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FINAL DRAFT REPORT

Natural Gas Fuel Switching Potential in Maryland

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This report was prepared for the Maryland Energy Administration (MEA) by GDS Associates, Inc. (GDS). GDS would like to acknowledge the insights, information and critical review of key study inputs and assumptions provided by MEA staff and the overall project leadership that was provided by MEA's program managers, Dennis Hartline and Kevin Lucas.

1.0 EXECUTIVE SUMMARY

1.1 Introduction

The need for this analysis was initially created by the Maryland Energy Efficiency Act of 2008, which requires a study of the feasibility of setting energy savings targets in 2015 and 2020 for electric and natural gas companies. MEA contracted with GDS in June of 2012 to conduct this natural gas fuel switching potential study for the State of Maryland. The primary objective of this study is to estimate the technical, economic and achievable electric savings potential associated with natural gas fuel switching in the residential and commercial sectors in the State of Maryland over a 10 year period (2013 to 2022).

For this study, the natural gas fuel switching potential is defined as the potential over time of energy efficient natural gas equipment replacing standard electric equipment. Cost effective fuel switching measures are defined as those that are cost effective according to the Total Resource Cost (TRC) test. All fuel switching measures were screened for cost effectiveness at the measure level; excluding program costs such as program administration and natural gas main connect charges. This screening at the measure level was conducted solely for the purpose of identifying individual measures to be included in the cost-effective natural gas fuel switching potential, independent of how these measures might ultimately be bundled and included in programs. This report also provides natural gas fuel switching potential and TRC test results for three achievable potential scenarios (high, medium and low market penetration of natural gas fuel switching measures).

The last section of this report presents information on natural gas fuel switching plans and programs from other states and identifies options for incorporating fuel switch into existing DSM programs in Maryland.

1.2 Overview of Study Methodology

GDS estimated the natural gas fuel switching potential for the following measures:

- Residential Space Heating
- Residential Water Heating
- Residential Clothes Dryers
- Commercial Space Heating
- Commercial Water Heating

The technical, economic and achievable potential were estimated for each natural gas fuel switching measure, where:

Technical Potential is electric energy efficiency savings that would result from the complete and immediate penetration of all analyzed natural gas fuel switching measures in applications where they are deemed to be technically feasible and natural gas is available.

Economic Potential represents that portion of the total technical potential that is cost effective in accordance with the TRC test.

Achievable Potential is defined as savings that would result given an expected market penetration rate of all technically feasible and cost-effective measures over the ten year study horizon. Because market penetration is highly dependent on program design and delivery, including most importantly incentive levels, GDS did not attempt to estimate specific market penetration rates for individual measures in the achievable potential scenarios. This can be done more appropriately when new fuel switching programs are developed or existing programs are modified to include natural gas fuel switching measures identified in this study. Instead this study examined three market penetration scenarios (40%, 60%, and 80%) for the calculations of achievable potential with 60% representing the medium or base case. The market penetration rate is defined for this study as the percent of cost-effective, technically feasible fuel switching measures that will be installed by customers over the 10 year (2013-2022) study horizon. The assumed values of market penetration rates are intended to capture likely outcomes of successful, well managed and well-funded programs. The 80 percent market penetration scenario (the “high case” scenario) would require very aggressive funding, and a concerted, sustained campaign involving highly aggressive programs and market interventions. It should be viewed as a best estimate of the “high case” achievable cost effective potential for the natural gas fuel switching measures included in this study.

The incentive levels associated with these market penetration scenarios was assumed to be 45%, 72.5%, and 100% respectively. The 45% figure is based on an analysis of the BG&E gas conversion filing and the non-connection incentives, and is assumed to represent a low incentive level in this study. The 100% incentive level is used to represent the maximum achievable potential that could be captured as defined by the National Action Plan for Energy Efficiency.[1] The 72.5% figure is an average of the 45% and 100% incentive levels, and is assumed to represent a base case incentive level in this study.

The achievable potential reflects the market driven implementation of fuel switching measures. In other words, it was assumed that existing electric equipment will be replaced at the end of the equipment’s effective useful life. For example, only half of the electric boilers with a 20 year useful life are assumed to be replaced over the 10 year study horizon. The 80 percent market penetration rate assumed in the achievable potential scenario is applied to the electric equipment that is expected to be replaced over the 10 year study horizon to determine the number of replaced units that will be switched to natural gas.

Figure 1-1 below shows a picture of how these three types of energy efficiency potential relate to each other. Table 1-1, later in the executive summary, provides a summary of the technical, economic and achievable potential for natural gas savings in the years 2015 and 2020.

[1] National Action Plan for Energy Efficiency: Guide for Conducting Energy Efficiency Potential Studies, November 2007.

Figure 1-1: Types of DSM Potential[2]

The general methodology used for estimating the potential for natural gas fuel switching in the residential and commercial sectors for the years 2013-2022 includes the following major steps:

1. Identify natural gas fuel switching measures to be included in the assessment.
2. Collect and analyze the baseline and forecasted characteristics of the electric end use markets, including residential equipment saturations and commercial consumption, by market segment and end use.
3. Determine the characteristics of each natural gas fuel switching measure including the saturation of the end-use or percent of applicable electric use to which the measure applies, its incremental cost (compared to standard efficiency electric equipment), electric savings, increased natural gas use, the effective useful life of the measure and its technical feasibility.
4. Screen each measure to determine cost effectiveness according to the Total Resource Cost (TRC) Test. This included avoided cost benefits associated with the elimination of electric load and the offsetting increase in natural gas consumption that would occur.
5. Sort measures from most to least cost effective.
6. Estimate technical potential (immediate penetration of all measures) by integrating measure characteristics such as savings factors, base saturations and use, the remaining end uses to be replaced with the measure, technical feasibility and the availability of natural gas.
7. Produce estimates of economic potential by removing measures from the technical potential analysis that are not cost-effective.
8. Apply achievable penetration rates and natural equipment replacement rates to determine a range of the achievable potential over the ten year study horizon.

1.3 Natural Gas Availability

For this study, natural gas availability is defined as the percent of electric customers in Maryland that either currently possess a natural gas account yet maintain selected electric-consuming end-uses or are on a natural gas main but are not connected. The analysis assumes

[2] Reproduced from "Guide to Resource Planning with Energy Efficiency" November 2007. ES EPA. Figure 2-1.

that 100% of customers with existing gas accounts that continue to use electric space heating, water heating, and/or clothes drying equipment can be converted. Further, based on a review of the BGE and Washington Gas fuel switching program filings provided by MEA, GDS estimates that an additional 6.5% of current electric customers are on a natural gas main but not connected can also be converted over the study timeframe. It is assumed that this percentage will remain unchanged over the 10 year study period.

1.4 Study Results

Table 1-1 below provides a summary of the 2015 and 2020 technical, economic and achievable potential estimates for natural gas fuel switching in the State of Maryland for the residential, and commercial sectors. Estimates of technical and economic potential assume immediate implementation of all eligible measures. Any increase in potential from 2015 to 2020 can be attributed to sector growth through new construction and related activities. Comparatively, achievable potential takes into account the timing of eligible equipment replacement as well as an estimated market penetration rate, resulting in significant growth in potential savings estimates over time. As achievable potential factors in the timing of equipment replacement and a ramped in target market penetration rate which grows over time, it is possible for the achievable potential to be dramatically lower than the economic potential, especially during the early years of the study.

Achievable potential was examined for three market penetration scenarios. Figure 1-2 provides a breakdown of the achievable potential by sector for the years 2015 and 2020 for the base case market penetration scenario (60% long-term market penetration). A more gradual ramp up is forecasted in the residential sector due to market barriers that must be overcome such as limited access to capital and greater financing risks and costs. GDS estimates that the total achievable potential for electric fuel switching savings in Maryland by 2015 is 143,356 MWh, which is approximately 0.25% of the forecasted retail electric sales in 2015, and by 2020 is 589,918 MWh, which represents approximately 0.97% of the forecasted electric sales in 2020.

Table 1-1: Natural Gas Fuel Switching Potential – State of Maryland (MWh)

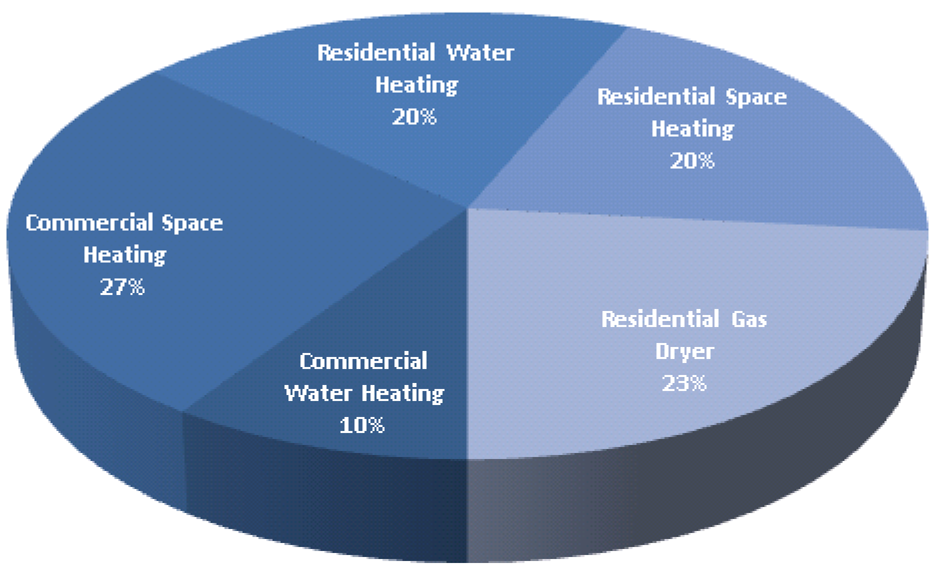
Summary of Maryland Natural Gas Fuel Switching Potential			
	Technical	Economic	Achievable 60% Market Penetration
2015			
Residential	1,959,400	1,875,690	62,236
Commercial	714,380	714,380	81,120
Total MWh Savings	2,673,780	2,590,070	143,356
% of 2015 Forecasted Annual Sales	*4.70%*	*4.55%*	*0.25%*
2020			
Residential	2,047,566	1,956,993	373,597
Commercial	769,853	769,853	216,321
Total MWh Savings	2,817,419	2,726,846	589,918
% of 2020 Forecast Annual Sales	*4.61%*	*4.46%*	*0.97%*

Table 1-2 provides information on the TRC Test results for the base case achievable market penetration scenario (60% long-term market penetration). This table shows that the TRC Test net present value savings to electric ratepayers is $80.5 million. The overall TRC Test benefit/cost ratio for this scenario is 1.24.

Table 1-2: TRC Test Net Present Value Savings for Achievable Potential -60% Market Penetration Scenario ($ in millions)

Cost Effectiveness Screening Results - 60% Market Penetration Scenario				
Market Sector	Present Value of Total Benefits ($2013)	Present Value of Total Costs ($2013)	Present Value of Savings ($2013)	Benefit/Cost Ratio
Residential	303.4	254.3	49.1	1.19
Commercial	107.9	76.7	31.2	1.41
Total	411.3	331.0	80.3	1.24

Figure 1-2: Achievable Natural Gas Fuel Switching Potential by 2020 by Market Sector and End Use (60% Market Penetration)



Figures 1-3 and 1-4 show the breakdown of achievable potential in the year 2020 by type of energy efficiency measure for the residential and commercial sectors respectively for the 60% market penetration scenario.

Figure 1-3: Residential Sector Achievable Fuel Switching Potential in 2020 by Measure[3]

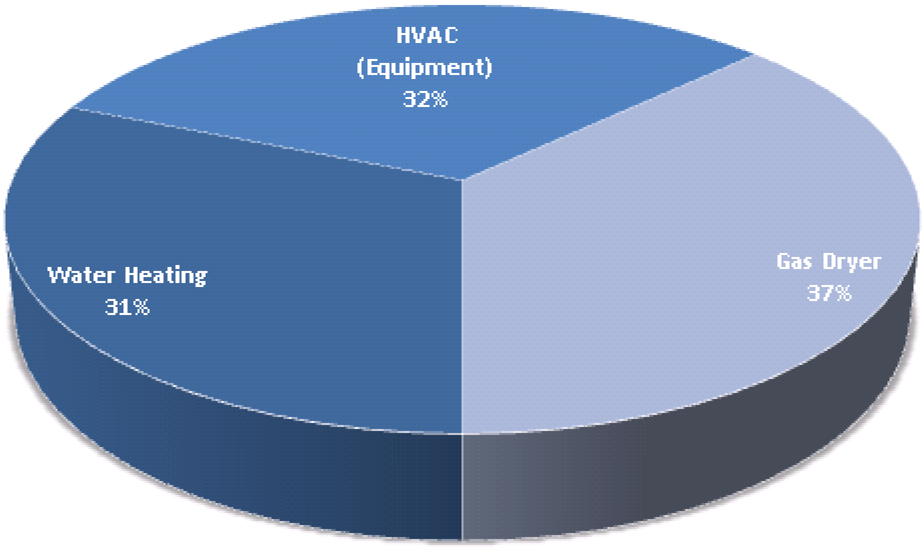
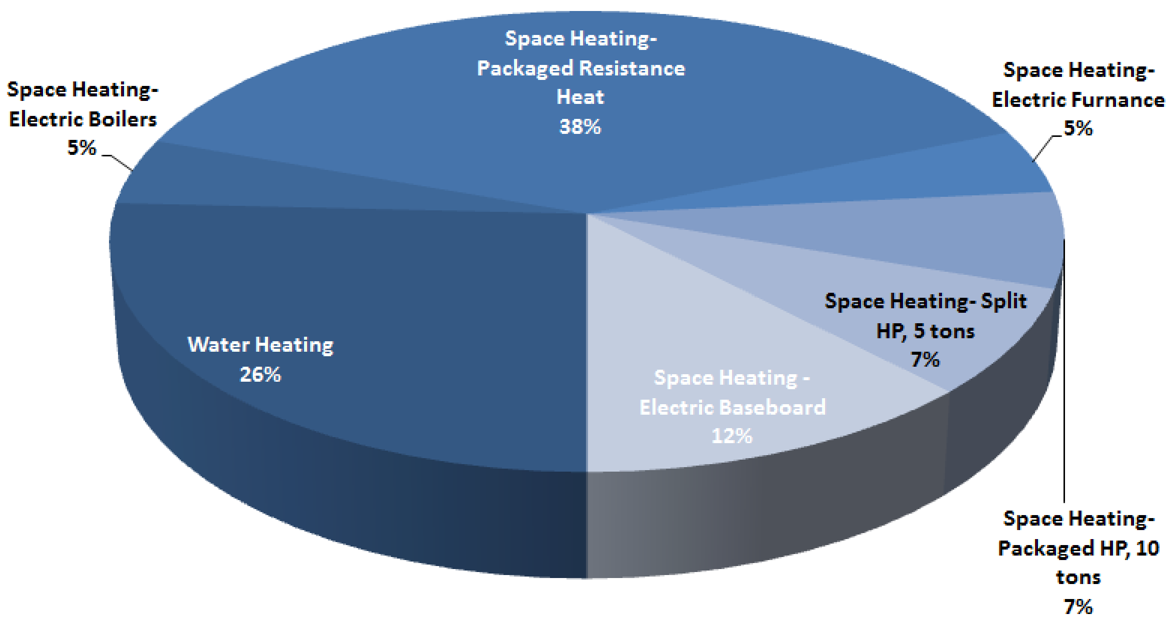


Figure 1-4: Commercial Sector Achievable Fuel Switching Potential in 2020 by Measure



[3] As discussed in Chapter 5, the significant potential for savings associated with gas drying is due to the large percentage of customers with current gas connections who continue to use electric dryers compared to the percentage of customers with gas connections who continue to use electric space heating and electric water heating equipment. The analysis assumes that 100% of customers with current gas connections can be converted, while only 6.5% of customers not currently connected to gas will have the opportunity to switch to natural gas over the course of the study.

2.0 INTRODUCTION

MEA commissioned this study for the purpose of determining the technical, economic, and achievable potential for natural gas fuel switching in Maryland. This study examines the natural gas fuel switching potential for residential and commercial space heating and water heating, and residential clothes drying. The industrial sector was not included in the analysis because of technical/engineering limitations associated with switching electric process load to an alternative fuel and very limited electric boiler and domestic hot water heating usage. Natural gas fuel switching potential was assessed over a ten year period from 2013 through 2022. Achievable potential was then identified specifically for the years 2015 and 2020.

2.1 Project History

In the spring of 2011, MEA identified the need to determine the potential for natural gas energy efficiency savings in Maryland, and to identify the types of natural gas energy efficiency programs and measures that could save the most natural gas and be the most cost effective for the State of Maryland. The need for this analysis was initially created by the Maryland Energy Efficiency Act of 2008, which requires a study of the feasibility of setting energy savings targets in 2015 and 2020 for natural gas companies. MEA contracted with GDS in June of 2011 to conduct a natural gas energy efficiency potential study for the State of Maryland. The study which was completed in November of 2011, did not address natural gas fuel switching opportunities. Instead, an additional study was commissioned to expand the analysis of natural gas energy efficiency opportunities to include switching from electric to natural gas equipment in the residential and commercial sectors in Maryland. This report presents the results of GDS's additional analysis of fuel switching potential.

2.2 Overview of this Report

As with any assessment of energy efficiency potential, this study necessarily builds on a large number of assumptions, from average measure lives, savings and costs, to the discount rate for determining the net present value of future savings. While the authors, with the assistance of the MEA, have sought to use the best available data including existing residential and commercial electric baseline studies for Maryland, additional primary data collection to inform the analysis was not called for in the study scope.

Furthermore, the list of analyzed measures represents the most common, commercially available natural gas energy efficiency measures that can replace current electric technologies. No attempt was made to forecast future technologies. Also, there was no attempt to place a dollar value on some difficult to quantify benefits that may result from some measures, such as increased comfort or reduced maintenance, which may in turn support some personal choices to implement a natural gas measures that may otherwise not be cost-effective or only marginally so. Thus, the various potential estimates are specific to and limited by the measures lists and assumptions described in this study.

The remainder of this report is organized as follows:

- Section 3 – Project Overview and Background
- Section 4 – Overall Project Methodology

- Section 5 – Residential Sector Energy Efficiency Potential
- Section 6 – Commercial Sector Energy Efficiency Potential
- Section 7 – Pros and Cons of Electric and Fossil Fuel Program Joint Delivery

3.0 PROJECT OVERVIEW AND BACKGROUND

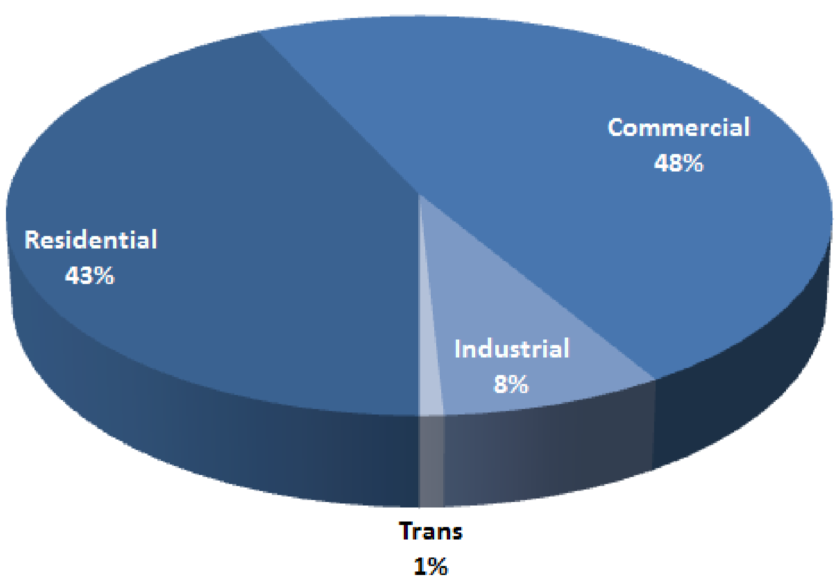
This chapter provides key background information used by GDS to determine the economic and achievable potential for natural gas fuel switching in Maryland. It presents the State of Maryland data on electric energy consumption; saturation for electric equipment for which a common natural gas alternative exists; history and forecast of residential electric customers, sales, and revenues; and breakdown of commercial electric sales by type of business type and further by heating and water heating end uses. This data provides the foundation for determining estimates of natural gas fuel switching potential in Maryland. It is important to have information on the current electric consumption levels and uses of electricity for a natural gas alternative as a starting point for the natural gas fuel switching potential study.

3.1 Electricity Consumption in Maryland

3.1.1 Introduction

Approximately 63,581 MWh were delivered to retail customers in Maryland in 2011, the most recent year where detailed electric consumption data for Maryland is available. Figure 3-1 shows the proportion of electric use by major retail customer segment in Maryland. Residential and commercial customers, the two sectors considered in this study, account for 91% of total electric consumption in the State.

Figure 3-1: Breakdown of Retail Electric Energy Sales, Maryland, 2011



GDS has characterized electric energy use by customer segment based on the latest historical data available from the U.S. Energy Information Administration (EIA) and forecasts of electric sales and customers developed by GDS for this project. The remainder of this chapter describes forecasted electric use for the residential and commercial segments and usage by those electric end uses that offer the greatest opportunity for fuel switching in Maryland. The sources used to develop this characterization include:

- The 2011 Maryland electric baseline study of the commercial and industrial sectors;[4]
- The 2010 Maryland electric baseline study of the residential sector;[5]
- EIA Annual Energy Outlook Data.

This detailed market assessment of electric end-use saturations and usage is an essential component of this study. In order to estimate the potential for natural gas fuel switching, one must have a thorough understanding of current and forecasted electric use in Maryland.

3.1.2 Electric Sales Forecast

GDS developed electric energy sales forecasts for the residential and commercial sectors based on actual 2011 sales and Department of Energy, Energy Information Administration (EIA) forecasts.[6] These forecasts project that residential electric energy sales will increase from 27,274,000 MWh in 2011 to 29,103,885 MWh in 2022 (representing a compound average annual rate of growth of 0.6%). Commercial sales are projected to increase from 30,748,000 MWh in 2011 to 33,808,364 MWh in 2022 (representing a compound average annual rate of growth of 0.8%). Table 3-1 shows the electric sales forecast for Maryland for the residential and commercial class of service.

Table 3-1: Forecast of Electric Sales by Class of Service, 2011-2022 (MWh)

Forecast of Electric Sales by Class of Service, 2011-2022						
Class of Service	2011	2012	2015	2020	2022	Compound Annual Growth Rate, 2011-2022
Residential	27,274,000	26,511,548	26,402,626	28,254,296	29,103,885	0.6%
Commercial	30,748,000	29,708,631	30,488,158	32,855,609	33,808,364	0.8%

3.2 Residential Electric Usage

3.2.1 Residential Electric Customer Forecast

As shown in Table 3-2, the number of residential electric customers in Maryland is projected to increase on average by 22,031 per year over the period from 2011 to 2022. The compound average annual growth rate for residential electric customers is 0.96%.

Table 3-2: Forecast of Residential Electric Customers by Housing Type, 2011-2022

Forecast of Residential Electric Customers by Housing Type, 2011-2022					
Housing Units	2011	2012	2015	2020	2022
Single Family, detached	1,135,947	1,147,435	1,181,898	1,239,338	1,262,315
Single Family, attached	467,170	471,895	486,068	509,691	519,140
Multifamily	40,828	41,240	42,479	44,544	45,369
Mobile Homes	534,498	539,903	556,120	583,147	593,958
Total	2,178,442	2,200,473	2,266,565	2,376,720	2,420,782

4 Maryland Baseline Studies – Commercial and Industrial Sectors. Itron. December 2010.
5 Maryland Energy Baseline Study – Residential Sector. KEMA. June 2011.
6 This forecast was developed by GDS in the summer of 2012 based upon current electric energy use in Maryland and EIA's 2011 long term electric sales forecast for the South Atlantic region.

3.2.2 Average Annual Electric Use per Residential Customer

The electric end uses in the residential sector that present the greatest opportunity for replacing with natural gas are space heating, water heating and clothes drying. Table 3-3 shows data on the estimated average annual electric use per residential customer in Maryland for each of the above end uses. These estimated averages are statewide numbers for customers using electricity for the specified end use. The averages are based on REM/Rate[7] modeling and data from the EPA which were used to estimate the savings for measures included in this study. The averages were cross-checked against known electric equipment saturations and with retail sales of electricity data provided by the U.S. Energy Information Administration (EIA) to ensure reasonableness and confidence in the modeling results.

Table 3-3: Estimated Average Annual Electricity Use per Residential Customer by End Use in Maryland

Estimated Average Annual Electricity Use per Residential Customer by End Use in Maryland		
End Use	**Average Annual Use per Customer (kWh)**	**Data Source**
Space Heating (Includes Air Source Heat Pumps & Electric Furnaces)	7,922	GDS modeling and calculations; EIA
Water Heating	3,493	GDS modeling and calculations; EIA
Clothes Dryer	900	EPA

3.2.3 Residential Customer Saturation Estimates by End Use

Tables 3-4 through 3-6 list the latest available information on the saturation (percent of housing units) of electric end uses for Maryland that were considered as fuel switching opportunities in this study. The saturation data for residential end uses was obtained by GDS through a detailed analysis of the KEMA's Residential Baseline Study report.

Table 3-4: Saturation of Electric Space Heating, Water Heating and Clothes Dryers

	Maryland Baseline Study, 2011
End Use	**All Housing Units**
Space Heating	33.81%
Water Heating	46.80%
Clothes Dryer	72.29%

Based on the Maryland Energy Baseline Study, Table 3-5 shows that more than one third of residential housing units use electricity for space heating. Additionally, electricity is used for water heating in over 46 percent of Maryland residential housing units.

[7] REM/Rate™ software (a product of Architectural Energy Corporation) calculates heating, cooling, hot water, lighting, and appliance energy loads, consumption and costs for new and existing single and multi-family homes. Climate data is available for cities and towns throughout North America.

Table 3-5: Residential Saturation of Space Heating Equipment by Type of Housing Unit[8]

Residential Saturation of Electric Space Heating and Water Heating Equipment						
Primary Electric Heating (Equipment Type)	**Single Family Detached**	**Single Family Attached**	**Mobile Homes**	**Multi-family 2-4**	**Multi- family 5+**	**Weighted Average**
Electric (Resistance Heat)	12.05%	25.41%	26.34%	32.16%	48.03%	23.56%
Electric (Heat Pump)	12.01%	17.49%	5.15%	3.03%	17.86%	13.90%
Primary Water Heating (Equipment Type)	**Single Family Detached**	**Single Family Attached**	**Mobile Homes**	**Multi-family 2-4**	**Multi- family 5+**	**Weighted Average**
Electric Tank	38.07%	33.59%	88.49%	40.06%	46.39%	39.85%
Tankless	0.61%	0.99%	0.00%	5.15%	3.35%	1.45%

Table 3-6 shows historical and forecast data on the number of residential housing units in Maryland that use electricity for space heating, water heating and clothes drying.

Table 3-6: Residential Housing Units That Use Electric Space Heating, Water Heating and Clothes Drying

Residential Electric Customers by End Use			
Year	**Space Heating**	**Water Heating**	**Clothes Dryer**
2011	816,044	899,696	1,574,796
2012	824,297	908,795	1,590,722
2013	832,550	917,894	1,606,648
2014	840,803	926,993	1,622,574
2015	849,055	936,092	1,638,500
2016	857,308	945,190	1,654,426
2017	865,561	954,289	1,670,352
2018	873,814	963,388	1,686,279
2019	882,066	972,487	1,702,205
2020	890,319	981,585	1,718,131
2021	898,572	990,684	1,734,057
2022	906,825	999,783	1,749,983

3.3 Commercial Electricity Sales

Figure 3-2 provides a breakdown of Maryland commercial sector electric sales for heating and water heating end uses by building type. Unlike the residential sector, estimates of commercial natural gas fuel switching potential are based on a breakdown of commercial sales by end uses that can potentially be switched to natural gas.

[8] The source of this data is the 2011 Maryland Energy Baseline Study prepared for the Maryland Public Service Commission by KEMA.

Figure 3-2: Commercial Electric Heating and Water Heating Sales by Building Type, 2011

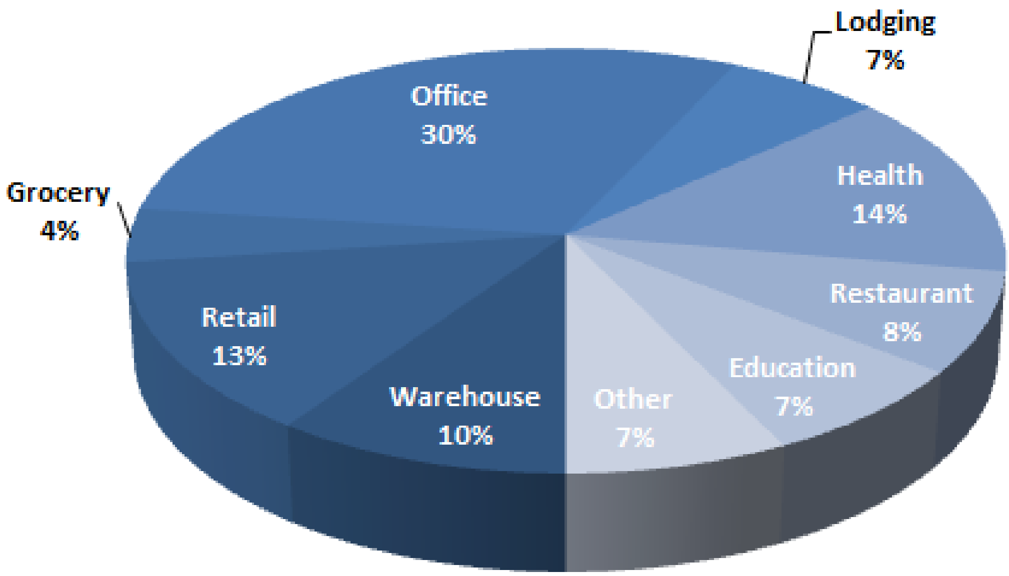
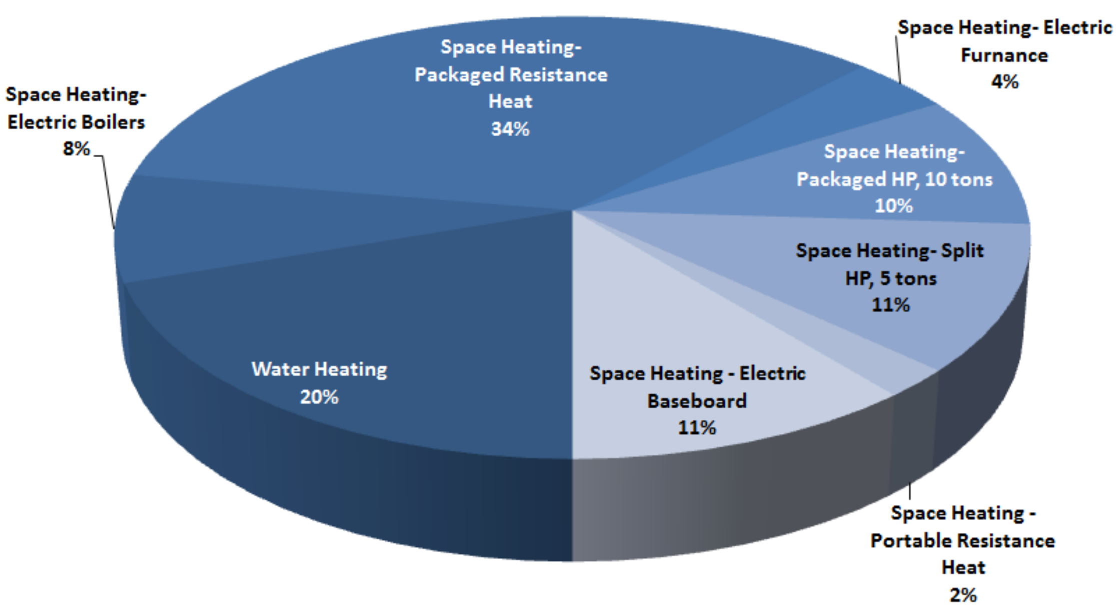


Figure 3-3 provides a breakdown of total commercial sector electric space and water heating use by equipment type. Space heating represents 80% of total electric space and water heating use with packaged space heating being the largest user at 34%, followed by heat pumps at 22% and water heating at 20%.

Figure 3-3: Commercial Electric Space and Water Heating Use by Equipment Type



4.0 OVERALL PROJECT METHODOLOGY

This section describes the overall methodology used to develop estimates of natural gas fuel switching potential and explains the general steps and methods used at each stage of the analytical process. Specific differences in methodology from one sector to another have been noted throughout the report.

Fuel switching studies involve carrying out a number of analytical steps to produce estimates of fuel switching potential. This study utilizes the GDS Benefit/Cost Screening Tool, and other GDS developed Excel-based models that integrate technology-specific impacts and costs, customer characteristics, residential and commercial electric sales forecasts for Maryland, electric and natural gas avoided cost forecasts and more. Excel was used as the modeling platform to provide transparency to the estimation process and to allow for simple customization based on Maryland's unique characteristics and the availability of Maryland specific model input data.

4.1 Measure List Development

Natural gas fuel switching measure lists were based on the GDS team's knowledge and current databases of natural gas end-use technologies and energy efficiency measures, and existing baseline electric end uses that are likely candidates for switching to natural gas. The study scope included natural gas equipment that is currently commercially available.

This study includes natural gas equipment that could be substituted for electric equipment on a replace-on-burnout basis. Replace-on-burnout applies to equipment replacements that are made normally in the market when a piece of equipment is at the end of its useful life. Replace-on-burnout measures are generally characterized by incremental measure costs and savings (*e.g.* the costs and savings of a high-efficiency natural gas water heater versus standard efficiency electric water heater). For new construction, natural gas fuel switching can be implemented when each new home or building is constructed, thus the rate of availability is a direct function of the rate of new construction.

4.2 Measure Characterization

A significant amount of data is needed to estimate the savings potential for individual natural gas fuel switching for the residential and commercial sectors. Therefore, considerable effort was expended to identify, review, and document all available data sources.[9] This review allowed development of reasonable assumptions regarding measure lives; incremental costs, electric savings and increased natural gas use for each measure included in this study.

Savings: Estimates of base electrical equipment use and replacement natural gas equipment use were developed from a variety of sources, including:

- Existing technical reference manuals (TRMs) including the Vermont TRM, Pennsylvania TRM
- Building energy modeling software and engineering analyses (REM/Rate)

[9] The appendices to this report provide the data sources used by the GDS Team to obtain up-to-date data on measure costs, savings and useful lives.

- Secondary sources such as the American Council for an Energy-Efficient Economy ("ACEEE"), Department of Energy ("DOE"), Energy Information Administration ("EIA"), Energy Star® and other technical potential studies
- Program evaluations conducted by other utilities and program administrators

Measure Costs: Measure costs represent the incremental cost of installing high efficiency natural gas equipment instead of standard efficiency electric equipment. For purposes of this study, nominal measures costs were held constant over time. Cost estimates were typically derived from the following sources:

- Existing technical reference manuals (TRMs) including the Vermont TRM, Pennsylvania TRM
- Mid-Atlantic Technical Reference Manual
- Secondary sources such as ACEEE, Energy Star®, the National Renewable Energy Laboratory, the Northeast Energy Efficiency Partnerships Incremental Cost Study and other technical potential studies
- RS Means Plumbing and HVAC Cost Data

Measure Life: Represents the number of years that energy-using equipment is expected to operate. Useful life estimates were derived from:

- Mid-Atlantic Technical Reference Manual
- GDS Measure Life Report, 2007

Baseline Equipment Saturations: In order to assess the amount of natural gas fuel switching potential, estimates of the current saturation of baseline electrical equipment are necessary. Up-to-date measure saturation data were primarily obtained from the following recent studies:

- Recently completed residential baseline study for Maryland[10]
- Recently completed commercial baseline study for Maryland[11]

4.3 Potential Savings Overview

Potential studies typically distinguish between three different types of efficiency potential: technical, economic and achievable. However, because there are often important definitional issues between studies, it is important to understand the definition and scope of each potential estimate as it applies to this analysis.

The first two types of potential, technical and economic, provide a theoretical upper bound for energy savings. Still, even the best designed portfolio of programs is unlikely to capture 100 percent of the technical or economic potential. Therefore, achievable potential attempts to estimate what may realistically be achieved, when it can be captured. Figure 4-1 illustrates the three most common types of efficiency potential.

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[10] Maryland Energy Baseline Study, Residential Sector, prepared for the Maryland Public Service Commission and its sponsors in support of the EmPower Maryland Programs, June 2011.

[11] Maryland Baseline Study –Commercial and Industrial Sectors prepared by Itron/Kema for the Maryland Public Service Commission and its sponsors in support of the EmPower Maryland Programs, December 2010.

Figure 4-1: Types of DSM Potential[12]

4.4 Technical Potential

For this fuel switching study, technical potential is defined as the theoretical maximum amount of electric energy use that could be displaced by switching from electric to natural gas equipment (for all identified fuel switching measures), disregarding non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the fuel switching measures. It is as a “snapshot” in time assuming immediate implementation of all technologically feasible natural gas fuel switching measures, with additional fuel switching opportunities assumed as they arise from new construction.[13]

This study used a “bottom-up” approach in the residential sector to calculate the natural gas fuel switching potential. A bottom-up approach first starts with the savings and costs associated with replacing one piece of equipment with its efficient or alternative fuel counterpart, and then multiplies these values by the number of measures available to be installed throughout the life of the program. The bottom-up approach is often preferred in the residential sector because of better data availability and greater homogeneity of the building and equipment stock to which measures are applied.

For the commercial sector, a “top-down” approach was used for developing the technical potential estimates. This approach builds an energy use profile based on estimates of sales by business segment and end use. Savings factors (in this case, 100% of electric energy use) for natural gas fuel switching measures are then applied to applicable end use electric energy estimates after assumptions are made regarding:

1. The fraction of sales that are associated with existing electrical equipment that is capable of being switched to natural gas;
2. The technical/engineering feasibility of each natural gas fuel switching measure, and;
3. The availability of natural gas.

[12] Reproduced from “Guide to Resource Planning with Energy Efficiency” November 2007. ES EPA. Figure 2-1.
[13] National Action Plan for Energy Efficiency, “Guide for Conducting Energy Efficiency Potential Studies”, page 2-4

4.4.1 Core Equation for the Residential Sector

The core equation used in the residential sector technical potential analysis for each individual efficiency measure is shown below in Figure 4-2.

Figure 4-2: Core Equation for the Residential Sector Technical Potential

Technical Potential for Fuel Switching Measure	=	Total Number of Households or Buildings	X	Base Case Electric Equipment End Use Intensity [kWh/unit]	X	Base Case Factor	X	Remaining Factor	X	Applicability Factor	X	Savings Factor

Where:

- Base Case Equipment End Use Intensity = the electricity used per customer per year by each base-case technology in each market segment. This is the consumption of the electric energy using equipment that the natural gas equipment replaces.
- Base Case Factor = the fraction of an end use applicable for a fuel switch technology in a given market segment. For example, for residential water heating, this would be the fraction of all residential customers with electric water heating in their households.
- Remaining Factor = the fraction of applicable dwelling units that have not yet been converted to the gas fuel switching measure (100% of applicable electric equipment for this study).
- Applicability Factor = the fraction of the applicable units that is technically feasible for conversion to natural gas from an engineering/technical perspective (e.g., it may not be possible to replace an electric water heater with natural gas water heater if piped natural gas is not readily available to the home).
- Savings Factor = the percentage reduction in electric use (100% for this study) resulting from replacement of electric equipment with natural gas equipment.

4.4.2 Core Equation for the Commercial Sector

The core equation used in the commercial technical potential analysis for each individual natural gas fuel switching measure is shown below in Figure 4-3.

Figure 4-3: Core Equation for Commercial Sector Technical Potential

Technical Potential for Fuel Switching Measure	=	Total End Use kWh Sales by Business Type	X	Base Case Factor	X	Remaining Factor	X	Applicability Factor	X	Savings Factor

Where:

- Total end use kWh sales by Business Type = the forecasted level of electricity sales for a given end-use (e.g., space heating) in a commercial market segment (e.g., office buildings).
- Base Case factor = the fraction of the end use electric energy that is applicable for the efficient technology in a given market segment. For example, for boiler heating, this would be the fraction of all space heating kWh in a given market segment that is associated with electric boilers.
- Remaining factor = the fraction of applicable kWh sales that are associated with equipment that has not yet been converted to the gas fuel switching measure (100% of applicable end use electricity sales for this study).
- Applicability factor = the fraction of the applicable electric energy that is technically feasible for conversion to natural gas from an engineering/technical perspective (e.g., it may not be possible to replace an electric water heater with natural gas water heater if piped natural gas is not readily available to the business).
- Savings factor = the percentage reduction in electricity consumption (100% for this study) resulting from application of the efficient technology.

4.5 Economic Potential

Economic potential refers to the subset of the technical potential that is cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential are theoretical numbers that assume immediate implementation of natural gas fuel switching measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them. All measures that were not found to be cost-effective based on the results of the Total Resource Cost Test were excluded from future analysis. The TRC Test is defined in greater detail later in this section.

4.6 Achievable Potential

Achievable potential is the amount of energy use that can realistically be expected to save assuming a specific market penetration. Achievable potential takes into account barriers that hinder consumer adoption of energy efficiency measures such as financial, political and regulatory barriers, the administrative and marketing costs associated with efficiency programs, and the capability of programs and administrators to ramp up activity over time. For this study, GDS calculated the achievable potential for the 2013 to 2022 time period for three market penetration scenarios: 40 percent, 60 percent and 80 percent. The incentive levels associated with these market penetration scenarios was assumed to be 45%, 72.5%, and 100% respectively. The 45% figure is based on an analysis of the BG&E gas conversion filing and the non-connection incentives, and is assumed to represent a low incentive level in this study. The 100% incentive level is used to represent the maximum achievable potential that could be captured as defined by the National Action Plan for Energy Efficiency.[14] The 72.5% figure is an average of the 45% and 100% incentive levels, and is assumed to represent a base case incentive level in this study.

Achievable potential can also vary with program parameters, such as the magnitude of rebates or incentives offered to customers for installing energy efficiency measures and thus, many different scenarios can be modeled. As achievable potential factors in the timing of equipment replacement and a ramped in target market penetration rate which grows over time, it is possible for the achievable potential to be dramatically lower than the economic potential, especially during the early years of the study.

For new construction, fuel switching measures can be implemented when each new home or building is constructed, thus the rate of availability is a direct function of the rate of new construction. For existing buildings, determining the annual rate of availability of savings is more complex. For this study, natural gas fuel switching potential in the existing stock of buildings is assumed to be captured over time as equipment replacements when a piece of electrical equipment is at the end of its effective useful life (referred to as replace on burnout),

For replace on burnout measures, existing electrical equipment is assumed to be replaced with high efficiency natural gas equipment at the time a consumer or business is shopping for a new appliance or other energy consuming equipment, or is in the process of building or remodeling. Using this approach, only electrical equipment that needs to be replaced in a given year is eligible to be switched to natural gas.

4.7 Natural Gas Availability

For this study, natural gas availability is defined as the percent of electric customers in Maryland that either currently possess a natural gas account yet maintain selected electric-consuming end-uses or are on a natural gas main but are not connected. The analysis assumes that 100% of customers with existing gas accounts that continue to use electric space heating, water heating, and/or clothes drying equipment can be converted. Further, based on a review of the BGE and Washington Gas fuel switching program filings provided by MEA, GDS estimates that an additional 6.5% of current electric customers in Maryland are on a natural gas main but not connected and can also be converted over the study timeframe. It is assumed that this percentage will remain unchanged over the 10 year study period.

4.8 Determining Cost-Effectiveness

For the economic and achievable potential it is necessary to develop a method by which it can be determined that a measure is cost-effective. For this study, GDS identified fuel switching measures as cost effective if they passed the TRC test (value of at least 1.0)

The Total Resource Cost (TRC) test measures the net costs of an energy efficiency program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.[15]

[14] National Action Plan for Energy Efficiency: Guide for Conducting Energy Efficiency Potential Studies, November 2007.

[15] California Public Utilities Commission, California Standard Practice Manual, Economic Analysis of Demand-Side Management Programs and Projects, October 2001, page 18.

Benefits and Costs: The TRC test represents the combination of the effects of a program on both the customers participating and those not participating in a program. In a sense, it is the summation of the benefit and cost terms in the Participant and the Ratepayer Impact Measure tests, where the revenue (bill) change and the incentive terms intuitively cancel (except for the differences in net and gross savings).

The benefits calculated in the Total Resource Cost Test include the avoided electric supply costs for the periods when there is an electric load reduction, as well as savings or increases of other resources such as natural gas, in the case of fuel switching. The avoided supply costs are calculated using net program savings, which are the savings net of changes in energy use that would have happened in the absence of the program.

The costs in this test are the program costs paid by the utility and the participants plus any increase in supply costs for periods in which load is increased. Thus all equipment costs, installation, operation and maintenance, cost of removal (less salvage value), and administration costs, no matter who pays for them, are included in this test. Any tax credits are considered a reduction to costs in this test.

4.9 Avoided Costs

GDS was able to obtain forecasts of electric avoided costs from Baltimore Gas and Electric (BGE), Potomac Edison (PE), Potomac Electric Power Company (PEPCO), Delmarva Power & Light (DPL) and Southern Maryland Electric Cooperative (SMECO). Avoided costs for each of these utilities were obtained from their 2012 - 2014 EmPOWER Maryland - Energy Efficiency and Conservation Plans. These avoided electric costs were then weighted by each utility's projected sales in Maryland as reported in Maryland Public Service Commission's 2012 Ten Year Plan of Electric Utilities in Maryland.

Natural gas avoided costs were the same as those used in the 2011 Natural Gas Energy Efficiency Potential Study conducted by GDS for MEA.

4.10 Free-Ridership versus Free-Drivers

Free riders are defined as participants in a DSM program who would have implemented the program measure or practice in the absence of the program or monetary incentive. Free drivers, on the other hand, are those who adopt a program measure or practice as an indirect result of the program, but are difficult to identify either because they do not collect an incentive or are not aware of their exposure to the program. The presence of free riders in a program tends to overstate program energy savings results (because free riders would have taken the action in the absence of the program) and complicates the evaluation of the effectiveness of DSM programs. Conversely, if one does not assess the impact of free drivers, this can result in understating a program's energy savings effectiveness. In determining whether a DSM program has had a direct impact on customer energy use, the focus should be on net savings- calculated by determining the share of free riders and free drivers and adjusting the associated savings accordingly.

Although the issue of free riders and free drivers is important, it is also one that is notoriously difficult to measure, and even more difficult to predict. Based on a review of the experiences and practices of energy efficiency program administrators and evaluators at NYSERDA, National Grid, Wisconsin Focus on Energy, the Minnesota Public Service Commission and other organizations, this analysis has adopted the approach that free riders and free drivers offset each other. The result is an assumed net to gross ratio of 1.0 for measures or programs considered in this analysis, where the energy savings that are eventually measured and verified will align exactly with the savings claimed. GDS has reviewed the result of free rider and free driver studies at such organizations and recommends this approach until programs can be fully implemented and follow-up net-to-gross research studies can be conducted to assess these issues.

5.0 RESIDENTIAL SECTOR FUEL SWITCHING POTENTIAL

5.1 Introduction and Summary of Results

This section of the report presents the estimates of technical, economic, and achievable natural gas fuel switching potential for the existing and new construction market segments of the residential sector in the State of Maryland. The base case achievable potential estimates are based on a market penetration scenario that targets the installation of energy efficient natural gas fueled equipment in 60% of the remaining eligible market by 2020. This scenario reflects the market driven implementation of fuel switching measures that were modeled as non-retrofit (replace on burn-out) measures. In other words, it was assumed that residential customers would replace existing electric equipment with efficient natural gas measures at the end of the electric equipment's effective useful life.

According to this analysis, the potential for electricity savings resulting from fuel switching in the residential sector are small relative to total electric sales in Maryland. This is due primarily to the small percentage of homes currently using electricity for water heating and space heating that were assumed to have access to gas over the course of the next 10 years. As noted on in Section 4.7, it was assumed that 6.5% current electric customers not currently connected to natural gas are located on a natural gas main but not connected and that that this percentage will remain unchanged over the 10 year study period. All customers presently connected to a natural gas line but continuing to utilize electric equipment were also eligible for fuel-switching applications.

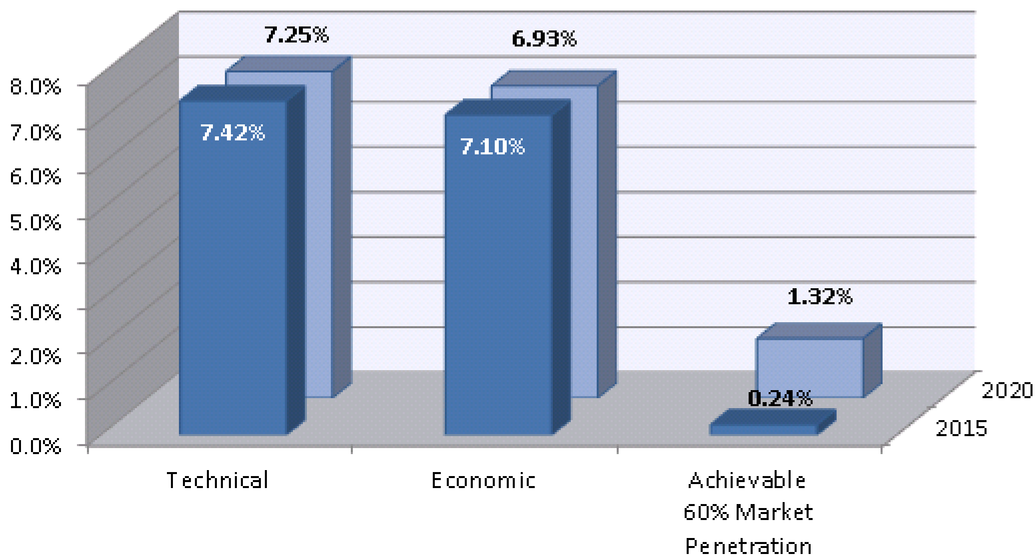
Figure 5-1 and Table 5-1, below summarize the technical, economic (based on the Total Resource Cost "TRC" test), and achievable savings potential by 2015 and 2020. If the targeted market penetration for all remaining eligible cost-effective measures can be reached over the next decade, the achievable potential for residential electricity savings by the year 2020 is 373,597 MWh, or approximately 1.32% of projected residential electricity sales.

Market penetration scenarios targeting 40% and 80% are also included later in this section to demonstrate the impacts of lowered or increased natural gas fuel switching measure adoption.

Table 5-1: Summary of Residential Natural Gas Fuel Switching Savings Potential by 2015 and 2020

Summary of Residential Natural Gas Fuel Switching Potential			
	Technical	Economic	Achievable 60% Market Penetration
2015			
Total MWh Savings	1,959,400	1,875,690	62,236
% of 2015 Forecast Residential Sales	7.42%	7.10%	0.24%
Total Peak Demand Savings (MW)	378.7	378.7	13.6
2020			
Total MWh Savings	2,047,566	1,956,993	373,597
% of 2020 Forecast Residential Sales	7.25%	6.93%	1.32%
Total Peak Demand Savings (MW)	397.1	397.1	81.5

Figure 5-1: Summary of Residential Fuel Switching Savings Potential by 2015 and 2020



5.2 Residential Fuel Switching Measures

Six unique residential natural gas fuel switching measures were included in the energy savings analysis for the residential sector.[16] Table 5-2 provides a brief listing of the various residential natural gas fuel switching technologies considered in this analysis. The list of residential fuel switching measures was developed by GDS based on typical fuel-switching opportunities in the residential sector. The set of fuel switching measures considered was pre-screened to only include those measures that are currently commercially available. Thus, emerging technologies, or technologies with extremely low market availability were not included in the analysis. Appendix A-1 provides a brief discussion of each measure or program as well as the savings, useful life, cost, and equipment saturations associated with each measure.

The portfolio of measures includes only those that have some level of technical feasibility for implementation by being applied to existing technologies on a market driven basis. Market driven refers to equipment replacements that are made normally in the market when a piece of equipment is at the end of its effective useful life.

Table 5-2: List of Residential Fuel Switching Measures

List of Residential Fuel Switching Measures		
End Use Type	**End Use Description**	**Measures/Programs Included**
Water Heating	Water Heating/Kitchen/Laundry	* Efficient storage tank water heaters (0.67 EF, 0.80 EF) * Tankless water heaters (0.82 EF)

[16] After accounting for adjustments to different home types, housing characteristics and efficiency tiers, particularly for measures targeting the space heating and water heating end-use, the number of measures grew to 114 measure permutations.

List of Residential Fuel Switching Measures		
End Use Type	**End Use Description**	**Measures/Programs Included**
HVAC (Equipment)	Heating Equipment/Controls	* Efficient gas furnace (90 AFUE, 92 AFUE, 94 AFUE) * Efficient furnace fan motor * Efficient dual fuel heat pump (90 AFUE)
Gas Dryers	Laundry	* Gas Dryers

5.3 Characteristics of Residential Fuel Switching Measures

GDS collected data on the energy savings, incremental costs, useful lives, and other key "per unit" characteristics for each of the residential natural gas fuel switching technologies. Estimates of the size of the eligible market were also developed for each efficiency measure. For example, natural gas water heating fuel switching measures (e.g. efficient storage tank water heaters, tankless gas water heaters) are only applicable to homes that currently have electric water heating. Due to differences in the saturation of appliances and equipment, such as electric water heating, for detached single-family homes, attached single-family homes and multi-family homes, GDS estimated the fuel switching potential for these housing types separately. To obtain up-to-date appliance and end-use saturation data, GDS made extensive use of the 2011 Maryland Energy Baseline Study as well as other available regional data, such as EIA's 2009 Residential Energy Consumption Survey (RECS).

The estimate of the percentage of homes that already have fuel switching measures installed is assumed to be 0%. This assumption is based on the fact that the study only includes homes using equipment fueled by electricity which have the opportunity to switch to equipment fueled by natural gas.

5.4 Residential Measure Cost Effectiveness

GDS screened individual residential natural gas fuel switching measures to determine their cost effectiveness in accordance with the Total Resource Cost test. Benefits and costs were calculated by incorporating the various measure assumptions (electricity energy and demand savings from switching to natural gas, added natural gas requirements, incremental costs, and useful life) into the GDS cost-effectiveness screening tool. Any programmatic costs (e.g., marketing, analysis, administration, gas connection costs) were ignored in the measure-level cost effectiveness analysis in order to determine whether fuel switching technologies were cost-effective on their own merit, prior to any assistance or marketing endeavors from utilities or other organizations. Gas connection costs were factored into the overall portfolio level cost effectiveness calculations.

Table 5-3 below presents the cost effectiveness screening results for each residential measure by type of home (single-family/multi-family). Those measures that did not pass the TRC test (benefit/cost ratio of less than 1.0) were not included in the estimates of economic and achievable potential.

A total of 52 fuel switching measures were not cost-effective: 12 single-family detached measures, 13 single-family attached measures, and 27 multi-family measures. The measures that were not cost-effective are excluded from the calculation of economic and achievable potential savings.

Table 5-3: Residential Fuel Switching Measure Screening Results

Residential Natural Gas Measure Level TRC Screening Results				
Measure Name	**Existing vs. New Construction**	**TRC Ratio (Single-Family Detached)**	**TRC Ratio (Single-Family Attached)**	**TRC Ratio (Multi-Family)**
Water Heating End Use				
High Efficiency Gas Tank WH (0.67 EF)	EX	1.65	1.65	1.44
High Efficiency Gas Tank WH (0.80 EF)	EX	1.53	1.53	1.33
High Efficiency Tankless WH (0.82 EF)	EX	1.62	1.62	1.41
High Efficiency Tankless WH (0.82 EF)	EX	1.60	1.60	1.40
High Efficiency Gas Tank WH (0.67 EF)	NC	1.65	1.65	1.44
High Efficiency Gas Tank WH (0.80 EF)	NC	1.53	1.53	1.33
High Efficiency Tankless WH (0.82 EF)	NC	1.62	1.62	1.41
High Efficiency Tankless WH (0.82 EF)	NC	1.60	1.60	1.40
HVAC (Equipment)				
High Efficiency Furnace (90 AFUE) (w/ 13 SEER AC)	EX	3.54	2.01	0.82
High Efficiency Furnace (92 AFUE) (w/ 13 SEER AC)	EX	3.41	1.94	0.80
High Efficiency Furnace (94 AFUE) (w/ 13 SEER AC)	EX	3.29	1.87	0.78
High Efficiency Furnace w/ ECM (90 AFUE) (w/ 13 SEER AC)	EX	3.34	1.91	0.80
High Efficiency Furnace w/ ECM (92 AFUE) (w/ 13 SEER AC)	EX	3.22	1.85	0.77
High Efficiency Furnace w/ ECM (94 AFUE) (w/ 13 SEER AC)	EX	3.12	1.79	0.75
High Efficiency Furnace (90 AFUE) (w/ 13 SEER AC)	EX	0.28	0.19	0.21
High Efficiency Furnace (92 AFUE) (w/ 13 SEER AC)	EX	0.35	0.23	0.22
High Efficiency Furnace (94 AFUE) (w/ 13 SEER AC)	EX	0.41	0.26	0.23
High Efficiency Furnace w/ ECM (90 AFUE) (w/ 13 SEER AC)	EX	0.33	0.23	0.23
High Efficiency Furnace w/ ECM (92 AFUE) (w/ 13 SEER AC)	EX	0.39	0.27	0.23
High Efficiency Furnace w/ ECM (94 AFUE) (w/ 13 SEER AC)	EX	0.44	0.29	0.24
Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF) / High Efficiency Gas Furnace (90 AFUE)	EX	8.13	4.67	2.02
Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF) / High Efficiency Gas Furnace (90 AFUE)	EX	2.56	1.14	0.75
High Efficiency Furnace (90 AFUE) (w/ 13 SEER AC)	NC	3.55	1.38	0.40
High Efficiency Furnace (92 AFUE) (w/ 13 SEER AC)	NC	3.42	1.33	0.39
High Efficiency Furnace (94 AFUE) (w/ 13 SEER AC)	NC	3.30	1.28	0.37
High Efficiency Furnace w/ ECM (90 AFUE) (w/ 13 SEER AC)	NC	3.33	1.30	0.39
High Efficiency Furnace w/ ECM (92 AFUE) (w/ 13 SEER AC)	NC	3.21	1.26	0.38

Residential Natural Gas Measure Level TRC Screening Results				
Measure Name	**Existing vs. New Construction**	**TRC Ratio (Single-Family Detached)**	**TRC Ratio (Single-Family Attached)**	**TRC Ratio (Multi-Family)**
High Efficiency Furnace w/ ECM (94 AFUE) (w/ 13 SEER AC)	NC	3.11	1.22	0.36
High Efficiency Furnace (90 AFUE) (w/ 13 SEER AC)	NC	0.21	0.17	0.23
High Efficiency Furnace (92 AFUE) (w/ 13 SEER AC)	NC	0.29	0.20	0.22
High Efficiency Furnace (94 AFUE) (w/ 13 SEER AC)	NC	0.36	0.22	0.22
High Efficiency Furnace w/ ECM (90 AFUE) (w/ 13 SEER AC)	NC	0.25	0.19	0.23
High Efficiency Furnace w/ ECM (92 AFUE) (w/ 13 SEER AC)	NC	0.31	0.22	0.23
High Efficiency Furnace w/ ECM (94 AFUE) (w/ 13 SEER AC)	NC	0.37	0.23	0.22
Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF) / High Efficiency Gas Furnace (90 AFUE)	NC	8.14	3.20	0.98
Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF) / High Efficiency Gas Furnace (90 AFUE)	NC	2.31	0.85	0.59
Gas Dryers				
Gas clothes dryer	EX	4.20	4.20	4.20
Gas clothes dryer	NC	4.20	4.20	4.20

5.5 Residential Technical and Economic Savings Potential

In instances where there were two (or more) competing technologies for the same end use, such as high efficiency storage water heating and tankless water heating, GDS assigned a percent of the available population to each measure. In the event that one of the competing measures was not found to be cost-effective, the homes assigned to that measure were transitioned over to the cost-effective alternative (if any).

Technical potential represents the savings that could be captured if 100 percent of the baseline electrical equipment were replaced instantaneously (where they are deemed to be technically feasible). As shown in Table 5-4, total technical potential savings in the Maryland residential sector are 2,047,566 MWh, or 7.42% of forecast residential MWh sales in 2020. Peak demand savings are over 397 MW by 2020.

Table 5-4: Residential Fuel Switching Technical Potential Savings by End Use

Residential Fuel Switching Technical Potential Savings by End Use				
End Use	**2015 MWh**	**2020 MWh**	**2015 Peak MW**	**2020 Peak MW**
Water Heating	510,174	534,934	49	51
HVAC (Equipment)	802,265	834,225	0	0
Gas Dryer	646,961	678,407	330	346
Total	**1,959,400**	**2,047,566**	**379**	**397**
% of Annual Sales Forecast	*7.42%*	*7.25%*	-	-

As shown in Table 5-5, the residential economic fuel switching potential is 1,956,993 MWh in 2020. Peak demand savings are over 397 MW by 2020. The economic potential assumes 100% of all cost-effective measures eligible for installation are installed, but excludes measures previously included in the technical potential that did not pass the TRC benefit/cost screening test. As a result, the estimates for economic potential are lower than the technical potential estimates.

Table 5-5: Residential Fuel Switching Economic Potential Savings by End Use

Residential Fuel Switching Economic Potential Savings by End Use				
End Use	2015 MWh	2020 MWh	2015 Peak MW	2020 Peak MW
Water Heating	510,174	534,934	49	51
HVAC (Equipment)	718,555	743,652	0	0
Gas Dryer	646,961	678,407	330	346
Total	**1,875,690**	**1,956,993**	**379**	**397**[17]
% of Annual Sales Forecast	*7.10%*	*6.93%*	-	-

5.6 Base Case Achievable Potential Results (60% Market Penetration)

The achievable potential is a subset of the economic potential and is limited by various market and adoption barriers. Because this analysis has adopted a replace-on-burnout approach for replacing electrical equipment with high efficiency natural gas technologies, each year the eligible market is limited to those measures that are expected to reach the end of their useful life and be targeted for replacement. For example, if a measure has a 20 year useful life, only half of the existing units would be expected to burnout during the 10 year timeframe, and only 1/20 would be eligible for replacement annually.

In the residential base case scenario, the fuel switching achievable potential represents the attainable savings if the market penetration of the selected measures ramps up to replace 60% of the eligible market turning over each year by 2020. Again, the eligible market refers to homes currently equipped with electric space heating and/or electric water heating that currently have access to natural gas. Based on the high up-front costs associated with replacing standard electric equipment with high efficiency natural gas equipment (including proper venting of natural gas equipment), it was assumed that the targeted market penetration (60% of annual turnover in the base case achievable potential scenario) would not be fully realized until the eighth year of the analysis, and is ramping up during the 2013-2020 time period. Although this methodology simplifies what an adoption curve might look like in practice, it succeeds in providing a concise method for estimating achievable savings potential over a specific period of time.

Table 5-6 provides the achievable potential in the 60% market penetration base case scenario by measure type. As participation ramps up to 60% of the remaining eligible annual market turnover, the achievable potential for fuel switching savings in 2015 is estimated at 62,236 MWh 0.24% of residential electricity sales in 2015. As program participation continues, the

[17] The demand savings in the technical and economic potential scenarios are the same. This is because there is no demand savings associated with the measures that did not pass the economic screening for cost-effective measures.

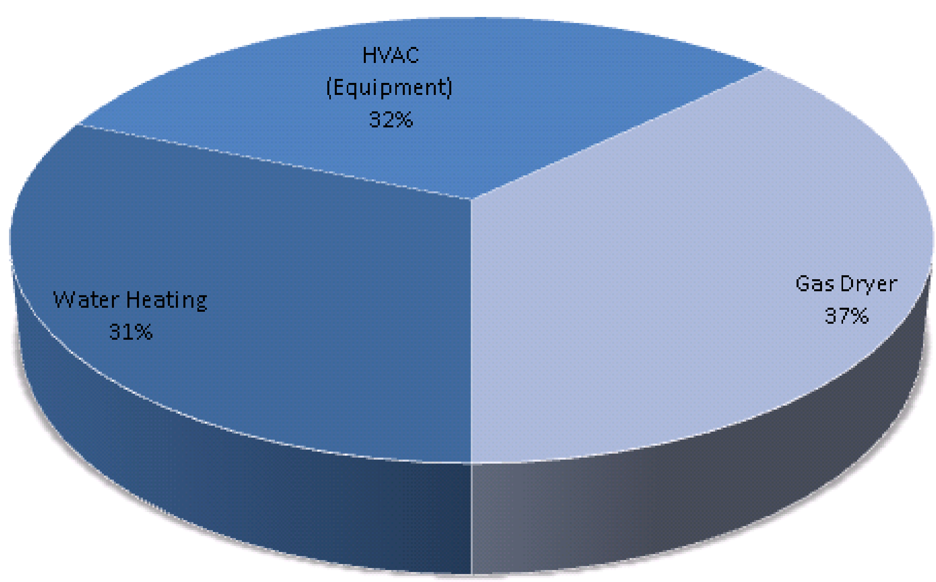
achievable potential savings increases to 373,597 MWh in 2020, or 1.32% of 2020 residential sales. Peak demand savings are nearly 82 MW by 2020.

Table 5-6: Residential Achievable Fuel Switching Savings Potential by Measure Type (60% Market Penetration)

Residential Fuel Switching Achievable Potential Savings by End Use (60% Market Penetration Scenario)				
End Use	2015 MWh	2020 MWh	2015 Peak MW	2020 Peak MW
Water Heating	19,379	116,263	2	11
HVAC (Equipment)	19,841	119,225	0	0
Gas Dryer	23,016	138,109	12	70
Total	**62,236**	**373,597**	**14**	**82**
% of Annual Sales Forecast	*0.24%*	*1.32%*	-	-

Figure 5-2 provides a detailed breakdown of the end-use savings as a percent of the total achievable potential for the 60% market penetration scenario. The opportunities for natural gas fuel switching are fairly evenly distributed across Gas Drying (37%), HVAC Equipment (32%), and Water Heating (31%) of the total achievable potential in 2020. Note that the gas drying end use has the greatest amount of potential relative to water heating and HVAC equipment primarily due to the large amount of customers who are currently connected to gas yet continue to use electric dryers compared to electric space heating and water heating equipment as well as the assumption that homes currently supplied with gas can adopt the fuel switching measures at a much greater rate than homes not currently supplied with natural gas.

Figure 5-2: Residential Sector End-Use Savings as a % of 2020 Base Case Achievable Potential



For the achievable potential, the 60% market penetration scenario assumes that consumers would receive a financial incentive equal to approximately 70% of the incremental cost of the natural gas fuel switching measure. In addition, an overall non-incentive or administrative cost was assigned to each measure in order to run the achievable cost-effectiveness tests. Non-incentive costs were estimated at approximately 30% of the incentive cost per participant. Non-incentive costs include marketing, education, program delivery, fulfillment, program tracking, reporting, and evaluation.

The overall benefit/cost screening results for the residential sector 60% market penetration scenario are shown below in Table 5-7. The net present value costs (in $2013) include $227.8 million dollars of utility costs (for incentive payments to participants as well as the associated costs for program marketing, labor, monitoring, as well as any assumed connection costs) and $26.4 million in net participant costs associated with the purchase and installation of efficient natural gas technologies (after incentives). The net present value benefits of $303.4 million dollars represent the lifetime benefits of all measures installed during the same time period.

Table 5-7: Overall Residential Sector Cost Effectiveness Screening Results ($ in Millions)

Residential Sector Cost Effectiveness Screening Results - 60% Market Penetration Scenario					
Benefit Cost Test	Present Value of Total Benefits ($2013)	Present Value of Utility Costs ($2013)	Present Value of Participant Costs ($2013)	Present Value of Total Costs ($2013)	Benefit/Cost Ratio
TRC Test	$303.4	$227.8	$26.4	$254.3	1.19

The base case achievable potential estimates would require an investment in fuel switching from the State of Maryland, its utilities and their consumers totaling $254.3 million for utility and participant costs combined. The resulting energy and demand savings would yield an estimated net present value savings (benefits minus costs) of $49.1 million dollars (in $2013).

5.7 Residential Market Penetration Scenarios

In addition to the 60% market penetration scenario results presented above, this report also includes a low and high case market penetration scenario. The low case scenario achieves approximately 40% market penetration by 2020; the high case achieves 80% market penetration by 2020. As noted earlier, the 60% market penetration assumed financial incentives equal to approximately 70% (72.5%) of the measure incremental cost. The high up-front cost of fuel switching technologies is an important adoption barrier and altering incentive levels is likely to have an impact on the achievable market potential. The low and high case scenarios illustrate the impacts of changing the incentive level.

Financial incentives equal to 100% and 45% of the measure incremental cost were used for the 80% and 40% market penetration scenarios, respectively. Similarly, administrative costs were assumed to represent 25% and 35% of the total utility budget (excluding connection costs) in the 80% and 40% market penetration scenarios.

Figure 5-3 graphically illustrates the low and high case achievable savings by year and compares it to the equivalent base case scenario savings. Table 5-8 shows that the achievable potential savings by 2020 range from a low of 0.88% in the 40% market penetration scenario to a high of 2.55% in the 80% market penetration scenario. The targeted market penetration is reached in the 4th year of the 80% market penetration scenario based on the assumption that 100% incentives will reduce market barriers to customer adoption of fuel switching applications. In the 60% and 40% market penetrations, the targeted annual market penetration is not achieved until 2020.

Figure 5-3: Achievable Potential Savings (MWh) Results for the Residential Sector in all Market Penetration Scenarios

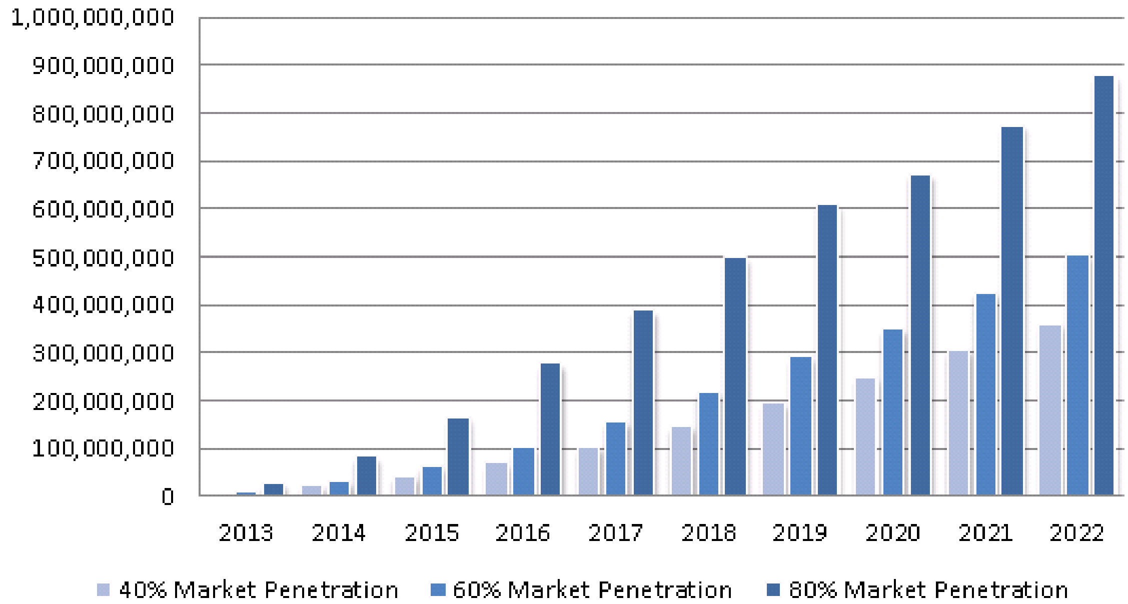


Table 5-8 also presents the total benefits and costs for the TRC Test in the 40%, 60%, and 80% market penetration scenarios. The net present value benefits (benefits minus costs) range from approximately $36.9 million in the 40% market penetration scenario to $77.0 million in the 80% market penetration scenario.

Table 5-8: Benefit/Cost Ratios for all Market Penetration Scenarios Using the TRC Test ($ in millions)

Benefit/Cost Ratios for all Market Penetration Scenarios Using the TRC Test							
Market Penetration Scenario	MWh Savings 2015	% of 2015 Forecast	MWh Savings 2020	% of 2020 Forecast	Present Value of Total Benefits ($2013)	Present Value of Total Costs ($2013)	Benefit / Cost Ratio
40% Penetration	41,749	0.16%	249,214	0.88%	$202.1	$165.2	1.22
60% Penetration	62,236	0.24%	373,597	1.32%	$303.4	$254.3	1.19
80% Penetration	165,873	0.63%	719,425	2.55%	$549.3	$472.3	1.16

Finally, annual MWh savings are detailed in Tables 5-9 through 5-11. Annual savings are presented at both incremental annual (savings based on new measures installed in that year) and cumulative annual (savings based on new measures installed in that year as well as any prior year measures installed still producing savings).

Table 5-9: Residential Incremental and Cumulative Annual Fuel Switching Achievable Savings (80% Market Penetration)

Incremental Annual MWh Savings - Achievable 80%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	8,615	17,246	25,847	34,431	34,431	34,431	34,431	34,431	34,431	34,431
HVAC Equipment	8,762	17,655	26,364	35,356	35,356	35,356	35,356	35,356	35,356	35,356
Gas Dryers	10,231	20,461	30,693	40,923	40,923	40,923	40,923	40,923	40,923	40,923
Total	**27,608**	**55,361**	**82,904**	**110,710**	**110,710**	**110,710**	**110,710**	**110,710**	**110,710**	**110,710**
% of Annual Forecast Sales	*0.11%*	*0.21%*	*0.31%*	*0.42%*	*0.41%*	*0.40%*	*0.40%*	*0.39%*	*0.39%*	*0.38%*
Cumulative Annual MWh Savings - Achievable 80%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	8,615	25,861	51,708	86,139	120,570	155,002	189,433	223,864	258,295	292,727
HVAC Equipment	8,762	26,416	52,781	88,137	123,493	158,849	194,206	229,562	264,918	300,274
Gas Dryers	10,231	30,692	61,385	102,308	143,231	184,154	225,077	266,000	306,923	347,846
Total	**27,608**	**82,969**	**165,873**	**276,584**	**387,294**	**498,004**	**608,715**	**719,425**	**830,136**	**940,846**
% of Annual Forecast Sales	*0.11%*	*0.32%*	*0.63%*	*1.04%*	*1.43%*	*1.82%*	*2.18%*	*2.55%*	*2.90%*	*3.23%*

Table 5-10: Residential Incremental and Cumulative Annual Fuel Switching Achievable Savings (60% Market Penetration)

Incremental Annual MWh Savings - Achievable 60%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	3,240	6,442	9,697	12,914	16,159	19,366	22,597	25,847	25,847	25,847
HVAC Equipment	3,267	6,710	9,864	13,297	16,677	19,945	23,100	26,364	26,364	26,364
Gas Dryers	3,834	7,673	11,508	15,347	19,181	23,018	26,854	30,693	30,693	30,693
Total	**10,341**	**20,825**	**31,070**	**41,558**	**52,016**	**62,330**	**72,552**	**82,904**	**82,904**	**82,904**
% of Annual Forecast Sales	*0.04%*	*0.08%*	*0.12%*	*0.16%*	*0.19%*	*0.23%*	*0.26%*	*0.29%*	*0.29%*	*0.28%*
Cumulative Annual MWh Savings - Achievable 60%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	3,240	9,682	19,379	32,293	48,452	67,818	90,416	116,263	142,110	167,958
HVAC Equipment	3,267	9,977	19,841	33,139	49,815	69,761	92,861	119,225	145,589	171,953
Gas Dryers	3,834	11,507	23,016	38,363	57,543	80,562	107,416	138,109	168,801	199,494
Total	**10,341**	**31,166**	**62,236**	**103,795**	**155,811**	**218,141**	**290,693**	**373,597**	**456,501**	**539,405**
% of Annual Forecast Sales	*0.04%*	*0.12%*	*0.24%*	*0.39%*	*0.58%*	*0.80%*	*1.04%*	*1.32%*	*1.59%*	*1.85%*

Table 5-11: Residential Incremental and Cumulative Annual Fuel Switching Achievable Savings (40% Market Penetration)

Incremental Annual MWh Savings - Achievable 40%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	2,121	4,311	6,442	8,615	10,752	12,914	15,079	17,246	17,246	17,246
HVAC Equipment	2,296	4,523	6,710	8,762	10,995	13,297	15,423	17,655	17,655	17,655
Gas Dryers	2,557	5,116	7,673	10,231	12,787	15,347	17,902	20,461	20,461	20,461
Total	**6,974**	**13,949**	**20,825**	**27,608**	**34,535**	**41,558**	**48,403**	**55,361**	**55,361**	**55,361**
% of Annual Forecast Sales	*0.03%*	*0.05%*	*0.08%*	*0.10%*	*0.13%*	*0.15%*	*0.17%*	*0.20%*	*0.19%*	*0.19%*
Cumulative Annual MWh Savings - Achievable 40%										
End-Use	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Heating	2,121	6,432	12,875	21,490	32,242	45,156	60,235	77,480	94,726	111,972
HVAC Equipment	2,296	6,819	13,528	22,290	33,285	46,583	62,005	79,660	97,315	114,970
Gas Dryers	2,557	7,673	15,346	25,577	38,364	53,711	71,613	92,074	112,534	132,995
Total	**6,974**	**20,923**	**41,749**	**69,357**	**103,891**	**145,450**	**193,853**	**249,214**	**304,575**	**359,936**
% of Annual Forecast Sales	*0.03%*	*0.08%*	*0.16%*	*0.26%*	*0.38%*	*0.53%*	*0.69%*	*0.88%*	*1.06%*	*1.24%*

6.0 COMMERCIAL SECTOR ENERGY EFFICIENCY POTENTIAL

6.1 Introduction and Summary of Results

This section of the report provides the estimates of technical, economic and achievable potential for achievable natural gas fuel switching potential for the commercial sector in Maryland. The commercial sector as defined in this analysis is based on the natural gas sales data for the following business segments:

- Warehouse
- Retail
- Grocery
- Office
- Lodging
- Health
- Restaurant
- Education
- Other

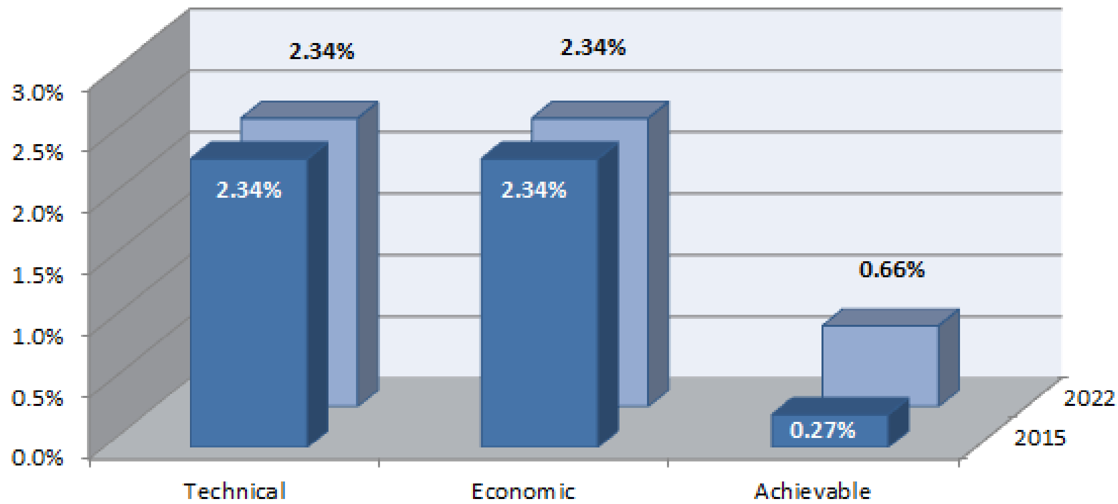
Commercial natural gas fuel switching potential estimates can be developed using either a top-down or a bottom-up approach, depending on data availability. A top-down approach was used was used for the commercial sector. This approach builds an energy use profile based on estimates of sales by business segment and end use. Savings factors for energy efficiency measures are then applied to applicable end use energy estimates after assumptions are made regarding the fraction of sales that are associated with inefficient equipment and the technical/engineering feasibility of each energy efficiency measure.

Table 6-1 and Figure 6-1, below, summarize the technical, economic (based on the TRC test), and the achievable savings potential, based upon a 60% market penetration, for 2015 and 2020. The fuel switching potential for the residential sector assumed that 60% market penetration would not be fully realized until the eighth year of the analysis due to high up-front costs associated with replacing standard electric equipment with high efficiency natural gas equipment. The ramp-up period for commercial fuel switching utilizes a straight-line curve, assuming that penetration is equally spread among the 10 year analysis period.

Table 6-1: Summary of Commercial Natural Gas Fuel Switching Savings Potential in 2015 and 2020

Summary of Commercial Natural Gas Fuel Switching Efficiency Potential			
	Technical	**Economic**	**Achievable 60% Market Penetration**
2015			
Total MWh Savings	714,380	714,380	81,120
% of 2015 Forecast Commercial Sales	2.34%	2.34%	0.27%
2020			
Total MWh Savings	769,853	769,853	216,321
% of 2020 Forecast Commercial Sales	2.34%	2.34%	0.66%

Figure 6-1: Summary of Commercial Fuel Switching Savings Potential in 2015 and 2020



As can be seen above, all of the commercial technical potential is economically feasible. . The amount of this economic potential that can be achieved by 2020 is approximately 2.4% of 2020 commercial sales assuming a market penetration rate of 60% over the next ten years.

6.2 Commercial Energy Efficiency Measures

The list of commercial energy efficiency measures was developed by GDS based on a review of measures included in other studies conducted by GDS and research of the latest gas technologies and efficiency standards. Only measures that are commercially available were considered.

A total of 13 commercial natural gas energy efficiency measures were included in the fuel switching efficiency potential analysis. These measures, which impact space and water heating end uses, are summarized below in Table 6-2.

Table 6-2: List of Commercial Fuel Switching Efficiency Measures

List of Commercial Energy Efficiency Measures		
End Use Type	**End Use Description**	**Measures Included**
Space Heating	High Efficiency Gas Boilers	Hot Water Boilers and Condensing Hot Water Boilers
	High Efficiency Gas Furnace	High Efficiency Gas Furnace, Gas Fired Rooftop Units
Water Heating	High Efficiency Water Heaters	High Efficiency Stand Alone, Indirect and On-Demand Tankless Water Heaters

6.3 Characteristics of Commercial Energy Efficiency Measures

GDS collected data and developed estimates of measure savings, cost and effective useful life for each of the commercial natural gas energy fuel switching efficiency measures. Savings factors for each measure, which represent the percent savings in annual electric energy use (in this case 100%) resulting from implementation of the natural gas fuel switching measure, were then applied to the applicable end-use energy. So, for example, water heating measure savings factors were applied to the estimated electric water heating end-use energy that is associated with equipment that has not yet been converted to natural gas and is technically feasible for conversion.

Table 6-3 in the next section shows the measure cost and effective useful life for each commercial fuel switching measure. All measures costs are defined as incremental costs, the cost difference between the standard efficiency electric measure and the replacement natural gas measure. Replace on burn-out measures are generally characterized by incremental measure costs and savings (e.g., the incremental costs and savings of a high-efficiency gas boiler versus a standard efficiency electric boiler).

6.4 Commercial Measure Cost Effectiveness

GDS screened individual commercial sector natural gas fuel switching energy efficiency measures to determine their cost effectiveness in accordance with the TRC test. Table 6-3 below shows the screening results for each measure. All measures pass the TRC test (benefit/cost ratio of less than 1.0) and are included in the estimate of economic and achievable economic potential. Benefits and costs were calculated by incorporating the various measure assumptions (electricity energy and demand savings from switching to natural gas, added natural gas requirements, incremental costs, and useful life) into the GDS cost-effectiveness screening tool. Any programmatic costs (e.g., marketing, analysis, administration, gas connection costs) were ignored in the measure-level cost effectiveness analysis in order to determine whether fuel switching technologies were cost-effective on their own merit, prior to any assistance or marketing endeavors from utilities or other organizations. Gas connection costs were factored into the overall portfolio level cost effectiveness calculations.

Table 6-3: Measure Characteristics and Cost-Effectiveness Screening Results

Commercial Natural Gas Measure Level TRC Screening Results					
Measure Name	**Savings Factor**	**Measure Cost**	**Cost Type: 1=Full 2=Incr.**	**Useful Life**	**TRC B/C Ratio**
Water Heating End Use					
On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)	100%	$1,954	2	20	3.43
On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)	100%	$2,129	2	20	4.01
On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	100%	$5,506	2	20	5.53
High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)	100%	$1,090	2	13	3.46

Commercial Natural Gas Measure Level TRC Screening Results					
Measure Name	**Savings Factor**	**Measure Cost**	**Cost Type: 1=Full 2=Incr.**	**Useful Life**	**TRC B/C Ratio**
Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	100%	$16,532	2	13	1.77
Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	100%	$8,434	2	15	2.96
Space Heating - Electric Boilers					
High Efficiency Hot Water Boiler (<=300,000 Btu/h)	100%	$13,497	2	20	3.71
Condensing Boiler (<=300,000 Btu/h)	100%	$15,406	2	18	3.33
Space Heating- Electric Furnace					
High Efficiency Furnace (<=300,000 Btu/h)	100%	$20,741	2	18	1.92
Space Heating- Packaged Resistance Heat					
Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	100%	$21,232	2	18	1.43
Space Heating- Packaged HP, 10 tons					
High Efficiency Furnace (<=300,000 Btu/h)	100%	$21,232	2	18	2.12
Space Heating- Split HP, 5 tons					
High Efficiency Furnace (<=300,000 Btu/h)	100%	$8,400	2	18	2.68
Space Heating - Electric Baseboard					
High Efficiency Furnace (<=300,000 Btu/h)	100%	$15,689	2	18	2.54

6.5 Commercial Technical and Economic Savings Potential

As can be seen in Table 6-4, technical potential for commercial natural gas energy fuel switching efficiency in Maryland is 2.34% of the projected 2015 and 2.34% of 2020 commercial electric sales.

Table 6-4: Commercial Fuel Switching Technical Potential by End Use

Commercial Natural Gas Fuel Switching Technical Potential Savings by End Use		
End Use	**2015 MWh**	**2020 MWh**
Space Heating	544,485	586,765
Water Heating	169,896	183,088
Total	**714,380**	**769,853**
% of Annual Sales Forecast	*2.34%*	*2.34%*

Table 6-5, shows a breakdown of commercial sector economic potential. Since all space and water heating measures reviewed in the study are cost effective, the economic and technical potential for these measures is the same.

Table 6-5: Commercial Fuel Switching Economic Potential by End Use

Commercial Natural Gas Fuel Switching Economic Potential Savings by End Use		
End Use	**2015 MWh**	**2020 MWh**
Space Heating	544,485	586,765
Water Heating	169,896	183,088
Total	**714,380**	**769,853**
% of Annual Sales Forecast	*2.34%*	*2.34%*

6.6 Base Case Achievable Potential Savings (Base Case – 60% Market Penetration)

The achievable natural gas fuel switching potential is a subset of the economic potential and is limited by various market and adoption barriers. Because this analysis has adopted a replace-on-burnout approach for replacing standard efficiency electric equipment with high efficiency natural gas technologies, each year the eligible market is limited to those measures that are expected to reach the end of their useful life and be targeted for replacement. For example, if a measure has a 20 year useful life, only half of the existing units would be expected to burnout during the 10 year timeframe, and only 1/20 would be eligible for replacement annually.

In the commercial base case scenario, the natural gas achievable potential represents the attainable savings if: (1) the market penetration of the selected replace on burnout measures represents 60% of the equipment available for replacement with energy efficiency equipment in each year, and (2) 10% of all available retrofit measures are installed each year. This this methodology simplifies what an adoption curve might look like in practice, which would be highly dependents of program features and benefits and a capital investment decision making processing the commercial sector that is dependent on many financial, political and corporate and bureaucratic factors.

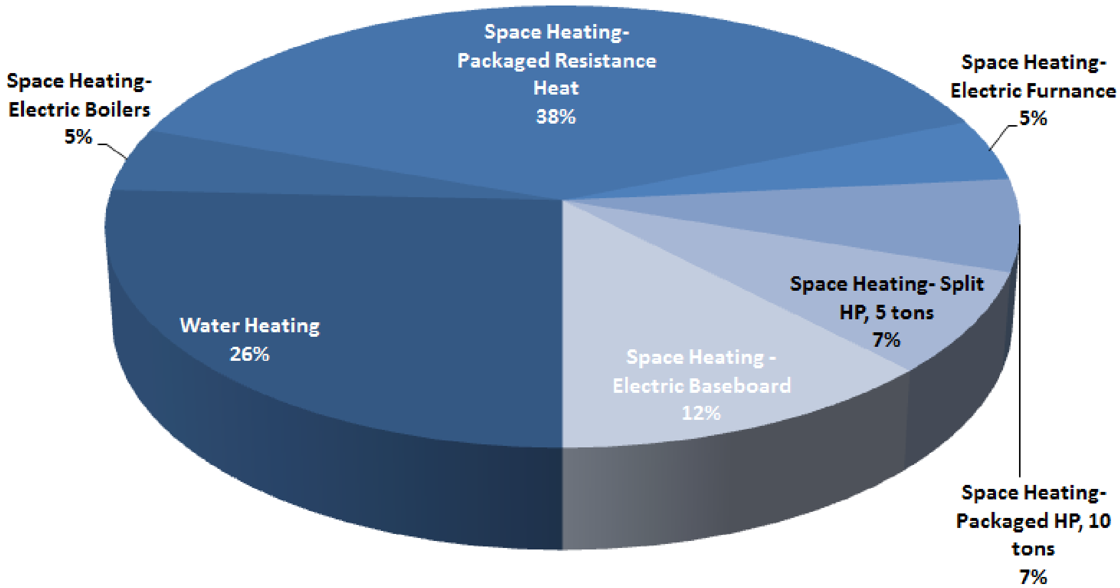
Table 6-6 provides the achievable potential in the 60% market penetration base case scenario by measure type. The achievable potential for natural gas fuel switching efficiency savings in 2015 is estimated at 81,293 MWh or 0.27% of commercial electric sales in 2015. The achievable potential savings is 216,780 MWh in 2020, or 0.66% of 2020 commercial sales.

Table 6-6: Commercial Achievable Fuel Switching Savings Potential by Measure Type(60% Market Penetration)

Commercial Natural Gas Achievable Fuel Switching Savings Potential (60% Market Penetration) by Measure Type (MWh)		
Measure Name	**Achievable Potential 2015**	**Achievable Potential 2020**
Water Heating End Use		
On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)	2,826	7,536
On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)	2,826	7,536
On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	2,826	7,536
High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)	4,348	11,594
Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	4,348	11,594
Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	3,768	10,048
Space Heating - Electric Boilers		
High Efficiency Hot Water Boiler (<=300,000 Btu/h)	1,790	4,773
Condensing Boiler (<=300,000 Btu/h)	1,989	5,303
Space Heating- Electric Furnace		
High Efficiency Furnace (<=300,000 Btu/h)	3,666	9,775
Space Heating- Packaged Resistance Heat		
Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	31,127	83,006
Space Heating- Packaged HP, 10 tons		
High Efficiency Furnace (<=300,000 Btu/h)	5,484	14,624
Space Heating- Split HP, 5 tons		
High Efficiency Furnace (<=300,000 Btu/h)	6,104	16,276
Space Heating - Electric Baseboard		
High Efficiency Furnace (<=300,000 Btu/h)	10,020	26,720
Total	**81,120**	**216,321**
% of Annual Sales Forecast	*0.27%*	*0.66%*
Note: Measures in the above Table with "0" achievable potential are ones that did not pass the TRC Test		

Figure 6-2 provides a detailed breakdown of the end-use savings as a percent of the total achievable potential for the 60% market penetration scenario. The opportunities for natural gas fuel switching in the commercial sector are predominantly found in converting packaged resistance heat, electric water heating, and electric baseboard heating. Other fuel switching applications include electric heat pumps, furnaces, and boilers.

Figure 6-2: Commercial Sector End-Use Savings as a % of 2020 Base Case Achievable Potential



For the achievable potential, the 60% market penetration scenario assumes that consumers would receive a financial incentive equal to approximately 70% of the incremental cost of the natural gas efficiency measure. In addition, an overall non-incentive or administrative cost was assigned to each measure in order to run the achievable cost-effectiveness tests. Non-incentive costs were estimated at approximately 30% of the incentive cost per participant. Non-incentive costs include marketing, education, program delivery, fulfillment, program tracking, reporting, and evaluation.

The overall benefit/cost screening results for the commercial sector 60% market penetration scenario are shown below in Table 5-7. The net present value costs (in $2013) include $62.7 million dollars of utility costs (for incentive payments to participants as well as the associated costs for program marketing, labor, monitoring, as well as any assumed connection costs) and $14.4 million in net participant costs associated with the purchase and installation of efficient natural gas technologies (after incentives). The net present value benefits of $108.5 million dollars represent the lifetime benefits of all measures installed during the same time period.
For the base case market penetration scenario, the TRC benefit/cost ratio for the commercial sector program portfolio is 1.41.

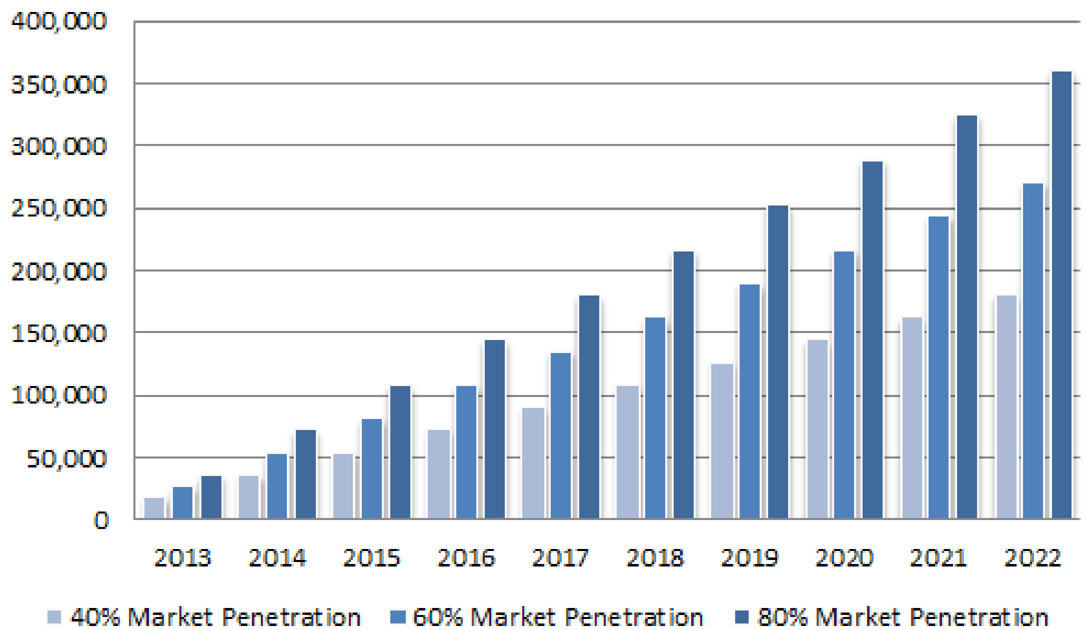
Table 6-7: Overall Commercial Sector Cost Effectiveness Screening Results ($ in Millions)

Commercial Sector Cost Effectiveness Screening Results - 60% Market Penetration Scenario					
Benefit Cost Test	Present Value of Total Benefits ($2013)	Present Value of Utility Costs ($2013)	Present Value of Participant Costs ($2013)	Present Value of Total Costs ($2013)	Benefit/Cost Ratio
TRC Test	$107.9	$62.7	$14.3	$76.7	1.41

6.7 Commercial Achievable Market Penetration Scenario Results

Estimates of achievable potential were developed based on an assumption that the maximum penetration rates for energy efficiency measures over the 10 year study period range from 40% to 80%. We have used the 60% market penetration case as the base case for determining achievable potential. The low case scenario achieves approximately 40% market penetration by 2022; the high case achieves 80% market penetration by 2022. Figure 6-3 graphically illustrates the low and high case achievable savings by year and compares it to the base case scenario savings.

Figure 6-3: Achievable Potential Savings (MWh) Results for the Commercial Sector in all Market Penetration Scenarios



As noted earlier, the 60% market penetration assumed financial incentives equal to 72.5% of the measure incremental cost. The high up-front cost of energy efficient technologies is an important adoption barrier and altering incentive levels is likely to have an impact on the achievable market potential. The low and high case scenarios illustrate the impacts of changing the incentive level. Financial incentives equal to 100% and 45% of the measure incremental cost were assumed for the 80% and 40% market penetration scenarios, respectively.

Additionally, program administrative costs were also varied for each scenario to represent the assumption that more aggressive marketing, promotion and program staffing that would be necessary to achieve greater levels of customer participation. However this is not a linear relationship as some administrative costs are either fixed costs or do not vary proportionately with increased program participation. Therefore, administrative costs represent 30% of the total program budget for the 60% market penetration scenario, 25% of the total program budget for the high market penetration scenario and 35% of the total program budget for the low market penetration scenario. The decline in administrative costs as a percent of the total program budget as assumed market penetration increases reflects both economies of scale for program administration and increased incentives budgets that are necessary to achieve higher levels of customer participation.

Table 6-8 shows that the achievable potential MWh savings by 2020 range from a low of 0.44% in the 40% market penetration scenario to a high of .88% in the 80% market penetration scenario. Table 6-8 also presents the total benefits and costs for the TRC Test in the 40%, 60%, and 80% market penetration scenarios. The net present value benefits (benefits minus costs) range from approximately $23.3 million in the 40% market penetration scenario to $40.2 million in the 80% market penetration scenario.

Table 6-8: Benefit/Cost Ratios for all Market Penetration Scenarios Using the TRC Test ($ in millions)

Commercial Sector Cost Effectiveness Screening Results for Three Market Penetration Scenarios							
Market Penetration Scenario	MWh Savings 2015	% of 2015 Forecast	MWh Savings 2020	% of 2020 Forecast	Present Value of Total Benefits ($2013)	Present Value of Total Costs ($2013)	Benefit/ Cost Ratio
40% Penetration	54,080	0.18%	144,214	0.44%	$71.9	$48.8	1.48
60% Penetration	81,120	0.27%	216,321	0.66%	$107.9	$76.7	1.41
80% Penetration	108,160	0.35%	288,427	0.88%	$143.9	$103.9	1.39

Tables 6-9 to 6-11 provide detailed information on the projected annual MWh savings and required budgets for the three achievable potential scenarios based on 40%, 60% and 80 long-term market penetrations.

Table 6-9: Commercial Incremental and Cumulative Annual Fuel Switching Achievable Savings (80% Market Penetration)

Incremental Annual MWh Savings - Achievable 80%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	26,726	26,726	26,726	26,726	26,726	26,726	26,726	26,726	26,726	26,726
Water Heating	9,327	9,327	9,327	9,327	9,327	9,327	9,327	9,327	9,327	9,327
Total	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**	**36,053**
% of Annual Forecast Sales	*0.12%*	*0.12%*	*0.12%*	*0.12%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*	*0.11%*
Cumulative Annual MWh Savings - Achievable 80%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	26,726	53,453	80,179	106,905	133,632	160,358	187,085	213,811	240,537	267,264
Water Heating	9,327	18,654	27,981	37,308	46,635	55,962	65,289	74,616	83,944	93,271
Total	**36,053**	**72,107**	**108,160**	**144,214**	**180,267**	**216,321**	**252,374**	**288,427**	**324,481**	**360,534**
% of Annual Forecast Sales	*0.12%*	*0.24%*	*0.35%*	*0.47%*	*0.57%*	*0.68%*	*0.78%*	*0.88%*	*0.97%*	*1.07%*

Table 6-10: Commercial Incremental and Cumulative Annual Fuel Switching Achievable Savings (60% Market Penetration)

Incremental Annual MWh Savings - Achievable 60%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	20,060	20,060	20,060	20,060	20,060	20,060	20,060	20,060	20,060	20,060
Water Heating	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980
Total	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**	**27,040**
% of Annual Forecast Sales	*0.09%*	*0.09%*	*0.09%*	*0.09%*	*0.09%*	*0.08%*	*0.08%*	*0.08%*	*0.08%*	*0.08%*
Cumulative Annual MWh Savings - Achievable 60%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	20,060	40,119	60,179	80,239	100,299	120,358	140,418	160,478	180,537	200,597
Water Heating	6,980	13,961	20,941	27,921	34,902	41,882	48,863	55,843	62,823	69,804
Total	**27,040**	**54,080**	**81,120**	**108,160**	**135,200**	**162,240**	**189,281**	**216,321**	**243,361**	**270,401**
% of Annual Forecast Sales	*0.09%*	*0.18%*	*0.27%*	*0.35%*	*0.43%*	*0.51%*	*0.58%*	*0.66%*	*0.73%*	*0.80%*

Table 6-11: Commercial Incremental and Cumulative Annual Fuel Switching Achievable Savings (40% Market Penetration)

Incremental Annual MWh Savings - Achievable 40%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	13,373	13,373	13,373	13,373	13,373	13,373	13,373	13,373	13,373	13,373
Water Heating	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654
Total	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**	**18,027**
% of Annual Forecast Sales	*0.06%*	*0.06%*	*0.06%*	*0.06%*	*0.06%*	*0.06%*	*0.06%*	*0.05%*	*0.05%*	*0.05%*
Cumulative Annual MWh Savings - Achievable 40%										
End-Use	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Space Heating	13,373	26,746	40,119	53,493	66,866	80,239	93,612	106,985	120,358	133,731
Water Heating	4,654	9,307	13,961	18,614	23,268	27,921	32,575	37,229	41,882	46,536
Total	**18,027**	**36,053**	**54,080**	**72,107**	**90,134**	**108,160**	**126,187**	**144,214**	**162,240**	**180,267**
% of Annual Forecast Sales	*0.06%*	*0.12%*	*0.18%*	*0.23%*	*0.29%*	*0.34%*	*0.39%*	*0.44%*	*0.49%*	*0.53%*

7.0 PROS AND CONS OF ELECTRIC AND FOSSIL FUEL PROGRAM JOINT DELIVERY

As the State of MD considers the most cost effective approach to implementing enhance efficiency programs throughout the State, it is important to consider best practices and lessons learned from programs in other states. The question of whether gas and electric programs should be administered jointly is one issue that several states and utilities have attempted to address over the past several years, and one that the State of MD should take into account in the development of programs for 2014 and beyond.

Various types of combined electric/gas programs have emerged over the past several years and can be classified into three categories:

- Programs administered jointly through a single entity (state administered)
- Collaboration and integration of separately administered programs (utility programs)
- Isolated, separately administered programs

A recent study[18] found that in states where combined electric-gas programs operate, they serve to cut total program costs through joint marketing and administration, simplify efficiency programs for customers, and, in most cases, increase market penetration and customer participation.

Table 7-1: Single Entity vs. Joint Program Delivery

Single Entity	Collaboration of Separate Programs
Efficiency Vermont	Connecticut Utilities
New Jersey BPU	Massachusetts Utilities
Wisconsin Focus on Energy	-
Oregon Energy Trust	-

The consensus from the report is that programs administered by a single entity are ideal in terms of maximizing energy efficiency impacts. However, collaboration of separate programs can still be successful as long as funding and cost attribution issues are resolved.

Massachusetts and Connecticut are the two examples from the report that warrant a closer look. While some Massachusetts efficiency programs are administered by combined electric-gas utilities and Connecticut programs are jointly administered by separate electric and gas utilities, the two states are actually quite similar in the programs structures, and both states programs are extremely effective. In both states, the utilities have ceded some degree of ownership and control of program components, and have instead agreed to jointly select contracted vendors to deliver programs. Connecticut utilities have already contracted with one another and have come to agreements on respective portions of gas and electric costs and attributions[19]. Once those issues are resolved, the vendors take over and run the programs as if one entity is managing it.

[18] Summary Report of Recently Completed Potential Studies and Recommendations for Maine's Energy Efficiency Programs, January 22, 2010. Prepared for Maine Public Utility Commission by Summit Blue Consulting, LLC and American Council for an Energy Efficient Economy.

[19] Cost attribution refers to the allocation of cost to multiple parties (e.g., electric and gas programs or utilities) in proportion to the electric and fuel savings that result from a given energy efficiency measure.

For additional information on ways that electric and combination utilities are considering direct use of natural gas as a means to achieve electric demand side management (DSM) goals, please see Appendix D: Additional Fuel Switching Program.

APPENDICES

APPENDIX A
Residential Sector Data

APPENDIX A-1

Residential Assumptions & Sources

MEA - Fuel Switching Study - Residential Measure Database

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	% kWh Savings	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)*	Measure/End Use Description	Base Saturation	EE Saturation
100	Water Heating													
101	High Efficiency Gas Tank WH (0.67 EF)	SFD	ROB	3418.1	100.0%	3418.1	0.31	0.31	15.67	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	38.07%	0.00%
102	High Efficiency Gas Tank WH (0.80 EF)	SFD	ROB	3418.1	100.0%	3418.1	0.31	0.31	13.12	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	38.07%	0.00%
103	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	3418.1	100.0%	3418.1	0.31	0.31	12.80	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	38.07%	0.00%
104	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	3107.4	100.0%	3107.4	0.29	0.29	12.80	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	0.72%	0.00%
105	High Efficiency Gas Tank WH (0.67 EF)	SFD	NC	3418.1	100.0%	3418.1	0.31	0.31	15.67	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	38.07%	0.00%
106	High Efficiency Gas Tank WH (0.80 EF)	SFD	NC	3418.1	100.0%	3418.1	0.31	0.31	13.12	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	38.07%	0.00%
107	High Efficiency Tankless WH (0.82 EF)	SFD	NC	3418.1	100.0%	3418.1	0.31	0.31	12.80	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	38.07%	0.00%
108	High Efficiency Tankless WH (0.82 EF)	SFD	NC	3107.4	100.0%	3107.4	0.29	0.29	12.80	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	0.72%	0.00%
109	High Efficiency Gas Tank WH (0.67 EF)	SFA	ROB	3418.1	100.0%	3418.1	0.31	0.31	15.67	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	38.00%	0.00%
110	High Efficiency Gas Tank WH (0.80 EF)	SFA	ROB	3418.1	100.0%	3418.1	0.31	0.31	13.12	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	38.00%	0.00%
111	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	3418.1	100.0%	3418.1	0.31	0.31	12.80	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	38.00%	0.00%
112	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	3107.4	100.0%	3107.4	0.29	0.29	12.80	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	0.91%	0.00%
113	High Efficiency Gas Tank WH (0.67 EF)	SFA	NC	3418.1	100.0%	3418.1	0.31	0.31	15.67	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	38.00%	0.00%
114	High Efficiency Gas Tank WH (0.80 EF)	SFA	NC	3418.1	100.0%	3418.1	0.31	0.31	13.12	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	38.00%	0.00%
115	High Efficiency Tankless WH (0.82 EF)	SFA	NC	3418.1	100.0%	3418.1	0.31	0.31	12.80	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	38.00%	0.00%
116	High Efficiency Tankless WH (0.82 EF)	SFA	NC	3107.4	100.0%	3107.4	0.29	0.29	12.80	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	0.91%	0.00%
117	High Efficiency Gas Tank WH (0.67 EF)	MF	ROB	2879.5	100.0%	2879.5	0.31	0.31	13.20	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	45.24%	0.00%
118	High Efficiency Gas Tank WH (0.80 EF)	MF	ROB	2879.5	100.0%	2879.5	0.31	0.31	11.05	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	45.24%	0.00%
119	High Efficiency Tankless WH (0.82 EF)	MF	ROB	2879.5	100.0%	2879.5	0.31	0.31	10.78	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	45.24%	0.00%
120	High Efficiency Tankless WH (0.82 EF)	MF	ROB	2617.7	100.0%	2617.7	0.29	0.29	10.78	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	3.68%	0.00%
121	High Efficiency Gas Tank WH (0.67 EF)	MF	NC	2879.5	100.0%	2879.5	0.31	0.31	13.20	13	$970.00	Installing a high efficiency gas tank water heater (0.67 EF) in homes with electric tank water heaters	45.24%	0.00%
122	High Efficiency Gas Tank WH (0.80 EF)	MF	NC	2879.5	100.0%	2879.5	0.31	0.31	11.05	13	$1,220.00	Installing a high efficiency gas tank water heater (0.80 EF) in homes with electric tank water heaters	45.24%	0.00%
123	High Efficiency Tankless WH (0.82 EF)	MF	NC	2879.5	100.0%	2879.5	0.31	0.31	10.78	13	$1,170.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with electric tank water heaters	45.24%	0.00%
124	High Efficiency Tankless WH (0.82 EF)	MF	NC	2617.7	100.0%	2617.7	0.29	0.29	10.78	13	$1,000.00	Installing a high efficiency tankless gas water heater (0.82 EF) in homes with tankless electric water heaters	3.68%	0.00%
200	HVAC Equipment													
201	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	87.2%	15749.2	12.28	0.00	61.64	18	$2,477.50	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	10.65%	0.00%
202	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	87.3%	15767.9	12.28	0.00	60.33	18	$2,631.34	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	10.65%	0.00%
203	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	87.4%	15786.7	12.28	0.00	59.02	18	$2,785.18	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	10.65%	0.00%
204	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	88.1%	15901.9	12.38	0.00	61.64	18	$2,677.50	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%
205	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	88.1%	15909.7	12.38	0.00	60.33	18	$2,831.34	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%
206	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	18057.8	88.1%	15917.6	12.38	0.00	59.02	18	$2,985.18	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%
207	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	77.6%	7997.9	12.41	0.00	61.64	18	$2,026.58	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	12.01%	0.00%
208	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	77.8%	8016.7	12.41	0.00	60.33	18	$2,180.42	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	12.01%	0.00%
209	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	78.0%	8035.4	12.41	0.00	59.02	18	$2,334.26	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	12.01%	0.00%
210	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	79.1%	8150.6	12.51	0.00	61.64	18	$2,226.58	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
211	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	79.2%	8158.5	12.51	0.00	60.33	18	$2,380.42	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
212	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	10306.6	79.2%	8166.3	12.51	0.00	59.02	18	$2,534.26	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
213	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	ROB	18057.8	75.3%	13594.9	5.92	0.00	29.53	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	10.65%	0.00%
214	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	ROB	10306.6	65.5%	6752.4	6.06	0.00	29.53	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	12.01%	0.00%
215	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	88.9%	15830.7	11.25	0.00	61.88	18	$2,477.50	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	10.65%	0.00%
216	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	89.1%	15849.6	11.25	0.00	60.53	18	$2,631.34	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	10.65%	0.00%
217	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	89.2%	15868.1	11.25	0.00	59.23	18	$2,785.18	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	10.65%	0.00%
218	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	89.6%	15941.9	11.35	0.00	61.88	18	$2,677.50	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%
219	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	89.6%	15950.0	11.35	0.00	60.53	18	$2,831.34	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%
220	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	17797.5	89.7%	15957.8	11.35	0.00	59.23	18	$2,985.18	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	10.65%	0.00%

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	% kWh Savings	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)*	Measure/End Use Description	Base Saturation	EE Saturation
221	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	80.1%	7939.8	11.25	0.00	61.88	18	$2,026.58	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	12.01%	0.00%
222	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	80.3%	7958.7	11.25	0.00	60.53	18	$2,180.42	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	12.01%	0.00%
223	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	80.5%	7977.2	11.25	0.00	59.23	18	$2,334.26	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	12.01%	0.00%
224	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	81.3%	8051.0	11.35	0.00	61.88	18	$2,226.58	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
225	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	81.4%	8059.1	11.35	0.00	60.53	18	$2,380.42	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
226	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	9906.6	81.4%	8066.9	11.35	0.00	59.23	18	$2,534.26	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	12.01%	0.00%
227	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	NC	17797.5	76.6%	13631.2	5.48	0.00	29.64	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	10.65%	0.00%
228	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	NC	9906.6	65.4%	6479.7	5.48	0.00	29.64	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	12.01%	0.00%
229	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	83.9%	8933.0	8.00	0.00	35.20	18	$2,477.50	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	21.60%	0.00%
230	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	84.0%	8947.0	8.00	0.00	34.40	18	$2,631.34	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	21.60%	0.00%
231	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	84.2%	8960.0	8.00	0.00	33.70	18	$2,785.18	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	21.60%	0.00%
232	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	85.1%	9061.5	8.00	0.00	35.20	18	$2,677.50	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
233	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	85.2%	9066.2	8.00	0.00	34.40	18	$2,831.34	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
234	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	10646.0	85.2%	9070.4	8.00	0.00	33.70	18	$2,985.18	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
235	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	72.8%	4587.0	8.00	0.00	35.20	18	$2,026.58	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	16.50%	0.00%
236	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	73.0%	4601.0	8.00	0.00	34.40	18	$2,180.42	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	16.50%	0.00%
237	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	73.2%	4614.0	8.00	0.00	33.70	18	$2,334.26	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	16.50%	0.00%
238	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	74.8%	4715.5	8.00	0.00	35.20	18	$2,226.58	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
239	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	74.9%	4720.2	8.00	0.00	34.40	18	$2,380.42	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
240	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	6300.0	75.0%	4724.4	8.00	0.00	33.70	18	$2,534.26	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
241	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	ROB	10646.0	72.1%	7678.0	3.70	0.00	16.00	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	21.60%	0.00%
242	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	ROB	6300.0	52.9%	3332.0	3.70	0.00	16.00	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	16.50%	0.00%
243	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	83.4%	6127.0	5.10	0.00	24.10	18	$2,477.50	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	21.60%	0.00%
244	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	83.6%	6136.0	5.10	0.00	23.50	18	$2,631.34	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	21.60%	0.00%
245	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	83.7%	6144.0	5.10	0.00	23.00	18	$2,785.18	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	21.60%	0.00%
246	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	84.4%	6199.9	5.10	0.00	24.10	18	$2,677.50	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
247	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	84.5%	6203.4	5.10	0.00	23.50	18	$2,831.34	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
248	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	7344.0	84.5%	6206.4	5.10	0.00	23.00	18	$2,985.18	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	21.60%	0.00%
249	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	72.7%	3241.0	5.10	0.00	24.10	18	$2,026.58	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	16.50%	0.00%
250	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	72.9%	3250.0	5.10	0.00	23.50	18	$2,180.42	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	16.50%	0.00%
251	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	73.1%	3258.0	5.10	0.00	23.00	18	$2,334.26	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	16.50%	0.00%
252	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	74.3%	3313.9	5.10	0.00	24.10	18	$2,226.58	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
253	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	74.4%	3317.4	5.10	0.00	23.50	18	$2,380.42	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
254	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	4458.0	74.5%	3320.4	5.10	0.00	23.00	18	$2,534.26	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	16.50%	0.00%
255	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	NC	7344.0	71.2%	5232.0	2.30	0.00	10.70	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	21.60%	0.00%
256	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	NC	4458.0	52.6%	2346.0	2.30	0.00	10.70	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	16.50%	0.00%
257	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	72.7%	3797.0	4.10	0.00	15.10	18	$2,585.46	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	38.49%	0.00%
258	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	72.9%	3806.0	4.10	0.00	14.70	18	$2,739.30	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	38.49%	0.00%
259	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	73.1%	3815.0	4.10	0.00	14.40	18	$2,893.14	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	38.49%	0.00%

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	% kWh Savings	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)*	Measure/End Use Description	Base Saturation	EE Saturation
260	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	74.3%	3879.7	4.10	0.00	15.10	18	$2,785.46	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
261	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	74.4%	3882.1	4.10	0.00	14.70	18	$2,939.30	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
262	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	5221.0	74.4%	3883.9	4.10	0.00	14.40	18	$3,093.14	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
263	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	61.1%	2237.0	4.10	0.00	15.10	18	$2,289.56	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	15.17%	0.00%
264	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	61.3%	2246.0	4.10	0.00	14.70	18	$2,443.40	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	15.17%	0.00%
265	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	61.6%	2255.0	4.10	0.00	14.40	18	$2,597.24	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	15.17%	0.00%
266	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	63.4%	2319.7	4.10	0.00	15.10	18	$2,489.56	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
267	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	63.4%	2322.1	4.10	0.00	14.70	18	$2,643.40	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
268	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3661.0	63.5%	2323.9	4.10	0.00	14.40	18	$2,797.24	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
269	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	ROB	5221.0	62.4%	3257.0	1.80	0.00	6.50	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	38.49%	0.00%
270	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	ROB	3661.0	46.4%	1697.0	1.80	0.00	6.50	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	15.17%	0.00%
271	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	65.2%	1824.0	2.20	0.00	7.30	18	$2,585.46	Installing a high efficiency gas furnace (90 AFUE) in homes with a central electric furnace	38.49%	0.00%
272	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	65.3%	1829.0	2.20	0.00	7.10	18	$2,739.30	Installing a high efficiency gas furnace (92 AFUE) in homes with a central electric furnace	38.49%	0.00%
273	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	65.5%	1834.0	2.20	0.00	7.00	18	$2,893.14	Installing a high efficiency gas furnace (94 AFUE) in homes with a central electric furnace	38.49%	0.00%
274	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	66.9%	1873.3	2.20	0.00	7.30	18	$2,785.46	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
275	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	67.0%	1874.5	2.20	0.00	7.10	18	$2,939.30	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
276	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2799.0	67.0%	1875.1	2.20	0.00	7.00	18	$3,093.14	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with a central electric furnace	38.49%	0.00%
277	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	58.0%	1348.0	2.20	0.00	7.30	18	$2,289.56	Installing a high efficiency gas furnace (90 AFUE) in homes with an air-source heat pump	15.17%	0.00%
278	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	58.2%	1353.0	2.20	0.00	7.10	18	$2,443.40	Installing a high efficiency gas furnace (92 AFUE) in homes with an air-source heat pump	15.17%	0.00%
279	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	58.5%	1358.0	2.20	0.00	7.00	18	$2,597.24	Installing a high efficiency gas furnace (94 AFUE) in homes with an air-source heat pump	15.17%	0.00%
280	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	60.2%	1397.3	2.20	0.00	7.30	18	$2,489.56	Installing a high efficiency gas furnace (90 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
281	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	60.2%	1398.5	2.20	0.00	7.10	18	$2,643.40	Installing a high efficiency gas furnace (92 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
282	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	2323.0	60.2%	1399.1	2.20	0.00	7.00	18	$2,797.24	Installing a high efficiency gas furnace (94 AFUE) with an efficient furnace fan motor in homes with an air-source heat pump	15.17%	0.00%
283	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	NC	2799.0	55.8%	1562.0	0.90	0.00	3.00	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with a central electric furnace	38.49%	0.00%
284	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	NC	2323.0	46.7%	1086.0	0.90	0.00	3.00	18	$1,300.00	Installing a high efficiency dual fuel heat pump (90 AFUE, 13 SEER/7.7 HSPF) in homes with an air-source heat pump	15.17%	0.00%
300	Gas Dryer													
301	Gas clothes dryer	SFD	ROB	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	81.43%	0.00%
302	Gas clothes dryer	SFD	NC	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	81.43%	0.00%
303	Gas clothes dryer	SFA	ROB	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	74.47%	0.00%
304	Gas clothes dryer	SFA	NC	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	74.47%	0.00%
305	Gas clothes dryer	MF	ROB	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	51.68%	0.00%
306	Gas clothes dryer	MF	NC	900.0	100.0%	900.0	4.80	4.80	3.00	14	$230.00	Installing a gas dryer in homes with an electric dryer	51.68%	0.00%

MEA - Fuel Switching Study - Residential Measure Database (Sources)

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)	Base Saturation	EE Saturation*	Notes
100													
101	High Efficiency Gas Tank WH (0.67 EF)	SFD	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
102	High Efficiency Gas Tank WH (0.80 EF)	SFD	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
103	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
104	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
105	High Efficiency Gas Tank WH (0.67 EF)	SFD	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
106	High Efficiency Gas Tank WH (0.80 EF)	SFD	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
107	High Efficiency Tankless WH (0.82 EF)	SFD	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
108	High Efficiency Tankless WH (0.82 EF)	SFD	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
109	High Efficiency Gas Tank WH (0.67 EF)	SFA	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
110	High Efficiency Gas Tank WH (0.80 EF)	SFA	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
111	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
112	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
113	High Efficiency Gas Tank WH (0.67 EF)	SFA	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
114	High Efficiency Gas Tank WH (0.80 EF)	SFA	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
115	High Efficiency Tankless WH (0.82 EF)	SFA	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
116	High Efficiency Tankless WH (0.82 EF)	SFA	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
117	High Efficiency Gas Tank WH (0.67 EF)	MF	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
118	High Efficiency Gas Tank WH (0.80 EF)	MF	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
119	High Efficiency Tankless WH (0.82 EF)	MF	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
120	High Efficiency Tankless WH (0.82 EF)	MF	ROB	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
121	High Efficiency Gas Tank WH (0.67 EF)	MF	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)	Base Saturation	EE Saturation*	Notes
122	High Efficiency Gas Tank WH (0.80 EF)	MF	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / ES RWH	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from NREL; EE cost from ES RWH; estimate includes $300 for venting
123	High Efficiency Tankless WH (0.82 EF)	MF	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Estimate includes $300 for venting
124	High Efficiency Tankless WH (0.82 EF)	MF	NC	GDS calc.	GDS calc.	PA TRM	PA TRM	GDS calc.	MID-ATL-TRM	NREL / GEP	KEMA	GDS estimate	Baseline kWh / Annual kWh: calculations based on standard water heating energy usage algorithms; parameter estimates are based on Maryland climate; Cost: Baseline cost from GEP; EE cost from NREL; estimate includes $300 for venting
200													
201	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
202	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
203	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
204	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
205	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
206	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
207	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
208	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
209	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
210	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
211	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
212	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
213	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
214	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFD	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
215	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
216	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
217	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
218	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
219	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
220	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
221	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
222	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
223	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
224	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
225	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
226	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
227	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
228	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFD	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
229	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
230	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
231	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
232	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
233	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
234	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
235	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
236	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
237	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
238	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
239	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
240	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
241	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
242	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFA	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
243	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
244	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
245	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
246	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
247	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
248	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
249	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
250	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
251	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
252	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
253	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
254	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 To	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
255	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
256	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency	SFA	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
257	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
258	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting

MEA - Fuel Switching Study - Residential Measure Database (Sources)

Measure	Measure Name (Gas Equipment)	Home Type	ROB vs. Retrofit vs. NC	Baseline Annual Electric kWh	Annual kWh Savings	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual Gas Consumption (MMBTu) added	Useful Life	Incremental Cost ($)	Base Saturation	EE Saturation*	Notes
259	High Efficiency Furnace (94 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
260	High Efficiency Furnace w/ ECM (90 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
261	High Efficiency Furnace w/ ECM (92 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
262	High Efficiency Furnace w/ ECM (94 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
263	High Efficiency Furnace (90 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
264	High Efficiency Furnace (92 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
265	High Efficiency Furnace (94 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
266	High Efficiency Furnace w/ ECM (90 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
267	High Efficiency Furnace w/ ECM (92 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
268	High Efficiency Furnace w/ ECM (94 AFUE, 60K)(w/ 13 SEER 2 To	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
269	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
270	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency	MF	ROB	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
271	High Efficiency Furnace (90 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
272	High Efficiency Furnace (92 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
273	High Efficiency Furnace (94 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
274	High Efficiency Furnace w/ ECM (90 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
275	High Efficiency Furnace w/ ECM (92 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
276	High Efficiency Furnace w/ ECM (94 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
277	High Efficiency Furnace (90 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
278	High Efficiency Furnace (92 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
279	High Efficiency Furnace (94 AFUE, 60K)(w/ 13 SEER 2 Ton AC)	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
280	High Efficiency Furnace w/ ECM (90 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
281	High Efficiency Furnace w/ ECM (92 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
282	High Efficiency Furnace w/ ECM (94 AFUE, 60K)(w/ 13 SEER 2 To	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	MID-ATL-TRM	NEEP 2011	KEMA	GDS estimate	Cost: Estimate includes $300 for venting
283	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
284	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency	MF	NC	REM/Rate	REM/Rate	REM/Rate	REM/Rate	REM/Rate	GDS MLR	GDS estimate	KEMA	GDS estimate	Cost: GDS research found several websites suggesting $1,000 cost; estimate includes $300 for venting
300													
301	Gas clothes dryer	SFD	ROB	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting
302	Gas clothes dryer	SFD	NC	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting
303	Gas clothes dryer	SFA	ROB	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting
304	Gas clothes dryer	SFA	NC	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting
305	Gas clothes dryer	MF	ROB	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting
306	Gas clothes dryer	MF	NC	ECOVA	ECOVA	ECOVA	ECOVA	ECOVA	MID-ATL-TRM	MET-ED	KEMA	GDS estimate	Cost: Includes venting

*EE saturation assumed to be 0% because study focuses on switching from electric measures to natural gas measures

ECOVA: report titled, "What Lurks Beneath: Energy Savings Opportunities from Better Testing and Technologies in Residential Clothes Dryers", presented at 2012 ACEEE Summer Study conference
GDS calc.: calculations based on standard energy usage algorithms; parameter estimates are based on Maryland climate
GDS estimate: Relied on industry experience and professional judgement due to lack of available primary research at the state/regional level.
GDS MLR: "Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures", GDS Associates, June 2007.
GDS/NEEP: Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. / Incremental Cost Study Report. A Report on Costs in Six Northeast and Mid-Atlantic Markets. Navigant Consulting, Inc. September 23, 2011
KEMA: Maryland Energy Baseline Study. Prepared by KEMA. June 2011.
MET-ED: Act 129 Fuel Switching Working Group Comments of Metropolitan Edison Company, Pennsylvania Electric Company and Pennsylvania Power Company February 16, 2010
MID-ATL-TRM: NEED Mid Atlantic Technical Reference Manual Version 2.0, 2011
NEEP: Incremental Cost Study Report. A Report on Costs in Six Northeast and Mid-Atlantic Markets. Navigant Consulting, Inc. September 23, 2011
NREL: National Renewable Energy Laboratory, National Residential Efficiency Measures Database, Version v2.0.0
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NREL / GEP: National Renewable Energy Laboratory, National Residential Efficiency Measures Database, Version v2.0.0 / Electric Tankless Water Heating: Competative Analysis, Global Energy Partners LLC, March 2005
PA TRM: Pennsylvania Technical Reference Manual, p. 20, June 2012.
REM/Rate: Building Energy Modeling Software. Prototype homes were modeled based on average characterstics using the KEMA Maryland Energy Baseline Study

APPENDIX A-2

Residential Potential Data

Residential Sector Achievable Potential By Measure (60% Market Penetration)

Measure	Measure Name	Home Type	ROB vs. Retrofit	Per Unit Annual Electricity (kWh) Savings	Achievable Participants per Year (Based on 60% Market Penetration Scenario) 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Achievable Electricity (kWh) Savings by 2015	Achievable Electricity (kWh) Savings by 2020	Achievable Summer kW Savings by 2015	Achievable Summer kW Savings by 2020	Additional Gas (MMBTu) Consumption by 2015	Additional Gas (MMBTu) Consumption by 2020
100	Water Heating																			
101	High Efficiency Gas Tank WH (0.67 EF)	SFD	ROB	3,418	141	281	423	563	704	845	985	1,127	1,127	1,127	2,888,310	17,326,441	265	1,589	13,238	79,412
102	High Efficiency Gas Tank WH (0.80 EF)	SFD	ROB	3,418	141	281	423	563	704	845	985	1,127	1,127	1,127	2,888,310	17,326,441	265	1,589	11,087	66,508
103	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	3,418	141	281	423	563	704	845	985	1,127	1,127	1,127	2,888,310	17,326,441	265	1,589	10,816	64,885
104	High Efficiency Tankless WH (0.82 EF)	SFD	ROB	3,107	8	15	24	32	40	47	56	64	64	64	146,047	888,711	13	82	602	3,661
105	High Efficiency Gas Tank WH (0.67 EF)	SFD	NC	3,418	18	37	55	73	92	110	128	147	147	147	375,993	2,255,958	34	207	1,723	10,340
106	High Efficiency Gas Tank WH (0.80 EF)	SFD	NC	3,418	18	37	55	73	92	110	128	147	147	147	375,993	2,255,958	34	207	1,443	8,659
107	High Efficiency Tankless WH (0.82 EF)	SFD	NC	3,418	18	37	55	73	92	110	128	147	147	147	375,993	2,255,958	34	207	1,408	8,448
108	High Efficiency Tankless WH (0.82 EF)	SFD	NC	3,107	1	2	3	4	5	6	8	8	8	8	18,644	114,973	2	11	77	474
109	High Efficiency Gas Tank WH (0.67 EF)	SFA	ROB	3,418	63	125	188	252	314	377	440	503	503	503	1,285,212	7,731,783	118	709	5,890	35,437
110	High Efficiency Gas Tank WH (0.80 EF)	SFA	ROB	3,418	63	125	188	252	314	377	440	503	503	503	1,285,212	7,731,783	118	709	4,933	29,678
111	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	3,418	63	125	188	252	314	377	440	503	503	503	1,285,212	7,731,783	118	709	4,813	28,955
112	High Efficiency Tankless WH (0.82 EF)	SFA	ROB	3,107	5	9	14	18	23	27	32	36	36	36	87,007	509,610	8	47	358	2,099
113	High Efficiency Gas Tank WH (0.67 EF)	SFA	NC	3,418	8	17	24	32	41	49	57	66	66	66	167,488	1,004,927	15	92	768	4,606
114	High Efficiency Gas Tank WH (0.80 EF)	SFA	NC	3,418	8	17	24	32	41	49	57	66	66	66	167,488	1,004,927	15	92	643	3,857
115	High Efficiency Tankless WH (0.82 EF)	SFA	NC	3,418	8	17	24	32	41	49	57	66	66	66	167,488	1,004,927	15	92	627	3,763
116	High Efficiency Tankless WH (0.82 EF)	SFA	NC	3,107	0	1	2	3	3	3	4	5	5	5	9,322	65,255	1	6	38	269
117	High Efficiency Gas Tank WH (0.67 EF)	MF	ROB	2,879	79	157	237	315	394	472	551	629	629	629	1,361,992	8,160,433	148	888	6,242	37,402
118	High Efficiency Gas Tank WH (0.80 EF)	MF	ROB	2,879	79	157	237	315	394	472	551	629	629	629	1,361,992	8,160,433	148	888	5,228	31,324
119	High Efficiency Tankless WH (0.82 EF)	MF	ROB	2,879	79	157	237	315	394	472	551	629	629	629	1,361,992	8,160,433	148	888	5,100	30,560
120	High Efficiency Tankless WH (0.82 EF)	MF	ROB	2,618	20	38	58	77	96	116	134	154	154	154	303,654	1,814,069	33	198	1,251	7,473
121	High Efficiency Gas Tank WH (0.67 EF)	MF	NC	2,879	11	20	31	41	52	61	72	82	82	82	178,527	1,065,406	19	116	818	4,883
122	High Efficiency Gas Tank WH (0.80 EF)	MF	NC	2,879	11	20	31	41	52	61	72	82	82	82	178,527	1,065,406	19	116	685	4,090
123	High Efficiency Tankless WH (0.82 EF)	MF	NC	2,879	11	20	31	41	52	61	72	82	82	82	178,527	1,065,406	19	116	669	3,990
124	High Efficiency Tankless WH (0.82 EF)	MF	NC	2,618	3	5	8	10	12	15	17	20	20	20	41,883	235,593	5	26	173	970
200	HVAC Equipment																			
201	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,749	10	22	32	43	54	65	75	85	85	85	1,007,946	6,079,172	0	0	3,945	23,791
202	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,768	10	22	32	43	54	65	75	85	85	85	1,009,146	6,086,409	0	0	3,861	23,285
203	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,787	10	22	32	43	54	65	75	85	85	85	1,010,346	6,093,647	0	0	3,777	22,780
204	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,902	10	22	32	43	54	65	75	85	85	85	1,017,721	6,138,131	0	0	3,945	23,791
205	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,910	10	22	32	43	54	65	75	85	85	85	1,018,223	6,141,155	0	0	3,861	23,285
206	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	15,918	10	22	32	43	54	65	75	85	85	85	1,018,724	6,144,180	0	0	3,777	22,780
207	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	7,998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	8,017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
209	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	8,035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
210	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	8,151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
211	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	8,158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	ROB	8,166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
213	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	ROB	13,595	10	22	32	43	54	65	75	85	85	85	870,070	5,247,612	0	0	1,890	11,399
214	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	ROB	6,752	85	170	254	339	424	509	594	678	678	678	3,436,982	20,615,138	0	0	15,031	90,155
215	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,831	2	4	5	8	10	12	13	15	15	15	174,138	1,092,318	0	0	681	4,270
216	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,850	2	4	5	8	10	12	13	15	15	15	174,346	1,093,622	0	0	666	4,176
217	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,868	2	4	5	8	10	12	13	15	15	15	174,549	1,094,895	0	0	651	4,087
218	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,942	2	4	5	8	10	12	13	15	15	15	175,361	1,099,993	0	0	681	4,270
219	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,950	2	4	5	8	10	12	13	15	15	15	175,450	1,100,552	0	0	666	4,176
220	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	15,958	2	4	5	8	10	12	13	15	15	15	175,536	1,101,089	0	0	651	4,087
221	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	7,940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
222	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	7,959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	7,977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
224	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	8,051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
225	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	8,059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
226	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFD	NC	8,067	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
227	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	NC	13,631	2	4	5	8	10	12	13	15	15	15	149,943	940,553	0	0	326	2,045

Residential Sector Achievable Potential By Measure (60% Market Penetration)

Measure	Measure Name	Home Type	ROB vs. Retrofit	Per Unit Annual Electricity (kWh) Savings	Achievable Participants per Year (Based on 60% Market Penetration Scenario) 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Achievable Electricity (kWh) Savings by 2015	Achievable Electricity (kWh) Savings by 2020	Achievable Summer kW Savings by 2015	Achievable Summer kW Savings by 2020	Additional Gas (MMBTu) Consumption by 2015	Additional Gas (MMBTu) Consumption by 2020
228	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFD	NC	6,480	15	30	45	62	77	92	107	122	122	122	583,170	3,563,816	0	0	2,668	16,302
229	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	8,933	10	20	30	39	49	58	68	78	78	78	535,980	3,144,416	0	0	2,112	12,390
230	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	8,947	10	20	30	39	49	58	68	78	78	78	536,820	3,149,344	0	0	2,064	12,109
231	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	8,960	10	20	30	39	49	58	68	78	78	78	537,600	3,153,920	0	0	2,022	11,862
232	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	9,061	10	20	30	39	49	58	68	78	78	78	543,688	3,189,633	0	0	2,112	12,390
233	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	9,066	10	20	30	39	49	58	68	78	78	78	543,975	3,191,318	0	0	2,064	12,109
234	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	9,070	10	20	30	39	49	58	68	78	78	78	544,226	3,192,792	0	0	2,022	11,862
235	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,587	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
236	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
237	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,715	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
239	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	ROB	4,724	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
241	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	ROB	7,678	10	20	30	39	49	58	68	78	78	78	460,680	2,702,656	0	0	960	5,632
242	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	ROB	3,332	52	104	157	209	261	312	364	417	417	417	1,042,916	6,250,832	0	0	5,008	30,016
243	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,127	2	3	5	7	9	10	12	14	14	14	61,270	379,874	0	0	241	1,494
244	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,136	2	3	5	7	9	10	12	14	14	14	61,360	380,432	0	0	235	1,457
245	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,144	2	3	5	7	9	10	12	14	14	14	61,440	380,928	0	0	230	1,426
246	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,200	2	3	5	7	9	10	12	14	14	14	61,999	384,391	0	0	241	1,494
247	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,203	2	3	5	7	9	10	12	14	14	14	62,034	384,613	0	0	235	1,457
248	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	6,206	2	3	5	7	9	10	12	14	14	14	62,064	384,799	0	0	230	1,426
249	High Efficiency Furnace (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,241	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
250	High Efficiency Furnace (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
251	High Efficiency Furnace (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
252	High Efficiency Furnace w/ ECM (90 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
253	High Efficiency Furnace w/ ECM (92 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,317	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
254	High Efficiency Furnace w/ ECM (94 AFUE, 80K) (w/ 13 SEER 3 Ton AC)	SFA	NC	3,320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
255	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	NC	5,232	2	3	5	7	9	10	12	14	14	14	52,320	324,384	0	0	107	663
256	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 3 Ton) / High Efficiency Gas Furnace (90 AFUE, 80K)	SFA	NC	2,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
257	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,797	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
259	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,815	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,880	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,882	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	3,884	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,237	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
264	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,246	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
265	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
266	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,322	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Residential Sector Achievable Potential By Measure (60% Market Penetration)

Measure	Measure Name	Home Type	ROB vs. Retrofit	Per Unit Annual Electricity (kWh) Savings	Achievable Participants per Year (Based on 60% Market Penetration Scenario) 2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Achievable Electricity (kWh) Savings by 2015	Achievable Electricity (kWh) Savings by 2020	Achievable Summer kW Savings by 2015	Achievable Summer kW Savings by 2020	Additional Gas (MMBTu) Consumption by 2015	Additional Gas (MMBTu) Consumption by 2020
268	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	ROB	2,324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	ROB	3,257	128	256	384	511	640	768	895	1,023	1,023	1,023	2,501,376	14,998,485	0	0	4,992	29,933
270	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	ROB	1,697	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,824	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,829	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
273	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,873	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	High Efficiency Furnace (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,348	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
278	High Efficiency Furnace (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	High Efficiency Furnace (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,358	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	High Efficiency Furnace w/ ECM (90 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,397	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	High Efficiency Furnace w/ ECM (92 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,399	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	High Efficiency Furnace w/ ECM (94 AFUE, 60K) (w/ 13 SEER 2 Ton AC)	MF	NC	1,399	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	NC	1,562	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	Duel Fuel Heat Pump (13 SEER ; 7.7 HSPF ; 2 Ton) / High Efficiency Gas Furnace (90 AFUE, 60K)	MF	NC	1,086	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	Gas Dryer																			
301	Gas clothes dryer	SFD	ROB	900	2,190	4,379	6,568	8,757	10,947	13,136	15,325	17,515	17,515	17,515	11,823,300	70,935,300	6,024	36,143	39,411	236,451
302	Gas clothes dryer	SFD	NC	900	306	614	920	1,228	1,534	1,842	2,148	2,455	2,455	2,455	1,656,000	9,942,300	844	5,066	5,520	33,141
303	Gas clothes dryer	SFA	ROB	900	895	1,791	2,686	3,582	4,477	5,372	6,268	7,164	7,164	7,164	4,834,800	29,011,500	2,463	14,782	16,116	96,705
304	Gas clothes dryer	SFA	NC	900	125	251	377	502	627	753	879	1,004	1,004	1,004	677,700	4,066,200	345	2,072	2,259	13,554
305	Gas clothes dryer	MF	ROB	900	653	1,308	1,961	2,616	3,269	3,923	4,577	5,231	5,231	5,231	3,529,800	21,184,200	1,799	10,794	11,766	70,614
306	Gas clothes dryer	MF	NC	900	91	183	275	367	458	550	641	734	734	734	494,100	2,969,100	252	1,513	1,647	9,897

	Achievable Electricity (kWh) Savings by 2015	Achievable Electricity (kWh) Savings by 2020	Achievable Summer kW Savings by 2015	Achievable Summer kW Savings by 2020	Additional Gas (MMBTu) Consumption by 2015	Additional Gas (MMBTu) Consumption by 2020
Total Achievable Potential:	**62,236,220**	**373,596,755**	**13,590**	**81,543**	**227,301**	**1,364,505**
% of Annual Sales:	*0.24%*	*1.32%*	*13.6*	*81.5*	*N/A*	*N/A*

APPENDIX B
Commercial Sector Data

APPENDIX B-1

Commercial Assumptions & Sources

MEA Fuel Switching Study- August 12 - Commercial Measure Database

#	Cost Type: 1=Full 2=Inc.	End Use	Measure Name	Annual kWh Savings	kWh Savings Source	Per Unit Winter NCP kW Savings	Per Unit Summer NCP kW Savings	Annual MMBtu savings	MMBtu savings source	Incremental Cost	Cost Source
100			*Water Heating*								
101	2	Water Heating	On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)	6,748	1	2.1	1.4	(25.27)	1	$1,954	7
102	2	Water Heating	On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)	7,827	1	2.5	1.6	(25.30)	1	$2,129	8
103	2	Water Heating	On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	29,896	2	9.4	6.2	(108.00)	2	$5,509	9
104	2	Water Heating	High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)	5,501	1	1.7	1.1	(25.21)	1	$1,090	10
105	2	Water Heating	Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	33,837	2	10.6	7.1	(108.23)	2	$16,532	11
106	2	Water Heating	Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	28,870	2	9.1	6.0	(108.11)	2	$8,434	12
150			*Space Heating- Electric Boilers*								
154	2	Space Heating- Electric Boilers	High Efficiency Hot Water Boiler (<=300,000 Btu/h)	101,458	3	401.0	0.0	(375.00)	3	$13,497	13
155	2	Space Heating- Electric Boilers	Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)	101,458	3	412.8	0.0	(360.60)	3	$15,406	14
200			*Space Heating- Electric Furnance*								
201	2	Space Heating- Electric Furnance	High Efficiency Furnace (<=300,000 Btu/h) (AFUE>=92%)	61,627	4	9.9	0.0	(222.83)	4	$20,741	15
300			*Space Heating- Packaged Resistance Heat*								
301	2	Space Heating- Packaged Resistance Heat	Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	61,627	4	9.9	0.0	(222.83)	4	$21,232	16
320			*Space Heating- Packaged HP, 10 tons*								
321	2	Space Heating- Packaged HP, 10 tons	High Efficiency Furnace (<=300,000 Btu/h)	69,700	5	11.2	0.0	(252.02)	5	$21,232	16
341	2	Space Heating- Split HP, 5 tons	High Efficiency Furnace (<=300,000 Btu/h)	34,850	6	5.6	0.0	(126.01)	6	$8,400	17
400			*Space Heating - Electric Baseboard*								
401	2	Space Heating - Electric Baseboard	High Efficiency Furnace (<=300,000 Btu/h)	61,627	4	9.9	0.0	(222.83)	4	$15,689	18

MEA Fuel Switching Study- August 12 - Commercial Measure Database

#	Cost Type: 1=Full 2=Inc.	End Use	Measure Name	Source Notes	Cost/Unit Descriptor	Persistence Factor	Measure Life	Effective Measure Life	Measure Life Source
100			*Water Heating*						
101	2	Water Heating	On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)		$/unit	1	20.0	20.0	1
102	2	Water Heating	On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)		$/unit	1	20.0	20.0	1
103	2	Water Heating	On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	FEMP calculator shows 9528 annual kWH for 120 gal tank water heater (equates to 3 - 120 gallon tanks). From Rinnai Website 157,000 BTU/h is equivalent to 50 gal water heater. Based on this ratio would need 2 tankless	$/unit	1	20.0	20.0	1
104	2	Water Heating	High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)		$/unit	1	13.0	13.0	1
105	2	Water Heating	Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	FEMP calculator shows 9528 annual kWH for 120 gal tank water heater (equates to 4 - 120 gallon tanks). Vas ues = 108MMBTU - FEMP website estiamted annul use this would require 3 condenting gas water heaters.	$/unit	1	13.0	13.0	1
106	2	Water Heating	Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	Gas unit Based on NEEP incremental cost study (average of about $2k versus stanadard gas) plus additional incremental cost (std electric versus standard gas - standard gas cost from CA Codes and Standards Report, October 2011)	$/unit	1	15.0	15.0	1
150			*Space Heating- Electric Boilers*						
154	2	Space Heating- Electric Boilers	High Efficiency Hot Water Boiler (<=300,000 Btu/h)		$/unit	1	20.0	20.0	1
155	2	Space Heating- Electric Boilers	Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)		$/unit	1	18.0	18.0	1
200			*Space Heating- Electric Furnance*						
201	2	Space Heating- Electric Furnance	High Efficiency Furnace (<=300,000 Btu/h) (AFUE>=92%)	5 Electric Units or 4 Gas Units	$/unit	1	18.0	18.0	1
300			*Space Heating- Packaged Resistance Heat*						
301	2	Space Heating- Packaged Resistance Heat	Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	Four 10 Ton Units required for both electric and gas	$/unit	1	18.0	18.0	1
320			*Space Heating- Packaged HP, 10 tons*						
321	2	Space Heating- Packaged HP, 10 tons	High Efficiency Furnace (<=300,000 Btu/h)	Four 10 Ton Units required for both electric and gas	$/unit	1	18.0	18.0	1
341	2	Space Heating- Split HP, 5 tons	High Efficiency Furnace (<=300,000 Btu/h)	Seven 5 Tons units required for both electric and gas	$/unit	1	18.0	18.0	1
400			*Space Heating - Electric Baseboard*						
401	2	Space Heating - Electric Baseboard	High Efficiency Furnace (<=300,000 Btu/h)	5 Electric Units and 4 Gas Units	$/unit	1	18.0	18.0	1

MEA Fuel Switching Study- August 12 - Commercial Measure Database

#	Cost Type: 1=Full 2=Inc.	End Use	Measure Name	Annualized cost	Levelized cost per kWh saved	Savings Factor	TRC B/C Ratios
100			*Water Heating*				
101	2	Water Heating	On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)	$97.68	$ 0.01447	100%	3.43
102	2	Water Heating	On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)	$106.43	$ 0.01360	100%	4.01
103	2	Water Heating	On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	$275.45	$ 0.00921	100%	5.53
104	2	Water Heating	High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)	$83.81	$ 0.01524	100%	3.46
105	2	Water Heating	Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	$1,271.69	$ 0.03758	100%	1.77
106	2	Water Heating	Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	$562.28	$ 0.01948	100%	2.96
150			*Space Heating- Electric Boilers*				
154	2	Space Heating- Electric Boilers	High Efficiency Hot Water Boiler (<=300,000 Btu/h)	$674.85	$ 0.00665	100%	3.71
155	2	Space Heating- Electric Boilers	Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)	$855.89	$ 0.00844	100%	3.33
200			*Space Heating- Electric Furnance*				
201	2	Space Heating- Electric Furnance	High Efficiency Furnace (<=300,000 Btu/h) (AFUE>=92%)	$1,152.29	$ 0.01870	100%	1.92
300			*Space Heating- Packaged Resistance Heat*				
301	2	Space Heating- Packaged Resistance Heat	Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	$1,179.56	$ 0.01914	100%	1.43
320			*Space Heating- Packaged HP, 10 tons*				
321	2	Space Heating- Packaged HP, 10 tons	High Efficiency Furnace (<=300,000 Btu/h)	$1,179.56	$ 0.01692	100%	2.12
341	2	Space Heating- Split HP, 5 tons	High Efficiency Furnace (<=300,000 Btu/h)	$466.67	$ 0.01339	100%	2.68
400			*Space Heating - Electric Baseboard*				
401	2	Space Heating - Electric Baseboard	High Efficiency Furnace (<=300,000 Btu/h)	$871.62	$ 0.01414	100%	2.54

Sources

1 Baseline - Federal Energy Management Program (FEMP), Energy Cost Calculator for Electric and Gas Water Heaters (Assumes 64 gal. per day)

2 Baseline - Direct Final Rule: Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards for Commercial Water Heaters, Hot Water Supply Boilers and Unfired Hot Water Storage Tanks, Federal Register, October 21, 2004

3 Baseline - NYSERDA Deemed Savings Database, Rev 09-082006 (NYSERDA data adjusted to account for location -- Used Baltimore, Baseline measure efficiency difference (95% vs. 85%), and size 210,000 Btu vs. 100,000 Btu) Base Use = 375 MMBtu

4 Baseline - NYSERDA Deemed Savings Database, Rev 09-082006 (NYSERDA data adjusted to account for location -- Used Baltimore, measure efficiency difference, 92% vs. 90% and size 120,00 Btu vs. 80,000 Btu) Base Use = 222.83 MMBtu

5 Baseline - Energy Star Air Source Heat Pump Calculator 10 Ton HP (43,542 kWh) + FEMP Unitary 10 Ton A/C unit (26,158 kWh) - Total 67,700 kWh

6 Baseline - Energy Star Air Source Heat Pump Calculator 5 Ton HP (21,771 kWh) + FEMP Unitary 5 Ton A/C unit (13,079 kWh) - Total 34,850 kWh

7 Electric: RS Means, Gas: GN Study + $700 Power Vent Kit

8 Electric: RS Means, Gas: GN Study + $700 Power Vent Kit

9 Electric: RS Means, Gas: GN Study + $700 Power Vent Kit

10 Electric: RS Means Residential Sized Water Heater, Gas: GN Study + $700 Power Vent Kit

11 Electric/Gas : RS Means. 100 MBH, 50 Gallon Commercial Water Heater, Gas + $700 Power Vent Kit

12 Electric: RS Means, Gas: GN Study + $700 Power Vent Kit

13 410 MBH Electric Boiler, RS Means including installation Labor: 235213102070, Gas: Crown BWC425 Bimini Commercial Electronic Ingnition Condensing Boiler - priced on Younits.com +$500 venting + $700 Chimney liner + 849 Inslall labor

14 410 MBH Electric Boiler, RS Means including installation Labor, Gas: RS Means + $500 Venting + $700 Chimney Liner

15 Electric: 85.3 MBH Electric, Gas: RS Means 100 MBH + $500 Venting + $700 Chimney Liner

16 BC HYDRO POWER SMART 2007 CONSERVATION POTENTIAL REVIEW: The Potential for Electricity Savings through Fuel Switching, 2006-2026 Commercial Sector in British Columbia

17 Assumes (5 ton RTU - DX unit) - MSI Webpage

18 Electric: 85.3 MBH Electric, Gas: RS Means 100 MBH + $2.50 x 20,208 Avg SqFt Installation x 10% of Buildings w/o Ducts

APPENDIX B-2

Commercial Potential Data

MEA Fuel Switching Study- August 12 - Commercial Measure Database

#	Cost Type: 1=Full 2=Inc.	End Use	Measure Name	Achievable Electricity (MWh) Savings by 2015	Achievable Electricity (MWh) Savings by 2020
100			*Water Heating*		
101	2	Water Heating	On-Demand, Tankless Water Heater (40 gallon, 40,000Btu/h)	2,826	7,536
102	2	Water Heating	On-Demand, Tankless Water Heater High Efficiency (40 gallon, 40,000Btu/h)	2,826	7,536
103	2	Water Heating	On-Demand, Tankless Water Heater (2 Units, 314,000Btu/h)	2,826	7,536
104	2	Water Heating	High Efficiency Stand Alone Commercial Water Heater (Baseline <=75000 Btu)	4,348	11,594
105	2	Water Heating	Condensing Stand Alone Commercial Water Heater (Baseline >75000 btu)	4,348	11,594
106	2	Water Heating	Indirect Water Heater - Combined appliance efficiency rating (CAE)>=85%	3,768	10,048
150			*Space Heating- Electric Boilers*		
154	2	Space Heating- Electric Boilers	High Efficiency Hot Water Boiler (<=300,000 Btu/h)	1,790	4,773
155	2	Space Heating- Electric Boilers	Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)	1,989	5,303
200			*Space Heating- Electric Furnance*		
201	2	Space Heating- Electric Furnance	High Efficiency Furnace (<=300,000 Btu/h) (AFUE>=92%)	3,666	9,775
300			*Space Heating- Packaged Resistance Heat*		
301	2	Space Heating- Packaged Resistance Heat	Electric Packaged Resistance Heat to Gas-fired Rooftop Unit	31,127	83,006
320			*Space Heating- Packaged HP, 10 tons*		
321	2	Space Heating- Packaged HP, 10 tons	High Efficiency Furnace (<=300,000 Btu/h)	5,484	14,624
340			*Space Heating- Split HP, 5 tons*		
341	2	Space Heating- Split HP, 5 tons	High Efficiency Furnace (<=300,000 Btu/h)	6,104	16,276
400			*Space Heating - Electric Baseboard*		
401	2	Space Heating - Electric Baseboard	High Efficiency Furnace (<=300,000 Btu/h)	10,020	26,720
Total					
TOTAL ACHEIVABLE POTENTIAL				81,122	216,321

APPENDIX C

Benefit/Cost Model Inputs & Assumptions

General Modeling Assumptions & Avoided Cost

Discount Rate: 8.24%
Inflations Rate: 2.00%
Real Discount Rate: 6.12%

Avoided Cost Forecast Data (Natural Gas, Other Fuels, and Electric) in Real Dollars:

Avoided Cost Data Format: Real

Natural Gas Forecast (Real $/MMBTU) **Source:** Weighted Washington Gas and BGE Avoided Cost Forecast from Utility

	Commercial & Industrial			Residential				All Retail
	Non Heating	Heating	All	Existing Heat	New Heating	Hot Water	All Residential	
Data Year	2011	2011	2011	2011	2011	2011	2011	2011
2009								
2010								
2011	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36
2012	7.99	7.99	7.99	7.99	7.99	7.99	7.99	7.99
2013	8.73	8.73	8.73	8.73	8.73	8.73	8.73	8.73
2014	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20
2015	9.57	9.57	9.57	9.57	9.57	9.57	9.57	9.57
2016	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
2017	10.32	10.32	10.32	10.32	10.32	10.32	10.32	10.32
2018	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.72
2019	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15
2020	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60
2021	12.07	12.07	12.07	12.07	12.07	12.07	12.07	12.07
2022	12.55	12.55	12.55	12.55	12.55	12.55	12.55	12.55
2023	13.04	13.04	13.04	13.04	13.04	13.04	13.04	13.04
2024	13.64	13.64	13.64	13.64	13.64	13.64	13.64	13.64
2025	14.26	14.26	14.26	14.26	14.26	14.26	14.26	14.26
2026	14.91	14.91	14.91	14.91	14.91	14.91	14.91	14.91
2027	15.59	15.59	15.59	15.59	15.59	15.59	15.59	15.59
2028	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30
2029	17.04	17.04	17.04	17.04	17.04	17.04	17.04	17.04
2030	17.82	17.82	17.82	17.82	17.82	17.82	17.82	17.82
2031	18.63	18.63	18.63	18.63	18.63	18.63	18.63	18.63
2032	19.48	19.48	19.48	19.48	19.48	19.48	19.48	19.48
2033	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37
2034	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30
2035	22.27	22.27	22.27	22.27	22.27	22.27	22.27	22.27
2036	23.29	23.29	23.29	23.29	23.29	23.29	23.29	23.29
2037	24.35	24.35	24.35	24.35	24.35	24.35	24.35	24.35
2038	25.47	25.47	25.47	25.47	25.47	25.47	25.47	25.47
2039	26.63	26.63	26.63	26.63	26.63	26.63	26.63	26.63

General Modeling Assumptions & Avoided Cost

Electric Avoided Cost Forecast (Real $)

Source: Weighted Avoided cost from BGE, SMECO, Delmarva, PEPCO, and PE 08/07/2012

	Marginal Wholesale Power Price						Avoided T+D Costs		Electric Retail Rate		
	Winter Peak Energy	Winter Off-Peak Energy	Summer Peak Energy	Summer Off-Peak Energy	Summer Capacity	Winter Capacity	Residential	C/I	Residential	Commercial	Industrial
Units:	$/kWh	$/kWh	$/kWh	$/kWh	$/kW-yr	$/kW-yr	($/kW)	($/kW)	(¢/kWh)	(¢/kWh)	(¢/kWh)
Data Year	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.072	0.066	0.077	0.066	53.771	0.000	6.540	4.240	14.571	5.666	3.137
2013	0.079	0.072	0.084	0.072	83.719	0.000	6.540	4.240	14.571	5.666	3.137
2014	0.078	0.071	0.083	0.071	52.808	0.000	6.540	4.240	14.571	5.666	3.137
2015	0.080	0.073	0.085	0.073	83.884	0.000	6.540	4.240	14.571	5.666	3.137
2016	0.082	0.075	0.088	0.075	88.202	0.000	6.540	4.240	14.571	5.666	3.137
2017	0.084	0.077	0.090	0.077	92.718	0.000	6.540	4.240	14.571	5.666	3.137
2018	0.086	0.079	0.092	0.079	97.314	0.000	6.540	4.240	14.571	5.666	3.137
2019	0.089	0.081	0.094	0.081	102.156	0.000	6.540	4.240	14.571	5.666	3.137
2020	0.091	0.084	0.097	0.084	106.802	0.000	6.540	4.240	14.571	5.666	3.137
2021	0.093	0.085	0.099	0.085	109.812	0.000	6.540	4.240	14.571	5.666	3.137
2022	0.095	0.087	0.101	0.087	112.923	0.000	6.540	4.240	14.571	5.666	3.137
2023	0.096	0.088	0.102	0.089	116.296	0.000	6.540	4.240	14.571	5.666	3.137
2024	0.098	0.091	0.104	0.091	119.714	0.000	6.540	4.240	14.571	5.666	3.137
2025	0.100	0.093	0.106	0.093	123.779	0.000	6.540	4.240	14.571	5.666	3.137
2026	0.100	0.093	0.107	0.093	124.467	0.000	6.540	4.240	14.571	5.666	3.137
2027	0.101	0.093	0.107	0.093	125.170	0.000	6.540	4.240	14.571	5.666	3.137
2028	0.101	0.093	0.107	0.094	125.887	0.000	6.540	4.240	14.571	5.666	3.137
2029	0.101	0.094	0.107	0.094	126.620	0.000	6.540	4.240	14.571	5.666	3.137
2030	0.101	0.094	0.108	0.094	127.368	0.000	6.540	4.240	14.571	5.666	3.137
2031	0.102	0.094	0.108	0.094	127.918	0.000	6.540	4.240	14.571	5.666	3.137
2032	0.102	0.094	0.108	0.095	128.481	0.000	6.540	4.240	14.571	5.666	3.137
2033	0.102	0.095	0.109	0.095	129.058	0.000	6.540	4.240	14.571	5.666	3.137
2034	0.103	0.095	0.109	0.095	129.647	0.000	6.540	4.240	14.571	5.666	3.137
2035	0.103	0.095	0.109	0.096	130.251	0.000	6.540	4.240	14.571	5.666	3.137
2036	0.103	0.096	0.110	0.096	130.869	0.000	6.540	4.240	14.571	5.666	3.137
2037	0.104	0.096	0.110	0.096	131.502	0.000	6.540	4.240	14.571	5.666	3.137
2038	0.104	0.096	0.110	0.097	132.150	0.000	6.540	4.240	14.571	5.666	3.137
2039	0.104	0.097	0.111	0.097	132.813	0.000	6.540	4.240	14.571	5.666	3.137

APPENDIX D
Additional Fuel Switching Program

Natural Gas in a Smart Energy System

American Gas Association

http://www.aga.org/our-issues/energyefficiency/Pages/NaturalGasinaSmartEnergySystem.aspx

The world in which utility companies deliver energy is changing

Amidst pending carbon legislation, emerging "smart" technology, and increasingly integrated, consumer-driven energy markets, electric and natural gas utilities are exploring both new requirements and new opportunities. In this changing world, utilities must take a more holistic look at our energy system in order to continue serving the needs of American homes and businesses in the most cost-effective and environmentally sustainable way.

Increasingly, electric and combination utilities are considering direct use of natural gas as a way to achieve electric demand side management (DSM) goals such as reduction in the rate of growth of peak demand, and lower overall use of primary energy.

Encouraging the use of natural gas where it is a viable substitute for electricity and converting loads currently served by electricity to natural gas will:

- Improve the efficiency with which energy is consumed
- Reduce electricity usage
- Reduce CO2 emissions and could become an important component of an electric utilities overall energy efficiency strategy

Resources for understanding the issues associated with natural gas end use as an electric DSM tool (Smart DSM):

- Northwest Gas Association Assessment of the Potential Benefits of Direct Use of Natural Gas - An assessment of the potential benefits of natural gas as a regional resource strategy. This study finds there is potential for direct use of natural gas to reduce regional greenhouse gas emissions by 1.3 million tons annually beginning in 2009.
- NRRI Study - Electric-to-Gas Substitution: What Should Regulators Do? - On May 29, 2009, the National Regulatory Research Institute (NRRI) published a study on "fuel switching," discussing the benefits and costs, market defects and regulator options. Electric-to-gas substitution or fuel switching refers to the decision of small, generally residential, consumers to use natural gas rather than electricity for certain end-use applications, such as space heating, water heating, cooking and clothes drying. The study states that if there are market barriers, imperfections or regulatory obstacles that prevent consumers from making rational or socially desirable end-use appliance decisions, regulatory intervention may be appropriate where the regulatory intervention passes a cost-benefit test.
- Electric-to-Gas Fuel Switching Presentation by consultant Paul Raab at the summer meeting of the National Association of Regulatory Commissioners (NARUC) on June 20, 2009.

Examples of proceedings in states where Commissions have received comments related to Smart DSM:

- **Oklahoma (various utilities)** - Oklahoma Natural Gas presented testimony demonstrating direct use of natural gas as effective and cost-effective for acheiving electric efficiency goals. One accomplishment of the ruling was that utilities would in the future be allowed to promote natural gas as an electric DSM tool if it “supports the goals of the commission.” A filing of this nature is planned for later this year or early next. See the record (Docket No. RM-200700007) for a summary of written comments filed at the Commission. See Appendix A for summary of latest comments as of November 28, 2008 regarding fuel-switching. The appendix includes comments from regional utilties including: **Centerpoint Energy** Page 2; **OG&E** Page 3; **ONG** Page 4; **PSO** Page 5.
- **Pennsylvania (UGI) -** In Pennsylvania, **Act 129** mandates electric efficiency targets. UGI is successfully reaching out to electric utilities to show how natural gas can serve as a DSM tool. See Comments of UGI Utilities, Inc. filed March 12, 2009. The concept is receiving good reception so far; of the four electric utilities with filings, two include natural gas. See the record (Docket No. M-2008-2069887) for a view of the Case Summary, Daily Actions and public documents associated with the selected docket number.
- **Kansas (Kansas Gas) -** In May 2009, the Kansas Comission concluded a hearing on fuel-switching, to determine “whether it is appropriate to offer incentives to encourage customers to behave in consumer switching behavior.” See the record (Docket No. 09-GIMX-160-GIV) for example of how commission staff are responding to the concept in general.