



Independent Statistics & Analysis
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Administration

Assessing Existing Energy Efficiency Program Activity

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Assessing Existing Energy Efficiency Program Activity

Given the increasing prevalence of energy efficiency (EE) activity and development of state-level energy efficiency resource standards (EERSs), understanding the effects that EE programs have on energy consumption and technology choice within buildings in the United States is important. The U.S. Energy Information Administration (EIA) contracted with ICF Incorporated, LLC (ICF) to identify and characterize a variety of EE incentives available from state efficiency organizations and electric and natural gas utilities. These incentives are used to develop analytic assumptions and modeling structure within EIA's National Energy Modeling System (NEMS) [residential demand module \(RDM\)](#) and [commercial demand module \(CDM\)](#).

EIA and others use NEMS to produce long-term projections of energy use within the United States. Given its role in analyzing future EE policies, EIA has implemented explicit characterization and modeling of EE to improve projections of energy consumption in buildings. ICF reviewed existing state and utility studies and literature to identify available EE program data. ICF used Form EIA-861, [Annual Electric Power Industry Report](#), to identify and prioritize utilities across the [nine U.S. census divisions](#) based on total energy savings. They also conducted research to establish technology-level rebates for specific technologies within end uses such as space heating and cooling, water heating, and lighting. Combined with other sources, this report allows EIA to adjust residential and commercial model inputs to account for historical EE activity and to project effects of EE activity into the future.

Incentives, in the form of equipment subsidies or rebates, are deducted from installed equipment costs for high-efficiency equipment—namely, those [equipment types or appliances](#) that meet or exceed ENERGY STAR® specifications—in RDM and CDM technology choice menus. This approach lowers the relative cost of efficiency adoption when consumers choose between equipment that meets federal minimum EE standards and equipment that is more efficient.

When referencing the contract report, it should be cited as a report by ICF Incorporated, LLC prepared for the U.S. Energy Information Administration.

APPENDIX



Assessing Existing Energy Efficiency Program Activity: *Literature Research and Estimates of Program Activity*

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ACRONYMS AND ABBREVIATIONS

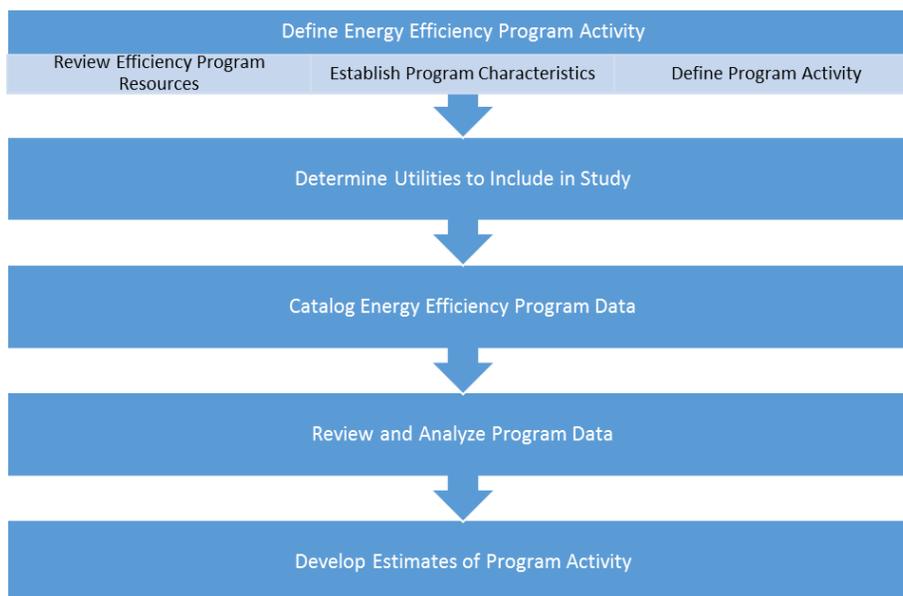
CD	U.S. Census division
CDM	Commercial Demand Module
DOE	U.S. Department of Energy
DSM	Demand-Side Management
DSIRE	Database of State Incentives for Renewables and Efficiency
EIA	U.S. Energy Information Administration
EUI	Energy Use Index
EM&V	Evaluation, Measurement, & Verification
HVAC	Heating, Ventilation, and Air-Conditioning
ICF	ICF International
NEMS	National Energy Modeling System
PUC	Public Utility Commission
RDM	Residential Demand Module
TRM	Technical Reference Manual

INTRODUCTION

The U.S. Energy Information Administration’s (EIA) Annual Energy Outlook provides a long-term analysis of U.S. energy markets. The forecasts are developed following the methodologies in the Commercial Demand Module (CDM) and Residential Demand Module (RDM) of the National Energy Modeling System (NEMS). The NEMS model currently embeds energy efficiency program activity in building energy use indices (EUI) and baseline assumptions, rather than through an explicit definition of program activity.

Two recent EIA studies sought to characterize program activity from state-sponsored and utility demand side management programs. The *Analysis of Energy Efficiency Impacts Based on Program Spending*¹ study used a top-down approach that leveraged publicly available utility data, state Public Utility Commission (PUC) reports, and Evaluation, Measurement, and Verification (EM&V) reports to estimate regional variations in total energy efficiency program spending at the end-use level. A follow-on report, *Analysis of Energy Efficiency Program Activity & Program Impacts on Energy Consumption*, used a bottom-up approach which leveraged publicly available utility website data on energy efficiency programs to estimate the regional variance of end-use equipment subsidies. A small sample size of utilities underpin these analyses, which produced broad estimates of program spending and end-use subsidies by building sector, end-use, and U.S. Census Division.

Figure 1 – Approach for Defining Energy Efficiency Program Activity



¹ U.S. Energy Information Administration, Analysis and Projections, Analysis of Energy Efficiency Program Impacts Based on Program Spending; <http://www.eia.gov/analysis/studies/buildings/efficiencyimpacts/>

The objective of this work is to provide more explicit definitions of energy efficiency program activity. It is intended to improve upon previous work efforts and provide EIA greater granularity for how energy efficiency program activity is defined in NEMS. Our approach for developing these data are illustrated in **Figure 1**. The results of this work will enable EIA to leverage the technology choice subsidy structure of NEMS to more accurately account for reductions in building energy consumption from energy efficiency program activity.

DEFINE ENERGY EFFICIENCY PROGRAM DATA

ICF conducted secondary research on energy efficiency programs to determine which characteristics would be used to define and quantify energy efficiency program activity. Previous EIA studies were reviewed for how the programs were characterized in order to evaluate methods to improve the analytical rigor in estimating program activity. Similar studies conducted by other governmental agencies and energy advocacy groups were reviewed to identify work products and data sources to support the analysis.

Review Efficiency Program Resources

ICF reviewed previous studies conducted on energy efficiency program activity for the purpose of understanding how programs were characterized, what their limitations were, and what data is available for improving the analytical rigor and granularity. These studies describe a landscape of energy efficiency programs that have unique characteristics influenced by differences in regional and geographical political environments and weather. There are also variances in how efficiency measures are defined, implemented, and reported by the various utilities, implementation contractors, and PUCs. We acknowledge the extent of data inconsistencies faced in collecting and aggregating these data, and have chosen to catalog measure data rather than those challenges.

Several data sources (refer to **Table 1**) are available to describe efficiency programs. They are used by stakeholders for different purposes through a program's lifecycle. Samples of these data sources were reviewed for content, including data accuracy and granularity. It was generally observed that program and measure data is more granular during the policy and planning phases; the data during these stages, however, is more theoretical. Data accuracy, on the other hand, is more certain during the evaluation and reporting phases but is reported with less granularity. There is not a single source that best defines program activity.

This study suggests that program-level data from PUC and regulator reports can be combined with measure-level data from utility program websites, then paired with measure-level data from Technical Reference Manuals (TRMs) to describe program activity.

Table 1 - Available Energy Program Data Sources

Program Phase	Energy Efficiency Program Data Sources	Data Accuracy	Data Granularity
Policy	Technical Reference Manuals	Potential	Mostly complete measure-level data; excluding incentives and participation
	Potential and Planning Studies	Planned	May include comprehensive measure-level data
	Energy Efficiency Potential Models	Planned	Comprehensive measure-level data

Program Phase	Energy Efficiency Program Data Sources	Data Accuracy	Data Granularity
Planning, and Design	Technical Reference Manuals	Potential	Measure-level data excluding incentive and participation
	Program Design Calculators	Planned	Comprehensive measure-level data
	Utility Websites	Actual	Partial measure-level data; includes incentive only
Evaluation, Measurement, and Verification (EM&V)	EM&V Reports	Actual	Program-level data
Reporting	Demand-Side Management (DSM) Program Public Utility Commission Filings	Actual	Program-level data
	U.S. Energy Information Administration Form 861	Actual	Portfolio-level data; includes savings and total administrative and incentive costs

Establish Program Characteristics

Efficiency programs are characterized by the markets they serve and by the delivery methods administrators use to implement them. This analysis collected program data from residential and commercial energy efficiency programs, predominantly administered by electric utilities offering prescriptive incentives for equipment efficiency improvements. Program incentives are offered to participants such as building owners, homebuilders or installing contractors, and sometimes retailers, as seen in upstream and mid-stream programs. Each program includes efficiency measures that can be categorized by their energy end use (e.g., space heating) and technology choice (e.g., air-source heat pump). Measures are further defined by their program delivery type, which describes how they are offered and defines the efficiency levels for baseline and upgraded cases. **Table 2** provides a partial listing of the various characteristics that may be used to define energy efficiency programs.

Table 2 – Partial Listing of Energy Efficiency Program Characteristics

Program Administrators	Program Definition	Program Type	Program Delivery Type	Fuel Types
Utility ✓	Upstream ✓	Prescriptive ✓	New Construction ✓	Electric ✓
State ✓	Midstream ✓	Performance ✓	Time of Sale ✓	Natural Gas ✓
Public ✓	Downstream ✓		Retrofit ✓	
			Early Replacement ✓	
			Early Retirement ✓	
			Direct Install ✓	
			Efficiency Kits ✓	

Define Program Activity

There is no standard definition for efficiency program activity. It may be defined by energy savings, implementation costs, or incentives at the portfolio-, program-, or measure-level. This work proposes to define program activity as the estimated energy savings per incentive (e.g., first year kWh saved / \$ incentive paid to customer) by the NEMS RDM and CDM *Technology Choice*. Energy savings estimates may be developed from regional and state TRMs, rather than actual savings claimed by the utility and reported to the PUC.

DETERMINE UTILITIES TO INCLUDE IN STUDY

ICF used detailed data files from EIA-861² (2014) to identify candidate utilities for inclusion in the study. The *Energy Efficiency* file includes about 700 utilities categorized by state and their portfolio, which reports annual energy savings, customer incentives, and other costs. Data for several of the listed utilities were incomplete; in these cases, a review of the previous 2 years' of EIA-861 data was evaluated and determined to have similar and incomplete data. Data collection for this study was conducted between July and October 2016.

Each utility was mapped to a U.S. Census Division according to its state. Multiple listings were provided for several utilities, indicating that their program's service territories extend across multiple states. Utilities were stratified according to residential and commercial market sector, filtered by U.S. Census Division, and ranked by *Energy Savings*. Two utilities from each U.S. Census Division were initially selected as representative utilities; from about the 90th and 50th percentiles, according to the number of energy savings reported.

Each representative utility was reviewed for availability and accessibility to its program data. Utility websites were the primary data source for collecting this program and measure-level data, and were mostly accessed through the Database of State Incentives for Renewables and Efficiency³ (DSIRE). The DSIRE website summarizes state energy efficiency programs and provides links that point to utility program landing pages. When program data was not readily available, or was available but inaccessible, such as in a password-protected file, data was collected from the next most representative utility until all data had been collected from 2 residential and 2 commercial energy efficiency programs within each census division.

² U.S. Energy Information Administration, Electricity, Detailed Survey Data Files;
<http://www.eia.gov/electricity/data/eia861/index.html>

³ Database of State Incentives for Renewable and Efficiency, NC Clean Energy Technology Center;
<http://www.dsireusa.org/>

Preliminary research suggested there may be large variations in the quantity of measures collected by utility and by NEMS *Technology Choice*, given the prevalence of high-impact measures (e.g., lighting) and the number of combinations of technology choices within each U.S. Census Division. Some utilities may have mature programs that cover the breadth and depth of the technologies choices, while others may have limited coverage. Gaps in coverage cannot be known until after the data is collected and assessed for completeness. The sample size was, therefore, periodically reassessed and determined as an outcome of this work based on available resources, rather than statistical criteria. **Appendix A** lists the utilities that underpin this study.

CATALOG ENERGY EFFICIENCY PROGRAM DATA

Utility websites were the primary source for collecting program and measure level data. They were predominately accessed from the DSIRE website using links to utility programs. Most visited websites included a portfolio of efficiency programs administered by the utility. These sites provided the relevant energy efficiency measure data, which included detailed measure definitions (e.g., market sector, end use, technology choice) as well as the associated incentives for each measure. In some cases, this data was available in tabular form and easily accessed; in other cases it was contained in PDF reports, or additional internet research was required. In select cases where data collection would have been too time-consuming, another utility of similar energy savings was selected instead.

Table 3 – Program Data Sources, Types, and Fields

Energy Efficiency Program Document / Data Source	Portfolio-Level Data			Program-Level Data			Measure-Level Data			
	Utility	Energy Savings	Admin & Incentive Costs	Program	Energy Savings	Admin & Incentive Costs	Market Sector	Baseline and Retrofit Definition	Energy Savings	Incentive
U.S. EIA Form 861	✓	✓	✓							
Utility Websites	✓			✓			✓	✓		✓
Technical Reference Manuals							✓	✓	✓	

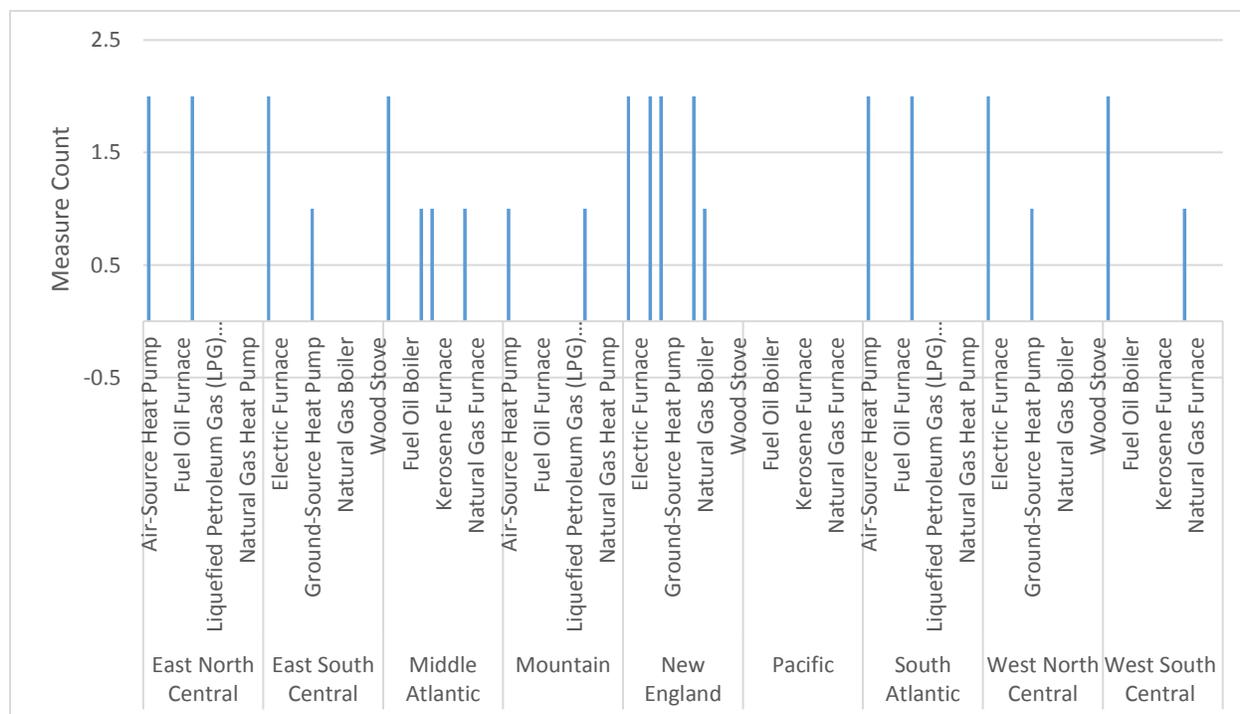
Measure-level data was cataloged in an Excel data model. It was then summarized in a single worksheet after mapping measures to NEMS *Technology Choices* and using common nomenclature. **Table 3** summarizes the various program data sources used and corresponding data type and fields collected. The shaded cells indicate common data and mapping points between these sources, or key data required for the study. For example, EIA-861 Energy Savings data narrows down utilities for inclusion in the study, the corresponding utility websites contain the incentive data, and these measures can be then mapped with energy savings data from the appropriate TRM. Once the measure-specific incentives are paired with their corresponding energy savings data, we can more explicitly define program activity for each *NEMS Technology Choice*. The data model is expandable and can accept additional efficiency program data to improve the breadth and depth of *Technology Choice* data and increase the program activity confidence level.

Technology Choice Summary

Figure 2, Figure 3, Figure 4, and Figure 5 provide summaries of the residential and commercial space heating and space cooling technology choices, respectively. The values presented are the number of utilities in each U.S. Census Division that included those technologies in their energy efficiency programs. They were aggregated from detailed incentive lists that often included multiple listings for similar measures. These summaries illustrate the breadth and depth of the technologies covered by this analysis rather than the total list of measure data collected, and is intended to shed light on where future data collection activities may focus. Providing a total number of measures collected for each technology choice would be misleading; for example, a utility program may list multiple incentives for ground-source heat pumps based on levels of efficiency, whereas the same utility may have a single incentive for a broad spectrum of high efficiency air-source heat pumps. This does not necessarily mean that ground-source heat pumps are incentivized more than air-source heat pumps; this is simply a matter of how granular the utility happened to categorize its incentive.

The graphs are meant to provide a sense of which technologies tend to be incentivized more in energy efficiency programs (both residential and commercial) across the U.S. Census Divisions, as opposed to which technologies do not appear as often.

Figure 2 – Residential Space Heating Measure Count, by U.S. Census Division⁴



⁴ Data Sources: Refer to Appendix A - Selected Utilities, Table 4 - Residential Utility Data Sources

Figure 3 – Residential Space Cooling Measure Count, by U.S. Census Division⁵

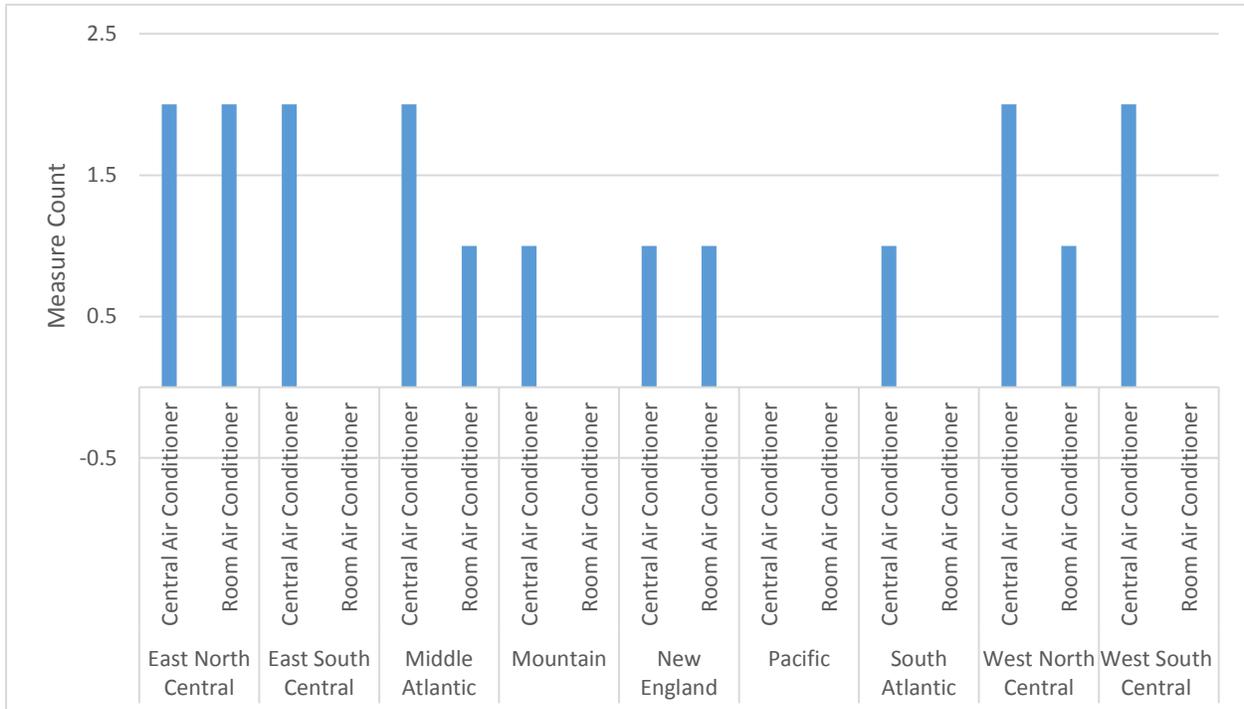


Figure 4 – Commercial Space Heating Measure Count, by U.S. Census Division⁶

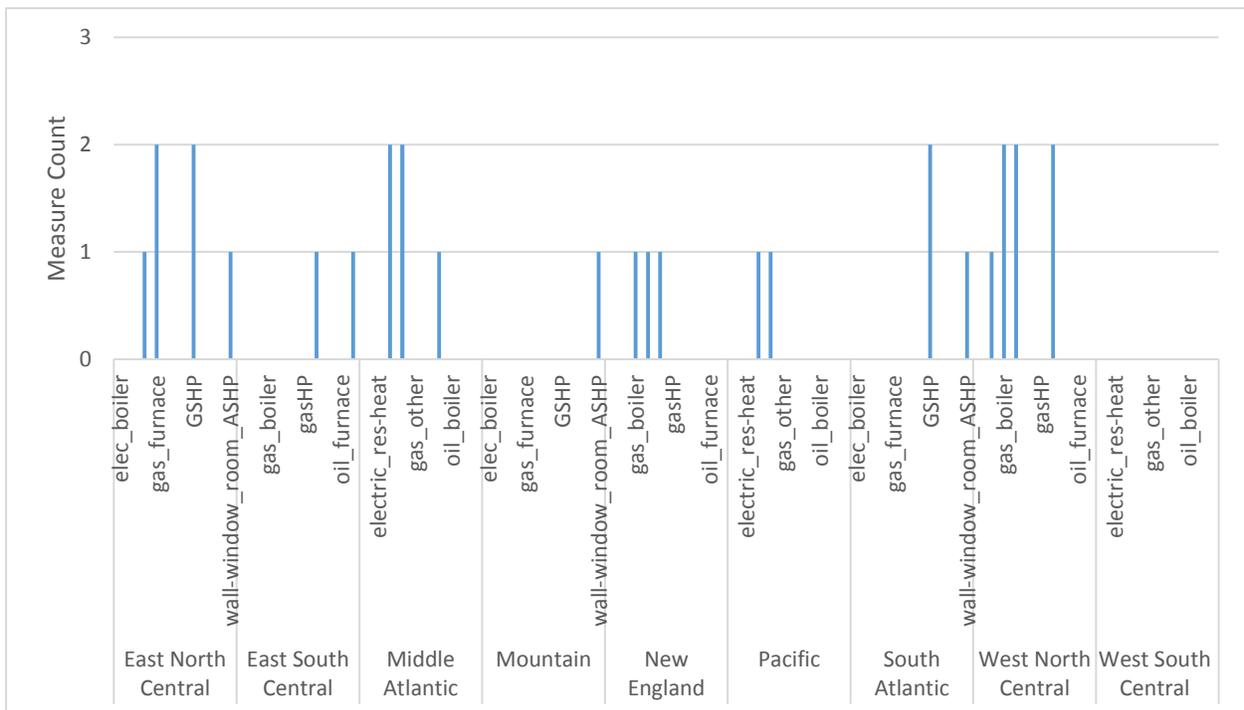
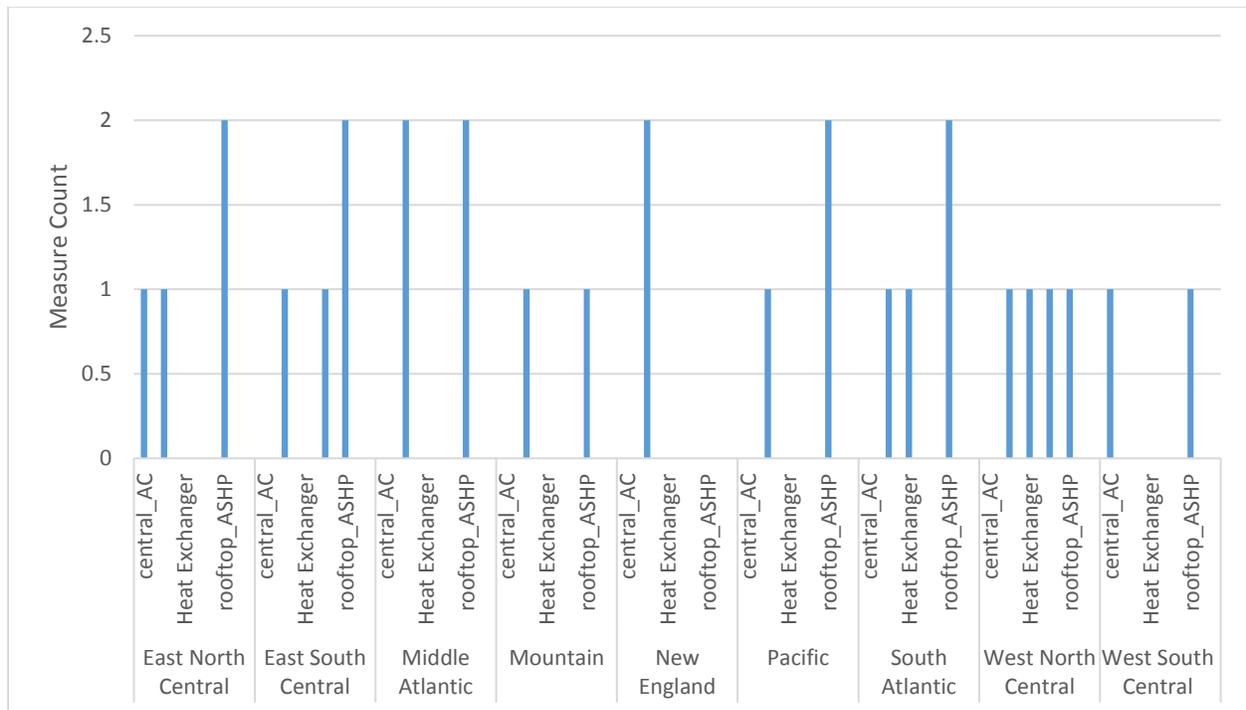


Figure 5 – Commercial Space Cooling Measure Count, by U.S. Census Division⁷



⁵ Data Sources: Refer to Appendix A - Selected Utilities, Table 4 - Residential Utility Data Sources

⁶ Data Sources: Refer to Appendix A - Selected Utilities, Table 5 - Commercial Utility Data Sources

⁷ Data Sources: Refer to Appendix A - Selected Utilities, Table 5 - Commercial Utility Data Sources

REVIEW AND ANALYZE PROGRAM DATA

Program measure data was normalized and paired with similar type data from available state-wide Technical Reference Manuals (TRMs) to develop estimates of program activity. Utility websites used to collect the vast quantity of measure data contained only limited measure characteristics, such as measure definition and incentive level. These data are not presented consistently across programs and in many cases did not align with TRM definitions. For example, a program could incentivize a homeowner for installing an air-source heat pump on a per unit basis, or on a per-ton basis. Where adjustments in datasets were needed to combine data for analysis, additional research was conducted using public resources, such as the U.S. Department of Energy's (DOE's) Residential Prototype Building Models and Commercial Building Models to identify appropriate data for normalizing and scaling measures.

Assess and Normalize Data Sets

ICF reviewed program incentive data to identify variances in measure unit definitions and the prevalence of data gaps between measures of similar end use and technology choice. The measures were first stratified by technology choice; then their unit definitions were compared to a select group of state-wide technical reference manuals. When measure definitions were inconsistent with the TRMs, they were normalized so that each technology choice had a single unit definition, thus providing a basis for comparing similar technologies. Measures were predominately normalized using building and system characteristics from DOE's Residential Prototype Building Models (2009 IECC) and Commercial Building Models (ASHRAE 90.1-2013). These values were used as proxies to translate between the program incentive data obtained from utility websites and unit definitions most commonly found in the available TRMs.

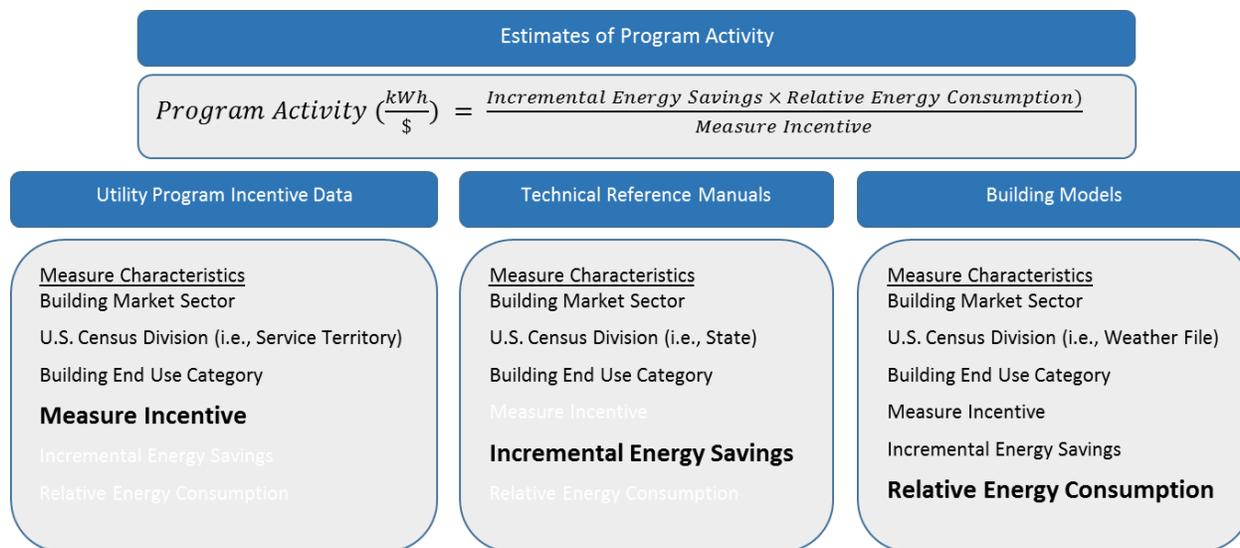
Previous research conducted on incentive data yielded variations in the quantity of measures corresponding to NEMS CDM and RDM technology choices. It was neither practical nor feasible to survey additional efficiency programs to compile a more complete data set corresponding to the NEMs technology choices. In many cases the technology choices were mapped to the next highest technology level (e.g., chiller rather than centrifugal chiller), such that the technology choices are represented by a range of similar technologies rather than every specific technology case. In other cases, no corresponding measures were identified; no attempt was made to gap-fill technology choices where no data had been collected, and consequently those technologies are omitted from this study. Likewise, several technology choices that were thoroughly cataloged did not have corresponding and relevant incentive data from the TRMs to be linked with; these have also been omitted from the results.

Once the incentive data was organized and normalized in a consistent format, we linked this data with energy savings data from relevant TRMs. The intersection of this data allows us to explicitly define energy efficiency program activity data for each technology choice as a fraction of estimated energy savings per incentivized dollar amount.

DEVELOP ESTIMATES OF PROGRAM ACTIVITY

ICF aggregated individual measure-level program activity data to develop estimates of program activity in a format suitable for inputs into NEMS. The measures were stratified by residential and commercial market sector and mapped to similar state-wide TRM energy efficiency measures to produce aggregated estimates of program activity by U.S. Census Division and NEMS Technology Choice. **Figure 6** illustrates the analytical process, which is described in the following sections.

Figure 6- Methodology for Developing Estimates of Program Activity



Develop Measure Savings Estimates

Three state-wide technical reference manuals (TRMs) served as the basis for developing measure incremental energy savings estimates; they include the *Illinois Statewide Technical Reference Manual for Energy Efficiency*, the *State of Ohio Energy Efficiency Technical Reference Manual*, and the *Indiana Technical Resource Manual*. Savings estimates were developed from the various residential and commercial energy efficiency measures by taking the straight average of all possible combinations of that measure that corresponded to the various state microclimates, program delivery types, and building types. The TRM measures were mapped to building energy uses for mapping between program incentive data and building energy models.

ICF extracted and converted pertinent data from building energy simulations to account for variations in incremental energy savings across U.S. census divisions. DOE’s Residential Prototype Building Models (2009 IECC) and Commercial Building Models (ASHRAE 90.1-2013) were the basis for the analysis. The simulations produced estimated annual energy consumption values by building end use, which were used to scale energy savings between U.S. census divisions. Savings for a particular measure were scaled by taking the ratio of the measure’s estimated consumption in TRM’s census division over the measure’s estimated consumption from the relevant census division where the measure is actually incentivized. This ratio was particularly useful in allowing us to adapt the savings data to all of the cataloged incentive data despite the fact that the TRM data was only originally pertinent to a handful of states.

Develop Estimates of Program Activity

ICF developed estimates of program activity by U.S. census division for each Technology Choice where incentive and measure savings data were available. Energy efficiency program activity in this study is defined as the annual energy savings divided by the incentive paid (kWh saved / \$ incentive). In other words, the program activity for each technology choice is the estimated measure energy savings obtained from the referenced TRMs divided by the program incentive data obtained from utility websites.

Results

Due to the sheer size and variance in utility incentives, it is difficult to thoroughly summarize the results in a handful of graphics; nevertheless, we can draw upon some general observations in the dataset when breaking it down to specific technology choices. **Figure 7** and **Figure 8** summarize a range of kWh hours per dollar incentives for residential air-source heat pumps and commercial central air conditioning systems, respectively. In these cases, the incentives were taken from utilities across all census divisions as a dollar value per ton of cooling capacity. This data then linked with estimated savings data from TRMs, then scaled according to ratios drawn from the DOE prototypical building models. This resulted in a useful metric that shows the relationship of how much energy (kWh) tends to be saved across census divisions as a result of utilities incentivizing the installation of high-efficiency equipment (in this case, air-source heat pumps and central AC units). This metric details our definition of energy efficiency “program activity”: a general understanding of what types of measures are being incentivized across the country, how much money the incentives are, and what impact these incentives have on the measure’s energy savings. A more expansive summary of all technology choices and their respective “program activity” estimates are tabulated in **Appendix C**.

Although a number of estimations and assumptions make the data imperfect, it is interesting to note some of the logical trends in the figures that one would expect. For example, in the case of **Figure 8**, the southern census divisions (East South Central, South Atlantic, West South Central) appear to have the highest ratios of energy efficiency program activity for incentivized central A/C systems. Given the prevalence of air conditioning electricity consumption in the South and the likelihood – therefore – that this equipment would be more incentivized there, the results of the data for this measure make sense.

Figure 7 - Residential Air Source Heat Pump, Estimates of Program Activity

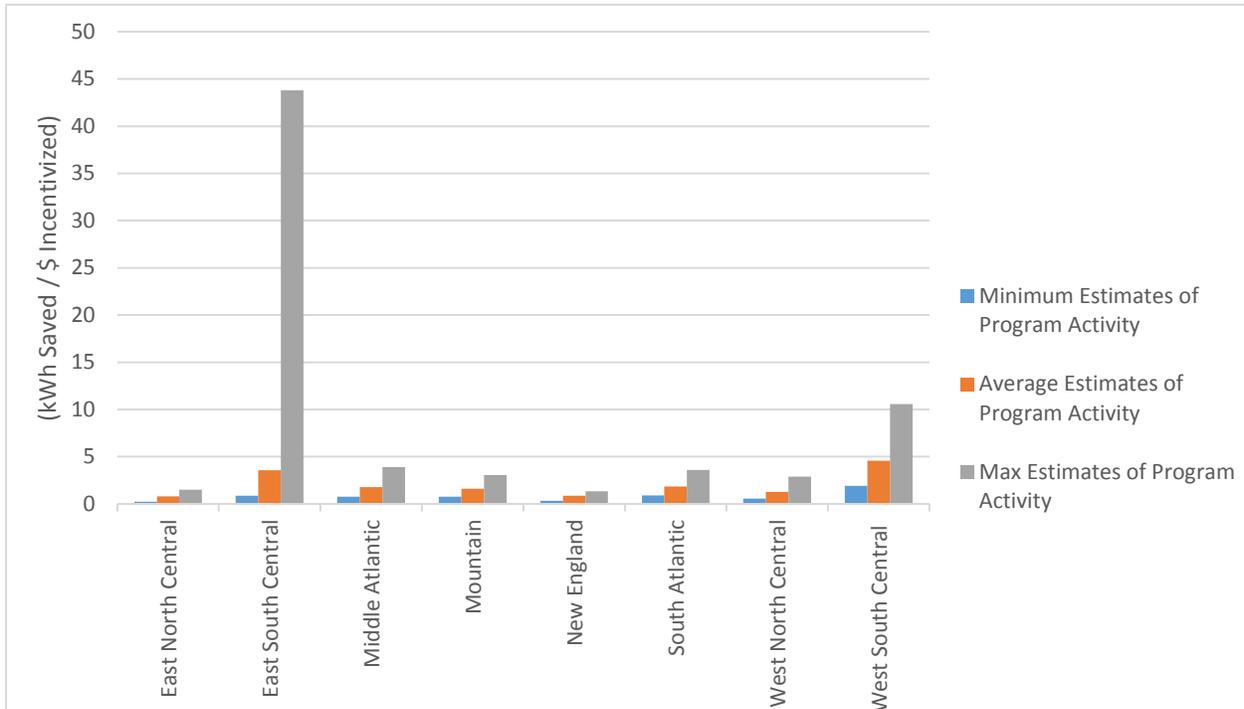
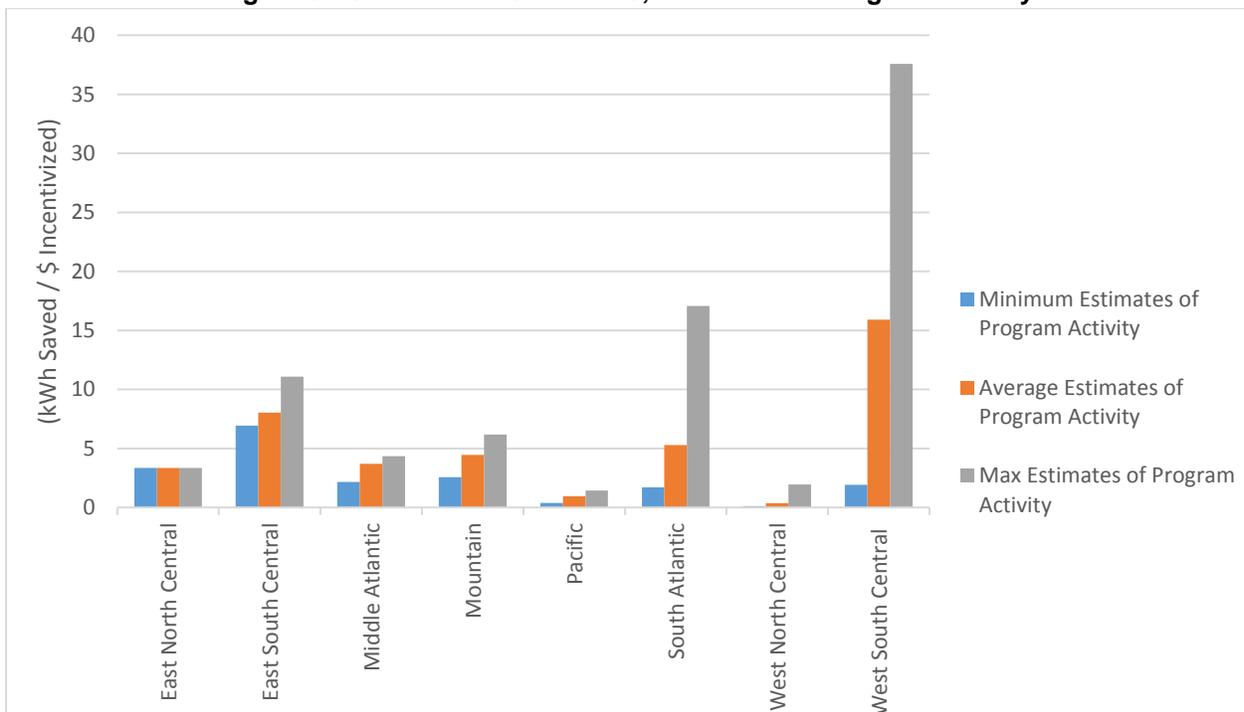


Figure 8 - Commercial Central AC, Estimates of Program Activity



APPENDIX A – Selected Utilities

Table 4 - Residential Utility Data Sources

Census Division	Residential Utility	Data Source
1	NSTAR Electric Company	http://www.masssave.com/
	Vermont Energy Investment Corporation	https://www.encyvermont.com/rebates/list?type=Residential
2	NJ Clean Energy Program	http://www.njcleanenergy.com/main/rebates-and-promotions/rebates-and-promotions
	Duquesne Light Co.	https://wattchoices.duquesnelight.com/Home/EnergyEfficiencyRebateProgram.cfm#EL
3	Commonwealth Edison Co.	https://www.comed.com/WaysToSave/ForYourHome/Pages/HomePromo.aspx
	Indiana Michigan Power Co.	http://www.electricideas.com/home/
4	Ameren Missouri	https://www.ameren.com/missouri/energy-efficiency/residential/hvac
	Omaha Public Power District	http://www.oppd.com/residential/products-programs/
5	AEP Appalachian Power West Virginia	http://takechargewv.com/residential/default.aspx
	Duke Energy	http://www.duke-energy.com/north-carolina/savings/smart-saver.asp https://www.progress-energy.com/carolinas/home/save-energy-money/energy-efficiency-improvements/heip/index.page?
6	Kentucky Utilities Co.	https://lge-ku.com/saving-energy-money/home-energy-rebates
	Tennessee Valley Authority	http://www.hartselleutilities.org/wp-content/uploads/2015/06/eScore-Rebate-Schedule-07.25.20141.pdf
7	Entergy Arkansas, Inc.	http://www.energy-arkansas.com/your_home/save_money/EE/residential-solutions.aspx
	Southwestern Electric Power Co. Arkansas	http://www.swepcogridsmart.com/arkansas/residential-overview.html
8	NorthWestern Energy	http://www.northwesternenergy.com/save-energy-money/residential-services/efficiency-plus-rebates-and-programs/montana/rebates-incentives
	Salt River Project	http://www.savewithsrp.com/RD/default.aspx
9	Pacific Gas & Electric Co.	http://www.pge.com/includes/docs/pdfs/shared/saveenergymoney/rebates/ee_residential_rebate_catalog.pdf
	San Diego Gas & Electric Co.	https://www.sdge.com/sites/default/files/documents/354174311/SDGE_PLA_2016_HEER_Application_v3.pdf

Table 5 - Commercial Utility Data Sources

Census Division	Commercial Utility	Data Source
1	Cape Light Compact	http://www.capelightcompact.org/energy-efficiency/business/business-incentives/
	NSTAR Electric Company	http://www.masssave.com/
2	Consolidated Edison Company of New York, Inc.	http://commercial.coned.com/incentives-and-rebates/
	New York State Elec. & Gas Corp.	http://nyseg.com/UsageAndSafety/usingenergywisely/eeps/cirprebates.html
3	Commonwealth Edison Co.	http://www.comed.com/WaysToSave/ForYourBusiness/Pages/Incentives.aspx
	Indianapolis Power & Light Co.	https://www.iplpower.com/Business/Business_Energy_Savings/Prescriptive_Incentives/
4	Lincoln Electric System	http://www.les.com/savings-energy/sep
	Xcel Energy	https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates/equipment_rebates
5	FirstEnergy Corporation Maryland	https://www.firstenergycorp.com/save_energy/save_energy_maryland.html
	Georgia Power Co.	http://business.georgiapower.com/rebates/?show=all
6	Tennessee Valley Authority	https://www.energyright.com/For-Business-%2B-Industry/Standard-Incentives
	Louisville Gas & Electric Co.	https://lge-ku.com/saving-energy-money/commercial-rebates
7	Public Service Co. of Oklahoma	http://www.powerforwardwithpso.com/wp-content/uploads/2015/03/19907-PSO-Business-Rebates-Sales-Sheet-Final.pdf
	Entergy Arkansas, Inc.	http://www.energy-arkansas.com/your_business/save_money/EE/business-solutions.aspx
8	Salt River Project	http://www.savewithsrpbiz.com/rebates/standardrebate.aspx
	El Paso Electric Co.	http://www.epesaver.com/
9	Pacific Gas & Electric Co.	http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/Business_Rebates_List.pdf
	Idaho Power Co.	https://www.idahopower.com/EnergyEfficiency/Business/new_construction/program_overview.cfm

APPENDIX B – Resources

- U.S. Energy Information Administration, Residential Demand Module; [online] Available at: <http://www.eia.gov/forecasts/aeo/assumptions/pdf/residential.pdf>
- U.S. Energy Information Administration, Commercial Demand Module; [online] Available at: <http://www.eia.gov/forecasts/aeo/assumptions/pdf/commercial.pdf>
- U.S. Energy Information Administration, Analysis and Projections, Analysis of Energy Efficiency Program Impacts Based on Program Spending; [online] Available at: <http://www.eia.gov/analysis/studies/buildings/efficiencyimpacts/>
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APPENDIX C – Detailed Estimates of Program Activity

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Commercial	1	Chiller	14.7264	21.0323	41.2339
Commercial	1	gas_boiler	0.1770	0.9088	1.7696
Commercial	1	gas_furnace	2.9493	4.4240	5.8986
Commercial	1	gas_other	2.3595	2.3595	2.3595
Commercial	1	Kitchen Equipment	0.8848	10.9452	70.7835
Commercial	1	LED	1.5342	14.0961	30.6843
Commercial	1	LED - Other	1.4152	1.8195	2.2239
Commercial	1	LED Fixtures	0.4721	2.4243	7.6711
Commercial	1	Lighting Controls	22.6608	41.3226	75.5360
Commercial	1	Linear Fluorescent	153.4217	153.4217	153.4217
Commercial	1	Occupancy Sensor	6.1369	8.3871	10.2281
Commercial	1	Photocell	6.1369	6.1369	6.1369
Commercial	2	central_AC	2.1736	3.6886	4.3472
Commercial	2	Chiller	11.9508	25.0967	47.8032
Commercial	2	gas_boiler	0.1180	1.3977	8.8479
Commercial	2	gas_furnace	0.7078	4.8369	17.6959
Commercial	2	gas_water_heater	5.6177	5.6177	5.6177
Commercial	2	GSHP	2.7170	2.7170	2.7170
Commercial	2	Kitchen Equipment	70.7835	70.7835	70.7835
Commercial	2	LED	15.2163	24.7265	38.0408
Commercial	2	LED - Other	1.5440	2.0586	2.5733
Commercial	2	LED Fixtures	0.7608	3.0815	15.2163
Commercial	2	Lighting Controls	14.9833	14.9833	14.9833
Commercial	2	Linear Fluorescent Fixtures	2.0288	4.7150	10.1442
Commercial	2	Metal-Halide Fixtures	3.3814	5.4948	7.6082
Commercial	2	Motor Controls	3.6227	8.6571	18.7258
Commercial	2	Occupancy Sensor	3.0433	5.8450	10.1442
Commercial	2	rooftop_ASHP	0.0830	0.1604	0.4149
Commercial	2	wall-window_room_AC	4.3472	4.3472	4.3472
Commercial	3	Anti-Sweat	34.0291	42.5363	51.0436
Commercial	3	Battery	3.2862	3.2862	3.2862
Commercial	3	central_AC	3.3515	3.3515	3.3515
Commercial	3	CFL	16.9214	49.9180	76.1462
Commercial	3	Chiller	1.4742	2.2932	2.4570
Commercial	3	Dishwasher	0.6554	1.0330	1.2640

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Commercial	3	GSHP	0.4788	0.4788	0.4788
Commercial	3	Induction	1.2183	1.6245	2.0306
Commercial	3	Kitchen Equipment	1.1797	10.0716	63.1996
Commercial	3	LED	3.3843	23.4796	118.4496
Commercial	3	LED - Other	1.5453	2.3179	2.5754
Commercial	3	LED Fixtures	0.3807	1.4037	3.3843
Commercial	3	Lighting Controls	20.4491	21.9638	24.9933
Commercial	3	Linear Fluorescent	4.3512	57.0307	152.2923
Commercial	3	Linear Fluorescent Fixtures	3.3843	3.3843	3.3843
Commercial	3	Metal-Halide	5.0764	6.5268	15.2292
Commercial	3	Motor	11.3430	19.1751	29.1678
Commercial	3	Motor Controls	2.7930	22.6363	40.8349
Commercial	3	Occupancy Sensor	3.8073	4.4419	5.0764
Commercial	3	Refrigerator	9.2807	23.2788	51.0436
Commercial	3	rooftop_ASHP	0.1599	0.1942	0.2285
Commercial	3	Transformer	2.3569	10.2020	29.4931
Commercial	3	VAV_Vent	45.1425	45.1425	45.1425
Commercial	3	wall-window_room_AC	4.7879	4.7879	4.7879
Commercial	3	wall-window_room_ASHP	4.7879	4.9874	5.5859
Commercial	4	Anti-Sweat	83.5228	83.5228	83.5228
Commercial	4	central_AC	0.1074	0.3570	1.9330
Commercial	4	CFL	304.1725	304.1725	304.1725
Commercial	4	CFL Fixtures	4.3453	5.1661	6.0834
Commercial	4	Chiller	2.8341	3.4540	5.3139
Commercial	4	Dishwasher	7.0784	9.4378	14.1567
Commercial	4	gas_boiler	0.0506	0.3312	0.7078
Commercial	4	gas_furnace	2.5280	6.4716	11.7973
Commercial	4	GSHP	0.1074	0.4234	1.9330
Commercial	4	Heat Exchanger	0.3222	0.5168	0.8054
Commercial	4	high_pressure_sodium	3.3797	4.2246	5.0695
Commercial	4	Kitchen Equipment	1.7696	5.0675	11.7973
Commercial	4	LED	0.9505	8.6704	22.1032
Commercial	4	LED - Other	0.7716	0.7716	0.7716
Commercial	4	LED Fixtures	0.7604	2.7391	6.0834
Commercial	4	Linear Fluorescent	8.5168	84.9607	304.1725
Commercial	4	Metal-Halide Fixtures	1.2674	2.4450	6.0834
Commercial	4	Motor	17.6959	17.6959	17.6959
Commercial	4	Occupancy Sensor	3.8022	6.2736	10.1391

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Commercial	4	Photocell	6.0834	6.0834	6.0834
Commercial	4	Refrigerator	10.0227	10.0227	10.0227
Commercial	4	rooftop_AC	6.4432	6.4432	6.4432
Commercial	4	rooftop_ASHP	0.0051	0.0171	0.0922
Commercial	4	wall-window_room_AC	1.2886	1.2886	1.2886
Commercial	5	Anti-Sweat	132.3278	205.8432	352.8740
Commercial	5	Battery	1.2093	2.1163	3.0233
Commercial	5	central_AC	1.7076	5.2853	17.0757
Commercial	5	CFL	23.3647	72.4307	121.4967
Commercial	5	CFL Fixtures	3.0374	5.7630	10.1247
Commercial	5	Chiller	6.2589	8.5122	15.0215
Commercial	5	Dishwasher	7.0784	38.9309	70.7835
Commercial	5	GSHP	1.1384	3.1116	6.8303
Commercial	5	Kitchen Equipment	2.3595	15.4839	44.2397
Commercial	5	LED	5.6952	39.6535	151.8709
Commercial	5	LED - Other	2.2014	2.2014	2.2014
Commercial	5	LED Fixtures	0.3797	2.2022	10.1247
Commercial	5	Lighting Controls	14.9545	31.5113	44.8635
Commercial	5	Linear Fluorescent	9.1123	24.7673	86.0602
Commercial	5	Linear Fluorescent Fixtures	1.7867	3.5935	6.0748
Commercial	5	Occupancy Sensor	16.8745	19.2852	21.6958
Commercial	5	Refrigerator	7.0575	18.5259	42.3449
Commercial	5	rooftop_ASHP	0.0163	0.1476	0.4074
Commercial	5	Supermkt_display_case	529.3110	529.3110	529.3110
Commercial	5	wall-window_room_AC	1.7076	2.9527	5.6919
Commercial	5	wall-window_room_ASHP	0.5692	2.7511	5.6919
Commercial	6	Battery	3.0233	3.0233	3.0233
Commercial	6	central_AC	6.9220	8.0295	11.0752
Commercial	6	CFL	34.9557	49.8846	76.4655
Commercial	6	Chiller	4.6840	109.3844	553.5695
Commercial	6	GSHP	13.8440	13.8440	13.8440
Commercial	6	Kitchen Equipment	3.5392	8.4310	14.7466
Commercial	6	LED	21.8473	59.1242	152.9310
Commercial	6	LED Fixtures	1.7379	3.4178	5.0977
Commercial	6	Lighting Controls	225.8833	225.8833	225.8833
Commercial	6	Linear Fluorescent	12.7442	59.4625	382.3275
Commercial	6	Metal-Halide	6.3721	10.6202	12.7442

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Commercial	6	Motor	52.3237	52.3237	52.3237
Commercial	6	Motor Controls	5.5376	31.6219	34.8825
Commercial	6	Refrigerator	2.4623	11.8665	20.9295
Commercial	6	rooftop_AC	9.2293	9.6908	11.0752
Commercial	6	rooftop_ASHP	0.3303	0.3925	0.5285
Commercial	6	Supermkt_display_case	6.9765	6.9765	6.9765
Commercial	6	wall-window_room_AC	6.9220	8.4053	27.6879
Commercial	6	wall-window_room_ASHP	6.9220	6.9220	6.9220
Commercial	7	Anti-Sweat	131.4421	131.4421	131.4421
Commercial	7	central_AC	1.9125	15.9068	37.5802
Commercial	7	Kitchen Equipment	3.2619	3.2619	3.2619
Commercial	7	LED	3.4655	16.6688	38.1202
Commercial	7	LED - Other	0.7547	0.8852	1.1461
Commercial	7	Linear Fluorescent	30.4961	61.5005	101.6538
Commercial	7	Linear Fluorescent Fixtures	3.0496	3.0496	3.0496
Commercial	7	Motor	210.3074	210.3074	210.3074
Commercial	7	Occupancy Sensor	6.0992	6.0992	6.0992
Commercial	7	Refrigerator	6.5721	14.3549	22.1376
Commercial	7	rooftop_ASHP	0.3520	0.5964	0.8213
Commercial	8	Anti-Sweat	341.0388	341.0388	341.0388
Commercial	8	central_AC	2.5542	4.4408	6.1727
Commercial	8	CFL	26.8252	26.8252	26.8252
Commercial	8	Chiller	1.0181	1.4707	2.0363
Commercial	8	LED	8.7374	10.4266	12.2323
Commercial	8	Motor	10.2312	25.5779	40.9247
Commercial	8	Motor Controls	13.6416	13.6416	13.6416
Commercial	8	Refrigerator	34.1039	34.1039	34.1039
Commercial	8	rooftop_ASHP	0.1219	0.1219	0.1219
Commercial	8	wall-window_room_AC	0.9259	2.4132	3.0863
Commercial	8	wall-window_room_ASHP	3.0863	3.0863	3.0863
Commercial	9	Anti-Sweat	40.3574	43.7206	50.4468
Commercial	9	central_AC	0.3746	0.9499	1.4270
Commercial	9	Chiller	0.8238	0.8987	1.6477
Commercial	9	Dishwasher	3.5392	6.1936	8.8479
Commercial	9	gas_boiler	0.3539	0.7742	1.2640
Commercial	9	gas_furnace	5.8986	8.4055	11.7973
Commercial	9	gas_water_heater	9.1205	9.1205	9.1205

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Commercial	9	Induction	3.4280	7.2655	12.3408
Commercial	9	Kitchen Equipment	0.3539	5.0897	50.5596
Commercial	9	LED	8.7928	17.2000	39.8091
Commercial	9	LED Fixtures	0.7713	2.0246	3.8565
Commercial	9	Linear Fluorescent	102.8403	128.5504	154.2605
Commercial	9	Linear Fluorescent Fixtures	1.2341	3.4623	7.7130
Commercial	9	Motor	13.4525	18.9776	28.8267
Commercial	9	Motor Controls	13.4525	13.4525	13.4525
Commercial	9	Occupancy Sensor	6.1704	8.2272	10.2840
Commercial	9	Refrigerator	5.0447	10.9488	20.1787
Commercial	9	rooftop_ASHP	0.0184	0.0438	0.1192
Commercial	9	Supermkt_display_case	5.7653	121.8410	288.2675
Residential	1	Air-Source Heat Pump	0.3380	0.8519	1.3518
Residential	1	Biomass Furnace	0.8748	0.8748	0.8748
Residential	1	Central Air Conditioner	0.1694	0.3388	0.5083
Residential	1	Clothes Washer	1.0752	3.1062	5.3761
Residential	1	Electricity Water Heater	1.0940	1.4587	2.1881
Residential	1	Fuel Oil Boiler	0.4999	1.9202	4.3740
Residential	1	Fuel Oil Furnace	2.3328	4.0824	6.9984
Residential	1	Fuel Oil Water Heater	1.9369	3.6586	5.1651
Residential	1	General Service – Light-Emitting Diode (LED)	9.6091	12.8943	19.4646
Residential	1	Liquefied Petroleum Gas (LPG) Furnace	1.7496	3.0618	3.4992
Residential	1	Natural Gas Furnace	1.7496	3.8491	5.8320
Residential	1	Natural Gas Water Heater	0.4427	5.6988	15.4954
Residential	1	Natural Gas Boiler	3.8739	5.8249	7.7760
Residential	1	Refrigerator	0.5320	1.7512	3.3250
Residential	1	Room Air Conditioner	0.7066	0.7066	0.7066
Residential	1	Solar Water Heater	2.4826	2.4826	2.4826
Residential	2	Air-Source Heat Pump	0.7781	1.7767	3.8905
Residential	2	Central Air Conditioner	0.3291	0.7337	1.6456
Residential	2	Clothes Washer	3.0674	3.0674	3.0674
Residential	2	Electricity Water Heater	1.4136	10.9608	29.4495
Residential	2	Exterior (LED)	19.6228	19.6228	19.6228
Residential	2	Freezer	98.9000	98.9000	98.9000
Residential	2	Fuel Oil Furnace	6.2391	6.2391	6.2391
Residential	2	gas_furnace	1.5998	4.5793	15.5977

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Residential	2	General Service – Compact Fluorescent Lamp (CFL)	5.7198	5.7198	5.7198
Residential	2	General Service – Light-Emitting Diode (LED)	3.4557	19.0064	34.5571
Residential	2	Ground-Source Heat Pump	2.9445	2.9445	2.9445
Residential	2	Natural Gas Water Heater	3.1283	3.1283	3.1283
Residential	2	Natural Gas Boiler	1.9497	4.3869	5.1992
Residential	2	Occupancy Sensor	13.7360	13.7360	13.7360
Residential	2	Refrigerator	2.1280	3.3693	5.3200
Residential	2	Room Air Conditioner	1.3016	1.3016	1.3016
Residential	2	Solar Water Heater	1.5872	3.9679	6.3486
Residential	3	Air-Source Heat Pump	0.2269	0.7839	1.5125
Residential	3	Ceiling Fans	10.8000	10.8000	10.8000
Residential	3	Central Air Conditioner	0.4265	0.7336	1.1374
Residential	3	Clothes Washer	4.3500	4.3500	4.3500
Residential	3	Electricity Water Heater	1.7962	2.6515	3.5923
Residential	3	Ground-Source Heat Pump	0.6439	0.6439	0.6439
Residential	3	Refrigerator	2.6600	2.9925	3.3250
Residential	3	Room Air Conditioner	1.5180	1.5180	1.5180
Residential	3	Upright Freezer (automatic defrost, 20 cubic foot capacity)	39.5600	39.5600	39.5600
Residential	4	Air-Source Heat Pump	0.5650	1.2660	2.9057
Residential	4	Central Air Conditioner	0.2731	0.5254	0.7647
Residential	4	Electricity Water Heater	1.8026	1.8026	1.8026
Residential	4	Ground-Source Heat Pump	0.9621	1.4432	2.4053
Residential	4	Room Air Conditioner	1.8901	1.8901	1.8901
Residential	5	Air-Source Heat Pump	0.8987	1.8307	3.5946
Residential	5	Central Air Conditioner	0.5406	0.6938	0.8650
Residential	5	Clothes Washer	4.0157	4.0157	4.0157
Residential	5	Electricity Water Heater	0.8056	1.0358	1.1509
Residential	5	Ground-Source Heat Pump	5.4412	5.4412	5.4412
Residential	5	Refrigerator	2.6600	2.6600	2.6600
Residential	5	Upright Freezer (automatic defrost, 20 cubic foot capacity)	39.5600	39.5600	39.5600
Residential	6	Air-Source Heat Pump	0.8761	3.5481	43.8048
Residential	6	Central Air Conditioner	0.3294	1.3675	16.4701
Residential	6	Clothes Washer	2.2451	2.2451	2.2451
Residential	6	Dishwasher	1.7573	1.7573	1.7573
Residential	6	Electricity Water Heater	1.0240	1.2800	1.5360

Sector	Census Division	Technology Choice	Min of Estimates of Program Activity (kWh Saved / \$ incent)	Average of Estimates of Program Activity (kWh Saved / \$ incent)	Max of Estimates of Program Activity (kWh Saved / \$ incent)
Residential	6	Ground-Source Heat Pump	4.9731	4.9731	4.9731
Residential	6	Refrigerator	1.3300	1.3300	1.3300
Residential	6	Upright Freezer (automatic defrost, 20 cubic foot capacity)	19.7800	19.7800	19.7800
Residential	7	Air-Source Heat Pump	1.9195	4.5649	10.5571
Residential	7	Biomass Cookstove	5.1992	5.1992	5.1992
Residential	7	Ceiling Fans	1.5032	1.5032	1.5032
Residential	7	Central Air Conditioner	0.7443	2.0836	9.9234
Residential	7	Clothes Washer	7.6685	7.6685	7.6685
Residential	7	Electricity Water Heater	1.0075	1.0915	1.1755
Residential	7	General Service – Compact Fluorescent Lamp (CFL)	7.1497	20.3900	28.5989
Residential	7	General Service – Light-Emitting Diode (LED)	2.3038	8.3513	17.2785
Residential	7	Natural Gas Furnace	10.3985	10.3985	10.3985
Residential	7	Natural Gas Water Heater	2.0811	2.0811	2.0811
Residential	7	Natural Gas Boiler	10.3985	10.3985	10.3985
Residential	8	Air-Source Heat Pump	0.7654	1.5946	3.0616
Residential	8	Central Air Conditioner	0.2878	0.5995	1.1511
Residential	8	General Service – Compact Fluorescent Lamp (CFL)	5.1139	5.1139	5.1139
Residential	8	Natural Gas Furnace	18.3092	18.3092	18.3092
Residential	8	Natural Gas Boiler	9.9074	9.9074	9.9074
Residential	8	Solar Water Heater	1.4594	1.4594	1.4594
Residential	9	Clothes Washer	0.8801	2.5303	3.0804
Residential	9	Electricity Water Heater	0.9347	1.2463	1.8695
Residential	9	Exterior (Halogen)	2.4570	2.4570	2.4570
Residential	9	Exterior (LED)	7.2210	21.8743	36.1049
Residential	9	General Service – Compact Fluorescent Lamp (CFL)	3.8488	4.3299	4.8110
Residential	9	General Service – Light-Emitting Diode (LED)	1.4533	2.3011	2.9066
Residential	9	Natural Gas Furnace	4.1771	5.9523	8.3541
Residential	9	Natural Gas Water Heater	1.6549	4.5509	8.2744
Residential	9	Refrigerator	5.3200	5.3200	5.3200

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