Energy Efficiency and the Customer Experience
It is impossible to understand the evolution of natural gas usage in buildings without recognizing the efficiency gains achieved during the past 40 years. Since the 1970s, customers have used less natural gas on average to heat their homes and businesses. As more customers have been added to the natural gas distribution system, lower consumption on average has offset these additions, resulting in a largely flat growth profile.

As such energy efficiency may serve as a demand side management tool, and many natural gas utilities recognize this. From near-term winter demand forecasting to long-term integrated resource planning, natural gas efficiency is often a component of system design planning, meeting customer requirements, and helping reduce costs to consumers.

Improvements in energy efficiency had a substantive and positive effect on the natural gas distribution system and on customers this past winter. Clearly, had efficiency not been a factor, utility systems would have been pushed harder, and customers would have paid more. Instead, energy efficiency in combination with relatively low natural gas prices, buffered consumers from what would have been higher bills this past winter.

This paper begins by exploring the historical trends in average natural gas use per customer. Then it explores how efficiency has shaped natural gas utility supply and demand planning, and it concludes by estimating the direct effects of energy efficiency on natural gas consumption and consumer bills this past winter heating season.

**Declines in Natural Gas Use per Customer**

One critical feature of natural gas use in buildings has been the steady and inexorable improvement in efficiency as measured by use per customer. Reductions in use per customer can be attributed to a number of factors including the following:

- Increasingly efficient end use appliances;
- Tighter building envelopes;
- Growing utility investments in energy efficiency programs; and
- Consumer conservation.

**Residential Energy Efficiency Gains**

The natural gas residential customer has shown substantial gains in energy efficiency. In 2003 the average customer used 84.1 Mcf on a weather normalized basis. A decade later the average annual use for a gas home was 63.2 Mcf, roughly a 25 percent decline. Technology improvement was the prevalent factor behind this trend: customers replaced their older gas appliances—particularly space heating units—with more efficient models. Additionally, new homes were built to higher standards and featured better insulation, windows, and doors.
Also contributing to this sector’s enhanced efficiency are utility and government programs that encourage energy conservation. Through these programs, utilities offered consumers equipment rebates and other financial incentives for efficiency improvements. Tax deductions were also in effect on investments that met or exceeded regulated standards for appliances or buildings. These programs accelerated energy efficiency gains in homes.

Predicting customer conservation is not an exact science. An AGA survey\(^1\) asked its members if they under or over predicted normalized residential demand this past winter. Of 37 responses, nine (24 percent) overestimated residential customer use by one to five percent. On the other hand, 29 utilities (76 percent) underestimated customer usage by one to twelve percent, with an average of five percent.

If utility underestimation of normalized demand was representative of the nation, it could indicate that the households did not conserve as expected, which would have required utilities to acquire more natural gas than planned. However, utilities were able to meet demand even when they underestimated. Based on this limited sample, it appears that residential market behavior may be in flux.

\(^{1}\) American Gas Association Bill Comparison Survey for March 2014, Question of the Quarter
COMMERCIAL ENERGY EFFICIENCY GAINS

Similar improvements in energy efficiency can be seen in commercial buildings. The decline in natural gas use per customer in the commercial sector has been steady since the late 1970s-early 1980s.

Demand in the commercial sector is much higher than the residential sector on average. However, the heating portion of a commercial customer’s natural gas consumption is typically lower than that of a residential customer, which would explain why conservation impacts are lower for business customers. These businesses exhibited a reduction in use per customer of 13 percent, from 630 Mcf of annual per customer demand in 2003 to 546 Mcf in 2013.

Source: American Gas Association, Gas Facts
Efficiency-Directed Gas Utility Investments

As mentioned earlier, utility programs played a role in efficiency gains and reduced costs to customers. A number of these programs have existed for decades; however, the pace of utility investments in efficiency programs has accelerated in recent years—having more than tripled, from $320 million in 2007 to $1.1 billion in 2012. Energy savings more than doubled as a result of these investments—from 48.4 trillion Btu of saved energy in 2008 to 135.9 trillion Btu in 2012. Also for 2013, Utilities budgeted nearly $1.5 billion (projecting a 30 percent increase in spending). This helped residential program participants save 16 percent of household gas usage on average or about 112 Therms per year, averaging $117 in cost saving on their annual energy bill.

Natural Gas Efficiency Program Expenditures
United States

Source: AGA Natural Gas Efficiency programs Survey – 2008 through 2013

Natural Gas Efficiency and Distribution System Planning

Energy efficiency has also affected gas utility supply planning, design day requirements, and integrated resource planning. For many utilities, energy efficiency gains—both the declines in use per customer and the long-term flattened or lower natural gas consumption—form a part of peak natural gas demand day forecasts and overall supply planning. For others, the inclusion of use per customer is more implicit: These companies forecast design day requirements using usage data from prior years.
According to a recent informal survey\(^2\) of AGA member natural gas utilities, most respondent companies incorporate energy efficiency into gas supply planning and design day requirements. Also companies integrate energy efficiency to a lesser extent into their integrated resource planning (IRP). Not all natural gas utilities go through the IRP exercise, which may explain the lower incidence of positive responses.

### HAVE ENERGY EFFICIENCY GAINS IMPACTED THE FOLLOWING ACTIVITIES?

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Source: AGA Query on Interruptible Service and Energy Efficiency in the Context of 2013-14 Winter Heating Season

In response to a separate question on the survey, 20 of 60 companies indicated that the utility calculates *use per customer* into an integrated resource plan. Another 14 companies noted that they integrate “use per customer” in their overall planning, but they don’t have an IRP. Sixteen respondents replied that use per customer was not a part of their forecasting process.

Based on utility data, it is clear that energy efficiency reduces average consumption over time. There is also anecdotal evidence from some companies that the effects of energy efficiency (i.e. lower consumption) tend to be muted on peak demand days. The reasons cited for this are that heating equipment may be running at full capacity or that customers may disregard conservation measures on the coldest day(s) of the year. This suggests that energy efficiency appears to reduce average energy consumption over time but may have less of an impact proportionally on peak day consumption. Nevertheless, energy efficiency remains a critical aspect of natural gas utility planning and helped shape the customer experience this past winter.

\(^2\)SOS Query Results on Interruptible Service and Energy Efficiency –07/21/14
How Were Customers Impacted and How Did They Respond to the Harsh Winter?

Customer bills increased primarily due to increased demand. Despite natural gas demand reaching record levels this past winter, residential gas prices rose only 3.1 percent. The winter 2013-14 natural gas price was still lower than what the average household paid during the winters of 2004 to 2012. Overall residential customer bills increased by ten percent from the previous winter, and natural gas continues to be the low cost option for households.

![Average Consumer Expenditures for Heating Fuels During the Winter]

In spite of the bill increase, by spring 2014 the percentage of customers disconnected from utility service due to nonpayment hardly changed compared to the prior year, as many were able pay at least a portion of what they owed. However, the challenge to pay utility winter bills persists for some customers.

- The number of customers disconnected was 2.2 percent, an increase of less than one percentage point from the previous year.
- The number of customers in arrears rose to 21.5 percent of small volume customers for those companies surveyed.
- The amount owed by customers in arrears increased 9.6 percent.

For those that continued to have difficulties paying their heating bills, assistance from federal, state, and utility energy efficiency and bill payment assistance programs were available to help them stay current on their bills. But not all those that require assistance obtain it: 22 percent of such customers are at least 30 days late in arrears on their bills, and a little over two percent were disconnected from utility service at the end of the winter heating season. Survey results are presented in the table below.
EFFICIENCY GAINS AND AVOIDED COSTS ON RESIDENTIAL AND COMMERCIAL CUSTOMERS

As mentioned earlier, the use per residential customer declined 25 percent from 2003 to 2013. If consumers had not implemented such efficiency measures over the past decade, natural gas consumption would have been 965 Bcf higher during the winter of 2013-14, adding $9.7 billion more to consumers’ natural gas heating bills—keeping price constant (i.e., assuming no upward pressure on natural gas price due to heightened demand).

Commercial customers also reduced energy consumption over the past decade. Had commercial customers not conserved, the increased natural gas usage for commercial space heating this past winter would have resulted in about 325 Bcf of additional natural gas for the commercial sector.

Predicting customer conservation is not an exact science, however. A recent informal AGA survey(3) asked natural gas utilities to assess their weather-normalized residential demand forecasts for this past winter heating season. Of 37 companies, nine (24 percent) overestimated residential customer use by one to five percent. On the other hand, 29 utilities (76 percent) underestimated customer usage by one to twelve percent or an average five percent. If this underestimation of normalized demand by 76 percent of the survey utilities is representative of the nation, one could infer that households did not conserve energy as expected, which would require utilities to acquire more natural gas than planned. This said, utilities did meet their load requirements even though demand forecasts in many instances were not 100 percent on target.

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3 American Gas Association Bill Comparison Survey: Question of the Quarter, March 2014
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