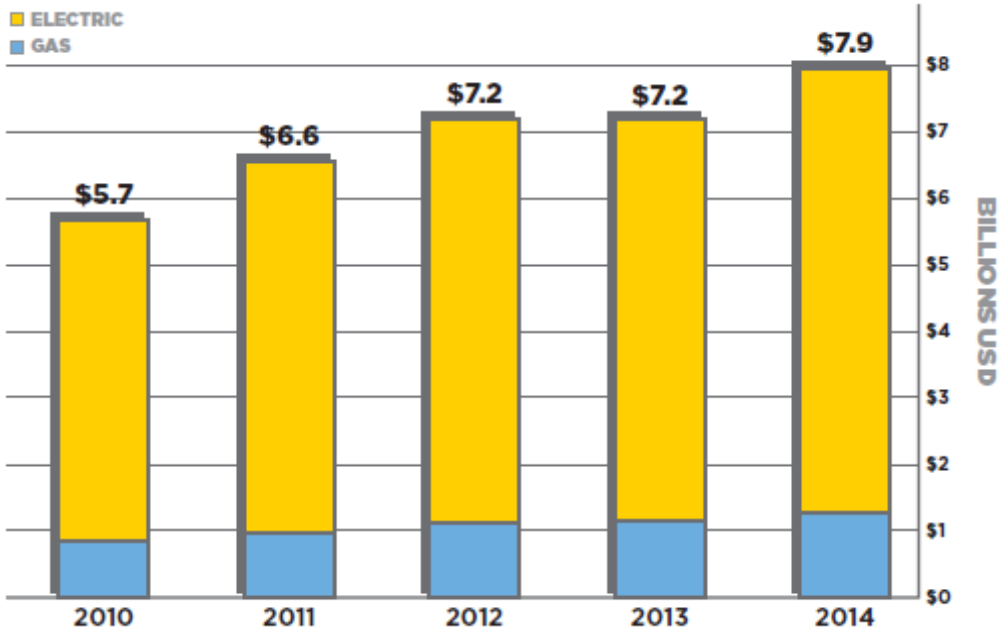
## Efficiency Initiatives

Energy efficiency has become a big business in the electric and gas utility world over the past decade. Exhibit 14 illustrates the rising trend in efficiency program spending; total spending has increased some sevenfold since 1999, though a review of industry data from the 2012-14 period indicates that total spending has begun to level off. While gas efficiency program spending has accounted for less than 20% of total spending in recent years, the growth rate in gas programs has exceeded that of electric programs, and recent-year spending has exceeded $1 billion.

This data points to the potential for using energy efficiency incentives to support gas service expansion goals in multifamily markets. However, depending on individual state and utility situations, the regulatory environment for efficiency programs can place limits on the use of efficiency incentives for competitive purposes. Some commissions may not permit the use of incentives for explicit fuel switching, while others may be silent on the competitive aspects of efficiency programs. In some states and service areas, regulators encourage utilities to provide incentives that can support fuel switching in specific end uses, consistent with regulatory policy goals. In new construction markets, where fuel choice has not been made, utilities are generally freer to link efficiency incentives to marketing activities; in retrofit situations, the rules can vary.

Studies have shown that substantial energy efficiency potential exists in the nation's multifamily housing stock. Exhibit 15 provides a state-by-state snapshot of potential electricity and natural gas savings potential. A nonprofit organization collaborative effort to encourage energy efficiency in multifamily housing can be found at http://aceee.org/multifamily-project. This site contains program design guides, research studies, best practices and other resources for utilities interested in pursuing efficiency programs as part of their multifamily efforts.

**Exhibit 14: U.S. Utility Energy Efficiency Program Spending Trends**




Source: Consortium for Energy Efficiency Annual Industry Report

**Exhibit 15: Energy Efficiency Potential in U.S. Multifamily Housing Stock**

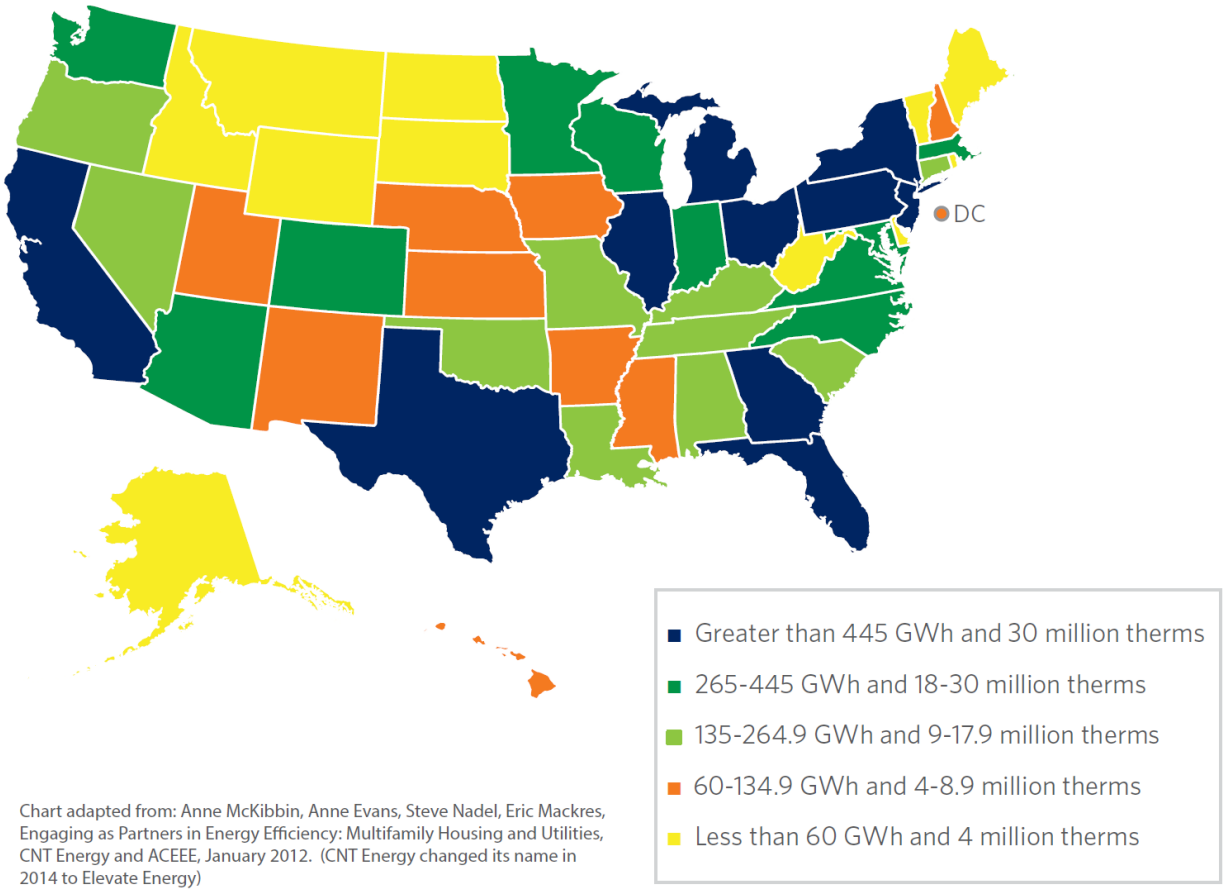



Chart adapted from: Anne McKibbin, Anne Evans, Steve Nadel, Eric Mackres, Engaging as Partners in Energy Efficiency: Multifamily Housing and Utilities, CNT Energy and ACEEE, January 2012. (CNT Energy changed its name in 2014 to Elevate Energy)

## Federal, state, and local public policy initiatives

This section addresses public policy and program initiatives that gas utilities can engage and influence to support their multifamily gas service expansion goals. The gas industry has enjoyed success in such endeavors, such as advocating for source-energy methodologies to guide the analyses behind federal appliance standards and building rating methods. At present, key opportunities in public policy engagement include:

- **State utility commission ratemaking policies.** Multifamily buildings represent an important revenue growth opportunity, where utility commissions apply revenue-per-customer formulas in non-volumetric ratemaking policies. Coupled with the trend toward individual metering of multifamily dwelling units, such policies create a regulatory environment in which providing gas service to one multifamily building creates multiple new accounts and the revenue growth that comes with them. In states where ratemaking policies are seen as advantaging one energy type over another, involvement in regulatory proceedings and other forms of advocacy represents another option.
- **Environmental regulations and related initiatives.** The gas industry is already benefitting from federal air regulations on criteria air pollutants, which have the effect of

accelerating market trends toward cleaner, higher-efficiency gas power generation. The EPA Clean Power Plan, currently under a Supreme Court stay, encourages the use of energy efficiency in state compliance plans. Because gas technologies can show dramatically lower $CO_2$ emissions compared to electric technologies, gas utilities could work with state air agencies, utility commissions, and other stakeholders to advocate for conversion to gas end-use technologies as high-priority $CO_2$ emission-reduction measures. At a more local level, cities and metro areas that are struggling with regional air quality issues can be receptive to initiatives that improve local air quality; the Clean Heat program in New York City is a recent example. From 2012 to 2015, over 6,000 building heating systems were converted from high-polluting No. 4 or No. 6 oil, many of these conversions to natural gas. Where other cities can be engaged to pursue such efforts, opportunities for the gas industry could be significant.

## Nonprofit and technical society processes

Several technically-based organizations and processes can affect natural gas usage in the buildings sector, from the residential energy rating methods developed through RESNET, to ASHRAE standards, test procedures, and guidelines, and International Code Council model code development processes. Leading opportunities include:

- **Zero-energy building initiatives.** A number of nonprofit groups, such as the New Buildings Institute, are conducting analysis, research, and demonstration to advance the concepts and practices of zero-energy buildings. DOE recently issued a Zero Energy definitional document that uses source-energy methodology, providing four Zero Energy definitions:
    1. **Zero Energy Building (ZEB)**. An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
    2. **Zero Energy Campus**. An energy-efficient campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
    3. **Zero Energy Portfolio.** An energy-efficient portfolio where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
    4. **Zero Energy Community**. An energy-efficient community where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

  As states, communities, and other entities become more interested in the Zero Energy concept, gas utilities can work actively to leverage these core definitions in ways that encourage gas applications for building end uses. This also creates the opportunity to build alliances with renewables advocates that can help place gas even more prominently in the green building movement.

- **ASHRAE committees.** In addition to the standards committees such as SSPC 90.1 and 90.2, gas utilities can increase their participation in technical committees, project committees and task groups working on test methods, protocols, special projects and advanced energy design guides that can influence multifamily building and HVAC

system markets. A strategic review of current and emerging activities and priorities could identify key areas where even modest increases in gas utility activity could serve to shift the direction of these efforts in favor of gas technologies. The same approach could be applied to other technical organizations, such as ASTM, ASME, ANSI and others.

- **International Code Council.** The ICC, which produces the "I-Codes" that are adopted by most U.S. states and localities, conducts three-year code development cycles in which any party can propose code changes in an open process where committees make rules on proposals and ICC member code officials vote on final actions. The International Energy Conservation Code (IECC), International Fuel Gas Code (IFGC), and the International Mechanical Code (IMC) are among the code documents that can have the greatest influence on multifamily end-use energy markets. While the gas industry has been active in ICC processes, an enhanced effort in which AGA and member companies collaborate more widely with other stakeholders could identify and effect changes in the I-Codes that could give gas service a better chance in multifamily markets.

## Case Studies

**Member Company Marketing Case Study**
**Washington Gas Maryland Multifamily Piping Program (MMFPP)**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | **Owned** |
| **Income** | Affordable | **Market Rate** |
| **Building cycle** | **New construction** | **Retrofit** |
| **Construction type** | **High-rise** | **Low-rise** |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** The MMFPP provides incentives to builders or building owners to offset costs of gas line installation involved with building or converting condominium or apartment complexes to individually metered natural gas service. This program has enabled the company to help several major multifamily complexes take advantage of high-efficiency gas service at competitive costs.

**Key program features:**

- **Target market.** MMFPP targets new and existing multifamily building owners and developers.
- **Strategic approach.** The program leverages a Maryland Public Service Commission approved tariff provision called  This tariff provision enables the company to offer financial incentives if the present value of new revenues associated with the service extension exceeds the present value of the costs of extending the service, up to the full cost of the service extension. The present value calculation is based on a 30-year life cycle, which often produces positive results, enabling the company to make the cost of new or extended gas service more competitive to builders and owners.
- **Key techniques.** In addition to the tariffed incentive, Washington Gas sales team engages Engineered Sales Support to coordinate customer service, engineering, meter setting, and other aspects of the line extension process. Responsiveness has been the key to success; as customers have commented, Washington Gas' timely and focused responses convince builders and developers to go with gas. These businesspeople are typically on tight timelines to get their projects done, and utilities seeking to be their partners must show the kind of rapid response required in competitive markets.
- **Incentives.** As described above, in Maryland Washington Gas is able to offer incentives that, subject to the required economic analysis, can in some cases fully offset the costs of service extension. The "Economic Evaluation of Facilities Extension" provisions are found at https://www.washingtongas.com/-/media/washgas/pdf/my-account/current-rates/md_rates_and_tariffs.pdf#page=107.

**Key Outcomes:** Washington Gas has succeeded in growing gas service to multifamily customers in several projects. A leading example is the Cider Mill project in Gaithersburg, MD. The 864-unit complex converted from a 1971-vintage boiler system to an energy-efficient tankless water system, featuring a Rinnai tankless hydronic system with air handler and cooling coil. The owner, Donaldson Group, was looking to convert an old central plant that was costly to maintain, very inefficient, and relied on underground pipes for distribution, which caused additional energy losses and maintenance costs. Washington Gas helped by applying its MMFPP incentives as well as its Engineered Sales Support team to respond to the owner's needs in making this conversion.

Key selling points:

- **Size**: combining heating and hot water functions in a single burner saves space compared to stand-alone water heating and heating equipment. This increases rentable space and enables utility service conversions with minimal added in-unit construction costs.
- **Efficiency**: Converting from central boilers with relative low combustion efficiency plus distribution piping heat loss to high-efficiency Rinnai tankless water heaters that serve both heating and hot water loads increased total system efficiency
- **Individual meters**: Going from 12 big meters to 864 individual meters turns the tenant into the bill payer, which encourages more economical use of energy.
- **Free vent kits:** Rinnai provided venting kits for their systems free to the owner. This further improved project economics.
- **MMFPP incentives:** Washington Gas was able to provide an incentive under its Maryland tariff provision that fully covered the cost of the service extension work. This made the conversion even more attractive to the owner.

The economic benefits of the project from the owner's standpoint were dramatic: the Donaldson Group supplied the following summary data:

| **Cider Mill Apartments Project: Summary Financial Performance** | | | |
|---|---|---|---|
| | | | |
| Added net operating income (NOI): total and per-unit | | $1,304,968 | $1,510 |
| Capital costs for utility conversion: total and per-unit | | $20,076,431 | $23,237 |
| Added value (at 6.5% cap factor): total and per-unit | | $7,080,997 | $8,196 |
| | | | |
| **Utility cost type** | **Pre-conversion utility costs** | **Post-conversion utility costs** | **Percent savings** |
| Electricity | $838,773 | $97,638 | 88.4% |
| Natural Gas | $428,937 | $45,534 | 89.4% |
| Water/sewer | $587,706 | $407,276 | 30.7% |
| **Total** | **$1,855,416** | **$550,448** | **70.3%** |

These tables illustrate several compelling benefits to the owner:

- 70% reduction in total utility costs, and nearly 90% reductions in both gas and electricity costs, noting that a large portion of the reductions in owner utility costs come from shifting from master metering to tenant-unit metering for electricity and gas service, so that owner utility costs reflect only common area usage;
- A $1.3 million increase in Net Operating Income (NOI), a key financial indicator in the real estate business; and
- A total increase in property value of over $20 million, about three times the total cost of the conversion project.

This project exemplifies the win-win-win ideal: customers benefit through higher-efficiency, lower-cost energy services; building owners benefit from reduced costs of conversion, reduced maintenance costs, improved operating income, and increased property value. Washington Gas also benefits from such projects, not only by increasing its multifamily market share, but also by growing its total revenues. In its Maryland regulatory regime, the company's revenue recovery is decoupled from its energy sales, on a revenue-per customer basis. In this regulatory scheme, adding meters creates the ability to grow total revenues; and because multifamily projects can create large numbers of new meters in one transaction, they are especially attractive from a revenue growth standpoint.

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Additional resources can be found on Washington Gas' Natural Gas for Multifamily Projects web page:
https://www.washingtongas.com/builders-contractors/builder-services/multifamily#overview

**Member Company Marketing Case Study**
**Atlanta Gas Light Multifamily Marketing Program**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | Affordable | **Market Rate** |
| **Building cycle** | **New construction** | Retrofit |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** Atlanta Gas Light offers this program in its Atlanta service area, targeting multifamily new construction. It focuses on larger multifamily new construction projects, targeting developers and design professionals with an integrated package of technical services, financial incentives, and media support. In the last few years, this approach has enabled the company to begin to regain market share in its service area.

**Background:** Atlanta Gas Light (AGL), serving 1.6 million customers in Georgia, is a unit of AGL Resources, serving seven states from Illinois to Florida. Natural gas enjoyed some market share in the Atlanta multifamily market until the mid-1990s, when deregulation, rising natural gas prices, cutbacks in gas marketing programs, electric utility incentives and cost cutting by developers led to increased use of electric equipment for heating, cooking and water heating. The first-cost economics of all-electric construction helped push the market strongly away from gas service; consequently, AGL achieved very little market penetration from 1995 to 2014. Starting in 2014, the company launched an effort to regain market share in the multifamily construction market.

Today, AGL is seeing a huge influx of high-rise apartment projects in Midtown Atlanta, with a preponderance of wood-frame, garden style and midrise projects in the suburbs. Since the 2008 housing market slump, the multifamily home market has been more active than the single family home market, with increased focus on urban infill vs. suburban development, driven in part by Millennials preference to rent rather than own. It is estimated that metro Atlanta will add more than 20,000 multifamily units between 2014 and 2018; this represents a potential revenue growth between $2-3 million per year for AGL.

Since it is extremely difficult to retrofit gas into an existing high-rise, AGL focuses on design and construction phases of the market, by promoting natural gas use to developers and their design professionals. Prior to AGL's 2014 program launch, almost all multifamily projects had been going total electric, with natural gas only used for amenities and retail spaces. In addition to these market barriers, AGL faces direct competition from electric utility energy efficiency incentive programs, in which incentives for high-efficiency electric technologies can be used to make electric service even more competitive.

On the regulatory side, Georgia's gas deregulation scheme makes AGL a distribution-only company, such that the distribution company does not realize the commodity revenue component from gas service extensions such as those shown in this case study. The business model works

for AGL, however, in that the company is able to realize an average simple payback period of less than five years for cash incentives, while requiring a contract length of 10 years.

AGL pictures the most significant major barriers it faces thus:

*Glass and concrete construction makes venting of appliances difficult*

*Difficult to shoehorn gas into "cookie cutter" TE designs*

*Gas piping and appliances add to first cost: $800-$1,950 per unit cost premiums*

*Consumers don't demand gas appliances*

A particular problem discovered early in the program development effort was that contractors, being used to lower-cost, all-electric designs, were overestimating costs for gas service. To counter this issue, AGL reached out to educate contractors, and in the process organized a team of "pro-gas" contractors that would bid projects fairly. These contractors put together a "sample bid letter" which AGL used to show developers truer cost estimates for gas service. This letter spurred other contractors to bid more competitively. By mid-year 2014, AGL saw a 50% drop in the per-unit premium for natural gas equipment in high-rise multifamily units.

AGL also encountered building code and other standards issues in extending gas service into some multifamily buildings. In some cases, they were required to install individual shutoff valves for each unit, and to provide mechanical ventilation for gas cooktops with more than four burners. In addition, the EarthCraft green building program, which originated in Georgia, does not allow any atmospheric combustion devices inside the dwelling unit; this can severely limit gas burner tip options.

**Key program features:**

- **Target market.** Given the strong market share AGL is seeing for multifamily new construction, it targets this market primarily. While the economics of multifamily natural gas service as well as other factors listed above present challenges, AGL sees multifamily new construction as the best if not the only window of opportunity to gain a share of this key market. Accordingly, AGL's multifamily marketing focuses on cultivating relationships with developers, architects and engineers in the metro area market.

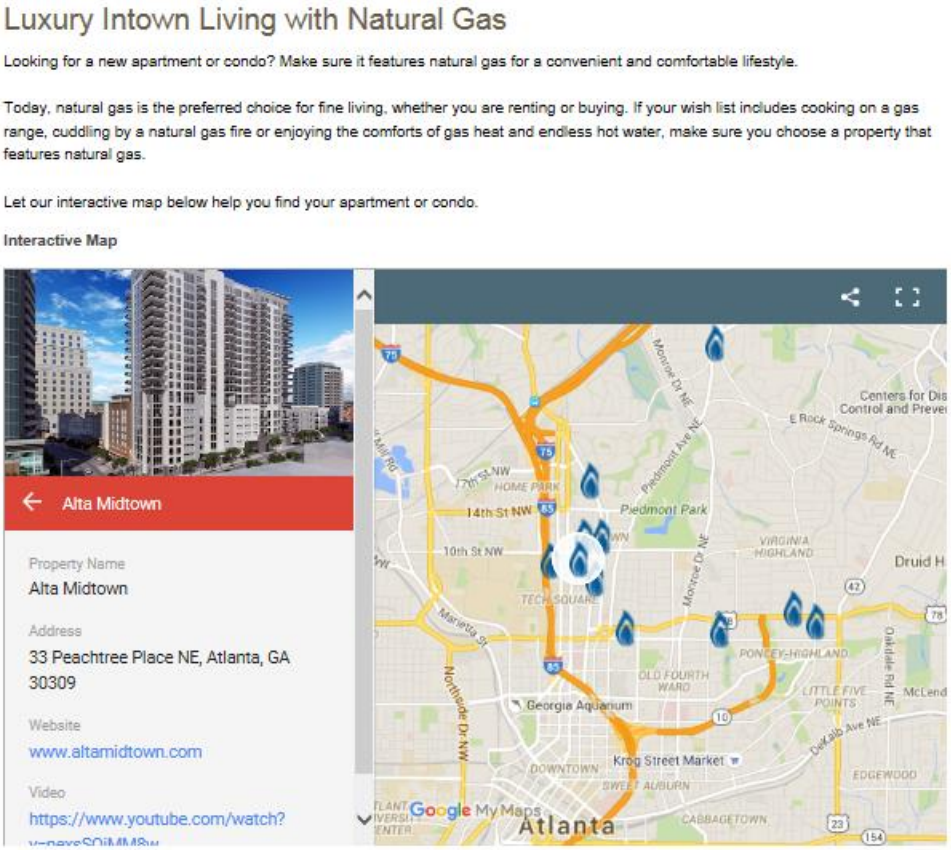
- **Strategic approach.** AGL's strategy revolves around selling various combinations of benefits to developers and tenants:
    - **Green certifications.** High-efficiency gas technologies can help with green globes/ LEED certifications; and because "green" buildings are in growing demand in markets like Atlanta, this helps developers differentiate their products and compete for tenants.
    - **Amenity value**. Gas cooktops and fireplace logs are perceived as luxury items; and gas is perceived as delivering superior comfort, faster and more abundant hot water.
    - **Operating costs.** Whether the pitch is to the owner for master-metered uses, or to the tenant for individually-metered service, AGL promotes the operating cost advantages of natural gas. Direct use of natural gas is more cost effective compared to electric
    - **Safety and reliability**. AGL has put substantial effort into convincing developers that the natural gas delivery system is safe and reliable

  AGL created an internal task force to develop its multifamily marketing effort. They quickly converged on key trade allies as the keys to success: manufacturers like Rinnai, developers, architects and engineers. Like other companies, AGL had to overcome the first-cost bias against gas service in competition with total electric service.

- Key Techniques: The main program elements AGL evolved in this respect are:
    - **Getting the costs right.** As described above, AGL early on worked to establish a fair range of costs for gas service, engaged cooperative contractors, and provided a sample bid letter for developers and their design teams to use.
    - **Defining market niches.** In the past, AGL's efforts used a single three-burner-tip offer that required developers to install heating, hot water, and cooking equipment to qualify for incentives. This proved not to be cost-competitive or practical for many projects, so the company built more flexibility into its approach, allowing developers to install the gas end uses that make best market and economic sense for each project.
    - **Sales focused on the owner and the architect** on the concept of natural gas use because if either party is not on board, the project won't happen.
    - **Training focused on architects and the engineers** on requirements for technologies like tankless water heaters. Leverage professional organizations like AIA, ASHRAE or ASPE, by offering registered presentations to gain access and spark conversations.
    - **Targeting the "right" firms** –90% of the projects are designed by a handful of A/E firms, and the MEP subcontractors they use most. Identify the major players by looking at historic projects.
    - **Determining company-paid incentive levels** that give shareholders an acceptable time period for return on investment.

**Developing cost-effective, targeted media**—AGL developed an interactive website and sponsored the "High-Rise Living" television series. AGL does not retain the rights to the on-air content, but is able to use the footage from the showcase multifamily properties. Links to those YouTube videos are shown in the building examples below.

Interactive Website




"High Rise Living" TV Series


**Key Outcomes:**

AGL has made progress in recent years, gaining natural gas service in several major Atlanta metro-area projects. Since 2014, AGL has secured contracts to serve 33 new developments

totaling 4,730 individual units, 2,674 of these committed in 2015-2016. These latter 2,674 units are generating more than $350,000 in annual revenue, plus additional revenue from commercial meters for amenities and makeup air units for common areas in the building. In 2016, AGL is trending to add another 2,000 multifamily units in the Midtown/Buckhead corridor.

| Key Results | |
|---|---|
| 4,370 customers added | More than $500,000 in annual revenue |
| Four 30 minute "High Rise Living" TV segments shot and aired | Multifamily contractor alliance formed and bid estimate produced |
| Multifamily web page created | Architect and engineer lunch-n'-learn Program created |

Case study examples of successful project are shown below.

**Alta Midtown – 369 units**
***Under Construction***

- Natural gas equipment "shoehorned" into a TE building template
- Natural gas heating, water heating, cooking and drying
- Venting challenges took multiple meetings to resolve

Video found at: https://www.youtube.com/watch?v=nexsSQjMM8w

**Modera Midtown - 435 units**
***Under Construction***

- Gas heat, water heat, and cooking.
- Central boilers in the tower, tankless/air handler in the low rise
- Designed with gas in mind from the start

Video found at: https://www.youtube.com/watch?v=hfbZUSsW5RM

**Ponce City Market - 250 units**
***Completed***


- Largest adaptive reuse project in Atlanta history—1.1 million square feet of the historic Sears and Roebuck building
- Gas cooking was attractive enough for the designers to warrant inclusion without cash incentives

Video found at: https://www.youtube.com/watch?v=QnMaRbrGOas

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**Member Company Marketing Case Study**
**Atmos Energy Multifamily Program**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | Affordable | **Market Rate** |
| **Building cycle** | **New construction** | Retrofit |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** The MidTex Division's multifamily program provides opportunities for builders to realize revenues from selling easements to Atmos Energy for on-property distribution mains. These revenues may offset costs of gas appliance installations involved in building these projects. This program has enabled the company to work with several project developers to utilize natural gas at competitive costs.

**Background:** In recent decades, multifamily markets in the Atmos Energy service area had gone almost completely all-electric. Heating and hot water costs were seen as unimportant, electric cooling is required in that climate, and the low first costs of all-electric utility service were compelling to developers. More recently, the company saw an opening in the rising demand for gas cooking; developers were installed gas ranges without individual metering. This, however, imposes an additional inspection burden for the gas piping into dwelling units, which Atmos Energy saw as an opportunity to provide individually-metered service. A task force was established to assess the potential, define the product, and develop a sales plan.

**Key program features:**

- **Target market.** The Atmos Energy task force began by commissioning a local engineering firm with multifamily construction experience to study comparative costs of gas vs. electric service for multiple end uses. This included estimating reduced electric service costs where gas is substituted, e.g. reduced electric service amperage when hot water heaters are gas rather than electric. This study also helped focus in on priority burner tips, including cooking and hot water; in the Dallas metro market, heating loads are so small that gas equipment can be hard to size appropriately, and in any case imposes high first costs compared to competitive options. This study helped the company focus on new multifamily construction with emphasis on cooking and water heating service; especially in higher-end projects, gas cooking especially is viewed as a desired amenity.
- **Strategic approach.** As noted above, current regulations required inspections plus needed maintenance for building owners/operators in any master meter applications. Individual unit meters eliminate these activities for the property manager / owner but requires Atmos Energy owned mains/lines up to the meters on or in the property. The installation of mains on/in the property will utilize an easement (and corresponding agreement) between Atmos Energy and the building owner including the associated compensation. This could become an offset for the building owner towards the higher upfront cost of gas installations. In addition Atmos Energy believes this results in a safer operating environment for the gas facilities on the property. Coupled with a total

marketing and technical support effort, this approach can make gas service more competitive by offsetting the added construction costs that gas service adds to the project. The main features of the program design are:

- Developer specifies individually-metered gas service for water heating and cooking, plus dryer stub and fireplace (if applicable).
- Heating is offered as an option, as is tankless water heating and combination designs that utilizes the domestic hot water in conjunction with a hydronic coil in the air handler.
- Atmos Energy provides the approach main, distribution pipes inside the complex, service lines, meters, etc. at no cost to developer.
- Atmos Energy performs leak inspection surveys as required and perform all maintenance through individual-unit meter, taking this burden off the developer.
- Atmos Energy negotiates a private easement price based on market value.

- **Key techniques.** In addition to the value of the easement purchase offer, Atmos Energy established an integrated product offering to coordinate customer service, engineering, meter setting, and other aspects of the line extension process. In taking this product to market, program staff learned several techniques:
  - **Understand the project.** Campus-style, low-rise complexes present fewer obstacles than high-rise single-building projects, because the former configuration simplifies the easement purchase and related aspects of gas service extension. High-rise projects require vertical-main designs that require more integrated design with the overall project architecture and engineering.
  - **Get in early.** Designing the project to accommodate gas lines, meter rooms, venting, and related infrastructure requires engaging the developer and A/E firm very early in the design process.
  - **Reach out actively.** Program staff held "lunch and learn" sessions as well as individual outreach conversations to build relationships with key players in the real estate and design professional communities.
  - **Bundle the deal.** The program worked with Operations and Tech Services to provide key technical support for all aspects of installation. For high-rise projects, for example, this involves arranging to install 'vertical mains' with needed stipulations such as pipe and welding specifications, valving and ventilation requirements, and meter room locations. This also requires close coordination with the A/E firm working on the project.
- **Project Economics.** In recognition of Atmos Energy proving distribution mains and piping facilities up to and including regulators and individual meters, the builder must be willing to utilize natural gas in each unit and convey the necessary easements for the gas facilities the cost of said easement to be based on market rates and negotiated by parties. Combined with the desirability of gas for cooking and aesthetic uses like gas fireplaces, and the ability to reduce building owners' operating costs by individually metering units, Atmos Energy has had initial success in some projects in convincing developers to install individually-metered gas service.

**Key Outcomes:** Atmos Energy is still in the pilot phase with this program. One project that has gone forward is a 200-unit campus complex interested in individually-metered service for gas

cooking. The Atmos Energy team worked with the developer's engineers to devise a piping plan for the acreage, and conducted a survey to define the easement / right-of-way. The easement was negotiated based on market costs for that southwest metroplex area. The finalized easement payment was sufficient to reduce the gas appliances cost premiums to a negligible amount. The meters have been set and the developer / manager has reported high satisfaction. One lesson learned was that the cost of the survey (in the five figures) could be avoided by using the appropriate easement language, such as agreeing to set the easement as "X feet on either side of the installed distribution line," which the legal department has determined protects the utility and the developer. As of this writing, Atmos Energy has two other campus complexes committed to individual meter service for gas, and several other prospects in the pipeline.

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**Member Company Marketing Case Study**
**CenterPoint Energy Natural Gas Advantage Multi-Family Program**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | Affordable | **Market Rate** |
| **Building cycle** | **New construction** | Retrofit |
| **Construction type** | **High-rise** | Low-rise |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** CenterPoint Energy offers this program in its Houston, Texas service area, targeting multifamily new construction. The company provides an innovative product offering as the Natural Gas Advantage multifamily program with coordinated customer service, engineering, meter setting coupled with incentives to help builders and developers to install natural gas appliances in multifamily projects. The Natural Gas Advantage has enabled the company to gain significant market share in its service area.

**Background:** Like other gas utilities in warmer climates, CenterPoint Energy had seen its multifamily market share dwindle in recent decades. But beginning in 2003-2004, the company became more focused on marketing natural gas solutions in this market; by building up sales team, developing an integrated program strategy, offering multiple incentives, Natural Gas Advantage has gained substantial market share in multifamily new construction.

**Key program features:**

- **Target market.** CenterPoint Energy sees up to half of new construction in its service area going multifamily, and thus sees a large opportunity as well as an imperative to claim market share. While the economics of multifamily natural gas service present challenges, especially in terms of competing on first cost, it is also true that new construction is the best if not the only window of opportunity to capture part of this key market. Accordingly, the Natural Gas Advantage program focuses on cultivating relationships with developers, architects and engineers in the multifamily metro area market. Program staff also pay for data on upcoming projects, through http://www.multifamilydata.com/, and find this a helpful source to tap into the multifamily construction pipeline.

- **Strategic approach.** CenterPoint Energy has innovated with ways to help builders and developers offset the first costs of natural gas service. This is the key issue that gas utilities are finding in this market: the benefits of gas service appeal to many builders and developers, but most of those benefits flow to tenants. Developers are happy to market those benefits to prospective tenants, but their business decisions are first-cost-driven. So it's all about making gas competitive on a first-cost basis. The main features of the Natural Gas Advantage program design are:

    - Developer specifies individually-metered gas service for water heating and/or cooking, plus dryer stub and fireplace (if applicable).

- If central boiler system - construction charges are waived if the project is economically feasible.
- Heating is offered as an option, as is tankless water heating and combination designs that use the tankless burner for a heating coil in the air handler.
- CenterPoint Energy provides the approach main, distribution pipes inside the complex, service lines, meters, etc.
- Developer incentives are determined by such factors as cost to serve, gas load and number of units.
- CenterPoint Energy provides training to leasing staff so they can market the property more effectively using natural gas sales points
- CenterPoint Energy provides cooperative advertising, 50% of cost up to $2500. An example can be found at https://www.youtube.com/watch?v=4tiVtOWlqXw&feature=youtu.be

- **Key techniques.** CenterPoint Energy provides an integrated product offering to coordinate customer service, engineering, meter setting, and other aspects of the line extension process in addition to the incentives value related service cost offer. Key elements include:

  - **Get in early.** Designing the project to accommodate gas lines, meter rooms, venting, and related infrastructure requires engaging the developer and A/E firm very early in the design process. CenterPoint Energy's purchase of data from www.multifamilydata.com supports that effort.

  - **Bundle the deal.** The program works across CenterPoint Energy departments and teams to provide technical support for all aspects of installation, including installation of vertical mains, ventilation requirements, and rooftop meters and meter room locations.

  - **Incentives.** Projects may be able to leverage incentives through gas service cost incentives and through the Houston Electric Market Transformation programs. Under Public Utility regulations, CenterPoint Energy is able to leverage incentives from the Houston Electric Market Transformation Program as part of energy efficiency measures to pay developers to avoided peak demand impact. There is also an Energy Star Multi-family Program incentive for high-efficiency total building designs. .

**Key Outcomes:** Since launching in 2003-2004, Natural Gas Advantage has made significant progress in gaining natural gas service and individual metering in multifamily new construction. Staff estimates that 30-40% of new multifamily projects are getting natural gas service, with over 3,000 dwelling units built with gas service in Q1 2016 alone. The program's brochure illustrates a number of examples, including the examples on following pages.

**Member Company Marketing Case Study**
**Con Edison's Area Growth (Oil to Gas Conversion) Program**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | **Owned** |
| **Income** | Affordable | **Market Rate** |
| **Building cycle** | New construction | **Retrofit** |
| **Construction type** | **High-rise** | **Low-rise** |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** Con Edison currently offers its Area Growth Program within in its gas service territory in New York City, and is anticipating expanding this program into parts of Westchester County, north of the city. The Area Growth Program is a flexible and scalable growth strategy to expand its natural gas business, while minimizing the financial impact on its current firm customer base. This program provides a utility-commission-approved, area-specific incentive program for existing buildings to convert from oil to natural gas heating, within defined geographic boundaries and timelines. In addition, the company leverages its portfolio of energy efficiency and gas conversion incentive programs. The Area Growth Program has been very successful in serving multifamily and commercial buildings over the past five years, and has been recognized as a model for growth by many of the company's key stakeholders, including our state regulator, the New York State Public Service Commission.

**Area Growth Program Background:** Traditionally, Con Edison has converted buildings from oil to natural gas heating on an individual basis:

1) We received an individual gas service request for a building;
2) We determined the associated individual engineering solution;
3) We analyzed the expected construction cost, applied the applicable tariff entitlement and estimated revenues; and
4) We scheduled construction individually and connected the customer.

The Area Growth Program allows us to:

1) Analyze aggregated revenues and costs for all buildings in a defined geographic area;
2) Determine a longer-term engineering solution for that area and the overall gas system that allows for future expansion;
3) Increase probability of offering more customers a zero capital cost connection opportunity; and
4) Obtain permits from the applicable agencies and perform street construction in a coordinated way by constructing "once" in accordance with a communicated timeline and schedule.

Prior to 2011, New York City had identified ~10,000 large buildings that were heating with heavy #6 and #4 heating oils (~7,000 in our service territory and ~3,000 in National Grid's territory). In April 2011, to support the Mayor's particulate matter reduction goals, NYC passed a regulation that phased out the use of these polluting fuels to help improve the air quality in NYC. The regulation required buildings to convert to an alternate heating source as soon as 2015 (e.g., to #4 oil, #2 oil natural gas, steam). This regulation, combined with the financial and

environmental benefits that natural gas has enjoyed over oil, lead to a significant increase in demand for natural gas. In response, Con Edison created the Gas Conversion Group, which was designed specifically to target and serve buildings in NYC interested in converting from oil to natural gas. In 2012, this group developed this Area Growth approach as a new way of doing business and to accelerate the ability for customers to convert to natural gas. Con Edison developed ~100+ Area Growth Zones over a seven-year Area Growth Program (2013-2019) to provide every oil-heated building in the company's NYC gas service territory an opportunity to participate and convert to natural gas.

Con Edison also administers energy efficiency programs for gas and electric customers. Depending on the project, rebates and other services from these programs can enhance project economics. The City of New York has also played complementary roles to some Con Edison program initiatives. From 2012 to 2015, the City mounted the Clean Heat program, designed to improve air quality by converting old boilers and furnaces from polluting oil fuels to cleaner fuels. NYC Clean Heat helped spur nearly 6,000 heating oil conversions across the city from No. 6 or No.4 oil to cleaner fuels, including natural gas, reducing PM 2.5 particulate emissions from these buildings by about two-thirds. NYC Clean Heat has since transitioned into the NYC Retrofit Accelerator, a one-stop resource to help building owners and operators increase the value and sustainability of their properties through energy and water upgrades.

Con Edison identified the following major benefits and barriers to the Area Growth Program:

**Key Benefits:**

Strategic and Creative Approach: Instead of an entitlement, the tariff modification allows us to use an economic test that aggregates revenues and costs by area to increase the probability of offering all customers a zero capital connection cost.

Asset Optimization/Cost Mitigation: Allows the company to build efficiently and optimize existing gas infrastructure assets, while minimizing cost of construction and disruption to neighborhoods by building once and collaborating with the respective permitting agencies in a comprehensive, coordinated way.

Set and Meet Customer's Expectations: With specific timelines and deadlines, both the customer and company know what is required, where they are in the process and when to expect the oil to gas conversion to be completed.

Geographically-focused marketing: Allows the company (sales team, engineering and construction) and interested parties (plumbers, engineers, energy partners, etc.) to market their services to a target audience in specific areas.

Program Coordination/Integration: The Area Growth Program coordinates with Con Edison's portfolio of energy efficiency programs for mutual referrals.

Proven Results: In 2015 and 2016, 100% of Area Growth applicants were provided a zero capital costs connection option, which is the best possible option we can offer.

**Barriers:**

Internal costs: While Con Edison is able to provide most/all of its Area Growth customers a zero capital cost option to the building's property line, the other costs to convert (e.g., new equipment, chimney liner and internal piping) are the sole responsibility of the buildings. These costs can be significant and may be outside of the building's acceptable payback criteria, especially with competing capital projects, such as necessary/emergency repairs and city and state mandated work to comply with building codes and other efforts. It is essential for the success of the Area Growth Program for buildings to assess their internal conversion costs as early in the process as possible.

Commodity Price: Most multifamily buildings, regardless of their ownership structure, whether privately-owned or co-op/condo, have "baked" fuel costs into the operating budgets and pass all of those costs along to tenants. Therefore, there is not as much motivation for the owner/board to try and lower the building's operating costs because they will not directly benefit from the potential savings of converting to natural gas, which also may require a significant up front cost to convert.

Additionally, oil prices have fluctuated wildly in recent months and customers need significant reassurance that the conversion payback makes sense for the building.

**More information on Con Edison's Area Growth Program can be found at:**
http://www.coned.com/gasconversions/area-growth.asp

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**Member Company Marketing Case Study**
**PSE&G Residential Multifamily Housing Program**

| Market Segmentation Map (Bold type signifies affected segments) | | |
|---|---|---|
| **Ownership** | **Rented** | Owned |
| **Income** | **Affordable** | **Market Rate** |
| **Building cycle** | New construction | **Retrofit** |
| **Construction type** | **High-rise** | **Low-rise** |
| **Demographics** | **Baby Boomers** | **Millennials** |

**Summary:** PSE&G, New Jersey's largest electric and gas utility operates its Residential Multifamily Housing Program to encourage the installation of energy efficiency improvements in eligible multifamily housing projects. The program provides participants with cost incentives, upfront payments to eliminate the building owner's need to secure a loan to fund the capital investment in energy efficiency upgrades before the project begins, and on-bill financing for the customer share of the program costs. The customer is able to afford the energy efficiency investment, while at the same time recognizing the associated energy efficiency benefits immediately upon installation, before repayments begin. The full cost of energy efficiency upgrades (including engineering, the energy audit and the cost of construction), are covered through a combination of PSE&G's buy-down/grant and zero-percent on-bill repayment/financing. The PSE&G on-bill payment option is a critical component to the success of the Multifamily Program. Eligible participants include low-rise and high-rise multifamily buildings with five or more units, where natural gas and/or electricity are provided by PSE&G, and may be either master metered or individually metered for utility services.

**Background:** PSE&G's Multifamily Housing Program was designed to address common market barriers facing multifamily building owners including lack of access to capital, lack of technical expertise, the landlord-tenant split-incentive problem, and the larger policy goal of preserving the affordability of multifamily housing. PSE&G's program is delivered using a multi-faceted approach by providing full program oversight from project inception to conclusion, including the review of program applications and energy audit results, project engineering and site inspections.

**Key program features:**

- **Target Market.** Existing residential multifamily housing facilities which meet program participation criteria.
- **Strategic Approach.**
    - **Provide technical support.** The program offers a free, in-depth energy audit and follow-up analyses including engineering to help identify and qualify projects.
    - **Buy-down incentives.** The program's incentive structure is are designed to buy-down project costs by 6 years to no less than a 3-year simple payback; typically covering half to two-thirds of the total project cost.
    - **Provide attractive financing.** The program offers customers the ability to repay their share (after the buy-down incentive) of the project cost at zero percent interest on their PSE&G bill.
    - **Bundled services.** The program provides oversight and support from project inception to conclusion eliminating market barriers to participation.

- **Program Process**
    - Multifamily property owners receive a professional energy audit with a detailed report of energy conservation measures (ECMs) having a simple payback of 15 years or less.
    - A project cost-effectiveness analysis determines an approved package of ECMs. The program provides for both electric and gas ECMs, and eligible measures include lighting, HVAC systems including gas conversions ventilation improvements, and appliances such as refrigerators, water saving devices and controls.
    - PSE&G's program incentive "buys-down" project costs by six years, but to not less than three years.
    - The customer's share of the project cost is repaid at zero percent interest on the customer's monthly PSE&G utility bill in one lump sum payment if they choose. Repayment terms are ten years for New Jersey Housing and Mortgage Finance Agency (NJHMFA) mortgaged projects, and five years for Non-NJHMFA projects.
- **Additional Program Details**
    - ECMs can be installed both building common areas and individual living units/tenant spaces.
    - In addition to energy efficiency, most projects provide the additional benefits of reduced maintenance costs and increased comfort and safety for building residents.
    - The program covers all project costs upfront, including project design, measure installation, contractor bidding, administration and construction thus eliminating the need for building owner's to secure a loan to fund the capital investment before the project begins. The customer contracts with their own installation contractor to install the approved ECMs.
        - PSE&G provides 30% of the project construction costs at the start of the approved project.
        - Additional "progress payments" can be made as the project progresses totaling another 50% of the project cost.
        - The remaining 20% of the project costs are paid to the customer at the conclusion of the project, after commissioning and final inspection.
        - The customers also have the benefit of continuous commissioning for some of the ECMs installed, which provides additional assurances that performance is being achieved.

**Program Outcomes:**

- The program has invested over $39 million to date, with an additional $35 million in program funding approved by the New Jersey Board of Public, utilities bringing total program funding to $74 million.
- The program has received over 200 project applications and served over 250 buildings and 10,000 residents, saving more than 2 million therms and over 9 million kWh. Of the 45 projects completed and currently in the repayment phase) all are repaying their share of the project costs through on-bill financing, with no defaults to date.
- The program has addressed a number of facilities with oil heat to explore the cost effectiveness of oil-to-gas conversions. To date, eight oil-to-gas conversion projects have

been completed; six were low-income senior facilities and two were low-income housing. Those projects include over 1,600 living units and the number of oil-to-gas conversions under the program is expected to increase.

**Boulevard Senior Apartments**
**Passaic, New Jersey**

The Boulevard Seniors Housing Facility is a 12-story, 146,500 SF, multifamily building built in 1978. There are a total of 187 single bedroom dwelling units and the facility is fully occupied.

PSE&G proposed and approved a package of energy conservation measures (ECMs) through its Residential Multifamily Housing Program. The total project cost for the installation of the ECMs, including engineering, was $568,270.39. The customer was responsible for repaying their share of the project cost which was $147,058.00, over a period of 10 years in equal monthly installments on their PSE&G bill.

Installed Measures:

- Lighting Upgrades
- Variable Speed Heating Pumps
- Premium Efficiency Motors
- Programmable Thermostats
- Boiler Replacement
- Valve Insulation Blankets
- Domestic Hot Water Improvements


Originally, the central heating plant consisted of two (2) 6,277 MBH Cleaver Brooks Model CB 800-150 fire tube boilers with #2 oil burners using approximately 90,000 gallons of fuel a year. The project replaced the two existing oil-fired boilers with three gas-fired, high-efficiency AERCO Benchmark BM-K2.0LN condensing boilers.

## Project Results

Post project evaluation performed in 2014 by a third party consultant, Cadmus, indicated successful results for the customer with the replacement gas fired boilers saving the equivalent of 14,250 gallons of fuel oil annually.

A regression analysis of the customer's energy consumption history suggests a current reduction of 109,104 kWh and 10,293 therms from pre-project levels. The lower than expected therm savings appear to be a result of less than optimal operation of the heating plant during the recent evaluation period. Overall, the customer is seeing the benefit of greater on-bill savings than originally estimated.

| BASELINE CONSUMPTION (2009-2010) | PREDICTED SAVINGS | WEATHER ADJUSTED SAVINGS (2015-2016) | REALIZATION RATE |
|---|---|---|---|
| **607,400 kWh** | **101,130 kWh** | **109,104 kWh** | **108%** |
| **112,938 Therms** | **36,129 Therms** | **10,293 Therms** | **28%** |
| **104 kWsp** | **10.5 kW sp** | **24 kW sp** | **229%** |

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# APPENDIX A

## State Regulatory Actions on Master Metering Restrictions

**California**

Instituted 3 year pilot program designed to incentivize voluntary conversions of master-metered mobile home parks. Utilities will be authorized to fully recover the reasonably incurred, actual costs of the conversion program in distribution rates. Reasonable incremental expenses for program development and administration, not otherwise recovered in rates, should be entered as incurred for annual recovery in the utility's pilot program balancing account. (Decision 14-03-021, issued on March 13, 2014 in Rulemaking 11-02-018)

San Diego, CA enacted an ordinance in 2010 that requires sub-meters to be installed in every new multi-unit building with at least three residential units and an existing multi-unit building with at least three residential units, whenever the entire potable water supply piping is being replaced. It exempts existing multi-unit buildings with individual units that are served by more than one cold water riser and one hot water riser system. The ordinance also regulates sub-metered billing by requiring monthly or bi-monthly billing; requiring fixed charges to be allocated equally among units; requiring variable charges to be charged at the same rate as in the water utility's bill; allowing an administrative fee up to $4 per month; allowing a late fee up to $10 per billing cycle; and setting bill content and notification requirements.

The commission shall require that, whenever gas or electric service, or both, is provided by a master-meter customer to users who are tenants of a mobile home park, apartment building or similar residential complex, the master-meter customer shall charge each user of the service at the same rate that would be applicable if the user were receiving gas or electricity, or both, directly from the gas or electrical corporation. The commission shall require the corporation furnishing service to the master-meter customer to establish uniform rates for master-meter service at a level that will provide a sufficient differential to cover the reasonable average costs to master-meter customers of providing submeter service, except that these costs shall not exceed the average cost that the corporation would have incurred in providing comparable services directly to the users of the service (Cal. Public Utilities Code §739.5).

**Minnesota (Electric)**

A public utility and the Public Service Commission cannot limit the availability of submetering to a building occupant when the building is served by a public utility's master meter which measures the total electric energy delivered to the building (Minn. Stat. §216B.022).

**Nevada**

In 2012, following an investigation performed by the Public Utilities Commission of Nevada (Docket No. 12-06043), the Commission determined that safety regulations were becoming too complicated and onerous for small master meter operators and that the only viable solution to address these aging master meter systems was to have the systems replaced by the LDC.

As part of the program, master meter systems are replaced in their entirety by the LDC, as LDCs will not assume ownership and/or operation of existing systems. Some contribution by the master meter operator is required, with 20 to 30 percent of the conversion cost having to be contributed

funds or contributed work by the master meter operator. The LDC costs are included in general rates for full recovery.

**New York**
The practice of master metering new apartment buildings was banned by the PSC in 1976. See Opinion No. 79-24, Case 26998--Proceeding on motion of the Commission as to rent inclusion and submetering, Opinion and Order on Submetering of Electricity and Gas, at 3-5 (Nov. 14, 1979).

**North Carolina**
Each individual dwelling unit shall have individual electric service with a separate electric meter and, if it has natural gas, individual natural gas service with a separate natural gas meter, which service and meters shall be in the name of the tenant or other occupant of said apartment or other dwelling unit. No electric supplier or natural gas supplier, whether regulated public utility or municipal corporation or electric membership corporation supplying said utility service, shall connect any residential building for electric service or natural gas service through a master meter (N.C. Gen. Stat. §143-151.42)

**Texas (Electric)**
A political subdivision may not authorize the construction or occupancy of a new apartment house, including the conversion of property to a condominium, unless the construction plan provides for the measurement of the quantity of electricity consumed by the occupants of each dwelling unit of the apartment house, either by individual metering by the utility company or by submetering by the owner. This section does not prohibit a political subdivision from issuing a permit to a nonprofit organization for construction of a new apartment house for occupancy by low-income elderly tenants if the nonprofit organization establishes, by submitting engineering and cost data and a sworn statement, that all cost savings will be passed on to the low-income elderly tenants (Tex. Utilities Code Ann. §184.012).

**Virginia**
Columbia Gas of Virginia was given regulatory approval to take over or replace master meter systems in their service territory. They are allowed to recover up to $1 million per year.

# APPENDIX B

## National Benefits of Natural Gas Service: Potential Impacts of NAECA-Minimum Gas Space Heating and Water Heating for Multifamily Markets

This table summarizes the estimated benefits of converting multifamily units from electricity to natural gas. Using federal data on residential energy consumption, we began by listing the number of dwelling units using natural gas vs. electricity for space heating and water heating as of 2009.

To estimate the dollar savings to end users from converting all electric space heating and hot water end uses to natural gas, we compared average annual energy costs for typical NAECA-minimum gas and electric technologies (as shown in Exhibit 2 of the main report) to estimate the annual energy cost savings per dwelling unit. We then multiplied the per-unit savings by the applicable number of dwelling units to yield total national dollar benefits to end users. For example, for space heating in 2-4 unit dwellings, the annual savings from converting from NAECA-minimum electric to NAECA-minimum gas technology was $36 per dwelling unit; multiplying by 3.3 million dwelling units yielded a total benefit of $119 million.

A similar method was used to estimate Btu savings, using the per-unit Btu values found in Exhibit 2, calculating the difference between gas and electric technology Btu consumption, and then multiplying by the applicable number of dwelling units.

| End Use Type | Building Type | Natural Gas | Electricity | Potential Benefits from Conversion to Natural Gas |
|---|---|---|---|---|
| Dwelling Units (Millions) | | | | |
| Space Heating | 2-4 Dwelling Units | 4.6 | 3.3 | |
| | 5+ Dwelling Units | 7.2 | 8.9 | |
| | Total | 11.8 | 12.2 | |
| | | | | |
| Water Heating | 2-4 Dwelling Units | 5.2 | 3.3 | |
| | 5+ Dwelling Units | 9.2 | 8.7 | |
| | Total | 14.4 | 12 | |
| Customer Bill Expenditures ($ Million) | | | | |
| Space Heating | 2-4 Dwelling Units | $3,360 | $1,100 | $119 |
| | 5+ Dwelling Units | $3,120 | $2,390 | $320 |
| | Total | $6,480 | $3,490 | $439 |
| | | | | |
| Water Heating | 2-4 Dwelling Units | $1,220 | $920 | $498 |
| | 5+ Dwelling Units | $1,290 | $1,990 | $1,314 |
| | Total | $2,150 | $2,910 | $1,812 |

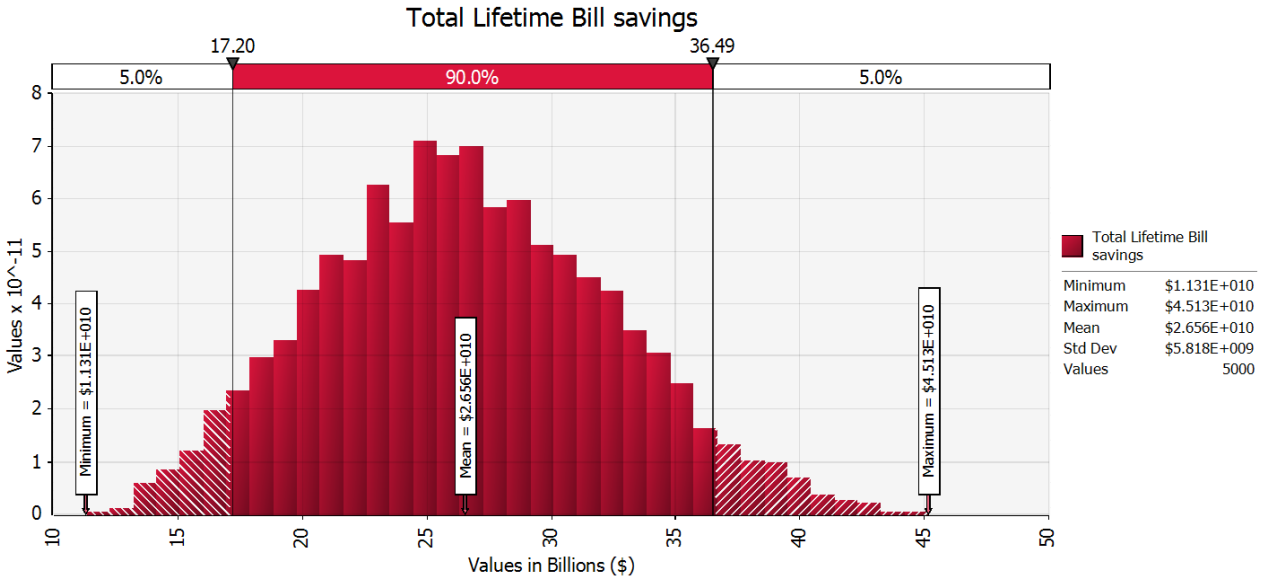
| | | | | |
|---|---|---|---|---|
| | | **Total Customer Bill Savings** | | **$2,251** |
| Site Energy Consumption (Trillion Btu) | | | | |
| Space Heating | 2-4 Dwelling Units | 267 | 32 | -26 |
| | 5+ Dwelling Units | 247 | 71 | -69 |
| | Total | 514 | 103 | -95 |
| | | | | |
| Water Heating | 2-4 Dwelling Units | 98 | 26 | -19 |
| | 5+ Dwelling Units | 103 | 57 | -51 |
| | Total | 201 | 83 | -71 |
| | | **Total Site Btu Savings** | | **-166** |
| Source Energy Consumption (Trillion Btu) | | | | |
| Space Heating | 2-4 Dwelling Units | 294 | 100 | 9 |
| | 5+ Dwelling Units | 272 | 223 | 23 |
| | Total | 566 | 323 | 32 |
| | | | | |
| Water Heating | 2-4 Dwelling Units | 108 | 82 | 41 |
| | 5+ Dwelling Units | 113 | 179 | 109 |
| | Total | 221 | 261 | 150 |
| | | **Total Source Btu Savings** | | **182** |

**Source: U.S. DOE Energy Information Administration, 2009 Residential Energy Consumption Survey**

## Supplemental probabilistic analysis

While the scope of this project does not permit a full-blown potential study for the benefits of natural gas conversion, ICF developed a limited snapshot analysis to provide further detail on this topic, using a Monte Carlo simulation technique to estimate lifetime energy bill savings for the gas technologies shown above.

**Probabilistic Estimate of Lifetime Energy Bill Savings for Natural Gas Conversions**




This graphic shows that lifetime savings for gas conversions in multifamily markets would likely fall in the range of $17.2 - $36.5 Billon, with a mean value of $26.6 Billon (at the 90% confidence level).

This analysis, while somewhat more sophisticated that the simple indicative assessment shown above, did not consider key issues that would be important in utility regulatory proceedings, such as cost-effectiveness, customer participation rates, current or project market shares for equipment sales. It did segment the analysis into a more differentiated set of space heating and water heating measures, using the data in Exhibit 1 for baseline and efficient model values. It also applied probabilistic analysis to the EIA housing characteristic data to bracket the number of dwelling units of each type. Finally, it applied judgment estimates on technical feasibility and market acceptance to help bound value ranges.

# APPENDIX C

## EZ Retrofit: an Energy Efficiency Assessment Tool[11]

EZ Retrofit is a free, do-it-yourself Excel-based audit tool that gives multifamily property owners and managers an easy way to identify cost-effective energy and water efficiency upgrades. EZ Retrofit runs in Excel and streamlines the building review process. It serves as an alternative to the traditional energy audit; it gives the multifamily sector an easy way to identify cost-effective energy and water retrofit opportunities. It provides specific cost and savings estimates for each retrofit measure based on each building's characteristics and utility consumption. The tool enables owners to customize a retrofit scope for their individual property.

After inputting information about your current systems, EZ Retrofit recommends improvements to help you maximize savings. For each recommendation, you receive detailed costs and savings estimates. Plus, you get a graphic visualization of retrofit savings and a customized audit report for your building that you can download and share with colleagues.

EZ Retrofit takes a whole building approach to reducing energy and water costs and addresses ten building systems:

- HVAC (In-unit / Central Equipment & Programmable Thermostat)
- DHW (In-unit / Central Equipment, Pipe Insulation, & Tank Jacket)
- Clothes Washers (Apartment / Common Area)
- Kitchen Appliances (Dishwasher, Refrigerator, & Freezer)
- Lighting (Apartment / Common Area Lighting & Lighting Controls)
- Motors and Controls (VFDs on Pumps/Fans and Demand Control DHW Pump)
- Duct Sealing
- Air Sealing
- Water Fixtures (Low-Flow Aerators and Showerhead)
- Water Conservation (Low-Flow Toilets)

### *EZ Retrofit Tool's Features*

The tool is intended to be an easy-to-use tool for non-technical users, but it has several powerful features:

- Considers interactive effects of ECMs
- Calibrates results based on utility bills, if available
- Associates savings to owners and tenants
- Allows users to override baseline and cost assumptions
- Creates customized EE improvement packages based on user's priorities

11 Steward for Affordable Housing for the Future (SAHF) developed the EZ Retrofit Tool with contractors ICF International and Bright Power, Inc. under a grant from the U.S. Department of Housing and Urban Development's Energy Innovation Fund.

- Adjusts retrofit costs by regional factors developed based on location for each system type (CCI)
- Provides multiple options to view results and to conduct analyses- graphs, audit report, and "Select Criteria"
- Includes a User Guide embedded into the Tool ('How Do I Do It" buttons in EZ Path & "Help/User Manual" buttons in Advanced Path)
- Provides printable checklists so users can collect site data on paper and enter it into the Tool wherever convenient

### *EZ Retrofit – Five Simple Steps to Savings*


### *EZ Retrofit - Additional Information and Resources*

Additional information and the following resources on EZ Retrofit can be found at the SAHF website: [www.sahfnet.org/ezretrofit.html](www.sahfnet.org/ezretrofit.html)

- User Guide
- Data Collection Checklist
- EZ Retrofit FAQs
- Video Tutorials
- Case Studies
- Webinar
- Benefits Beyond Energy And Water Cost Savings

*EZ Retrofit Factsheet*

# EZ Retrofit

## Save Energy, Water, and Money at Your Multifamily Property

Every building has opportunities to save money by making energy and water efficiency improvements. EZ Retrofit is a free, do-it-yourself audit tool that gives multifamily property owners and managers an easy way to identify cost-effective energy and water efficiency upgrades that can help:

- Reduce energy and water consumption and costs
- Improve indoor air quality and tenant comfort
- Attract and retain tenants
- Increase property efficiency
- Reduce maintenance and extend equipment life

EZ Retrofit runs in Excel and streamlines the building review process. EZ Retrofit considers how building systems can work together to effectively reduce energy and water use and costs. EZ Retrofit can be used for small to medium-size multifamily properties in any climate zone.

### EZ Retrofit Takes a Whole-Building Approach to Energy and Water Efficiency

Understand how to maximize energy and water efficiency when you combine improvements. More upgrades mean more savings and an improved building.


SAHF

## How EZ Retrofit Works

Start by entering information about your building's characteristics, including utility data. Based on this information, EZ Retrofit assesses energy and water savings potential for your building, comparing site energy use intensity and water use intensity with similar buildings. You then add more information about your building's systems, choosing either the EZ Path or the Advanced Path. EZ Retrofit offers a simple data collection **checklist** for your convenience in gathering and entering your data.

EZ Retrofit recommends system improvements to help you maximize savings. For each recommendation, you will receive a detailed analysis that includes potential consumption and cost savings, installation cost estimates, expected useful life, and payback period. Plus, you get a graphic visualization of retrofit savings and a customized audit report for your building that you can download and share with colleagues.

## Choose Your Path To Savings

### EZ Path

Quickly assess opportunities for energy efficiency improvements in 10 categories.

Only minimum data needed.

Ideal for buildings with a simple central heating and cooling system.

Building data you enter in EZ Path is automatically entered in Advanced Path.

### Advanced Path

Easy-to-use Excel spreadsheet.

Start with Advanced Path or add greater detail to EZ Path data.

Ideal for buildings with more complex heating and cooling systems.

Customizable with your own equipment efficiency, usage, and cost information.

## Start Saving Today

**Learn more about EZ Retrofit and how energy and water efficiency upgrades can enhance tenant comfort and improve your bottom line.**

Visit **sahfnet.org/ezretrofit.html** or email **EZRetrofit@sahfnet.org.**

**Stewards of Affordable Housing for the Future (SAHF)** developed EZ Retrofit under a grant from the U.S. Department of Housing and Urban Development and in collaboration with affordable housing owners and managers and housing industry partners. Launched in 2003, SAHF is a network of 11 not-for-profit members who acquire, preserve, and are committed to long-term affordability of multifamily rental properties for low-income families, seniors, and disabled individuals. SAHF members own and operate housing in 49 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands, providing homes to more than 115,000 low-income households.

# APPENDIX D

## Natural Gas Utility Multi-family Buildings Incentive Programs

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
|---|---|---|---|---|---|
| Alagasco (Spire) | AL | New Construction, Retrofit, New Low Income, Low Income Retrofit | Alagasco looks at each multifamily project as a stand-alone working with the Developer and ME to incorporate gas equipment into their project. No two projects have been the same, some require incentive dollars and some do not. | Offer direct financial incentives based on project ROI. The amount of funding varies based upon the desired ROI. | Ratepayer funded |
| SoCalGas | CA | New Construction, Retrofit, New Low Income, Low Income Retrofit | Tariff Rule 20 provides multi-family customers an allowance mechanism based on Allowance = NET REVENUE/Cost-OF-SERVICE FACTOR to offset their project's gas installation costs<br><br>For Multi-Family Residential Construction, SoCalGas offers an elevated pressure program that enables developers to reduce plumbing costs by receiving elevated pressure at 2psig. To qualify, the development must install gas space and water heating in each dwelling unit (Central units do not qualify) and have at least 3 additional end uses (4 additional end uses if gas fireplaces are planned). | Water heating<br>Space heating<br>cooktop and oven<br>dryer stub<br>space cooling | Ratepayer funded |
| Atlanta Gas Light | GA | New Construction, Retrofit, New Low Income, Low Income Retrofit | AGL looks at each multifamily project as a stand-alone project working with the Developer and Mechanical Engineering firm to incorporate gas equipment into projects. | Offer direct financial incentives up to $1300 per apartment unit. The amount of funding varies based upon ROI requirements. | Funded with shareholder monies. |
| Avista Utilities | ID | New Construction, New Low Income | Incentives are available to multifamily developers who install natural gas space and water heating measures rather than electric. Multifamily is defined as 5 or more units per | An incentive of $3,500 per unit is available for installation of natural gas space | Ratepayer funded |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
|---|---|---|---|---|---|
| | | | building for this incentive. Incentives are available for new construction only. Supplemental electric heat is allowable in the units as long as 75% of the unit is heated with natural gas. Qualifying water heating applications can either be individual natural gas hot water heaters in each unit or a central natural gas hot water system. | heat and natural gas water heat. | |
| Northern Indiana Public Service Company | IN | New Construction, Retrofit, New Low Income, Low Income Retrofit | NIPSCO's tariff allows for incentives based on margin credits applied toward the project's cost. | Installation costs are multiplied by a factor of 0.52. This multiplied factor includes overhead costs and is subtracted from the customer's responsibility for cost. Credits are then calculated based on the 6 year margin for each meter and are weighed against this installation cost. The balance, if any, is the responsibility of the customer. (b) Maximum if $1,800/residential meter. | Funded using the expected 6 year residential margin for each residential meter and applying these as credit toward the project installation costs. In addition, for rural gas customers, there is an additional 20 year margin test. The rural customer can use which is more advantageous to his situation. In the 20 year test, the total cost of the project minus 13% overhead (87% of project cost) is compared to 20 years of margin. If 20 years of margin is greater than 87% of the project cost, there is no charge to the customer. If it is not, the customer owes only the |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
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| | | | | | difference. The costs are covered through NIPSCO's Transmission, Distribution and Storage System Improvement Charge. |
| Columbia Gas of Kentucky (NiSource, Inc.) | KY | New Construction & Retrofit | Not exclusive to multi-family. Provides first 100 feet of main line for free for new meters. | Free main line | Funded through base rates |
| Columbia Gas of Massachusetts | MA | Retrofit, Low Income Retrofit | Has a tariff section to address cost barriers. Multi-family apartment or condominium facilities with five units or more per property using natural gas for space and/or water heating are eligible to participate in the program. | The company will pay 50-100% of the installed cost, up to a maximum of $50,000 | Funded through EE program and a special rider. |
| Columbia Gas of Maryland | MD | Retrofit, Low Income Retrofit | Has a tariff section to address cost barriers for low income. | Offers incentives through its EE programs. | Funded through EE program and a special rider. |
| Washington Gas Light Company | MD | New Construction, Retrofit, New Low Income, Low Income Retrofit | The company's tariff allows value of net present value (NPV) in excess of hurdle rate for Contributions in Aid of Construction (CIAC) contribution to be used to offset customer internal piping costs. Other programs include marketing outreach programs, including social media. | Washington Gas Light Company | |
| Laclede Gas and Missouri Gas Energy (Spire) | MO | New Construction, Retrofit, New Low Income, Low Income Retrofit | Main Extension Allowance | For prospective customers whose annual consumption is less than 6,000 therms, the company will install at no cost to the customer up to 175 feet of main and 75 feet of service. In no case, however, shall the company be obligated to invest more than $1,000 per | Ratepayer funded |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
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| | | | | customer in the aggregate for both the main extension and service extension. | |
| | | | Elevated pressure | Enables developers to reduce plumbing costs by receiving elevated pressure at 2psig. Eligibility is determined based upon availability and the characterization of appliances being installed. | |
| | | | Vertical Risers | Offered for mid and high rise multifamily developments. Eligibility is determined based upon availability and the characterization of appliances being installed. | |
| | | | Residential Rebate Program | Provides rebates to residential owners and customers for the installation of high efficiency heating systems, water heating systems, and thermostats. | |
| | | | Commercial Rebate Program | (Master Meter) Standard Rebates are offered on popular commercial equipment for pre-determined amounts to supplement the installation and improvement | |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
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| | | | | costs, including HVAC, boiler, water heating systems and food service equipment. Custom rebates are also available for specialized energy efficiency projects. The incentive amount is calculated by the amount of energy the project saves. Pre-qualification is required before beginning custom project. | |
| | | | Home Energy Advisor Tool | Provides an online analysis of monthly natural gas bill gives us an understanding of your existing energy habits, and helps prioritize any planned changes or upgrades. | |
| | | | Residential Direct Install Low-Income Program | Delivers natural gas savings and bill reductions to low income customers who occupy multifamily units. This will be achieved through direct install water consumption reduction and heat retention measures at no cost to participating units. Measures include thermostats, pipe wrap, low flow | |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
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| | | | | aerators and showerheads. (Currently expired but is being considered for extension – check with the company for any updates.) | |
| NJ Natural Gas | NJ | New customer additions for both the new construction and conversion markets | Tariff conditions allow for ten times annual distribution revenue credit towards the cost for gas main and service. Currently, the credit amount is approximately $5,000 for each new house heat account.<br><br>Organizational structure includes close working relationship with builder design teams. Staffing consists of dedicated marketing management, marketing consultants and field construction coordinators. | Safe, flexible gas main and service installations at little or no cost to builder. Help reduce builder first cost with 2PSIG option and multiple service placements on the building. | |
| Consolidated Edison Company of New York, Inc. | NY | Retrofit, Low Income Retrofit | Con Edison offers a 5-75 multifamily oil to gas conversion incentive program and offers a customized oil to gas conversion incentive program. | Offers direct financial incentives to property owners to defray costs with a maximum of $300 per apartment unit. | Funded through ratepayer funds. The oil to gas conversion incentives are recovered through the monthly rate adjustment. |
| Columbia Gas of Ohio (NiSource, Inc.) | OH | New Construction, Retrofit, Low Income Retrofit | Not exclusive to multi-family. Has a tariff section to address cost barriers for low income customers. Provides first 100 feet of main line extension for free for each meter added. Free footage applies to any new meter. | Free main line<br><br>Offers incentives through its EE programs. | Funded through a combination of the EE program, base rates, and a special rider. |
| CenterPoint Energy | OK | New Construction, Retrofit | Has gas Energy Efficiency (EE) program which includes fuel switching incentives for Multifamily Transformation from electric to high-efficiency natural gas. | The incentives are: $2,000 / furnace, $900 / water heater, $450 / dryer, and $300 / cooking range. | Ratepayer funded. The EE incentives are recovered through an approved EE rider. |

| Company | State | Eligibility | Tariff or Program | Incentives | Funding |
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| NW Natural | OR | New Construction, Retrofit | Incentives available to developer depending on type of appliances installed. Requires individual tenant metering. The company will also extend service line up through the building to individual meters at its expense. This program is applicable for developments with 5 units and more, excluding duplexes, triplexes, fourplexes and townhomes. | Up to $500/unit depending on number and type of gas appliances installed in individual apartments. | Shareholder incentives. |
| Columbia Gas of Pennsylvania (NiSource, Inc.) | PA | New construction, Retrofit, Low Income Retrofit | Has a tariff section to address cost barriers for low income customers. For all new customers and not exclusive to multi-family, tariff provides 150 free feet of main line extension for each new gas meter. This can be for new construction or retrofit. The tariff also allows for 150 free feet of service line for each gas meter. Has a tariff provision that allows payment of the uneconomic portion of the line extension to be paid over time by whoever is paying the bill. The charge stays with the meter until it is paid. | Offers incentives through its EE programs.<br><br>Main Extension<br><br>Service line | Funded through a combination of the EE program, special rider, and base rates. |
| CenterPoint Energy | TX | New Construction | Gas service cost incentives are part of the company's 'Natural Gas Advantage' program; in addition, the company is able to leverage incentives to install gas appliances instead of electric appliances through its electric utility Energy Efficiency (EE) program as part of the Multi-family Heating and Water Heating program. | The gas service incentives vary per project based on cost-effectiveness. The electric utility EE incentives are $250/water heating, and $350/heating. | Ratepayer funded. The electric utility EE program costs are recovered through an approved EE rider. |
| Columbia Gas of Virginia (NiSource, Inc.) | VA | New Construction & Retrofit | Not exclusive for multi-family, but a tariff rider for any new residential or commercial meter. Optional tariff provisions that allows a customer to pay a flat fee (currently $6.63/ month) for 240 months to cover the | | Funded through a rider |

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| | | | uneconomic portion of the line extension. | | |
| Avista Utilities | WA | New Construction, New Low Income | Incentives are available to multifamily developers who install natural gas space and water heating measures rather than electric. Multifamily is defined as 5 or more units per building for this incentive. Incentives are available for new construction only. Supplemental electric heat is allowable in the units as long as 75% of the unit is heated with natural gas. Qualifying water heating applications can either be individual natural gas hot water heaters in each unit or a central natural gas hot water system. | An incentive of $2,000 per unit is available for installation of natural gas space heat and natural gas water heat. | Ratepayer funded |
| Puget Sound Energy | WA | Retrofit, Low Income Retrofit | Has a tariff to address barriers. | Offers both financial and non-financial energy efficiency incentives, as well as construction allowance as part of line extension policies. | Through a combination of its DSM program and ratepayer funds. This program has a special rider for its funding. |