American Gas FOUNDATION

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# The Growing Imperative for Natural Gas Energy Efficiency:

## An Assessment Study of Gas Utility Energy Efficiency Programs

An American Gas Foundation Study Prepared by:

MCR

# Acknowledgements and Disclaimers


## Acknowledgements

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## About AGF and MCR Performance Solutions

Founded in 1989, the American Gas Foundation (Foundation) is a 501(c)(3) organization that focuses on being an independent source of information, research, and programs on energy and environmental issues that affect public policy, with a particular emphasis on natural gas. Overseen by a Board of Trustees, the Foundation has developed numerous public policy reports. For more information on the Foundation, please visit www.gasfoundation.org.

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## Authors of this Study

This report is the culmination of the work of many members of the MCR team. Led by project manager Ed Schmidt Jr. and engagement executive Sam Brothwell, the team included Frank Craig, Cindy Menhorn, Tom Crooks, Melanie Gillette, Richard Milward, Ian MacDougall, and Ted Konstantino.

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# Abstract

Energy utilities have taken on multiple new mandates in recent years: reducing environmental impact; enhancing safety, reliability, and resilience against physical climate threats such as flooding, storms, and wildfires; and making energy affordable and accessible for all consumers. Making the most of every unit of energy produced, transported, and delivered—in other words, energy efficiency—typically emerges among the simplest, least-cost, and most effective means to achieving these ends.

The American Gas Foundation (AGF) engaged MCR Performance Solutions (MCR) to evaluate the full range of current and future potential benefits that could accrue from natural gas utility energy efficiency (EE) programs. Specifically, MCR was asked to 1) evaluate the current state of gas utility EE programs and the cost-effectiveness of a prototypical portfolio of programs under current methodologies and an assumed future state, and 2) provide perspective on the potential for gas utility EE programs to support achieving the aforementioned customer and societal goals. The purpose of the study is to fill knowledge gaps by evaluating the full range of benefits derived from natural gas utility energy efficiency programs and review trends and factors that can lead to improvements in program design, targeting, and implementation.

### Definition of EE Program

For purposes of this study and report, "EE program" refers to a utility (customer)-funded activity, or portfolio of multiple activities, that aims to enable customers to accomplish the same amount or more of an end use (e.g., heating, water heating) with less gas consumption. EE programs are generally offered only when the utility is authorized by its regulatory commission to recover the costs associated with those programs. With such authorization (or "program approval"), a full, formal filing must be made to document prudence, realistic chance of success, and cost-effectiveness (which will be discussed at length in this report) and then defended before all intervenor parties.

In collaboration with AGF staff and a Steering Committee comprised of representatives from natural gas utility companies, MCR performed the following analyses:

- A national portfolio review of existing natural gas utility EE programs, including spending, regulatory mechanisms, delivery mechanisms, and non-energy benefits (NEBs) currently reported and/or included in cost-effectiveness analyses.
- Evaluation of a current and assumed future approach to cost-effectiveness testing, including quantification of energy savings, cost avoidance, and customer bill impact using MCR's proprietary modeling tools.
- A trends assessment examining future EE potential, including emerging EE programs and measures as well as potential positive externalities including benefits to non-gas energy consumers, energy equity/needs of low-income and underserved constituencies, and policy/regulatory activity.

MCR made several key observations:

- Current federal policy and funding priorities emphasize energy efficiency, bringing new or increasing scale of existing parties directly or indirectly related to EE program implementation.
- The deployment of and spending devoted to natural gas EE programs varies considerably, both between regions and within them.
- A wide range of EE measures and technologies are currently available, and though only a handful of new measures and technologies appear imminent in the near future, there are opportunities for new approaches to program design and incentives.
- Although most jurisdictions primarily use the Total Resource Cost Test or Utility Cost Test,[1] test parameters vary widely.
- Natural gas EE programs can drive a wide range of impactful, cost-effective direct[2] and indirect[3] non-energy benefits to the broader energy system.

Driven by the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (NSPM-DER), the evolution of approaches to the cost-effectiveness analyses that enable regulatory approval, cost recovery, and often utility performance incentives—especially the benefits included in such analyses—may create opportunity for some natural gas utilities that consider EE from a strategic, not only compliance, perspective over the next three to five years. EE program designs may be able to leverage new federal sources to enable support for new EE measures (e.g., gas hybrid heat pumps). Approaches to EE program implementation may be able to leverage new partners (e.g., weatherization agencies and state energy offices) and new strategies, such as geotargeting, to emphasize specific sectors and/or geographic pockets of the utility customer base where such targeting is advantageous. In short, policy, regulatory, and market dynamics are bringing change.

This report provides an in-depth review of existing natural gas utility EE programs as well as the potential for future development of programs, delivery approaches, and incentive strategies. The study also highlights the many opportunities to leverage indirect and non-energy benefits that come from the optimal and efficient use of natural gas delivery infrastructure.

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[1] The most common cost-effectiveness tests, including these, are defined, discussed, and executed in the Cost-Effectiveness Case Study section of the report.
[2] The term “direct” refers to those related to the primary form of energy being examined—in this case, natural gas.
[3] The term “indirect” refers to sources of energy other than the primary form being examined—in this case, primarily electricity.

# Table of Contents

# Tables and Figures

## Tables

## Figures

# TERMINOLOGY

| Term | Definition |
|---|---|
| ACEEE | American Council for an Energy Efficient Economy |
| AFUE | Annual Fuel Utilization Efficiency |
| AGA | American Gas Association |
| AGF | American Gas Foundation |
| AHP | Air Source Heat Pump |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BCR | Benefit-to-Cost Ratio |
| BPS | Building Performance Standard |
| C&I | Commercial and Industrial |
| CBO | Community-Based Organization |
| CEE | Center for Energy and Environment (Minnesota) |
| Census | U.S. Census Bureau |
| CHP | Combined Heat and Power |
| CHS | Clean Heat Standard |
| CO2 | Carbon Dioxide |
| CO2e | Carbon Dioxide Equivalent (includes other GHG including Methane) |
| CSPM | California Standard Practice Manual for Economic Analysis of Demand-Side Programs and Projects |
| DEI | Diversity, Equity, and Inclusion |
| DG | Distributed Generation |
| DOE | U.S. Department of Energy |
| DRIPE | Demand Reduction Induced Price Effects |
| EE | Energy Efficiency |
| EFLH | Effective Full Load Hours |
| EIA | Energy Information Administration |
| EJ | Environmental (or Energy) Justice |
| EM&V | Evaluation, Measurement, and Verification |
| EPA | U.S. Environmental Protection Agency |
| EUL | Estimated Useful Life |
| GHP | Ground Source Heat Pump |
| HDD | Heating Degree Day |
| ICC | International Code Council |

| Term | Definition |
|---|---|
| IECC | International Energy Conservation Code |
| IIJA | Infrastructure Investment and Jobs Act |
| IMT | Institute for Market Transformation |
| IRA | Inflation Reduction Act |
| IRC | International Residential Code |
| JST | Jurisdiction-Specific Test |
| LEEP | Local Energy Efficiency Planning (model) |
| LMI | Low- and Moderate-Income |
| LNG | Liquefied Natural Gas |
| MAP | Market Access Program |
| MCR | MCR Performance Solutions, LLC |
| NEB | Non-Energy Benefit (of EE activity) |
| NESP | National Energy Screening Project |
| NSPM, NSPM-DER | National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources |
| NTG | Net-to Gross Ratio |
| NYMEX | New York Mercantile Exchange |
| O&M | Operations and Maintenance |
| PACE | Property Assessed Clean Energy (financing) |
| PAYS | Pay As You Save |
| PCT | Participant Cost Test |
| PSPS | Public Safety Power Shutoff |
| RECS | Residential Energy Consumption Survey |
| REO | Regional Energy Organization |
| RIM | Rate Impact Measure (test) |
| RNG | Renewable Natural Gas |
| S&P | S&P Global |
| SCT | Societal Cost Test |
| TRC | Total Resource Cost (test) |
| TRM | Technical reference Manual |
| TSB | Total System Benefits (metric of cost-effectiveness testing) |
| UCT (PACT) | Utility (or Program Administrator) Cost Test |
| WACC | Weighted Average Cost of Capital |
| WAP | Weatherization Assistance Program |

# EXECUTIVE SUMMARY

## Key Takeaways

The Assessment Study of Gas Utility Energy Efficiency Programs yielded numerous insights and areas of potential action by natural gas utilities. Here are the most important takeaways:

(1) The number and scope of stakeholder and regulatory processes relating to natural gas utility energy efficiency (EE) programs, especially cost-effectiveness testing, are increasing, with participation in such processes becoming more important than ever in representing the perspective of natural gas utilities and consumers.

(2) New funding streams, technologies, and partnering opportunities are creating new ways to achieve energy efficiency goals while supporting energy affordability and social priorities such as greenhouse gas emissions reductions. Examples include technologies such as gas heat pumps and program approaches such as joint delivery of weatherization programs with federal Weatherization Assistance Program providers.

(3) The growing inclusion of non-energy benefits in cost-effectiveness testing; the rising focus of regulators, policymakers, consumers, and other stakeholders on environmental issues; and the deepening dependency of the electric system on the natural gas system create potential new opportunities for natural gas utility EE programs. Examples include gas heat pumps and networked geothermal systems.

(4) More consistent, granular data on EE budgets, spending, and savings is needed to better enable natural gas utility strategy development and planning.

(5) Achieving identified outcomes and securing the myriad benefits of natural gas EE programs will require systems thinking that integrates utility strategy, regulatory and policy compliance, and creativity.

## The Project

MCR Performance Solutions was engaged by the American Gas Foundation to evaluate the full range of current and future potential benefits that could be realized from natural gas utility energy efficiency programs. While this study took a deep dive into existing EE programs and identification of future trends, the dynamic nature of the energy delivery sector also lent itself to a broader and more strategic energy efficiency discussion. Thus, MCR also explored ways in which existing gas delivery infrastructure could be leveraged to improve overall energy efficiency and to sustain the financial integrity of these utility programs—and utilities themselves—while advancing broader economic, social, and environmental goals.

This report is structured around the project's three principal deliverables or tasks:

(1) A detailed review of existing current-state energy efficiency programs of approximately 20 natural gas utility companies with a focus on specific EE measures, delivery mechanisms, and measures of effectiveness and benefit-to-cost (also referred to as cost-effectiveness) analysis.

(2) A deeper-dive case study comparing cost-effectiveness testing and results for a prototypical portfolio of EE programs at the national level in both a current and an assumed future state.

(3) A trends analysis identifying and analyzing market and policy dynamics alongside evolving EE program design. This analysis further explored potential economic, social, energy security, and environmental benefits that could come from optimized use of the U.S. natural gas delivery system.

## Energy Efficiency Saves More than Just Money

The development of utility energy efficiency programs has been rooted in periods of resource scarcity, high prices, and the resulting need to minimize waste. While U.S. energy abundance has surged with shale over the past decade, numerous headwinds portend potential challenges: higher inflation and interest rates, rapidly rising energy demand from data processing, and geopolitically driven reshoring of critical industries.

Concurrently, natural gas has entered a period of considerable strategic importance to U.S. (and indeed global) energy and economic security. Natural gas provides much of U.S. space and water heating, even as technology and politics seek the substitution of electricity for any fossil fuel in some regions. Further, the supply of U.S. electricity from natural gas has roughly doubled in the last decade to around 40%, and the increased deployment of renewable—but variable—wind and solar generation highlights the symbiosis between these resources and natural gas power generation, which is highly flexible, responsive, and resilient.

The critical role of natural gas and gas infrastructure underscores the need to optimize its use, particularly when the economic and siting challenges of new energy infrastructure development in many regions require making the best use of what already exists. The growing dependence on natural gas to enhance energy security also speaks to the value of maximizing the deliverability of molecular energy, especially on the coldest days of the year. The efficient use of natural gas under those conditions is a highly cost-effective way to sustain energy reliability, resilience, and security to benefit all energy consumers with minimal environmental impact.

In alignment with the three principal tasks, this report examines:

(1) The current state of natural gas energy efficiency programs, incentives to encourage their adoption, and the relationship between energy savings and the costs to achieve them.

(2) A potential future state with cost-effectiveness testing that incorporates EE benefits beyond basic therm-based savings.

(3) Potential efficiency, reliability, and resiliency gains across the energy delivery chain, customer cost savings, and support for utility financial integrity.

## Task 1: Review of Existing Natural Gas EE Programs

The review of existing natural gas EE programs (Portfolio Review) included a comprehensive review of current-state gas utility EE programs and portfolios and the policy/regulatory context driving their development, approval, implementation, and oversight. The Portfolio Review had three primary objectives:

(1) Gain a deep understanding of current-state EE programming and associated policy/regulatory context.

(2) Develop a foundation that would inform the Cost-Effectiveness Case Study.

(3) Identify initial themes to explore further in the Trends Assessment.

The Portfolio Review examined publicly available data on the EE status of 22 selected utilities, chosen according to a defined set of criteria and a web-based market scan of the EE activities of more than 70 natural gas utilities or non-utility EE program administrators.

**Result**

The Portfolio Review revealed numerous challenges, including wide variations not only in absolute EE spending levels, but also between customer segments. The work also found a lack of granularity and consistency of the publicly available data, particularly for spending and activity targeting specific subsets of the utility customer base (carveouts), such as the low-income sector. While narrative descriptions of utility EE plans address mandated carveouts and compliance, and progress reporting states achievement of goals related to carveouts, the supporting budget, spending and savings reporting tables tend to be lacking and, where present, inconsistent. Nonetheless, the Portfolio Review extensively described gas utility EE measures (e.g., heating, water heating, weatherization), delivery structures (e.g., rebates, direct installation), and incentive mechanisms (e.g., prescriptive per measure, performance per unit of proven savings) as well as costs and benefits and cost-effectiveness testing methodologies. Importantly, sufficient data was gathered to inform the subsequent Cost-Effectiveness Case Study and Trends Assessment. Beyond the data gathering and the resultant key learnings, the Portfolio Review illuminated the extent of data problems.

## Task 2: Cost-Effectiveness Case Study

To explore the impact of changes in the approach to cost-effectiveness in the near-term future, a Cost-Effectiveness Case Study was conducted to determine the quantitative results of changing the cost-effectiveness testing methodology applied to a single, identical portfolio of natural gas EE programs. With a focus on maintaining relevance to all natural gas utilities and jurisdictions, the Case Study included development of a portfolio of natural gas utility EE programs to be tested for cost-effectiveness in a current state and a future state based on the measures, program types, and cost-effectiveness approaches identified in Task 1, the Portfolio Review.

Recognizing that the Portfolio Review identified EE measures ranging from none at all to the most complex and cutting edge, the resulting prototype portfolio sought to be relevant to all jurisdictions and thus reflects straightforward programs, such as customer rebates and direct installation of EE measures, as well as common EE measures, such as upgraded commercial kitchen heating equipment.

**Result**

Using national average gas cost data from the U.S. Department of Energy (DOE), all five of the California Standard Practice Manual (CSPM) cost-effectiveness tests (Utility Cost, Total Resource Cost, Participant Cost, Societal Cost, and Rate Impact Measure, or Non-Participant) were calculated. The Portfolio Review indicated that a base level of non-energy benefits should be included in the current state cost-effectiveness analysis. It further concluded that NEBs would best be applied to cost-effectiveness testing as a proxy adder or increment to the avoided cost of gas. The avoided cost of gas is the basis for monetizing gas EE savings and serves as the numerator in cost-effectiveness tests.

The Cost-Effectiveness Case Study identified eight levers, or impactful elements, of cost-effectiveness testing that are assumed by modelers or otherwise may be variable. The Case Study also showed that the number, type, and valuation of non-energy

**Cost-Effectiveness Levers:**

1. Measure and installation costs
2. Program costs
3. Discount rates
4. Weather
5. Non-energy benefits
6. Measure configurations
7. Avoided costs
8. Retail rates

benefits are the most significant drivers of change in cost-effectiveness—and it is anticipated that this will be the case going forward. The Cost-Effectiveness Case Study achieved its aim of evaluating the impact of a change to the cost-effectiveness testing methodology. Not surprisingly, the results showed that increasing NEBs and modifying some of the economic inputs and assumptions drives greater cost-effectiveness.

## Task 3: Gas EE Trends Assessment

Based on the research and results of the Portfolio Review and Cost-Effectiveness Case Study, a Trends Assessment was conducted. The assessment led to the identification of six policy issues currently in play and pathways for natural gas utilities to consider in addressing them.

### Policy Issues

The following six policy issues and trends were identified as likely to have the greatest impact on natural gas utility EE programs:

(1) The role of cost-effectiveness methods and non-energy benefits (NEBs). Regardless of whether or how NEBs are included in cost-effectiveness in any particular jurisdiction today, the growing influence of the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources means that discussions about the topic are likely happening and that some NEBs may be adopted into cost-effectiveness methods in the near future.

(2) Funding and financing mechanisms for EE initiatives, including but not limited to federal and state tax credits, on-bill financing, interest buydowns, and property assessments, which can enable more customers to participate in more EE programs more deeply and more cost-effectively.

(3) The influence of federal minimum efficiency standards, such as those put forth by the U.S. Department of Energy, and product specifications such as ENERGY STAR on EE programs. These standards and specifications are creating new, higher-energy baselines against which cost-effectiveness and EE savings are measured, and therefore causing natural gas utilities to revisit what EE measures and programs they can offer.

(4) Building energy codes and performance standards, which establish construction and energy performance requirements that serve as baselines for EE measurement, but which are seldom aligned across jurisdictions and thus may create confusion and a burden on market actors such as contractors.

(5) Education and workforce development, which involves EE program implementation and pursuit of equity priorities and affects virtually all EE programs and customer segments.

(6) How natural gas EE delivers greenhouse gas emissions reductions, largely due to the cleanliness of gas combustion, the contributions of natural gas and natural gas EE programs to meeting clean heat standards and/or achieving mandated emissions caps, and natural gas decarbonization strategies.

### Strategic Approaches to Address Market, Policy, and Financial Opportunities

The following six approaches were identified as possibly worthy of pursuit by natural gas utilities to address the areas of policy activity outlined above, as well as market trends and the financial integrity of utilities. These approaches often take advantage of existing resources and frameworks with minimal incremental cost and potentially large benefit returns.

(1) Leveraging existing and new programs, such as DOE's Weatherization Assistance Program (WAP) and state energy office programs, and identifying synergies with other utility industry EE programs.

(2) Utilizing new and emerging cost-effectiveness frameworks and metrics, such as California's Total System Benefit (TSB) metric and various Jurisdiction-Specific Tests (JSTs).

(3) Addressing equity issues and meeting low- and moderate-income (LMI) consumer needs by increasing participation and delivery of benefits to defined segments of the overall customer base.

(4) Geotargeting, which can be a cost-effective method for delivering EE benefits to specific communities (such as LMI) that are often the focus of mandated EE program budget and participation carveouts and/or non-EE policy initiatives (e.g., Justice40), and/or addressing congestion and other utility operational issues without requiring investment of limited available capital.

(5) Employing new and emerging technologies, which can include hybrid heat pumps and natural gas peaking/backup, network geothermal systems, and distributed generation/microgrid technology, to yield EE savings, increase overall energy system reliability, and assist in maintaining energy affordability.

(6) Ensuring utility financial integrity through rate base alternatives such as volumetric decoupling, EE-specific rate riders and trackers, and performance incentive mechanisms to compensate for reaching or exceeding program goals.

**<u>Emerging Opportunities Natural Gas EE May Leverage</u>**

These strategic approaches also offer the potential to drive economic, environmental, and social benefits, including:

(1) Enhancing resilience and reliability for end users across all energy delivery systems given the characteristics of natural gas (e.g., underground, capable of storage and injection) and the ability of natural gas heating, for example, to mitigate electric system winter peak concerns.

(2) Integrating emissions reductions into program planning and design by quantifying the cleanliness of combusting natural gas compared with other fuels, whether such combustion is related to direct use (e.g., heating) or indirect use (e.g., electric power generation).

(3) Addressing the needs of underserved and low/moderate-income market segments by virtue of the health benefits (e.g., improved air circulation) of natural gas, the safety and efficiency of new gas equipment, and the relative affordability of natural gas in most cases.

(4) Mitigating the emerging electric winter peak load challenge by using natural gas rather than electricity as a supplemental fuel for heating.

(5) Partnering with other utilities, EE and related program administrators, and/or supply chain players, such as water utilities, community action agencies (WAP implementers), manufacturers, distributors, and HVAC and weatherization contractors.

(6) Aligning company strategy with regulatory and public policy goals, including the goals of social, environmental, economic development, and health policy.

## Conclusion

In summary, over the next three to five years, natural gas utility EE has the opportunity to create a triple win:

(7) Supporting current and future policy issues, including energy security and environmental concerns.

(8) Meeting natural gas EE savings goals while also creating affordability benefits for customers.

(9) Capitalizing on opportunities that enhance and sustain gas utility financial integrity.

A threshold problem to be resolved before these outcomes can be achieved is that of granularity and consistency of publicly available data. Whether through the alignment of state utility regulatory bodies, the establishment of a third-party data clearinghouse, or other means, consistent, granular data on EE budgets, spending, and savings is needed.

In addition to improved data, achieving the identified outcomes will require systems thinking that integrates utility strategy, regulatory and policy compliance, and creativity. It will also require participation in the processes driving change, and collaboration with manufacturers and the entire supply chain for efficient natural gas products. Natural gas utilities should invest time and effort in building new partnerships, supporting new technologies, and articulating the positive environmental and economic virtues of natural gas and natural gas EE clearly and often.

# INTRODUCTION

MCR Performance Solutions was engaged to develop this Gas EE Assessment Study for the American Gas Foundation.

The **objectives** of this study were to:

- Assess the ability of natural gas utility EE programs to achieve their stated quantitative and/or qualitative program goals, as well as how natural gas EE programs can continue to enhance and promote efficient and effective energy use.
- Identify and evaluate additional benefits that have been or could be realized through natural gas utility EE programs.
- Review industry trends and policies that are likely to lead to changes in natural gas utility EE program design, targeting, implementation, and evaluation, including cost-effectiveness analysis.

The defined **scope** was to:

- Develop an in-depth understanding of the current state of EE program portfolios for an agreed-upon study group of 22 gas utilities.
- Identify and evaluate current cost-effectiveness evaluation and testing methodologies.
- Develop a case study of existing EE programs, including a comparison of current regulatory cost-effectiveness methodologies and an agreed-upon potential future approach.
- Develop a forward-looking perspective on EE, including a focus on customer and societal impacts.

The study also assessed likely changes in natural gas EE programs over the mid- to long-term (3-5 years) with an added focus on related ancillary and non-energy benefits, including those that accrue to non-gas energy consumers.

In addition to kick-off work and development of reports and presentations, the **approach** included three primary tasks that make up the core of this study:

- Task 1: Review Gas Utility EE Program Portfolios
- Task 2: Develop a Case Study on One Portfolio
- Task 3: Assess Trends and Impacts

Figure 1 summarizes the approach at a high level.

**Figure 1: Project Approach**


# TASK 1: GAS EE PORTFOLIO REVIEW

## Introduction

The initial project task was to gain a comprehensive understanding of the current state of gas utility EE programs and portfolios and the policy/regulatory context driving their development, approval, implementation, and oversight. Defined in the project plan as the Portfolio Review, this research and assembly of data served as the foundation on which subsequent research, analyses, and conclusions were based. The Portfolio Review further informed the Cost-Effectiveness Case Study and the Trends Assessment detailed later in this report. The Portfolio Review had three primary objectives:

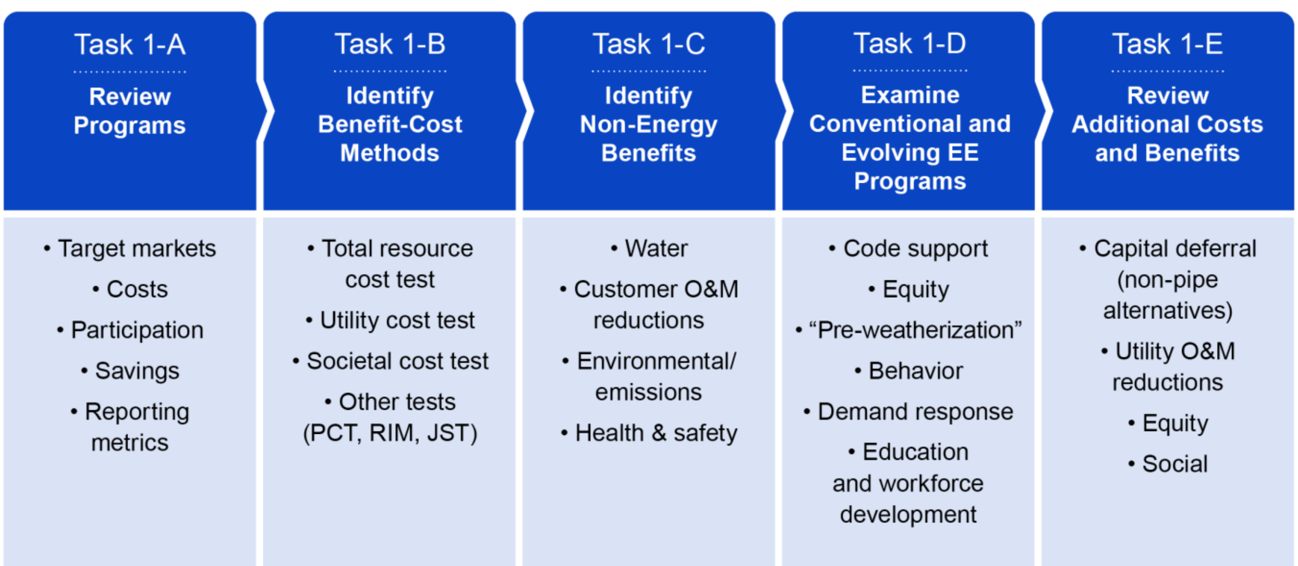
(1) Gain a deep understanding of the current state of EE programming and the associated policy/regulatory context.

(2) Develop comprehensive information to inform the Cost-Effectiveness Case Study.

(3) Identify initial themes to further explore in the Trends Assessment.

Given the substantial scope of the Portfolio Review, a task-level work plan was defined. This is shown in Figure 2.

**Figure 2: Portfolio Review Approach**



Note that in conducting the Portfolio Review, additional data related to various policy/regulatory issues and elements of EE programming (e.g., issues related to cost recovery) were collected in an expansion of the Portfolio Review scope.

## Research and Data Collection

The original project scope called for identification of approximately 20 gas utilities whose EE portfolios and broader policy/regulatory context would be explored and described in depth. Working with AGF and the Steering Committee, the project team sought to review a cross-section of utilities with differing characteristics that, as a whole, would paint an accurate picture of the state of natural gas EE programs across the United States. To that end, we used the following selection criteria to evaluate utilities for consideration:

- Type (gas or combination utility)
- Size (number of customers[4])
- Region
- Climate
- Political attributes of service area(s)

Ultimately, the 22 utilities shown in Table 1, anonymized in the interest of confidentiality, were selected for examination in the Portfolio Review and approved by the Steering Committee:

[4] Small utilities were defined as those with less than 200,000 customers, medium utilities as those with between 200,000 and 500,000 customers, and large utilities as those with over 500,000 customers.

**Table 1: Selected Utilities**

| Utility | Corp. Type | Size | Census Region | Census Division | EIA Climate Zone | State Gov't Party |
|---|---|---|---|---|---|---|
| **LDC #1** | LDC/Combo | Large | South | South Atlantic | Mixed/Hot - Humid | Rep |
| **LDC #2** | Combo/Combo | Large | South | South Atlantic | Mixed - Humid | Dem |
| **LDC #3** | Combo/Combo | Large | West | Mountain | Cold | Dem |
| **LDC #4** | LDC/Combo | Large | Midwest | W. N. Central | Cold | Dem |
| **LDC #5** | Combo/Combo | Small | Northeast | Mid-Atlantic | Cold | Dem |
| **LDC #6** | LDC/Combo | Large | Midwest | E. N. Central | Cold | Rep |
| **LDC #7** | LDC/Combo | Large | South | South Atlantic | Mixed - Humid | Mix |
| **LDC #8** | Combo/Muni | Large | South | W. S. Central | Hot - Humid | Rep |
| **LDC #9** | LDC/Combo | Large | Midwest | E. N. Central | Cold | Dem |
| **LDC #10** | Combo/Combo | Large | Northeast | New England | Cold | Mix |
| **LDC #11** | LDC/LDC | Large | Northeast | Mid-Atlantic | Mixed - Humid | Dem |
| **LDC #12** | LDC/LDC | Large | West | Pacific | Marine/Cold | Dem |
| **LDC #13** | LDC/LDC | Large | South | W. S. Central | Mixed - Humid | Rep |
| **LDC #14** | LDC/Combo | Large | Midwest | E. N. Central | Cold | Dem |
| **LDC #15** | LDC/Combo | Medium | South | South Atlantic | Mixed - Humid | Mix |
| **LDC #16** | Combo/Combo | Large | West | Pacific | Marine/Cold | Dem |
| **LDC #17** | LDC/Combo | Small | West | Mountain | Cold | Mix |
| **LDC #18** | LDC/LDC | Large | West | Pacific | Marine/Hot - Dry | Dem |
| **LDC #20** | LDC/LDC | Large | Midwest | W. N. Central | Mixed - Humid | Rep |
| **LDC #21** | LDC/LDC | Small | South | W. S. Central | Mixed - Humid | Rep |
| **LDC #22** | Combo/Combo | Large | Northeast | Mid-Atlantic | Mixed - Humid/Cold | Mix |

For these 22 focus utilities, regulatory commission websites and various publicly available resources were mined, including but not limited to the U.S. Census (Census), U.S. Department of Energy, U.S. Energy Information Administration (EIA), American Gas Association, American Council for an Energy Efficient Economy (ACEEE), and nonprofit regional energy organizations (REOs)—for example, the Midwest Energy Efficiency Alliance.

Core EE data collected included utility and EE attributes, such as number of customers, firm sales, revenue, planned and actual EE spending, and customer participation and savings. This data, excluding outlier and counterintuitive data points found in the research, is summarized in Tables 2 through 6.

**Table 2: EE Spending by Selected Utilities**

| Metric | Northeast | Midwest | West | South | All 22 |
|---|---|---|---|---|---|
| **EE Spend** | | | | | |
| Highest single-utility | $149,808,628 | $49,195,913 | $118,083,630 | $16,466,812 | $149,808,628 |
| Lowest single-utility | $1,387,819 | $1,754,233 | $5,207,400 | $1,275,000 | $1,275,000 |
| Mean | $55,030,849 | $30,820,679 | $36,908,983 | $9,327,714 | $33,613,269 |
| **Spend per Customer** | | | | | |
| Highest single-utility | $273.96 | $54.61 | $42.40 | $172.66 | $273.96 |
| Lowest single-utility | $15.88 | $2.18 | $6.09 | $1.59 | $1.59 |
| Mean | $102.97 | $31.23 | $24.49 | $64.10 | $48.32 |
| **Spend Percent of Revenue** | | | | | |
| Highest single-utility | 17.66% | 3.06% | 3.68% | 11.29% | 17.66% |
| Lowest single-utility | 0.74% | 0.15% | 0.81% | 0.11% | 0.11% |
| Mean | 6.58% | 2.00% | 2.12% | 4.36% | 3.34% |

### Table 3: EE Savings of Selected Utilities

| Metric | Northeast | Midwest | West | South | All 22 |
|---|---|---|---|---|---|
| **Annual MMBtu** | | | | | |
| Highest single-utility | 378,581 | 1,852,393 | 4,404,498 | 4,217,607 | 4,404,498 |
| Lowest single-utility | 71,342 | 908,359 | 159,075 | 200,392 | 71,342 |
| Mean | 237,022 | 1,548,917 | 1,290,579 | 1,921,257 | 1,263,945 |
| **Annual MMBtu as Percent of Sales** | | | | | |
| Highest single-utility | 0.82% | 1.47% | 1.48% | 8.99% | 8.99% |
| Lowest single-utility | 0.42% | 0.96% | 0.44% | 0.40% | 0.40% |
| Mean | 0.65% | 1.25% | 0.81% | 5.43% | 2.02% |

### Table 4: Residential EE Data for Selected Utilities

| Metric | Northeast | Midwest | West | South | All 22 |
|---|---|---|---|---|---|
| **Residential EE Spend** | | | | | |
| Highest single-utility | $86,802,803 | $28,600,000 | $47,653,134 | $10,541,076 | $86,802,803 |
| Lowest single-utility | $922,474 | $1,152,001 | $2,071,266 | $637,500 | $637,500 |
| Mean | $32,184,452 | $14,933,258 | $18,182,151 | $5,877,386 | $17,655,287 |
| **Residential Spend per Customer** | | | | | |
| Highest single-utility | $168.58 | $31.64 | $17.74 | $57.00 | $168.58 |
| Lowest single-utility | $11.22 | $1.63 | $2.57 | $0.88 | $0.88 |
| Mean | $65.35 | $15.82 | $13.03 | $23.50 | $26.33 |

**Table 5: Commercial and Industrial EE Data for Selected Utilities**

| Utility | Northeast | Midwest | West | South | All 22 |
|---|---|---|---|---|---|
| **C&I EE Spend** | | | | | |
| Highest single-utility | $49,577,185 | $10,936,201 | $29,374,539 | $3,471,476 | $49,577,185 |
| Lowest single-utility | $379,928 | $8,197,660 | $1,000,000 | $637,500 | $379,928 |
| Mean | $17,268,270 | $9,811,287 | $7,978,087 | $2,147,775 | $9,036,701 |
| **C&I Spend per Customer** | | | | | |
| Highest single-utility | $1,552.54 | $177.01 | $132.46 | $536.17 | $1,552.54 |
| Lowest single-utility | $36.76 | $133.93 | $23.97 | $8.32 | $8.32 |
| Mean | $542.92 | $155.05 | $76.33 | $191.60 | $208.45 |

**Table 6: EE per Heating Degree Day Data for Selected Utilities**

| Utility | Northeast | Midwest | West | South | All 22 |
|---|---|---|---|---|---|
| **EE Spend per Heating Degree Day** | | | | | |
| Highest single-utility | $36,419.66 | $6,992.72 | $56,133.04 | $4,641.41 | $56,133.04 |
| Lowest single-utility | $237.15 | $164.77 | $1,041.44 | $511.04 | $164.77 |
| Mean | $13,041.77 | $4,928.41 | $13,254.02 | $2,578.95 | $9,131.24 |
| **EE Annual MMBtu per Heating Degree Day** | | | | | |
| Highest single-utility | 92.04 | 367.29 | 2,847.31 | 1,139.70 | 2,847.31 |
| Lowest single-utility | 13.68 | 164.14 | 32.10 | 118.54 | 13.68 |
| Mean | 54.00 | 264.91 | 586.36 | 529.29 | 412.04 |

Two important observations immediately emerged from the research and data collection undertaken:

(1) The availability and consistency of publicly available data is problematic in that some basic data—for example, both planned or budgeted and actual results—is not publicly available in a reasonably useful form and/or accessible manner.

(2) Data specific to the low-income residential sector that is an important, and increasingly so, population to isolate is generally not publicly available. Nonetheless, the data mined served its purpose of informing the development of the Cost-Effectiveness Case Study and Trends Assessment that were conducted subsequent to the Portfolio Review.

The broad and robust data collection also generated critical information to support the project's Cost-Effectiveness Case Study and Trends Assessment, including:

- Specific California Standard Practice Manual cost-effectiveness tests reported to regulators, including specific benefits and costs (the numerator and denominator, respectively).
- Carveouts designating portions of the budget, participants, and/or savings to specific customer segments (e.g., low-income).
- Decarbonization, electrification, and other policy initiatives.
- Utility revenue decoupling, lost revenue recovery, performance incentives, and related constructs.
- Non-energy benefits included in cost-effectiveness testing or otherwise tracked and reported.

To supplement the deep-dive data collection on the 22 focus utilities, a broader, internet market scan of the EE activities of more than 70 gas utilities and/or EE program administrators, including some of the 22 selected utilities, was performed. The complete list of gas utilities and program administrators researched as part of the national market scan is shown in Appendix 1.

## Analysis and Conclusions

The Portfolio Review results are summarized below and organized by 1) current EE program types, 2) current and pending EE measures, 3) cost-effectiveness tests, and 4) non-energy benefits and policies.

### Current EE Program Types

The following program types—i.e., incentive designs and delivery mechanisms—were identified:

- **Prescriptive downstream programs,** which offer fixed per-unit incentives to program participants or designees (e.g., home improvement or HVAC contractors).
- **Custom downstream programs,** which offer performance-based, dollars-per-unit savings incentives to program participants or designees (e.g., home improvement or HVAC contractors).
- **Direct install (DI) programs**, which directly provide participants with EE measures for their home or business. DI programs typically involve a basic walk-through assessment or detailed energy audit and may require customer co-payments. DI can also involve hybrid designs in which rebates or other financing incentives are offered for major measures selected by the participant.
- **Midstream programs,** which provide incentives to market actors upstream of the end-use customer, such as a retailer or HVAC distributor.

- **Upstream programs,** which provide incentives for manufacturers and others at the top of the supply chain.
- **Education/training/support activities,** which encourage customers and/or other market participants, such as building code officials, HVAC contractors, or retailers, to adopt EE measures or comply with policy requirements.
- **Online marketplaces,** which offer targeted EE products at a discount to point of sale prices (i.e., reflecting application of program incentives or rebates) via an internet storefront.
- **Behavior/peer comparison report programs,** which inform participating customers how their gas usage compares to a group of similar customers based on an analysis of billing data and offer specific end-use recommendations, rebates, or other energy saving incentives.
- **Joint delivery of programs,** which involves a gas utility partnering with an electric utility or a federal Weatherization Assistance Program (WAP) to deliver enhanced weatherization services to income-eligible households.
- **Active demand response programs,** in which the gas utility directly initiates load curtailment and/or shifting by managing space or water heating loads during periods of high demand, constrained delivery capacity, or high gas costs.
- **Passive demand response programs,** in which the gas utility deploys price signals or electronic communication to encourage customers to curtail or shift load during periods of high demand, constrained delivery capacity, or high gas costs.

Note that there is regional and jurisdictional inconsistency in whether demand response activities are allowed or required to be offered within energy efficiency portfolios.

### Current and Pending EE Measures

In researching the 22 selected utilities and conducting a broader market scan, a “universe” of current or pending EE measures offered by gas utility EE programs was identified, as shown in Table 7.

**Table 7: Current State Gas EE Measures**

**Measures**

- Air sealing
- Attic insulation
- Behavior reports
- Boiler burner replacement
- Boiler cutout control
- Boiler reset controls
- Boiler tune-up
- Caulking
- Clothes dryer
- Clothes washer
- Combination oven
- Combination space/water heater
- Combined heat and power
- Condensing unit heater
- Conveyor oven
- Demand Response
- Direct-fired space heater
- Dishwasher
- Domestic hot water controls
- Dryer moisture sensor
- Duct repair
- Duct sealing
- Energy audit
- Exterior doors
- Faucet aerator
- Fitting insulation
- Flat or tiered incentives based on model/score results
- Fryer
- Furnace and boiler sizing
- Furnace tune-up
- Gas cooking range
- Gas heat conversion
- Gas-fired absorption heat pump
- Griddle
- Heat recovery ventilation
- Heating circulation controls
- High efficiency boiler (condensing)
- High efficiency boiler (non-condensing)
- High efficiency furnace
- Hybrid heat pump - engine
- Hybrid heat pump - furnace
- Infrared heating system
- Linkageless heating controls
- Low-flow showerhead
- Modulating valves
- Per unit custom or performance-based incentives
- Pool cover
- Pool heater
- Pre-rinse spray valves
- Programmable thermostat
- Rack oven
- Rotating rack oven
- Solar - PV
- Solar Thermal
- Solar water heater
- Steam trap jacket
- Steam trap repair
- Steam trap replacement
- Steam trap survey
- Steamer
- Tankless (on-demand) water heater
- Tank-type water heater
- Valve insulation
- Wall insulation
- Water heater wraps
- Water/steam pipe insulation
- Weatherstripping
- WiFi thermostat
- Windows
- Window treatments

## Cost-Effectiveness Testing

Although cost-effectiveness is discussed at length in the Cost-Effectiveness Case Study and Trends Assessment sections that follow, it is important to establish an initial understanding of what cost-effectiveness is and how it works before discussing the research findings. Our current-state research focused on the five tests prescribed by the California Standard Practice Manual for Economic Analysis of Demand-Side Programs and Projects. The CSPM tests all support two key metrics:

1) The benefit-to-cost ratio (BCR), which equals the net present value of the benefits of an EE action divided by the costs of the EE action.

2) The net benefit, which equals the net present value of the benefits of an EE action minus the costs of an EE action.

The five CSPM tests are:

***Participant Cost Test (PCT)***

The PCT quantifies the costs and benefits of a natural gas utility energy efficiency program from the perspective of utility customers who participate in the program (participants). The CSPM identifies the PCT as "a measure of the quantifiable benefits and costs to the customer due to participation in a program." [5] It cautions that the test addresses only quantifiable factors, whereas consumers make decisions in large part on non-quantifiable factors. Appendix 2 provides specific mathematical equations for calculating the PCT.

***Utility Cost Test or Program Administrator Cost Test (UCT or PACT)***

The UCT or PACT quantifies the costs and benefits of a natural gas utility energy efficiency program from the perspective of the utility. The CSPM identifies the UCT as a measure of "the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant."[6] Appendix 2 provides specific mathematical equations for calculating the UCT.

***Rate Impact Measure (RIM) or Non-Participant Test***

RIM is also known as the non-participant test because it quantifies the costs and benefits of a natural gas utility energy efficiency program from the perspective of all the utility's customers, including those who do not participate in the program. The CSPM identifies the RIM as a measure of "what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program."[7] Appendix 2 provides specific mathematical equations for calculating the RIM.

***Total Resource Cost Test (TRC)***

The TRC quantifies the costs and benefits of natural gas programs from a resource perspective. The CSPM identifies the TRC as a measure of "the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs."[8] Appendix 2 provides specific mathematical equations for calculating the TRC.

***Societal Cost Test (SCT)***

The SCT quantifies the costs and benefits of a natural gas utility energy efficiency program from the perspective of society as a whole. The CSPM identifies the SCT as "a measure of the economic efficiency implications of the total energy supply system."[9] It is often recognized as a variant of the Total Resource Cost test, adding to that test monetized non-energy benefits and applying a different, lower discount rate to present value calculations. Appendix 2 provides specific mathematical equations for calculating the SCT.

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[5] CSPM (https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/utilities_and_industries/energy_-_electricity_and_natural_gas/energy_programs/cpuc-standard-practice-manual.pdf), page 8.
[6] Ibid, page 23.
[7] Ibid, page 13.
[8] Ibid, page 18.
[9] Ibid, page 18.

While the definitions of these tests appear straightforward, the specific benefits and costs included in a BCRs numerator and denominator lack consistency. For purposes of this project and report, the composition of the five tests is as shown in Table 8.

**Table 8: Cost-Effectiveness Tests**

| Element | PCT | UCT | RIM | TRC | SCT |
|---|---|---|---|---|---|
| Avoided energy costs | | Benefit | Benefit | Benefit | Benefit |
| Other resource savings (water, secondary fuel) | | | | | Benefit |
| Non-energy benefits | | | | | Benefit |
| Equipment and installation costs | Cost | | | Cost | Cost |
| Program overhead costs | | Cost | Cost | Cost | Cost |
| Incentive payments | Benefit | Cost | Cost | | |
| Bill savings | Benefit | | Cost | | |

BENEFIT COST

Additional detail on cost-effectiveness and cost-effectiveness testing is provided in the Cost-Effectiveness Case Study and Trends Assessment sections of this report.

Examination of the data for the 22 focus utilities indicated that all five CSPM tests are currently used by at least one jurisdiction. A small but growing number of jurisdictions prescribe the use of a Jurisdiction-Specific Test, or JST. The JST is a concept introduced by the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources,[10] a resource that is discussed in more detail in the Cost-Effectiveness Case Study and the Trends Assessment sections. In short, the NSPM-DER establishes a process by which stakeholders first align around the policy issues to be addressed by EE and associated cost-effectiveness analyses, then reach agreement on the various specific costs, benefits, and other inputs to be used in executing the JST. As more and more jurisdictions undertake processes to develop a JST, it is becoming increasingly important for the affected utilities to engage them to inform outcomes

Table 9 summarizes the testing approaches applied to the 22 utilities selected for the Portfolio Review, with “Primary” designating a primary test for regulatory decision-making and “Secondary” indicating a secondary test.

[10] https://www.nationalenergyscreeningproject.org/national-standard-practice-manual/

**Table 9: Cost-Effectiveness Tests Used by Selected Utilities**

| Utility | TRC | PACT (UCT) | SCT | PCT | RIM | JST |
|---|---|---|---|---|---|---|
| LDC #1 | No mandate; cost-effectiveness tests not submitted | | | | | |
| LDC #2 | Secondary | | | Secondary | Secondary | Primary |
| LDC #3 | Primary | Secondary | | Secondary | Secondary | |
| LDC #4 | | Secondary | Primary | Secondary | Secondary | |
| LDC #5 | | Secondary | Primary | | Secondary | |
| LDC #6 | Secondary | Secondary | Primary | | | |
| LDC #7 | Primary | | | Secondary | Secondary | |
| LDC #8 | No mandate; cost-effectiveness tests not submitted | | | | | |
| LDC #9 | | | | Secondary | | Primary |
| LDC #10 | Primary | | | | | |
| LDC #11 | | | | Secondary | Secondary | Primary |
| LDC #12 | Primary | Secondary | | | | |
| LDC #13 | Primary | | | Secondary | Secondary | |
| LDC #14 | Primary | | | Secondary | Secondary | |
| LDC #15 | Primary | Primary | | Secondary | | |
| LDC #16 | | | Primary | Secondary | | |
| LDC #17 | Primary | Secondary | | Primary | Secondary | |
| LDC #18 | Primary | | | Secondary | Secondary | Secondary |
| LDC #19 | | | Primary | | | |
| LDC #20 | Primary | Secondary | Secondary | Secondary | Secondary | |
| LDC #21 | Primary | | | Secondary | Secondary | |
| LDC #22 | Primary | | | | | |

A review of the table shows that the TRC is the most commonly used test among regulators, with the SCT and UCT as the primary test in several states, and the new JST emerging in a growing number of others. Again, the NSPM-DER and JST are discussed in more detail in the Cost-Effectiveness Case Study and Trends Assessment sections at the end of this report.

## Non-Energy Benefits and Policy

Although technical purists will note that the CSPM excludes externalities such as NEBs from the TRC—the most used test in the jurisdictions hosting the 22 focus utilities—the research shows evidence of NEBs being included in the SCT and increasingly in the TRC. NEBs represent additional benefits, meaning they increase the value of the numerator of the benefit-to-cost ratio and, therefore, the BCR and net benefit of the measure, program, or portfolio being evaluated.

Accordingly, the team compiled a list of the NEBs most commonly noted among the 22 focus utilities. Since consideration of NEBs is largely a policy-driven endeavor, a preliminary list of notable NEBs and policy issues as part of the Portfolio Review research was assembled (see Appendixes 3 and 4).

Beyond state and federal building energy codes, appliance minimum efficiency standards, and product specifications such as ENERGY STAR—topics discussed in the Trends Assessment Section —the following issues were also identified as driving broad inclusion of NEBs in current-state cost-effectiveness testing:

- Climate, emissions, and decarbonization.
- Policy-driven electrification, gas transition proceedings, and gas bans,[11] including the pursuit of both outright bans on new gas service installations and prohibitions against utilities providing incentives or other support for gas-fueled equipment.[12]
- Building performance standards and clean heat standards, in which building efficiency levels and what are essentially de facto bans on gas-fueled equipment are mandated.
- Diversity, equity, and inclusion (DEI) (e.g., low-income energy issues).

Although there are scores, even hundreds, of NEBs included in cost-effectiveness testing in the current state, the following types of NEBs were included in the current state analyses by virtue of their relatively frequent appearance:

- Water savings, which are generally measured as the dollar value of water saved by EE measures such as faucet aerators, low-flow showerheads, ENERGY STAR dishwashers, etc.
- Greenhouse gas (GHG) emission reductions and associated compliance costs that can be mitigated or avoided through EE, and monetization of avoided $CO_2$ or $CO_{2e}$ (with “e” indicating equivalent—e.g., methane) emissions.[13]

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[11] Appendix 6 contains research on gas bans and a state-by-state listing of passed or pending legislation on prohibiting gas bans.

[12] Intentional application of NEBs that specifically increase the benefit term of benefit-to-cost ratios enables EE measures related to electrification—for example, heat pumps in many cases—to become cost-effective.

[13] The monetization of GHG emissions is highly variable nationwide, with some jurisdictions using the federally published Social Cost of Carbon, others conducting state-specific studies, and still others deeming a value.

### $CO_2$ and $CO_{2e}$: An Important Distinction

The terms $CO_2$ and $CO_{2e}$ are often misunderstood in discussions, graphics, and narratives about emissions. Understanding the distinction between these two terms is critical. Quite simply, $CO_2$ refers to carbon dioxide, and $CO_{2e}$ refers to carbon dioxide equivalent—that is, carbon dioxide plus the carbon dioxide equivalent of other emissions. Specific to natural gas, this is primarily about methane. Methane is incorporated in $CO_{2e}$ at a rate of approximately 28 pounds of $CO_2$ for each pound of methane. When comparing natural gas emissions to other energy sources, $CO_{2e}$ is also important since it includes many of the gasses associated with other energy sources. For example when considering electric generation and referencing the Climate Partner website (www.climatepartner.org), $CO_{2e}$ incorporates nitrous oxide at a rate of 265 pounds of $CO_2$ for each pound of nitrous oxide.

- Health and safety, such as the estimated value of properly functioning combustion appliances.
- Comfort, often the estimated value of improved heating consistency and coverage (e.g., elimination of "cold spots") and/or reduced air leakage and draftiness.

The conclusion of the Portfolio Review was followed by a workshop with the project Steering Committee to evaluate results and align on the approach to be taken in the Cost-Effectiveness Case Study.

**<u>Conclusion</u>**

The Portfolio Review was a research endeavor intended to inform the development of the Cost-Effectiveness Case Study. The findings served their purpose by fostering an understanding of:

- EE measures currently supported by natural gas utilities.
- EE programs currently offered by natural gas utilities.
- Delivery structures and incentive methods used to deliver the natural gas utility EE programs currently offered.
- Methodologies currently used to determine cost-effectiveness.
- Costs and benefits included in the cost-effectiveness testing methodologies currently used.

The Portfolio Review also led to several conclusions that provided a head start on (and are discussed further in) the Trends Assessment, and that are themselves among the study's overall conclusions listed at the end of the report. They include:

- Incomplete and inconsistent EE data creates difficulties in developing standardized presentations of such data describing multiple jurisdictions and performing comparative analytics.
- The TRC is currently used by regulators in the majority of jurisdictions. However, as the influence of the NSPM and NSPM-driven stakeholder processes expands, the TRC in many

states has evolved to include increasing numbers and types of NEBs that the CSPM explicitly excludes from the TRC, identifying addition of NEBs and other externalities to the TRC as a core part of the definition of the SCT. The manner in which NEBs, are included and quantified may create an uneven cost-effectiveness playing field that favors electrification measures over natural gas measures, for example by treating avoided emissions from combustion of natural gas without symmetrically considering the emissions impact of increased electricity consumption. However, inclusion of NEBs in the TRC in this fashion may enable natural gas utilities to provide EE support for new measures such as gas heat pumps. Ensuring consistent treatment of NEBs across all fuels is an example of why engagement of stakeholder processes to define cost-effectiveness methods by natural gas utilities is important.

- Emergence and/or increasing presence of new programs such as behavior reports that represent new sources of EE savings, and new program implementation types such as mid- and upstream and leveraged joint delivery that may bring lower EE program administrative costs and increased participation and/or comprehensiveness.
- Inclusion within natural gas EE programs and portfolios of non-gas measures such as networked geothermal systems, owned and operated by the utility and using natural gas back-up/supplemental heat, may represent investment opportunities to natural gas utilities in some jurisdictions.

# TASK 2: COST-EFFECTIVENESS CASE STUDY

## Introduction

Upon completion of the Portfolio Review, attention turned to developing and executing a Cost-Effectiveness Case Study to compare cost-effectiveness testing and results for a prototypical national perspective portfolio of EE programs in a current state with cost-effectiveness testing and results in a future state. The intent of the current-state/future-state approach was to acknowledge that there is significant policy and regulatory change happening today that will impact the way cost-effectiveness testing is done in the three- to five-year future time horizon used in the EE Assessment, that natural gas EE program design and administration (and attendant costs) can be expected to change, and that financial markets are also not static. Therefore, the current state reflects current financial parameters, the current policy and regulatory context, and current experience regarding program design and administrative costs. For a future state three to five years from today, the following changes were incorporated:

- Modestly lower allowed utility capital costs and market interest rates.
- A doubling of the value of NEBs included in cost-effectiveness testing.
- Inclusion of avoided distribution costs in cost-effectiveness testing.
- A modest decrease in EE program administrative costs as experience and efficiencies accrue.

The Case Study utilized MCR's Local Energy Efficiency Planning (LEEP) model to execute the four steps shown in Figure 3.

**Figure 3: Case Study Steps**


## The Portfolio

The potential EE measures and delivery mechanisms from the Portfolio Review were narrowed and vetted through the Steering Committee to the portfolio identified in Tables 10-15. Residential and Commercial/Industrial Behavior Reports Programs were also identified to be modeled for cost-effectiveness in both the current and future states.

Although not highlighted in the tables, behavior report programs are vitally important. Also known as "peer comparison reports," behavior reports provide comparisons of natural gas consumption by recipients of them (i.e., participants) to their peers and neighbors based on statistical analysis, along with specific behavioral recommendations and direction to other natural gas EE programs and measures. For residential customers who are more socially conscious, environmentally active, and financially concerned about energy costs, the behavioral angle of these programs can be empowering to the customer and lead to action on their part. Likewise, as commercial and industrial customers engage in corporate citizenship and environmental sustainability initiatives and reporting—while, as always, staying focused on costs and their bottom line—behavior reports can be quite impactful. From an education perspective, behavior reports are also an excellent platform for informing recipients of the economic, environmental, and resilience virtues of natural gas.

In Tables 10-15, the left column, "Measure," indicates the specific EE measure to be offered in the program. The right column, "Delivery," indicates the way the measure will be offered. Three program delivery approaches are featured in the analyzed portfolio:

- Direct install programs, providing EE products and/or services (i.e., measures) directly to the recipient.
- Downstream rebate programs, providing participant compensation for completion or installation of a given EE measure. Participants may also designate an agent (e.g., their contractor) to receive the rebate. Downstream rebate programs include the Residential Prescriptive, Commercial and Industrial Prescriptive, and Commercial Kitchens programs.
- Hybrid direct install/rebate programs, offering direct installation of some measures at the time of a site visit and audit, augmented by downstream rebate offers for eligible participants.

The Home Performance/Assisted Home Performance Program is a single program with tiered incentives targeted to income-eligible participants (i.e., those designated as eligible for Assisted Home Performance) who may receive higher rebates than other participants.

### Table 10: Multifamily Dwelling Unit Program

| Measure | Delivery |
|---|---|
| **DHW Pipe Wrap** | Direct Install |
| **Aerator** | Direct Install |
| **Low-Flow Showerhead** | Direct Install |
| **DHW Temperature Turndown** | Direct Install |
| **Weatherization Kit** | Direct Install |
| **Smart Thermostat** | Participant Rebate Offered |

### Table 11: Home Performance/Assisted Home Performance Program

| Measure | Delivery |
|---|---|
| **DHW Pipe Wrap** | Direct Install |
| **Boiler Pipe Wrap** | Direct Install |
| **Aerator** | Direct Install |
| **Low-Flow Showerhead** | Direct Install |
| **DHW Temperature Turndown** | Direct Install |
| **Weatherization Kit** | Direct Install |
| **Smart Thermostat** | Participant Rebate Offered |
| **Tankless Water Heater** | Participant Rebate Offered |
| **95 AFUE Furnace** | Participant Rebate Offered |
| **96 AFUE Furnace** | Participant Rebate Offered |
| **90 AFUE Boiler** | Participant Rebate Offered |
| **Combination Boiler** | Participant Rebate Offered |

### Table 12: Residential Prescriptive Program

| Measure | Delivery |
|---|---|
| **Outlet Gasket** | Downstream Rebate |
| **Door Sweep** | Downstream Rebate |
| **Caulking** | Downstream Rebate |
| **Weatherstripping** | Downstream Rebate |
| **Smart Thermostat** | Downstream Rebate |
| **Tankless Water Heater** | Downstream Rebate |
| **95 AFUE Furnace** | Downstream Rebate |
| **96 AFUE Furnace** | Downstream Rebate |
| **90 AFUE Boiler** | Downstream Rebate |
| **Combination Boiler** | Downstream Rebate |

### Table 13: Commercial and Industrial Prescriptive Program

| Measure | Delivery |
|---|---|
| **Condensing Boiler (92 AFUE)** | Downstream Rebate |
| **Furnace (95 AFUE)** | Downstream Rebate |
| **Infrared Heater** | Downstream Rebate |
| **Unit Heater (90% efficient)** | Downstream Rebate |
| **Tank-Type Water Heater (95% efficient)** | Downstream Rebate |
| **Tankless Water Heater (93% efficient)** | Downstream Rebate |
| **Combination Boiler (residential size)** | Downstream Rebate |
| **Boiler Tune-Up** | Downstream Rebate |
| **Boiler Reset Controls** | Downstream Rebate |
| **Steam Traps** | Downstream Rebate |

**Table 14: Commercial Kitchens Program**

| Measure | Delivery |
|---|---|
| **Pre-Rinse Spray Valve** | Downstream Rebate |
| **Conveyor Oven** | Downstream Rebate |
| **Combination Oven** | Downstream Rebate |
| **Convection Oven** | Downstream Rebate |
| **Rotisserie Oven** | Downstream Rebate |
| **Rack Oven** | Downstream Rebate |
| **Infrared Broiler** | Downstream Rebate |
| **Steamer** | Downstream Rebate |
| **Fryer** | Downstream Rebate |
| **Griddle** | Downstream Rebate |

**Table 15: Small Business Direct Install Program**

| Direct Install Measures | Rebate Offered Measures |
|---|---|
| **Boiler Tune-Up** | Smart Thermostat |
| **Boiler Reset Controls** | Furnace (95 AFUE) |
| **Steam Traps** | Condensing Boiler (92 AFUE) |
| **Heating Pipe Insulation** | Fryer<br>Griddle<br>Convection Oven<br>Steamer<br>Dishwasher |

## EE Measure Quantification

Quantification is the critical process that determines the costs and savings associated with individual EE measures. Typically, such quantification is guided by algorithms and deemed values published in a jurisdiction- or utility-specific Technical Reference Manual (TRM). To develop a national quantification perspective, numerous TRMs were mined, primarily from the jurisdictions in which the Portfolio Review focus utilities operate, supported by other TRMs based on input from Steering Committee members. Although TRMs from numerous jurisdictions were examined, the TRMs from the following jurisdictions were referred to for measure quantification because they include substantial numbers of natural gas EE measures:

- Illinois (primary)
- Delaware
- Arkansas
- Pennsylvania
- Connecticut
- California

Based on the review, the Illinois TRM emerged as the primary basis for quantification of savings because the Illinois TRM includes more of the natural gas EE measures selected for inclusion in the natural gas EE portfolio assessed in the Cost-Effectiveness Case Study than the others. Figure 4 shows an example of the basis for calculating high-efficiency furnace savings per the Illinois TRM.

**Figure 4: Illinois TRM Algorithm for High-Efficiency Furnace**

$$\Delta Therms = \frac{\frac{EFLH * CAPInput}{(1 - Derating_{eff})} * \left(\frac{AFUE(eff) * (1 - Derating(eff))}{AFUE(base) * (1 - Derating(base))} - 1\right)}{100{,}000}$$

The algorithm for high-efficiency furnaces is simple compared to those for many other inputs, but it highlights the key point that quantification of savings is driven by numerous inputs—in this case including:

- EFLH, or effective full load heating hours: the number of hours per year the furnace can be expected to operate at capacity.
- CAP*Input*: the input capacity in Btu per hour.
- $Derating_{eff}$ and $Derating_{base}$: the reductions from rated efficiency, in this example reflecting installation quality issues such as proper sizing.
- $AFUE_{eff}$ and $AFUE_{base}$: the Annual Fuel Utilization Efficiency values for the base and efficient cases.

From these illustrative inputs, two important drivers of gas energy savings calculations emerge:

(1) EFLH is a function of weather and related heating degree days, and

(2) $AFUE_{base}$ is a highly debated parameter that can reflect the efficiency of a unit being removed, the minimum federal efficiency standard level for equipment used as replacement or in new construction, an efficiency level regarded as typical of a given (jurisdiction's) market, or a compound of baseline efficiency of equipment being removed and the federal minimum or market-typical efficiency of new equipment.

## Costs

Determination of cost for cost-effectiveness evaluation varies with the scenario in which the measure is assumed to be supported by an EE program:

- Retrofits or early replacements involve proactive replacement, primarily to improve efficiency. Here, the evaluated cost includes the incremental cost of the installed equipment over baseline efficiency equipment plus the installation cost.
- In the case of failed equipment or new construction, only the incremental cost is considered since installation was required regardless of the efficiency of the new equipment.

Numerous TRMs were examined, and supplementary research was conducted to establish costs. Ultimately, measure costs used in the evaluation of cost-effectiveness were drawn from TRMs that had explicit information on costs associated with natural gas EE measures included in the portfolio assessed: Delaware, Illinois, California; the average of the three states; or internet research. However, two important findings are that 1) finding useful measure cost data is difficult, and 2) there is little consistency across jurisdictions, or even utilities within jurisdictions, regarding measure costs[14] modeled in cost-effectiveness analyses.

Additional attributes of the EE measures were evaluated for cost-effectiveness:

- Estimated useful life (EUL).
- Realization rate, or the percentage of quantified savings borne out by gas meter data. This is often lower than 100% due to record-keeping errors, EE measures purchased but not installed, and/or measures installed and subsequently removed. Factoring the realization rate into calculated gross savings yields “adjusted gross savings.”[15]
- Net-to-gross (NTG) ratio, which is an important concept in EE that adjusts gross savings derived from customer meter data for “free riders” (i.e., those who would have installed an EE measure even absent an EE program), and “free drivers” (i.e., those who installed an EE measure without participating in the program). Applying the NTG ratio to adjusted gross savings yields net savings, which is what the EE-delivering utility program “gets credit for” and forms the basis for evaluation of cost-effectiveness.[16]

After initial development of the savings and costs for all measures, the results were compared to the corresponding values in the other TRMs referenced, and sometimes changed, before being accepted as the preliminary final set of measure quantification data to model for cost-effectiveness.

Several aspects of measure quantification, including baselines as influenced by codes, efficiency standards, and other policy drivers such as ENERGY STAR, are discussed further in the Trends Assessment section.

## LEEP Configuration

The LEEP model applies various mathematical operations to input data, including measure quantification (as described above) and various other portfolio design assumptions and economic

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14 Whether or not a jurisdiction has requirements related to labor costs (e.g., prevailing wage requirements, David-Bacon Act compliance, etc.) exemplify the jurisdiction-specific nature of measure quantification with respect to measure cost.

15 In the project’s evaluation of cost-effectiveness, realization rates were set to 100% for all measures, and the impacts captured by them were included in the net-to-gross ratios.

16 Although most jurisdictions credit utilities and evaluate cost-effectiveness based upon net savings, a few rely on gross or adjusted gross savings. The project’s evaluation of cost-effectiveness considered net savings throughout.

inputs and assumptions to generate the costs and benefits associated with the cost-effectiveness equations to be evaluated. These other inputs and assumptions are explained below.

**Avoided Costs**

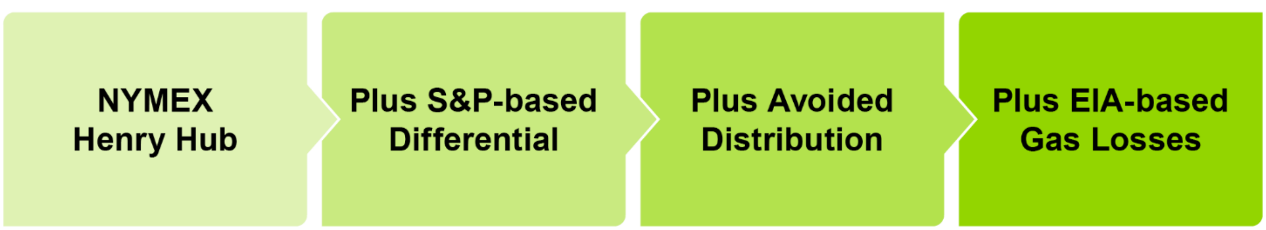
The avoided cost of gas is the primary means by which gas energy savings arising from EE programs are monetized and represents a key component of the benefit side of cost-effectiveness equations. The Case Study defined avoided costs as the sum of Henry Hub commodity gas price plus a basis differential to capture transportation and storage costs to the utility's city gate, plus utility distribution costs. The commodity cost of gas was defined by NYMEX Henry Hub natural gas futures contract as settled on April 16, 2024, and then extrapolated based on EIA cost escalation rates for the trailing years beyond the bounds of the NYMEX strip.

The differential or basis cost was defined as the difference between Henry Hub commodity gas costs and the average of the cost of gas delivered to 22 major market delivery points in the United States as identified in the S&P Global IQ Natural Gas Summary dataset for June 7, 2024. This value was used as a proxy for the differential between Henry Hub and the utility's city gate.[17]

The existence and magnitude of avoidable distribution costs are presently an unsettled issue, with most jurisdictions excluding such costs in gas EE cost-effectiveness analysis. Therefore, the value of avoided distribution costs was set to zero for the current-state analysis. However, a value of 1% of the cost of gas delivered to the city gate was assumed in the future-state analysis since modest avoided distribution costs are now fairly common for electric utility EE cost-effectiveness and are under discussion for gas EE in several jurisdictions. Finally, the cost of gas at the customer meter was increased by 1% to reflect losses, based on the average of all states as reported by ACEEE in a dataset drawn from the EIA's 2022 *Natural Gas Annual*.

Annual values were assembled and separated into peak month totals for November-April and off-peak month totals for May-October to derive the total avoided cost of gas. Beginning with the assumed year of EE measure installation, the present value of the stream of avoided costs for 25 years was calculated using a discount rate (discussed below in "Other Inputs and Assumptions"). The build-up of avoided costs is shown in Figure 5.

**Figure 5: Assembly of Avoided Costs**




**Non-Energy Benefits (including other resource savings)**

Non-energy benefits, or NEBs, are the monetized value of considerations apart from the primary energy source being addressed by EE and/or funded by the utility delivering EE. NEBs are traditionally considered within the SCT only if the CSPM is applied strictly. However, treatment and inclusion of NEBs has become perhaps the single biggest issue currently under discussion among

[17] The Henry Hub in Louisiana is served by nine interstate and four intrastate pipelines, making the Henry Hub the primary U.S. benchmark for natural gas prices.

EE stakeholders. Many progressive jurisdictions have moved to include certain NEBs in the TRC, and even the UCT, in recent years. Furthermore, the rising profile of the NSPM-DER, first published in 2020 by the National Energy Screening Project (NESP) and driven by an energy-environmental advocacy-oriented organization called E4TheFuture, is driving reconsideration of the entire approach to and scope of benefit-to-cost testing.

The manner in which NEBs are included in the benefit term of a benefit-to-cost ratio varies considerably. Though not current, a paper[18] by Skumatz Economic Research Associates presented at the 2016 ACEEE Summer Study on Energy Efficiency in Buildings remains accurate in its discussion of the topic. In the paper, Skumatz identifies four approaches to inclusion of NEBs and four approaches to developing monetized dollar-values for NEBs, shown in Table 16.

**Table 16: Approaches to Valuing NEBs**

| Approaches to Inclusion of NEBs |
|---|
| (Proxy) Adders |
| Monetization of Easy to Measure NEBs |
| Monetization of All NEBS |
| Hybrid of Adders and Monetization |
| **Approaches to Monetization of NEBs** |
| Direct Measurement |
| Secondary Data |
| Modeling |
| Surveys |

For purposes of this Case Study, informed by the Portfolio Review research, a proxy adder (to avoided energy costs—gas in this case, of course) was utilized. An adder of 15% of avoided costs generally and 30% for EE programs serving low-income and multifamily customers was used in the current-state analysis based on current practice in Vermont. For the future state, 30% was used generally and 60% was used for low-income and multifamily. Doubling the adder for NEBs reflects a reasonable estimate of the magnitude of change given the current focus on NEBs.

## Program Overhead Costs

Program overhead includes all costs other than the incentive or direct installation costs associated with EE support of a measure, program, or portfolio. Similar to NEBs, program overhead costs are a common focus of stakeholders as advocates and intervenors in regulatory proceedings seek to minimize such costs to increase cost-effectiveness. Overhead costs include utility administration; third-party implementation, fulfillment, and quality assurance/quality control contractor costs; marketing; program and portfolio planning; data tracking; and evaluation, measurement, and verification (EM&V). Based on EE planning and regulatory assignments with other utilities, adders of

[18] Pages 6-1 and 6-2 of https://www.aceee.org/files/proceedings/2016/data/papers/6_1147.pdf.

75% of measure cost for direct install programs and 50% for all other programs in the current state and 70% and 40% in the future state were used on the assumption that stakeholder pressure and administrative efficiencies drive such costs down over time.[19] Costs other than rebates, directly installed measures, and services to participants were modeled as between 35% and 45% of total budget. Aspects of program overhead costs are discussed further in the Trends Assessment section.

## Incentive Payments

Incentive payments are paid directly to a participant, their designee, or an upstream market actor such as a retailer, distributor, or manufacturer in support of an EE measure. The Case Study reflects costs of measures and installation provided through direct install programs in this category. The Case Study also used payback-probability analysis to drive the percent of measure cost assumed to be paid as rebates by the natural gas EE programs. Payback-probability analysis generally holds that when consumers are presented with a purchase or investment option that yields a simple payback (cost versus time to recover that cost in bill savings) of two years or less, approximately two-thirds of people will participate.

A generally accepted utility EE planning rule of thumb is that a 50% incentive yields a simple payback of two years or less. Accordingly, incentive (rebate) rates of approximately 50% of measure cost were assumed. Further, many low-income and multifamily customers receive enhanced incentive offers relative to other customers,[20] and the Case Study portfolio also includes a hybrid of programs, including direct install as well as those supported by a rebate that exceeds an offer under a prescriptive rebate program to all customers. Accordingly, incentive levels were set at 45% of measure cost as the baseline, and 55% for enhanced offerings (i.e., low-income, multifamily, and direct install programs). Incentive payments, including related offerings such as financing, are discussed further in the Trends Assessment section.

## Bill Savings

Bill savings is the net present value of the reduction in customer bills over the EUL (lifetime) derived from an EE measure installed or accepted by EE program participants. As this component of cost-effectiveness testing is straightforward, the study utilized the EIA 2023 Annual Energy Outlook prices of gas delivered to the residential sector and the average of the delivered prices for the (separately reported) commercial and industrial sectors as the assumed retail rates. Rates and rate design, however, are evolving. This is discussed further in the Trends Assessment section.

## Other Inputs and Assumptions

To arrive at the components of the benefit-to-cost ratio, various other inputs and assumptions were used, including:

- The discount rate used in current-state analysis reflects an average gas utility weighted average cost of capital (WACC) of 6.86%, based on 2023 gas utility allowed equity returns,[21] a 50% debt-50% equity capital structure, and a BBB after-tax corporate bond yield. The societal discount rate of 4.54% is based on the June 2024 30-year U.S. treasury

[19] The administrative cost adders are very much a simplifying assumption. Some types of programs may have higher administrative costs (e.g., home performance) and some may have lower administrative costs (e.g., behavior reports).

[20] Low-income or income-eligible customers may receive rebates as high as equal to 100% of the incremental cost assumed in planning and cost-effectiveness analyses, making the measures a no-cost proposition to the participant.

[21] As tabulated in "Major Energy Rate Case Decisions in US" provided online to subscribers of S&P Global Market Intelligence.

bond yield. For the future-state analysis, MCR reduced the assumed WACC to 6.5% and the societal discount rate to 4.00% given current gradual downward trends in allowed equity rates of return and an expectation that interest rates will moderate.

- Heating degree days (HDD) and effective full load hours (of operation) are key factors in savings calculations for furnaces, boilers, and related gas EE measures. Use of the Illinois TRM for much of the measure quantification led to use of the Illinois statewide average HDD and EFLH initially. To enable a single national perspective, American Gas Association HDD data was used to develop a national average of HDD (7,695) and HDD for the Census East-North-Central region, which includes Illinois (10,106). The Illinois TRM residential EFLH (928) and commercial and industrial EFLH (1,390) were used to compute EFLH per HDD and then applied to the national average HDD to generate a national residential EFLH of 700 and a national commercial and industrial EFLH of 1,050. The Case Study scope was also expanded to run the current state and future state cost-effectiveness analyses with both national and Census East-North-Central HDD and EFLH underlying measure quantification in order to correct for any bias introduced by reliance on the Illinois TRM.

- Total household gas consumption and gas heating consumption are drivers of quantification of certain EE measures for the residential sector, so 2020 U.S. Residential Energy Consumption Survey (RECS) average MMBtu and Census East-North-Central MMBtu were used in the Case Study modeling.

Table 17 summarizes the various inputs and assumptions used in modeling, including those related to development of avoided costs.

**Table 17: Inputs and Assumptions**

| Variable | Current-State Value | Future-State Value | Source/Note |
|---|---|---|---|
| **WACC Discount Rate** | 6.86% | 6.50% | S&P – 2023 Rate Case Data |
| **Societal Discount Rate** | 4.54% | 4.00% | 30-Year T-Bond |
| **Differential from Henry** | 1.32% | 1.32% | S&P – Avg. Mkt. Center Prices |
| **Lost/Unaccounted for Gas** | 1.00% | 1.00% | EIA |
| **Avoided Distribution** | 0.00% | 1.00% | EIA/ACEEE |
| **Base NEB Adder** | 15% | 30% | Portfolio Review Research |
| **LMI NEB Adder** | 30% | 60% | Portfolio Review Research |
| **Annual Heating MMBtu – Residential (National)** | 0za | 46.7 | 2020 RECS |
| **Annual Heating MMBtu – Residential (Cold Climate)** | 69.1 | 69.1 | 2020 RECS |
| **Annual MMBtu – Residential (National)** | 95.6 | 95.6 | 2020 RECS |
| **HDD (National)** | 7,695 | 7,695 | AGA Data |
| **HDD (Cold Climate)** | 10,106 | 10,106 | AGA Data |
| **Residential Heat EFLH (National)** | 700 | 700 | Derived EFLH per HDD |
| **Residential Heat EFLH (Cold Climate)** | 928 | 928 | Illinois TRM |
| **C&I Heat EFLH (National)** | 1,050 | 1,050 | Derived EFLH per HDD |
| **C&I Heat EFLH (Cold Climate)** | 1,390 | 1,390 | Illinois TRM |
| **Admin. % DI Incentives** | 75% | 70% | MCR Planning Filings |
| **Admin. % Other Incentives** | 50% | 45% | MCR Planning Filings |
| **Incentive % of Cost – DI** | 45% | 45% | Payback-Probability Analysis |
| **Incentive % of Cost – Other** | 55% | 55% | Payback-Probability Analysis |

## Cost-Effectiveness Modeling

With the portfolio of EE measures and programs defined, the measures quantified, and the LEEP model configured, the modeling was executed. LEEP is designed to be highly flexible and dynamic to perform iterative modeling under various scenarios that feature virtually any of the inputs and assumptions. Harnessing that flexibility, four scenarios were modeled:

- Current State – National
- Current State – Cold Climate
- Future State – National
- Future State – Cold Climate

Census East-North-Central weather (HDD and EFLH) and RECS data were used for the cold climate scenarios.

To maintain the Cost-Effectiveness Case Study's focus on the impact of changing from the current state to the future state, and to minimize the risk that readers of this report may attempt to apply the modeling results to their specific context in terms of budgets, participation, savings, etc., modeling was conducted on one unit of participation for each EE measure within each EE program. Likewise, to maintain the Case Study focus on modeling one prototypical portfolio to highlight the impact of changing from the current state to the future state, the measures, their quantification, and their costs were not varied. Finally, iterative modeling or changing the structure of the portfolio did not seek to achieve BCRs of greater than one for all measures and programs. Instead, the focus was on program and portfolio BCRs with little concern about whether programs generated BCRs of greater than 1. Indeed, seeing current-state BCRs of less than 1 that improved noticeably in the future state proved to be a positive observation, consistent with the intent of the Cost-Effectiveness Case Study.

Tables 18 through 22 show the results of the cost-effectiveness analyses from a national perspective at the program, sector, and portfolio levels. The cold climate perspective is provided in Appendix 5.

## Table 18: Total Resource Cost Test Results

| Program/Descriptor | Discounting at WACC, no NEBS | | | Discounting at WACC, w/NEBs | | |
|---|---|---|---|---|---|---|
| | Future | Current | Change | Future | Current | Change |
| Multifamily Dwelling Unit | 1.03 | 0.92 | 11.96% | 1.33 | 1.06 | 25.59% |
| Assisted Home Performance | 1.06 | 0.95 | 11.58% | 1.37 | 1.09 | 26.50% |
| Home Performance | 0.97 | 0.87 | 11.49% | 1.26 | 0.99 | 26.32% |
| Residential Prescriptive | 0.85 | 0.76 | 11.84% | 1.10 | 0.87 | 25.91% |
| Behavior Reports | 1.83 | 1.63 | 12.27% | 2.37 | 1.87 | 26.33% |
| **Residential** | **0.95** | **0.85** | **11.76%** | **1.31** | **1.01** | **29.70%** |
| C&I Prescriptive | 0.44 | 0.40 | 10.00% | 0.57 | 0.46 | 25.61% |
| Commercial Kitchens | 1.01 | 0.92 | 9.78% | 1.31 | 1.06 | 23.73% |
| Small Business | 1.65 | 1.48 | 11.49% | 2.12 | 1.70 | 25.05% |
| **C&I** | **0.98** | **0.89** | **10.11%** | **1.27** | **1.02** | **24.51%** |
| **Portfolio Total** | **0.98** | **0.88** | **11.36%** | **1.27** | **1.02** | **24.51%** |

**Table 19: Societal Cost Test Results**

| Program/Descriptor | Discounting at T-Bond, w/NEBs | | |
|---|---|---|---|
| | Future | Current | Change |
| Multifamily Dwelling Unit | 1.57 | 1.23 | 27.63% |
| Assisted Home Performance | 1.67 | 1.29 | 28.93% |
| Home Performance | 1.54 | 1.19 | 28.89% |
| Residential Prescriptive | 1.35 | 1.05 | 28.48% |
| Behavior Reports | 2.39 | 1.89 | 26.36% |
| **Residential** | **1.60** | **1.21** | **32.23%** |
| C&I Prescriptive | 0.71 | 0.55 | 28.36% |
| Commercial Kitchens | 1.48 | 1.18 | 25.18% |
| Small Business | 2.48 | 1.95 | 27.02% |
| **C&I** | **1.49** | **1.18** | **26.27%** |
| **Portfolio Total** | **1.50** | **1.18** | **27.12%** |

**Table 20: Utility Cost Test Results**

| Program/Descriptor | Discounting at WACC, no NEBS | | | Discounting at WACC, w/NEBs | | |
|---|---|---|---|---|---|---|
| | Future | Current | Change | Future | Current | Change |
| Multifamily Dwelling Unit | 1.24 | 1.10 | 12.73% | 1.60 | 1.27 | 26.26% |
| Assisted Home Performance | 1.41 | 1.25 | 12.80% | 1.82 | 1.43 | 27.53% |
| Home Performance | 1.49 | 1.31 | 13.74% | 1.92 | 1.50 | 27.79% |
| Residential Prescriptive | 1.57 | 1.38 | 13.77% | 2.02 | 1.58 | 27.86% |
| Behavior Reports | 1.83 | 1.63 | 12.27% | 2.37 | 1.87 | 26.33% |
| **Residential** | **1.48** | **1.30** | **13.85%** | **2.04** | **1.55** | **31.61%** |
| C&I Prescriptive | 0.82 | 0.72 | 13.89% | 1.05 | 0.83 | 27.55% |
| Commercial Kitchens | 1.87 | 1.67 | 11.98% | 2.41 | 1.92 | 25.65% |
| Small Business | 2.47 | 2.20 | 12.27% | 3.18 | 2.52 | 26.43% |
| **C&I** | **1.67** | **1.49** | **12.08%** | **2.16** | **1.70** | **27.06%** |
| **Portfolio Total** | **1.66** | **1.47** | **12.93%** | **2.15** | **1.69** | **27.22%** |

**Table 21: Participant Cost Test Results**

| Program/Descriptor | Discounting Rates at WACC | | |
|---|---|---|---|
| | Future | Current | Change |
| Multifamily Dwelling Unit | 26.72 | 26.75 | -0.11% |
| Assisted Home Performance | 14.76 | 14.76 | 0.00% |
| Home Performance | 9.30 | 9.30 | 0.00% |
| Residential Prescriptive | 6.87 | 6.87 | 0.00% |
| Behavior Reports | N/A | N/A | N/A |
| **Residential** | **9.40** | **9.40** | **0.00%** |
| C&I Prescriptive | 2.56 | 2.56 | 0.00% |
| Commercial Kitchens | 5.34 | 5.30 | 0.75% |
| Small Business | 9.46 | 9.41 | 0.53% |
| **C&I** | **5.15** | **5.13** | **0.39%** |
| **Portfolio Total** | **5.44** | **5.41** | **0.55%** |

**Table 22: Rate Impact Measure Test Results**

| Program/Descriptor | Discounting at WACC, no NEBs | | |
|---|---|---|---|
| | Future | Current | Change |
| Multifamily Dwelling Unit | 0.84 | 0.76 | 10.53% |
| Assisted Home Performance | 1.00 | 0.89 | 12.36% |
| Home Performance | 1.05 | 0.93 | 12.90% |
| Residential Prescriptive | 1.04 | 0.92 | 13.04% |
| Behavior Reports | 1.09 | 0.95 | 14.74% |
| **Residential** | **1.02** | **0.91** | **12.09%** |
| C&I Prescriptive | 0.33 | 0.30 | 10.00% |
| Commercial Kitchens | 0.39 | 0.36 | 8.33% |
| Small Business | 0.49 | 0.45 | 8.89% |
| **C&I** | **0.43** | **0.39** | **10.26%** |
| **Portfolio Total** | **0.45** | **0.41** | **9.76%** |

## Conclusion

The Cost-Effectiveness Case Study achieved its purpose: to document the impact of a change to the cost-effectiveness testing methodology. The future state iteration of the cost-effectiveness module of the LEEP model doubled the monetized benefit of NEBs in recognition of the NSPM-driven trend toward ever-increasing presence of them in cost-effectiveness analyses in many jurisdictions and the evidence of more and more jurisdictions developing new JST in which NEBs are prominent. Although not all parties in all jurisdictions embrace NEBs, their inclusion can significantly enhance the real or perceived value of energy efficiency programs, making them more attractive to both utilities and regulators. By capturing benefits like improved health, safety, comfort, and reduced greenhouse gas emissions, NEBs provide a more comprehensive—that is, beyond energy alone—view of an EE program's impact. The results of the Cost-Effectiveness Case Study show that by increasing NEBs and modifying some of the economic inputs and assumptions, cost-effectiveness under the CSPM tests will improve.

Beyond the influence of NEBs, two other questions emerged from the Cost-Effectiveness Case Study:

1) What is the relationship between cost-effectiveness and gas affordability?

2) How can natural gas utilities optimize cost-effectiveness testing results?

### Relationship between cost-effectiveness and gas affordability

The first question, on affordability, can be answered straightforwardly and theoretically. At a basic level, increased utility spending on EE programs raises the utility's revenue requirement, which could lead to higher overall rates. Participants in EE can expect to see their bills go down, while non-participants can expect to see their bills go up. The Rate Impact Measure (RIM) test addresses affordability at a more theoretical level.

RIM is alternatively known as the non-participant test. It looks at the impact of natural gas EE from the perspective of the utility as a whole and the utility's customer base. The numerator (benefit) of the RIM test is the same number as the energy-specific component of the TRC, SCT, and UCT—that is, the avoided cost of gas produced, transported, and delivered due to EE. However, the denominator (cost) includes not only the utility's cost of program incentive payments and administrative costs related to operating an EE program, but also the reduction in utility revenue as a result of lower sales of gas due to an EE program. If rates are viewed in the simplest terms, as revenue requirement divided by sales, and the avoided cost of gas due to an EE program is viewed as the reduction in revenue requirement due to an EE program, then RIM can be thought of as the change in revenue requirement divided by the change in sales revenue, or the potential impact on rates. In other words, if the ratio of decreased revenue requirement to decreased sales revenue is greater than 1, costs to the utility because of EE-induced sales reductions decline by more than the revenue lost because of EE-induced sales reductions. That means rates will tend to go down and affordability will tend to go up. The Cost-Effectiveness Case Study indicates that under a future state, RIM test results increase relative to the current state, and therefore natural gas EE increases affordability.

### Optimization of cost-effectiveness testing results

The second key insight stemming from the Cost-Effectiveness Case Study is that there are opportunities for natural gas utilities to optimize cost-effectiveness testing relative to specific strategies and goals by engaging NSPM-DER processes and being intentional as they contribute to the processes as rules associated with measure quantification, inputs, and assumptions included in cost-effectiveness testing are defined. In evaluating the specific inputs and assumptions to the cost-effectiveness testing models, the study identified several "levers" within cost-effectiveness models that are or could potentially be activated. For example, inputs and assumptions such as avoided costs and program overhead costs can vary. Likewise, monetized NEBs are a particularly important driver of cost-effectiveness results that may or may not be included among the benefits of natural gas utility EE programs, depending on EE and non-EE priorities. Lastly, since weather is a key driver of quantification of heating-related EE measures, each natural gas utility can identify which EE products, services, and technologies (i.e., measures) make sense within their service territory, and therefore should be included within programs being tested for cost-effectiveness. Varying measure quantification and/or various inputs and assumptions causes increases or decreases to the benefit-to-cost ratio output of cost-effectiveness testing. Table 23 shows the cost-effectiveness levers available, or potentially available, to utilities.

**Table 23: Cost-Effectiveness Levers**

| Levers | |
|---|---|
| Measure and installation costs | Non-energy benefits monetized or assumed in proxy adders |
| Incentive and administrative cost levels | Measure sizes, configurations, etc. assumed in quantification |
| Discount rates | Avoided costs |
| Weather and effective full load hours | Retail rates |

The Cost-Effectiveness Case Study defined a portfolio of natural gas EE programs and measures, quantified the EE measures using publicly available TRM and weather data, and developed the CSPM cost-effectiveness tests and resulting benefit-to-cost ratios in both a current state and an assumed future state. By keeping the EE portfolio (i.e., programs and measures) the same in both the current and future state, and varying only several of the identified cost-effectiveness levers, primarily NEBs, the study identified that cost-effectiveness and affordability of natural gas EE programs are likely to improve over the next three to five years.

# TASK 3: GAS EE TRENDS ASSESSMENT

## Introduction

Upon completing of the Portfolio Review and Cost-Effectiveness Case Study, the focus turned to identifying and analyzing market dynamics; policy influences; and natural gas utility EE program design, technology trends, and opportunities likely to shape future-state natural gas utility EE (the Trends Assessment). The Trends Assessment also sought to further identify strategic opportunities for natural gas utilities that could arise from EE over the next three to five years.

While much of this report—and indeed, many of the regulatory economic tests for the cost-effectiveness of utility energy efficiency programs—are focused on maximizing the return on a therm of natural gas (or a kilowatt-hour of electricity) from various perspectives (e.g., utility, participant, non-participant, society), there is ample evidence that numerous energy and non-energy benefits also accrue from conserving and optimizing the use of the energy delivery system as a whole.

**Key Questions for Evaluating EE Program Benefits**

With input from the project Steering Committee, three core questions emerged as the focus:

(1) What benefits of natural gas utility EE currently reported warrant continued, and perhaps enhanced, attention?

(2) What new or emerging benefits of natural gas utility EE programs warrant additional development and/or more prominent reporting?

(3) How will market dynamics, policy trends, and focus on the full range of benefits of natural gas utility EE affect program and portfolio planning, including specific gas EE measures and program implementation, administration approaches, and implementation?

To address these questions, extensive research was conducted—including examination of approximately 200 documents and a dozen telephone or email interviews with utility staff—and 10 iterations of the LEEP model were executed, all leading to the identification and then application of trends and opportunities beginning or likely to soon impact natural gas utility EE over the near- to mid-term.

## Policy-Driven Trends Influencing Natural Gas EE Programs

Utility energy efficiency programs have always been largely policy-driven, but it appears likely that the scope and nature of the policy influence will become even more pronounced. Accordingly, the following request from AGF's RFP underlies virtually the entire assessment of trends, description of opportunities, and identification of areas for further study:

> *Track the policies that could impact the future of gas programs and describe their potential impacts.*

Coalescing the research and results of the Portfolio Review and Cost-Effectiveness Case Study with an eye toward future trends, the policy issues and trends to likely reveal themselves as among the most impactful on natural gas utility EE programs in the coming three to five years were identified as shown in Table 24.

**Table 24: Policy Issues and Trends Impactful on Natural Gas Utility EE Programs**

| Issue/Trend | |
|---|---|
| Cost-Effectiveness Methods and NEBs | EE Project Funding and Financing |
| Minimum Efficiency Standards | Building Energy Codes and<br>Building Performance Standards |
| Education and Workforce Development | Emissions Reductions |

Each of these policy trends and issues is discussed in detail below.

### <u>The Role of Cost-Effectiveness Methods and Non-Energy Benefits (NEBs)</u>

The NSPM-DER espouses a process whereby stakeholders and an ultimate arbiter (typically, the regulator) define one or more Jurisdiction-Specific Tests to symmetrically[22] value all costs and benefits consistent with agreed-upon policy issues to be represented. Policy goals other than those directly related to energy widen the scope of benefit-to-cost analysis to consider social and economic development policies, for example, and bring myriad possible benefits that may be incorporated into benefit-cost test(s). Generally, these new benefits are identified as non-energy benefits, or NEBs. Most jurisdictions recognize and monetize avoided environmental compliance costs and water NEBs. Now, however, states that are more aggressively oriented toward EE spending can identify in their

[22] Symmetry is a frequently used term in utility regulatory matters. Specific to EE cost-effectiveness, it refers to balancing the treatment of attributes of energy efficiency by recognizing both their costs and benefits.

TRMs, or otherwise, literally scores, even over 100, discrete NEBs to be included in cost-effectiveness testing.

Regardless of whether or how NEBs are included in cost-effectiveness in any particular jurisdiction today, the growing influence of the NSPM-DER means there are likely discussions happening about the topic, and some NEBs may be adopted into cost-effectiveness methods in the near future. Natural gas utilities and other stakeholders have an opportunity to engage NSPM-DER processes to help shape the outcomes, with respect to the treatment of NEBs in particular.

## Funding and Financing Mechanisms for Energy Efficiency Initiatives

### *EE Funding Sources*

The most common source of funding for natural gas utility EE programs is retail gas rates, typically via an EE-specific tariff rider or surcharge. However, there are additional sources of funds that may directly increase natural gas utility EE budgets or underlie programs that complement utility EE programs by providing financial support for the same products and services included in the utility EE program. Current federal funding streams are a prime example. The Inflation Reduction Act (IRA) extends and/or enhances tax credits and various rebate programs. Tax credits are generally addressed in Section 13302 of the IRA and apply to the purchase and installation of a variety of EE measures. Provisions of the IRA also create new federally funded rebate programs, for example the Home Energy Rebate Program, to be administered by grantees—presumably, the state energy office in most jurisdictions. Likewise, various provisions of the Infrastructure Investment and Jobs Act (IIJA) involve financial support for energy efficiency investments by utility customers. Non-ratepayer funds may be handled by the natural gas utility in two ways:

(1) When executing cost-effectiveness tests, gas EE programs can reduce the measure cost input to BCA models by whatever number of rebates or tax credits participants in a program will receive. In the language of evaluation, measurement, and verification (EM&V) and EE planning, such reductions are identified as transfer payments.

(2) When presenting customers the opportunity to invest in an EE product or service, gas EE programs can define the potential participant’s out of pocket cost as the full cost of the product or service, minus all EE program incentives, non-utility rebates, and tax credits.

Funding sources other than the utility bill make EE investments more attractive to customers than they otherwise would be without increasing customer gas bills. In fact, leveraging new funding sources could show the leveraged money as funding non-incentive categories. This would have the effect of increasing the proportion, currently the majority at 55-65%, of ratepayer funds budgeted to rebates and other direct-to-consumer incentives and services.

### *EE Financing Mechanisms*

In addition to rebates and incentives, natural gas utility EE programs may also provide information about and/or financial support for financing mechanisms that EE program participants can take advantage of. The following are four examples of financing mechanisms sometimes associated with natural gas utility EE programs:

(1) **On-bill financing** is a mechanism where the utility uses its own capital to finance customer investments in EE measures supported by other programs offered by the utility, and then uses a line item on the utility bill for the monthly repayment by the participating customer. Often these structures provide a below-market or even zero percent interest rate, and the utility uses energy efficiency budget dollars to pay itself for the difference

between what, if any, interest rate the customer pays and a stipulated market rate. One example of the on-bill financing approach is the Small Business Energy Advantage Program[23] of Energize Connecticut (a joint initiative of the state's utilities, the Connecticut Green Bank, and the Connecticut Department of Energy and Environmental Protection).

**PAYS,** or "pay as you save," programs are a variant of on-bill financing in which the financing is based on shared savings, meaning a portion of the money saved by the customer due to their investment in an EE project is retained by the customer and a portion is utilized for repayment of the financed amount. Missouri has been particularly active in developing PAYS programs, and Ameren[24] is one example of this type of program.

(2) **On-bill repayment** is where a utility enters into a relationship with a traditional financial institution to fund loans (or leases) for the utility's customers to finance investment in EE offered though other programs offered by the utility, and then the utility uses a line item on the utility bill for the monthly repayment that is received by the utility and forwarded to the financial institution. Often these structures also include a buydown of the interest rate paid by the customer. For example, the financial institution may charge 12% interest, and some portion of that, often a significant amount or even all of it, is paid by the utility with energy efficiency budget dollars.

(3) **Interest buydowns** are offerings where the utility partners with a traditional financial institution to fund and service EE loans for customers participating in one or more EE programs. These loan offerings typically come with a high, unsecured home improvement loan rate which is "bought down" by the utility. For example, for an 18% interest rate loan, the monthly principal and interest payment paid by the customer reflects a much lower interest rate, as low as zero percent, with the utility paying the remainder to partner financial institution.

(4) **PACE,** or property assessed clean energy, financing uses a customer's property tax bill to fund investments in EE or clean energy by establishing a lien on the property (i.e., attached to the premise rather than the customer). Such programs usually require state legislation to allow one or more third parties to act as the financing facilitator (funder), who in conjunction with eligible contractors or EE providers, develops the EE project and closes a loan, then works with the tax levying authority (e.g., municipality or county) to establish the line and receive payments that the tax levying authority receives as a line item on the otherwise regular property tax bill. Energize Delaware's[25] C-PACE ("C" for commercial customers only) is an example.

Financing mechanisms are another way natural gas utility EE programs can make efficiency investments more attractive to customers than they otherwise would be.

## The Influence of Federal Minimum Efficiency Standards on EE Programs

The U.S. Department of Energy is statutorily required to issue minimum efficiency standards for a wide range of products through a federal rulemaking process.[26] The federal rulemaking process is complex and involves many stakeholders. The standards legally prohibit the manufacture, sale, or

[23] https://energizect.com/energy-assessments/small-business.
[24] https://www.ameren.com/missouri/residential/energy-efficiency/natural-gas-pays.
[25] https://www.delawarecpace.org/developers/developers-how-it-works/.
[26] https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program.

installation of products whose rated efficiency is lower than the federally established minimum. Similarly, through a different but equally complex process, ENERGY STAR product specifications establish minimum performance criteria that many natural gas utilities treat as a threshold above which products must perform in order to be eligible for EE program support. However, there is significant inconsistency in how minimum efficiency standards and ENERGY STAR affect different jurisdictions depending on factors such as the timing of when a new standard is treated as baseline. For example, in one jurisdiction, EE rules may require that the baseline efficiency against which savings from a furnace is calculated be the federal minimum efficiency standard or ENERGY STAR level of efficiency as of the effective date of the standard, whereas in a neighboring jurisdiction, the rules may allow one or more years for non-compliant furnaces to "sell-through."[27] Such inconsistencies can create consumer confusion and confound upstream market actors that operate in multiple states and municipalities. However, experience shows that impending minimum efficiency standards and ENERGY STAR can be a substantial opportunity for natural gas utility EE programs. Typically, the effective date of a new minimum efficiency standard is five years after the standard advances out of the federal rulemaking process as law, and new ENERGY STAR specifications have a shorter but still meaningful lead time before becoming in force. Rather than allow rising baselines to eliminate opportunities to achieve EE savings, natural gas utility EE programs can use this time to heavily support affected equipment. Regardless, minimum efficiency standards necessitate that natural gas utility EE programs be updated to ensure the specific products they support are above minimum efficiency standard baselines.

## Building Energy Codes and Building Performance Standards

**Building energy codes** establish baseline requirements for construction and define many gas consumption baselines above which natural gas EE program savings are calculated. The federal government, states, and municipalities generally prescribe their building energy codes as those articulated in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1[28] for non-residential buildings, and the International Energy Conservation Code (IECC)[29] for residential buildings. The processes by which these bodies of work are developed are complex and, by design, involve many stakeholders. The vintage of the codes the U.S. Department of Energy (and other agencies that rely on these so-called "model codes") and individual states and/or municipalities within them embrace varies by jurisdiction. Furthermore, states and municipalities are increasingly adopting as their mandatory baseline so-called "stretch codes" that are more stringent than the baseline model codes. Therefore, what is code-compliant baseline in one jurisdictional context may differ from what is code-compliant baseline in another. Appendix 7 provides the status of building energy codes by state.

The inconsistencies among which vintage of the building energy codes is law can create consumer confusion and confound upstream market actors that operate in multiple states and municipalities. For example, a home builder developing a new residential sub-division that spans two municipalities may be required to adhere to materially different building energy codes as adjacent and otherwise identical homes are built. Because this phenomenon means the builder may have to incorporate different insulation levels, mechanical systems, etc. for the homes built in the two municipalities, building energy code policy can hinder natural gas utility EE programs—in this case, residential new construction programs—by forcing the programs to have rules and requirements that vary by municipality.

[27] "Sell-through" provisions allow some period of time for existing inventories of product to be sold and installed after the effective date of a new minimum efficiency standard.
[28] https://www.ashrae.org/technical-resources/bookstore/standard-90-1.
[29] https://www.iccsafe.org/products-and-services/codes-standards/energy/.

Despite the challenges building energy codes may create for natural gas utility EE programs, there are also opportunities. For example, natural gas EE programs can provide training and support to building code officials and then measure the increase in code compliance and associate the natural gas savings associated with it. As a result, building energy code policy can become a cost-effective way to increase EE program savings and other impacts. For example, consider the following MCR logic:

> If a home built in compliance with IECC-2021 is 10% more efficient (9 MMBtu per year based on 2020 average household consumption of natural gas) based on building energy modeling than the same home built in compliance with IECC-2018, and a natural gas EE program offers training that leads to a documented 15% increase in code compliance, if we assume there are 1,000 new homes built in a utility's service territory each year, then the natural gas EE program can assert 150 * 9 = 1,350 MMBtu of savings is attributable to the training program.

In addition to gas savings, electric, water, and other savings (NEBs) will likely accrue to such code training programs. And, in a similar fashion, programs that deliver education to, for example, HVAC and insulation contractors, may be able to identify program-attributable savings.

**Building performance standards** (BPS), a relatively new tool in the energy policy toolbox, resemble building energy codes in that they set compliance requirements. The Institute for Market Transformation (IMT)[30] defines it this way:

> *A BPS requires buildings to meet carbon or energy performance targets by specific deadlines.*[31]

IMT also provides a graphic indicating the status of building energy benchmarking and performance requirements, shown in Figure 6.

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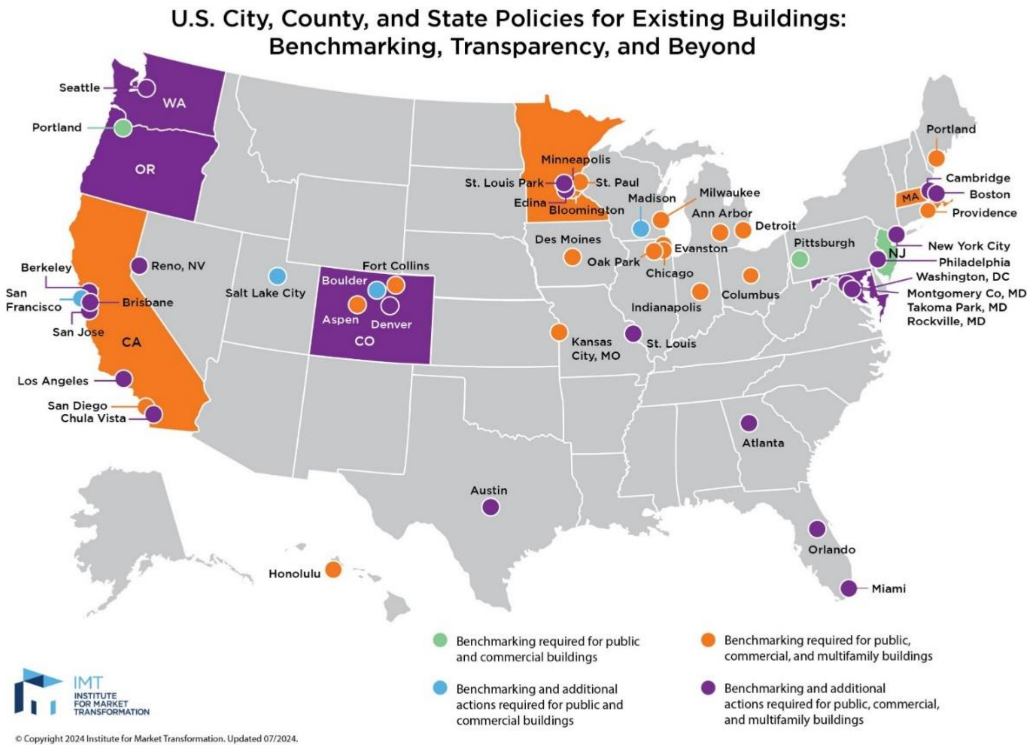
[30] IMT (https://imt.org/about/) is a nonprofit organization that "bridges the intersection of business, government, and community priorities to spotlight business practices and advance public policy to improve U.S. buildings."
[31] Infographic at https://imt.org/wp-content/uploads/2022/01/Institute_for_Market_Transformation_BPS-Infographic_v5_final.pdf.

**Figure 6: Benchmarking and Building Performance Requirements**




In certain instances, the EM&V community and regulators will assert that BPS create an energy baseline above building energy codes, thus reducing the amount of savings that a gas utility may claim from EE interventions and ultimately having a negative impact on gas utilities and their EE programs. However, BPS also represent opportunity. Because BPS require the achievement of an energy or emissions target by a deadline, natural gas utility EE programs have an opportunity to accelerate their interventions prior to the BPS deadline to assist customers to achieve the BPS requirements. That is, BPS can simultaneously generate creditable EE savings via installation of new, efficient gas equipment, and a win for the customer by their complying with the standard.

## Fostering Education and Workforce Development in Energy Efficiency

Focus on education and workforce development has emerged as a priority to ensure adequate numbers of appropriately skilled workers to deliver energy efficiency programs, products, and services. By emphasizing disadvantaged communities and populations with education and workforce development programs, natural gas utilities also have an opportunity to address diversity, equity, and inclusion (DEI) priorities as well. One example of a focused Workforce Development Program is the partnership between major utilities in Minnesota and Minnesota's Center for Energy and Environment (CEE). CEE is a nonprofit organization whose mission is to create a "healthy, carbon-neutral economy that works for all people.[32] A February 2024 CEE blog post frames the issue well:

> The Workforce Development program focuses on recruiting, training, and retaining Black, Indigenous, Asian, Latino, people of color, and women in the energy efficiency sector, building a workforce to deliver services that represents traditionally underserved markets. In Minnesota, the clean energy workforce has been dominated by white men. As of 2021, the

[32] https://www.mncee.org/mission-values.

breakdown showed that only 27.5% of the workforce were people of color and 27.4% were women.[33]

Whether by legislation, administrative rules, regulatory commission decisions, or the influence of other stakeholders, focus and investment by natural gas utility EE programs on education and workforce development to support energy efficiency and renewable energy, typically in the form of partnerships or provision of direct funding to state agencies or non-government organization (NGOs) as part of utility energy efficiency portfolios, is increasingly common across the country.

## How Natural Gas Energy Efficiency Delivers Emissions Reductions

### *Natural Gas Is a Clean Burn*

No discussion of how natural gas energy efficiency delivers greenhouse gas (GHG) emissions reductions would be adequate without understanding combustion cleanliness. The primary end uses associated with natural gas and natural gas energy efficiency are heating and water heating, including that which is related to industrial process. These end uses mean combustion—even in the case of electric heating and water heating because most electricity continues to be produced by burning something. Therefore, the Energy Information Administration data on $CO_2$ emitted by combustion of various fuels, as shown in Table 25, is critical.

**Table 25: Combustion Emissions of $CO_2$[34]**

| Fuel | Pounds $CO_2$ per MMBtu |
|---|---|
| Natural Gas | 116.65 |
| Propane | 138.63 |
| Distillate Fuel Oil | 163.45 |
| Coal (EIA “all types”) | 211.47 |

Regardless of whether natural gas is directly used to fire heating and water heating equipment, or used to fire power plants that generate the electricity used by electric heating and water heating equipment, combustion of natural gas creates the lowest $CO_2$ emissions of all fossil fuels. Therefore, natural gas utility EE programs that assist customers in selecting efficient natural gas-fired equipment by definition deliver GHG emissions savings.

### *Natural Gas Utility Decarbonization Strategies*

A natural gas decarbonization plan often includes initiatives and strategies to reduce greenhouse gas emissions (in a bit of a misnomer, since usually GHG are associated only with $CO_2$ but also include methane emissions) associated with natural gas production, transportation, storage, delivery, and use. Some of the initiatives may include policy and reporting changes, infrastructure upgrades, fuel substitution, or development of new programs. A primary strategy is energy efficiency, including gas

[33] https://www.mncee.org/creating-equitable-workforce-solutions-clean-energy-industry.
[34] https://www.eia.gov/environment/emissions/co2_vol_mass.php.

hybrid heating systems. Other strategies include those focused on renewable natural gas, hydrogen, and carbon capture.

Approximately half of the selected utilities and a moderate percentage of utilities from the broader market scan have developed decarbonization plans or included this information in sustainability or clean energy plans. Strategies include but are not limited to:

- Reducing demand through energy efficiency including weatherization.
- Decarbonizing the gas network with renewable natural gas and hydrogen.
- Reducing methane emissions from their own gas network while working with the industry to reduce emissions through the entire value chain.
- Enabling and optimizing distributed generation.
- Developing and deploying carbon-capture systems.

All five of the above strategies are positive, with EE and weatherization bringing the benefits described throughout the report, and RNG, hydrogen, tightening the system, distributed generation, and carbon capture all bringing possible revenue enhancement to the natural gas utility.

### *Clean Heat Standards and Emissions Caps*

Clean heat standards (CHS) are an emerging and not yet consistent or standardized tool "in which heating applications are examined for potential GHG reductions."[35] Given their nascency, the design of a CHS in one jurisdiction can vary significantly from designs in others. Some CHS are clearly oriented toward electrification, while others also include decarbonization of the natural gas system. Regardless, the focus of CHS is on emissions. In work for the Environmental Defense Fund,[36] the advocacy- and climate-oriented consulting firm Energy Futures Group (EFG) speaks to CHS as policies that focus on "reductions in 'bad things' (e.g., the total emissions still being produced)." EFG describes compliance with CHS as "a 'bottom up' tallying of estimated emission reductions from individual measures such as heat pump installations, weatherization jobs, sales of different types of low-GHG fuels, etc." A similar but different policy tool is emissions caps. In the EDF report, EFG identifies emissions caps as a top-down tool measuring "increases in 'good things' (e.g., the number of emission-reducing measures installed or used)."

For the natural gas utility, CHS and emissions caps represent great ways to "tell the gas story" in terms of emissions reductions associated with adoption of clean-burning high-efficiency natural gas-fueled equipment versus a baseline.

## Strategic Considerations for Advancing Natural Gas Energy Efficiency

The following sections describe different strategic considerations and approaches to address market, policy, and financial opportunities in natural gas EE programs and planning that can benefit consumers and society, while aligning potential business objectives for LDCs.

[35] https://www.utilitydive.com/spons/how-states-are-tackling-clean-heat-and-what-it-means-for-utilities/711096/
[36] Stebbins, Gabrielle and Chris Neme, *A Comparison of Clean Heat Standards: Current Progress and Key Elements* February 2024. https://www.edf.org/sites/default/files/2024-03/Clean%20Heat%20Standards%20Report_FINAL%2002-2024.pdf, at pp. 14-15.

**Approach #1: Leveraging Existing and New Programs**

All of the policy trends and issues create opportunities for natural gas utility EE programs to collaborate with and leverage the programs and activities of other utilities and non-utility program administrators, as well as to innovate new program approaches.

### *Expanding Program Reach through the Weatherization Assistance Program*

The federally (DOE) funded Weatherization Assistance Program for income-eligible[37] residents is administered by grantees and sub-grantees in each of the United States and is an audit-driven direct install program bound by specific rules. The program received a multibillion-dollar infusion of funds through the IIJA legislation, and several of the IRA programs also include rebates or enhanced rebates for income-eligible residential customers. This support can improve cost-effectiveness and provide the opportunity to extend program reach to the benefit of income-eligible customers.

### *Maximizing Impact with State Energy Office Partnerships*

Beyond WAP, IIJA and IRA provisions include billions of dollars to support new programs to be delivered by state energy offices. Not only can these funds and programs be leveraged by natural gas utility EE programs to reduce program costs and improve cost-effectiveness, but they also open the door for natural gas utilities to directly help customers meet more stringent building energy codes for new construction and comply with building performance standards emerging in many states and municipalities.

### *Cross-Utility Collaborations for Enhanced Administrative Efficiency*

Electric and some water utilities also offer efficiency programs. Partnering on EE programs can better meet customer needs, improve customer experiences, and decrease implementation and delivery costs, thus improving cost-effectiveness. Such partnerships can also support many other benefits, including water savings, decarbonization, meeting clean heat standards, and other policy priorities. Supporting electric EE programs with dual fuel equipment such as heat pumps using gas, rather than resistance electric supplemental/back-up heating, can also address the growing winter peak problem.

### *New Program Models*

Natural gas utilities also have the opportunity to develop and implement entirely new gas EE programs or types of programs, for example:

- Mid- and upstream heating and water heating programs that partner with and incentivize manufacturers, distributors, manufacturer representatives (“reps”), and other points of the supply chain can be effective. This approach may lead to lower implementation and administrative costs for utilities by leveraging existing related infrastructure of the mid- or upstream partner and can help the supply chain sell off highly efficient gas equipment that will nonetheless become non-compliant with finalized but not yet effective minimum efficiency standards or ENERGY STAR specifications. Offsetting the potential for lower implementation and administrative costs, however, is the fact that such programs may also see lower net savings monetized and a cost-effectiveness benefit.

- California’s market access program (MAP) approach is an example that incorporates several innovations. MAP utilizes population-level normalized metered energy consumption (NMEC)

[37] Critically important to all discussion of and opportunities related to “income-eligible” customers is the Biden Administration’s Justice40 Initiative—also widely embraced by non-government entities—which targets populations such as income-eligible and historically underserved populations to receive at least 40% of the benefit derived from federal funding.

rules that are a change from most current state approaches to determining savings and thus meeting cost-effectiveness requirements. In addition, MAP is an example of a pay-for-performance approach to program incentives that only pays for measured actual savings. MAP is also an example of an open-ended program that allows implementers to find whatever cost-effective, measurable energy efficiency projects they can, rather than prescribing specific types of eligible projects.

## Approach #2: Examining New/Emerging Cost-Effectiveness Frameworks

As initially discussed in both the Portfolio Review and Cost-Effectiveness Case Study, the benefits being considered in many cost-effectiveness tests are increasing substantially as cost-effectiveness approaches evolve. The outcomes of NSPM-DER-driven development of JSTs (new benefit-to-cost tests) are instructive. The National Energy Screening Project, the lead organization for the NSPM-DER, identifies Arkansas, Maryland, Michigan, Minnesota, New Hampshire, and Rhode Island as states involved in developing or having developed JST and related frameworks based on the NSPM-DER. Other states, however, also utilize the process prescribed by the NSPM-DER for developing a new approach to cost-effectiveness testing or are influenced by it. Connecticut, New York, and most recently Virginia are examples. These processes are, in all known cases, open to participation by natural gas utilities and engagement in them can enable natural gas utilities to shape the outcomes that, in turn, will heavily impact cost-effectiveness frameworks and associated regulation.

### California's TSB as an Example of the JST

To examine one example more closely, the JST currently being used in California includes a metric called the Total System Benefit, or TSB. By increasing the benefit term of a benefit-to-cost ratio, the TSB encourages conservation at high value times and locations and is fuel agnostic. It also factors in NEBs such as emissions reductions, health and wellness, and equity priorities. This broad scope enables the TSB to provide a path to resolving tension between cost-effectiveness and other policy objectives being pursued by utility EE programs (e.g., equity, etc.) by enabling more energy efficiency activities—especially those with benefits beyond energy alone—to be cost-effective. The process and regulatory decision in California that led to the embrace of the TSB established California's position that traditional cost-effectiveness approaches (i.e., the CSPM tests) are not the most appropriate tool for judging whether today's many policy goals have been met. In turn, this creates new or enhanced opportunities for natural gas utility EE programs to also fund activities and accrue savings from EE programs that support building codes, building performance standards, and social and environmental policy goals, for example, while also leveraging new federal funding.

## Approach #3: Addressing Equity and Low- and Moderate-Income Consumer Needs

Low participation in energy efficiency programs by low-income and underserved customers is not a new issue, but there are some interesting findings and some new program approaches emerging to effectively serve these customers. For example, some of the findings from recent reports include:

- Low- and moderate-income households and households identifying as, for example, black, Latino, indigenous, rural, or non-English speaking, are widely recognized as underserved by utility energy efficiency programs relative to other households. They have lower rates of participation in available incentive programs and fewer available options for energy-efficient equipment that is eligible for program incentives.[38]

- Inequities in providing energy efficiency services and incentives can result in disproportionate negative impacts—including high energy burdens and various residential comfort, safety, and health problems—for underserved households.[39]
- Several program approaches are emerging that reach underserved customers effectively. These approaches include the following:[40]
  - Improving program design and customer engagement by working with community-based organizations (CBOs) and prioritizing equity and inclusion by, for example, harnessing the language and cultural orientation of many CBOs.
  - Expanding targeted low-income programs, such as weatherization assistance, to include major appliances, home mechanical equipment, and NEB-oriented services such as repairs to enable weatherization, and health and safety improvements.
  - Intervening upstream (of customer purchase) choices by working with manufacturers, distributors, and other points of the supply chain to expand the availability of entry price point models of major appliances and equipment that are more efficient than baseline.
  - Creating new affordable and flexible options for purchasing energy-efficient technologies, such as microfinancing and online markets with available incentives applied at checkout.
  - Aligning program objectives with equity and similarly adapting program metrics and evaluation.

Note that the focus on equity can be a platform for a variety of gas utility interventions, from increased engagement of environmental justice (EJ) stakeholders to natural gas utility EE programs specifically targeting low-income and underserved populations and buildings, to creative rate structures including pre-paid gas service and income-based billing programs.[41]

**Approach #4: Geotargeting**

Geotargeting is the intentional targeting of efficiency programs to specific, discrete geographic areas or pockets of consumers for a specific, well-defined reason. For example, geotargeting can direct new or emphasize existing natural gas EE program activity at discrete locations within the utility's footprint with high concentrations of specific types of customers or where system needs make EE attractive. For example:

- Income-eligible customers
- Underserved ethnic or language communities

[38] Amann, Jennifer and Carolin Tolentino and Dan York. ACEEE, Mau 23, 2024. Toward More Equitable Energy Efficiency Programs for Underserved Households.
[39] Ibid.
[40] Ibid.
[41] North Shore Gas in Illinois is an example: https://www.northshoregasdelivery.com/payment-bill/percentage-income-payment-plan.

- Micro businesses (i.e., very small businesses) in leased space
- Multifamily buildings
- Distribution system pressure problems

Targeting based on customer demographics or characteristics addresses multiple policy issues and trends. For example, targeting based on system needs can free up capital, that for all intents and purposes is rationed rather than unlimited, for "want to" investments such as in renewable natural gas or compressed natural gas opportunities, rather than "have to" investments such as those to support the distribution system. Geotargeting can also help improve customer participation in natural gas EE programs as well as cost-effectiveness.

## Approach #5: Emerging Technologies in Gas Energy Efficiency: Innovations and Applications

### *Heat Pumps*

Heat pumps currently capture significant mindshare—primarily as electrification measures to support decarbonization efforts—however, gas hybrid versions[42] are an often-overlooked opportunity that are poised to become a significant technology for natural gas utilities. Both air source heat pumps (AHP) and ground source heat pumps (GHP) were examined, including:

### *Gas Hybrid Air-Source Heat Pumps*

Gas hybrid AHP are of two types: 1) those that power the heat pump with a gas engine or absorption chilling, and 2) those that pair a new or existing gas furnace, or interface with one, for supplemental or back-up heat. Both represent a significant opportunity for natural gas utility EE programs because they not only bring new or retained loads, but they also further mitigate the problem of the growing winter electric peak (with greater end-to-end efficiency) while harnessing the proven resilience and reliability of the natural gas delivery system.

### *Gas Hybrid Ground-Source Heat Pumps*

Gas hybrid heat pumps are emerging as a cost-effective option in the ground-source or geothermal heat pump space. Like air-source heat pumps, gas hybrid systems use natural gas for auxiliary heating or cooling. The earth's constant temperature makes use of the ground as a heat sink (rather than the air, as AHP do) highly efficient, but the associated installation is costly. Gas hybrid systems can allow climate-targeted optimization of the ground loop system (i.e., the heat sink) by correcting for imbalances between heating and cooling loads without requiring electric resistance heat. Thermal imbalance is a challenge for geothermal systems because, for example, when weather is very cold, a supplemental heat source is required.

### *Networked Geothermal*

Networked geothermal systems—which serve multiple buildings or a community—are also beginning to appear. For example, in Massachusetts, some utilities are installing the first gas utility geothermal networks. Minnesota, New York, and Colorado have passed laws allowing, or even requiring, gas utilities to build geothermal networks—and more laws, feasibility studies, and installations are moving forward across the country.[43]

[42] The North American Gas Heat Pump Collaborative (https://gasheatpumpcollab.org/) is an important resource for natural gas utilities exploring gas hybrid heat pumps.
[43] Feinstein, Laura and Emily Moore. *Without Gas, What Business Models Could Gas Utilities Pursue?* July 2023.

### *Distributed Generation*

Distributed generation (DG) is a broad topic, typically referring to a grid-interconnected alternative to the traditional utility-scale central generation feeding a unidirectional flow of electricity. DG is often co-located or integrated with the user or users of the electricity produced (see combined heat and power discussion below). Because DG systems are usually interconnected to the electric distribution system, excess local (distributed) generation can be sent back to the grid to supplement or displace utility-scale generation. Examples of the types of DG in service today include rooftop solar generation of electricity (photovoltaic systems), solar water heating (thermal systems), on-site energy storage (e.g., batteries), and on-site micro-generation (often fueled by natural gas). Two examples of DG systems are microgrids and CHP.

### *Combined Heat and Power*

Combined heat and power (CHP), or cogeneration, is the concurrent generation—very often fueled by natural gas—of heat and electricity or mechanical power. This is accomplished using a single fuel source located near the point or points of end-use consumption. Due to their smaller (relative to utility-scale central generation) scale, CHP systems can often be deployed quickly, using a number of technology options.[44] There is considerable potential for expanded application of CHP in the industrial and large commercial sectors. The potential centers on the increase in overall system efficiency that can be achieved by obtaining both electricity and heat for steam or thermal processes from a single on-site system when the annual electric load factor and thermal utilization rate are both sufficiently high to satisfy economic requirements (e.g., customer payback). Gas-fueled CHP is a frequent interest of natural gas utilities, especially, of course, when the delivery of the natural gas is via the LDC's distribution system. Micro CHP is a nascent set of CHP products, geared toward residential and smaller C&I applications, which may merit consideration by natural gas utilities.

### *Microgrids*

Microgrids are extended networks of DG that combine multiple forms of DG—for example, larger scale solar production with battery storage and onsite generation including CHP to give the discrete (i.e., "micro") connected system the ability to "island" in the event of a power grid outage—are an increasing focus of policymakers and stakeholders. Microgrids are an emerging tool to address reliability and resilience by leveraging the proven underground gas delivery network that powers the onsite generation, not only to address weather and seasonal variability, but also to serve as a firm back-up when grid-supply is interrupted. As discussed in the Portfolio Review section of this report, natural gas utilities in solar-favorable or decarbonization-intense states, such as Arizona, are beginning to support solar DG. Others have deployed microgrids in LMI and underserved communities as well.

These examples of new technology opportunities for natural gas utility EE share two common themes:

(1) They bring with them many new and non-energy benefits that are becoming part of cost-effectiveness testing frameworks. For example, all touch on benefits such as health, comfort, reliability, resilience, affordability, and, especially in the case of distributed generation, environmental benefits.

[44] Combined Heat and Power Basics, U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, https://www.energy.gov/eere/iedo/combined-heat-and-power-basics.

(2) Except perhaps for distributed generation, the new technologies are an opportunity for EE savings to replace savings lost by the elimination of EE program eligibility of traditional gas heating equipment due to minimum efficiency standards or ENERGY STAR specifications.

**<u>Approach #6: Ensuring Utility Financial Integrity Through EE Programs</u>**

Energy efficiency programs raise the financial questions of cost recovery and return on investment in the classic utility economic/regulatory model. Cost recovery is straightforward: utilities are entitled to recover their costs. However, the impact of EE programs on return on investment may be less clear. Typically, at a very high level, utility rates are based on total utility costs including the allowed rate of return on assumed capital investment divided by forecast sales. EE programs may reduce sales below that which was forecast in the rate case for ratemaking purposes as well as affect the amount of capital investment. Both of these circumstances may, mathematically, create downward pressure on the utility's ability to earn its allowed return, and exacerbate regulatory lag The ultimate effect of the utility's increasing inability to earn its allowed return may lead to increased cost of capital, higher revenue requirements even as sales decrease, and thus more frequent rate cases. To ensure the financial integrity of natural gas utilities as EE programs are implemented, several tools are available to utilities and regulators alike:

(1) Volumetric decoupling or similar normalization mechanisms can eliminate concerns about the impact of reduced throughput on revenue and earnings.

(2) Use of EE-specific riders and trackers can isolate the recovery of EE costs from base rates and avoid the time, expense, and risk of general rate cases.

(3) Alternative and innovative rate structures can bring earnings opportunities from EE. For example, performance incentive mechanisms (PIM) that include appropriate rewards for good outcomes not just risks of penalties for poor outcomes. PIM can bring upward basis-point or set dollars of allowed revenue adjustments due to success in advancing the policy objectives, including generation of many NEBs, associated with new cost-effectiveness frameworks.

    Other examples of NEBs and policy support EE outcomes that may bring rewards to the natural gas utility under PIM include: 1) lowering the rate of delinquency disconnections, 2) freeing up capacity to serve peak period demand (including on the electricity grid), 3) customer satisfaction, and 4) income stability improvement.

(4) Apart from PIM, other forms of performance incentives can be embedded in EE-specific budgets. For example, some natural gas utilities are granted a percentage of the EE budget as a performance incentive, tiered based on percent of EE savings goal achieved, and others are granted a percentage of the net benefit (i.e., monetized program benefit minus program costs) associated with EE program savings.

## Leveraging Emerging Opportunities in Natural Gas EE Programs

The foregoing policy issues are evident in some jurisdictions today, and are likely to emerge in many others, heavily influencing natural gas utility EE programs and planning going forward. While multiple, and potentially competing, policy initiatives might add complexity, they can open new opportunities for natural gas utilities at the same time. Some key areas of opportunity that natural gas utility EE can support include:

(1) Enhancing resilience and reliability for end users across all energy delivery systems.

Natural gas is inherently resilient on several fronts. First, it is primarily an underground system. Second, the ability to inject and withdraw gas from storage and to line pack gas adds reliability and flexibility for all energy users, including distributed and utility-scale central power generation. Third, use of the natural gas system can address winter peak power delivery challenges, as noted in point 5 below.

(2) Integrating emissions reductions into program planning and design.

Natural gas utilities can document avoided emissions due to EE reductions in natural gas use and the relative cleanliness of natural gas EE combustion, including for electricity generation, compared to other fossil options.

(3) Addressing the needs of underserved and low/moderate-income market segments.

Underserved, low- and moderate-income customers benefit from, for example, improved indoor air circulation, higher safety and efficiency of new gas-fired equipment, and the affordability of natural gas, especially when delivery of natural gas utility-funded EE programs leverages other funding sources and programs.

(4) Mitigating the emerging electric winter peak load challenge.[45]

Related to reliability and resilience, natural gas heat as a peak-period supplement to other forms of heat relieves stress on the electric system caused by, for example, increased utilization of electric heat and electric vehicle charging during the winter peak period.

(5) Partnering with other utilities and/or supply chain players to leverage other EE programs as well as new and emerging technologies.

Related to meeting of the needs of underserved and low- and moderate-income customers, but extending to virtually all segments, natural gas utilities have an opportunity to leverage many other existing EE programs, such as those of other utilities and federal Weatherization Assistance Program providers, as well as emerging new funding from federal legislation and programs such as IIJA and IRA.

(6) Bringing company and industry strategy into alignment with regulatory and public policy goals.

When planned and executed using emerging changes to cost-effectiveness approaches and incorporating policy priorities beyond energy, natural gas EE can measurably support multiple social and environmental policies.

## Conclusion: Market Trends, Energy Challenges and the Hidden Value of Gas EE

Natural gas and gas infrastructure play a critical and growing role in the global production and delivery of all forms of energy, including and increasingly importantly in the generation of electricity. Recent and emergent market and policy trends underscore the critical role of natural gas on several

[45] The emerging winter electric peak load challenge is the reality that rapidly increasing loads, such as for heating and electric vehicle charging, occur largely at night and, in the case of heating loads, specifically in winter. This phenomenon is causing many electric utility planners to expect their utilities to become dual- or winter-peaking, requiring new generation and sometimes transmission and distribution resources to meet the load.

fronts, including supply security, reliability and resilience, reducing emissions, and making energy accessible and affordable. Gas energy efficiency, when viewed strategically, holistically, and with an eye toward the three focus questions on the benefits of natural gas EE programs, can directly support the attainment of multiple goals. The policy trends, emerging opportunities, and strategic considerations identified in the Trends Assessment lead to a significant conclusory view of the next three to five years as follows.

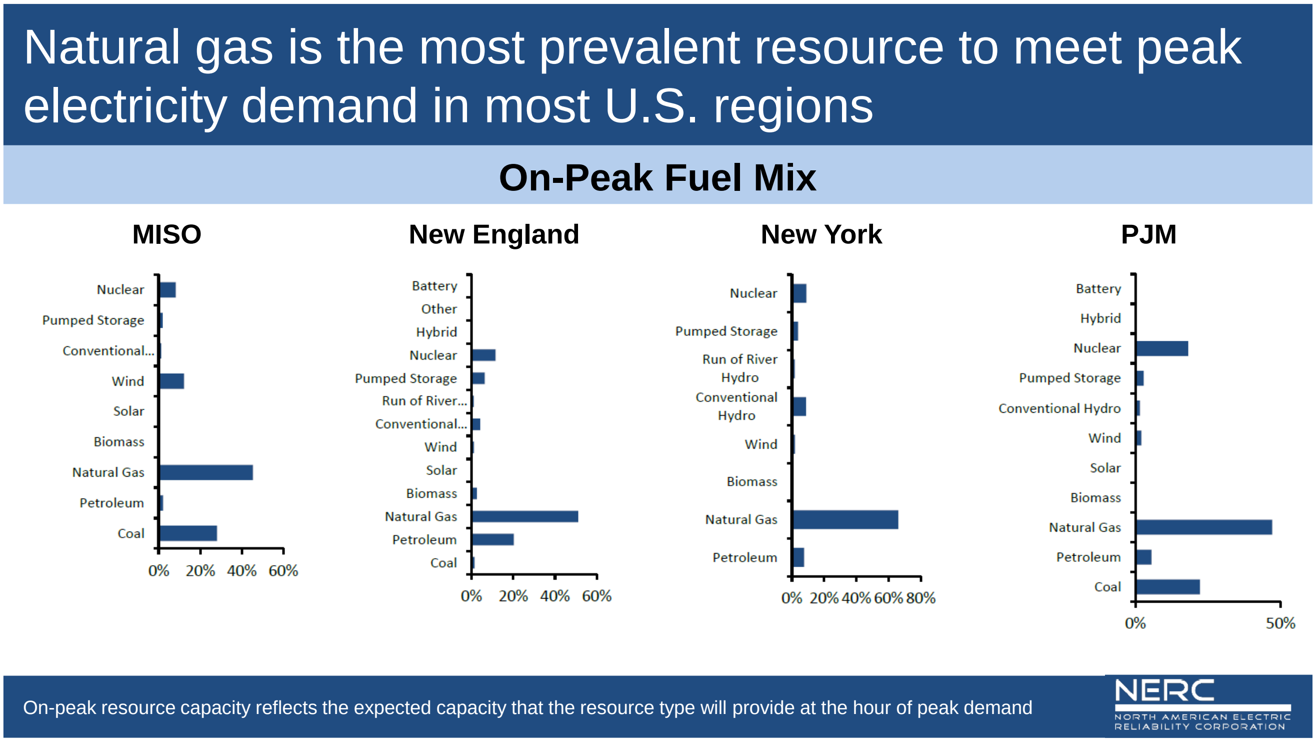
## Energy Security

The United States has emerged as the world's largest producer of natural gas, with reserves capable of supplying current domestic demand for over a century, even as liquefied natural gas (LNG) exports have risen sharply in the face of significant global geopolitical upheaval. Domestically, natural gas has increased its share of U.S. generation fuel supply from—on average—less than 20% in 2004 to just over 40% currently, driven largely by the economic displacement of coal-fired baseload power generation.

Apart from becoming the largest source of U.S. electricity, gas has also become critically important to electricity resilience and reliability during periods of peak demand, which increasingly occur during winter rather than summer months on a seasonal basis and in the hours without sunlight on a daily basis. Gas turbine generation can quickly ramp production up or down, while line pack, cavern, and reservoir storage provide a deep, fast-response, and geographically dispersed backstop with the distinct advantage of having already been paid for.

As shown in Figure 7, natural gas is the overwhelmingly dominant source of peak electricity generation, particularly in regions that have moved away from coal and/or lack significant nuclear resources. A combination of transportation electrification, expansion of data processing, and "re-shoring" of key manufacturing industries, coupled with continued renewable resource deployment, will affect both the level and timing of energy usage, thereby demanding even greater flexibility and responsiveness, which natural gas is well-positioned to deliver.

**Figure 7: Sources of Peak Electricity Generation by Region**




Source: National Electric Reliability Council 2024-2025 Winter Reliability Assessment

## Environmental Benefits of Gas Efficiency

According to the U.S. Energy Information Administration, fuel oil releases about 163 pounds of $CO_2$ per MMBtu of heat and coal emits at least 206 pounds per MMBtu, compared to 117 pounds per MMBtu for natural gas.[46] The displacement of coal-fired baseload electric power generation by natural gas along with renewable wind and solar power (assisted by gas) has driven the majority of U.S. carbon emission reductions since their 2005/2007 peaks. However, as evidenced by Figure 7 many regions still rely on heavier carbon fuels such as oil or coal for power generation under peak conditions. Rising power demand therefore has the potential to increase the use of higher-emitting fuels, especially under peak conditions. At the same time, the pace of emission-free generation development remains gradual and increasingly hindered by local opposition.

With its much lower emissions profile, natural gas is clearly the cleanest conventional power generation fuel. However, a lack of adequate pipeline transportation infrastructure can constrain the ability to produce electricity with gas, forcing the use of higher-emitting fuels (see the New England case study beginning on page 62). In supply-constrained regions, improved gas utility end-user efficiency has the highly beneficial (and cost-effective) potential to free up gas molecules to displace coal or petroleum fuels.

The direct use of natural gas also remains the most efficient end-to-end means of space and water heating. However, state and regional plans to reduce heating-related emissions often rest on the substitution of electricity, which often translates to gas by wire or—in regions lacking in gas capacity—oil by wire on the coldest days. Conversely, the substitution of natural gas for oil-based

[46] https://www.eia.gov/environment/emissions/co2_vol_mass.php.

space and water heating could result in a 40% reduction in $CO_2$ emissions per Btu, not to mention the elimination of most particulate emissions, especially from older heating equipment.

## Economic Impacts of Gas Efficiency

Consumers in the Northeast, on the West Coast, and in Hawaii pay the highest electricity rates in the nation across all customer segments. The commodity cost of electricity is the single largest factor contributing to the high rates factor and is a direct reflection of concentration of generation portfolios in higher-cost resources to produce and store energy, and a de-emphasis (West Coast) or lack (Northeast and Hawaii) of more economic generation options (natural gas) to balance those portfolios. The growing trend toward time-of-use pricing exacerbates bill pressure and can force painful spending choices on lower-income consumers.

Table 26 illustrates the wide disparity in delivered power prices across U.S. regions by major customer class.

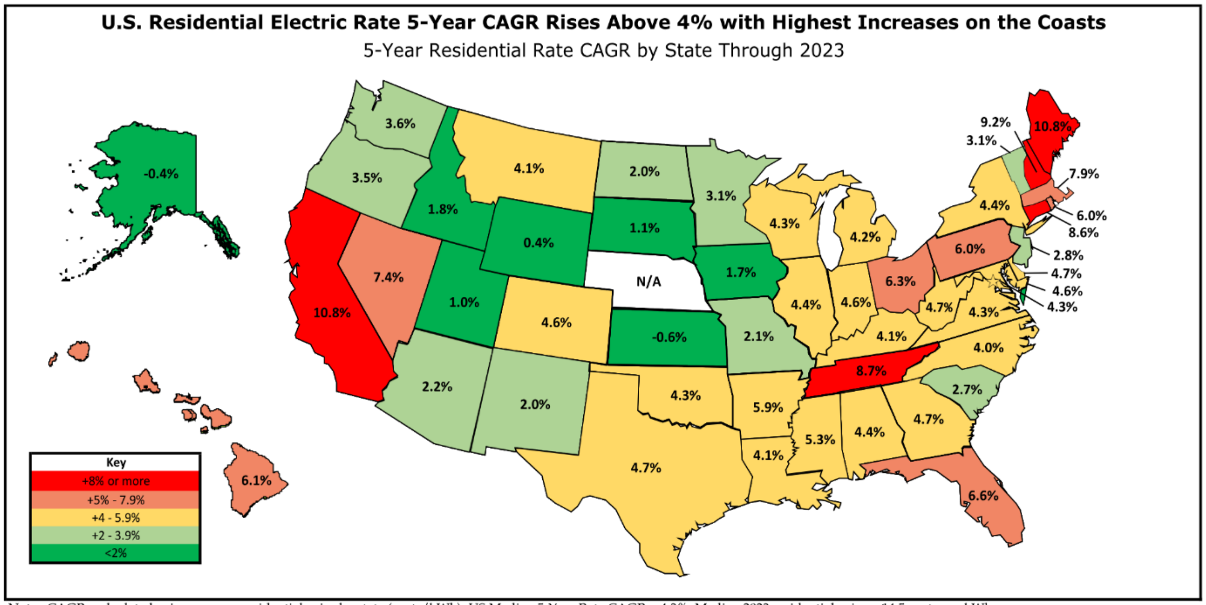
**Table 26: Average Retail Price of Electricity (Cents per Kilowatt hour) – May 2024**

| | Residential | Commercial | Industrial |
|---|---|---|---|
| **New England** | 26.4 | 19.06 | 15.76 |
| **Middle Atlantic** | 20.02 | 15.14 | 8.29 |
| **East North Central** | 17.07 | 12.36 | 8.08 |
| **West North Central** | 13.73 | 9.95 | 7.5 |
| **South Atlantic** | 14.46 | 10.65 | 7.44 |
| **East North Central** | 13.44 | 11.97 | 6.49 |
| **West South Central** | 13.85 | 8.86 | 5.95 |
| **Mountain** | 14.44 | 11.11 | 7.41 |
| **Pacific Contiguous** | 25.07 | 19.96 | 14.46 |
| **Pacific Noncontiguous** | 36.22 | 30.89 | 31.14 |

Source: EIA Electric Power Monthly

As shown in Figure 8, electricity prices have also been rising at a greater than 4% annual rate nationally, and much higher than that in some states. This is a trend that is unlikely to abate given significant spending on high-voltage transmission, renewable energy, storage, and, increasingly, storm response and hardening. While many of these investments are being made to advance policy goals of “moving off fossil fuels,” they are also driving higher costs to energy consumers, which are particularly burdensome for lower-income households.

**Figure 8: Trends in U.S. Residential Electricity Prices**




Note: CAGRs calculated using average residential price by state (cents/kWh); US Median 5-Year Rate CAGR = 4.3%; Median 2023 residential price = 14.5 cents per kWh
Note: Nebraska does not have any Investor-Owned Utilities
Source: SNL Financial LC and Wells Fargo Securities, LLC
SNL Disclaimer: SNL FINANCIAL LC. CONTAINS COPYRIGHTED AND TRADE SECRET MATERIAL DISTRIBUTED UNDER LICENSE FROM SNL. FOR RECIPIENT'S USE ONLY

Increased efficiency across all forms of energy is the most cost-effective way to mitigate customer bill inflation. In capacity-constrained regions, end-use efficiency that frees up capacity on the natural gas transportation and delivery system delivers economic benefits to all consumers by displacing the need for fuel oil, which typically becomes significantly more costly during cold weather. As previously discussed, the growing trend of winter "needle peaks" can also be directly addressed by maintaining the availability of natural gas even in locations electric heat pumps are seeing greater adoption.

## Recognizing Social Considerations

Limiting access to natural gas and/or eliminating support for gas appliance efficiency programs both deny consumers the opportunity to upgrade inefficient and ineffective heating systems, which are often found in lower-income households. As previously mentioned, peak power demand is also often met with aging oil or coal resources, which, in addition to being more costly to run and less energy-efficient, are often located in lower-income "energy justice" communities.

## Enhancing Reliability and Resilience

Many parts of the U.S. are experiencing more frequent power outages as the frequency and severity of weather events continue to rise. In regions such as California, outages have become elective in the form of "public safety power shutoffs" (PSPS), in which power is disconnected in fire-prone areas during periods of dry heat and high winds.

Not surprisingly, many natural gas utilities are experiencing a rise in customer connections to standby generators, particularly at the residential level and for critical infrastructure facilities, to leverage the high reliability of the gas system's robust underground delivery network. Commercial and industrial consumers are also increasingly seeking the reliability and security of a redundant parallel energy delivery network—for example, as data centers embrace on-site, gas-fired, primary generation.

These reliability and resilience-conscious energy consumers are increasingly seeking more robust and often multiple and redundant energy pathways to homes and businesses. Some are taking matters into their own hands by adding the ability to "island" their facilities or premises with on-site power generation and/or fuel storage. Many consumers are leveraging the parallel energy pathway offered by the robust underground natural gas connection to provide not only on-site backup power generation, but also end-use applications that can run independently, such as self-powered gas heating systems. Longer-term, some of these resources can prevent reliability events through dispatch to manage peak load conditions, for example as part of a distributed microgrid configuration.

These may be nascent trends, but they highlight the potential of a more distributed energy delivery system that draws on the resources of both the electricity and gas grids not only to enhance reliability and resilience, but also to potentially offer timely economic arbitrage between fuels, including the potential to optimize delivery under peak load conditions and store energy during times of oversupply.

### Resilience vs. Reliability

As defined in a 2021 Guidehouse report for the American Gas Foundation, **resilience** is "a system's ability to prevent, withstand, adapt to, and quickly recover from a high-impact, low-likelihood event." On the other hand, **reliability** is simply system uptime, or a lack of outages.

The reliability of an energy delivery system, such as a gas or electric utility, is underpinned by its design as well as routine and preventive maintenance that anticipates the potential for interruption. Examples include protection from weather via undergrounding or adding protection to vulnerable parts of the system. Resilience takes many forms, but usually involves redundancy or a "plan B," such as a backup generator at the user level or LNG storage at the supply level.

Reliability and resilience are increasingly important to energy consumers for a variety of reasons, from the growing frequency, intensity, and duration of weather events to increased sensitivity to even brief interruptions in energy supply in a more technology-dependent world. Blinking alarm clocks are a nuisance, but a momentary interruption in energy supply to a microchip fabrication plant or petrochemical process can cause substantial economic damage. The loss of heat or cooling can also be a life and death scenario, as evidenced by the grim aftermath of many recent storms. The winter storm of early 2021 demonstrated both the reliability and resilience of the natural gas delivery system, as well as the potential for improvement, as wellhead freezing and electrical supply interruptions curtailed gas production and compression.

## New England Case Study

The New England states embody many of the emerging market challenges just described, but also serve as a proxy for benefits that can be realized from improved natural gas energy efficiency. Geographically, the region sits at the end of the electricity and natural gas transmission systems, making it delivery constrained. New England is also more dependent than other regions on "truck-delivered" energy sources, principally heating oil and propane. There are both very rural and highly concentrated urban areas as well as strategically important medical, defense, and research institutions that require a highly reliable and resilient energy supply. Winters are cold, summers are increasingly hot, and accelerating coastal storms threaten reliability.

New England has steadfastly resisted efforts to increase natural gas deliverability even as the region's aging coal (and some nuclear) power plants closed, driving greater reliance on gas. The resistance to increasing gas deliverability supported longstanding climate policy goals to make electricity the dominant source of energy for all end-uses—and to derive that electricity entirely from renewable sources, with a heavy emphasis on imported Canadian hydropower and offshore wind. Importing Canadian hydro-power became a case study in “not in my backyard” opposition to new transmission infrastructure, while offshore wind has suffered the double whammy of rising interest rates and inflation. Some 2.4 GW of projects have recently been canceled or deferred due to a threefold increase in capital and many raw material costs, while others have sought to re-price contracts with off-takers.

On average, natural gas currently supplies roughly half of New England’s space and water heating as well as its electricity. Efforts to move heating customers off of fuel oil (24% of heating) heavily favor heat pump adoption, which, of course, relies on electricity that is largely natural gas (or oil) delivered by wire. Absent an orders-of-magnitude shift in electricity supply (i.e., a massive buildout of some combination of high voltage transmission to tap Canadian hydropower, a similarly scaled and rapid buildout of offshore wind, an economic and technical breakthrough in nuclear power, or a huge uptick in sunny days), that energy mix is unlikely to materially change anytime soon.

New England relies on natural gas but is also a heavy user of emissions-intensive fuel oil to provide power during times when natural gas demand in the region exceeds the limited pipeline capacity to deliver it, particularly on very cold, and recently very hot, days that also drive high gas demand for space heating (cold days) or coincide with gas storage injection or system maintenance (hot days). Most of the region’s fuel oil deliveries are by ship, which can be challenged by rough/extreme weather and icy harbors. Seaborne deliveries also support natural gas supply on peak days via an LNG terminal in Boston Harbor that faced shutdown for economic reasons earlier this year. The region’s heavy reliance on gas and finite import capability greatly magnifies the value of every molecule freed up by natural gas EE efforts.

**Conclusion: Lessons Learned and Broader Implications**

The New England case study highlights the potential direct and indirect benefits of increased gas system energy efficiency in a supply-constrained region. However, New England’s energy challenges—and the role of natural gas EE in addressing them—are by no means unique. Indeed, some of the starkest examples of energy vulnerability have occurred in the middle of the nation’s energy production “heartland” of the Gulf Coast and Southwest, highlighting the importance of parallel paths and redundancy, as well as the interconnectedness of the gas, renewable, and electrical energy systems.

Years of cheap capital have influenced energy policy in some states and regions. However, as today’s economic reality continues to set in, the wisdom of making the highest and best use of infrastructure that’s already built is becoming ever more apparent. Efficiency may be rooted in getting the most out of every unit of energy produced and delivered, but the indirect and non-energy benefits that accrue can be significant, far-reaching, compounding, and consequential.

# FINDINGS AND CONCLUSIONS

This study evaluated the full range of benefits that can be derived from natural gas utility energy efficiency programs and the trends and factors that could lead to changes in program design, targeting, and implementation. The results will equip stakeholders to leverage the potential of these EE programs as the policies that drive them evolve.

The goals of the study were to: 1) document the current state of EE program measures and delivery models, and the approaches to cost-effectiveness and regulatory review; 2) explore the impact of change in the approach to cost-effectiveness; and 3) identify policy, regulatory, and market and technology trends and articulate the potential impact of such trends on natural gas EE planning and programs—and, more broadly, on natural gas utilities in general, natural gas utility customers, and society as a whole. The findings and conclusions for each of these three tasks are presented below.

## Task 1: Current State of Natural Gas EE Programs

The Portfolio Review conducted in Task 1 examined publicly available data on the EE status of 22 selected utilities, chosen according to a defined set of criteria and a web-based market scan of the EE activities of more than 70 natural gas utilities or non-utility EE program administrators.

### Findings

- Eleven types of natural gas EE and demand response programs are in operation today.
- 70 EE products or services (measures) are currently being offered by natural gas EE programs.
- All five California Standard Practice Manual cost-effectiveness tests are currently in use, along with new Jurisdiction-Specific Tests created through the National Standard Practice Manual process.
- The composition of the Total Resource Cost, the Societal Cost, and Jurisdiction-Specific Tests is converging into a single similarly structured test regardless of the name ascribed to it.
- The policy issues addressed in natural gas EE cost-effectiveness analysis are expanding, generating corresponding increases in the number and impact of non-energy benefits included in cost-effectiveness tests, for example:
    - Climate, emissions, and decarbonization
    - Electrification
    - Diversity, equity, and inclusion (DEI)
    - Workforce development and education
- A variety of cost recovery mechanisms and constructs exist to keep utilities financially whole—for example, expensing versus amortizing EE program costs, and various forms of decoupling and performance incentives.
- There is a lack of data quality in terms of accessibility, standardization, and reporting for all 22 selected utilities.

### Conclusions

Based on the findings, the following conclusions emerge:

- The data challenges encountered in the research suggest that pursuit of accessible, consistent data would afford natural gas utilities the opportunity to better inform their strategies and conduct their EE (and enterprise) planning by utilizing robust information and accurate benchmarking. Development of accessible and consistent data could come about through collaboration among state regulators, leading to alignment, or through the independent effort of a third party such as AGA with funding from utilities.

- The Portfolio Review revealed that there is little comparability or consistency of natural gas utility EE policy or regulatory guidance across jurisdictions in the current state. This means that natural gas utilities have an opportunity to shape policy and regulation in their specific jurisdictions and to be consistent with broader strategies and objectives nationally.
- Changes to regulatory cost-effectiveness frameworks are beginning to happen—and in some jurisdictions are very much happening. Natural gas utilities have an opportunity to engage in processes to define new cost-effectiveness approaches and shape or inform them to yield outcomes consistent with their strategic objectives and maximize the value delivered to consumers and society.
- As new types of products, services, and technologies emerge in some jurisdictions, natural gas utilities have an opportunity to inform the processes that establish what measures constitute EE so that the universe of such measures includes those that align with enterprise goals.

## Task 2: Impact of Change in the Approach to Cost-Effectiveness

To explore the impact of changes in the approach to cost-effectiveness, a Cost-Effectiveness Case Study was conducted. This included an examination of the quantitative results of changing the cost-effectiveness testing methodology applied to a single, identical portfolio of natural gas EE programs.

**Findings**

- Cost-effectiveness tests bearing the same name (e.g., Total Resource Cost Test) do not always have the same composition, especially in terms of what comprises the benefit, or numerator.
- Important aspects of quantifying measures—e.g., savings and costs—vary among jurisdictions.
- Weather—e.g., heating degree days—has a significant impact on cost-effectiveness results for many measures viewed as foundational to natural gas EE portfolios (e.g., heating and water heating equipment).
- The following eight “levers,” or impactful assumptions, within cost-effectiveness testing were identified:

  (1) Measure and installation costs

  (2) Incentive and administrative cost levels

  (3) Discount rates

  (4) Weather and effective full load hours

  (5) Non-energy benefits monetized or assumed in proxy adders

  (6) Measure sizes, configurations, etc. assumed in quantification

(7) Avoided costs

(8) Retail rates

- Many non-energy benefits are already prevalent in cost-effectiveness testing in some jurisdictions, including the following summary types:

  (1) Water and non-gas fuel savings

  (2) Emissions (e.g., GHG or $CO_{2e}$), environmental compliance costs, and "environmental damage"

  (3) Utility variable O&M and customer O&M

  (4) Economic development and jobs

  (5) Energy equity and other DEI considerations

  (6) Credit and collection costs

  (7) Health, comfort, and safety

  (8) Utility credit risk premiums

## Conclusions

Based on the findings, the following conclusions were drawn:

- Much of the change in cost-effectiveness frameworks, including tests and their composition and treatment of non-energy benefits, is driven by the principles and processes espoused by the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources. To reiterate a recurring theme of this report: Natural gas utilities can engage NSPM-DER and similar processes to define new cost-effectiveness approaches and shape or inform them to yield outcomes consistent with policy expectations, EE program design, and enterprise strategies.

- Natural gas utilities have an opportunity to optimize cost-effectiveness testing relative to their specific strategies and goals by being intentional about measure quantification sources and establishing various inputs and assumptions for cost-effectiveness testing.

- Natural gas utilities have an opportunity to optimize the design and implementation (including targeting, for example) of the EE products, services, and technologies that make sense for weather conditions prevalent in their specific service territories before investing in cost-effectiveness analysis. This would ensure that investments are directed toward the most cost-effective measures, programs, and implementation tactics.

- Non-energy benefits are an increasingly important driver of EE cost-effectiveness analysis, and therefore regulatory approval. This creates opportunities for natural gas utilities to support NEBs that customers will likely support, and that align with EE and non-EE priorities.

## Task 3: Trends Assessment

Against the backdrop of the Portfolio Review and Cost-Effectiveness Case Study, the Trends Assessment sought to identify and qualitatively evaluate emerging and future influences on natural gas utility EE program design and targeting; gas, energy, and other policies; and their impact. The findings include six policy actions and six approaches by which natural gas utilities have an opportunity to respond in their strategy, planning, and programs specific to EE and in general.

### Findings

- These six areas of policy activity are likely to continue to be in focus—or will become so over the next three to five years:

  (1) The role of cost-effectiveness methods and non-energy benefits (NEBs). Regardless of whether or how NEBs are included in cost-effectiveness in any particular jurisdiction today, the growing influence of the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources means that discussions about the topic are likely happening, and that some NEBs may be adopted into cost-effectiveness methods in the near future.

  (2) Funding and financing mechanisms for EE initiatives, including but not limited to federal and state tax credits, on-bill financing, interest buydowns, and property assessments, all of which can enable more customers to participate in more EE programs more deeply and more cost-effectively.

  (3) The influence of federal minimum efficiency standards—such as those put forth by the U.S. Department of Energy and product specifications such as ENERGY STAR—on EE programs, creating new, higher energy baselines against which cost-effectiveness and EE savings are measured, and therefore prompting natural gas utilities to revisit what EE measures and programs they can offer.

  (4) Building energy codes and performance standards, which establish construction and energy performance requirements that serve as baselines for EE measurement, but which are seldom aligned across jurisdictions and thus may create confusion and burden on market actors such as contractors.

  (5) Education and workforce development, which involves EE program implementation and pursuit of equity priorities and affects virtually all EE programs and customer segments.

  (6) How natural gas EE delivers greenhouse gas emissions reductions, including due to the cleanliness of gas combustion, the contributions of natural gas and natural gas EE programs to meeting clean heat standards and/or achieving mandated emissions caps, and natural gas decarbonization strategies.

- The following are six approaches natural gas utilities may pursue to address the areas of policy activity listed above:

  (1) Leveraging existing and new programs, such as DOE’s Weatherization Assistance Program (WAP) and state energy office programs and identifying synergies with other utility industry EE programs.

(2) Utilizing new and emerging cost-effectiveness frameworks and metrics such as California's Total System Benefit (TSB) metric and various Jurisdiction-Specific Tests (JSTs).

(3) Addressing equity issues and meeting low- and moderate-income (LMI) consumer needs by increasing participation and delivery of benefits to defined segments of the overall customer base.

(4) Geotargeting, which can be a cost-effective method for delivering EE benefits to specific communities (such as LMI) that are often the focus of mandated EE program budget and participation carveouts and/or non-EE policy initiatives (e.g., Justice40), and/or addressing congestion and other utility operational issues without requiring investment of limited available capital.

(5) Employing new and emerging technologies, which can include hybrid heat pumps and natural gas peaking/backup, network geothermal systems, and distributed generation/microgrid technology, to yield EE savings, increase overall energy system reliability, and assist in maintaining energy affordability.

(6) Ensuring utility financial integrity through rate base alternatives such as volumetric decoupling, EE-specific rate riders and trackers, and performance incentive mechanisms to compensate for reaching or exceeding program goals.

**Conclusions**

The areas of policy activity listed above present natural gas utilities with an opportunity to respond in their strategy, planning, and programs specific to EE—and in general—through six pathways. The pathways are encouraged to stimulate discussions within natural gas utilities that may involve asking questions about each policy and pathway, such as, "What should my organization do?" and "How should my organization address this?" Following are two examples.

**Example: Policy Trend #2 - EE Project Funding and Financing**

New funding streams and new EE project financing mechanisms are an opportunity to reduce first cost to the customer of EE investments and to enable such investments via creative, often new, financing mechanisms that customers may find attractive or may need due to lack of otherwise available capital. Often, new financing mechanisms also enable natural gas utilities to earn interest or administrative fees as the source of capital or the administrator of third-party programs. Here are some specific questions a natural gas utility may want to consider:

- What specific rebate, tax credit, and grant programs are available, including from the federal IIJA and IRA and various state grant programs? What specific types of improvements are eligible? What are the rules and procedures by which a third party like our utility can leverage them?

- If our utility takes advantage of third-party rebates, tax credits, or grants to reduce the first cost to customers of EE investments, what will be the impact on cost-effectiveness under jurisdictional rules? Will our utility be able to claim, and monetize for cost-effectiveness testing purposes, all savings resulting from participation in EE programs that utilize state or federal rebates, tax credits, and/or grants?

- What EE or EE-related programs are offered by other utilities, state entities, or providers that complement our EE programs to potentially make them more comprehensive, of lower administrative cost to our utility, or complementary to our utility's strategic priorities?

- As they relate to our utility's social (e.g., DEI) goals, bad debt write-off levels, shut-off for non-payment costs, etc., how can new funding streams, funding mechanisms, and leveraging opportunities enhance our utility's services to lower-income and otherwise disadvantaged or underserved customers? How can our utility tell that story to generate goodwill and benefit stakeholder relationships, including those with intervenors, regulators, and policymakers?

- How can our utility engage new funding streams and financing mechanisms to generate revenue?

**Example: Approach #4 - Geotargeting of Natural Gas EE Programs**

Targeting or geotargeting natural gas utility EE means emphasizing marketing and outreach of existing EE programs, enhancing services or rebate levels of existing EE programs, or offering entirely new EE programs to discrete customer populations for specific strategic reasons. Here are some specific questions a natural gas utility may want to consider:

- Are there segments or geographic pockets of customers who, if targeted by EE programs, present opportunities to accrue large amounts of non-energy benefits to improve the overall cost-effectiveness of our utility's EE portfolio?

- Are there segments or geographic pockets of customers who, if targeted by EE programs, present opportunities to enable or accelerate achievement of performance incentive or earnings adjustment metrics such as those related to education and workforce development?

- Are there segments or geographic pockets of customers within which education and workforce development can advance our utility's social (DEI) goals, fill needs for workers (employed by our utility or business partners) with specific skillsets, or improve our utility's financial situation (e.g., reduced costs related to bad debt, credit and collections, etc.)?

- Are there segments or geographic pockets of customers who, if targeted by EE programs, mitigate capital investment needs to allow such capital investment to be redirected to strategic opportunities that otherwise would not have access to as much capital as they require?

- Are there segments or geographic pockets of customers in which EE programs designed to complement electrification or clean heat policies would be beneficial to our utility's system or financial situation?

## Conclusion

Boiling everything down, natural gas utility EE is expected to have the opportunity to create a triple win:

(1) Supporting current and future energy policy issues, including environmental priorities.

(2) Meeting natural gas EE savings goals while also creating affordability benefits for customers (especially in the low-income and other Justice40 segments).

(3) Capitalizing on opportunities that enhance and sustain gas utility financial integrity.

A threshold problem to be resolved before these outcomes can be achieved is that of granularity and consistency of data. Whether by alignment of state utility regulatory bodies, establishment of a third-party data clearinghouse, or otherwise, consistent, granular data on EE budgets, spending, and savings is needed. In addition to improved data, achieving the identified outcomes and securing the myriad benefits of natural gas EE programs will require systems thinking that integrates utility strategy, regulatory and policy compliance, and creativity. It will also require participation in the processes driving change, and collaboration with manufacturers and the entire supply chain for efficient natural gas products. Given the current policy and regulatory context, treatment and inclusion of non-energy benefits and thoughtful development of natural gas utility performance incentives are key examples of topics that should be addressed internally by individual natural gas utilities with such systems thinking as a part of enterprise strategic planning rather than just matters of regulatory compliance. Likewise, natural gas utilities should invest time and effort in building new partnerships, supporting new technologies, and articulating the positive environmental and economic virtues of natural gas and natural gas EE clearly and often.

# APPENDICES

# Appendix 1: Market Scan Utilities

**Table A1: Market Scan Utilities**

| Jurisdiction | Entity |
|---|---|
| **Arizona** | Southwest Gas<br>UniSource |
| **Arkansas** | Summit (AOG) |
| **California** | San Diego Gas & Electric<br>SoCalGas |
| **Colorado** | Atmos<br>Black Hills<br>Colorado Natural Gas<br>Platte River |
| **Connecticut** | Energize CT<br>Norwich Public Utilities |
| **District of Columbia** | Pepco |
| **Georgia** | AGL (Southern) |
| **Idaho** | Intermountain Gas<br>Questar |
| **Illinois** | MidAmerican Energy<br>Nicor (Southern)<br>Peoples/North Shore |
| **Indiana** | Citizens Gas<br>NIPSCO<br>Vectren |
| **Maryland** | BGE<br>Washington Gas Light |
| **Massachusetts** | Gas Networks<br>Mass Save<br>National Grid |
| **Michigan** | Consumers Energy<br>DTE<br>Efficiency United |
| **Minnesota** | CenterPoint<br>Minnesota Energy Resources |
| **Mississippi** | Atmos |
| **Missouri** | Liberty<br>Spire |
| **Nebraska** | MidAmerican Energy |
| **Nevada** | Southwest Gas |

| Jurisdiction | Entity |
|---|---|
| **New Hampshire** | Liberty<br>Unitil |
| **New Jersey** | New Jersey Natural Gas<br>South Jersey Gas |
| **New Mexico** | New Mexico Gas |
| **New York** | Central Hudson<br>Con Edison<br>National Fuel Gas<br>National Grid (Brooklyn Union)<br>National Grid (Niagara Mohawk)<br>Orange & Rockland<br>Rochester Gas & Electric |
| **North Carolina** | Energy United<br>Piedmont Natural Gas<br>Public Service of NC |
| **Ohio** | Columbia Gas<br>Dominion<br>Duke<br>Vectren |
| **Oklahoma** | CenterPoint<br>OK Natural Gas |
| **Oregon** | Northwest Natural Gas |
| **Pennsylvania** | PECO<br>Philadelphia Gas Works<br>UGI |
| **South Dakota** | Montana-Dakota Utilities |
| **Texas** | CPS<br>Texas Gas Service |
| **Utah** | Questar |
| **Vermont** | Vermont Gas System |
| **Virginia** | Charlottesville Gas<br>Columbia Gas<br>Washington Gas Light |
| **Washington** | Avista<br>Cascades<br>Puget Sound Energy |

# Appendix 2: Cost-Effectiveness Equations

## Total Resource Cost Test

TRC benefit-to-cost ration = BTRC/CTRC

$$BTRC = \sum_{t=1}^{N} \frac{UAC_t + TC_t}{(1+d)^{t-1}} + \sum_{t=1}^{N} \frac{UAC_{at} + PAC_{at}}{(1+d)^{t-1}}$$

$$CTRC = \sum_{t=1}^{N} \frac{PRC_t + PCN_t + UIC_t}{(1+d)^{t-1}}$$

## Societal Cost Test

SCT benefit-to-cost ratio = BTRC/CTRC but with NEBs and other externalities included

$$BTRC = \sum_{t=1}^{N} \frac{UAC_t + TC_t}{(1+d)^{t-1}} + \sum_{t=1}^{N} \frac{UAC_{at} + PAC_{at}}{(1+d)^{t-1}}$$

$$CTRC = \sum_{t=1}^{N} \frac{PRC_t + PCN_t + UIC_t}{(1+d)^{t-1}}$$

## Utility (Program Administrator) Cost Test

UCT benefit-to-cost ratio = $B_{PA}/C_{PA}$

$$B_{pa} = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} + \sum_{t+1}^{N} \frac{UAC_{at}}{(1+d)^{t-1}}$$

$$C_{pa} = \sum_{t=1}^{N} \frac{PRC_t + INC_t + UIC_t}{(1+d)^{t-1}}$$

**Participant Cost Test**

PCT benefit-to-cost ratio = BP/CP

$$BP = \sum_{t=1}^{N} \frac{BR_t + TC_t + INC_t}{(1+d)^{t-1}} + \sum_{t=1}^{N} \frac{AB_{at} + PA_{at}}{(1+d)^{t-1}}$$

$$C = \sum_{t=1}^{N} \frac{PC_t + BI_t}{(1+d)^{t-1}}$$

**Rate Impact Measure Test**

RIM benefit-to-cost ratio = BRIM/CRIM

$$BP = \sum_{t=1}^{N} \frac{BR_t + TC_t + INC_t}{(1+d)^{t-1}} + \sum_{t=1}^{N} \frac{AB_{at} + PA_{at}}{(1+d)^{t-1}}$$

$$C = \sum_{t=1}^{N} \frac{PC_t + BI_t}{(1+d)^{t-1}}$$

## Equation Terms

| Term | Definition |
|---|---|
| **(1 + d)** | (1 + d) terms reflect the fact that the tests all consider present values over the estimated useful life of the measure at a discount rate of d |
| **Subscript t** | References the time period |
| **Subscript at** | References the alternate fuel |
| **BR** | Bill reductions experienced by the participant |
| **TC** | Tax credits received by the participant |
| **INC** | Incentives paid to participants |
| **AB** | Avoided bills experienced by participants related to alternate fuels |
| **PA** | Participant avoided costs associated with measures not chosen |
| **PAC** | Participant avoided costs for the fuels not chosen |
| **PC** | Participant costs |
| **BI** | Bill increases experienced by the participant |
| **UAC** | Utility avoided supply costs |
| **UIC** | Utility incremental supply costs |
| **RG** | Revenue gain to the utility from increased sales |
| **RL** | Revenue loss to the utility from decreased sales |
| **PRC** | Program costs to the program administrator |
| **PCN** | Net participant cost |

# Appendix 3: NEBs Found in Portfolio Review

| NEBs | |
|---|---|
| Water savings | Other fuel savings (e.g., electric) |
| Emissions (as “GHG” or “CO2e”) | Utility variable O&M |
| “Environmental damage” | Environmental compliance costs |
| Economic development and jobs | Energy security |
| Energy equity | Credit and collection costs |
| Reliability | Resilience |
| Land use and costs | Tax credits |
| DRIPE | Health |
| Comfort | Safety |
| Capital outlay | Transportation, storage, distribution |
| Utility credit risk premiums | Electric system benefits |
| Equipment replacement costs | Proxy adders |

# Appendix 4: Policy Issues Identified in Portfolio Review

| Policy Issues |
| --- |
| % AFUE federal minimum efficiency standard for residential furnaces and boilers |
| Heat pump and condensing water heater standard (residential) |
| Commercial boiler standard (potential re-issue) |
| Commercial water heater standard (potential) |
| State appliance (equipment) and building performance standards |
| Decarbonization/electrification |
| Gas bans/gas transitions |
| Decoupling, lost revenue adjustment mechanisms (“throughput disincentive”) |
| EE utility performance incentives (“earnings opportunity”) |
| Rate basing, performance incentive mechanisms (“earnings opportunity”) |
| Climate/emissions as primary metric |
| Customer opt-out or self-directed EE |

# Appendix 5: Cold Climate Cost-Effectiveness Results

### Table A5 - 1: Total Resource Cost Test Results – Cold Climate

| | Discounting at WACC, no NEBs | | | Discounting at WACC, w/NEBs | | |
|---|---|---|---|---|---|---|
| **Program/Descriptor** | **Future** | **Current** | **Change** | **Future** | **Current** | **Change** |
| Multifamily Dwelling Unit | 1.16 | 1.04 | 11.54% | 1.50 | 1.19 | 25.39% |
| Assisted Home Performance | 1.33 | 1.18 | 12.71% | 1.71 | 1.35 | 26.47% |
| Home Performance | 1.20 | 1.07 | 12.15% | 1.55 | 1.23 | 26.30% |
| Residential Prescriptive | 1.04 | 0.93 | 11.83% | 1.34 | 1.06 | 25.93% |
| Behavior Reports | 1.83 | 1.63 | 12.27% | 2.37 | 1.87 | 26.33% |
| **Residential** | **1.17** | **1.05** | **11.43%** | **1.61** | **1.24** | **29.84%** |
| C&I Prescriptive | 0.46 | 0.41 | 12.20% | 0.59 | 0.47 | 25.58% |
| Commercial Kitchens | 1.01 | 0.92 | 9.78% | 1.31 | 1.06 | 23.73% |
| Small Business | 1.67 | 1.50 | 11.33% | 2.15 | 1.72 | 25.06% |
| **C&I** | **1.00** | **0.90** | **11.11%** | **1.29** | **1.03** | **25.24%** |
| **Portfolio Total** | **1.01** | **0.91** | **10.99%** | **1.31** | **1.05** | **24.76%** |

### Table A5 - 2: Societal Cost Test Results – Cold Climate

| | Discounting at T-Bond, w/NEBs | | |
|---|---|---|---|
| **Program/Descriptor** | **Future** | **Current** | **Change** |
| Multifamily Dwelling Unit | 1.75 | 1.37 | 27.33% |
| Assisted Home Performance | 2.08 | 1.61 | 28.89% |
| Home Performance | 1.90 | 1.47 | 28.86% |
| Residential Prescriptive | 1.64 | 1.28 | 28.51% |
| Behavior Reports | 2.39 | 1.89 | 26.36% |
| **Residential** | **1.97** | **1.49** | **32.21%** |
| C&I Prescriptive | 0.73 | 0.57 | 28.31% |
| Commercial Kitchens | 1.48 | 1.18 | 25.18% |
| Small Business | 2.51 | 1.98 | 27.03% |
| **C&I** | **1.52** | **1.19** | **27.73%** |
| **Portfolio Total** | **1.55** | **1.22** | **27.05%** |

### Table A5 - 3: Utility Cost Test Results – Cold Climate

| | Discounting at WACC, no NEBs | | | Discounting at WACC, w/NEBs | | |
|---|---|---|---|---|---|---|
| **Program/Descriptor** | **Future** | **Current** | **Change** | **Future** | **Current** | **Change** |
| Multifamily Dwelling Unit | 1.39 | 1.24 | 12.10% | 1.80 | 1.43 | 26.05% |
| Assisted Home Performance | 1.76 | 1.55 | 13.55% | 2.27 | 1.78 | 27.50% |
| Home Performance | 1.84 | 1.62 | 13.58% | 2.38 | 1.86 | 27.76% |
| Residential Prescriptive | 1.91 | 1.68 | 13.69% | 2.47 | 1.93 | 27.88% |
| Behavior Reports | 1.83 | 1.63 | 12.27% | 2.37 | 1.87 | 26.33% |
| **Residential** | **1.82** | **1.60** | **13.75%** | **2.50** | **1.91** | **30.89%** |
| C&I Prescriptive | 0.84 | 0.74 | 13.51% | 1.09 | 0.85 | 27.53% |
| Commercial Kitchens | 1.87 | 1.67 | 11.98% | 2.41 | 1.92 | 25.65% |
| Small Business | 2.50 | 2.23 | 12.11% | 3.23 | 2.55 | 26.44% |
| **C&I** | **1.70** | **1.51** | **12.58%** | **2.19** | **1.73** | **26.59%** |
| **Portfolio Total** | **1.71** | **1.52** | **12.50%** | **2.22** | **1.74** | **27.59%** |

**Table A5 - 4: Participant Cost Test Results – Cold Climate**

| | Discounting Rates at WACC | | |
|---|---|---|---|
| **Program/Descriptor** | **Future** | **Current** | **Change** |
| Multifamily Dwelling Unit | 28.70 | 28.75 | -0.17% |
| Assisted Home Performance | 17.64 | 17.64 | 0.00% |
| Home Performance | 11.08 | 11.07 | 0.09% |
| Residential Prescriptive | 8.19 | 8.19 | 0.00% |
| Behavior Reports | N/A | N/A | N/A |
| **Residential** | **11.15** | **11.15** | **0.00%** |
| C&I Prescriptive | 2.62 | 2.61 | 0.38% |
| Commercial Kitchens | 5.34 | 5.30 | 0.75% |
| Small Business | 9.57 | 9.52 | 0.53% |
| **C&I** | **5.21** | **5.19** | **0.39%** |
| **Portfolio Total** | **5.61** | **5.59** | **0.36%** |

## Table A5 - 5: Rate Impact Measure Test Results – Cold Climate

| | Discounting at WACC, no NEBs | | |
|---|---|---|---|
| **Program/Descriptor** | **Future** | **Current** | **Change** |
| Multifamily Dwelling Unit | 0.92 | 0.83 | 10.84% |
| Assisted Home Performance | 1.17 | 1.04 | 12.50% |
| Home Performance | 1.21 | 1.08 | 12.04% |
| Residential Prescriptive | 1.18 | 1.05 | 12.38% |
| Behavior Reports | 1.09 | 0.95 | 14.74% |
| **Residential** | **1.18** | **1.05** | **12.38%** |
| C&I Prescriptive | 0.33 | 0.30 | 10.00% |
| Commercial Kitchens | 0.39 | 0.36 | 8.33% |
| Small Business | 0.49 | 0.45 | 8.89% |
| **C&I** | **0.43** | **0.39** | **10.26%** |
| **Portfolio Total** | **0.45** | **0.42** | **7.14%** |

# Appendix 6: Gas Bans and "Bans on Ban"

## Gas Ban Research

- DOE Proposed Regulations which impact gas stoves:
- Could ban 50-96% of natural gas stoves:
- Updated Proposal in Feb 2024: https://www.regulations.gov/document/EERE-2014-BT-STD-0005-12824
- DOE Proposed Regulations which impact natural gas water heaters: https://www.energy.gov/articles/doe-proposes-new-energy-efficiency-standards-water-heaters-save-americans-more-11-billion
- New York Natural Gas Equipment Ban legislation: https://www.urbangreencouncil.org/decoding-new-york-states-all-electric-new-buildings-law/
- Washington State new rules to phase out fossil fuel home equipment: https://www.seattletimes.com/seattle-news/environment/wa-adopts-new-rules-to-phase-out-fossil-fuels-in-new-construction/
- North Carolina HB 130 (2023 legislation), which bans natural gas bans: https://www.jdsupra.com/legalnews/north-carolina-s-house-bill-130-energy-2325752
- Article on Natural Gas Equipment Restrictions nationwide: https://angle.ankura.com/post/102j0y2/natural-gas-restrictions-in-the-u-s-examining-the-state-of-play-policy-objecti
- 9th Circuit Court overrules Natural Gas Ban in Berkeley: https://www.sfchronicle.com/politics/article/berkeley-gas-ban-18585687.php
- Chicago Clean and Affordable Building Ordinance (cannot find information on if adopted): https://occprodstoragev1.blob.core.usgovcloudapi.net/matterattachmentspublic/cd502415-4ff4-440a-8f92-7cdf53888b00.pdf
- ICC proposes, then removes electrification provisions in the IECC: https://www.energyindepth.org/activists-disregard-will-of-voters-in-latest-gas-stove-ban-attempts/
- "On 7 February 2024, energy officials from nine states, including California, Colorado, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, and Rhode Island, signed a memorandum of understanding to set a shared goal to deploy heat pumps in 65% of new buildings by 2030 and 90% of new buildings by 2040."
- https://www.klgates.com/Its-a-Gas-Federal-and-State-Developments-Continue-to-Light-Up-the-Natural-Gas-Debate-2-26-2024

**Table A6 – 1: Bans on Gas Bans**

| State | Legislation | Year |
|---|---|---|
| **Alabama** | HB 446 | 2021 |
| **Arizona** | HB 2686 | 2020 |
| **Arkansas** | SB 137 | 2021 |
| **Florida** | HB 919 | 2021 |
| **Georgia** | HB 150 | 2021 |
| **Idaho** | HB 106 | 2023 |
| **Indiana** | HB 1191 | 2021 |
| **Iowa** | HB 555 | 2021 |
| **Kansas** | SB 24 | 2021 |
| **Kentucky** | HB 207 | 2021 |
| **Louisiana** | SB 492 | 2020 |
| **Maine** | LD 894 | 2023 |
| **Michigan** | HB 4575 | 2022 |
| **Mississippi** | HB 632 | 2021 |
| **Missouri** | HB 734 | 2021 |
| **Montana** | SB 208 | 2023 |
| **New Hampshire** | SB 86 | 2021 |
| **North Carolina** | HB 130 | 2023 |
| **North Dakota** | HB 1234 | 2023 |
| **Ohio** | HB 201 | 2021 |
| **Oklahoma** | HB 3619 | 2020 |
| **Pennsylvania** | SB 143 | 2023 |
| **South Dakota** | SB 174 | 2023 |
| **Tennessee** | SB 1934 | 2020 |
| **Texas** | HB 17 | 2021 |
| **Utah** | HB 17 | 2021 |
| **Virginia** | HB 1783 | 2023 |
| **West Virginia** | HB 2842 | 2021 |
| **Wisconsin** | SB 49 | 2023 |
| **Wyoming** | SF 0152 | 2021 |

# Appendix 7: Building Energy Codes by State

**Alabama**
Codes used: https://dcm.alabama.gov/bldg_code.aspx
ASHRAE Standard 90.1-2013: https://ierga.com/hr/wp-content/uploads/sites/2/2017/10/ASHRAE-90.1-2013.pdf
2015 IECC: https://codes.iccsafe.org/content/IECC2015

**Alaska**
None Statewide.
Must follow Alaska Housing Finance Authority Building Energy Efficiency Standards for financial assistance: https://www.ahfc.us/pros/builders/building-energy-efficiency-standard

**Arizona**
None Statewide, but uses IECC and ASHRAE 90.1-2007 at the local jurisdiction level: https://www.energycodes.gov/sites/default/files/2020-05/Arizona_Certification_of_Com_and_Res_Codes_Standard90.1-2007and2009IECC.pdf

**Arkansas**
Residential uses IECC 2009 and Commercial uses IECC 2009 or ASHRAE 90.1-2007: https://www.adeq.state.ar.us/energy/resources/pdfs/2014-ar-energy-code-for-new-building-construction.pdf
2009 IECC: https://codes.iccsafe.org/content/IECC2009PDF
ASHRAE Standard 90.1-2007: http://www.ditar.cl/archivos/Normas_ASHRAE/T1160ASHRAE-90.1-2007-Energy-Std.pdf

**California**
State-Specific 2022 Energy Code: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency
Note that changes to the code are scheduled to go into effect in 2025: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency

**Colorado**
None statewide, but uses IECC and ASHRAE 90.1-2007 at the local jurisdiction level: https://www.energycodes.gov/sites/default/files/2019-09/Colorado_Certification_of_Com_and_Res_Codes_Standard90.1-2007and2009IECC.pdf
Established an Energy Code Board in 2022: https://energyoffice.colorado.gov/buildings/building-energy-codes/energy-code-board
Energy Code Board legislation: http://leg.colorado.gov/bills/hb22-1362

**Connecticut**
Building Codes: https://portal.ct.gov/-/media/das/office-of-state-building-inspector/2022-state-codes/2022-csbc-final.pdf
2021 IECC: https://codes.iccsafe.org/content/IECC2021P2

**Delaware**
Codes used: https://www.energycodes.gov/sites/default/files/2019-09/Delaware_Certification_of_Com_and_Res_Codes_Standard90.1-2007and2009IECC.pdf
2009 IECC and ASHRAE 90.1-2007

**Florida**
Codes used: https://codes.iccsafe.org/content/FLEC2023P1/preface
2021 IECC and ASHRAE 90.1-2019

**Georgia**
Codes used: https://www.dca.ga.gov/local-government-assistance/construction-codes-industrialized-buildings/construction-codes
IECC 2018: https://codes.iccsafe.org/content/IECC2018P5

**Hawaii**
Codes used: https://ags.hawaii.gov/wp-content/uploads/2021/01/soh_bcc_energycode_20201215.pdf
2018 IECC

**Idaho**
Codes used: https://dopl.idaho.gov/wp-content/uploads/2023/10/BLD-Rules.pdf
2018 IECC

**Illinois**
Codes used: https://cdb.illinois.gov/business/codes/illinois-energy-codes/illinois-energy-conservation-code.html
2021 IECC

**Indiana**
Codes used: https://www.in.gov/dhs/boards-and-commissions/fpbsc-rules/#675_IAC_19___Indiana_Energy_Conservation_Codes
2018 IECC and ASHRAE 90.1-2007

**Iowa**
Codes used: https://www.legis.iowa.gov/docs/iac/chapter/661.303.pdf
2012 IECC

**Kansas**
Codes adopted, but not enforced: https://law.justia.com/codes/kansas/2021/chapter-66/article-12/section-66-1227/
IECC 2006

**Kentucky**
Residential Codes (IECC 2009):
https://dhbc.ky.gov/Documents/2018%20Kentucky%20Residential%20Code%20-%20CLEAN_FINAL%207.17.20.pdf
Commercial Codes (IECC 2012):
https://dhbc.ky.gov/Documents/2018%20Kentucky%20Building%20Code%20-%20Third%20Edition.pdf

**Louisiana**
Codes used: https://lsuccc.dps.louisiana.gov/pdf/UCC_Amendments_03-20-24.pdf
IECC 2021

**Maine**
Codes used: https://www.maine.gov/dps/fmo/building-codes
IECC 2015 and ASHRAE 90.1-2016

**Maryland**
Codes used: https://www.dllr.state.md.us/labor/build/comar091251.pdf
2021 IECC

**Massachusetts:**
https://www.mass.gov/doc/780-cmr-ninth-edition-residential-chapter-3-building-planning-amendments/download
2015 IECC

**Michigan**
https://www.energycodes.gov/status/states/michigan
2015 IECC and ASHRAE 90.1-2013

**Minnesota**
https://codes.iccsafe.org/content/MNEC2020P1/2015-minnesota-residential-energy-code
https://www.dli.mn.gov/sites/default/files/pdf/AR4696-adopted.pdf
2012 IECC and ASHRAE 90.1-2019

**Mississippi**
No reference to building standards found.

**Missouri**
No reference to building standards found.

**Montana**
https://bsd.dli.mt.gov/building-codes-permits/current-codes
2021 IECC
**Nebraska**

https://neo.ne.gov/services/codes/codes.html#item-02
2018 IECC and ASHRAE 90.1-2016

**Nevada**
https://energy.nv.gov/Programs/Building_Energy_Codes/
2021 IECC

**New Hampshire**
https://www.firemarshal.dos.nh.gov/laws-rules-regulatory/state-fire-building-codes
2018 IECC

**New Jersey**
https://www.nj.gov/dca/divisions/codes/codreg/index.html
2021 IECC and ASHRAE 90.1-2019

**New Mexico**
https://www.rld.nm.gov/wp-content/uploads/2024/01/2021-New-Mexico-Residential-Energy-Conservation-Code-NMAC-14.7.6-effective-7.30.24.pdf
https://www.rld.nm.gov/wp-content/uploads/2024/01/2021-New-Mexico-Commercial-Energy-Code-NMAC-14.7.9-effective-7.30.2024.pdf
2021 IECC

**New York**
https://govt.westlaw.com/nycrr/Browse/Home/NewYork/UnofficialNewYorkCodesRulesandRegulations?guid=I2faf8040ac4311dd81fce471ddb5371d&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)
IECC 2018 and ASHRAE 90.1-2016

**North Carolina**
https://codes.iccsafe.org/content/NCECC2018/chapter-6-ce-referenced-standards
IECC 2015 and ASHRAE 90.1-2013

**North Dakota**
https://www.commerce.nd.gov/sites/www/files/documents/Community%20Services/Building%20Codes/2023NDStateBuildingCodeBook.pdf
IECC 2021

**Ohio**
https://com.ohio.gov/divisions-and-programs/industrial-compliance/boards/board-of-building-standards/building-codes-and-interpretations/energy-code-compliance-resources
IECC 2018 and ASHRAE 90.1

**Oklahoma**
https://oklahoma.gov/oubcc.html
2018 International Residential Code: https://codes.iccsafe.org/content/IRC2018/index

**Oregon:**
State-Specific Oregon Residential Code based on the 2021 IRC: https://www.oregon.gov/bcd/codes-stand/Pages/energy-residential-compliance.aspx
Commercial uses ASHRAE 90.1-2019: https://www.oregon.gov/bcd/codes-stand/Documents/2021oeesc.pdf

**Pennsylvania**
https://pacodeandbulletin.gov/secure/pabulletin/data/vol51/51-52/51-52.pdf
IECC 2018

**Rhode Island**
https://rules.sos.ri.gov/regulations/part/510-00-00-8
2018 IECC

**South Carolina**
https://www.energycodes.gov/sites/default/files/2024-02/South_Carolina_Certification_of_Com_and_Res_Codes_Standard90.1-2007and2009IECC.pdf
2009 IECC and ASHRAE 90.1-2007

**South Dakota**
2009 IECC

**Tennessee**
Residential has 2018 IRC and IECC: https://publications.tnsosfiles.com/rules_filings/04-25-20.pdf
Commercial has 2012 IECC:
https://www.tn.gov/content/dam/tn/commerce/documents/fire_prevention/posts/2020-4-12_sfmo-code-adoption-and-history.pdf

**Texas**
Residential 2015 IRC: https://comptroller.texas.gov/programs/seco/code/single-family.php
Commercial 2015 IECC: https://comptroller.texas.gov/programs/seco/code/commercial.php

**Utah**
2021 IECC: https://le.utah.gov/~2023/bills/static/HB0532.html

**Vermont**
2018 IECC: https://publicservice.vermont.gov/sites/dps/files/documents/06.21.23%20-%2022P28%20-%20PSD%20Adopted%20Rule%20Filing%20-%20Residential%20Building%20Energy%20Standards.pdf

**Virginia**
2018 IECC: https://www.dhcd.virginia.gov/sites/default/files/DocX/building-codes-regulations/archive-codes/2021/2021-virginia-construction-code.pdf

**Washington**
State Specific Residential: https://sbcc.wa.gov/sites/default/files/2024-01/2021_WSEC_R_2ndEd_012524.pdf
State Specific Commercial: https://sbcc.wa.gov/sites/default/files/2024-01/2021_WSEC_C_2ndEd_012824.pdf

**West Virginia**
2015 IECC, 2009 IECC, and ASHRAE 90.1-2010:
https://apps.sos.wv.gov/adlaw/csr/readfile.aspx?DocId=51028&Format=PDF

**Wisconsin**
2015 IECC and ASHRAE 90.1-2013: https://dsps.wi.gov/Pages/Programs/Energy/Default.aspx

**Wyoming**
No reference to building standards found.