# Ameren Illinois Energy Efficiency Market Potential Assessment

Report Number 1404

Volume 3: Energy Efficiency Potential Analysis

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# INTRODUCTION

## Background

Ameren Illinois contracted with EnerNOC to conduct an electricity and natural gas Energy Efficiency (EE) Market Potential study covering the period of performance from June 1, 2014 through May 31, 2017 to aid the development of a three-year plan for programs implemented by Ameren Illinois in Cycle 3. In addition, the analysis also included the period of performance from June 1, 2017 through May 31, 2024 to aid in benchmarking and other tasks related to future analyses. This study identifies the potential to achieve the kWh and therm annual load reduction targets within the rated caps identified in Sections 8-103 and 8-104 of the Illinois Public Utilities Act. In addition, the electric component of the study identifies the potential to achieve additional kWh savings per Section 5/16-111.5Bnew of the Act absent rate cap limitations. This comprehensive study includes primary market research, a full demand side management (DSM) potential analysis for electricity and natural gas, energy efficiency program design, supply curve development, and analysis of wasted energy.

EnerNOC teamed with YouGov|Definitive Insights and Washington University in St. Louis to perform saturation surveys and program-interest research with Ameren Illinois customers. The EnerNOC team worked in collaboration with Applied Energy Group who, under separate contract with Ameren Illinois, performed the program analysis. This report represents the combined effort of these four organizations.

## Objectives

The study addresses energy efficiency potential and informs the program design process in the following ways:

- Develop three-year plan for electric and natural gas EE programs implemented in Cycle 3 (2014-2017)
- Develop EE potential estimates for 2017-2024 for benchmarking and future analyses
- Conduct market research to better represent customers in the Ameren Illinois service territory
- Quantify wasted energy due to customer behavior

## Report Organization

This report is presented in 6 volumes as outlined below. This document is **Volume 3: Energy Efficiency Potential Analysis**.

- Volume 1, Executive Summary
- Volume 2, Market Research Report
- Volume 3, Energy Efficiency Potential Analysis
- Volume 4, Program Analysis
- Volume 5, Supply Curves
- Volume 6, EE Potential Analysis Appendices

## Definitions of Potential

In this study, we estimate the potential for energy efficiency savings. The savings estimates represent net savings[1] developed into three types of potential: technical potential, economic potential, and achievable potential. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. Because estimating achievable potential involves the inherent uncertainty of predicting human behaviors and responses to market conditions, we developed realistic and maximum achievable potential as boundaries for a likely range. The various levels are described below.

- **Technical Potential** is defined as the theoretical upper limit of energy efficiency potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option. Examples of measures that make up technical potential for electricity in the residential sector include:
  - Ductless mini-split air conditioners with variable refrigerant flow
  - Ground source (or geothermal) heat pumps
  - LED lighting

  Technical potential also assumes the adoption of every other available measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and air conditioner maintenance in all existing buildings with central and room air conditioning. These retrofit measures are phased in over a number of years, which is longer for higher-cost and complex measures.
- **Economic Potential** represents the adoption of all ***cost-effective*** energy efficiency measures. In this analysis, the cost effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure. If the benefits outweigh the costs (that is, if the TRC ratio is greater than 1.0), a given measure is considered in the economic potential. Customers are then assumed to purchase the most cost-effective option applicable to them at any decision juncture.
- **Maximum Achievable Potential** estimates customer adoption of economic measures when delivered through efficiency programs under ideal market, implementation, and customer preference conditions and an appropriate regulatory framework. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. Maximum Achievable Potential establishes a maximum target for the EE savings that an administrator can hope to achieve through its EE programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs.
- **Realistic Achievable Potential** reflects expected program participation given barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential.

[1] Savings in "net" terms instead of "gross" terms mean that the baseline forecast does include naturally occurring efficiency. In other words, the baseline assumes that energy efficiency levels reflect that some customers are already purchasing the more efficient option. In the baseline forecast chapter we explore other types of baselines, including a codes and standards case and a business-as-usual case.

## Abbreviations and Acronyms

Throughout the report we use several abbreviations and acronyms. Table 1-1 shows the abbreviation or acronym, along with an explanation.

***Table 1-1 Explanation of Abbreviations and Acronyms***

| Acronym | Explanation |
|---|---|
| ACS | American Community Survey |
| AEO | Annual Energy Outlook forecast developed annual by the Energy Information Administration of the DOE |
| AHAM | Association of Home Appliance Manufacturers |
| B/C Ratio | Benefit to cost ratio |
| BEST | EnerNOC's Building Energy Simulation Tool |
| CAC | Central air conditioning |
| C&I | Commercial and industrial |
| CFL | Compact fluorescent lamp |
| DEEM | EnerNOC's Database of Energy Efficiency Measures |
| DEER | State of California Database for Energy-Efficient Resources |
| DSM | Demand side management |
| DR | Demand response |
| EE | Energy efficiency |
| EIA | Energy Information Administration |
| EISA | Energy Efficiency and Security Act of 2007 |
| EPACT | Energy Policy Act of 2005 |
| EPRI | Electric Power Research Institute |
| EUEA | Efficient Use of Energy Act |
| EUI | Energy-use index |
| HH | Household |
| HID | High intensity discharge lamps |
| LED | Light emitting diode lamp |
| LoadMAP | EnerNOC's Load Management Analysis and Planning™ tool |
| NWPCC | Northwest Power and Conservation Council |
| MMTherms | Million therms |
| RTU | Roof top unit |
| Sq. ft. | Square feet |
| TRC | Total resource cost |
| TRM | Technical Reference Manual |
| UEC | Unit energy consumption |

# ANALYSIS APPROACH AND DATA DEVELOPMENT

This section describes the analysis approach taken for the study and the data sources used to develop the potential estimates.

## Analysis Approach

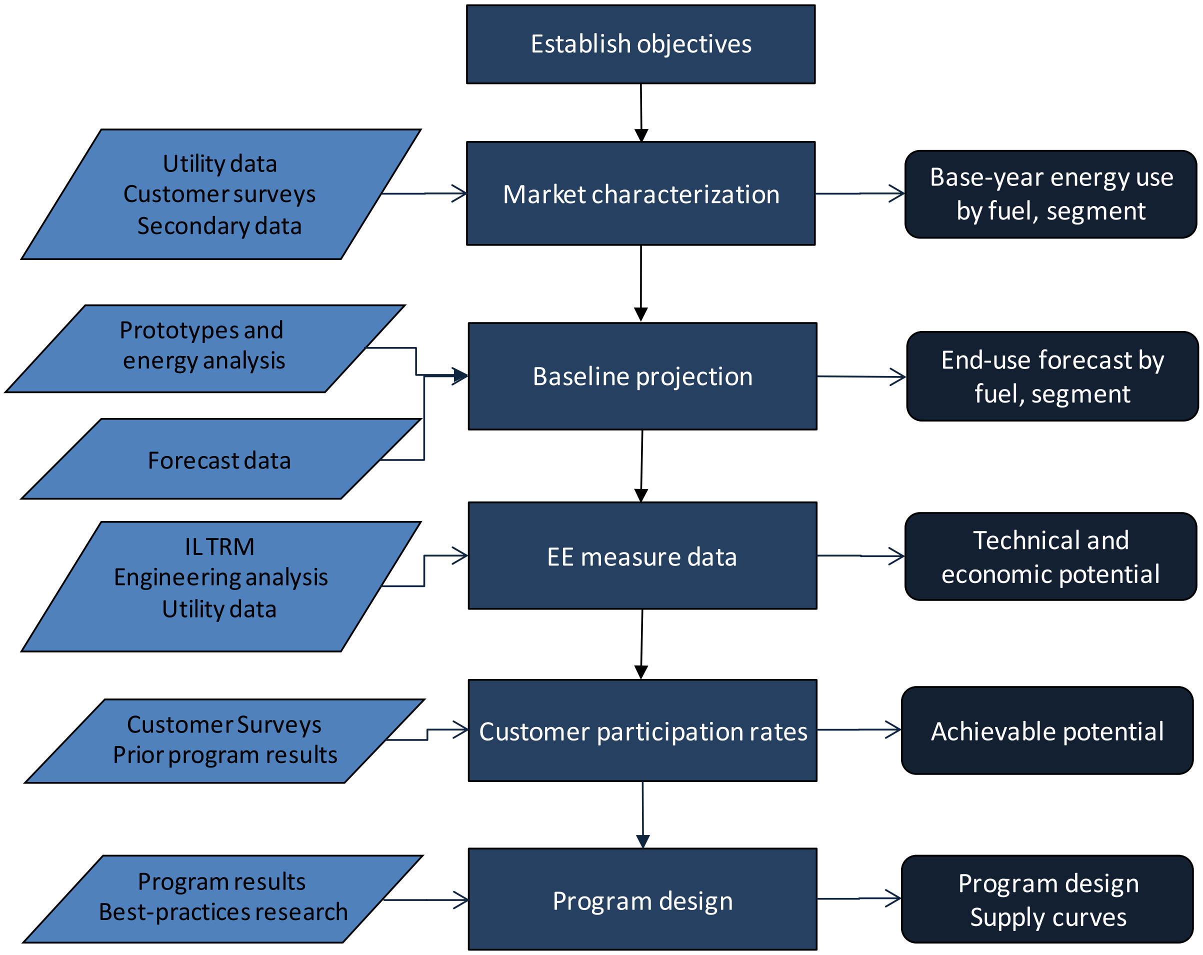
To perform the energy efficiency analysis, EnerNOC used a bottom-up analysis approach as shown in Figure 2-1. This involved the following steps.

1. Held a meeting with the client project team to refine the objectives of the project in detail. This resulted in a work plan for the study.
2. Conducted primary market research to identify equipment saturations, building characteristics, measure applicability and saturations, occupant behavior, and customer interest in programs.[2]
3. Performed a market characterization to describe sector-level electricity and natural gas use for the residential, commercial, and industrial sectors for the base year, 2011. This included using the results from the customer surveys and other secondary data sources such as the Energy Information Administration (EIA).
4. Developed a baseline electricity and natural gas projection by sector, segment, and end use for 2011 through 2024. Results presented in this volume focus on the upcoming three-year implementation cycle of 2014 through 2016[3]. Results beyond 2016 are available in the Appendices and in the LoadMAP models.
5. Identified several hundred measures and estimated their effects in four levels of energy-efficiency potential: *Technical, Economic, Maximum Achievable,* and *Realistic Achievable*. Measure costs and savings were taken from the Illinois TRM where available.
6. Reviewed the current programs offered in Illinois in light of the study findings to make strategic program recommendations for achieving savings.
7. Worked with AEG to develop appropriate program designs.
8. Incorporated the results of the program design analysis to develop supply curves.
9. Quantified wasted energy due to customer behavior.

These steps are described in further detail throughout the remainder of this chapter.

[2] Details on the market research methodology and results are available in Volume 2, Market Research.
[3] Note that 2014 represents the plan year that runs June 1, 2014 through May 31, 2015 and 2016 represents the plan year that runs June 1, 2016, through May 31, 2017.

***Figure 2-1 Overview of Analysis Approach***




## LoadMAP Model

We used EnerNOC's Load Management Analysis and Planning tool (LoadMAP™) version 3.0 to develop both the baseline projection and the estimates of energy efficiency potential. EnerNOC developed LoadMAP in 2007 and has enhanced it over time, using it for the EPRI National Potential Study and numerous utility-specific forecasting and potential studies. Built in Excel, the LoadMAP framework (see Figure 2-2) is both accessible and transparent and has the following key features.

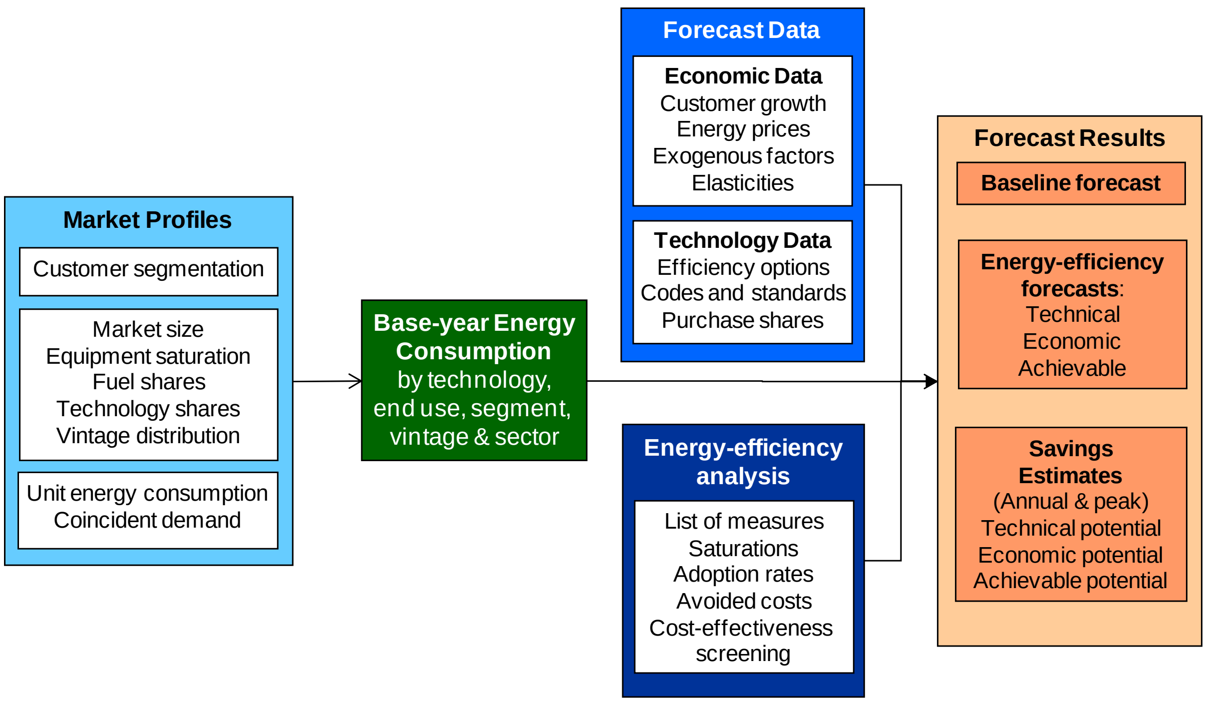
- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life and appliance vintage distributions defined by the user.
- Balances the competing needs of simplicity and robustness by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction and existing buildings separately.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision choice algorithms or diffusion assumptions, and the model

parameters tend to be difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.

- Includes appliance and equipment models customized by end use. For example, the logic for lighting is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

Consistent with the segmentation scheme and the market profiles we describe below, the LoadMAP model provides projections of baseline energy use by sector, fuel, segment, end use, and technology for existing and new buildings. It also provides projections of total energy use and energy-efficiency savings associated with the four types of potential.[4]

***Figure 2-2 LoadMAP Analysis Framework***




## Market Characterization

In order to estimate the savings potential from energy-efficient measures, it is necessary to understand how much energy is used today and what equipment is currently being used. This characterization begins with a segmentation of Ameren Illinois' energy footprint to quantify energy use by sector, segment, fuel, end-use application, and the current set of technologies used. We incorporate information from the primary market research analysis to advise the market characterization.

[4] The model computes energy and peak-demand forecasts for each type of potential for each end use as an intermediate calculation. Annual-energy and peak-demand savings are calculated as the difference between the value in the baseline forecast and the value in the potential forecast (e.g., the technical potential forecast).

### *Segmentation for Modeling Purposes*

The market assessment first defined the market segments (building types, end uses and other dimensions) that are relevant in Illinois. The segmentation scheme for this project is presented in Table 2-1.

***Table 2-1 Overview of Segmentation Scheme for Potentials Modeling***

| Market Dimension | Segmentation Variable | Dimension Examples |
|---|---|---|
| 1 | Sector | Residential, commercial, industrial |
| 2 | Building type | Residential (housing type)<br>Commercial (Office, Restaurant, Retail, etc.)<br>Industrial (Food Products, Petroleum, Metals, etc.) |
| 3 | Vintage | Existing and new construction |
| 4 | Fuel | Electricity, natural gas |
| 5 | End uses | Cooling, heating, lighting, water heat, motors, etc. (as appropriate by sector) |
| 6 | Appliances/end uses and technologies | Technologies such as lamp type, air conditioning equipment, motors by functional use, etc. |
| 7 | Equipment efficiency levels for new purchases | Baseline and array of higher-efficiency options as appropriate for each technology |

Following this scheme, the residential sector was segmented as described below, starting with customer segments by building type. The housing types are further separated based on what type of customer they are to Ameren Illinois. A single family- Electric only customer could represent an all-electric home or it could represent a single family home that gets the electricity service from Ameren Illinois, but the natural gas service from another utility. The designation Electric/Gas indicates that the customer receives both electricity and natural gas from Ameren Illinois. Gas only indicates that the customer receives natural gas from Ameren Illinois, but electricity from another utility. Ultimately, there are six segments in the residential analysis:

1. Single family - Electric only
2. Multi family – Electric only
3. Single family – Electric/Gas
4. Multi family – Electric/Gas
5. Single family – Gas only
6. Multi family Gas only

In addition to segmentation by housing type, we identified the set of end uses and technologies that are appropriate for Ameren Illinois. These are shown in Table 2-2 and Table 2-3.

***Table 2-2 Residential Electric End Uses and Technologies***

| End Use | Technology |
|---|---|
| Cooling | Central AC |
| Cooling | Room AC |
| Cooling | Air-Source Heat Pump |
| Cooling | Geothermal Heat Pump |
| Cooling | PTHP |
| Heating | Electric Room Heat |
| Heating | Furnace |
| Heating | Air-Source Heat Pump |
| Heating | Geothermal Heat Pump |
| Heating | PTHP |
| Water Heating | Water Heater <= 55 gal |
| Water Heating | Water Heater > 55 gal |
| Interior Lighting | Screw-in |
| Interior Lighting | Linear Fluorescent |
| Interior Lighting | Specialty |
| Exterior Lighting | Screw-in |
| Appliances | Refrigerator |
| Appliances | Second Refrigerator |
| Appliances | Freezer |
| Appliances | Clothes Washer |
| Appliances | Clothes Dryer |
| Appliances | Dishwasher |
| Appliances | Stove |
| Appliances | Microwave |
| Electronics | Personal Computers |
| Electronics | Monitor |
| Electronics | Laptops |
| Electronics | TVs |
| Electronics | Printer/Fax/Copier |
| Electronics | Set-top Boxes/DVR |
| Electronics | Devices and Gadgets |
| Miscellaneous | Air Purifier/Cleaner |
| Miscellaneous | Dehumidifier |
| Miscellaneous | Pool Heater |
| Miscellaneous | Pool Pump |
| Miscellaneous | Hot Tub / Spa |
| Miscellaneous | Well Pump |
| Miscellaneous | Furnace Fan |
| Miscellaneous | Bathroom Exhaust Fan |
| Miscellaneous | Miscellaneous |

***Table 2-3 Residential Natural Gas End Uses and Technologies***

| End Use | Technology |
|---|---|
| Heating | Furnace |
| Heating | Boiler |
| Heating | Other Heating |
| Water Heating | Water Heater <= 55 gal |
| Water Heating | Water Heater > 55 gal |
| Appliances | Clothes Dryer |
| Appliances | Stove |
| Miscellaneous | Pool Heater |
| Miscellaneous | Hot Tub / Spa |
| Miscellaneous | Miscellaneous |

For the commercial sector, it is useful to analyze the segments based on the unique characteristics of the building type. We also segmented electricity use and natural gas use. For this study, we used the following building types for each fuel.

- Office—all types of offices, including medical/dental offices, and large government facilities
- Restaurant—fast-food, sit-down and cafeteria-style restaurants
- Retail—retail establishments such as small boutiques, and large box retailers
- Grocery—convenience stores, small markets, and supermarkets
- College—colleges, universities and technical colleges
- School—primary and secondary schools
- Health—hospitals and nursing homes
- Lodging—motels, hotels, resorts and small inns
- Warehouse—storage facilities, refrigerated and unrefrigerated
- Miscellaneous—all remaining building types, such as police stations, parking garages, public assembly, amusement parks, etc.

In addition to segmentation by building type, we identified the set of end uses and technologies that are appropriate for Ameren Illinois. Table 2-4 and Table 2-5 list the end uses and technologies used in this study.

***Table 2-4 Commercial Electric End Uses and Technologies***

| End Use | Technology |
|---|---|
| Cooling | Air-Cooled Chiller |
| Cooling | Water-Cooled Chiller |
| Cooling | Roof top AC |
| Cooling | Air Source Heat Pump |
| Cooling | Geothermal Heat Pump |
| Cooling | PTAC |
| Cooling | PTHP |
| Cooling | Evaporative AC |
| Heating | Air Source Heat Pump |
| Heating | Geothermal Heat Pump |
| Heating | Electric Room Heat |
| Heating | Electric Furnace |
| Heating | PTAC |
| Heating | PTHP |
| Ventilation | Ventilation |
| Water Heating | Water Heating |
| Interior Lighting | Screw-in |
| Interior Lighting | High-Bay Fixtures |
| Interior Lighting | Linear Fluorescent |
| Exterior Lighting | Screw-in |
| Exterior Lighting | HID |
| Exterior Lighting | Linear Fluorescent |
| Refrigeration | Walk-in Refrigerator |
| Refrigeration | Reach-in Refrigerator |
| Refrigeration | Glass Door Display |
| Refrigeration | Open Display Case |
| Refrigeration | Icemaker |
| Refrigeration | Vending Machine |
| Food Preparation | Oven |
| Food Preparation | Fryer |
| Food Preparation | Dishwasher |
| Food Preparation | Hot Food Container |
| Food Preparation | Other |
| Office Equipment | Desktop Computer |
| Office Equipment | Laptop |
| Office Equipment | Server |
| Office Equipment | Monitor |
| Office Equipment | Printer/Copier/Fax |
| Office Equipment | POS Terminal |
| Miscellaneous | Non-HVAC Motors |
| Miscellaneous | Pool Pump |
| Miscellaneous | Pool Heater |
| Miscellaneous | Miscellaneous |

***Table 2-5 Commercial Natural Gas End Uses and Technologies***

| End Use | Technology |
|---|---|
| Heating | Furnace |
| Heating | Boiler |
| Heating | Unit Heater |
| Water Heating | Water Heater |
| Food Preparation | Oven |
| Food Preparation | Fryer |
| Food Preparation | Broiler |
| Food Preparation | Griddle |
| Food Preparation | Range |
| Food Preparation | Steamer |
| Food Preparation | Other |
| Miscellaneous | Pool Heater |
| Miscellaneous | Miscellaneous |

For the industrial sector, the study isolated the top four industries in Ameren Illinois by energy consumption, which accounted for 75% of the total 2011 industrial electricity sales and 65% of natural gas sales. The remaining group of industrial customers is considered in aggregate as "other industrial.[5]" While the commercial sector has a relatively small set of building types that have relatively uniform characteristics, the sheer number of unique industry types makes it infeasible to perform a deep dive into all but the largest ones. This results in a larger "other" segment than that which exists in the commercial sector. Nonetheless, these "other" industries typically have energy use characteristics that are similar enough to perform an accurate potential assessment.

The resulting segmentation is as follows for electricity and natural gas:

- Food products
- Petroleum
- Metals
- Machinery
- Other industrial

In addition to segmentation by industry, we identified the set of end uses and technologies that are appropriate for Ameren Illinois. These are shown in Table 2-6 and Table 2-7.

[5] Natural Gas customers that have opted out of energy efficiency programs (Self-Direct Customers) have been removed.

***Table 2-6 Industrial Electric End Uses and Technologies***

| End Use | Technology |
|---|---|
| Cooling | Air-Cooled Chiller |
| Cooling | Water-Cooled Chiller |
| Cooling | Roof top AC |
| Cooling | Other Cooling |
| Cooling/Heating | Air-Source Heat Pump |
| Cooling/Heating | Geothermal Heat Pump |
| Heating | Electric Resistance |
| Heating | Electric Furnace |
| Ventilation | Ventilation |
| Interior Lighting | Screw-in |
| Interior Lighting | High-Bay Fixtures |
| Interior Lighting | Linear Fluorescent |
| Exterior Lighting | Screw-in |
| Exterior Lighting | HID |
| Exterior Lighting | Linear Fluorescent |
| Motors | Pumps |
| Motors | Fans & Blowers |
| Motors | Compressed Air |
| Motors | Material Handling |
| Motors | Material Processing |
| Motors | Other Motors |
| Process | Process Heating |
| Process | Process Cooling and Refrigeration |
| Process | Electro-Chemical Processes |
| Process | Other Process |
| Miscellaneous | Miscellaneous |

***Table 2-7 Industrial Natural Gas End Uses and Technologies***

| End Use | Technology |
|---|---|
| Heating | Furnace |
| Heating | Boiler |
| Heating | Other Heating |
| Process | Process Heating |
| Process | Process Boiler |
| Process | Process Cooling and Refrigeration |
| Process | Other Process |
| Miscellaneous | Miscellaneous |

With the segmentation scheme defined, we then performed a high-level market characterization of electricity and natural gas sales in the base year to allocate sales to each customer segment. We used various data sources to identify the annual sales in each customer segment, as well as the market size for each segment. This information provided control totals at a sector level for calibrating the LoadMAP model to known data for the base-year.

### Market Profiles

The next step was to develop market profiles for each sector, customer segment, end use, and technology. A market profile includes the following elements:

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is number of employees.
- **Saturations** define the fraction of homes and square feet with the various technologies. (e.g., homes with electric space heating, commercial floor space with gas water heating).
- **UEC (unit energy consumption) or EUI (energy-use index)** describes the amount of energy consumed in 2011 by a specific technology in homes and buildings that have the technology. For electricity, UECs are expressed in kWh/household for the residential sector, and EUIs are expressed in kWh/square foot or kWh/employee for the commercial and industrial sectors, respectively.
- **Intensity** for the residential sector represents the average energy use for the technology across all homes in 2011. It is computed as the product of the saturation and the UEC and is defined as kWh/household for electricity. For the commercial and industrial sectors, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space or all employees in 2011.
- **Usage** is the annual energy use by a technology/end use in the segment. It is the product of the market size and intensity and is quantified in GWh for electricity and million thers (MMTherms) for natural gas.

The market assessment results and the market profiles are presented in Chapter 3.

### Baseline Projection

The next step was to develop the baseline projection of annual electricity and natural gas usage for 2011 through 2023 by customer segment and end use without new utility programs or naturally occurring efficiency. The end-use forecast does include the relatively certain impacts of codes and standards that will unfold over the study timeframe. All such mandates that were defined as of January 2012 are included in the baseline. The baseline projection is the foundation for the analysis of savings from future EE efforts as well as the metric against which potential savings are measured.

Inputs to the baseline projection include:

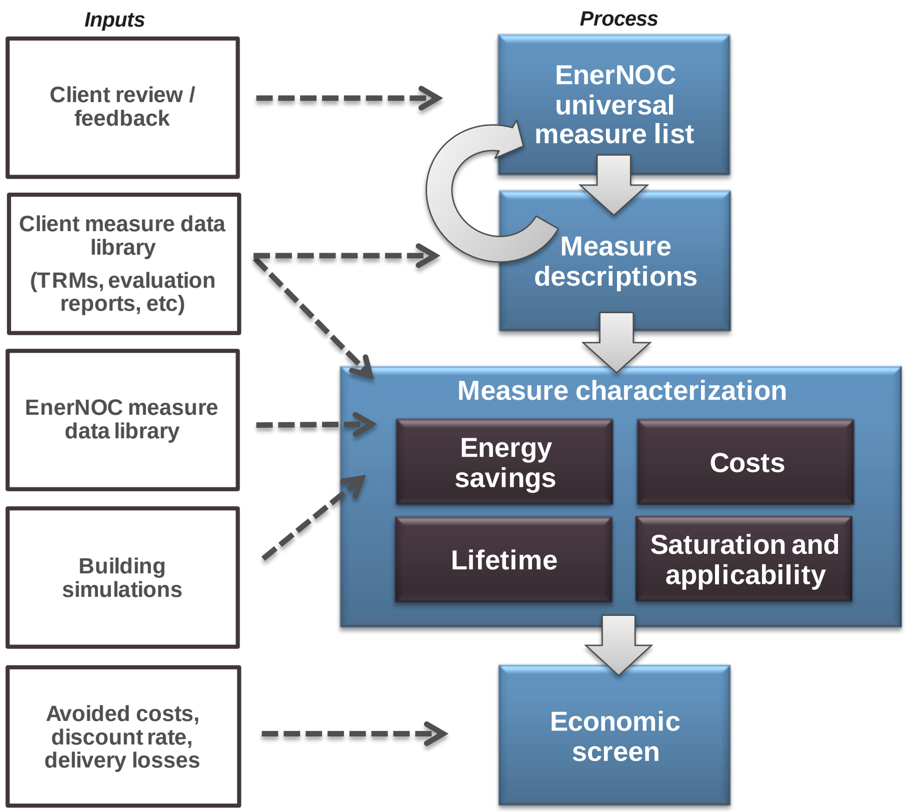
- Current economic growth forecasts (i.e., customer growth, income growth)
- Electricity and natural gas price forecasts
- Trends in fuel shares and equipment saturations
- Existing and approved changes to building codes and equipment standards

We present the results of the baseline-projection development in Chapter 4.

## Energy Efficiency Measure Analysis

This section describes the framework used to assess the savings, costs, and other attributes of energy-efficiency measures. These characteristics form the basis for measure-level cost-effectiveness analyses as well as for determining measure-level savings. For all measures, EnerNOC assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with Ameren Illinois' avoided costs data, in the economic screen to determine economically feasible measures. Figure 2-3 outlines the framework for measure analysis.

***Figure 2-3 Approach for Measure Assessment***




The framework for assessing savings, costs, and other attributes of energy efficiency measures involves identifying the list of energy efficiency measures to include in the analysis, determining their applicability to each market sector and segment, fully characterizing each measure, and performing cost-effectiveness screening.

We compiled a robust list of energy efficiency measures for each customer sector, drawing upon the Ameren Illinois program experience and protocols, the Illinois TRM, EnerNOC's own measure databases and building simulation models, stakeholder input and secondary sources. This universal list of EE measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption. If considered today, some of these measures would not pass the economic screens initially, but may pass in future years as a result of lower projected equipment costs or higher avoided costs.

The selected measures are categorized into two types according to the LoadMAP taxonomy: equipment measures and non-equipment measures.

- **Equipment measures** are efficient energy-consuming pieces of equipment that save energy by providing the same service with a lower energy requirement than a standard unit. An example is an ENERGY STAR refrigerator that replaces a standard efficiency refrigerator. For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the current federal standard SEER 13 unit and spans a broad spectrum up to a maximum efficiency of a SEER 21 unit.

- **Non-equipment measures** save energy by reducing the need for delivered energy, but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example would be a programmable thermostat that is pre-set to run heating and cooling systems only when people are home. Non-equipment measures can apply to more than one end use. For instance, addition of wall insulation will affect the energy use of both space heating and cooling. Non-equipment measures typically fall into one of the following categories:
  - Building shell (windows, insulation, roofing material)
  - Equipment controls (thermostat, energy management system)
  - Equipment maintenance (cleaning filters, changing setpoints)
  - Whole-building design (building orientation, passive solar lighting)
  - Lighting retrofits (included as a non-equipment measure because retrofits are performed prior to the equipment's normal end of life)
  - Displacement measures (ceiling fan to reduce use of central air conditioners)
  - Commissioning and retrocommissioning

We developed a preliminary list of EE measures, which was distributed to the stakeholders for review. The list was finalized after incorporating comments, and can be found in Chapter 5 of this report.

Once we assembled the list of EE measures, the project team assessed their energy-saving characteristics. For each measure we also characterized incremental cost, service life, and other performance factors. Following the measure characterization, we performed an economic screening of each measure, which serves as the basis for developing the economic and achievable potential.

### *Representative Measure Data Inputs*

To provide an example of the measure data, Table 2-8 and Table 2-9 present samples of the detailed data inputs behind both equipment and non-equipment measures, respectively, for the case of residential CAC in single-family homes. Table 2-8 displays the various efficiency levels available as equipment measures, as well as the corresponding useful life, energy usage, and cost estimates. The columns labeled On Market and Off Market reflect equipment availability due to codes and standards or the entry of new products to the market.

*Table 2-8 Sample Equipment Measures for Central Air Conditioning – Single Family Home*

| Efficiency Level | Useful Life | Equipment Cost | Energy Usage(kWh/yr) | On Market | Off Market |
|---|---|---|---|---|---|
| SEER 13 | 18 | $3,311 | 2,287 | 2011 | n/a |
| SEER 14.5 (ENERGY STAR) | 18 | $3,716 | 2,097 | 2011 | n/a |
| SEER 15 (CEE Tier 2) | 18 | $4,120 | 2,013 | 2011 | n/a |
| SEER 16 (CEE Tier 3) | 18 | $4,524 | 1,942 | 2011 | n/a |
| SEER 17 (Ductless Mini-split) | 18 | $5,943 | 1,882 | 2011 | n/a |
| SEER 21 | 18 | $6,395 | 1,524 | 2011 | n/a |

Table 2-9 lists some of the non-equipment measures applicable to CAC in an existing single-family home. All measures are evaluated for cost effectiveness based on the lifetime benefits relative to the cost of the measure. The total savings and costs are calculated for each year of the study and depend on the base year saturation of the measure, the applicability[6] of the measure, and the savings as a percentage of the relevant energy end uses.

*Table 2-9 Sample Non-Equipment Measures – Single Family Home, Existing*

| End Use | Measure | Saturation in 2011[7] | Applica-bility | Lifetime (yrs) | Measure Installed Cost | Energy Savings (%) |
|---|---|---|---|---|---|---|
| Cooling | Central AC - Maintenance | 37% | 100% | 2 | $175 | 5% |
| Cooling | Repair and Sealing – Ducting | 16% | 50% | 18 | $498 | 16% |
| Cooling | Insulation - Ceiling | 33% | 38% | 20 | $363 | 1% |
| Cooling | Windows – Install Reflective Film | 5% | 45% | 10 | $1,029 | 11% |
| Cooling | Windows - ENERGY STAR | 47% | 90% | 20 | $7,134 | 32% |

### *Screening Measures for Cost-Effectiveness*

Only measures that are cost-effective are included in economic and achievable potential. Therefore, for each individual measure, LoadMAP performs an economic screen. This study uses the TRC test that compares the lifetime energy benefits (and peak demand for electricity) of each applicable measure with its incremental installed cost, including material and labor. There is no program administration cost considered in this analysis, and therefore, no specific program delivery methods or mechanisms are assumed. The lifetime benefits are calculated by multiplying the annual energy and demand savings for each measure by all appropriate avoided costs for each year, and discounting the dollar savings to the present value equivalent. The analysis uses each measure's values for savings, costs, and lifetimes that were developed as part of the measure characterization process described above.

The LoadMAP model performs this screening dynamically, taking into account changing savings and cost data over time. Thus, some measures pass the economic screen for some — but not all — of the years in the projection.

[6] The applicability factors take into account whether the measure is applicable to a particular building type and whether it is feasible to install the measure. For instance, attic fans are not applicable to homes where there is insufficient space in the attic or there is no attic at all.

[7] Note that saturation levels reflected for the base year change over time as more measures are adopted.

It is important to note the following about the economic screen:

- The economic evaluation of every measure in the screen is conducted relative to a baseline condition. For instance, in order to determine the kilowatt-hour (kWh) savings potential of a measure, kWh consumption with the measure applied must be compared to the kWh consumption of a baseline condition.
- The economic screening was conducted only for measures that are applicable to each building type and vintage; thus if a measure is deemed to be irrelevant to a particular building type and vintage, it is excluded from the respective economic screen.

Table 2-10 shows the results of the economic screen for CAC and select other measures. Throughout the time frame shown, the most cost-effective CAC option is SEER 16 (starting in 2022). For water heaters with 55 gallons or less, the baseline unit of EF 0.9 is cost effective until 2015, when the new standard comes into effect. For refrigerators the AHAM federal efficiency standards cause existing ENERGY STAR units to become unavailable in 2014. Units compliant with AHAM 2014 thus become the new minimum efficiency baseline and are therefore assigned a benefit-to-cost (B/C) ratio of 1. Since there is not a more efficient, cost-effective unit available, they become the economic unit by default. If the measure passes the screen (has a B/C ratio greater than or equal to 1), the measure is included in economic potential. Otherwise, it is screened out for that year. If multiple equipment measures have B/C ratios greater than or equal to 1.0, the most efficient technology is selected by the economic screen.

***Table 2-10 Economic Screen Results for Selected Residential Equipment Measures***

| Technology | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Central AC | SEER 13 | SEER 14.5 | SEER 14.5 | SEER 14.5 |
| Water heater <= 55 gal | EF 0.9 | EF 0.9 | EF 0.95 | EF 0.95 |
| Refrigerator | ENERGY STAR | AHAM (2014) | AHAM (2014) | AHAM (2014) |

## Energy-Efficiency Potential

The approach we used for this study adheres to the approaches and conventions outlined in the National Action Plan for Energy-Efficiency (NAPEE) Guide for Conducting Potential Studies (November 2007).[8] The NAPEE Guide represents the most credible and comprehensive industry practice for specifying energy-efficiency potential. As described in Chapter 1, four types of potentials were developed as part of this effort: Technical potential, Economic potential, Maximum Achievable Potential and Realistic Achievable Potential

The calculation of Technical and Economic potential is a straightforward algorithm. To develop estimates for **Achievable potential**, we develop market adoption rates for each measure that specify the percentage of customers that will select the highest–efficiency economic option. The market adoption rates are developed based on the results of the program interest surveys that were conducted as part of the primary market research. This more accurately reflects the attitudes of Ameren Illinois' customers.

- For **Realistic Achievable**, we used the average take rates for a 3-year payback period for the measure. Several measures were tested in the survey. These were then mapped to the other remaining measures based on familiarity and ease of installing.
- For **Maximum Achievable**, we used the 1-year payback take rates for those respondents that were more aware and/or more experienced with the measure. This represents a scenario where customers are aware of the measure and the program and receive a higher incentive that reduces the payback to one year. Volume 2 provides detailed information about the estimation of take rates.

[8] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025: Developing a Framework for Change*. www.epa.gov/eeactionplan.

Based on EnerNOC's experience running programs and evaluating programs at other utilities, we estimate that the take rates will increase slightly each year as the program and awareness ramps up. Therefore we increase the base year take rates by 0.5% per year. The overall energy efficiency potential results are available in Chapter 6, and the results by sector are given in Chapter 7.

### Program Design

Once the measure level results were developed, EnerNOC provided the measure costs and savings to AEG to develop energy efficiency programs. AEG worked closely with the Ameren Illinois team to develop effective programs based on their recent experience and industry best practices. AEG provided a mapping of measures to programs and developed incentive and program administration budgets. Details about program design are presented in Volume 4.

### Supply Curves

Based on the results of the program design step, EnerNOC then developed several supply curves to match a variety of scenarios:

- Achievable potential in aggregate for all rate classes; with rate cap limits specified in the Act
- Achievable potential in aggregate for all rate classes; without rate cap limits specified in the Act
- Achievable potential disaggregated by rate class
- Achievable potential disaggregated by rate class by rate cap limits specified in the Act
- Achievable potential disaggregated by rate class by 0.5% increments above rate cap limits all the way to the estimated limit of achievable potential
- For electricity only, achievable potential disaggregated for the "bundled service" customer segment defined as "eligible retail customers" per the Illinois Public Agency Act and who are 150 kW and below and not obtaining energy from alternate retail energy suppliers.

Additional information about supply curve development is presented in Volume 5.

### Wasted Energy

The goal of the wasted energy task is to identify wasted energy and assess the potential energy savings that could be achieved by minimizing it. The term "wasted energy" is defined as excessive energy use that is a result of a customer's behavioral choices. Examples include leaving lights turned on in an unoccupied room, not performing regular maintenance on HVAC equipment, not replacing furnace filters, leaving office equipment on overnight, or leaving cell phone chargers plugged in when not in use.

For the Ameren Illinois study, we refined the definition of wasted energy to consider customer-lifestyle decisions. For example, if a customer prefers to maintain a temperature of 68 degrees year round when at home, this is not considered wasted energy. Similarly, if a customer leaves a light on overnight for personal security, it is not considered wasted energy.

In the study, we identified measures that eliminate the waste associated with customer behavior. Examples of the types of measures that address wasted energy include the following:

- Installing programmable thermostats
- Replacing furnace filters
- Installing occupancy sensors
- Sealing ducts
- Installing photosensors on exterior lighting
- Installing plug-load occupancy sensors

- Regular equipment maintenance

By categorizing measures into "wasted energy" we are then able to calculate the savings that can are associated with wasted energy, as opposed to efficient use of energy, or savings from increased efficiency of equipment. In Chapter 10, we show how we defined wasted energy and how much of the energy efficiency can be attributed to wasted energy.

## Data Development

This section details the data sources used in this study, followed by a discussion of how these sources were applied. In general, data were adapted to local conditions, for example, by using local sources for measure data and local weather for building simulations.

### Data Sources

The data sources are organized into the following categories:

- Ameren Illinois and Illinois - statewide data
- EnerNOC's databases and analysis tools
- Other secondary data and reports

#### *Ameren Illinois Data*

Our highest priority data sources for this study were those that were specific to Ameren Illinois.

- **Utility 2011 billing data.** The data request included billing data for 2011, the most recent year for which complete billing data was available. Ameren Illinois provided 2011 customer names, customer addresses, electricity sales, natural gas sales and customer contact information for the primary market research.
- **Utility forecasts:** Ameren Illinois provided a customer growth forecast by sector; energy-sales (electricity and natural gas) and peak-demand forecasts at the sector level; and retail energy price history and forecasts.
- **Economic information:** Ameren Illinois provided the avoided costs, discount rate, and line loss factor.
- **Primary market research:** As part of the study, EnerNOC and You Gov| Definitive Insights conducted customer surveys to characterize equipment and measure saturation, as well as customer interest in energy efficiency measures and programs.
- **Illinois TRM:** Ameren Illinois provided EnerNOC the final copy of the Illinois TRM that went into effect in June 2012. The TRM was used to characterize the energy efficiency measures evaluated in this study.

#### *EnerNOC Databases, Analysis Tools, and Reports*

EnerNOC maintains several databases and modeling tools that we use for forecasting and potential studies.

- ***EnerNOC Energy Market Profiles Database*:** For more than 10 years, EnerNOC staff have maintained profiles of end-use consumption for the residential, commercial, and industrial sectors. These profiles include market size, fuel shares, unit consumption estimates, and annual energy use by fuel (electricity and natural gas), customer segment and end use for 10 regions in the U.S. The Energy Information Administration surveys (RECS, CBECS and MECS) as well as state-level statistics and local customer research provide the foundation for these regional profiles.
- ***Building Energy Simulation Tool (BEST)***. EnerNOC's BEST is a derivative of the DOE 2.2 building simulation model, used to estimate base-year UECs and EUIs, as well as measure savings for the HVAC-related measures.

- ***EnerNOC's EnergyShape™*:** This database of load shapes includes the following: Residential – electric load shapes for 10 regions, 3 housing types, 13 end uses; Commercial – electric load shapes for 9 regions, 54 building types, 10 end uses; Industrial – electric load shapes, whole facility only, 19 2-digit SIC codes, as well as various 3-digit and 4-digit SIC codes
- ***EnerNOC's Database of Energy Efficiency Measures (DEEM)*:** EnerNOC maintains an extensive database of measure data for our studies. Our database draws upon reliable sources including the California Database for Energy Efficient Resources (DEER), the EIA Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, RS Means cost data, and Grainger Catalog Cost data.
- **Recent studies**. EnerNOC has conducted numerous studies of EE potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, which include AmerenUE, State of New Jersey, Los Angeles Department of Water and Power, Consolidated Edison of New York, Avista Utilities, the State of New Mexico, Tennessee Valley Authority, and Seattle City Light. In addition, we used the information about impacts of building codes and appliance standards from a recent report for the Institute for Energy Efficiency.[9]

### *Other Secondary Data and Reports*

Finally, a variety of secondary data sources and reports were used for this study. The main sources are identified below.

- **Annual Energy Outlook**. The Annual Energy Outlook (AEO), conducted each year by the U.S. Energy Information Administration (EIA), presents yearly projections and analysis of energy topics. For this study, we used data from the 2012 AEO.
- **EPRI End-Use Models (REEPS and COMMEND)**. These models provide the elasticities we apply to electricity prices, household income, home size and heating and cooling.
- **Database for Energy Efficient Resources (DEER).** The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) for the state of California. We used the DEER database to cross check the measure savings we developed using BEST and DEEM.
- **Northwest Power and Conservation Council Sixth Plan workbooks.** To develop its Power Plan, the Council maintains workbooks with detailed information about measures.
- **Other relevant regional sources:** These include reports from the Consortium for Energy Efficiency, the Northeast Energy Efficiency Partnership, the EPA, and the American Council for an Energy-Efficient Economy.

## Data Application

We now discuss how the data sources described above were used for each step of the study.

### *Data Application for Market Characterization*

To construct the high-level market characterization of electricity use and households/floor space for the residential, commercial, and industrial sectors, we applied the following data sources:

- Ameren Illinois customer surveys to allocate residential customers by housing type. This was compared to American Community Survey (ACS) and other Ameren Illinois studies.

[9] "Assessment of Electricity Savings in the U.S. Achievable through New Appliance/Equipment Efficiency Standards and Building Efficiency Codes (2010 – 2025)." Global Energy Partners, LLC for the Institute for Electric Efficiency, May 2011. http://www.edisonfoundation.net/iee/reports/IEE_CodesandStandardsAssessment_2010-2025_UPDATE.pdf

- Ameren Illinois billing data and customer surveys to estimate sales and square footage by building type for the commercial sector. The estimates were also compared with EIA, AEO 2012 and our Energy Market Profiles Database.
- Ameren Illinois billing data and customer surveys to estimate energy use by industry type and employment for the industrial sector. These estimates were then compared to EIA, Bureau of Labor Statistics and AEO 2012 data.

### *Data Application for Market Profiles*

The specific data elements for the market profiles, together with the key data sources, are shown in Table 2-11. To develop the market profiles for each segment, we did the following:

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity from the Ameren Illinois billing data.
2. Used the results of the saturation survey to incorporate information on existing appliance saturations, appliance and equipment characteristics, and building characteristics.
3. Incorporated secondary data sources to supplement and corroborate the data from items 1 and 2 above.
4. Compared and cross-checked with regional data obtained as part of the EPRI National Potential Study and with the Energy Market Profiles Database.
5. Ensured calibration to control totals for annual electricity and natural gas sales in each sector and segment.
6. Worked with Ameren Illinois staff to vet the data against their knowledge and experience.

***Table 2-11 Data Applied for the Market Profiles***

| Model Inputs | Description | Key Sources |
|---|---|---|
| Market size | Base-year residential dwellings commercial floor space, and industrial employment | Utility billing data; Utility saturation survey |
| Annual intensity | Residential: Annual energy use (kWh/household)<br>Commercial: Annual energy use (kWh/sq ft)<br>Industrial: Annual energy use (kWh/employee) | Utility saturation survey<br>Energy Market Profiles<br>AEO 2012<br>Previous studies |
| Appliance/equipment saturations | Fraction of dwellings with an appliance/technology<br>Percentage of C&I floor space/employment with equipment/technology | Utility saturation survey<br>Energy Market Profiles |
| UEC/EUI for each end-use technology | UEC: Annual electricity use for a technology in dwellings that have the technology<br>EUI: Annual electricity use per square foot/employee for a technology in floor space that has the technology | HVAC uses: BEST simulations using prototypes developed for Illinois<br>Illinois TRM<br>Engineering analysis<br>DEEM<br>Previous EnerNOC studies |
| Appliance/equipment vintage distribution | Age distribution for each technology | Utility saturation survey<br>Previous EnerNOC studies |
| Efficiency options for each technology | List of available efficiency options and annual energy use for each technology | Illinois TRM<br>DEEM<br>DEER<br>NWPCC workbooks<br>AEO 2012<br>Previous studies |
| Peak factors | Share of technology energy use that occurs during the peak hour | EnergyShape database |

### *Data Application for Baseline Projection*

Table 2-12 summarizes the LoadMAP model inputs required for the baseline projection. These inputs are required for each segment within each sector, as well as for new construction and existing dwellings/buildings.

***Table 2-12 Data Needs for the Baseline Projection and Potentials Estimation in LoadMAP***

| Model Inputs | Description | Key Sources |
|---|---|---|
| Customer growth forecasts | Forecasts of new construction in residential and C&I sectors | Ameren Illinois forecast<br>AEO 2012 growth forecast<br>US BLS |
| Equipment purchase shares for baseline forecast | For each equipment/technology, purchase shares for each efficiency level; specified separately for existing equipment replacement and new construction | Shipments data from AEO<br>AEO 2012 regional forecast assumptions[10]<br>Appliance/efficiency standards analysis<br>Ameren Illinois program results and evaluation reports |
| Electricity and natural gas prices | Forecast of average energy and capacity avoided costs and retail prices | Ameren Illinois forecast<br>AEO 2012 |
| Utilization model parameters | Price elasticities, elasticities for other variables (income, weather) | EPRI's REEPS and COMMEND models<br>AEO 2012 |

The avoided cost forecasts implemented in the models, provided by Ameren Illinois, are available in Appendix G. The discount rate used for NPV analysis is a nominal rate of 7%.

We also implemented assumptions for known future equipment standards as of January, 2012, as shown in the tables below.

[10] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2011), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and then held values constant for the study period. This removes any effects of naturally occurring conservation or effects of future DSM programs that may be embedded in the AEO forecasts.

### *Table 2-13 Residential Electric Equipment Standards Applicable to Illinois*

Today's Efficiency or Standard Assumption
1st Standard (relative to today's standard)
2nd Standard (relative to today's standard)

<table>
<tr><th>End Use</th><th>Technology</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td rowspan="4">Cooling</td><td>Central AC</td><td colspan="15">SEER 13</td></tr>
<tr><td>Room AC</td><td colspan="3">EER 9.8</td><td colspan="12">EER 11.0</td></tr>
<tr><td>Evaporative Central AC</td><td colspan="15">Conventional</td></tr>
<tr><td>Evaporative Room AC</td><td colspan="15">Conventional</td></tr>
<tr><td>Cooling/Heating</td><td>Heat Pump</td><td colspan="4">SEER 13.0/HSPF 7.7</td><td colspan="11">SEER 14.0/HSPF 8.0</td></tr>
<tr><td>Space Heating</td><td>Electric Resistance</td><td colspan="15">Electric Resistance</td></tr>
<tr><td rowspan="2">Water Heating</td><td>Water Heater (<=55 gallons)</td><td colspan="4">EF 0.90</td><td colspan="11">EF 0.95</td></tr>
<tr><td>Water Heater (>55 gallons)</td><td colspan="4">EF 0.90</td><td colspan="11">Heat Pump Water Heater</td></tr>
<tr><td rowspan="2">Lighting</td><td>Screw-in/Pin Lamps</td><td colspan="3">Incandescent</td><td colspan="6">Advanced Incandescent - tier 1 (20 lumens/watt)</td><td colspan="6">Advanced Incandescent - tier 2 (45 lumens/watt)</td></tr>
<tr><td>Linear Fluorescent</td><td colspan="2">T12</td><td colspan="13">T8</td></tr>
<tr><td rowspan="5">Appliances</td><td>Refrigerator/2nd Refrigerator</td><td colspan="3">NAECA Standard</td><td colspan="12">25% more efficient</td></tr>
<tr><td>Freezer</td><td colspan="3">NAECA Standard</td><td colspan="12">25% more efficient</td></tr>
<tr><td>Dishwasher</td><td colspan="2">Conventional (355kWh/yr)</td><td colspan="13">14% more efficient (307 kWh/yr)</td></tr>
<tr><td>Clothes Washer</td><td colspan="4">Conventional (MEF 1.26 for top loader)</td><td colspan="3">MEF 1.72 for top loader</td><td colspan="8">MEF 2.0 for top loader</td></tr>
<tr><td>Clothes Dryer</td><td colspan="4">Conventional (EF 3.01)</td><td colspan="11">5% more efficient (EF 3.17)</td></tr>
</table>

***Table 2-14 Commercial and Industrial Electric Equipment Standards Applicable to Illinois***

Today's Efficiency or Standard Assumption
1st Standard (relative to today's standard)
2nd Standard (relative to today's standard)

<table>
<tr><th>End Use</th><th>Technology</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td>Cooling</td><td>Packaged Terminal AC/HP</td><td>EPACT 1992 Std</td><td colspan="14">EER 11.0/11.2</td></tr>
<tr><td rowspan="2">Lighting</td><td>Screw-in/Pin Lamps</td><td colspan="3">Incandescent</td><td colspan="6">Advanced Incandescent - tier 1 (20 lumens/watt)</td><td colspan="6">Advanced Incandescent - tier 2 (45 lumens/watt)</td></tr>
<tr><td>Linear Fluorescent</td><td colspan="2">T12</td><td colspan="13">T8</td></tr>
<tr><td rowspan="3">Refrigeration</td><td>Glass Door Display</td><td>EPACT 2005 Standard</td><td colspan="14">42% more efficient</td></tr>
<tr><td>Open Display Case</td><td>EPACT 2005 Standard</td><td colspan="14">18% more efficient</td></tr>
<tr><td>Vending Machines</td><td>EPACT 2005 Standard</td><td colspan="14">33% more efficient</td></tr>
<tr><td rowspan="2">Miscellaneous</td><td>Non-HVAC Motors</td><td colspan="4">62.3% Efficiency</td><td colspan="11">70% Efficiency</td></tr>
<tr><td>Commercial Laundry</td><td colspan="2">MEF 1.26</td><td colspan="13">MEF 1.6</td></tr>
</table>

***Table 2-15 Residential Gas Appliance Standards Applicable to Illinois***

Today's Efficiency or Standard Assumption
Next Standard (relative to today's standard)

<table>
<tr><th>End Use</th><th>Technology</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td rowspan="2">Space Heating</td><td>Furnace</td><td colspan="15">AFUE 80%</td></tr>
<tr><td>Boiler</td><td colspan="2">EF 0.81</td><td colspan="13">EF 0.82</td></tr>
<tr><td rowspan="2">Water Heating</td><td>Water Heater (<=55 gallons)</td><td colspan="4">EF 0.59</td><td colspan="11">EF 0.62</td></tr>
<tr><td>Water Heater (>55 gallons)</td><td colspan="4">EF 0.59</td><td colspan="11">Condensing Technology</td></tr>
<tr><td rowspan="2">Appliances</td><td>Clothes Dryer</td><td colspan="4">Conventional</td><td colspan="11">5% more efficient</td></tr>
<tr><td>Range/Oven</td><td>Conventional</td><td colspan="14">No Standing Pilot Light</td></tr>
<tr><td>Miscellaneous</td><td>Pool Heater</td><td colspan="2">Conventional</td><td colspan="13">EF 0.82</td></tr>
</table>

***Table 2-16 Commercial and Industrial Gas Appliance Standards Applicable to Illinois***

Today's Efficiency or Standard Assumption
Next Standard (relative to today's standard)

<table>
<tr><th>End Use</th><th>Technology</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td>Space Heating</td><td>Boiler</td><td>EF 0.76</td><td colspan="14">EF 0.82</td></tr>
<tr><td>Miscellaneous</td><td>Pool Heater</td><td colspan="2">Conventional</td><td colspan="13">EF 0.82</td></tr>
</table>

### *Energy Efficiency Measure Data Application*

Table 2-17 details the data sources used for measure characterization.

***Table 2-17 Data Needs for the Measure Characteristics in LoadMAP***

| Model Inputs | Description | Key Sources |
|---|---|---|
| Energy Impacts | The annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects. | Illinois TRM<br>BEST<br>DEEM<br>DEER<br>NWPCC workbooks<br>Other secondary sources |
| Peak Demand Impacts | Savings during the peak demand periods are specified for each electric measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak. | Illinois TRM<br>BEST<br>EnergyShape |
| Costs | Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, or per employee basis for the residential, commercial, and industrial sectors, respectively.<br>Non-equipment measures: Existing buildings – full installed cost. New Construction - the costs may be either the full cost of the measure, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level. | Illinois TRM<br>DEEM<br>DEER<br>NWPCC workbooks<br>RS Means<br>Other secondary sources |
| Measure Lifetimes | Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis. | Illinois TRM<br>DEEM<br>DEER<br>NWPCC workbooks<br>Other secondary sources |
| Applicability | Estimate of the percentage of either dwellings in the residential sector or square feet/employment in the C&I sectors where the measure is applicable and where it is technically feasible to implement. | Illinois TRM<br>DEEM<br>DEER<br>Other secondary sources |
| On Market and Off Market Availability | Expressed as years for equipment measures to reflect when the equipment technology is available or no longer available in the market. | EnerNOC appliance standards and building codes analysis |

### *Data Application for Cost-effectiveness Screening*

To perform the cost-effectiveness screening, a number of economic assumptions were needed. All cost and benefit values were analyzed as real 2011 dollars. A discount rate of 7% in nominal terms was used. This is equivalent to a 3.93% discount rate in real terms when adjusting for 2.92% inflation.[11] Electric delivery losses of 6.7% and natural gas delivery losses of 0.0085% were provided by Ameren Illinois.

[11] Inflation adjuster of 2.92% based on the average annual growth forecast in US Consumer Price Index from the 2012 Annual Energy Outlook for 2010-2035.

***Achievable Potential Estimation***

To estimate achievable potential, three sets of parameters are needed to represent customer decision making behavior with respect to energy-efficiency choices.

- **Adoption curves for non-equipment measures**. Equipment measures are installed when existing units fail. Non-equipment measures do not have this natural periodicity and are , so rather than installing all available non-equipment measures in the first year of the projection (instantaneous potential), they are phased in according to adoption schedules that vary based on cost and complexity. The adoption rates used in this analysis take several factors into account to determine how quickly the market can absorb these measures. Typically, measures that cause disruption to the building, such as wall insulation in existing buildings, receive longer adoption curves, while those with drop-in installations, such as programmable thermostats in new buildings, receive shorter ones. High capital cost measures will also receive longer adoption curves than ones with low capital cost. These adoption rates are used within LoadMAP to generate the Technical and Economic potentials. In general, the rates align with the diffusion of similar equipment measures.
- **Maximum Achievable adoption rates**. Maximum achievable adoption rates are applied to Economic potential to estimate Maximum Achievable potential. These rates represent customer adoption of economic measures when delivered through ideally-operated efficiency programs and under a supportive regulatory framework. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. The only barrier to adoption reflected in this case is customer preferences.

  The Maximum Achievable adoption rates are based on the take rates for a 1-year payback from customers that are aware and have information about energy efficiency measures and programs. The take rates were developed based on the results of the program interest survey conducted as part of this study and described in Volume 2 of the report.
- **Realistic Achievable adoption rates**. To calculate Realistic Achievable potential, Realistic Achievable adoption rates are applied. The Realistic Achievable adoption rates are based on the average three-year payback take rate from the primary market research. These rates reflect expected program participation given significant barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets. This represents a lower bound on achievable potential.

Realistic Achievable and Maximum Achievable adoption rates are presented in Appendix E in Volume 6. The development of the take rates are detailed in Volume 2.

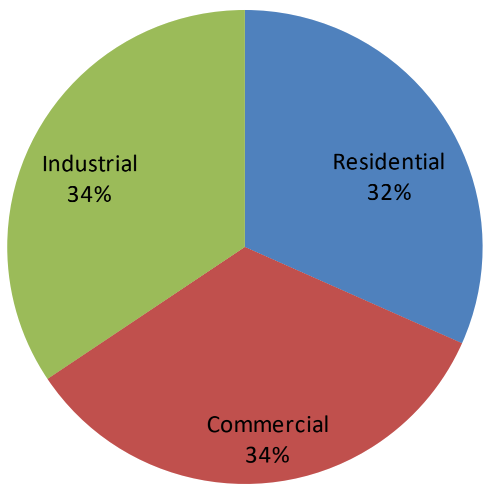
# MARKET CHARACTERIZATION AND MARKET PROFILES

In this section, we describe how customers in Ameren Illinois' service area use electricity and natural gas in the base year of the study, 2011. It begins with a high-level summary of energy use by sector and then delves into each sector in detail.

## Energy Use Summary

Total electricity use for the residential, commercial and industrial sectors for Illinois in 2011 was 36,571 GWh.[12] As shown in Figure 3-1, commercial and industrial account for 34% each (12,414 GWh for commercial and 12,580 GWh for industrial). The remaining consumption comes in the residential sector which in 2011 consumed 11,577 GWh.

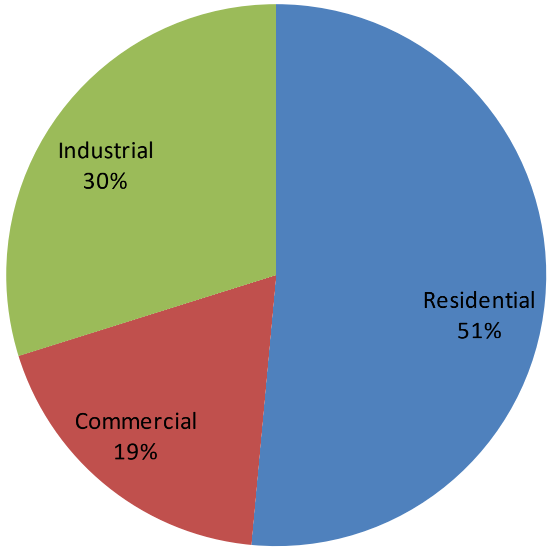
***Figure 3-1 Sector-Level Electricity Use, 2011***




Total natural gas use for all sectors in 2011 was 1,105 million therms. Note that the self-direct customers that have opted out of natural gas energy efficiency have been removed from the baseline projection. As shown in Figure 3-2, the largest sector is residential, accounting for 51%, or 569 million therms. The remaining use is split between the commercial and residential sectors, at 207 million therms and 330 million therms respectively.

[12] Energy given "at-the-meter," i.e. does not include line losses.

***Figure 3-2 Sector-Level Natural Gas Use, 2011***




## Residential Sector

The total number of households, electric sales, and natural gas sales for the service area of Ameren Illinois were obtained for the year 2011 from Ameren Illinois customer database. In 2011, there were 1.25 million households in Ameren's service area. They used 11.6 GWh of electricity and 569 million therms (MMTherms) of natural gas. We allocated these totals into the six residential segments based on the saturation survey data[13]. The values are shown in Table 3-1 below, and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

***Table 3-1 Residential Sector Energy Usage and Intensity by Segment Type, 2011***

| Segment | No. of Households | Electricity Use (GWh) | Electricity Avg Use per Household (kWh/hh) | Natural Gas Use (MMTherms) | Natural Gas Avg Use per Household (therms/hh) |
|---|---|---|---|---|---|
| SF – Electric only | 344,398 | 4,665 | 13,545 | n/a | n/a |
| MF- Electric only | 166,578 | 1,393 | 8,361 | n/a | n/a |
| SF – Electric/Gas | 455,512 | 4,772 | 10,476 | 373 | 818 |
| MF- Electric/Gas | 95,289 | 747 | 7,844 | 50 | 524 |
| SF – Gas only | 181,393 | n/a | n/a | 139 | 766 |
| MF- Gas only | 14,284 | n/a | n/a | 7 | 491 |
| **Total** | **1,257,456** | **11,577** | **10,904** | **569** | **762** |

Figure 3-3 and Figure 3-4 show the size of each of the segments as a percentage of customers and percentage of residential sector energy use.

[13] Note that the segment combines the housing type and the type of Ameren customer. Therefore Electric Only indicates that Ameren Illinois only provides electricity service to that household. This could indicate that it is an all electric home or that the customer receives natural gas from another utility. Electric/Gas indicates that Ameren Illinois provides both electricity and natural gas to the customer. Gas only indicates that Ameren Illinois only provides natural gas service, not electricity.

***Figure 3-3 Residential Market Segmentation by Housing Type – Percent of Households***

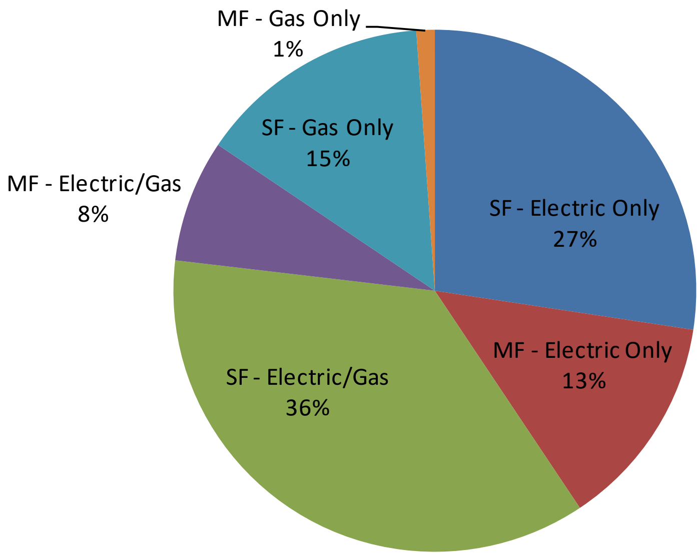
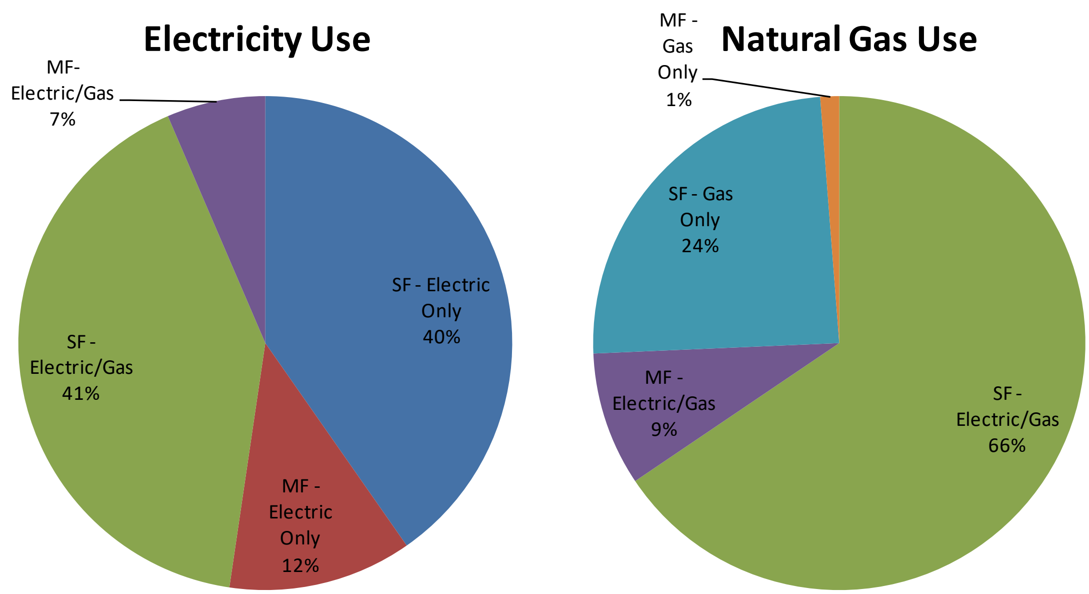



***Figure 3-4 Residential Market Segmentation by Housing Type – Percent of Energy Use***




As we describe in the previous chapter, the market profiles provide the foundation upon which we develop the baseline projection. The market profile for the residential sector as a whole is presented in Table 3-2 and Table 3-3. The residential market profiles for each housing segment are presented in Appendix A.

***Table 3-2 Electric Market Profile for the Residential Sector***

| End Use | Technology | Saturation | UEC (kWh) | Intensity (kWh/HH) | Usage (GWh) |
|---|---|---|---|---|---|
| Cooling | Central AC | 76.9% | 2,276 | 1,749 | 1,857.4 |
| Cooling | Room AC | 16.0% | 820 | 131 | 139.3 |
| Cooling | Air-Source Heat Pump | 2.4% | 2,182 | 51 | 54.5 |
| Cooling | Geothermal Heat Pump | 1.7% | 1,937 | 33 | 35.2 |
| Cooling | PTHP | 0.0% | 0 | 0 | 0.0 |
| Space Heating | Electric Resistance | 3.2% | 5,912 | 188 | 199.8 |
| Space Heating | Electric Furnace | 8.7% | 7,709 | 672 | 713.0 |
| Space Heating | Air-Source Heat Pump | 1.7% | 8,567 | 142 | 151.2 |
| Space Heating | Geothermal Heat Pump | 1.2% | 4,897 | 59 | 62.8 |
| Space Heating | PTHP | 0.0% | 0 | 0 | 0.0 |
| Water Heating | Water Heater <= 55 gal | 24.1% | 2,194 | 530 | 562.2 |
| Water Heating | Water Heater > 55 gal | 6.0% | 2,772 | 166 | 176.6 |
| Interior Lighting | Screw-in | 100.0% | 1,067 | 1,067 | 1,132.9 |
| Interior Lighting | Linear Fluorescent | 100.0% | 123 | 123 | 130.5 |
| Interior Lighting | Specialty | 100.0% | 282 | 282 | 299.0 |
| Exterior Lighting | Screw-in | 100.0% | 214 | 214 | 227.6 |
| Appliances | Refrigerator | 98.0% | 718 | 704 | 747.2 |
| Appliances | Second Refrigerator | 26.7% | 837 | 223 | 237.0 |
| Appliances | Freezer | 43.6% | 572 | 250 | 265.0 |
| Appliances | Clothes Washer | 87.7% | 95 | 83 | 88.5 |
| Appliances | Clothes Dryer | 72.0% | 706 | 508 | 539.7 |
| Appliances | Dishwasher | 62.0% | 395 | 245 | 260.4 |
| Appliances | Stove | 60.4% | 445 | 269 | 285.1 |
| Appliances | Microwave | 97.0% | 118 | 115 | 121.9 |
| Electronics | Personal Computers | 73.0% | 249 | 182 | 193.3 |
| Electronics | Monitor | 73.0% | 50 | 36 | 38.5 |
| Electronics | Laptops | 100.1% | 107 | 107 | 114.1 |
| Electronics | TVs | 272.5% | 203 | 552 | 586.2 |
| Electronics | Printer/Fax/Copier | 87.9% | 38 | 34 | 35.6 |
| Electronics | Set-top Boxes/DVR | 245.5% | 129 | 316 | 335.5 |
| Electronics | Devices and Gadgets | 100.0% | 95 | 95 | 100.9 |
| Miscellaneous | Air Purifier/Cleaner | 10.0% | 1,160 | 115 | 122.6 |
| Miscellaneous | Dehumidifier | 28.7% | 1,809 | 519 | 550.6 |
| Miscellaneous | Pool Pump | 6.4% | 1,425 | 91 | 96.7 |
| Miscellaneous | Pool Heater | 4.2% | 4,732 | 198 | 210.5 |
| Miscellaneous | Hot Tub / Spa | 2.1% | 903 | 19 | 20.4 |
| Miscellaneous | Well Pump | 9.4% | 533 | 50 | 53.0 |
| Miscellaneous | Furnace Fan | 93.4% | 445 | 415 | 440.7 |
| Miscellaneous | Bathroom Exhaust Fan | 30.4% | 134 | 41 | 43.4 |
| Miscellaneous | Miscellaneous | 100.0% | 328 | 328 | 348.8 |
| | **Total** | | | **10,904** | **11,577.3** |

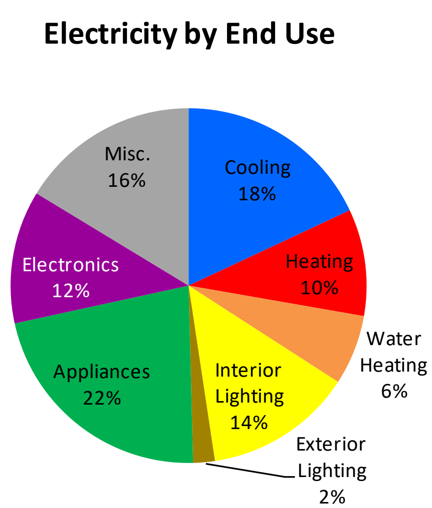
***Table 3-3 Natural Gas Market Profile for the Residential Sector***

| End Use | Technology | Saturation | UEC (therm) | Intensity (therm/HH) | Usage (MMtherm) |
|---|---|---|---|---|---|
| Space Heating | Furnace | 88.2% | 514 | 453 | 338.3 |
| Space Heating | Boiler | 8.4% | 709 | 60 | 44.4 |
| Space Heating | Other Heating | 2.4% | 411 | 10 | 7.5 |
| Water Heating | Water Heater <= 55 gal | 70.3% | 180 | 126 | 94.4 |
| Water Heating | Water Heater > 55 gal | 18.0% | 193 | 35 | 26.0 |
| Appliances | Clothes Dryer | 31.5% | 27 | 8 | 6.3 |
| Appliances | Stove/Oven | 45.9% | 55 | 25 | 18.9 |
| Miscellaneous | Pool Heater | 9.8% | 154 | 15 | 11.3 |
| Miscellaneous | Hot Tub / Spa | 0.0% | 0 | 0 | 0.0 |
| Miscellaneous | Miscellaneous | 100.0% | 29 | 29 | 21.5 |
| | **Total** | | | **762** | **568.5** |

Figure 3-5 shows the distribution of electricity and natural gas energy consumption by end use for all homes. Three main electricity end uses — appliances, cooling, and interior lighting account for over 54% of total use. The remaining energy is allocated to electronics (computers, televisions, video game consoles, etc.), heating, water heating, exterior lighting and miscellaneous. The miscellaneous category includes furnace fans, pool pumps, and other "plug" loads (hair dryers, power tools, coffee makers, etc.).

Natural gas usage is dominated by space heating (69%) and water heating (21%), with small amounts in appliances for cooking or clothes drying, as well as miscellaneous uses such as pool heaters.

***Figure 3-5 Residential Electricity and Natural Gas Use by End Use (2011), All Homes***



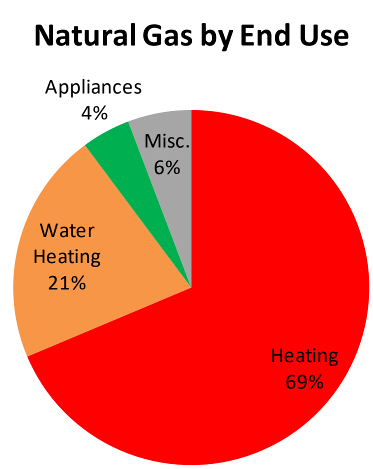




Figure 3-6 and Table 3-4 present the electricity intensities by end-use and housing segment, as well as all homes on average. Figure 3-7 shows the same data as a percentage of total energy use.

***Figure 3-6 Residential Electricity Intensity by End Use and Segment (kWh/household, 2011)***

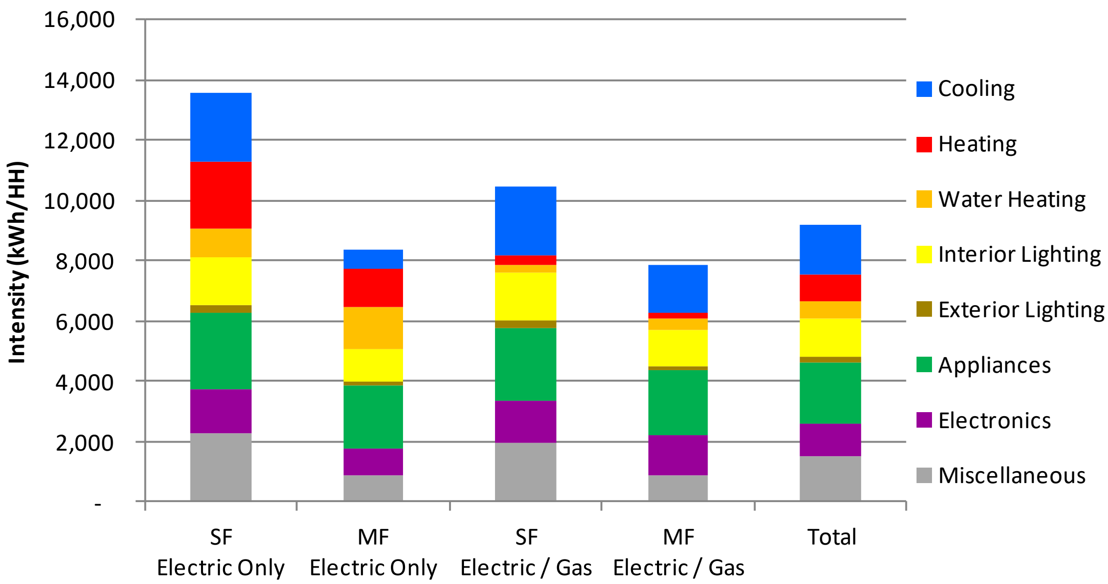



***Table 3-4 Residential Electricity Use by End Use and Segment (kWh/HH/year, 2011)***

| End Use | SF-Electric only | MF-Electric only | SF-Electric/Gas | MF-Electric/Gas | Average of all Segments |
|---|---|---|---|---|---|
| Cooling | 2,294 | 607 | 2,297 | 1,565 | 1,659 |
| Space Heating | 2,188 | 1,298 | 304 | 194 | 896 |
| Water Heating | 963 | 1,417 | 297 | 373 | 588 |
| Interior Lighting | 1,583 | 1,073 | 1,583 | 1,232 | 1,242 |
| Exterior Lighting | 247 | 108 | 247 | 125 | 181 |
| Appliances | 2,570 | 2,090 | 2,423 | 2,181 | 2,024 |
| Electronics | 1,421 | 925 | 1,396 | 1,312 | 1,117 |
| Miscellaneous | 2,279 | 844 | 1,930 | 862 | 1,500 |
| **Total** | **13,545** | **8,361** | **10,476** | **7,844** | **9,207** |

***Figure 3-7 Breakdown of Residential Electricity Use by End Use and Segment (2011)***

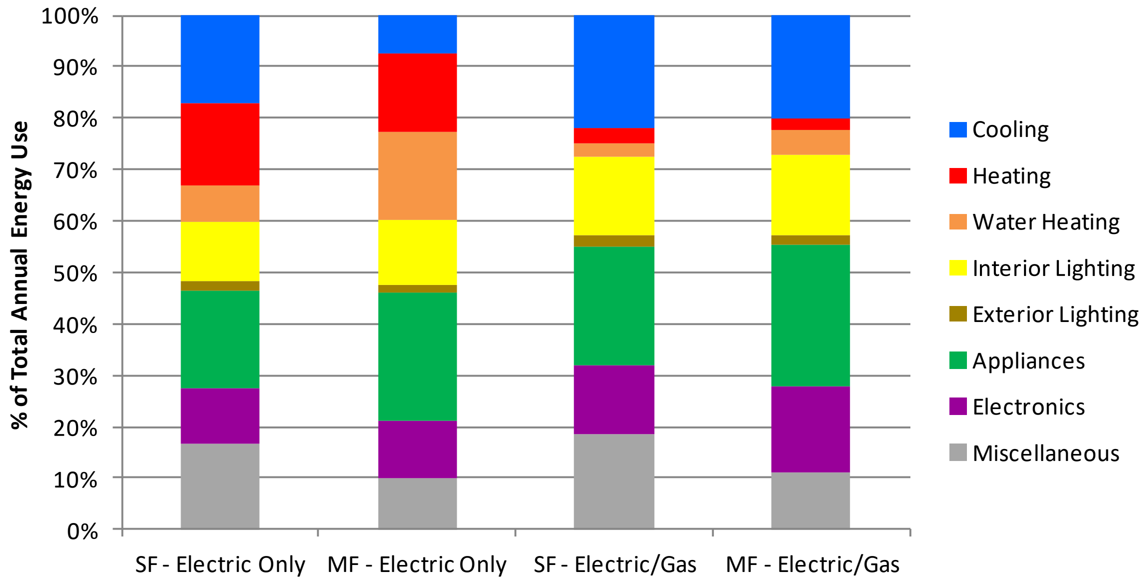



Figure 3-8 and Table 3-5 present the natural gas intensities by end-use and housing type, as well as all homes on average. Figure 3-9 shows the same data as a percentage of total energy use.

***Figure 3-8 Residential Natural Gas Intensity by End Use and Segment (therm/household, 2011)***

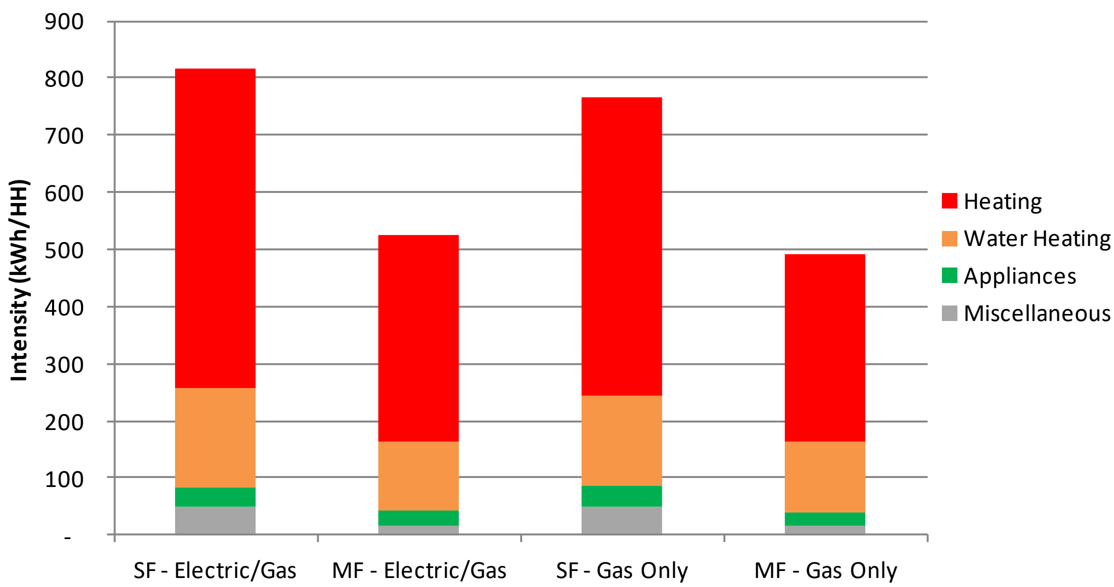
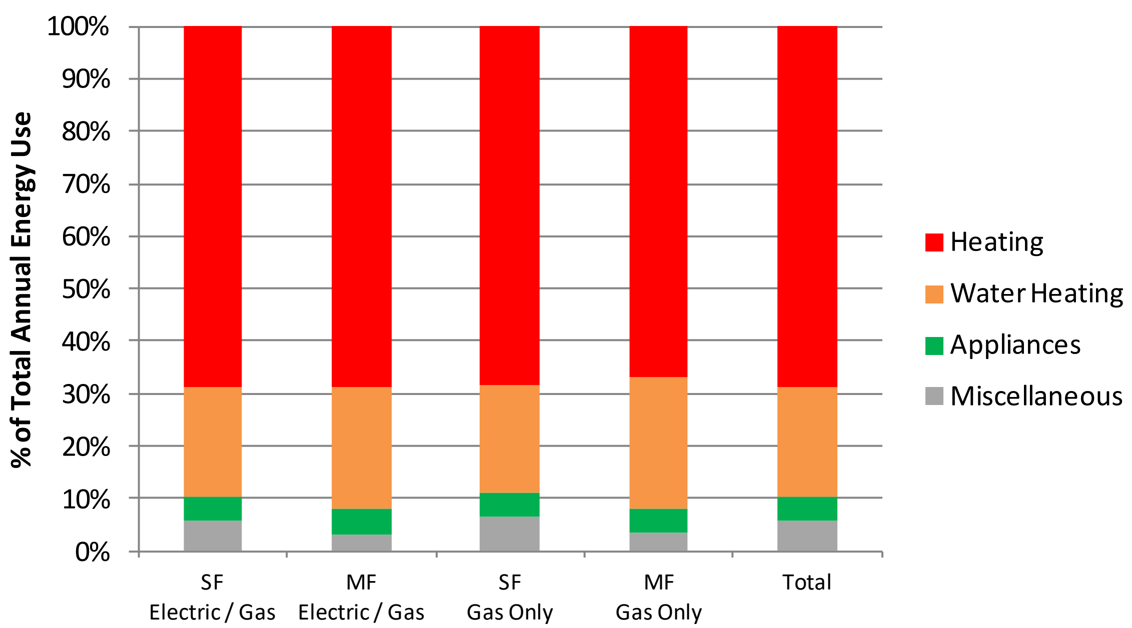


***Table 3-5 Residential Natural Gas Use by End Use and Segment (therm/HH/year, 2011)***

| End Use | Single Family Electric / Gas | Multi Family Electric / Gas | Single Family Gas Only | Multi Family Gas Only | All Homes |
|---|---|---|---|---|---|
| Space Heating | 562 | 361 | 524 | 328 | 310 |
| Water Heating | 173 | 122 | 156 | 124 | 96 |
| Appliances | 35 | 25 | 37 | 23 | 20 |
| Miscellaneous | 48 | 17 | 49 | 16 | 26 |
| **Total** | **818** | **524** | **766** | **491** | **452** |

***Figure 3-9 Breakdown of Residential Natural Gas Use by End Use and Segment (2011)***



## Commercial Sector

The total electric energy consumed by commercial Ameren Illinois commercial customers in 2011 was 12,414 GWh and the total natural gas energy consumed was 207 million therms. We used the results of the saturation survey to allocate this energy usage to the various building types. The values are shown in Table 3-6 below, and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

***Table 3-6 Commercial Market Segmentation by Building Type, Base Year 2011***

| Segment | Floor Space (1,000 sq. ft.) | Electricity 2011 Use (GWh) | Natural Gas 2011 Use (MMTherms) |
|---|---|---|---|
| Office | 152,614 | 1,962 | 13 |
| Restaurant | 32,237 | 1,094 | 23 |
| Retail | 154,792 | 1,659 | 31 |
| Grocery | 16,997 | 888 | 4 |
| College | 114,488 | 1,342 | 20 |
| School | 106,550 | 776 | 29 |
| Health | 81,656 | 1,462 | 37 |
| Lodging | 75,671 | 701 | 4 |
| Warehouse | 124,092 | 549 | 9 |
| Miscellaneous | 235,567 | 1,980 | 35 |
| **Total** | **1,094,665** | **12,414** | **207** |

Figure 3-10 shows the size of each of the building-types as a percentage of commercial sector energy sales.

***Figure 3-10 Commercial Market Segmentation by Building Type – Percent of Energy Use***

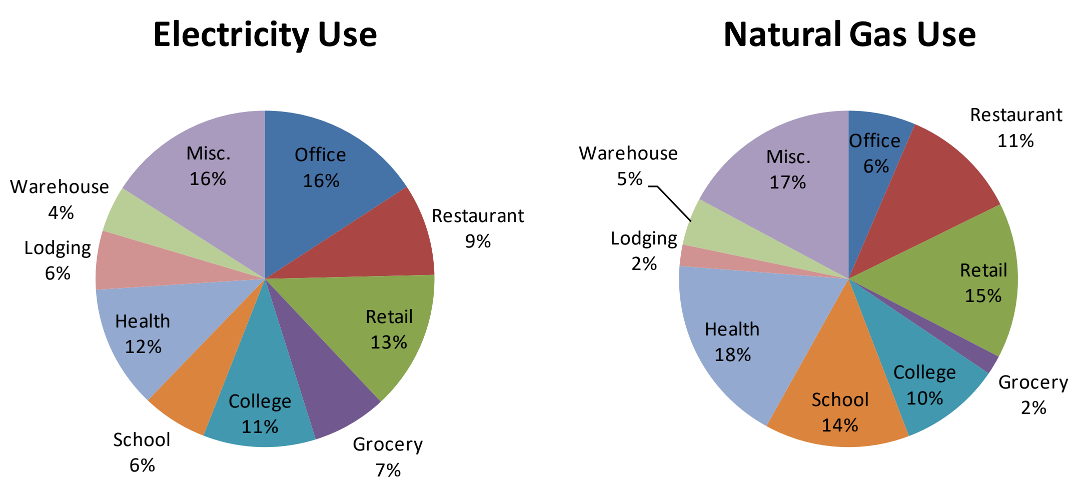



Table 3-7 shows the market profile for electricity of the commercial sector as a whole, representing a composite of all the building types. Overall, about 70% of commercial floor space is cooled. Only about 22% of commercial floor space is heated using electric equipment, either some form of resistance heating or heat pumps. Linear fluorescent lighting and screw-in lamps are the largest energy-consuming technologies in the commercial sector, followed by ventilation and roof top AC units.

Table 3-8 shows the natural gas market profile for the commercial sector as a whole. Boilers are the largest natural gas-consuming technology, followed by water heaters, and furnaces.

Market profiles for each building type are presented in Appendix A.

***Table 3-7 Commercial Sector Composite Electric Market Profile, 2011***

| End Use | Technology | Saturation | EUI (kWh) | Intensity (kWh/Sqft) | Usage (GWh) |
|---|---|---|---|---|---|
| Cooling | Air-Cooled Chiller | 3.9% | 3.78 | 0.15 | 160 |
| Cooling | Water-Cooled Chiller | 10.1% | 3.61 | 0.36 | 399 |
| Cooling | Roof top AC | 48.1% | 2.92 | 1.40 | 1,538 |
| Cooling | Air-Source Heat Pump | 0.5% | 2.96 | 0.01 | 16 |
| Cooling | Geothermal Heat Pump | 0.9% | 2.73 | 0.02 | 26 |
| Cooling | PTAC | 4.0% | 2.26 | 0.09 | 100 |
| Cooling | PTHP | 3.2% | 2.12 | 0.07 | 73 |
| Cooling | Evaporative AC | 0.0% | 9.00 | 0.00 | 0 |
| Heating | Air-Source Heat Pump | 0.5% | 2.43 | 0.01 | 13 |
| Heating | Geothermal Heat Pump | 0.9% | 4.08 | 0.03 | 38 |
| Heating | Electric Room Heat | 0.8% | 4.90 | 0.04 | 44 |
| Heating | Electric Furnace | 12.2% | 4.12 | 0.50 | 552 |
| Heating | PTAC | 4.0% | 2.93 | 0.12 | 130 |
| Heating | PTHP | 3.2% | 1.67 | 0.05 | 58 |
| Ventilation | Ventilation | 100.0% | 1.07 | 1.07 | 1,166 |
| Water Heating | Water Heating | 35.3% | 1.21 | 0.43 | 469 |
| Interior Lighting | Screw-in | 100.0% | 0.52 | 0.52 | 570 |
| Interior Lighting | High-Bay Fixtures | 100.0% | 0.28 | 0.28 | 304 |
| Interior Lighting | Linear Fluorescent | 100.0% | 2.86 | 2.86 | 3,126 |
| Exterior Lighting | Screw-in | 100.0% | 0.17 | 0.17 | 183 |
| Exterior Lighting | HID | 100.0% | 0.44 | 0.44 | 481 |
| Exterior Lighting | Linear Fluorescent | 100.0% | 0.06 | 0.06 | 66 |
| Refrigeration | Walk-in Refrigerator | 9.2% | 0.90 | 0.08 | 90 |
| Refrigeration | Reach-in Refrigerator | 14.0% | 0.10 | 0.01 | 16 |
| Refrigeration | Glass Door Display | 54.5% | 0.81 | 0.44 | 482 |
| Refrigeration | Open Display Case | 54.5% | 0.36 | 0.20 | 218 |
| Refrigeration | Icemaker | 54.5% | 0.17 | 0.09 | 103 |
| Refrigeration | Vending Machine | 54.5% | 0.17 | 0.09 | 103 |
| Food Preparation | Oven | 19.6% | 0.22 | 0.04 | 46 |
| Food Preparation | Fryer | 12.1% | 0.47 | 0.06 | 63 |
| Food Preparation | Dishwasher | 32.6% | 0.65 | 0.21 | 231 |
| Food Preparation | Hot Food Container | 17.1% | 0.14 | 0.02 | 26 |
| Food Preparation | Other | 0.3% | 0.07 | 0.00 | 0 |
| Office Equipment | Desktop Computer | 90.3% | 0.44 | 0.39 | 432 |
| Office Equipment | Laptop | 71.8% | 0.07 | 0.05 | 57 |
| Office Equipment | Server | 70.7% | 0.17 | 0.12 | 129 |
| Office Equipment | Monitor | 89.8% | 0.08 | 0.07 | 81 |
| Office Equipment | Printer/Copier/Fax | 82.5% | 0.06 | 0.05 | 50 |
| Office Equipment | POS Terminal | 56.8% | 0.05 | 0.03 | 29 |
| Misc | Non-HVAC Motors | 61.7% | 0.24 | 0.15 | 160 |
| Misc | Pool Pump | 26.0% | 0.00 | 0.00 | 1 |
| Misc | Pool Heater | 4.1% | 0.00 | 0.00 | 0 |
| Misc | Misc | 100.0% | 0.53 | 0.53 | 585 |
| **Total** | | | | **11.34** | **12,414** |

***Table 3-8 Commercial Sector Composite Natural Gas Market Profile, 2011***

| End Use | Technology | Saturation | EUI (therm) | Intensity (therm/Sqft) | Usage (MMtherm) |
|---|---|---|---|---|---|
| Heating | Furnace | 68.6% | 0.23 | 0.16 | 91 |
| Heating | Boiler | 10.7% | 0.39 | 0.04 | 24 |
| Heating | Unit Heater | 3.2% | 0.27 | 0.01 | 5 |
| Water Heating | Water Heating | 64.7% | 0.14 | 0.09 | 50 |
| Food Preparation | Oven | 22.7% | 0.02 | 0.01 | 3 |
| Food Preparation | Fryer | 18.7% | 0.07 | 0.01 | 8 |
| Food Preparation | Broiler | 21.5% | 0.05 | 0.01 | 6 |
| Food Preparation | Griddle | 24.3% | 0.04 | 0.01 | 5 |
| Food Preparation | Range | 28.2% | 0.04 | 0.01 | 6 |
| Food Preparation | Steamer | 3.4% | 0.07 | 0.00 | 1 |
| Food Preparation | Other | 0.2% | 0.02 | 0.00 | 0 |
| Misc | Pool Heater | 15.8% | 0.01 | 0.00 | 1 |
| Misc | Misc | 9.4% | 0.11 | 0.01 | 6 |
| **Total** | | | | **0.36** | **207** |

Figure 3-11 shows the distribution of electricity and natural gas energy consumption by end use for all commercial buildings. Electric usage is dominated by lighting, with interior and exterior varieties accounting for over one third of consumption. After lighting, the largest end uses are cooling, ventilation, refrigeration and office equipment. The remaining end uses comprise 7% or less of total usage: miscellaneous, space heating, water heating, and food preparation.

Natural gas usage is dominated by space heating (58%) and water heating (24%), with a small amount in food preparation and miscellaneous.

***Figure 3-11 Commercial Electricity and Natural Gas Use by End Use (2011), All Buildings***

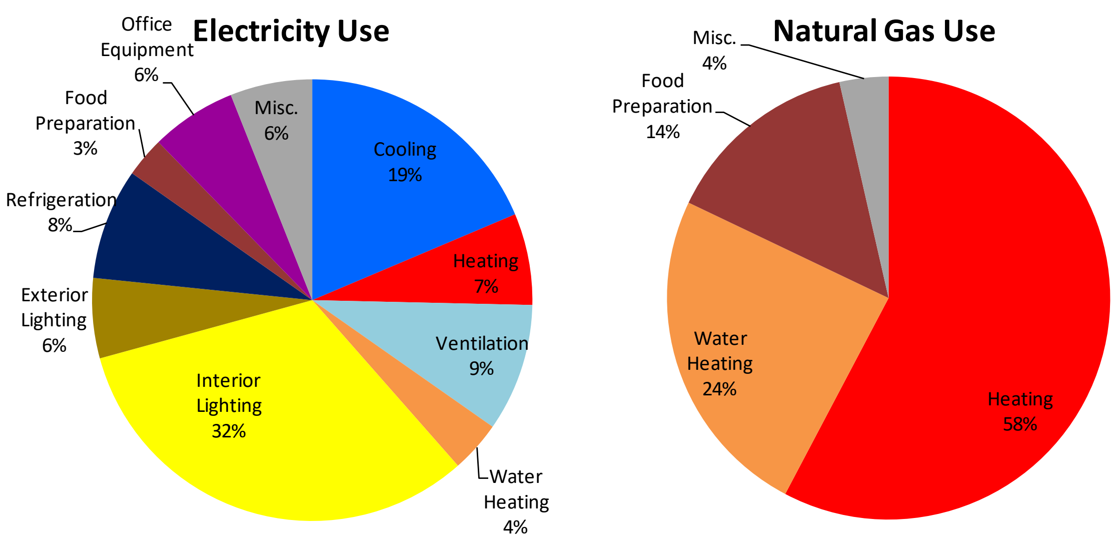



Figure 3-12 and Table 3-9 present the electricity intensity in kWh per square foot by end use and building type. Figure 3-13 shows the same data as a percentage of total energy use for each segment.

***Figure 3-12 Commercial Electricity Intensity by End Use and Segment (kWh/sq ft, 2011)***

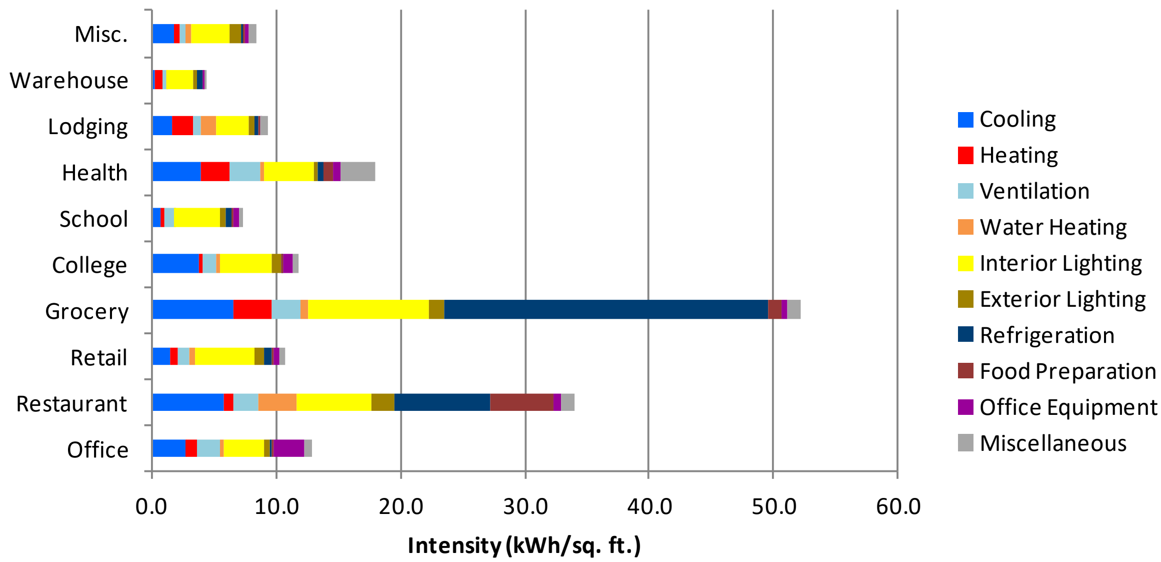



***Figure 3-13 Breakdown of Commercial Electricity Consumption by End Use and Segment (2011)***

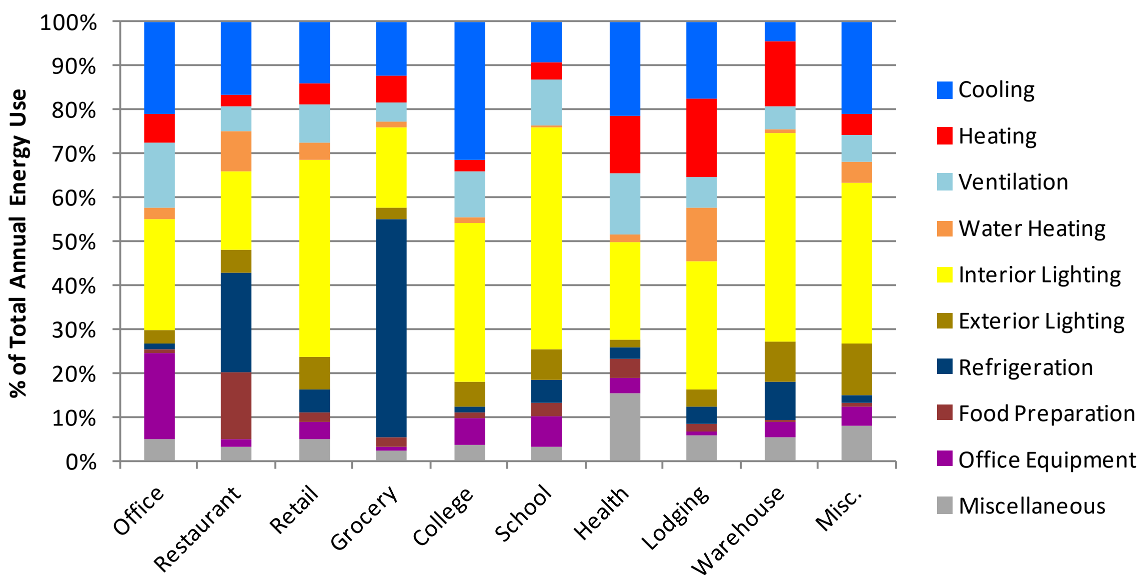


***Table 3-9 Commercial Electricity Intensity by End Use and Segment (kWh/sq ft, 2011)***

| Segment | Cooling | Space Heating | Ventilation | Water Heat | Int. Lighting | Ext. Lighting | Food Prep | Refrigeration | Office Equip | Misc | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Office | 2.7 | 0.8 | 1.9 | 0.3 | 3.3 | 0.4 | 0.1 | 0.1 | 2.5 | 0.6 | **12.9** |
| Restaurant | 5.7 | 0.8 | 2.0 | 3.1 | 6.1 | 1.8 | 7.7 | 5.1 | 0.6 | 1.0 | **33.9** |
| Retail | 1.5 | 0.5 | 0.9 | 0.5 | 4.8 | 0.8 | 0.6 | 0.2 | 0.4 | 0.5 | **10.7** |
| Grocery | 6.5 | 3.0 | 2.3 | 0.7 | 9.7 | 1.3 | 26.1 | 1.2 | 0.4 | 1.2 | **52.3** |
| College | 3.7 | 0.3 | 1.2 | 0.2 | 4.2 | 0.7 | 0.1 | 0.1 | 0.7 | 0.4 | **11.7** |
| School | 0.7 | 0.3 | 0.8 | 0.1 | 3.7 | 0.5 | 0.4 | 0.2 | 0.5 | 0.2 | **7.3** |
| Health | 3.8 | 2.4 | 2.5 | 0.3 | 3.9 | 0.4 | 0.5 | 0.8 | 0.7 | 2.7 | **17.9** |
| Lodging | 1.6 | 1.7 | 0.6 | 1.1 | 2.7 | 0.4 | 0.3 | 0.1 | 0.1 | 0.5 | **9.3** |
| Warehouse | 0.2 | 0.6 | 0.2 | 0.0 | 2.1 | 0.4 | 0.4 | 0.0 | 0.2 | 0.2 | **4.4** |
| Misc. | 1.8 | 0.4 | 0.5 | 0.4 | 3.1 | 1.0 | 0.2 | 0.1 | 0.4 | 0.7 | **8.4** |
| **Total** | **28.2** | **10.8** | **13.0** | **6.7** | **43.6** | **7.5** | **36.4** | **8.0** | **6.4** | **8.1** | **168.8** |

Table 3-10 and Figure 3-14present the natural gas intensity in therms per square foot by end use and building type. Figure 3-15 shows the same data as a percentage of total energy use for each segment.

***Table 3-10 Commercial Natural Gas Intensity by End Use and Segment (therms/sq ft, 2011)***

| Segment | Heating | Water Heating | Food Preparation | Miscellaneous | Total |
|---|---|---|---|---|---|
| Office | 0.20 | 0.04 | 0.02 | 0.01 | **0.28** |
| Restaurant | 0.24 | 0.33 | 0.80 | 0.02 | **1.39** |
| Retail | 0.32 | 0.04 | 0.01 | 0.01 | **0.38** |
| Grocery | 0.29 | 0.13 | 0.05 | 0.00 | **0.46** |
| College | 0.29 | 0.11 | 0.07 | 0.01 | **0.49** |
| School | 0.17 | 0.09 | 0.04 | 0.00 | **0.30** |
| Health | 0.40 | 0.32 | 0.13 | 0.04 | **0.90** |
| Lodging | 0.10 | 0.20 | 0.04 | 0.01 | **0.34** |
| Warehouse | 0.14 | 0.01 | - | 0.00 | **0.15** |
| Misc. | 0.13 | 0.05 | 0.01 | 0.02 | **0.21** |
| **Total** | **2.28** | **1.33** | **1.18** | **0.12** | **4.90** |

***Figure 3-14 Commercial Natural Gas Intensity by End Use and Segment (therms/sq ft, 2011)***

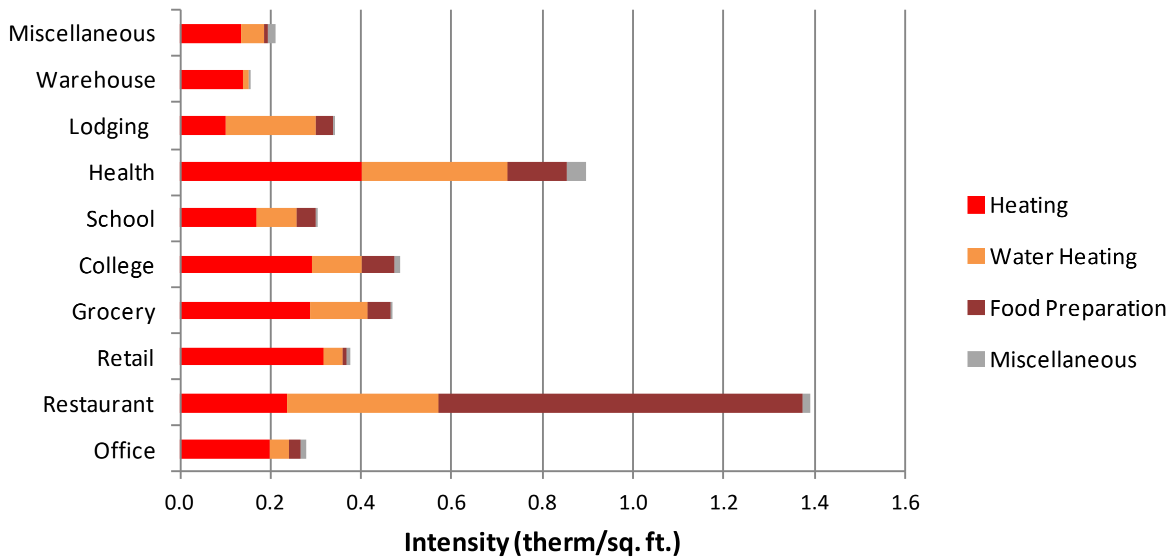
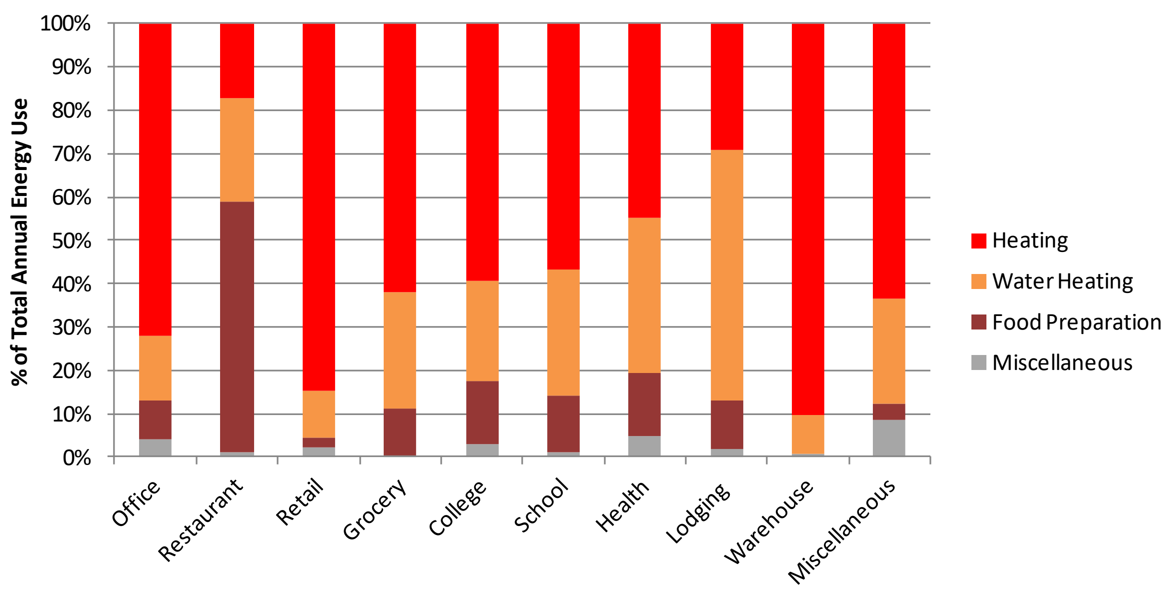



***Figure 3-15 Breakdown of Commercial Natural Gas Use by End Use and Segment (2011)***



## Industrial Sector

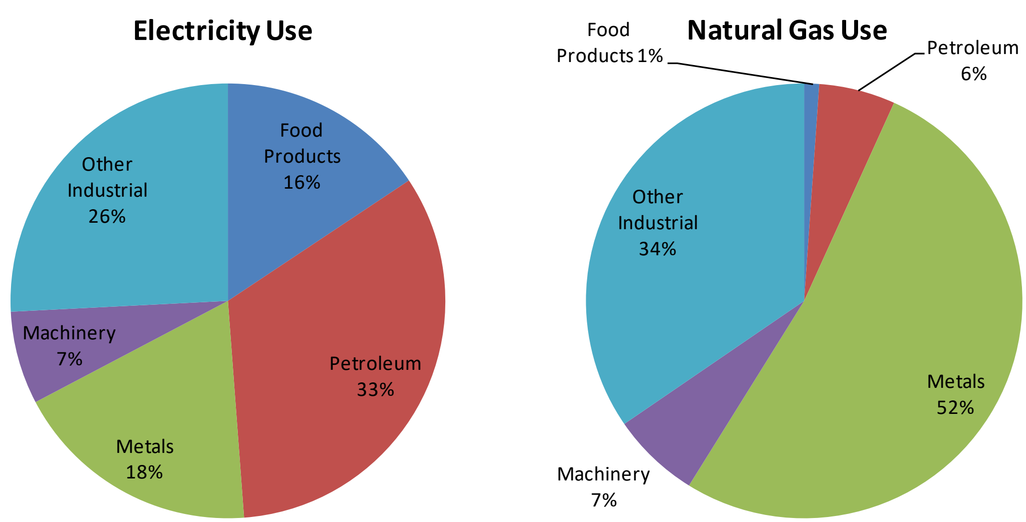
The total electric energy consumed by industrial customers in Ameren service territory in 2011 was 12,580 GWh and the total natural gas energy consumed was 330 million therms[14]. To allocate this energy usage to the various industries, we used the customer surveys to allocate energy use to the various industry types according to the number of employees and energy intensity. The resulting allocations are shown in Table 3-11 and referred to throughout the study as the *control totals* to which all energy usage is calibrated in the base year of the study.

***Table 3-11 Industrial Market Segmentation by Industry Type, Base Year 2011***

| Segment | Employees | Electricity 2011 Use (GWh) | Natural Gas 2011 Use (MMTherms) |
|---|---|---|---|
| Food Products | 68,236 | 1,971 | 3.6 |
| Petroleum | 13,195 | 4,207 | 18.7 |
| Metals | 68,010 | 2,337 | 171.7 |
| Machinery | 36,728 | 859 | 21.7 |
| Other Industrial | 174,778 | 3,245 | 113.9 |
| **Total** | **360,948** | **12,580** | **329.7** |

Figure 3-16 shows the size of each of the segments as a percentage of industrial sector energy sales.

***Figure 3-16 Industrial Market Segmentation – Percentage of Energy Use***




As with the residential and commercial sectors, the industrial market profiles characterize electricity and natural gas use in terms of end use and technology for the base year 2011. Table 3-12 and Table 3-13 show the composite market profiles for the industrial sector.

[14] This does not include the natural gas use for Self-Direct Customers.

***Table 3-12 Industrial Sector Composite Electric Market Profile, 2011***

| End Use | Technology | Saturation | EUI (kWh) | Intensity (kWh/Employee) | Usage (GWh) |
|---|---|---|---|---|---|
| Cooling | Air-Cooled Chiller | 2.5% | 7,561 | 189 | 68.2 |
| Cooling | Water-Cooled Chiller | 2.5% | 7,299 | 182 | 65.9 |
| Cooling | Roof top AC | 1.7% | 11,525 | 192 | 69.4 |
| Cooling | Air Source Heat Pump | 0.1% | 11,653 | 7 | 2.5 |
| Cooling | Geothermal Heat Pump | 3.7% | 7,772 | 290 | 104.6 |
| Cooling | Other Cooling | 0.0% | 0 | 0 | 0.0 |
| Heating | Air Source Heat Pump | 0.1% | 22,945 | 14 | 5.0 |
| Heating | Geothermal Heat Pump | 3.7% | 15,304 | 571 | 206.0 |
| Heating | Electric Resistance | 0.0% | 0 | 0 | 0.0 |
| Heating | Electric Furnace | 6.0% | 35,236 | 2,098 | 757.2 |
| Ventilation | Ventilation | 100.0% | 0 | 0 | 0.0 |
| Interior Lighting | Screw-in | 100.0% | 582 | 582 | 210.0 |
| Interior Lighting | High-Bay Fixtures | 100.0% | 124 | 124 | 44.7 |
| Interior Lighting | Linear Fluorescent | 100.0% | 1,695 | 1,695 | 611.8 |
| Exterior Lighting | Screw-in | 100.0% | 1 | 1 | 0.4 |
| Exterior Lighting | HID | 100.0% | 458 | 458 | 165.5 |
| Exterior Lighting | Linear Fluorescent | 100.0% | 0 | 0 | 0.0 |
| Motors | Pumps | 100.0% | 4,893 | 4,893 | 1,766.3 |
| Motors | Fans & Blowers | 100.0% | 3,152 | 3,152 | 1,137.8 |
| Motors | Compressed Air | 100.0% | 2,920 | 2,920 | 1,053.9 |
| Motors | Matl Handling | 100.0% | 1,264 | 1,264 | 456.3 |
| Motors | Matl Processing | 100.0% | 5,861 | 5,861 | 2,115.4 |
| Motors | Other Motors | 100.0% | 1,246 | 1,246 | 449.8 |
| Process | Process Heating | 100.0% | 4,180 | 4,180 | 1,508.7 |
| Process | Process Cooling and Refrigei | 100.0% | 2,612 | 2,612 | 942.9 |
| Process | Electro-Chemical Processes | 100.0% | 1,062 | 1,062 | 383.2 |
| Process | Other Process | 100.0% | 251 | 251 | 90.4 |
| Misc | Misc | 100.0% | 1,008 | 1,008 | 363.8 |
| **Total** | | | | **34,852** | **12,579.9** |

***Table 3-13 Industrial Sector Composite Natural Gas Market Profile, 2011***

| End Use | Technology | Saturation | EUI (therm) | Intensity (therm/Employee) | Usage (MMtherm) |
|---|---|---|---|---|---|
| Heating | Furnace | 44.2% | 885 | 391 | 102.6 |
| Heating | Boiler | 1.3% | 11,317 | 152 | 40.0 |
| Heating | Other Heating | 24.2% | 797 | 192 | 50.5 |
| Process | Process Heating | 100.0% | 1,271 | 1,271 | 333.6 |
| Process | Process Boiler | 100.0% | 837 | 837 | 219.6 |
| Process | Process Cooling and Refrige | 100.0% | 8 | 8 | 2.0 |
| Process | Other Process | 100.0% | 100 | 100 | 26.1 |
| Misc | Misc | 100.0% | 128 | 128 | 33.7 |
| **Total** | | | | **3,079** | **808.1** |

Figure 3-17 shows the distribution of electricity and natural gas energy consumption by end use for all industrial customers. Motors are clearly the largest overall electric end use for the industrial sector, accounting for 56% of energy use. Note that this end use includes a wide range of industrial equipment, such as air compressors, refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for 23% of electricity use, which includes refrigeration, and electro-chemical processes. Heating is the next highest, followed by interior lighting, miscellaneous, and cooling.

Natural gas usage is dominated by the process end use at 69%, primarily coming from process heating. Space heating (27%) and miscellaneous (4%) comprise the remainder of the sector's natural gas usage.

***Figure 3-17 Industrial Electricity and Natural Gas Use by End Use (2011), All Industries***

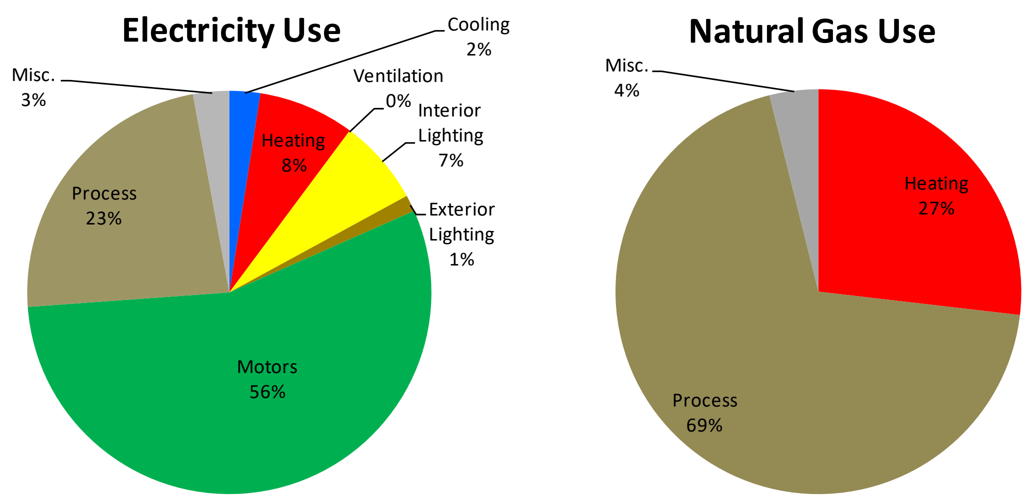



Figure 3-18 and Table 3-14 present the electric consumption by end-use and industry type. Figure 3-19 shows the same data as a percentage of total energy use for each segment.

***Figure 3-18 Industrial Electricity Use by End Use and Segment (GWh, 2011)***

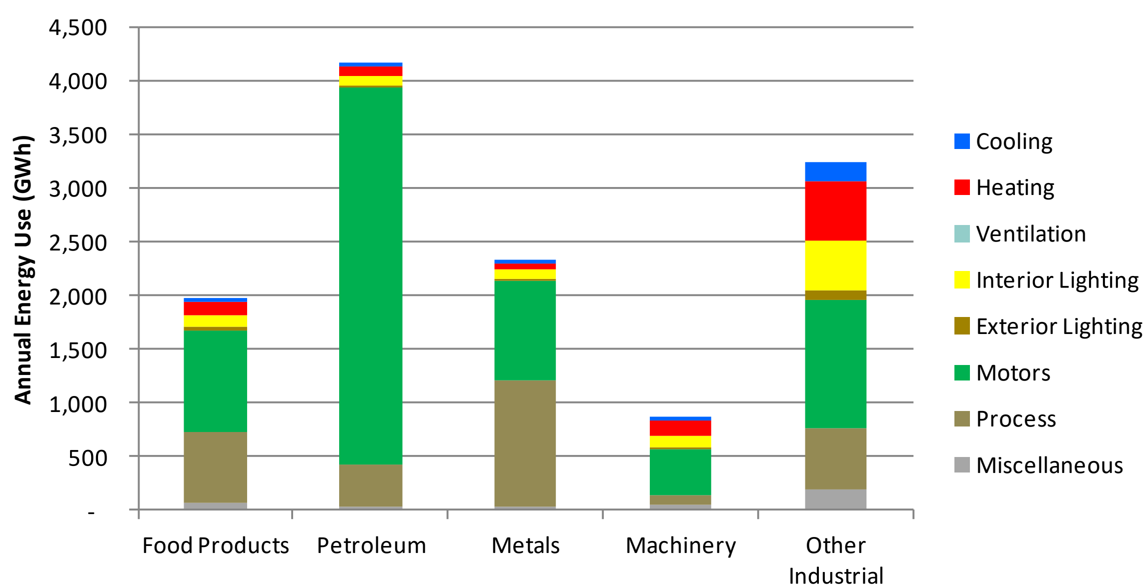


***Table 3-14 Industrial Electricity Use by End Use and Segment (GWh, 2011)***

| End Use | Food Products | Petroleum | Metals | Machinery | Other Industrial | All Industries Combined |
|---|---|---|---|---|---|---|
| Cooling | 36 | 31 | 21 | 44 | 179 | 311 |
| Heating | 111 | 97 | 66 | 138 | 556 | 968 |
| Interior Lighting | 121 | 83 | 84 | 108 | 470 | 867 |
| Exterior Lighting | 23 | 16 | 16 | 21 | 90 | 166 |
| Motors | 947 | 3,516 | 925 | 412 | 1,180 | 6,980 |
| Process | 663 | 393 | 1,181 | 103 | 585 | 2,925 |
| Misc. | 69 | 36 | 31 | 44 | 185 | 364 |
| **Total** | **1,970** | **4,171** | **2,324** | **870** | **3,245** | **12,580** |

***Figure 3-19 Breakdown of Industrial Electricity Use by End Use and Segment (2011)***

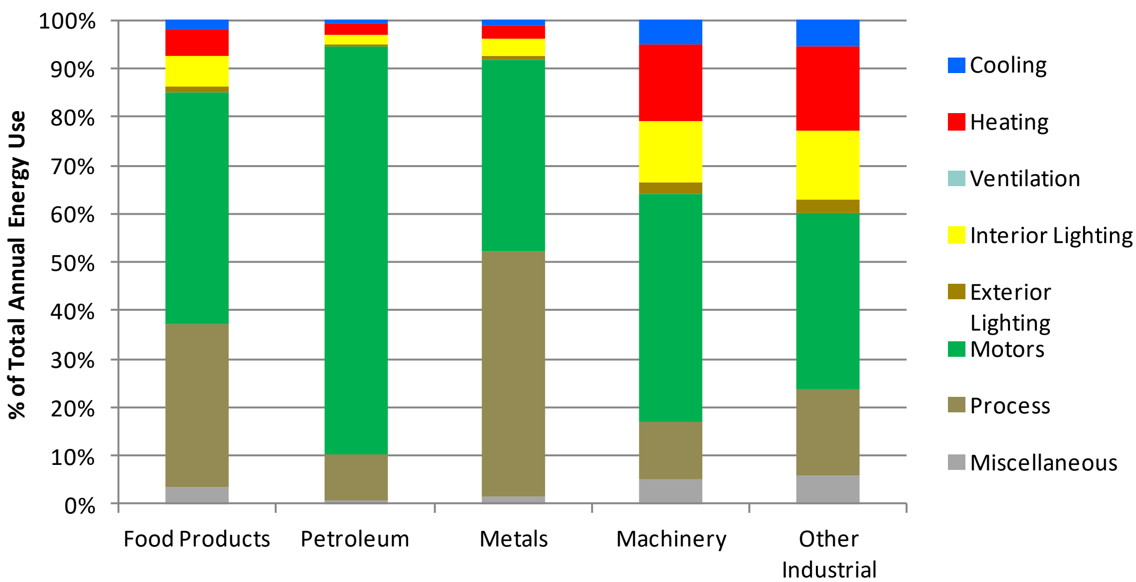



Figure 3-20 and Table 3-15 present the natural gas consumption by end-use and industry type. Figure 3-21 shows the same data as a percentage of total energy use.

***Figure 3-20 Industrial Natural Gas Use by End Use and Segment (MMTherms, 2011)***

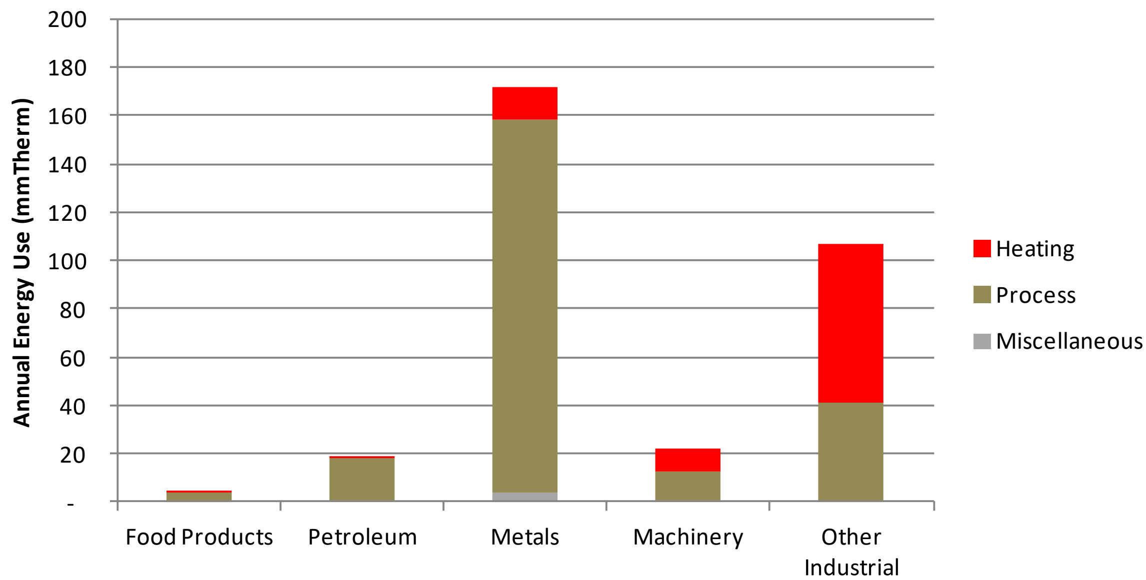
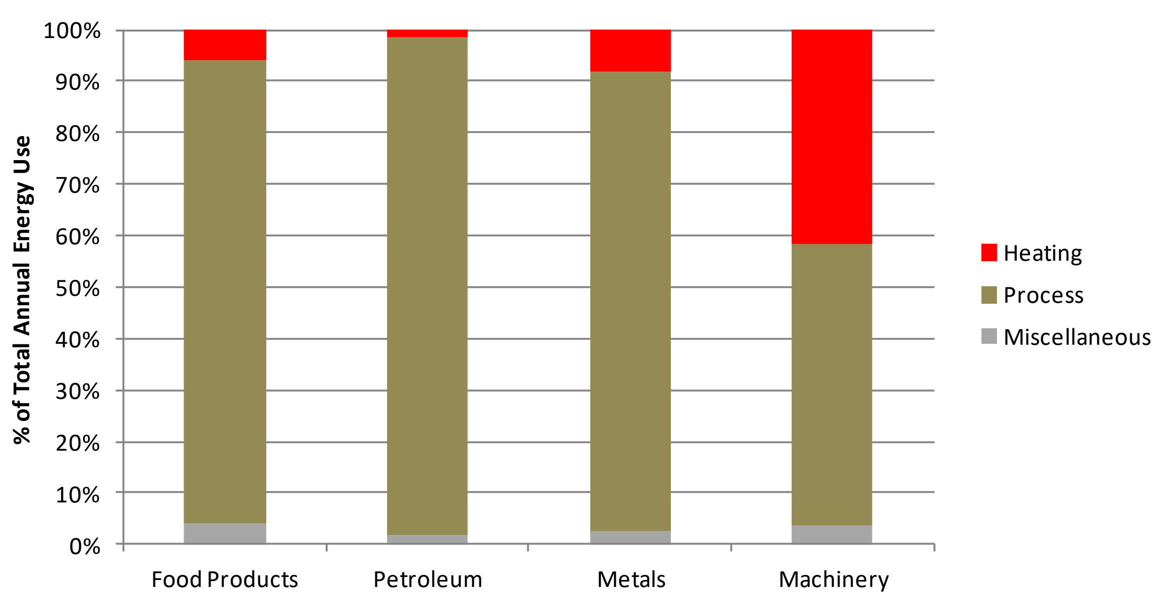



***Table 3-15 Industrial Natural Gas Use by End Use and Segment (MMTherms, 2011)***

| End Use | Food Products | Petroleum | Metals | Machinery | Other Industrial | All Industries Combined |
|---|---|---|---|---|---|---|
| Heating | 0.2 | 0.3 | 13.7 | 9.0 | 65.3 | 88 |
| Process | 3.3 | 18.1 | 153.9 | 11.8 | 41.2 | 228 |
| Miscellaneous | 0.1 | 0.3 | 4.2 | 0.8 | 7.4 | 13 |
| **Total** | **3.7** | **18.7** | **171.7** | **21.7** | **113.9** | **330** |

***Figure 3-21 Breakdown of Industrial Natural Gas Use by End Use and Segment (2011)***



# BASELINE PROJECTION

The baseline projection is an end-use forecast that incorporates a forecast of customer growth, changes in electricity and natural gas prices and trends in fuel shares. It also includes expected impact of appliance/equipment standards and building codes but does not include any efficiency programs. It serves as the metric against which energy efficiency potentials are measured. For this study, we developed two baseline projections:

- Baseline without Naturally Occurring efficiency (Baseline w/o NO)
- Baseline with Naturally Occurring efficiency (Baseline w/NO)

The difference between the two projections is the savings from naturally occurring efficiency.

## Residential Sector

The baseline projections incorporate assumptions about economic growth, electricity prices, and appliance/equipment standards and building codes that are already mandated as described in Chapter 2. Figure 4-1 shows the two baseline projections. The difference between the two lines is attributed to naturally occurring efficiency.

***Figure 4-1 Residential Electricity Baseline Projections***

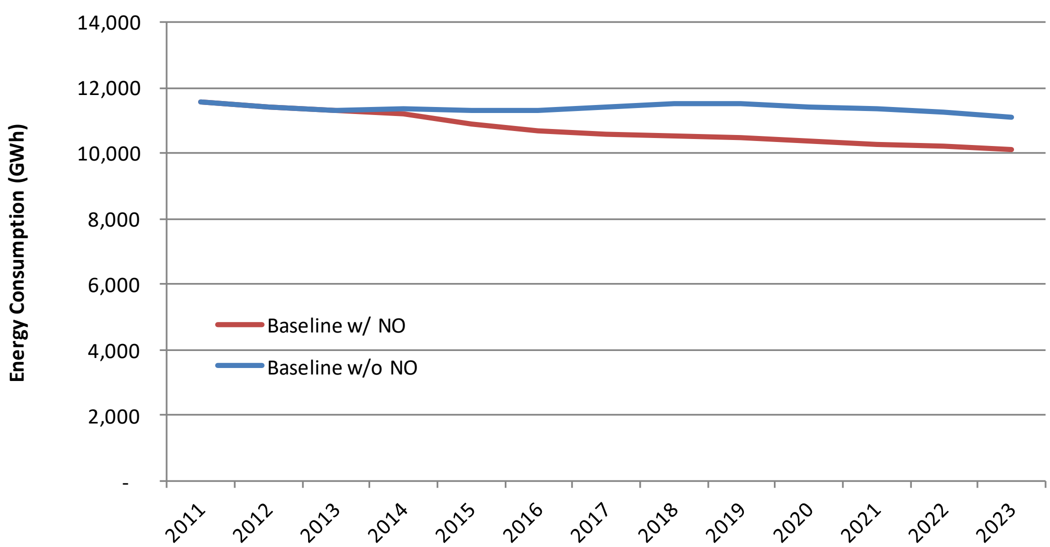



Table 4-1 presents the baseline projections for electricity at the end-use level for the residential sector as a whole.

- In the Baseline without Naturally Occurring efficiency, residential use decreases slightly from 11,577 GWh in 2011 to 11,332 GWh in 2016, a decrease of 0.2%, or an average reduction of 0.06% per year. This reflects the impact of the EISA lighting standard, additional appliance standards adopted in 2011, and modest customer growth.
- In the Baseline with Naturally Occurring efficiency, residential use decreases from 11,577 GWh in 2011 to 10,712 GWh in 2016, a decrease of 4.2%, or an average reduction of 1.4% during the program years. The naturally occurring efficiency savings come primarily from interior lighting and exterior lighting, as customers adopt CFL light bulbs instead of the minimum standard.

Figure 4-2 shows the Baseline with Naturally Occurring efficiency. Most notable is that lighting decreases as a result of efficiency standards and naturally occurring efficiency.

***Table 4-1 Residential Electricity Consumption by End Use and Baseline Projections (GWh)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Cooling | 2,086 | 1,981 | 1,944 | -1.8% | 1,975 | 1,929 | -2.3% |
| Heating | 1,127 | 1,145 | 1,153 | 0.8% | 1,145 | 1,153 | 0.8% |
| Water Heating | 739 | 741 | 736 | -0.6% | 741 | 734 | -0.9% |
| Interior Lighting | 1,562 | 1,600 | 1,570 | -1.8% | 1,506 | 1,187 | -21.2% |
| Exterior Lighting | 228 | 202 | 198 | -2.2% | 191 | 158 | -17.6% |
| Appliances | 2,545 | 2,268 | 2,107 | -7.1% | 2,266 | 2,103 | -7.2% |
| Electronics | 1,404 | 1,469 | 1,606 | 9.4% | 1,425 | 1,466 | 2.9% |
| Miscellaneous | 1,887 | 1,950 | 2,017 | 3.4% | 1,939 | 1,983 | 2.3% |
| **Total** | **11,577** | **11,355** | **11,332** | **-0.2%** | **11,188** | **10,712** | **-4.2%** |

***Figure 4-2 Residential Electricity Baseline with Naturally Occurring Efficiency by End Use***

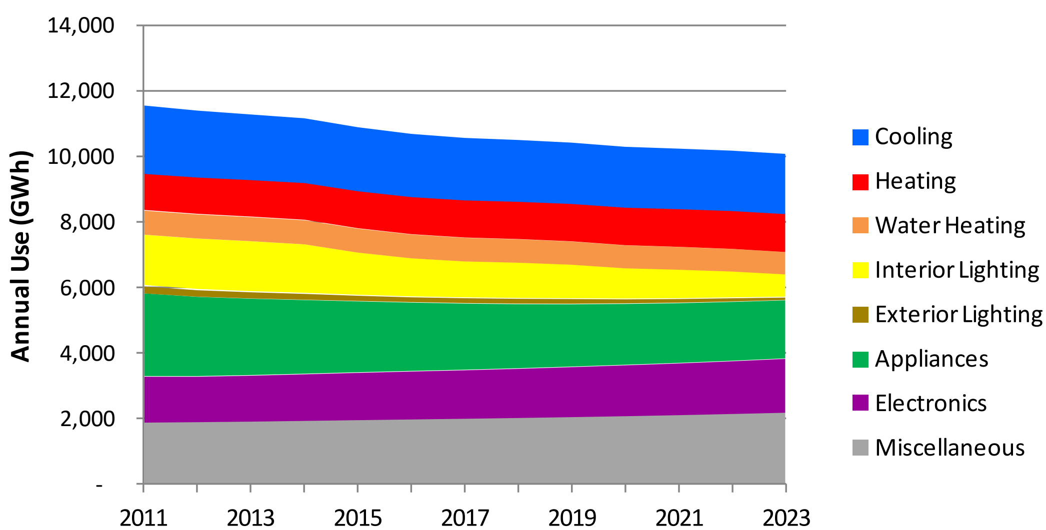



Table 4-2 shows the end-use projection at the technology level for the program years for the Baseline with Naturally Occurring efficiency projection. Specific observations include:

1. The primary reason for the reduction in the baseline projection beginning in 2012 is the federal lighting standards. The standard phases general service incandescent lamps out of the market over a three-year period, causing a decline in interior screw-in lighting use by 22% over the projection period.
2. Appliance energy use decreases by about 7%, reflecting efficiency gains from standards.
3. Growth in use in electronics is modest and reflects an increase in the saturation of electronics and the trend toward higher-powered computers.
4. Growth in miscellaneous use is also modest. This use includes various plug loads not elsewhere classified (e.g., hair dryers, power tools, coffee makers, etc.). This end use has grown consistently in the past and we incorporate future growth assumptions that are consistent with the Annual Energy Outlook.

***Table 4-2 Residential Electricity Baseline Projection with Naturally Occurring Efficiency (GWh)***

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change '14-'16 | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Cooling | Central AC | 1,857 | 1,759 | 1,741 | 1,720 | -1.5% | -1.5% |
| | Room AC | 139 | 133 | 132 | 130 | -1.4% | -1.4% |
| | Air-Source Heat Pump | 54 | 51 | 50 | 50 | -1.9% | -1.9% |
| | Geothermal Heat Pump | 35 | 31 | 30 | 29 | -3.6% | -3.6% |
| | PTHP | - | - | - | - | 0.0% | 0.0% |
| Heating | Furnace | 713 | 733 | 739 | 742 | 0.8% | 0.8% |
| | Electric Room Heat | 200 | 205 | 207 | 208 | 0.8% | 0.8% |
| | Air-Source Heat Pump | 151 | 143 | 141 | 139 | -1.6% | -1.6% |
| | Geothermal Heat Pump | 63 | 64 | 64 | 64 | 0.4% | 0.4% |
| | PTHP | - | - | - | - | 0.0% | 0.0% |
| Water Heating | Water Heater > 55 gal | 177 | 177 | 177 | 176 | -0.1% | -0.1% |
| | Water Heater <= 55 gal | 562 | 563 | 562 | 559 | -0.1% | -0.1% |
| Interior Lighting | Screw-in | 1,133 | 1,055 | 883 | 776 | -7.6% | -7.6% |
| | Linear Fluorescent | 130 | 131 | 131 | 130 | -0.1% | -0.1% |
| | Specialty | 299 | 321 | 300 | 281 | -1.2% | -1.2% |
| Ext. Lighting | Screw-in | 228 | 191 | 170 | 158 | -7.4% | -7.4% |
| Appliances | Clothes Washer | 88 | 84 | 82 | 80 | -1.9% | -1.9% |
| | Clothes Dryer | 540 | 482 | 465 | 449 | -3.7% | -3.7% |
| | Dishwasher | 260 | 209 | 197 | 187 | -6.6% | -6.6% |
| | Refrigerator | 747 | 635 | 594 | 557 | -5.9% | -5.9% |
| | Freezer | 265 | 244 | 238 | 233 | -2.6% | -2.6% |
| | Second Refrigerator | 237 | 196 | 185 | 176 | -6.0% | -6.0% |
| | Stove | 285 | 293 | 296 | 297 | 0.8% | 0.8% |
| | Microwave | 122 | 123 | 124 | 124 | 0.3% | 0.3% |
| Electronics | Personal Computers | 193 | 212 | 217 | 221 | 2.7% | 2.7% |
| | Monitor | 38 | 41 | 42 | 43 | 2.4% | 2.4% |
| | Laptops | 114 | 122 | 126 | 129 | 2.5% | 2.5% |
| | TVs | 586 | 570 | 568 | 566 | -0.7% | -0.7% |
| | Printer/Fax/Copier | 36 | 34 | 34 | 34 | -0.9% | -0.9% |
| | Set-top Boxes/DVR | 335 | 329 | 337 | 345 | 0.6% | 0.6% |
| | Devices and Gadgets | 101 | 117 | 122 | 128 | 4.7% | 4.7% |
| Misc. | Pool Pump | 97 | 102 | 104 | 105 | 1.7% | 1.7% |
| | Pool Heater | 210 | 207 | 207 | 208 | -0.2% | -0.2% |
| | Hot Tub / Spa | 20 | 22 | 22 | 22 | 1.7% | 1.7% |
| | Well Pump | 53 | 55 | 56 | 56 | 1.2% | 1.2% |
| | Furnace Fan | 441 | 455 | 460 | 464 | 1.0% | 1.0% |
| | Miscellaneous | 349 | 408 | 429 | 451 | 5.1% | 5.1% |
| | Air Purifier/Cleaner | 123 | 129 | 132 | 134 | 1.7% | 1.7% |
| | Dehumidifier | 551 | 521 | 512 | 502 | -1.8% | -1.8% |
| | Bathroom Exhaust Fan | 43 | 40 | 40 | 41 | -1.3% | -1.3% |
| **Total** | | **11,577** | **11,577** | **11,188** | **10,915** | **-4.2%** | **-1.6%** |

Figure 4-3 shows the two baseline projections for natural gas. The very subtle difference between the two lines is attributed to naturally occurring efficiency.

***Figure 4-3 Residential Natural Gas Baseline Projections***

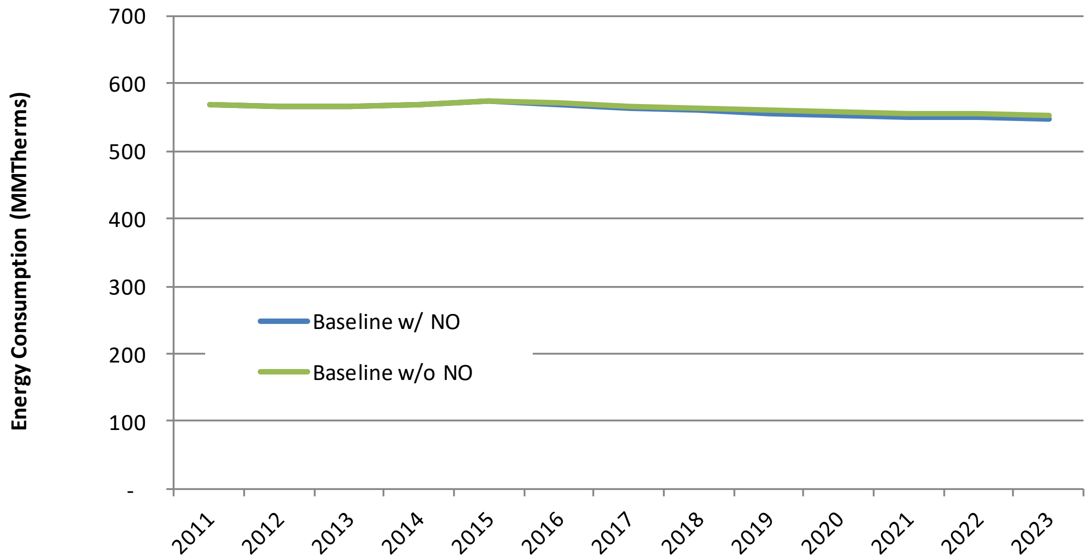



Table 4-3 presents the residential sector baseline projections for natural gas at the end use level. Natural gas use remains essentially flat under both projections. The baseline without Naturally Occurring efficiency goes from 569 million therms in 2011 to 571 million therms in 2016, an overall increase of 0.3%. The baseline projection, which includes Naturally Occurring efficiency, increases slightly from 569 million therms in 2011 to 570 million therms in 2016.

Figure 4-4 shows the Baseline projection with Naturally Occurring efficiency by end use.

***Table 4-3 Residential Natural Gas Consumption by End Use and Baseline Projections (MMTherms)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Heating | 390 | 390 | 389 | -0.2% | 389 | 388 | -0.6% |
| Water Heating | 120 | 120 | 120 | -0.5% | 120 | 120 | -0.6% |
| Appliances | 25 | 24 | 24 | -5.5% | 24 | 24 | -5.7% |
| Miscellaneous | 33 | 36 | 38 | 16.7% | 36 | 38 | 16.7% |
| **Total** | **569** | **570** | **571** | **0.5%** | **569** | **570** | **0.2%** |

***Figure 4-4 Residential Natural Gas Baseline with Naturally Occurring Efficiency by End Use***

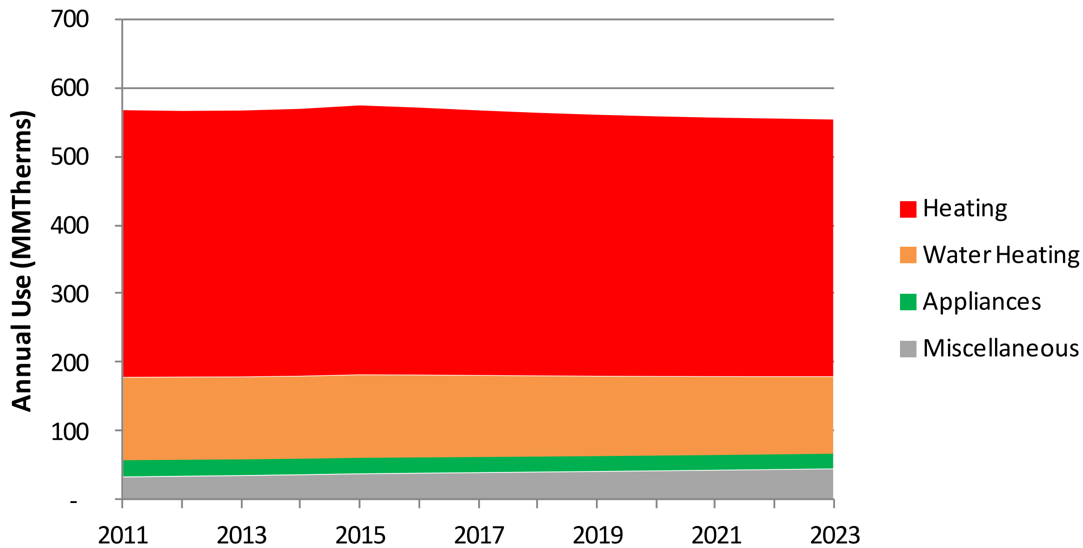



Table 4-4 shows the end use projection for natural gas at the technology level for the Baseline with Naturally Occurring efficiency. Usage from natural gas boilers decreases by almost 6% due to the appliance standard.

***Table 4-4 Residential Natural Gas Baseline Projection with Naturally Occurring Efficiency (MMTherms)***

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change '14-'16 | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Heating | Furnace | 338 | 341 | 344 | 342 | 0.3% | 0.1% |
| | Boiler | 44 | 41 | 40 | 38 | -5.7% | -1.9% |
| | Other Heating | 8 | 8 | 8 | 8 | 2.0% | 0.7% |
| Water Heating | Water Heater <=55 gal | 26 | 26 | 26 | 26 | -0.2% | -0.1% |
| | Water Heater > 55 gal | 94 | 94 | 95 | 94 | -0.2% | -0.1% |
| Appliances | Clothes Dryer | 6 | 5 | 5 | 5 | -10.0% | -3.3% |
| | Stove | 19 | 19 | 19 | 19 | 0.6% | 0.2% |
| Miscellaneous | Pool Heater | 11 | 12 | 12 | 12 | 1.5% | 0.5% |
| | Hot Tub / Spa | - | - | - | - | 0.0% | 0.0% |
| | Miscellaneous | 21 | 24 | 26 | 26 | 8.6% | 2.9% |
| **Total** | | **569** | **569** | **574** | **570** | **0.2%** | **-0.1%** |

## Commercial Sector

The baseline projections incorporate assumptions about economic growth, electricity prices, and appliance/equipment standards and building codes that are already mandated as described in Chapter 2. Figure 4-5 shows the two baseline projections. The difference between the two lines is attributed to naturally occurring efficiency.

***Figure 4-5 Commercial Electricity Baseline Projections***

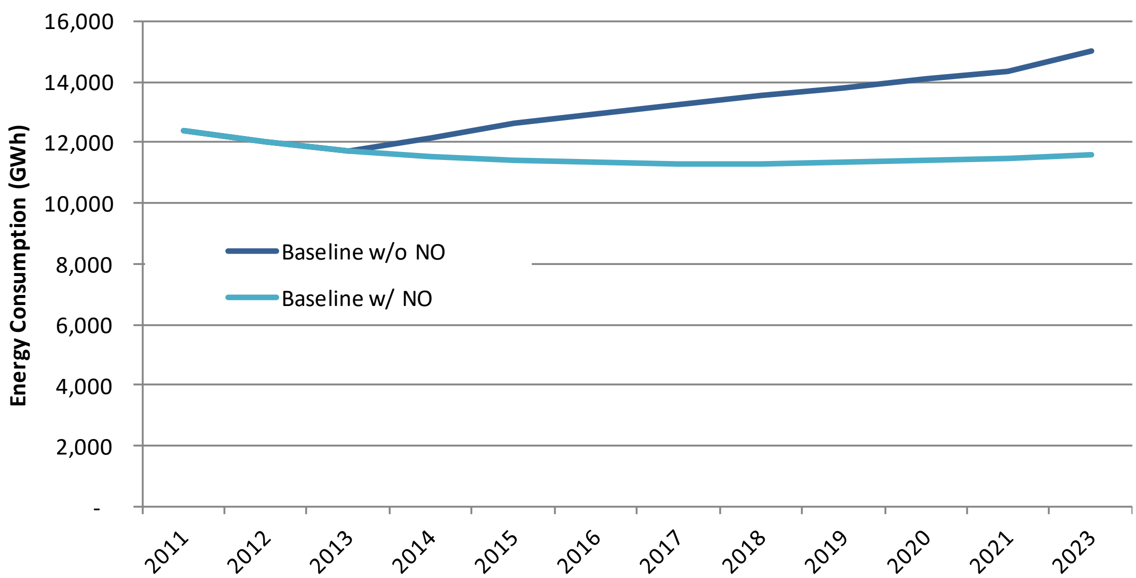



Table 4-5 and Figure 4-6 present the electricity baseline projections at the end-use level for the commercial sector as a whole. In the baseline without Naturally Occurring efficiency, commercial electricity use increases from 12,414 GWh in 2011 to 12,919 GWh in 2016, an increase of 6%. Electricity use in the Baseline with Naturally Occurring efficiency shows a decline of 2% overall during the program years. Commercial usage starts at 12,414 GWh in 2011, and decreases to 11,332 GWh in 2016. The largest difference between the two projections is in the lighting end uses. Although the EISA standard reduces the growth in lighting usage, customers are already adopting the higher efficiency lighting options that are currently available.

***Table 4-5 Commercial Electricity Consumption by End Use and Baseline Projections (GWh)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Cooling | 2,312 | 2,182 | 2,137 | -2.0% | 2,174 | 2,115 | -2.7% |
| Heating | 835 | 860 | 879 | 2.2% | 860 | 879 | 2.2% |
| Ventilation | 1,166 | 1,184 | 1,356 | 14.5% | 1,091 | 1,085 | -0.5% |
| Water Heating | 469 | 471 | 477 | 1.3% | 471 | 477 | 1.2% |
| Interior Lighting | 4,000 | 3,859 | 4,209 | 9.1% | 3,517 | 3,365 | -4.3% |
| Exterior Lighting | 730 | 712 | 811 | 13.8% | 587 | 537 | -8.5% |
| Refrigeration | 1,012 | 879 | 850 | -3.4% | 881 | 854 | -3.1% |
| Food Preparation | 366 | 375 | 397 | 5.9% | 367 | 373 | 1.6% |
| Office Equip. | 778 | 829 | 935 | 12.8% | 782 | 780 | -0.3% |
| Miscellaneous | 746 | 816 | 866 | 6.2% | 816 | 866 | 6.2% |
| **Total** | **12,414** | **12,168** | **12,919** | **6.2%** | **11,547** | **11,332** | **-1.9%** |

***Figure 4-6 Commercial Electricity Baseline with Naturally Occurring Efficiency by End Use***

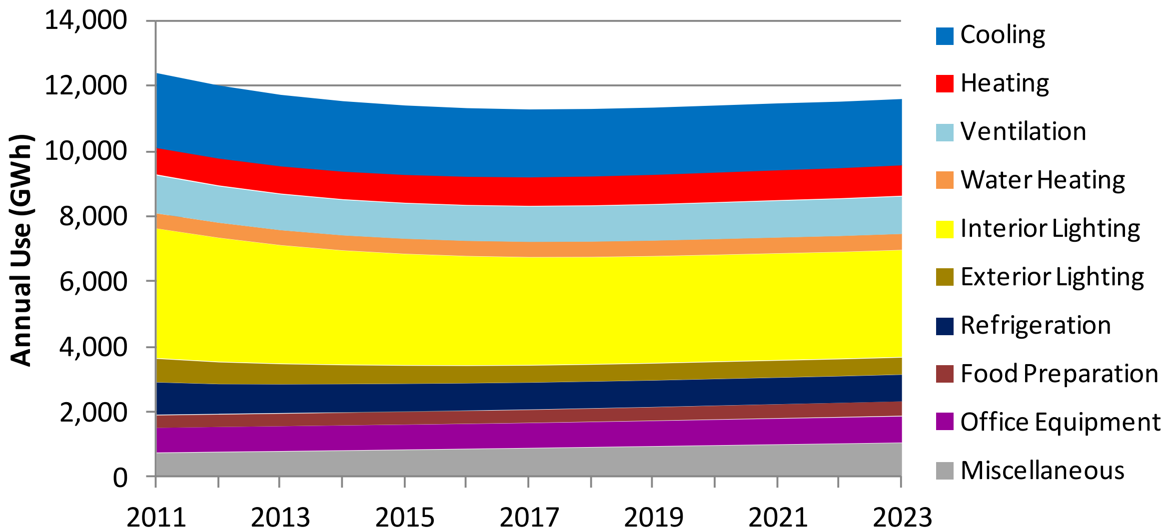



Table 4-6 presents the commercial sector electricity Baseline with Naturally Occurring efficiency by technology. Interior screw-in lighting and refrigeration decrease significantly over the projection period as a result of efficiency standards.

***Table 4-6 Commercial Electricity Baseline Projection w/Naturally Occurring Efficiency (GWh)***

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Cooling | Air-Cooled Chiller | 160 | 157 | 157 | 158 | 0.6% | 0.2% |
| | Water-Cooled Chiller | 399 | 355 | 347 | 340 | -4.2% | -1.4% |
| | Roof top AC | 1,538 | 1,453 | 1,430 | 1,411 | -2.9% | -1.0% |
| | Geothermal Heat Pump | 26 | 25 | 25 | 26 | 4.0% | 1.3% |
| | Air Source Heat Pump | 16 | 15 | 15 | 14 | -6.7% | -2.3% |
| | PTAC | 100 | 98 | 97 | 97 | -1.0% | -0.3% |
| | PTHP | 73 | 71 | 70 | 69 | -2.8% | -1.0% |
| | Evaporative AC | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| Heating | Geothermal Heat Pump | 38 | 38 | 38 | 39 | 2.6% | 0.9% |
| | Electric Room Heat | 44 | 45 | 45 | 46 | 2.2% | 0.7% |
| | Electric Furnace | 552 | 566 | 572 | 577 | 1.9% | 0.6% |
| | Air Source Heat Pump | 13 | 13 | 13 | 13 | 0.0% | 0.0% |
| | PTAC | 130 | 140 | 143 | 146 | 4.3% | 1.4% |
| | PTHP | 58 | 59 | 59 | 59 | 0.0% | 0.0% |
| Ventilation | Ventilation | 1,166 | 1,091 | 1,086 | 1,085 | -0.5% | -0.2% |
| Water Heating | Water Heating | 469 | 471 | 474 | 477 | 1.3% | 0.4% |
| Interior Lighting | Screw-in | 570 | 424 | 415 | 414 | -2.4% | -0.8% |
| | High-Bay Fixtures | 304 | 270 | 265 | 264 | -2.2% | -0.7% |
| | Linear Fluorescent | 3,126 | 2,823 | 2,748 | 2,687 | -4.8% | -1.6% |
| Exterior Lighting | Screw-in | 183 | 128 | 122 | 119 | -7.0% | -2.4% |
| | HID | 481 | 390 | 367 | 350 | -10.3% | -3.6% |
| | Linear Fluorescent | 66 | 69 | 70 | 68 | -1.4% | -0.5% |

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Refrigeration | Walk-in Refrigerator | 90 | 66 | 61 | 57 | -13.6% | -4.9% |
| | Reach-in Refrigerator | 16 | 12 | 11 | 10 | -16.7% | -6.1% |
| | Glass Door Display | 482 | 415 | 414 | 414 | -0.2% | -0.1% |
| | Open Display Case | 218 | 200 | 196 | 194 | -3.0% | -1.0% |
| | Icemaker | 103 | 100 | 100 | 101 | 1.0% | 0.3% |
| | Vending Machine | 103 | 88 | 84 | 79 | -10.2% | -3.6% |
| Food Preparation | Oven | 46 | 49 | 51 | 52 | 6.1% | 2.0% |
| | Fryer | 63 | 69 | 72 | 74 | 7.2% | 2.3% |
| | Dishwasher | 231 | 227 | 227 | 227 | 0.0% | 0.0% |
| | Hot Food Container | 26 | 21 | 21 | 20 | -4.8% | -1.6% |
| | Other | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| Office Equipment | Desktop Computer | 432 | 433 | 431 | 428 | -1.2% | -0.4% |
| | Laptop | 57 | 59 | 59 | 59 | 0.0% | 0.0% |
| | Server | 129 | 126 | 124 | 124 | -1.6% | -0.5% |
| | Monitor | 81 | 81 | 82 | 83 | 2.5% | 0.8% |
| | Printer/Copier/Fax | 50 | 57 | 59 | 60 | 5.3% | 1.7% |
| | POS Terminal | 29 | 26 | 26 | 25 | -3.8% | -1.3% |
| Miscellaneous | Non-HVAC Motors | 160 | 163 | 165 | 166 | 1.8% | 0.6% |
| | Pool Pump | 1 | 1 | 1 | 1 | 0.0% | 0.0% |
| | Pool Heater | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| | Miscellaneous | 585 | 651 | 675 | 699 | 7.4% | 2.4% |
| **Total** | | **12,414** | **11,547** | **11,415** | **11,332** | **-1.9%** | **-0.6%** |

Figure 4-7 shows the two baseline projections for natural gas. The very subtle difference between the two lines is attributed to naturally occurring efficiency.

***Figure 4-7 Commercial Natural Gas Baseline Projections***

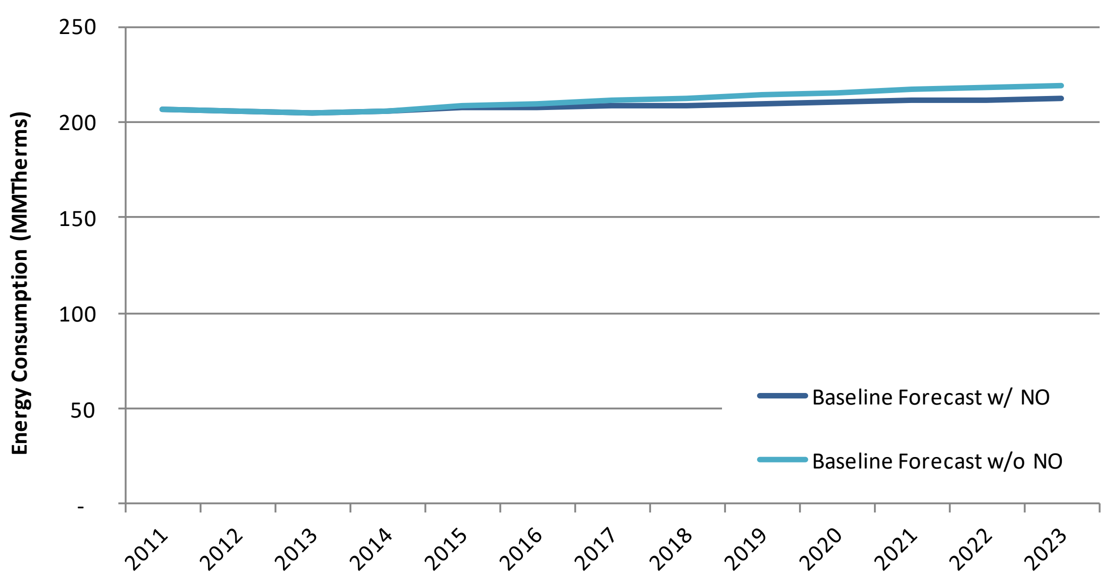



Table 4-7 shows the baseline projections for natural gas, which is expected to increase by 1.8% between 2011 and 2016 under the Without Naturally Occurring projection, but only increases by 1.2% under the With Naturally Occurring projection. The cumulative natural gas savings due to naturally occurring efficiency reach 2.2 million therms by 2016. Table 4-8 shows the commercial baseline gas projection at the technology level.

***Table 4-7 Commercial Gas Consumption by End Use and Baseline Projections (MMTherms)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Heating | 119 | 118 | 120 | 1.6% | 118 | 119 | 1.2% |
| Water Heating | 50 | 50 | 51 | 1.8% | 50 | 50 | 0.8% |
| Food Preparation | 30 | 30 | 31 | 3.1% | 30 | 31 | 1.5% |
| Miscellaneous | 7 | 8 | 8 | 1.8% | 8 | 8 | 2.1% |
| **Total** | **207** | **206** | **210** | **1.8%** | **205** | **208** | **1.2%** |

***Figure 4-8 Commercial Natural Gas Baseline with Naturally Occurring Efficiency by End Use***

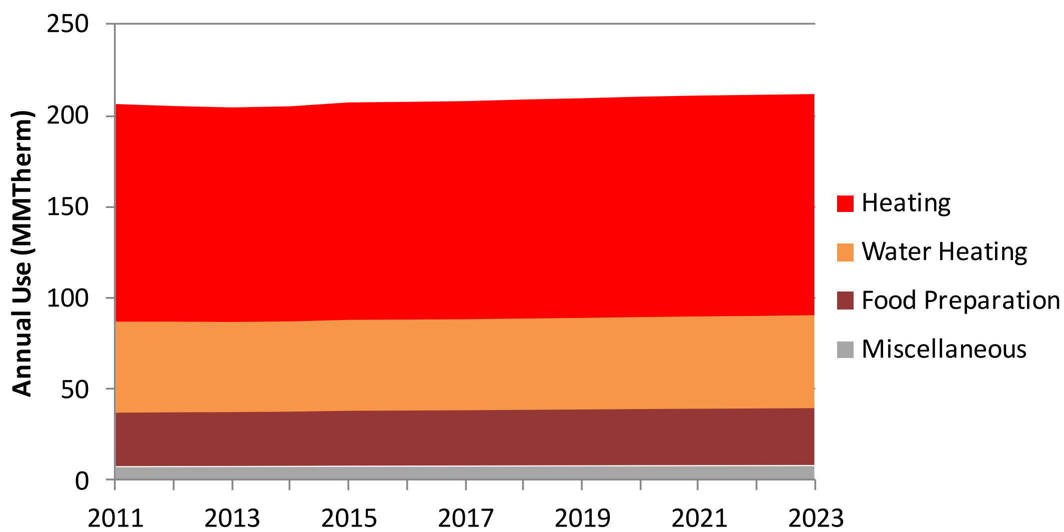



***Table 4-8 Commercial Natural Gas Baseline Projection with Naturally Occurring Efficiency (MMTherms)***

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change ('14-'16) | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Heating | Furnace | 91 | 92 | 93 | 93 | 1.6% | 0.5% |
| | Boiler | 24 | 21 | 21 | 21 | -0.6% | -0.2% |
| | Unit Heater | 5 | 5 | 5 | 5 | 2.1% | 0.7% |
| Water Heating | Water Heater | 50 | 50 | 50 | 50 | 0.8% | 0.3% |
| Food Preparation | Oven | 3 | 3 | 3 | 3 | -1.0% | -0.3% |
| | Fryer | 8 | 9 | 9 | 9 | 5.1% | 1.7% |
| | Broiler | 6 | 6 | 6 | 6 | -0.8% | -0.3% |
| | Griddle | 5 | 5 | 5 | 5 | 2.0% | 0.7% |
| | Range | 6 | 6 | 6 | 6 | 0.1% | 0.0% |
| | Steamer | 1 | 1 | 1 | 1 | -1.7% | -0.6% |
| | Other | 0 | 0 | 0 | 0 | 1.7% | 0.6% |
| Miscellaneous | Pool Heater | 1 | 1 | 1 | 1 | 2.0% | 0.7% |
| | Miscellaneous | 6 | 6 | 6 | 6 | 2.1% | 0.7% |
| **Total** | | **207** | **205** | **207** | **208** | **1.2%** | **0.4%** |

## Industrial Sector

The baseline projections incorporate assumptions about economic growth, electricity prices, and appliance/equipment standards and building codes that are already mandated as described in Chapter 2. Figure 4-9 shows the two baseline projections. The difference between the two lines is attributed to naturally occurring efficiency.

***Figure 4-9 Industrial Electricity Baseline Forecasts***

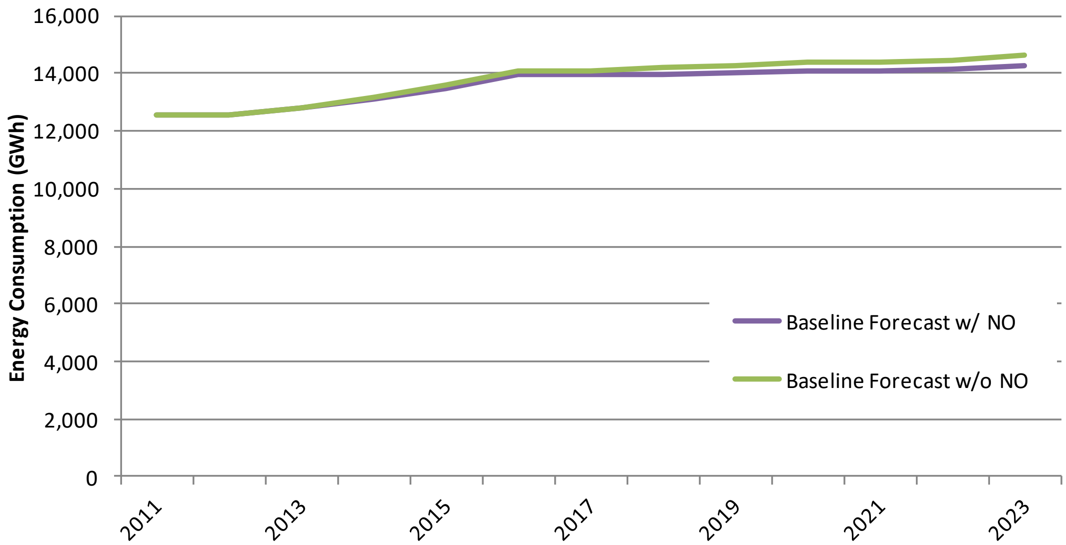



Table 4-9 and Figure 4-10 present the electricity baseline projection at the end-use level for the industrial sector as a whole. In the Baseline forecast without Naturally Occurring efficiency, industrial annual electricity use increases from 12,580 GWh in 2011 to 14,065 GWh in 2016. In the Baseline projection with Naturally Occurring efficiency, industrial electricity use increases from 12,580 GWh in 2011 to 13,955 GWh in 2016, an increase of 6.3%, during the program years. This is largely driven by the recovery of the economy.

***Table 4-9 Industrial Electricity Consumption by End Use and Baseline Projections (GWh)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Cooling | 311 | 316 | 333 | 5.3% | 314 | 326 | 4.0% |
| Heating | 968 | 993 | 1,034 | 4.1% | 993 | 1,034 | 4.1% |
| Ventilation | - | - | - | 0.0% | - | - | 0.0% |
| Interior Lighting | 867 | 744 | 770 | 3.4% | 709 | 698 | -1.6% |
| Exterior Lighting | 166 | 128 | 138 | 8.5% | 115 | 109 | -5.5% |
| Motors | 6,980 | 7,460 | 7,989 | 7.1% | 7,459 | 7,988 | 7.1% |
| Process | 2,925 | 3,129 | 3,344 | 6.9% | 3,129 | 3,344 | 6.9% |
| Miscellaneous | 364 | 411 | 456 | 10.8% | 411 | 456 | 10.8% |
| **Total** | **12,580** | **13,181** | **14,065** | **6.7%** | **13,130** | **13,955** | **6.3%** |

***Figure 4-10 Industrial Electricity Baseline Projection with Naturally Occurring by End Use***

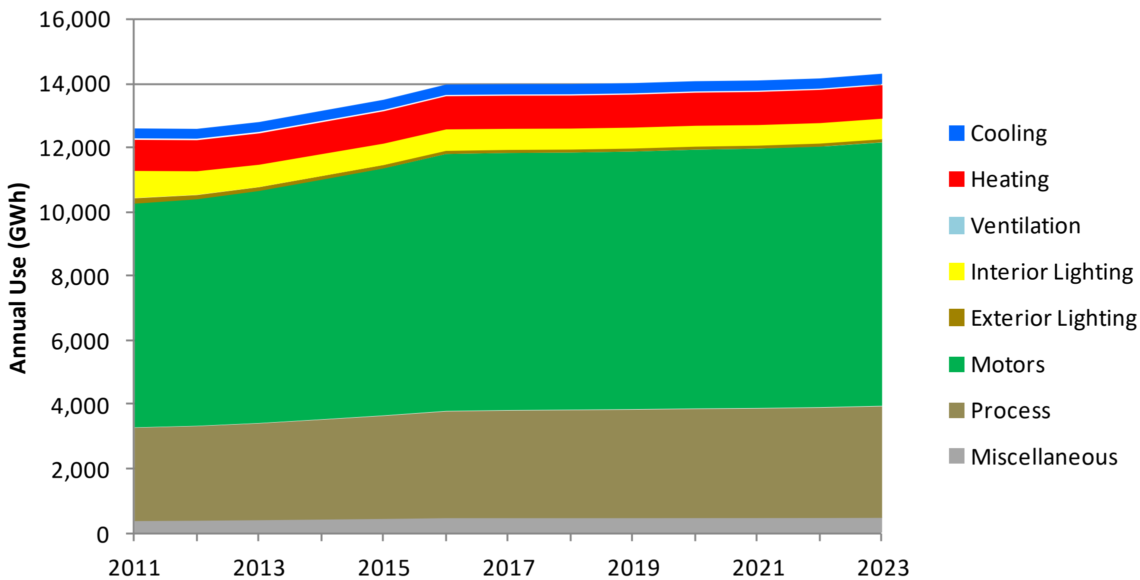



Table 4-10 presents the industrial sector electricity Baseline with Naturally Occurring efficiency by technology. Interior lighting and exterior lighting decrease significantly over the projection period as a result of efficiency standards.

***Table 4-10 Industrial Electricity Baseline Projection with Naturally Occurring Efficiency (GWh)***

| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change ('14-'16) | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| Cooling | Air-Cooled Chiller | 68 | 70 | 72 | 74 | 5.7% | 1.9% |
| | Water-Cooled Chiller | 66 | 69 | 70 | 73 | 5.8% | 1.9% |
| | Roof top AC | 69 | 67 | 67 | 68 | 1.5% | 0.5% |
| | Other Cooling | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| | Geothermal Heat Pump | 105 | 105 | 106 | 108 | 2.9% | 0.9% |
| | Air Source Heat Pump | 3 | 3 | 3 | 3 | 0.0% | 0.0% |
| Heating | Electric Furnace | 757 | 782 | 796 | 817 | 4.5% | 1.5% |
| | Geothermal Heat Pump | 206 | 206 | 208 | 212 | 2.9% | 1.0% |
| | Air Source Heat Pump | 5 | 5 | 5 | 5 | 0.0% | 0.0% |
| | Electric Resistance | - | - | - | - | 0.0% | 0.0% |
| Ventilation | Ventilation | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| Interior Lighting | Screw-in | 210 | 128 | 117 | 115 | -10.2% | -3.6% |
| | High-Bay Fixtures | 45 | 33 | 31 | 31 | -6.1% | -2.1% |
| | Linear Fluorescent | 612 | 548 | 546 | 551 | 0.5% | 0.2% |
| Exterior Lighting | Screw-in | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| | HID | 165 | 115 | 109 | 108 | -6.1% | -2.1% |
| | Linear Fluorescent | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| Motors | Pumps | 1,766 | 1,888 | 1,945 | 2,021 | 7.0% | 2.3% |
| | Fans & Blowers | 1,138 | 1,216 | 1,253 | 1,303 | 7.2% | 2.3% |

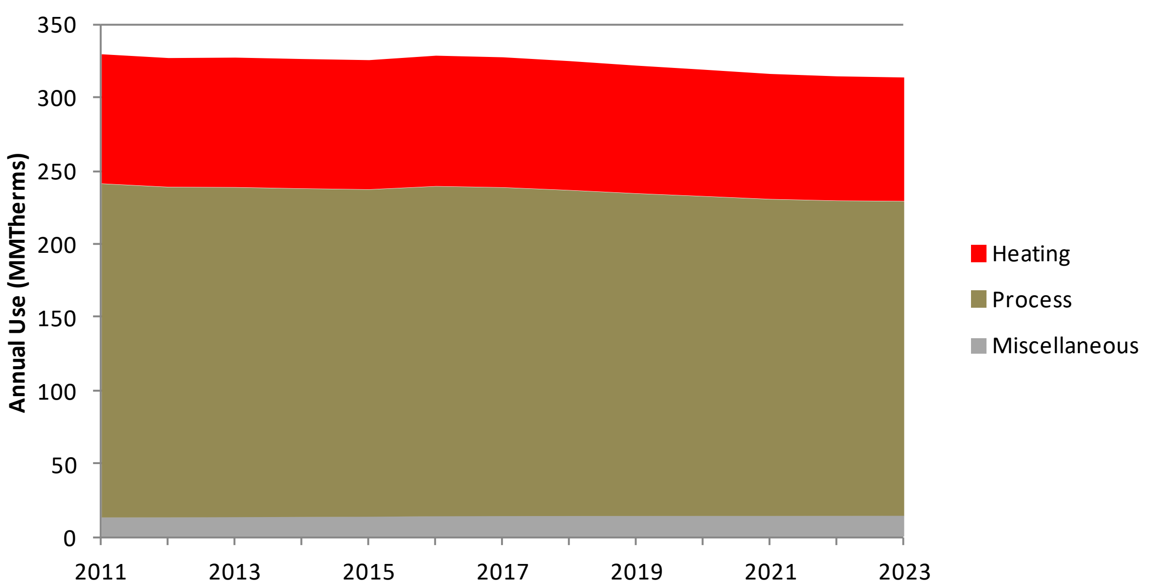
| End Use | Technology | 2011 | 2014 | 2015 | 2016 | % Change ('14-'16) | Avg. Growth Rate |
|---|---|---|---|---|---|---|---|
| | Compressed Air | 1,054 | 1,126 | 1,161 | 1,206 | 7.1% | 2.3% |
| | Material Handling | 456 | 488 | 503 | 522 | 7.0% | 2.2% |
| | Material Processing | 2,115 | 2,261 | 2,330 | 2,421 | 7.1% | 2.3% |
| | Other Motors | 450 | 481 | 495 | 515 | 7.1% | 2.3% |
| Process | Process Heating | 1,509 | 1,614 | 1,666 | 1,725 | 6.9% | 2.2% |
| | Process Cooling and Refrig | 943 | 1,009 | 1,041 | 1,078 | 6.8% | 2.2% |
| | Electro-Chemical Processes | 383 | 410 | 423 | 438 | 6.8% | 2.2% |
| | Other Process | 90 | 97 | 100 | 103 | 6.2% | 2.0% |
| Miscellaneous | Miscellaneous | 364 | 411 | 431 | 456 | 10.9% | 3.5% |
| **Total** | | **12,580** | **13,130** | **13,480** | **13,955** | **6.3%** | **2.0%** |

There is virtually no naturally occurring efficiency in the industrial sector between 2011 and 2016 as shown in Table 4-11.

***Table 4-11 Industrial Natural Gas Consumption by End Use and Baseline Projections (MMTherms)***

| End Use | Base year | Without Naturally Occurring Efficiency | | | With Naturally Occurring Efficiency | | |
|---|---|---|---|---|---|---|---|
| | 2011 | 2014 | 2016 | % Change ('14-'16) | 2014 | 2016 | % Change ('14-'16) |
| Heating | 88 | 89 | 90 | 1.0% | 89 | 89 | 0.8% |
| Process | 228 | 225 | 226 | 0.5% | 225 | 226 | 0.5% |
| Miscellaneous | 13 | 13 | 14 | 3.5% | 13 | 14 | 3.5% |
| **Total** | **330** | **327** | **329** | **0.8%** | **326** | **329** | **0.7%** |

***Figure 4-11 Industrial Natural Gas Baseline with Naturally Occurring Efficiency by End Use***



## Baseline Projection Summary

For the remainder of the report, the baseline forecast refers only to the baseline that **includes** naturally occurring efficiency. Table 4-12 and Figure 4-12 provide a summary of the baseline projection for electricity by sector for the Ameren Illinois service territory. Overall, the projection shows a slight decrease in electricity use, due to a challenging macroeconomic environment and codes and standards.

***Table 4-12 Electricity Baseline Projection Summary (GWh)***

| Sector | 2011 | 2014 | 2015 | 2016 | % Change | Avg. Growth Rate |
|---|---|---|---|---|---|---|
| Residential | 11,577 | 11,184 | 10,897 | 10,687 | -7.7% | -1.6% |
| Commercial | 12,414 | 11,547 | 11,415 | 11,332 | -8.7% | -0.6% |
| Industrial | 12,580 | 13,130 | 13,480 | 13,955 | 10.9% | 1.1% |
| **Total** | **36,571** | **35,861** | **35,792** | **35,973** | **-1.6%** | **-0.1%** |

***Figure 4-12 Electricity Baseline Projection Summary (GWh)***

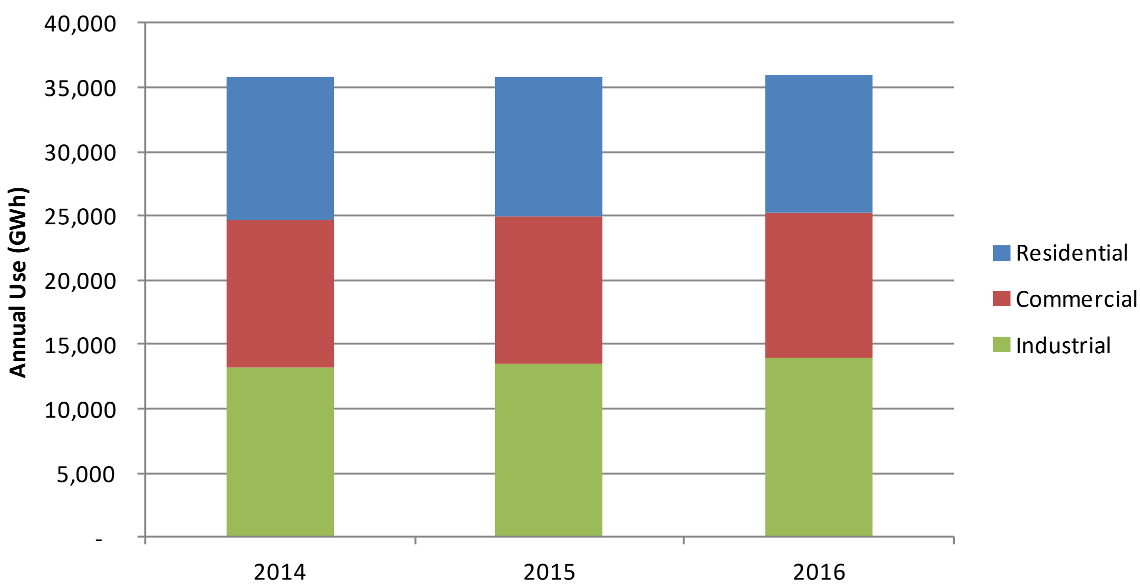
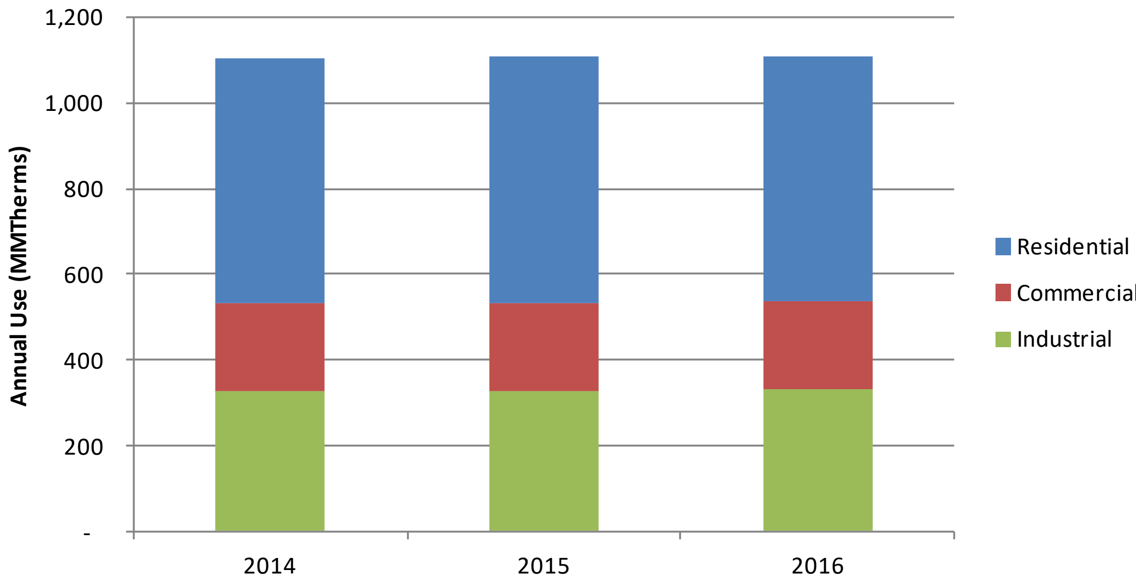



Table 4-13 and Figure 4-13 provide a summary of the natural gas baseline projection by sector for Ameren Illinois. Overall, the projection is increasing slightly across all sectors.

***Table 4-13 Natural Gas Baseline Projection Summary (MMTherms)***

| Sector | 2011 | 2014 | 2015 | 2016 | % Change | Avg. Growth Rate |
|---|---|---|---|---|---|---|
| Residential | 569 | 569 | 574 | 570 | 0.2% | 0.2% |
| Commercial | 207 | 205 | 207 | 208 | 0.6% | 0.5% |
| Industrial | 330 | 326 | 326 | 329 | -0.3% | -0.3% |
| **Total** | **1,105** | **1,101** | **1,107** | **1,106** | **0.1%** | **0.1%** |

***Figure 4-13 Natural Gas Baseline Projection Summary (MMTherms)***



# ENERGY EFFICIENCY MEASURES

## List of Energy Efficiency Measures

The first step of the energy efficiency measure analysis is to identify the list of all relevant energy efficiency measures that should be considered for the Ameren Illinois potential assessment.

For this study, EnerNOC prepared a preliminary list of measures for Ameren Illinois staff and stakeholders to review. After incorporating feedback, we populated the full databases for the three sectors.

Sources for the measure assumptions were primarily drawn from the Illinois TRM. Additional sources included Ameren Illinois past program experience, EnerNOC's building simulation tool (BEST), EnerNOC's measure database (DEEM), DEER, NWPCC workbooks, other secondary sources, and data from EnerNOC's previous studies and program work.

- **Residential Measures**. The residential measures span all end uses and vary significantly in the manner in which they impact energy consumption. Table 5-1shows the residential equipment measure options and the segments for which they were modeled. The electric measures are listed first, followed by natural gas measures. Table 5-2 shows the residential non-equipment measure options. All residential measures considered for this study are described in Appendix B.
- **Commercial Measures**. Table 5-3 and Table 5-4 present a summary of the commercial equipment and non-equipment measures, respectively. The measures shown were modeled for nearly all of the commercial building types, both new and existing, with only a few exceptions. For instance, hotel guest room controls were only modeled for the lodging sector. All commercial measures considered for this study are described in Appendix C.
- **Industrial Measures.** Table 5-5 and Table 5-6 present a summary of the industrial equipment and non-equipment measures, respectively. All industrial measures considered for this study are described in Appendix D.

***Table 5-1 Summary of Residential Equipment Measures***

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Cooling | Electric | Central AC | SEER 13 |
| Cooling | Electric | Central AC | SEER 14.5 (ENERGY STAR) |
| Cooling | Electric | Central AC | SEER 15 (CEE Tier 2) |
| Cooling | Electric | Central AC | SEER 16 (CEE Tier 3) |
| Cooling | Electric | Central AC | Ductless Minisplit |
| Cooling | Electric | Central AC | SEER 21 |
| Cooling | Electric | Room AC | EER 9.8 |
| Cooling | Electric | Room AC | EER 10.8 (ENERGY STAR) |
| Cooling | Electric | Room AC | EER 11.0 |
| Cooling | Electric | Room AC | EER 11.5 |
| Cooling | Electric | Room AC | EER 12.0 |
| Cooling | Electric | Air-Source Heat Pump | SEER 13, HSPF 7.7 |
| Cooling | Electric | Air-Source Heat Pump | SEER 14, HSPF 8.0 |
| Cooling | Electric | Air-Source Heat Pump | SEER 15, HSPF 8.2 |
| Cooling | Electric | Air-Source Heat Pump | SEER 16, HSPF 8.5 |
| Cooling | Electric | Air-Source Heat Pump | Ductless Minisplit |
| Cooling | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Cooling | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Cooling | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Cooling | Electric | Geothermal Heat Pump | EER 30, COP 5 |
| Cooling | Electric | PTHP | EER 9.8 |
| Cooling | Electric | PTHP | EER 10.2 |
| Cooling | Electric | PTHP | EER 10.8 |
| Cooling | Electric | PTHP | EER 11 |
| Cooling | Electric | PTHP | EER 11.5 |
| Heating | Electric | Furnace | Standard |
| Heating | Electric | Electric Room Heat | Standard |
| Heating | Electric | Air-Source Heat Pump | SEER 13, HSPF 7.7 |
| Heating | Electric | Air-Source Heat Pump | SEER 14, HSPF 8.0 |
| Heating | Electric | Air-Source Heat Pump | SEER 15, HSPF 8.2 |
| Heating | Electric | Air-Source Heat Pump | SEER 16, HSPF 8.5 |
| Heating | Electric | Air-Source Heat Pump | Ductless Minisplit |
| Heating | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Heating | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Heating | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Heating | Electric | Geothermal Heat Pump | EER 30, COP 5 |
| Heating | Electric | PTHP | EER 9.8 |
| Heating | Electric | PTHP | EER 10.2 |
| Heating | Electric | PTHP | EER 10.8 |
| Heating | Electric | PTHP | EER 11 |
| Heating | Electric | PTHP | EER 11.5 |
| Water Heating | Electric | Water Heater <= 55 gal | EF 0.9 |
| Water Heating | Electric | Water Heater <= 55 gal | EF 0.95 |
| Water Heating | Electric | Water Heater <= 55 gal | EF 2.0 (HP) |
| Water Heating | Electric | Water Heater <= 55 gal | EF 2.3 (HP) |
| Water Heating | Electric | Water Heater > 55 gal | EF 0.9 |
| Water Heating | Electric | Water Heater > 55 gal | EF 0.95 |
| Water Heating | Electric | Water Heater > 55 gal | EF 2.0 (HP) |
| Water Heating | Electric | Water Heater > 55 gal | EF 2.3 (HP) |
| Interior Lighting | Electric | Screw-in | Incandescent |
| Interior Lighting | Electric | Screw-in | Infrared Halogen |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Interior Lighting | Electric | Screw-in | Infrared Halogen (2020) |
| Interior Lighting | Electric | Screw-in | CFL |
| Interior Lighting | Electric | Screw-in | LED |
| Interior Lighting | Electric | Screw-in | LED (2020) |
| Interior Lighting | Electric | Linear Fluorescent | T12 |
| Interior Lighting | Electric | Linear Fluorescent | T8 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2011) |
| Interior Lighting | Electric | Linear Fluorescent | Super T8 |
| Interior Lighting | Electric | Linear Fluorescent | T5 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2020) |
| Interior Lighting | Electric | Specialty | Incandescent |
| Interior Lighting | Electric | Specialty | Infrared Halogen |
| Interior Lighting | Electric | Specialty | CFL |
| Interior Lighting | Electric | Specialty | LED |
| Interior Lighting | Electric | Specialty | LED (2020) |
| Exterior Lighting | Electric | Screw-in | Incandescent |
| Exterior Lighting | Electric | Screw-in | Infrared Halogen |
| Exterior Lighting | Electric | Screw-in | Infrared Halogen (2020) |
| Exterior Lighting | Electric | Screw-in | CFL |
| Exterior Lighting | Electric | Screw-in | LED |
| Exterior Lighting | Electric | Screw-in | LED (2020) |
| Appliances | Electric | Refrigerator | Standard |
| Appliances | Electric | Refrigerator | ENERGY STAR |
| Appliances | Electric | Refrigerator | High Efficiency |
| Appliances | Electric | Refrigerator | AHAM (2014) |
| Appliances | Electric | Refrigerator | High Efficiency (2014) |
| Appliances | Electric | Second Refrigerator | Standard |
| Appliances | Electric | Second Refrigerator | ENERGY STAR |
| Appliances | Electric | Second Refrigerator | High Efficiency |
| Appliances | Electric | Second Refrigerator | AHAM (2014) |
| Appliances | Electric | Second Refrigerator | High Efficiency (2014) |
| Appliances | Electric | Freezer | Standard |
| Appliances | Electric | Freezer | ENERGY STAR |
| Appliances | Electric | Freezer | High Efficiency |
| Appliances | Electric | Freezer | AHAM (2014) |
| Appliances | Electric | Freezer | High Efficiency (2014) |
| Appliances | Electric | Clothes Washer | Standard (1.26) |
| Appliances | Electric | Clothes Washer | ENERGY STAR (1.72) |
| Appliances | Electric | Clothes Washer | ENERGY STAR (MEF 2.0) |
| Appliances | Electric | Clothes Washer | Compact (MEF 2.79) |
| Appliances | Electric | Clothes Dryer | Baseline |
| Appliances | Electric | Clothes Dryer | High Efficiency |
| Appliances | Electric | Clothes Dryer | Baseline (2015+) |
| Appliances | Electric | Clothes Dryer | High Efficiency (2015+) |
| Appliances | Electric | Dishwasher | Standard (EF 0.63) |
| Appliances | Electric | Dishwasher | ENERGY STAR (EF 0.73) |
| Appliances | Electric | Dishwasher | AHAM (EF 0.73) |
| Appliances | Electric | Dishwasher | Ultra Efficient (EF 1.1) |
| Appliances | Electric | Stove | Standard |
| Appliances | Electric | Stove | Convection |
| Appliances | Electric | Stove | Halogen Burner |
| Appliances | Electric | Stove | Induction |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Appliances | Electric | Microwave | Standard |
| Electronics | Electric | Personal Computers | Standard |
| Electronics | Electric | Personal Computers | ENERGY STAR |
| Electronics | Electric | Monitor | Standard |
| Electronics | Electric | Monitor | ENERGY STAR |
| Electronics | Electric | Laptops | Standard |
| Electronics | Electric | Laptops | ENERGY STAR |
| Electronics | Electric | TVs | Standard |
| Electronics | Electric | TVs | ENERGY STAR (3.1) |
| Electronics | Electric | TVs | ENERGY STAR (4.1) |
| Electronics | Electric | TVs | ENERGY STAR (5.1) |
| Electronics | Electric | Printer/Fax/Copier | Standard |
| Electronics | Electric | Printer/Fax/Copier | ENERGY STAR |
| Electronics | Electric | Set-top Boxes/DVR | Standard |
| Electronics | Electric | Set-top Boxes/DVR | ENERGY STAR (2009) |
| Electronics | Electric | Set-top Boxes/DVR | ENERGY STAR (2011) |
| Electronics | Electric | Devices and Gadgets | Standard |
| Miscellaneous | Electric | Air Purifier/Cleaner | Standard |
| Miscellaneous | Electric | Air Purifier/Cleaner | ENERGY STAR |
| Miscellaneous | Electric | Dehumidifier | Standard |
| Miscellaneous | Electric | Dehumidifier | ENERGY STAR |
| Miscellaneous | Electric | Pool Pump | Standard |
| Miscellaneous | Electric | Pool Pump | High Efficiency |
| Miscellaneous | Electric | Pool Pump | Two-Speed |
| Miscellaneous | Electric | Pool Heater | Electric Resistance |
| Miscellaneous | Electric | Pool Heater | Heat Pump (COP = 5.0) |
| Miscellaneous | Electric | Hot Tub / Spa | Standard |
| Miscellaneous | Electric | Hot Tub / Spa | Efficient Pumps |
| Miscellaneous | Electric | Hot Tub / Spa | Improved Controls and Pumps |
| Miscellaneous | Electric | Well Pump | Standard |
| Miscellaneous | Electric | Furnace Fan | Standard |
| Miscellaneous | Electric | Furnace Fan | ECM |
| Miscellaneous | Electric | Bathroom Exhaust Fan | Standard |
| Miscellaneous | Electric | Bathroom Exhaust Fan | High Efficiency |
| Miscellaneous | Electric | Miscellaneous | Standard |
| Heating | Natural Gas | Furnace | AFUE 0.8 |
| Heating | Natural Gas | Furnace | AFUE 0.9 |
| Heating | Natural Gas | Furnace | AFUE 0.92 |
| Heating | Natural Gas | Furnace | AFUE 0.95 |
| Heating | Natural Gas | Furnace | AFUE 0.97 |
| Heating | Natural Gas | Boiler | EF 0.8 |
| Heating | Natural Gas | Boiler | EF 0.9 |
| Heating | Natural Gas | Boiler | EF 0.92 |
| Heating | Natural Gas | Boiler | EF 0.95 |
| Heating | Natural Gas | Other Heating | Gas Fireplace |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.59 |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.67 |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.74 |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.76 |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.82 (Tankless) |
| Water Heating | Natural Gas | Water Heater <= 55 gal | EF 0.86 (Condensing) |
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.59 |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.67 |
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.74 |
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.76 |
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.82 (Tankless) |
| Water Heating | Natural Gas | Water Heater > 55 gal | EF 0.86 (Condensing) |
| Appliances | Natural Gas | Clothes Dryer | Standard |
| Appliances | Natural Gas | Clothes Dryer | Standard (AHAM) |
| Appliances | Natural Gas | Clothes Dryer | Efficient |
| Appliances | Natural Gas | Stove | Standard (EF .399) |
| Appliances | Natural Gas | Stove | Efficient (EF .42) |
| Miscellaneous | Natural Gas | Pool Heater | EF .78 |
| Miscellaneous | Natural Gas | Pool Heater | EF .82 |
| Miscellaneous | Natural Gas | Pool Heater | EF .90 |
| Miscellaneous | Natural Gas | Pool Heater | EF .95 |
| Miscellaneous | Natural Gas | Hot Tub / Spa | EF .78 |
| Miscellaneous | Natural Gas | Hot Tub / Spa | EF .82 |
| Miscellaneous | Natural Gas | Hot Tub / Spa | EF .90 |
| Miscellaneous | Natural Gas | Hot Tub / Spa | EF .95 |
| Miscellaneous | Natural Gas | Miscellaneous | Standard |

***Table 5-2 Summary of Residential Non-Equipment Measures***

| Measure | Existing | New |
|---|---|---|
| Insulation - Ceiling | X | X |
| Insulation - Ducting | X | X |
| Insulation - Foundation | X | X |
| Insulation - Infiltration Control | X | X |
| Insulation - Radiant Barrier | X | X |
| Insulation - Wall Cavity | X | X |
| Insulation - Wall Sheathing | X | X |
| Ducting - Repair and Sealing | X | X |
| Windows - High Efficiency/ENERGY STAR | X | X |
| Windows - Install Reflective Film | X | X |
| Doors - Storm and Thermal | X | X |
| Roofs - High Reflectivity | X | X |
| Attic Fan - Installation | X | X |
| Attic Fan - Photovoltaic - Installation | X | X |
| Whole-House Fan - Installation | X | X |
| Ceiling Fan - Installation | X | X |
| Thermostat - Clock/Programmable | X | X |
| Home Energy Management System | X | X |
| Central AC - Early Replacement | X | X |
| Central AC - Maintenance and Tune-Up | X | X |
| Central Heat Pump - Maintenance | X | X |
| Room AC - Removal of Second Unit | X | X |
| Boiler - Hot Water Reset | X | X |

| Measure | Existing | New |
|---|---|---|
| Boiler - Pipe Insulation | X | X |
| Boiler - Maintenance | X | X |
| Furnace - Maintenance | X | X |
| Water Heater - Drainwater Heat Recovery | X | X |
| Water Heater - Faucet Aerators | X | X |
| Water Heater - Low-Flow Showerheads | X | X |
| Water Heater - Pipe Insulation | X | X |
| Water Heater - Tank Blanket/Insulation | X | X |
| Water Heater - Thermostat Setback | X | X |
| Water Heater - Timer | X | X |
| Water Heater - Desuperheater | X | X |
| Water Heater - Solar System | X | X |
| Interior Lighting - Occupancy Sensors | X | X |
| Exterior Lighting - Photosensor Control | X | X |
| Exterior Lighting - Photovoltaic Installation | X | X |
| Exterior Lighting - Timeclock Installation | X | X |
| Refrigerator - Early Replacement | X | X |
| Refrigerator - Maintenance | X | X |
| Refrigerator - Remove Second Unit | X | X |
| Freezer - Remove Second Unit | X | X |
| Freezer - Early Replacement | X | X |
| Freezer - Maintenance | X | X |
| Electronics - Smart Power Strip | X | X |
| Pool Pump - Timer | X | X |
| Pool Heater - Solar System | X | X |
| ENERGY STAR Home Design | X | X |
| Information Based Energy Efficiency Programs | X | X |
| Combined Boiler & Water Heating Unit | X | X |
| Pool/Spa cover | X | X |

***Table 5-3 Summary of Commercial Equipment Measures***

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Cooling | Electric | Air-Cooled Chiller | 1.5 kw/ton, COP 2.3 |
| Cooling | Electric | Air-Cooled Chiller | 1.3 kw/ton, COP 2.7 |
| Cooling | Electric | Air-Cooled Chiller | 1.26 kw/ton, COP 2.8 |
| Cooling | Electric | Air-Cooled Chiller | 1.0 kw/ton, COP 3.5 |
| Cooling | Electric | Air-Cooled Chiller | 0.97 kw/ton, COP 3.6 |
| Cooling | Electric | Water-Cooled Chiller | 0.75 kw/ton, COP 4.7 |
| Cooling | Electric | Water-Cooled Chiller | 0.60 kw/ton, COP 5.9 |
| Cooling | Electric | Water-Cooled Chiller | 0.58 kw/ton, COP 6.1 |
| Cooling | Electric | Water-Cooled Chiller | 0.55 kw/Ton, COP 6.4 |
| Cooling | Electric | Water-Cooled Chiller | 0.51 kw/ton, COP 6.9 |
| Cooling | Electric | Water-Cooled Chiller | 0.50 kw/Ton, COP 7.0 |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Cooling | Electric | Water-Cooled Chiller | 0.48 kw/ton, COP 7.3 |
| Cooling | Electric | Roof top AC | EER 9.2 |
| Cooling | Electric | Roof top AC | EER 10.1 |
| Cooling | Electric | Roof top AC | EER 11.2 |
| Cooling | Electric | Roof top AC | EER 12.0 |
| Cooling | Electric | Roof top AC | Ductless Minisplit |
| Cooling | Electric | Air Source Heat Pump | EER 9.3, COP 3.1 |
| Cooling | Electric | Air Source Heat Pump | EER 10.3, COP 3.2 |
| Cooling | Electric | Air Source Heat Pump | EER 11.0, COP 3.3 |
| Cooling | Electric | Air Source Heat Pump | EER 11.7, COP 3.4 |
| Cooling | Electric | Air Source Heat Pump | EER 12.0, COP 3.4 |
| Cooling | Electric | Air Source Heat Pump | Ductless Minisplit |
| Cooling | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Cooling | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Cooling | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Cooling | Electric | Geothermal Heat Pump | EER 30, COP 5.0 |
| Cooling | Electric | PTAC | EER 9.8 |
| Cooling | Electric | PTAC | EER 10.2 |
| Cooling | Electric | PTAC | EER 10.8 |
| Cooling | Electric | PTAC | EER 11 |
| Cooling | Electric | PTAC | EER 11.5 |
| Cooling | Electric | PTHP | EER 9.8 |
| Cooling | Electric | PTHP | EER 10.2 |
| Cooling | Electric | PTHP | EER 10.8 |
| Cooling | Electric | PTHP | EER 11 |
| Cooling | Electric | PTHP | EER 11.5 |
| Cooling | Electric | Evaporative AC | Direct |
| Cooling | Electric | Evaporative AC | Indirect |
| Cooling | Electric | Evaporative AC | Direct/Indirect |
| Heating | Electric | Air Source Heat Pump | EER 9.3, COP 3.1 |
| Heating | Electric | Air Source Heat Pump | EER 10.3, COP 3.2 |
| Heating | Electric | Air Source Heat Pump | EER 11.0, COP 3.3 |
| Heating | Electric | Air Source Heat Pump | EER 11.7, COP 3.4 |
| Heating | Electric | Air Source Heat Pump | EER 12.0, COP 3.4 |
| Heating | Electric | Air Source Heat Pump | Ductless Minisplit |
| Heating | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Heating | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Heating | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Heating | Electric | Geothermal Heat Pump | EER 30, COP 5.0 |
| Heating | Electric | Electric Room Heat | Standard |
| Heating | Electric | Electric Furnace | Standard |
| Heating | Electric | PTAC | EER 9.8 |
| Heating | Electric | PTAC | EER 10.2 |
| Heating | Electric | PTAC | EER 10.8 |
| Heating | Electric | PTAC | EER 11 |
| Heating | Electric | PTAC | EER 11.5 |
| Heating | Electric | PTHP | EER 9.8 |
| Heating | Electric | PTHP | EER 10.2 |
| Heating | Electric | PTHP | EER 10.8 |
| Heating | Electric | PTHP | EER 11 |
| Heating | Electric | PTHP | EER 11.5 |
| Ventilation | Electric | Ventilation | Constant Volume |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Ventilation | Electric | Ventilation | Variable Air Volume |
| Water Heating | Electric | Water Heating | EF .97 |
| Water Heating | Electric | Water Heating | EF .98 |
| Water Heating | Electric | Water Heating | EF 2.0 |
| Water Heating | Electric | Water Heating | EF 2.3 |
| Water Heating | Electric | Water Heating | EF 2.4 |
| Interior Lighting | Electric | Screw-in | Incandescent |
| Interior Lighting | Electric | Screw-in | 90W Halogen PAR-38 |
| Interior Lighting | Electric | Screw-in | 70W HIR PAR-38 |
| Interior Lighting | Electric | Screw-in | CFL |
| Interior Lighting | Electric | Screw-in | LED (2010) |
| Interior Lighting | Electric | Screw-in | LED (2020) |
| Interior Lighting | Electric | High-Bay Fixtures | Metal Halides |
| Interior Lighting | Electric | High-Bay Fixtures | LED (2010) |
| Interior Lighting | Electric | High-Bay Fixtures | T8 |
| Interior Lighting | Electric | High-Bay Fixtures | High Pressure Sodium |
| Interior Lighting | Electric | High-Bay Fixtures | Light Emitting Plasma |
| Interior Lighting | Electric | High-Bay Fixtures | T5 |
| Interior Lighting | Electric | High-Bay Fixtures | LED (2020) |
| Interior Lighting | Electric | Linear Fluorescent | T12 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2010) |
| Interior Lighting | Electric | Linear Fluorescent | T8 |
| Interior Lighting | Electric | Linear Fluorescent | Super T8 |
| Interior Lighting | Electric | Linear Fluorescent | T5 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2020) |
| Exterior Lighting | Electric | Screw-in | Incandescent |
| Exterior Lighting | Electric | Screw-in | 90W Halogen PAR-38 |
| Exterior Lighting | Electric | Screw-in | 70W HIR PAR-38 |
| Exterior Lighting | Electric | Screw-in | CFL |
| Exterior Lighting | Electric | Screw-in | LED (2010) |
| Exterior Lighting | Electric | Screw-in | LED (2020) |
| Exterior Lighting | Electric | HID | Metal Halides |
| Exterior Lighting | Electric | HID | LED (2010) |
| Exterior Lighting | Electric | HID | T8 |
| Exterior Lighting | Electric | HID | High Pressure Sodium |
| Exterior Lighting | Electric | HID | Light Emitting Plasma |
| Exterior Lighting | Electric | HID | T5 |
| Exterior Lighting | Electric | HID | LED (2020) |
| Exterior Lighting | Electric | Linear Fluorescent | T12 |
| Exterior Lighting | Electric | Linear Fluorescent | LED (2010) |
| Exterior Lighting | Electric | Linear Fluorescent | T8 |
| Exterior Lighting | Electric | Linear Fluorescent | Super T8 |
| Exterior Lighting | Electric | Linear Fluorescent | T5 |
| Exterior Lighting | Electric | Linear Fluorescent | LED (2020) |
| Refrigeration | Electric | Walk-in Refrigerator | 14600 kWh/yr |
| Refrigeration | Electric | Walk-in Refrigerator | 10800 kWh/yr |
| Refrigeration | Electric | Walk-in Refrigerator | 10000 kWh/yr |
| Refrigeration | Electric | Walk-in Refrigerator | 9000 kWh/yr |
| Refrigeration | Electric | Reach-in Refrigerator | 3800 kWh/yr |
| Refrigeration | Electric | Reach-in Refrigerator | 3100 kWh/yr |
| Refrigeration | Electric | Reach-in Refrigerator | 2500 kWh/yr |
| Refrigeration | Electric | Reach-in Refrigerator | 2400 kWh/yr |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Refrigeration | Electric | Reach-in Refrigerator | 1500 kWh/yr |
| Refrigeration | Electric | Glass Door Display | 14480 kWh/yr |
| Refrigeration | Electric | Glass Door Display | 11700 kWh/yr |
| Refrigeration | Electric | Glass Door Display | 8400 kWh/yr |
| Refrigeration | Electric | Glass Door Display | 6800 kWh/yr |
| Refrigeration | Electric | Open Display Case | 6500 kWh/yr |
| Refrigeration | Electric | Open Display Case | 5350 kWh/yr |
| Refrigeration | Electric | Open Display Case | 5300 kWh/yr |
| Refrigeration | Electric | Open Display Case | 4330 kWh/yr |
| Refrigeration | Electric | Icemaker | 7.0 kWh/100 lbs |
| Refrigeration | Electric | Icemaker | 6.3 kWh/100 lbs |
| Refrigeration | Electric | Icemaker | 6.0 kWh/100 lbs |
| Refrigeration | Electric | Icemaker | 5.5 kWh/100 lbs |
| Refrigeration | Electric | Vending Machine | 3400 kWh/year |
| Refrigeration | Electric | Vending Machine | 3000 kWh/year |
| Refrigeration | Electric | Vending Machine | 2400 kWh/year |
| Refrigeration | Electric | Vending Machine | 1700 kWh/year |
| Food Preparation | Electric | Oven | Standard |
| Food Preparation | Electric | Oven | ENERGY STAR |
| Food Preparation | Electric | Fryer | Standard |
| Food Preparation | Electric | Fryer | ENERGY STAR |
| Food Preparation | Electric | Dishwasher | Standard |
| Food Preparation | Electric | Dishwasher | ENERGY STAR |
| Food Preparation | Electric | Hot Food Container | Standard |
| Food Preparation | Electric | Hot Food Container | ENERGY STAR |
| Food Preparation | Electric | Other | Standard |
| Office Equipment | Electric | Desktop Computer | Standard |
| Office Equipment | Electric | Desktop Computer | ENERGY STAR |
| Office Equipment | Electric | Laptop | Standard |
| Office Equipment | Electric | Laptop | ENERGY STAR |
| Office Equipment | Electric | Server | Standard |
| Office Equipment | Electric | Server | ENERGY STAR |
| Office Equipment | Electric | Monitor | Standard |
| Office Equipment | Electric | Monitor | ENERGY STAR |
| Office Equipment | Electric | Printer/Copier/Fax | Standard |
| Office Equipment | Electric | Printer/Copier/Fax | ENERGY STAR |
| Office Equipment | Electric | POS Terminal | Standard |
| Office Equipment | Electric | POS Terminal | ENERGY STAR |
| Miscellaneous | Electric | Non-HVAC Motors | Standard (EPAct) |
| Miscellaneous | Electric | Non-HVAC Motors | Standard (EPAct 2015) |
| Miscellaneous | Electric | Non-HVAC Motors | High Efficiency |
| Miscellaneous | Electric | Non-HVAC Motors | High Efficiency (2015) |
| Miscellaneous | Electric | Non-HVAC Motors | Premium (NEMA) |
| Miscellaneous | Electric | Non-HVAC Motors | Premium (NEMA 2015) |
| Miscellaneous | Electric | Pool Pump | Standard |
| Miscellaneous | Electric | Pool Pump | High Efficiency |
| Miscellaneous | Electric | Pool Pump | High Efficiency, Multi-Speed |
| Miscellaneous | Electric | Pool Heater | Standard |
| Miscellaneous | Electric | Pool Heater | Heat Pump |
| Miscellaneous | Electric | Miscellaneous | Standard |
| Heating | Natural Gas | Furnace | EF .76 |
| Heating | Natural Gas | Furnace | EF .80 |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Heating | Natural Gas | Furnace | EF .82 |
| Heating | Natural Gas | Furnace | EF .90 |
| Heating | Natural Gas | Furnace | EF .96 |
| Heating | Natural Gas | Boiler | EF .76 |
| Heating | Natural Gas | Boiler | EF .80 |
| Heating | Natural Gas | Boiler | EF .83 |
| Heating | Natural Gas | Boiler | EF .90 |
| Heating | Natural Gas | Boiler | EF .96 |
| Heating | Natural Gas | Unit Heater | Standard |
| Heating | Natural Gas | Unit Heater | Condensing |
| Water Heating | Natural Gas | Water Heating | EF 0.77 |
| Water Heating | Natural Gas | Water Heating | EF 0.80 |
| Water Heating | Natural Gas | Water Heating | Tankless |
| Water Heating | Natural Gas | Water Heating | Indirect Fired |
| Water Heating | Natural Gas | Water Heating | EF 0.94 |
| Food Preparation | Natural Gas | Oven | Standard |
| Food Preparation | Natural Gas | Oven | ENERGY STAR |
| Food Preparation | Natural Gas | Fryer | Standard |
| Food Preparation | Natural Gas | Fryer | ENERGY STAR |
| Food Preparation | Natural Gas | Broiler | Standard |
| Food Preparation | Natural Gas | Broiler | High Efficiency |
| Food Preparation | Natural Gas | Griddle | Standard |
| Food Preparation | Natural Gas | Griddle | High Efficiency |
| Food Preparation | Natural Gas | Range | Standard |
| Food Preparation | Natural Gas | Range | High Efficiency |
| Food Preparation | Natural Gas | Steamer | Standard |
| Food Preparation | Natural Gas | Steamer | ENERGY STAR |
| Food Preparation | Natural Gas | Other | Standard |
| Food Preparation | Natural Gas | Other | ENERGY STAR |
| Miscellaneous | Natural Gas | Pool Heater | EF .78 |
| Miscellaneous | Natural Gas | Pool Heater | EF .82 |
| Miscellaneous | Natural Gas | Pool Heater | EF .90 |
| Miscellaneous | Natural Gas | Pool Heater | EF .95 |
| Miscellaneous | Natural Gas | Miscellaneous | Standard |

***Table 5-4 Summary of Commercial Non-Equipment Measures***

| Measure | Existing | New |
|---|---|---|
| Insulation - Ceiling | X | X |
| Insulation - Ducting | X | X |
| Insulation - Radiant Barrier | X | X |
| Insulation - Wall Cavity | X | X |
| HVAC - Duct Repair and Sealing | X | X |
| Doors - High Efficiency | X | X |
| Windows - High Efficiency | X | X |
| Roof - High Reflectivity | X | X |
| Air-Cooled Chiller - Condenser Air Temperature Reset | X | X |
| Air-Cooled Chiller - Economizer | X | X |

| Measure | Existing | New |
| --- | --- | --- |
| Air-Cooled Chiller - Thermal Energy Storage | X | X |
| Air-Cooled Chiller - VSD on fans | X | X |
| Air-Cooled Chiller - Chilled Water Reset | X | X |
| Air-Cooled Chiller - Chilled Water Variable-Flow System | X | X |
| Air-Cooled Chiller - High Efficiency Cooling Tower Fans | X | X |
| Air-Cooled Chiller - Maintenance | X | X |
| Water-Cooled Chiller - Condenser Water Temperature Reset | X | X |
| Water-Cooled Chiller - Economizer | X | X |
| Water-Cooled Chiller - Thermal Energy Storage | X | X |
| Water-Cooled Chiller - VSD on Fans | X | X |
| Water-Cooled Chiller - Chilled Water Reset | X | X |
| Water-Cooled Chiller - Chilled Water Variable-Flow System | X | X |
| Water-Cooled Chiller - High Efficiency Cooling Tower Fans | X | X |
| Water-Cooled Chiller - Maintenance | X | X |
| RTU - Evaporative Precooler | X | X |
| RTU - Maintenance | X | X |
| Gas Boiler - High Efficiency Hot Water Circulation | X | X |
| Gas Boiler - Hot Water Reset | X | X |
| Gas Boiler - Maintenance | X | X |
| Gas Furnace - Maintenance | X | X |
| Space Heating - Heat Recovery Ventilator | X | X |
| Heat Pump - Maintenance | X | X |
| Ventilation - ECM on VAV Boxes | X | X |
| Ventilation - Variable Speed Control | X | X |
| Ventilation - CO2 Controlled | X | X |
| Water Heater - Drainwater Heat Recovery | X | X |
| Water Heater - Faucet Aerators | X | X |
| Water Heater - Low Flow Showerheads | X | X |
| Water Heater - High Efficiency Circulation Pump | X | X |
| Water Heater - Desuperheater | X | X |
| Water Heater - Solar System | X | X |
| Water Heater - Install Timer | X | X |
| Water Heater - Pipe Insulation | X | X |
| Water Heater - Tank Blanket/Insulation | X | X |
| Water Heater - Pre-Rinse Spray Valve | X | X |
| Combined Boiler & Water Heating Unit | X | X |
| Interior Lighting - Daylighting Controls | X | X |
| Interior Lighting - LED Exit Lighting | X | X |
| Interior Lighting - Occupancy Sensors | X | X |
| Interior Lighting - Task Lighting | X | X |
| Interior Lighting - Timeclocks and Timers | X | X |
| Interior Fluorescent - Bi-Level Fixture | X | X |

| Measure | Existing | New |
|---|---|---|
| Interior Fluorescent - Delamp and Install Reflectors | X | X |
| Exterior Lighting - Bi-Level Fixture | X | X |
| Exterior Lighting - Daylighting Controls | X | X |
| Exterior Lighting - Photovoltaic Installation | X | X |
| Refrigerator - Anti-Sweat Door Heater | X | X |
| Refrigerator - Auto Door Closer | X | X |
| Refrigerator - Decommissioning | X | X |
| Refrigerator - Demand Defrost | X | X |
| Refrigerator - Door Gasket Replacement | X | X |
| Refrigerator - Economizer | X | X |
| Refrigerator - Evaporator Fan Controls | X | X |
| Refrigerator - Floating Head Pressure | X | X |
| Refrigerator - Strip Curtain | X | X |
| Refrigerator - High Efficiency Compressor | X | X |
| Refrigerator - Variable Speed Compressor | X | X |
| Vending Machine - Controller | X | X |
| Grocery - Display Case - LED Lighting | X | X |
| Grocery - Display Case Motion Sensors | X | X |
| Grocery - ECMs for Display Cases | X | X |
| Grocery - Open Display Case - Night Covers | X | X |
| Cooking - Exhaust Hoods with Sensor Control | X | X |
| Office Equipment - ENERGY STAR Power Supplies | X | X |
| Office Equipment - Plug Load Occupancy Sensors | X | X |
| Pool Pump - Timer | X | X |
| Pool Heater - Solar | X | X |
| Non-HVAC Motors - Variable Speed Control | X | X |
| Energy Management System | X | X |
| Thermostat - Clock/Programmable | X | X |
| Lodging - Guest Room Controls | X | X |
| HVAC - Occupancy Sensors | X | X |
| Commissioning - HVAC | X | X |
| Commissioning - Lighting | X | X |
| Retrocommissioning - HVAC | X | X |
| Retrocommissioning - Lighting | X | X |
| Advanced New Construction Designs | X | X |
| Custom Measures | X | X |
| Refrigerator - eCube | X | X |
| Electronics - Smart Power Strip | X | X |
| Electronics - Monitor Power Management | X | X |
| Insulation - Foundation | X | X |
| Water Heating - Booster Water Heater | X | X |
| Refrigeration - High Efficiency Evaporator Fan Motors | X | X |

| Measure | Existing | New |
|---|---|---|
| Boiler O2 Trim Controls | X | X |
| Boiler Parallel Positioning Control | X | X |
| Boiler blowdown heat exchanger (steam) | X | X |
| Repair malfunctioning steam traps | X | X |
| Insulate steam lines/condensate tank | X | X |
| Destratification Fans (HVLS) | X | X |
| Exhaust Hood Makeup Air | X | X |
| Optimizing Kitchen Ventilation | X | X |

***Table 5-5 Summary of Industrial Equipment Measures***

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Cooling | Electric | Air-Cooled Chiller | 1.5 kw/ton, COP 2.3 |
| Cooling | Electric | Air-Cooled Chiller | 1.3 kw/ton, COP 2.7 |
| Cooling | Electric | Air-Cooled Chiller | 1.26 kw/ton, COP 2.8 |
| Cooling | Electric | Air-Cooled Chiller | 1.0 kw/ton, COP 3.5 |
| Cooling | Electric | Air-Cooled Chiller | 0.97 kw/ton, COP 3.6 |
| Cooling | Electric | Water-Cooled Chiller | 0.75 kw/ton, COP 4.7 |
| Cooling | Electric | Water-Cooled Chiller | 0.60 kw/ton, COP 5.9 |
| Cooling | Electric | Water-Cooled Chiller | 0.58 kw/ton, COP 6.1 |
| Cooling | Electric | Water-Cooled Chiller | 0.55 kw/Ton, COP 6.4 |
| Cooling | Electric | Water-Cooled Chiller | 0.51 kw/ton, COP 6.9 |
| Cooling | Electric | Water-Cooled Chiller | 0.50 kw/Ton, COP 7.0 |
| Cooling | Electric | Water-Cooled Chiller | 0.48 kw/ton, COP 7.3 |
| Cooling | Electric | Roof top AC | EER 9.2 |
| Cooling | Electric | Roof top AC | EER 10.1 |
| Cooling | Electric | Roof top AC | EER 11.2 |
| Cooling | Electric | Roof top AC | EER 12.0 |
| Cooling | Electric | Roof top AC | Ductless Minisplit |
| Cooling | Electric | Air Source Heat Pump | EER 9.3, COP 3.1 |
| Cooling | Electric | Air Source Heat Pump | EER 10.3, COP 3.2 |
| Cooling | Electric | Air Source Heat Pump | EER 11.0, COP 3.3 |
| Cooling | Electric | Air Source Heat Pump | EER 11.7, COP 3.4 |
| Cooling | Electric | Air Source Heat Pump | EER 12.0, COP 3.4 |
| Cooling | Electric | Air Source Heat Pump | Ductless Minisplit |
| Cooling | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Cooling | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Cooling | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Cooling | Electric | Geothermal Heat Pump | EER 30, COP 5.0 |
| Cooling | Electric | Other Cooling | EER 9.8 |
| Cooling | Electric | Other Cooling | EER 10.2 |
| Cooling | Electric | Other Cooling | EER 10.8 |
| Cooling | Electric | Other Cooling | EER 11 |
| Cooling | Electric | Other Cooling | EER 11.5 |
| Heating | Electric | Air Source Heat Pump | EER 9.3, COP 3.1 |
| Heating | Electric | Air Source Heat Pump | EER 10.3, COP 3.2 |
| Heating | Electric | Air Source Heat Pump | EER 11.0, COP 3.3 |
| Heating | Electric | Air Source Heat Pump | EER 11.7, COP 3.4 |
| Heating | Electric | Air Source Heat Pump | EER 12.0, COP 3.4 |
| Heating | Electric | Air Source Heat Pump | Ductless Minisplit |
| Heating | Electric | Geothermal Heat Pump | EER 14.1, COP 3.3 |
| Heating | Electric | Geothermal Heat Pump | EER 16, COP 3.5 |
| Heating | Electric | Geothermal Heat Pump | EER 18, COP 3.8 |
| Heating | Electric | Geothermal Heat Pump | EER 30, COP 5.0 |
| Heating | Electric | Electric Resistance | Standard |
| Heating | Electric | Electric Furnace | Standard |
| Ventilation | Electric | Ventilation | Constant Volume |
| Ventilation | Electric | Ventilation | Variable Air Volume |
| Interior Lighting | Electric | Screw-in | Incandescent |
| Interior Lighting | Electric | Screw-in | 90W Halogen PAR-38 |
| Interior Lighting | Electric | Screw-in | 70W HIR PAR-38 |
| Interior Lighting | Electric | Screw-in | CFL |
| Interior Lighting | Electric | Screw-in | LED (2010) |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Interior Lighting | Electric | Screw-in | LED (2020) |
| Interior Lighting | Electric | High-Bay Fixtures | Metal Halides |
| Interior Lighting | Electric | High-Bay Fixtures | LED (2010) |
| Interior Lighting | Electric | High-Bay Fixtures | T8 |
| Interior Lighting | Electric | High-Bay Fixtures | High Pressure Sodium |
| Interior Lighting | Electric | High-Bay Fixtures | Induction |
| Interior Lighting | Electric | High-Bay Fixtures | Light Emitting Plasma |
| Interior Lighting | Electric | High-Bay Fixtures | T5 |
| Interior Lighting | Electric | High-Bay Fixtures | LED (2020) |
| Interior Lighting | Electric | Linear Fluorescent | T12 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2010) |
| Interior Lighting | Electric | Linear Fluorescent | T8 |
| Interior Lighting | Electric | Linear Fluorescent | Super T8 |
| Interior Lighting | Electric | Linear Fluorescent | T5 |
| Interior Lighting | Electric | Linear Fluorescent | LED (2020) |
| Exterior Lighting | Electric | Screw-in | Incandescent |
| Exterior Lighting | Electric | Screw-in | 90W Halogen PAR-38 |
| Exterior Lighting | Electric | Screw-in | 70W HIR PAR-38 |
| Exterior Lighting | Electric | Screw-in | CFL |
| Exterior Lighting | Electric | Screw-in | LED (2010) |
| Exterior Lighting | Electric | Screw-in | LED (2020) |
| Exterior Lighting | Electric | HID | Metal Halides |
| Exterior Lighting | Electric | HID | LED (2010) |
| Exterior Lighting | Electric | HID | T8 |
| Exterior Lighting | Electric | HID | High Pressure Sodium |
| Exterior Lighting | Electric | HID | Light Emitting Plasma |
| Exterior Lighting | Electric | HID | T5 |
| Exterior Lighting | Electric | HID | LED (2020) |
| Exterior Lighting | Electric | Linear Fluorescent | T12 |
| Exterior Lighting | Electric | Linear Fluorescent | LED (2010) |
| Exterior Lighting | Electric | Linear Fluorescent | T8 |
| Exterior Lighting | Electric | Linear Fluorescent | Super T8 |
| Exterior Lighting | Electric | Linear Fluorescent | T5 |
| Exterior Lighting | Electric | Linear Fluorescent | LED (2020) |
| Motors | Electric | Pumps | Standard |
| Motors | Electric | Pumps | High Efficiency |
| Motors | Electric | Fans & Blowers | Standard |
| Motors | Electric | Fans & Blowers | High Efficiency |
| Motors | Electric | Compressed Air | Standard |
| Motors | Electric | Compressed Air | High Efficiency |
| Motors | Electric | Material Handling | Standard |
| Motors | Electric | Material Handling | High Efficiency |
| Motors | Electric | Material Processing | Standard |
| Motors | Electric | Material Processing | High Efficiency |
| Motors | Electric | Other Motors | Standard |
| Motors | Electric | Other Motors | High Efficiency |
| Process | Electric | Process Heating | Standard |
| Process | Electric | Process Cooling and Refrig | Standard |
| Process | Electric | Electro-Chemical Processes | Standard |
| Process | Electric | Other Process | Standard |
| Miscellaneous | Electric | Miscellaneous | Standard |
| Heating | Natural Gas | Furnace | EF .76 |

| End Use | Fuel | Technology | Efficiency Option |
|---|---|---|---|
| Heating | Natural Gas | Furnace | EF .80 |
| Heating | Natural Gas | Furnace | EF .82 |
| Heating | Natural Gas | Furnace | EF .90 |
| Heating | Natural Gas | Furnace | EF .96 |
| Heating | Natural Gas | Boiler | EF .76 |
| Heating | Natural Gas | Boiler | EF .80 |
| Heating | Natural Gas | Boiler | EF .83 |
| Heating | Natural Gas | Boiler | EF .90 |
| Heating | Natural Gas | Boiler | EF .96 |
| Heating | Natural Gas | Other Heating | AFUE .74 |
| Heating | Natural Gas | Other Heating | AFUE .75 |
| Heating | Natural Gas | Other Heating | AFUE .76 |
| Heating | Natural Gas | Other Heating | AFUE .77 |
| Heating | Natural Gas | Other Heating | AFUE .80 |
| Process | Natural Gas | Process Heating | Standard |
| Process | Natural Gas | Process Boiler | EF .76 |
| Process | Natural Gas | Process Boiler | EF .80 |
| Process | Natural Gas | Process Boiler | EF .83 |
| Process | Natural Gas | Process Boiler | EF .90 |
| Process | Natural Gas | Process Boiler | EF .96 |
| Process | Natural Gas | Process Cooling | Standard |
| Process | Natural Gas | Other Process | Standard |
| Miscellaneous | Natural Gas | Miscellaneous | Standard |

***Table 5-6 Summary of Industrial Non-Equipment Measures***

| Measure | Existing | New |
|---|---|---|
| Insulation - Ceiling | X | X |
| Insulation - Ducting | X | X |
| Insulation - Wall Cavity | X | X |
| HVAC - Duct Repair and Sealing | X | X |
| Air-Cooled Chiller - Economizer | X | X |
| Air-Cooled Chiller - Efficient Mechanical Layout | X | X |
| Air-Cooled Chiller - Maintenance | X | X |
| Air-Cooled Chiller - Chilled Water Reset | X | X |
| Air-Cooled Chiller - Chilled Water Variable-Flow System | X | X |
| Air-Cooled Chiller - Condenser Water Temperature Reset | X | X |
| Air-Cooled Chiller - High Efficiency Cooling Tower Fans | X | X |
| Air-Cooled Chiller - VSD on Fans | X | X |
| Water-Cooled Chiller - Economizer | X | X |
| Water-Cooled Chiller - Efficient Mechanical Layout | X | X |
| Water-Cooled Chiller - Maintenance | X | X |
| Water-Cooled Chiller - Chilled Water Reset | X | X |
| Water-Cooled Chiller - Chilled Water Variable-Flow System | X | X |
| Water-Cooled Chiller - Condenser Water Temperature Reset | X | X |
| Water-Cooled Chiller - High Efficiency Cooling Tower Fans | X | X |
| Water-Cooled Chiller - VSD on Fans | X | X |

| Measure | Existing | New |
|---|---|---|
| RTU - Maintenance | X | X |
| Heat Pump - Maintenance | X | X |
| Process Boilers - Hot Water Reset | X | X |
| Process Boiler - Combustion Controls (O2 Trim) | X | X |
| Process Boiler - Condensate Return Lines | X | X |
| Process Boiler - Condensing Economizer | X | X |
| Process Boiler - Pipe Insulation | X | X |
| Process Boiler - Steam Trap Maintenance | X | X |
| Roofs - High Reflectivity | X | X |
| Energy Management System | X | X |
| Thermostat - Clock/Programmable | X | X |
| Interior Lighting - Occupancy Sensors | X | X |
| Interior Lighting - Skylights | X | X |
| Interior Lighting - Time Clocks and Timers | X | X |
| Interior Lighting - LED Exit Lighting | X | X |
| Interior Lighting - Daylighting Controls | X | X |
| Interior Screw-in - Task Lighting | X | X |
| Interior Fluorescent - Bi-Level Fixture | X | X |
| Interior Fluorescent - Delamp and Install Reflectors | X | X |
| Exterior Lighting - Bi-Level Fixture | X | X |
| Exterior Lighting - Daylighting Controls | X | X |
| Exterior Lighting - Photovoltaic Installation | X | X |
| Process - Conductivity Controls | X | X |
| Process - Controls on Fume Hoods | X | X |
| Process - Timers and Controls | X | X |
| Refrigeration - Floating Head Pressure | X | X |
| Refrigeration - System Controls | X | X |
| Refrigeration - System Maintenance | X | X |
| Refrigeration - System Optimization | X | X |
| Compressed Air - Air Usage Reduction | X | X |
| Compressed Air - Compressor Replacement | X | X |
| Compressed Air - System Controls | X | X |
| Compressed Air - System Maintenance | X | X |
| Compressed Air - System Optimization and Improvements | X | X |
| Pumping System - Controls | X | X |
| Pumping System - Maintenance | X | X |
| Pumping System - Optimization | X | X |
| Pumps - Variable Speed Control | X | X |
| Pump Equipment Upgrade | X | X |
| Fan Equipment Upgrade | X | X |
| Fan System - Controls | X | X |
| Fan System - Maintenance | X | X |

| Measure | Existing | New |
|---|---|---|
| Fan System - Optimization | X | X |
| Fans - Variable Speed Control | X | X |
| Motors - Magnetic Adjustable Speed Drives | X | X |
| Motors - Efficient Rewind | X | X |
| Motors - Variable Frequency Drive | X | X |
| Commissioning - HVAC | X | X |
| Commissioning - Lighting | X | X |
| Retrocommissioning - HVAC | X | X |
| Retrocommissioning - Lighting | X | X |
| Ventilation - CO2 Controlled | X | X |
| Gas Boiler - High Efficiency Hot Water Circulation | X | X |
| Gas Boiler - Hot Water Reset | X | X |
| Gas Boiler - Maintenance | X | X |
| Gas Furnace - Maintenance | X | X |
| Custom Measures | X | X |
| Boiler Blowdown Heat Exchanger (Steam) | X | X |
| Insulate Steam Lines / Condensate Tank | X | X |
| Direct Fired Make-up Air System | X | X |
| Direct Contact Water Heater | X | X |
| HVAC - Infrared Heater | X | X |

## Results of the Economic Screen

Table 5-7 summarizes the number of equipment and non-equipment measures evaluated for each segment within each sector.

***Table 5-7 Number of Measures Evaluated***

| | Residential | Commercial | Industrial | Total Number of Measures |
|---|---|---|---|---|
| Equipment Measures Evaluated | 165 | 179 | 125 | **469** |
| Non-Equipment Measures Evaluated | 49 | 94 | 87 | **229** |
| **Total Measures Evaluated** | **214** | **273** | **212** | **699** |

Appendix B gives results for the economic screening process by segment, vintage, end use and measure for the residential sector. Appendices C and D shows the equivalent information for the commercial and industrial sectors, respectively.

CHAPTER | 6

# ENERGY EFFICIENCY POTENTIAL RESULTS

This chapter presents the overall results of the energy-efficiency analysis for the entire service territory of Ameren Illinois[15]. Year-by-year savings for electric energy, electric peak demand, and natural gas energy are available in Appendix F. Sector-level details are presented in Chapter 7.

## Electric Energy Efficiency – Overall Results

Table 6-1 and Figure 6-1 summarize the electric energy-efficiency savings for the different levels of potential relative to the baseline projection. Note that naturally occurring efficiency is already included in the baseline; therefore all potential estimates shown in the report represent ***net*** savings. Figure 6-2 displays the electric energy-efficiency projections.

Key findings related to net electric potentials are summarized below.

- **Realistic Achievable Potential.** In 2014, net realistic achievable savings are 483 GWh which is 1.3% of the baseline projection. By 2016, cumulative net realistic achievable savings grow to 1,093 GWh which represents 3.0% of the baseline projection.
- **Maximum Achievable Potential**. In 2014 savings for this case are 630 GWh or 1.8% of the baseline and by 2016 cumulative net savings reach 1,432 GWh or 4.0% of the baseline projection.
- **Economic potential**, which reflects the savings when all cost-effective measures are taken. The savings for this case in 2014 are 1,149 GWh or 3.2% of the baseline projection and by 2016 the cumulative net savings reach 2,650, about 7.4% of the baseline.
- **Technical potential**, which reflects the adoption of all energy efficiency measures regardless of cost-effectiveness, is a theoretical upper bound on savings. Cumulative net savings in 2014 for the technical case are 1,584 GWh 4.4% of the baseline and by 2016 these savings reach 3,516 GWh about 9.8% of the baseline.

***Table 6-1 Summary of Electric Energy Efficiency Potential***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Baseline Projection (GWh)** | 35,861 | 35,792 | 35,973 |
| **Cumulative Savings (GWh)** | | | |
| Realistic Achievable Potential | 483 | 803 | 1,093 |
| Maximum Achievable Potential | 630 | 1,051 | 1,432 |
| Economic Potential | 1,149 | 1,958 | 2,650 |
| Technical Potential | 1,584 | 2,604 | 3,516 |
| **Energy Savings (% of Baseline)** | | | |
| Realistic Achievable Potential | 1.3% | 2.2% | 3.0% |
| Maximum Achievable Potential | 1.8% | 2.9% | 4.0% |
| Economic Potential | 3.2% | 5.5% | 7.4% |
| Technical Potential | 4.4% | 7.3% | 9.8% |

[15] Note that this includes the potential that would be achieved through programs offered through DCEO.

***Figure 6-1 Summary of Electric Energy Savings***

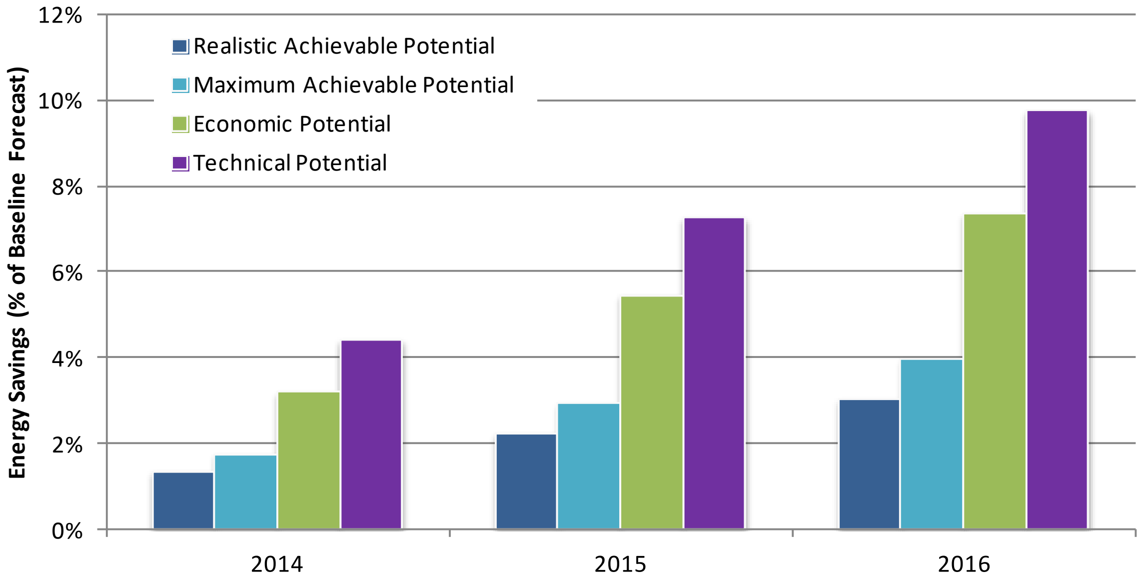
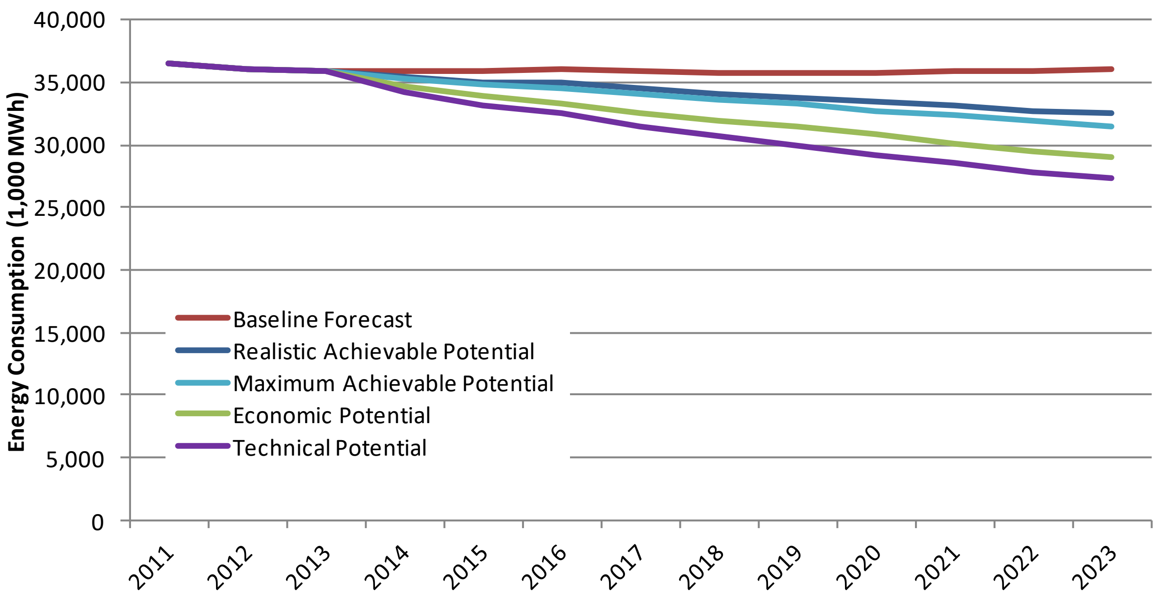



***Figure 6-2 Electric Potentials Projections (GWh)***



## Natural Gas Energy Efficiency – Overall Results

Table 6-2 and Figure 6-3 summarize the natural gas energy-efficiency savings for the different levels of potential relative to the baseline projection. Figure 6-4 displays the natural gas energy-efficiency projections.

Key findings related to net natural gas potentials are summarized below.

- **Realistic Achievable Potential**. In 2014, net realistic achievable savings are 6.1 million therms which is 0.5% of the baseline projection. By 2016, cumulative net realistic achievable savings grow to 14.1 million therms which represent 1.3% of the baseline projection.
- **Maximum Achievable Potential**. In 2014 cumulative net savings for this case are 9.0 million therms or 0.8% of the baseline and by 2016 cumulative net savings reach 20.8 million therms or 1.9% of the baseline projection.
- **Economic potential**. The cumulative net savings for this case in 2014 are 17.4 million therms or 1.6% of the baseline projection and by 2016 the cumulative net savings reach 39.6 million therms, about 3.6% of the baseline.
- **Technical potential**. Cumulative net savings in 2014 for the technical case are 29.1 million therms, 2.6% of the baseline and by 2016 these savings reach 65.3 million therms, about 5.9% of the baseline.

***Table 6-2 Summary of Natural Gas Energy Efficiency Potential***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Baseline Energy Forecasts (MMTherms)** | **1,102** | **1,109** | **1,109** |
| **Cumulative Energy Savings (MMTherms)** | | | |
| Realistic Achievable Potential | 6.1 | 9.5 | 14.1 |
| Maximum Achievable Potential | 9.0 | 14.1 | 20.8 |
| Economic Potential | 17.4 | 27.0 | 39.6 |
| Technical Potential | 29.1 | 45.2 | 65.3 |
| **Energy Savings (% of Baseline)** | | | |
| Realistic Achievable Potential | 0.5% | 0.9% | 1.3% |
| Maximum Achievable Potential | 0.8% | 1.3% | 1.9% |
| Economic Potential | 1.6% | 2.4% | 3.6% |
| Technical Potential | 2.6% | 4.1% | 5.9% |

***Figure 6-3 Summary of Natural Gas Energy Savings***

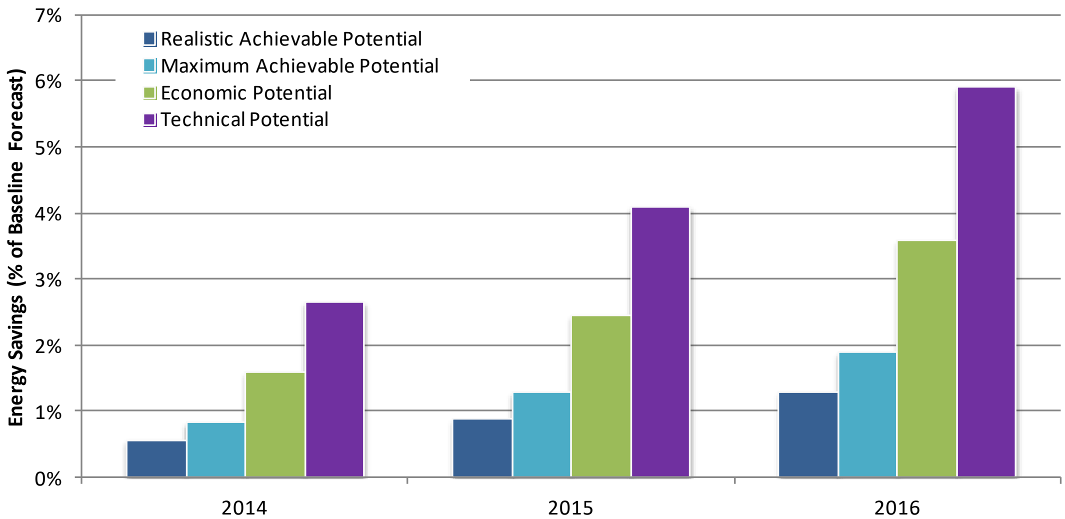
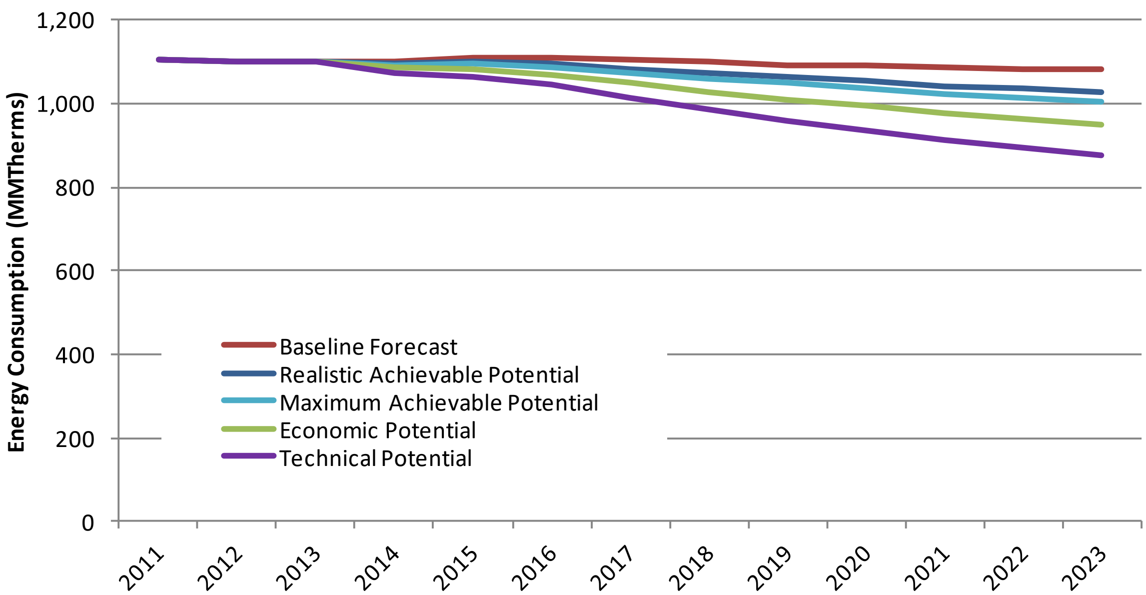



***Figure 6-4 Natural Gas Potential Projections (MMTherms)***



## Overview of Energy Efficiency Potential by Sector and Fuel

Table 6-3 and Figure 6-5 summarize the range of cumulative net electric achievable potential by sector. The commercial sector accounts for the largest portion of the savings, followed by industrial and then residential.

***Table 6-3 Electric Achievable Potential by Sector (GWh)***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Realistic Achievable Savings (GWh)** | | | |
| Residential | 103 | 233 | 322 |
| Commercial | 197 | 319 | 434 |
| Industrial | 182 | 251 | 336 |
| **Total** | **482** | **803** | **1,093** |
| **Maximum Achievable Savings (GWh)** | | | |
| Residential | 135 | 296 | 409 |
| Commercial | 269 | 442 | 604 |
| Industrial | 226 | 312 | 418 |
| **Total** | **630** | **1,051** | **1,432** |

***Figure 6-5 Maximum Achievable and Low Electric Potential by Sector (GWh)***

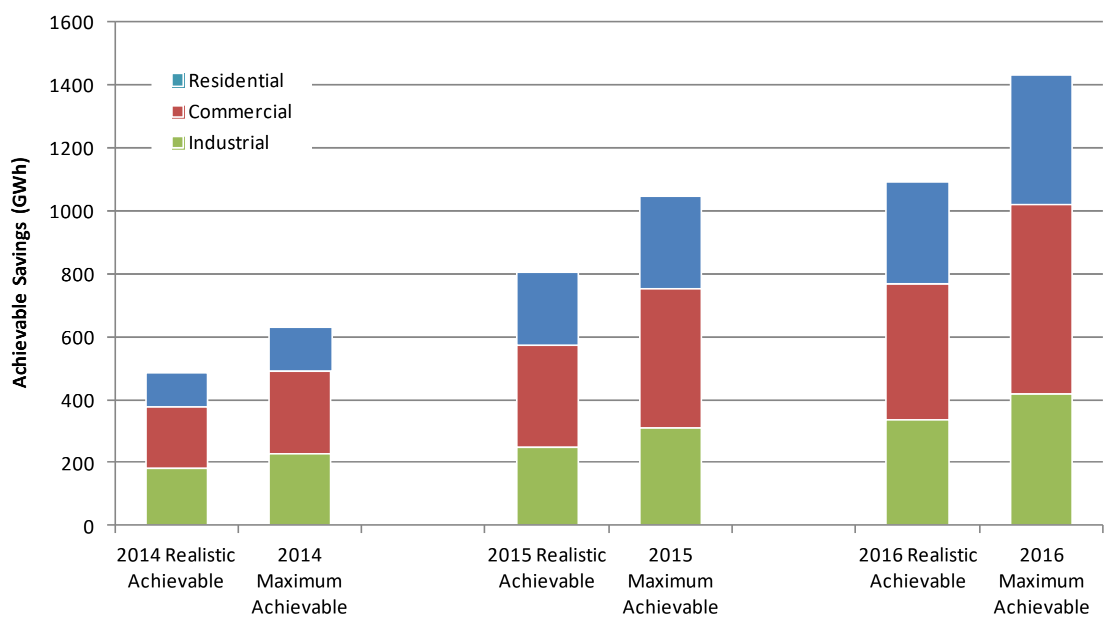
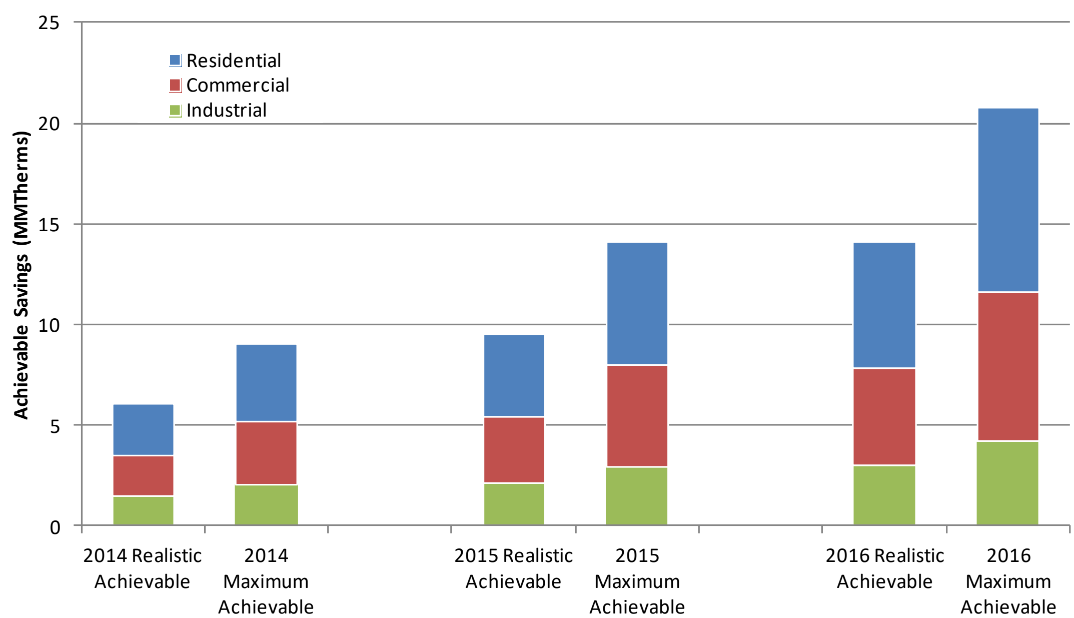



Table 6-4 and Figure 6-6 present the range of cumulative net natural gas achievable potential by sector. The residential sector accounts for the largest portion of the natural gas savings, followed by the commercial and then the industrial sectors.

***Table 6-4 Natural Gas Achievable Potential by Sector (MMTherms)***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Realistic Achievable Savings (MMTherms)** | | | |
| Residential | 2.6 | 4.1 | 6.3 |
| Commercial | 2.0 | 3.3 | 4.8 |
| Industrial | 1.5 | 2.1 | 3.0 |
| **Total** | **6.1** | **9.5** | **14.1** |
| **Maximum Achievable Savings (MMTherms)** | | | |
| Residential | 3.8 | 6.1 | 9.2 |
| Commercial | 3.1 | 5.0 | 7.4 |
| Industrial | 2.0 | 2.9 | 4.2 |
| **Total** | **9.0** | **14.1** | **20.8** |

***Figure 6-6 Maximum Achievable and Low Natural Gas Potential by Sector (MMTherms)***



# ENERGY EFFICIENCY POTENTIAL BY SECTOR

This chapter presents the results of the energy efficiency analysis at the sector level. First, the residential potential is presented, followed by the commercial, and lastly, industrial. Within each sector, electric results are presented first and natural gas results second.

## Residential Electricity Potential

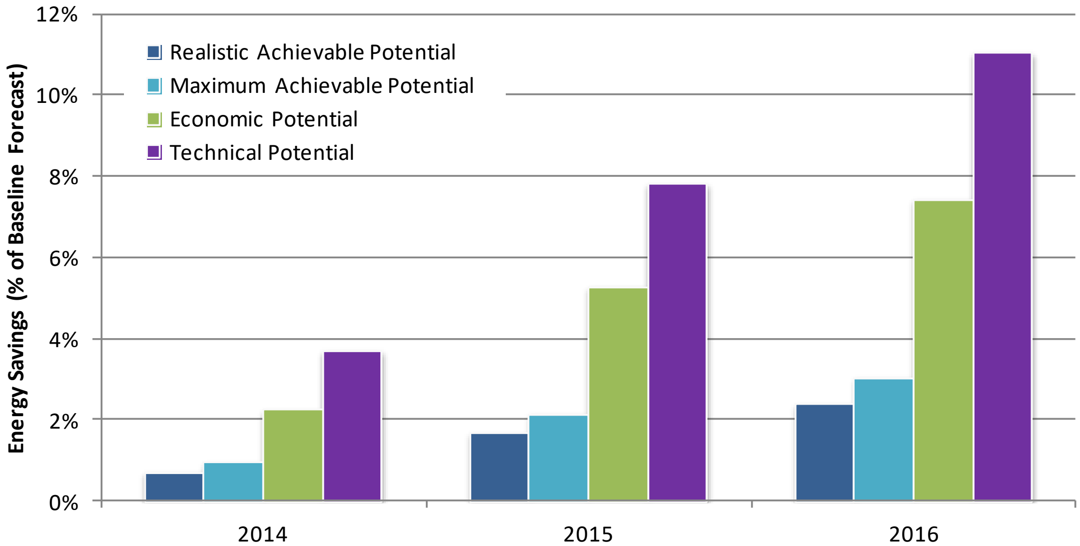
Table 7-1 presents estimates for the four types of potential for the residential electricity sector. Figure 7-1 depicts these potential energy savings estimates graphically.

- **Realistic Achievable Potential** projects 103 GWh of cumulative net energy savings in 2014, 0.9% of the baseline projection. This increases to 322 GWh, 3.0% of the baseline projection, in 2016.
- **Maximum Achievable Potential** is 135 GWh in 2014, which represents 1.2% of the baseline projection. By 2016, the cumulative net energy savings are 409 GWh, 3.8% of the baseline projection.
- **Economic potential** is 317 GWh in 2014. This represents 2.8% of the baseline projection. By 2016, cumulative net savings reaches 996 GWh, 9.3% of the baseline projection.
- **Technical potential** is 520 GWh, or 4.7% of the baseline projection in 2014. By 2016, cumulative net savings reaches 1,478 GWh, 13.8% of the baseline projection.

*Table 7-1 Electricity Energy Efficiency Potential for the Residential Sector*

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Baseline Projection (GWh)** | 11,188 | 10,915 | 10,712 |
| **Cumulative Net Energy Savings (GWh)** | | | |
| Realistic Achievable Potential | 103 | 233 | 322 |
| Maximum Achievable Potential | 135 | 296 | 409 |
| Economic Potential | 317 | 721 | 996 |
| Technical Potential | 520 | 1,069 | 1,478 |
| **Energy Savings (% of Baseline)** | | | |
| Realistic Achievable Potential | 0.9% | 2.1% | 3.0% |
| Maximum Achievable Potential | 1.2% | 2.7% | 3.8% |
| Economic Potential | 2.8% | 6.6% | 9.3% |
| Technical Potential | 4.7% | 9.8% | 13.8% |

***Figure 7-1 Residential Electric Energy Efficiency Potential Savings***




## Residential Electric Potential by Market Segment

Single-family homes in Illinois account for the majority of this sector's total sales in the base year and throughout the projection. Similarly, single-family homes account for the largest share of potential savings by segment, as displayed in Table 7-2, which shows results for 2016.

Table 7-3 shows the Realistic Achievable savings by end use and market segment in 2016. The segments are similar in terms of the distribution of savings opportunities by end use, but there are a few notable differences. Single-family homes have more exterior lighting therefore have more savings potential for this end use. Similarly, single-family homes are more likely to have swimming pools and therefore have more potential for savings in pool pumps (captured in the miscellaneous end use). Multi-family homes have a relatively larger opportunity in home electronics and air conditioning compared to single-family homes, reflecting older appliance stock.

***Table 7-2 Residential Electric Potential by Market Segment, 2016***

| | SF - Electric Only | MF - Electric Only | SF - Electric/Gas | MF - Electric/Gas |
|---|---|---|---|---|
| **Baseline Projection (GWh)** | 4,266 | 1,277 | 4,477 | 693 |
| **Cumulative Net Energy Savings (GWh)** | | | | |
| Realistic Achievable Potential | 93 | 30 | 167 | 27 |
| Maximum Achievable Potential | 120 | 39 | 209 | 33 |
| Economic Potential | 288 | 106 | 502 | 83 |
| Technical Potential | 496 | 156 | 709 | 117 |
| **Energy Savings as % of Baseline** | | | | |
| Realistic Achievable Potential | 2.2% | 2.4% | 3.7% | 3.8% |
| Maximum Achievable Potential | 2.8% | 3.0% | 4.7% | 4.8% |
| Economic Potential | 6.7% | 8.3% | 11.2% | 12.0% |
| Technical Potential | 11.6% | 12.2% | 15.8% | 16.9% |

***Table 7-3 Residential Electric Realistic Achievable Potential by End Use and Segment, 2016 (GWh)***

| End Use | SF - Electric Only | MF - Electric Only | SF - Electric/Gas | MF - Electric/Gas |
|---|---|---|---|---|
| Cooling | 12.5 | 1.9 | 15.8 | 2.2 |
| Heating | 5.9 | 3.7 | 0.9 | 0.3 |
| Water Heating | 6.9 | 4.7 | 2.3 | 1.0 |
| Interior Lighting | 42.4 | 15.4 | 93.0 | 16.3 |
| Exterior Lighting | 6.2 | 1.4 | 25.5 | 2.6 |
| Appliances | 7.6 | 0.9 | 8.5 | 0.8 |
| Electronics | 4.7 | 1.4 | 14.8 | 2.9 |
| Miscellaneous | 6.5 | 0.7 | 6.0 | 0.5 |
| **Total** | **92.5** | **30.0** | **166.9** | **26.6** |

## Residential Electric Potential by End Use

Figure 7-2 focuses on the net residential achievable potential in 2016. Lighting equipment replacement accounts for the highest portion of the savings in the near term as a result of the efficiency gap between CFL lamps and advanced incandescent lamps, even those that will meet the EISA 2007 standard. Although Ameren Illinois has achieved significant savings in lighting already, there are still significant savings available. Electronics, cooling, and appliances also contribute significantly to the savings. Detailed measure information is available in Volume 6, Appendix B. The key measures comprising the potential are listed below:

- Lighting: mostly CFL lamps and specialty bulbs
- Electronics (reduce standby wattage, televisions, set top boxes, PCs)
- Second refrigerator/ freezer removal
- HVAC: Removal of second room AC unit, efficient air conditioners, ducting repair/sealing, insulation, home energy management system and programmable thermostats

***Figure 7-2 Residential Electric Realistic Achievable Potential by End Use in 2016***

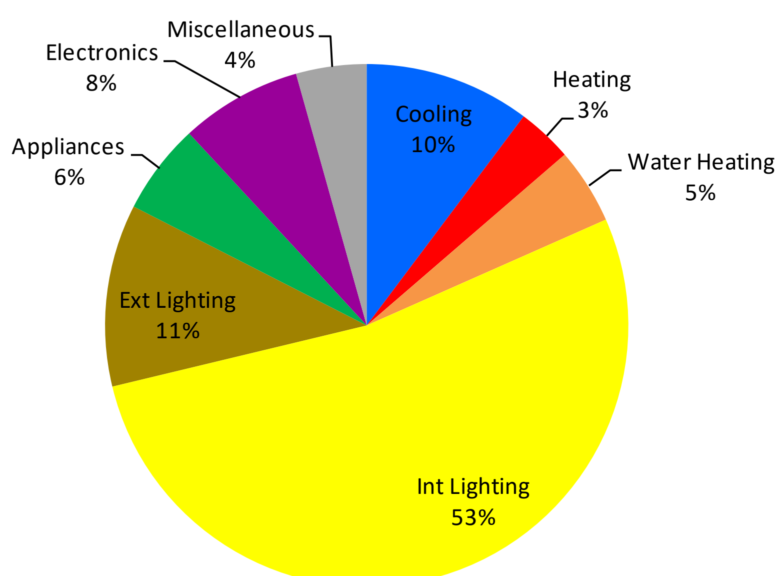


Table 7-4 provides estimates of net savings for each end use and type of potential. The most significant savings opportunities come from the lighting end use.

***Table 7-4 Residential Electric Savings by End Use and Potential Type (GWh)***

| End Use | Case | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Cooling | Realistic Achievable Potential | 14.66 | 22.51 | 32.38 |
| | Maximum Achievable Potential | 21.79 | 32.85 | 46.71 |
| | Economic Potential | 49.03 | 72.29 | 101.09 |
| | Technical Potential | 119.96 | 185.23 | 256.16 |
| Heating | Realistic Achievable Potential | 4.16 | 6.88 | 10.82 |
| | Maximum Achievable Potential | 6.05 | 9.94 | 15.56 |
| | Economic Potential | 15.27 | 24.75 | 38.24 |
| | Technical Potential | 25.28 | 40.08 | 59.56 |
| Water Heating | Realistic Achievable Potential | 4.65 | 8.87 | 14.85 |
| | Maximum Achievable Potential | 6.32 | 11.99 | 20.02 |
| | Economic Potential | 15.16 | 28.39 | 46.86 |
| | Technical Potential | 30.43 | 55.61 | 85.86 |
| Interior Lighting | Realistic Achievable Potential | 48.23 | 127.58 | 167.13 |
| | Maximum Achievable Potential | 58.13 | 153.61 | 201.10 |
| | Economic Potential | 143.61 | 407.71 | 539.72 |
| | Technical Potential | 177.84 | 470.03 | 617.84 |
| Exterior Lighting | Realistic Achievable Potential | 8.76 | 26.05 | 35.63 |
| | Maximum Achievable Potential | 10.57 | 31.37 | 42.88 |
| | Economic Potential | 21.96 | 64.72 | 88.13 |
| | Technical Potential | 30.89 | 80.07 | 106.69 |
| Appliances | Realistic Achievable Potential | 5.65 | 10.47 | 17.75 |
| | Maximum Achievable Potential | 7.23 | 13.36 | 22.59 |
| | Economic Potential | 14.18 | 25.94 | 43.47 |
| | Technical Potential | 38.89 | 70.66 | 108.31 |
| Electronics | Realistic Achievable Potential | 7.51 | 15.45 | 23.76 |
| | Maximum Achievable Potential | 9.16 | 18.89 | 29.06 |
| | Economic Potential | 23.60 | 48.23 | 73.59 |
| | Technical Potential | 38.56 | 76.72 | 122.95 |
| Miscellaneous | Realistic Achievable Potential | 8.19 | 10.82 | 13.76 |
| | Maximum Achievable Potential | 13.97 | 18.46 | 23.42 |
| | Economic Potential | 29.21 | 38.41 | 48.43 |
| | Technical Potential | 58.62 | 90.25 | 120.35 |
| **Total** | **Realistic Achievable Potential** | **101.81** | **228.63** | **316.08** |
| | **Maximum Achievable Potential** | **133.21** | **290.46** | **401.34** |
| | **Economic Potential** | **312.02** | **710.44** | **979.53** |
| | **Technical Potential** | **520.48** | **1,068.65** | **1,477.73** |

## Residential Natural Gas Potential

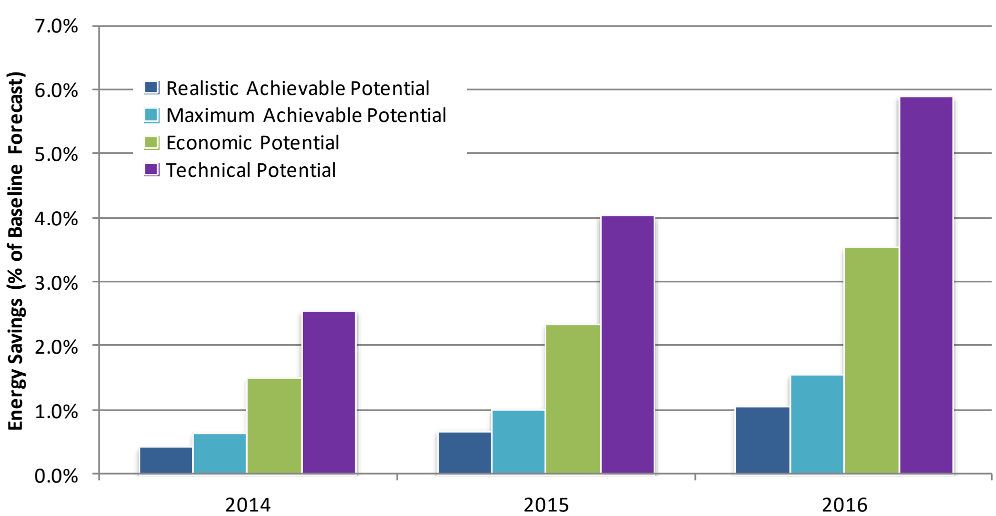
Table 7-5 presents estimates for the four types of potential for natural gas usage in the residential sector. Figure 7-3 depicts these potential energy savings estimates graphically.

- **Realistic Achievable Potential** projects 2.6 million therms of net energy savings in 2014, 0.4% of the baseline projection. This increases to 6.3 million therms, 1.1% of the baseline projection in 2016.
- **Maximum Achievable Potential** is 3.8 million therms in 2014, which represents 0.7% of the baseline projection. By 2016, the cumulative net energy savings are 9.2 million therms, 1.6% of the baseline projection.
- **Economic potential** is 8.9 million therms in 2014. This represents 1.6% of the baseline projection. By 2016, economic potential reaches 20.8 million therms, 3.6% of the baseline projection.
- **Technical potential** savings in 2014 are 15.1 million therms, or 2.6% of the baseline projection. By 2016, technical potential reaches 34.8 million therms, 6.1% of the baseline projection.

***Table 7-5 Natural Gas Energy Efficiency Potential for the Residential Sector***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Energy Projections (MMTherms)** | 570 | 575 | 572 |
| **Cumulative Net Energy Savings (MMTherms)** | | | |
| Realistic Achievable Potential | 2.6 | 4.1 | 6.3 |
| Maximum Achievable Potential | 3.8 | 6.1 | 9.2 |
| Economic Potential | 8.9 | 13.9 | 20.8 |
| Technical Potential | 15.1 | 23.9 | 34.8 |
| **Energy Savings (% of Baseline Projection)** | | | |
| Realistic Achievable Potential | 0.4% | 0.7% | 1.1% |
| Maximum Achievable Potential | 0.7% | 1.1% | 1.6% |
| Economic Potential | 1.6% | 2.4% | 3.6% |
| Technical Potential | 2.6% | 4.2% | 6.1% |

***Figure 7-3 Residential Natural Gas Potential Savings***



## Residential Natural Gas Potential by Market Segment

Single-family homes in Illinois account for the majority of this sector's total sales in the base year and throughout the projection. Similarly, single-family homes account for the largest share of potential savings by segment, as displayed in Table 7-6, which shows results for 2016. Table 7-7 shows the net savings by end use and market segment in 2016. Heating provides the lion share of savings.

***Table 7-6 Residential Natural Gas Potential by Market Segment, 2016 (MMTherms)***

| | SF - Electric/Gas | MF - Electric/Gas | SF - Gas Only | MF - Gas Only |
|---|---|---|---|---|
| **Baseline Projection (MMTherms)** | 376 | 50 | 139 | 7 |
| **Cumulative Net Energy Savings (MMTherms)** | | | | |
| Realistic Achievable Potential | 3.9 | 0.8 | 1.4 | 0.1 |
| Maximum Achievable Potential | 5.8 | 1.1 | 2.1 | 0.2 |
| Economic Potential | 12.6 | 3.2 | 4.6 | 0.4 |
| Technical Potential | 21.6 | 4.7 | 7.9 | 0.6 |
| **Energy Savings as % of Baseline** | | | | |
| Realistic Achievable Potential | 1.0% | 1.6% | 1.0% | 1.6% |
| Maximum Achievable Potential | 1.5% | 2.3% | 1.5% | 2.3% |
| Economic Potential | 3.4% | 6.4% | 3.3% | 6.4% |
| Technical Potential | 5.7% | 9.4% | 5.6% | 9.3% |

***Table 7-7 Residential Realistic Achievable Potential by End Use and Market Segment, 2016 (MMTherms)***

| End Use | SF - Electric/Gas | MF - Electric/Gas | SF - Gas Only | MF - Gas Only |
|---|---|---|---|---|
| Heating | 2.7 | 0.6 | 1.0 | 0.1 |
| Appliances | 0.9 | 0.2 | 0.3 | 0.0 |
| Miscellaneous | - | - | - | - |
| Water Heating | 0.3 | - | 0.2 | - |
| **Total** | **3.9** | **0.8** | **1.4** | **0.1** |

## Residential Natural Gas Potential by End Use

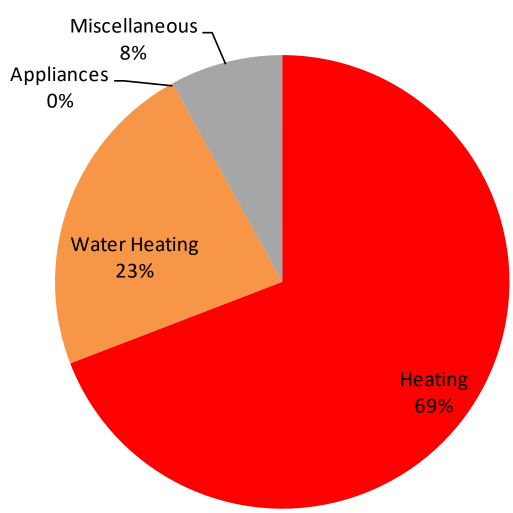
Table 7-8 provides estimates of cumulative net savings for each end use and type of potential. Figure 7-4 focuses on the range of net realistic achievable potential in 2016. As expected, space heating and water heating savings are the largest opportunities. Detailed measure information is available in Appendix B. The key measures comprising the potential are listed below:

- Efficient furnaces & boilers, boiler hot water reset ,ducting repair/sealing, insulation, home energy management system & programmable thermostats
- Efficient water heaters, low-flow showerheads, faucet aerators, and tank blankets

***Table 7-8 Residential Natural Gas Savings by End Use and Potential Type (MMTherms)***

| End Use | Case | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Heating | Realistic Achievable Potential | 1.71 | 2.81 | 4.34 |
| | Maximum Achievable Potential | 2.52 | 4.13 | 6.32 |
| | Economic Potential | 5.93 | 9.50 | 14.34 |
| | Technical Potential | 10.05 | 15.68 | 22.67 |
| Appliances | Realistic Achievable Potential | 0.47 | 0.85 | 1.43 |
| | Maximum Achievable Potential | 0.68 | 1.22 | 2.02 |
| | Economic Potential | 1.65 | 2.93 | 4.84 |
| | Technical Potential | 3.13 | 5.76 | 9.06 |
| Miscellaneous | Realistic Achievable Potential | - | - | - |
| | Maximum Achievable Potential | - | - | - |
| | Economic Potential | - | - | - |
| | Technical Potential | 0.10 | 0.20 | 0.30 |
| Water Heating | Realistic Achievable Potential | 0.38 | 0.44 | 0.50 |
| | Maximum Achievable Potential | 0.64 | 0.74 | 0.84 |
| | Economic Potential | 1.30 | 1.49 | 1.67 |
| | Technical Potential | 1.80 | 2.27 | 2.74 |
| **Total** | **Realistic Achievable Potential** | **2.56** | **4.11** | **6.27** |
| | **Maximum Achievable Potential** | **3.84** | **6.08** | **9.18** |
| | **Economic Potential** | **8.88** | **13.93** | **20.85** |
| | **Technical Potential** | **15.07** | **23.91** | **34.77** |

***Figure 7-4 Residential Natural Gas Realistic Achievable Potential by End Use in 2016***



## Commercial Electricity Potential

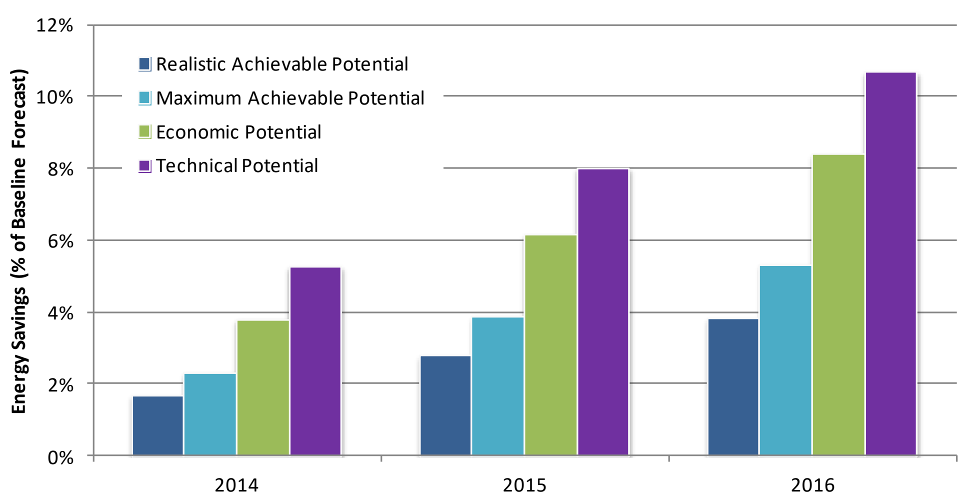
The baseline projection for the commercial sector only grows slightly, which reflects the sluggish near-term economy and forthcoming codes and standards. Nevertheless, the opportunity for energy-efficiency savings is still significant for the commercial sector. Table 7-9 presents estimates for the four types of potential for the residential electricity sector. Figure 7-5 depicts these potential energy savings estimates graphically.

- **Realistic Achievable Potential** projects 197 GWh of net energy savings in 2014, 1.7% of the baseline projection. This increases to 434 GWh, 3.8% of the baseline projection, in 2016.
- **Maximum Achievable Potential** is 269 GWh in 2014, which represents 2.3% of the baseline projection. By 2016, the cumulative net energy savings are 604 GWh, 5.3% of the baseline projection.
- **Economic potential** is 440 GWh in 2014. This represents 3.8% of the baseline projection. By 2016, economic potential reaches 950 GWh, 8.4% of the baseline projection.
- **Technical potential** is 610 GWh, or 5.3% of the baseline projection in 2014. By 2016, technical potential reaches 1,211 GWh, 10.7% of the baseline projection.

***Table 7-9 Electricity Efficiency Potential for the Commercial Sector***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Baseline Projection (GWh)** | 11,547 | 11,415 | 11,332 |
| **Cumulative Net Energy Savings (GWh)** | | | |
| Realistic Achievable Potential | 197 | 319 | 434 |
| Maximum Achievable Potential | 269 | 442 | 604 |
| Economic Potential | 440 | 704 | 950 |
| Technical Potential | 610 | 915 | 1,211 |
| **Savings (% of Baseline)** | | | |
| Realistic Achievable Potential | 1.7% | 2.8% | 3.8% |
| Maximum Achievable Potential | 2.3% | 3.9% | 5.3% |
| Economic Potential | 3.8% | 6.2% | 8.4% |
| Technical Potential | 5.3% | 8.0% | 10.7% |

***Figure 7-5 Commercial Energy Efficiency Potential Savings***



## Commercial Electric Potential by Market Segment

Table 7-10 shows net potential estimates by building type segment in 2016. Office has the largest absolute realistic achievable savings potential in 2016, followed by grocery, retail and miscellaneous. Table 7-11 summarizes achievable potential for each segment and end use.

***Table 7-10 Commercial Electric Potential by Market Segment, 2016***

| | Office | Restaurant | Retail | Grocery | College |
|---|---|---|---|---|---|
| **Baseline Projection** | 1,868 | 990 | 1,476 | 777 | 1,247 |
| **Cumulative Net Energy Savings (GWh)** | | | | | |
| Realistic Achievable Potential | 64 | 46 | 58 | 60 | 50 |
| Maximum Achievable Potential | 89 | 64 | 80 | 78 | 70 |
| Economic Potential | 140 | 102 | 127 | 127 | 110 |
| Technical Potential | 182 | 121 | 161 | 146 | 132 |
| **Energy Savings (% of Baseline)** | | | | | |
| Realistic Achievable Potential | 3% | 5% | 4% | 8% | 4% |
| Maximum Achievable Potential | 5% | 6% | 5% | 10% | 6% |
| Economic Potential | 7% | 10% | 9% | 16% | 9% |
| Technical Potential | 10% | 12% | 11% | 19% | 11% |

| | School | Health | Lodging | Warehouse | Misc. | Total |
|---|---|---|---|---|---|---|
| **Baseline Projection** | 698 | 1,368 | 652 | 482 | 1,773 | **11,332** |
| **Cumulative Net Energy Savings (GWh)** | | | | | | |
| Realistic Achievable Potential | 21 | 34 | 33 | 14 | 57 | **434** |
| Maximum Achievable Potential | 29 | 47 | 47 | 20 | 82 | **604** |
| Economic Potential | 45 | 74 | 70 | 30 | 125 | **950** |
| Technical Potential | 61 | 100 | 84 | 48 | 175 | **1,211** |
| **Energy Savings (% of Baseline)** | | | | | | |
| Realistic Achievable Potential | 3% | 2% | 5% | 3% | 3% | **4%** |
| Maximum Achievable Potential | 4% | 3% | 7% | 4% | 5% | **5%** |
| Economic Potential | 7% | 5% | 11% | 6% | 7% | **8%** |
| Technical Potential | 9% | 7% | 13% | 10% | 10% | **11%** |

***Table 7-11 Commercial Electric Realistic Achievable by End Use and Segment, 2016 (GWh)***

| Segment | Cooling | Space Heating | Ventilation | Water Heat | Int. Lighting | Ext. Lighting | Food Prep | Refrigeration | Office Equip | Misc | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Office | 14.5 | 2.7 | 7.9 | 2.3 | 21.2 | 1.3 | 0.4 | 0.5 | 13.0 | 0.2 | **64.0** |
| Restaurant | 5.6 | 0.3 | 2.7 | 7.5 | 14.6 | 0.8 | 3.6 | 9.8 | 0.6 | 0.0 | **45.6** |
| Retail | 7.7 | 0.9 | 7.0 | 3.4 | 28.2 | 4.3 | 1.4 | 2.2 | 2.2 | 0.2 | **57.5** |
| Grocery | 4.5 | 1.3 | 2.1 | 0.6 | 6.8 | 0.2 | 8.7 | 35.0 | 0.2 | 0.0 | **59.5** |
| College | 20.7 | 0.4 | 3.3 | 1.2 | 18.6 | 2.1 | 0.2 | 0.5 | 3.0 | 0.1 | **50.0** |
| School | 3.1 | 0.6 | 2.3 | 0.3 | 9.9 | 0.7 | 0.5 | 1.1 | 2.1 | 0.0 | **20.6** |
| Health | 10.2 | 0.9 | 3.5 | 1.5 | 13.0 | 0.1 | 0.5 | 1.6 | 1.8 | 0.6 | **33.6** |
| Lodging | 3.6 | 1.0 | 1.7 | 6.3 | 17.6 | 1.0 | 0.4 | 0.6 | 0.3 | 0.1 | **32.5** |
| Warehouse | 1.8 | 0.8 | 1.1 | 0.2 | 7.8 | 0.1 | 0.3 | 0.9 | 0.9 | 0.1 | **14.0** |
| Misc. | 15.0 | 1.7 | 3.3 | 4.1 | 24.0 | 4.9 | 0.6 | 0.4 | 2.7 | 0.5 | **57.2** |
| **Total** | **86.6** | **10.7** | **34.8** | **27.3** | **161.9** | **15.5** | **16.6** | **52.5** | **26.7** | **1.8** | **434.4** |

## Commercial Electric Potential by End Use

Table 7-12 presents the net commercial sector savings by end use and potential type. The end uses with the highest technical and economic potential are lighting, cooling, refrigeration, and ventilation. Figure 7-6 focuses on achievable potential savings by end use. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2016, exterior lighting is second, and refrigeration is third. Refrigeration energy savings are then followed in descending order by cooling, ventilation, office equipment, and small amounts of the other end uses.

Detailed measure information is available in Volume 6, Appendix C. The key measures comprising the potential are listed below:

- Lighting – CFLs, LED lamps, linear fluorescent, daylighting controls, occupancy sensors, and HID lamps for exterior lighting
- Energy management systems & programmable thermostats
- Ventilation – variable speed control
- Refrigeration – efficient equipment, control systems, and anti-sweat door heater
- Custom measures

***Figure 7-6 Commercial Realistic Achievable Potential Electricity Savings by End Use in 2016***

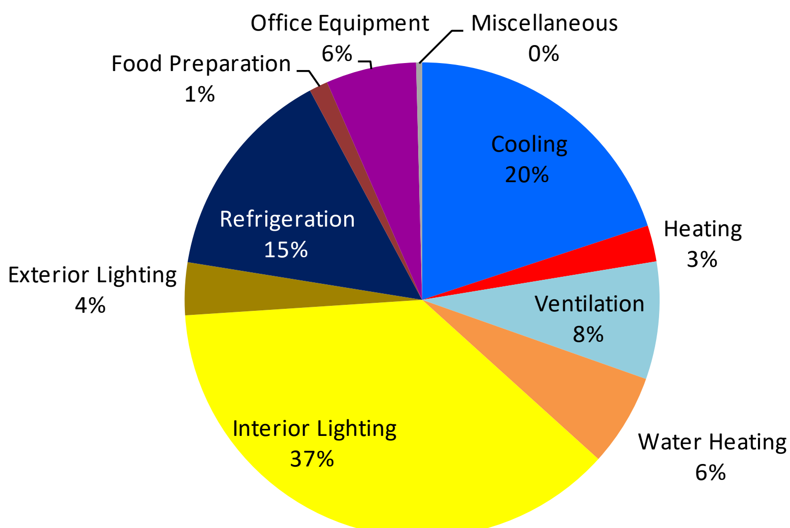


***Table 7-12 Commercial Potential by End Use and Potential Type (GWh)***

| End Use | Case | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Cooling | Realistic Achievable Potential | 46 | 64 | 87 |
| | Maximum Achievable Potential | 64 | 92 | 125 |
| | Economic Potential | 108 | 151 | 202 |
| | Technical Potential | 141 | 191 | 248 |
| Heating | Realistic Achievable Potential | 6 | 8 | 11 |
| | Maximum Achievable Potential | 8 | 11 | 15 |
| | Economic Potential | 13 | 18 | 24 |
| | Technical Potential | 17 | 25 | 35 |
| Ventilation | Realistic Achievable Potential | 17 | 25 | 35 |
| | Maximum Achievable Potential | 23 | 35 | 49 |
| | Economic Potential | 40 | 60 | 82 |
| | Technical Potential | 43 | 64 | 88 |
| Water Heating | Realistic Achievable Potential | 9 | 18 | 27 |
| | Maximum Achievable Potential | 14 | 29 | 44 |
| | Economic Potential | 23 | 47 | 71 |
| | Technical Potential | 26 | 50 | 75 |
| Interior Lighting | Realistic Achievable Potential | 64 | 118 | 162 |
| | Maximum Achievable Potential | 85 | 161 | 221 |
| | Economic Potential | 132 | 240 | 325 |
| | Technical Potential | 194 | 315 | 419 |
| Exterior Lighting | Realistic Achievable Potential | 7 | 13 | 16 |
| | Maximum Achievable Potential | 9 | 19 | 22 |
| | Economic Potential | 13 | 27 | 31 |
| | Technical Potential | 22 | 39 | 48 |
| Refrigeration | Realistic Achievable Potential | 36 | 49 | 64 |
| | Maximum Achievable Potential | 47 | 64 | 84 |
| | Economic Potential | 80 | 107 | 138 |
| | Technical Potential | 105 | 138 | 174 |
| Food Preparation | Realistic Achievable Potential | 2 | 4 | 6 |
| | Maximum Achievable Potential | 2 | 5 | 7 |
| | Economic Potential | 4 | 8 | 13 |
| | Technical Potential | 4 | 8 | 13 |
| Office Equipment | Realistic Achievable Potential | 11 | 19 | 27 |
| | Maximum Achievable Potential | 15 | 26 | 36 |
| | Economic Potential | 25 | 44 | 61 |
| | Technical Potential | 55 | 82 | 106 |
| Miscellaneous | Realistic Achievable Potential | 1 | 1 | 2 |
| | Maximum Achievable Potential | 1 | 2 | 2 |
| | Economic Potential | 2 | 3 | 4 |
| | Technical Potential | 2 | 3 | 4 |
| **Total** | **Realistic Achievable Potential** | **197** | **319** | **434** |
| | **Maximum Achievable Potential** | **269** | **442** | **604** |
| | **Economic Potential** | **440** | **704** | **950** |
| | **Technical Potential** | **610** | **915** | **1,211** |

## Commercial Natural Gas Potential

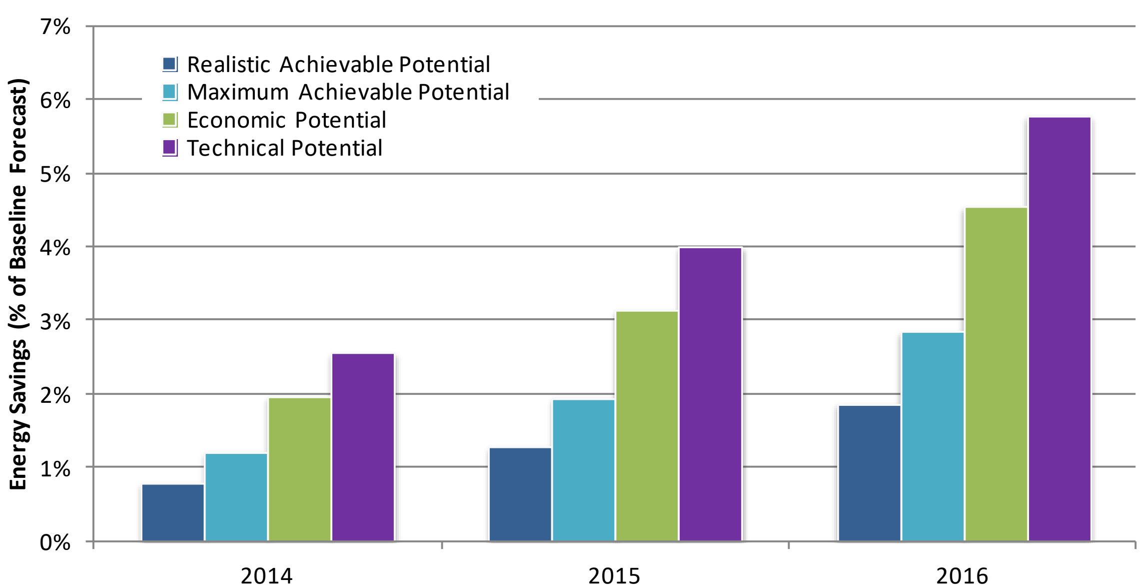
Table 7-13 and Figure 7-7 present the net savings associated with each level of potential. The highlights from the potentials are described below.

- **Realistic Achievable Potential** projects 2.03 million therms of cumulative net energy savings in 2014, 1.0% of the baseline projection. This increases to 4.83 million therms, 2.3% of the baseline projection, in 2016.
- **Maximum Achievable Potential** is 3.10 million therms in 2014, which represents 1.5% of the baseline projection. By 2016, the cumulative net energy savings are 7.38 million therms, 2.3% of the baseline projection.
- **Economic potential** is 5.04 million therms in 2014. This represents 2.5% of the baseline projection. By 2016, cumulative net savings reaches 11.78 million therms, 5.7% of the baseline projection.
- **Technical potential** in 2014 is 6.54 million therms, or 3.2% of the baseline projection. By 2016, cumulative net savings reaches 14.98 million therms, 7.2% of the baseline projection.

***Table 7-13 Natural Gas Efficiency Potential for the Commercial Sector (MMTherms)***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Energy Projections (MMTherms)** | 205 | 207 | 208 |
| **Cumulative Net Energy Savings (MMTherms)** | | | |
| Realistic Achievable Potential | 2.0 | 3.3 | 4.8 |
| Maximum Achievable Potential | 3.1 | 5.0 | 7.4 |
| Economic Potential | 5.0 | 8.1 | 11.8 |
| Technical Potential | 6.5 | 10.4 | 15.0 |
| **Energy Savings (% of Baseline Projection)** | | | |
| Realistic Achievable Potential | 1.0% | 1.6% | 2.3% |
| Maximum Achievable Potential | 1.5% | 2.4% | 3.6% |
| Economic Potential | 2.5% | 3.9% | 5.7% |
| Technical Potential | 3.2% | 5.0% | 7.2% |

***Figure 7-7 Commercial Natural Gas Potential Savings***



## Commercial Natural Gas Potential by Market Segment

Table 7-14 below shows net natural gas potential estimates by segment in 2016. Table 7-15 summarizes the achievable potential for each segment by end use.

***Table 7-14 Commercial Natural Gas Potential by Market Segment, 2016 (MMTherms)***

| | Office | Restaurant | Retail | Grocery | College |
|---|---|---|---|---|---|
| **Baseline Projection** | 13.84 | 23.86 | 31.42 | 3.89 | 20.04 |
| **Cumulative Net Energy Savings (MMTherms)** | | | | | |
| Realistic Achievable Potential | 0.32 | 0.68 | 0.47 | 0.11 | 0.50 |
| Maximum Achievable Potential | 0.51 | 0.96 | 0.66 | 0.16 | 0.80 |
| Economic Potential | 0.81 | 1.56 | 1.09 | 0.26 | 1.25 |
| Technical Potential | 0.83 | 1.78 | 2.75 | 0.32 | 1.28 |
| **Energy Savings (% of Baseline)** | | | | | |
| Realistic Achievable Potential | 2.3% | 2.8% | 1.5% | 2.8% | 2.5% |
| Maximum Achievable Potential | 3.7% | 4.0% | 2.1% | 4.1% | 4.0% |
| Economic Potential | 5.8% | 6.6% | 3.5% | 6.8% | 6.2% |
| Technical Potential | 6.0% | 7.4% | 8.8% | 8.2% | 6.4% |

| | School | Health | Lodging | Warehouse | Misc. | Total |
|---|---|---|---|---|---|---|
| **Baseline Projection** | 27.17 | 37.74 | 4.22 | 9.48 | 36.08 | **207.76** |
| **Cumulative Net Energy Savings (MMTherms)** | | | | | | |
| Realistic Achievable Potential | 0.64 | 0.89 | 0.16 | 0.17 | 0.90 | **4.83** |
| Maximum Achievable Potential | 1.00 | 1.39 | 0.23 | 0.26 | 1.40 | **7.38** |
| Economic Potential | 1.58 | 2.20 | 0.38 | 0.41 | 2.23 | **11.78** |
| Technical Potential | 1.95 | 2.25 | 0.42 | 0.85 | 2.56 | **14.98** |
| **Energy Savings (% of Baseline)** | | | | | | |
| Realistic Achievable Potential | 2.3% | 2.4% | 3.8% | 1.8% | 2.5% | **2.3%** |
| Maximum Achievable Potential | 3.7% | 3.7% | 5.5% | 2.8% | 3.9% | **3.6%** |
| Economic Potential | 5.8% | 5.8% | 8.9% | 4.4% | 6.2% | **5.7%** |
| Technical Potential | 7.2% | 6.0% | 9.9% | 9.0% | 7.1% | **7.2%** |

***Table 7-15 Commercial Natural Gas Maximum Achievable Potential by End Use and Market Segment, 2016 (MMTherms)***

| Segment | Heating | Water Heat | Food Prep | Misc. | Total |
|---|---|---|---|---|---|
| Office | 0.4 | 0.1 | 0.0 | 0.0 | 0.5 |
| Restaurant | 0.1 | 0.5 | 0.4 | 0.0 | 1.0 |
| Retail | 0.5 | 0.2 | 0.0 | 0.0 | 0.7 |
| Grocery | 0.1 | 0.1 | 0.0 | 0.0 | 0.2 |
| College | 0.5 | 0.2 | 0.1 | 0.0 | 0.8 |
| School | 0.6 | 0.3 | 0.1 | 0.0 | 1.0 |
| Health | 0.6 | 0.6 | 0.2 | 0.0 | 1.4 |
| Lodging | 0.1 | 0.2 | 0.0 | 0.0 | 0.2 |
| Warehouse | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 |
| Misc. | 1.1 | 0.3 | 0.0 | 0.0 | 1.4 |
| **Total** | **4.1** | **2.4** | **0.9** | **0.0** | **7.4** |

## Commercial Natural Gas Potential by End Use

Table 7-16 presents the commercial sector net savings by end use and potential type. The end uses with the highest technical and economic potential are heating, water heating, and food preparation. This study shows no savings available in the miscellaneous end use due to its uncertain composition.

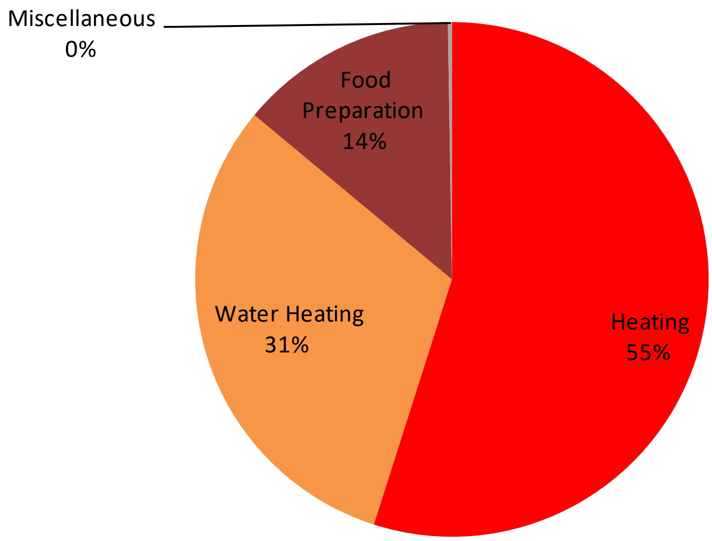
***Table 7-16 Commercial Natural Gas Potential by End Use and Potential Type (MMTherms)***

| End Use | Case | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Heating | Realistic Achievable Potential | 1.19 | 1.82 | 2.65 |
| | Maximum Achievable Potential | 1.83 | 2.81 | 4.10 |
| | Economic Potential | 2.96 | 4.50 | 6.50 |
| | Technical Potential | 4.18 | 6.35 | 9.24 |
| Water Heating | Realistic Achievable Potential | 0.61 | 1.02 | 1.51 |
| | Maximum Achievable Potential | 0.97 | 1.61 | 2.36 |
| | Economic Potential | 1.55 | 2.57 | 3.73 |
| | Technical Potential | 1.79 | 2.89 | 4.08 |
| Food Preparation | Realistic Achievable Potential | 0.22 | 0.45 | 0.66 |
| | Maximum Achievable Potential | 0.30 | 0.60 | 0.89 |
| | Economic Potential | 0.52 | 1.03 | 1.52 |
| | Technical Potential | 0.52 | 1.03 | 1.52 |
| Miscellaneous | Realistic Achievable Potential | 0.00 | 0.01 | 0.01 |
| | Maximum Achievable Potential | 0.01 | 0.01 | 0.02 |
| | Economic Potential | 0.01 | 0.02 | 0.03 |
| | Technical Potential | 0.05 | 0.09 | 0.13 |
| **Total** | **Realistic Achievable Potential** | **2.03** | **3.30** | **4.83** |
| | **Maximum Achievable Potential** | **3.10** | **5.04** | **7.38** |
| | **Economic Potential** | **5.04** | **8.13** | **11.78** |
| | **Technical Potential** | **6.54** | **10.36** | **14.98** |

Figure 7-8 below shows net achievable potential savings by end use. Water heating provides the largest share of the savings, with heating and food preparation each successively smaller. Detailed measure information is available in Appendix C. The key measures comprising the potential are listed below:

- Energy management systems, programmable thermostats, HVAC occupancy sensors
- Efficient boilers, boiler maintenance, steam trap repair and hot water reset
- Efficient water heaters
- Efficient food preparation equipment for the restaurant segment
- Insulation and high efficiency windows

***Figure 7-8 Commercial Natural Gas Realistic Achievable Potential Savings by End Use in 2016***




## Industrial Electricity Potential

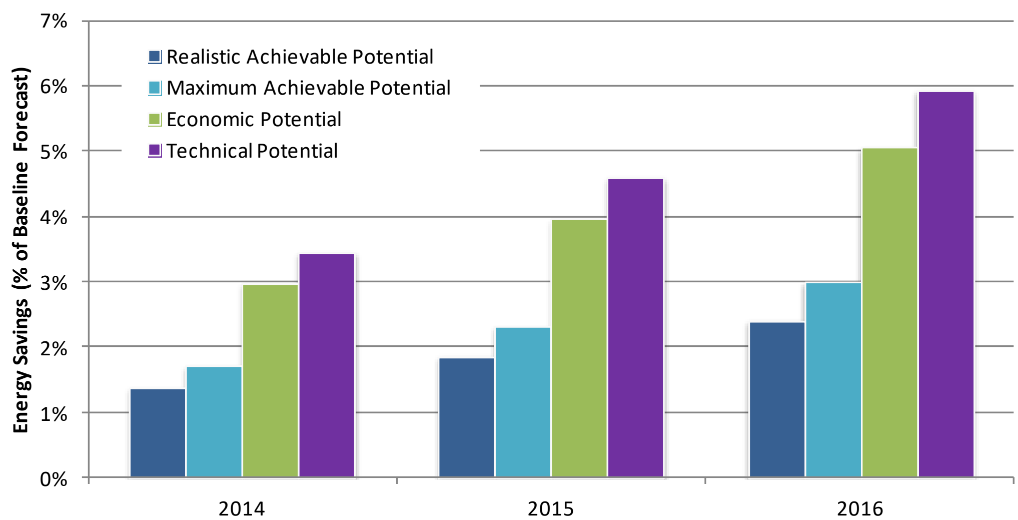
The industrial sector in Ameren Illinois accounts for about one-third of total energy consumption, but slightly more than one-third of the savings. Table 7-17 and Figure 7-9 present the net savings for the various types of potential considered in this study.

- **Realistic Achievable Potential** is 182 GWh of cumulative net energy savings in 2014 and 336 GWh in 2016. This corresponds to 1.4% of the baseline projection in 2014 and 2.4% in 2016.
- **Maximum Achievable Potential** is 226 GWh in 2014, which represents 1.7% of the baseline projection. By 2016, the cumulative net energy savings are 418 GWh, 3% of the baseline projection.
- **Economic potential** is 392 GWh in 2014. This represents 3% of the baseline projection. By 2016, cumulative net savings reaches 705 GWh, 5.0% of the baseline projection.
- **Technical potential** in 2014 is 453 GWh, or 3.5% of the baseline projection. By 2016, cumulative net savings reaches 828 GWh, 5.9% of the baseline projection.

*Table 7-17 Electric Efficiency Potential for the Industrial Sector*

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Energy Projections (GWh)** | 13,130 | 13,480 | 13,955 |
| **Cumulative Net Energy Savings (GWh)** | | | |
| Realistic Achievable Potential | 182 | 251 | 336 |
| Maximum Achievable Potential | 226 | 312 | 418 |
| Economic Potential | 392 | 533 | 705 |
| Technical Potential | 453 | 620 | 828 |
| **Energy Savings (% of Baseline Projection)** | | | |
| Realistic Achievable Potential | 1.4% | 1.9% | 2.4% |
| Maximum Achievable Potential | 1.7% | 2.3% | 3.0% |
| Economic Potential | 3.0% | 4.0% | 5.0% |
| Technical Potential | 3.5% | 4.6% | 5.9% |

*Figure 7-9 Industrial Electric Potential Savings*



## Industrial Electric Potential by Market Segment

Table 7-18 shows net electric energy efficiency potential for the five industrial segments in 2016. Table 7-19 shows the Realistic Achievable savings by end use and market segment in 2016.

***Table 7-18 Industrial Electric Potential by Market Segment, 2016***

| | Food | Petroleum | Metals | Machinery | Other Industrial | Total |
|---|---|---|---|---|---|---|
| **Baseline Projection (GWh)** | 2,195 | 4,728 | 2,617 | 938 | 3,477 | **13,955** |
| **Cumulative Net Energy Savings (GWh)** | | | | | | |
| Realistic Achievable Potential | 53 | 134 | 39 | 25 | 86 | **336** |
| Maximum Achievable Potential | 65 | 163 | 48 | 32 | 111 | **418** |
| Economic Potential | 111 | 280 | 82 | 52 | 180 | **705** |
| Technical Potential | 132 | 299 | 91 | 66 | 240 | **828** |
| **Energy Savings as % of Baseline** | | | | | | |
| Realistic Achievable Potential | 2.4% | 2.8% | 1.5% | 2.6% | 2.5% | 2.4% |
| Maximum Achievable Potential | 3.0% | 3.4% | 1.8% | 3.4% | 3.2% | 3.0% |
| Economic Potential | 5.0% | 5.9% | 3.1% | 5.5% | 5.2% | 5.0% |
| Technical Potential | 6.0% | 6.3% | 3.5% | 7.1% | 6.9% | 5.9% |

***Table 7-19 Industrial Electric Realistic Achievable Potential by End Use and Market Segment, 2016***

| End Use | Food | Petroleum | Metals | Machinery | Other Industrial |
|---|---|---|---|---|---|
| Cooling | 2.5 | 2.2 | 1.5 | 3.1 | 12.7 |
| Heating | 1.1 | 1.0 | 0.7 | 1.4 | 5.7 |
| Ventilation | - | - | - | - | - |
| Interior Lighting | 3.9 | 2.7 | 2.7 | 3.5 | 15.1 |
| Exterior Lighting | 0.9 | 0.6 | 0.6 | 0.8 | 3.4 |
| Motors | 33.3 | 122.5 | 27.3 | 14.8 | 42.6 |
| Process | 11.1 | 5.2 | 6.1 | 1.0 | 6.0 |
| Miscellaneous | - | - | - | - | - |
| **Total** | **52.8** | **134.1** | **38.9** | **24.6** | **85.5** |

## Industrial Electric Potential by End Use

Table 7-20 presents estimates of net savings for each end use and type of potential. Not surprisingly, the largest savings opportunities are found in motors and drives.

***Table 7-20 Industrial Electric Potential by End Use and Potential Type (GWh)***

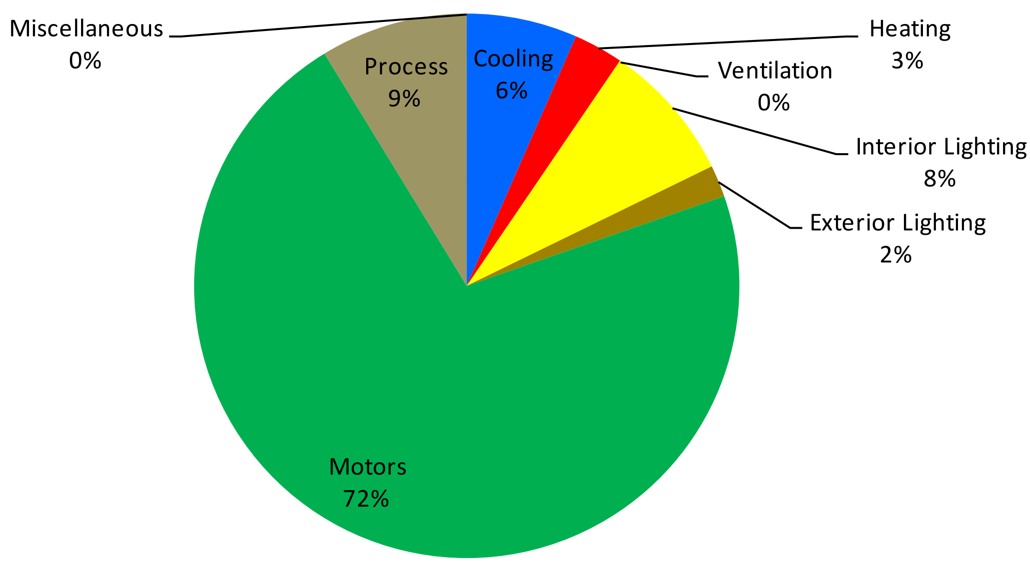
| End Use | Potential | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Cooling | Realistic Achievable Potential | 11 | 16 | 22 |
| | Maximum Achievable Potential | 16 | 23 | 33 |
| | Economic Potential | 25 | 36 | 50 |
| | Technical Potential | 27 | 39 | 54 |
| Heating | Realistic Achievable Potential | 6 | 8 | 10 |
| | Maximum Achievable Potential | 7 | 10 | 13 |
| | Economic Potential | 14 | 17 | 22 |
| | Technical Potential | 38 | 56 | 81 |
| Ventilation | Realistic Achievable Potential | - | - | - |
| | Maximum Achievable Potential | - | - | - |
| | Economic Potential | - | - | - |
| | Technical Potential | - | - | - |
| Interior Lighting | Realistic Achievable Potential | 9 | 20 | 28 |
| | Maximum Achievable Potential | 13 | 27 | 38 |
| | Economic Potential | 19 | 39 | 55 |
| | Technical Potential | 42 | 65 | 87 |
| Exterior Lighting | Realistic Achievable Potential | 3 | 5 | 6 |
| | Maximum Achievable Potential | 4 | 7 | 9 |
| | Economic Potential | 6 | 10 | 13 |
| | Technical Potential | 7 | 12 | 16 |
| Motors | Realistic Achievable Potential | 139 | 183 | 241 |
| | Maximum Achievable Potential | 168 | 220 | 290 |
| | Economic Potential | 298 | 387 | 502 |
| | Technical Potential | 302 | 395 | 514 |
| Process | Realistic Achievable Potential | 14 | 20 | 29 |
| | Maximum Achievable Potential | 17 | 25 | 35 |
| | Economic Potential | 31 | 44 | 62 |
| | Technical Potential | 37 | 53 | 76 |
| Miscellaneous | Realistic Achievable Potential | - | - | - |
| | Maximum Achievable Potential | - | - | - |
| | Economic Potential | - | - | - |
| | Technical Potential | - | - | - |
| **Total** | **Realistic Achievable Potential** | **182** | **251** | **336** |
| | **Maximum Achievable Potential** | **226** | **312** | **418** |
| | **Economic Potential** | **392** | **533** | **705** |
| | **Technical Potential** | **453** | **620** | **828** |

Figure 7-10 illustrates the achievable potential savings by electric end use in 2016 for the industrial sector. The largest shares of savings opportunities are in the motors and machine drives. Potential savings for straight equipment change-outs are diminishing due to the National Electrical Manufacturer's Association (NEMA) standards, which now make premium efficiency motors the baseline efficiency level. As a result, there are no substantially more efficient upgrade options to increase efficiency improvements. Many of the savings opportunities in this end use come from controls, timers, and variable speed drives, which improve system efficiencies where motors are utilized.

Beyond the replacement of motors, there are large opportunities for savings in cooling, lighting, process, ventilation, and finally space heating. Detailed measure information is available in Appendix D. The key measures comprising the potential are listed below:

- Motors – drives and controls
- Custom measures
- Application optimization and control – fans, pumps, compressed air
- Process – timers and controls
- Efficient high bay lighting

***Figure 7-10 Industrial Realistic Achievable Electricity Potential Savings by End Use in 2016***




## Industrial Natural Gas Potential

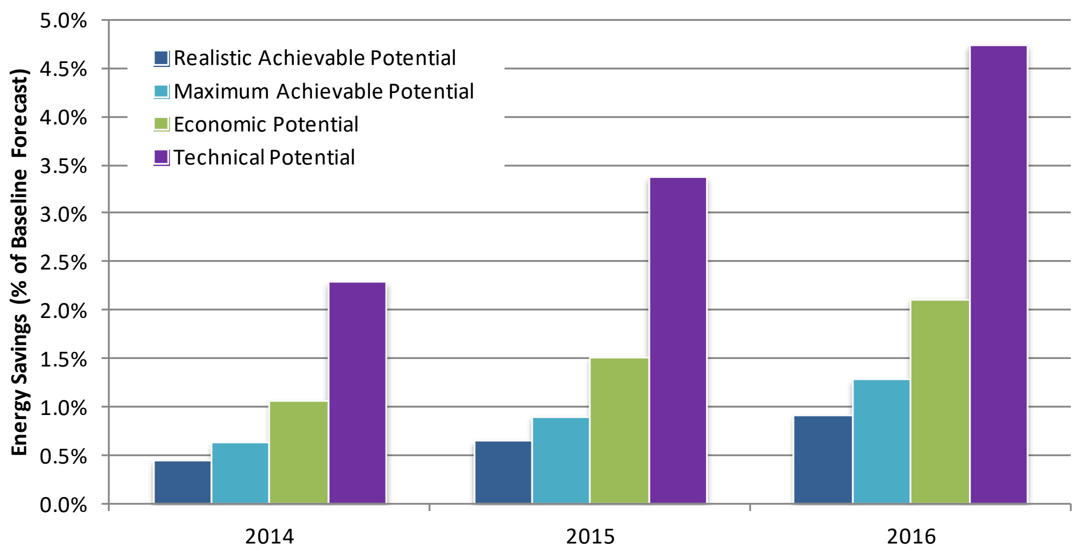
Table 7-21 and Figure 7-11 present the net savings for the various types of potential considered in this study for the industrial sector.

- **Realistic Achievable Potential** projects 1.5 million therms of cumulative net energy savings in 2014, 0.5% of the baseline projection. This increases to 3.0 million therms, 0.9% of the baseline projection, in 2016.
- **Maximum Achievable Potential** is 2.0 million therms in 2014, which represents 0.6% of the baseline projection. By 2016, the cumulative net energy savings are 4.2 million therms, 1.3% of the baseline projection.
- **Economic potential** is 3.5 million therms in 2014. This represents 1.1% of the baseline projection. By 2016, cumulative net savings are 6.9 million therms, 2.1% of the baseline projection.
- **Technical potential** in 2014 is 7.5 million therms, or 2.3% of the baseline projection. By 2016, cumulative net savings are 15.6 million therms, 4.7% of the baseline projection.

***Table 7-21 Natural Gas Efficiency Potential for the Industrial Sector***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Energy Projections (MMTherms)** | 326 | 326 | 329 |
| **Cumulative Net Energy Savings** | | | |
| Realistic Achievable Potential | 1.5 | 2.1 | 3.0 |
| Maximum Achievable Potential | 2.0 | 2.9 | 4.2 |
| Economic Potential | 3.5 | 4.9 | 6.9 |
| Technical Potential | 7.5 | 11.0 | 15.6 |
| **Energy Savings as a % of Baseline** | | | |
| Realistic Achievable Potential | 0.5% | 0.6% | 0.9% |
| Maximum Achievable Potential | 0.6% | 0.9% | 1.3% |
| Economic Potential | 1.1% | 1.5% | 2.1% |
| Technical Potential | 2.3% | 3.4% | 4.7% |

***Figure 7-11 Industrial Natural Gas Potential Savings***



## Industrial Natural Gas Potential by Market Segment

Table 7-22 shows net natural gas energy efficiency potential for the four industrial segments in 2016. Table 7-23 shows the net realistic achievable savings by end use and market segment in 2016. A large portion of the savings comes from space heating improvements in the Other Industrial category. The largest industrial segments typically dedicate very little of their energy to space conditioning, so the smaller businesses that are grouped into the Other Industrial category will have more by comparison.

***Table 7-22 Industrial Natural Gas Potential by Market Segment, 2016***

| | Food Products | Petroleum | Metals | Machinery | Other Industrial | Total |
|---|---|---|---|---|---|---|
| **Baseline Projection (MMTherms)** | 3.70 | 18.65 | 169.64 | 21.81 | 114.88 | 328.69 |
| **Cumulative Net Energy Savings (MMTherms)** | | | | | | |
| Realistic Achievable Potential | 0.04 | 0.13 | 0.95 | 0.27 | 1.62 | 3.01 |
| Maximum Achievable Potential | 0.06 | 0.19 | 1.28 | 0.39 | 2.29 | 4.20 |
| Economic Potential | 0.09 | 0.31 | 2.15 | 0.64 | 3.77 | 6.95 |
| Technical Potential | 0.21 | 0.67 | 4.57 | 1.46 | 8.65 | 15.56 |
| **Energy Savings as % of Baseline** | | | | | | |
| Realistic Achievable Potential | 1.0% | 0.7% | 0.6% | 1.3% | 1.4% | 0.9% |
| Maximum Achievable Potential | 1.5% | 1.0% | 0.8% | 1.8% | 2.0% | 1.3% |
| Economic Potential | 2.4% | 1.6% | 1.3% | 2.9% | 3.3% | 2.1% |
| Technical Potential | 5.5% | 3.6% | 2.7% | 6.7% | 7.5% | 4.7% |

***Table 7-23 Industrial Natural Gas Realistic Achievable Potential by End Use and Market Segment, 2016 (MMTherms)***

| End Use | Food Products | Petroleum | Metals | Machinery | Other Industrial |
|---|---|---|---|---|---|
| Heating | 0.004 | 0.005 | 0.278 | 0.184 | 1.326 |
| Process | 0.033 | 0.124 | 0.670 | 0.090 | 0.297 |
| Miscellaneous | 0.033 | 0.117 | 0.896 | 0.250 | 1.494 |
| **Total** | **0.070** | **0.245** | **1.843** | **0.524** | **3.177** |

## Industrial Natural Gas Potential by End Use

Table 7-24 provides estimates of savings for each end use and type of potential. Since natural gas is chiefly used for heating, the number of end uses is more limited than the electricity analysis.

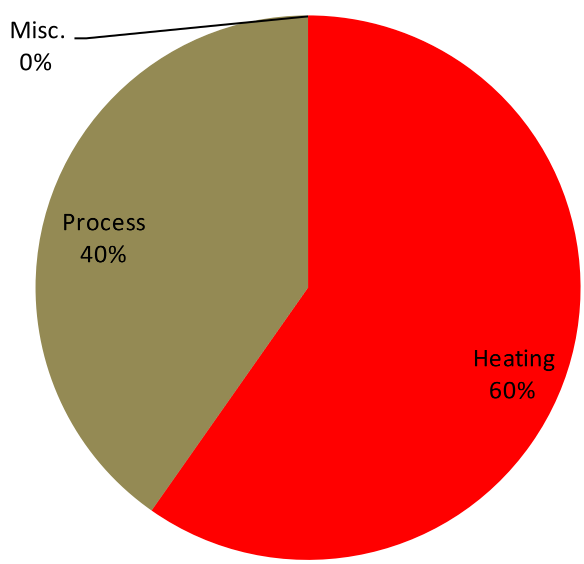
***Table 7-24 Industrial Natural Gas Potential by End Use and Potential Type (MMTherms)***

| End Use | Potential | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| Heating | Realistic Achievable Potential | 0.85 | 1.25 | 1.80 |
| | Maximum Achievable Potential | 1.19 | 1.75 | 2.52 |
| | Economic Potential | 2.00 | 2.92 | 4.14 |
| | Technical Potential | 4.44 | 6.73 | 9.61 |
| Process | Realistic Achievable Potential | 0.63 | 0.86 | 1.21 |
| | Maximum Achievable Potential | 0.86 | 1.19 | 1.69 |
| | Economic Potential | 1.46 | 2.01 | 2.81 |
| | Technical Potential | 3.02 | 4.25 | 5.95 |
| Miscellaneous | Realistic Achievable Potential | - | - | - |
| | Maximum Achievable Potential | - | - | - |
| | Economic Potential | - | - | - |
| | Technical Potential | - | - | - |
| **Total** | **Realistic Achievable Potential** | **1.48** | **2.11** | **3.01** |
| | **Maximum Achievable Potential** | **2.04** | **2.94** | **4.20** |
| | **Economic Potential** | **3.47** | **4.92** | **6.95** |
| | **Technical Potential** | **7.46** | **10.97** | **15.56** |

Figure 7-12 illustrates the net achievable potential savings by natural gas end use in 2016 for the industrial sector. Space heating and process heating are the only opportunities to speak of. Detailed measure information is available in Appendix D. The key measures comprising the potential are listed below:

- Energy management systems & programmable thermostats
- Efficient boilers & furnaces
- Insulation

***Figure 7-12 Industrial Natural Gas Realistic Achievable Potential Savings by End Use in 2016***



# WASTED ENERGY

One of the goals of the study was to identify "wasted energy" and assess the potential energy savings that could be achieved by minimizing it. This chapter presents the definition used for this study and the approach taken for estimating savings associated with wasted energy.

## Definition of Wasted Energy

The term "wasted energy" is defined as excessive energy use that is a result of a customer's behavioral choices. In the broadest definition, examples include leaving lights turned on in an unoccupied room, not performing regular maintenance on HVAC equipment, not replacing furnace filters, leaving office equipment on overnight, or leaving cell phone chargers plugged in when not in use.

For the Ameren study, the definition of wasted energy takes into consideration customer-lifestyle decisions and is narrower than the broad definition. For example, if a customer prefers to maintain a temperature of 68 degrees year round when at home, this is not considered wasted energy. Similarly, if a customer leaves a light on in unoccupied rooms for personal security, it is not considered wasted energy.

## Approach to Estimating Wasted Energy

There are at least two different ways to estimate the amount of energy that is currently wasted.

- One way is to conduct extensive on-site surveys with customers coupled with end-use metering and use the information to observe how customers use energy and to identify "waste" directly. For example, one approach is to ask customers whether they turn the lights off in unoccupied rooms and also meter the energy use in rooms to see if they actually do what they say. The result of this approach will be an estimate of wasted energy as well as an estimate of total energy, each by end use.
- Another approach is to infer the amount of energy that is currently wasted by estimating the savings that would occur from measures that reduce waste. So rather than estimating the waste directly, this second approach backs into it.

For the Ameren study, the second approach was used to estimate the amount of savings by reducing waste. A set of measures that reduces waste was identified and an estimate of savings was determined under the four cases of potential. Table 8-2, Table 8-4 and Table 8-6 identify the measures associated with wasted energy in the residential, commercial and industrial sectors. This approach and the measure list were vetted with Ameren staff and stakeholders in the early stages of the study.

In Table 8-1 and Figure 8-1 show the total net realistic achievable potential savings associated with wasted-energy measures as well as the potential from all other measures in 2016.

***Table 8-1 Residential Realistic Achievable Savings by Source***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Total Cumulative Net Savings (GWh)** | | | |
| Measures Associated with Wasted Energy | 11.80 | 21.98 | 58.30 |
| All Other Measures | 90.00 | 206.65 | 257.79 |
| **Total Potential Savings** | **101.81** | **228.63** | **316.08** |
| **Savings (% of total)** | | | |
| Measures Associated with Wasted Energy | 12% | 10% | 18% |
| All Other Measures | 88% | 90% | 82% |
| **Total Potential Savings** | **100%** | **100%** | **100%** |

***Figure 8-1 Residential Realistic Achievable Savings by Type of Measure***

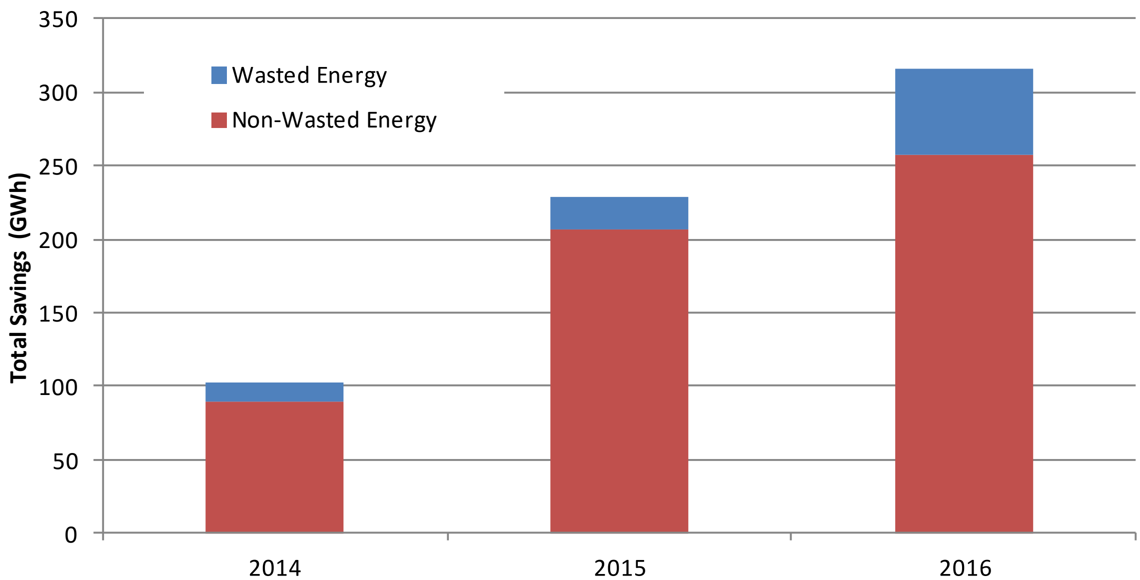



Table 8-2 shows the net cumulative savings for 2016 for each level of potential for the residential sector. If a measure has non-zero savings only for technical potential, then measure was not cost-effective.

***Table 8-2 Residential Cumulative Savings from Measures Associated with Wasted Energy by Level of Potential (2016)***

| Measures Associated with Wasted Energy | Realistic Achievable | Maximum Achievable | Economic | Technical |
|---|---|---|---|---|
| Boiler - Maintenance | - | - | - | 0.68 |
| Ceiling Fan - Installation | 3.21 | 5.45 | 12.95 | 12.26 |
| Doors - Storm and Thermal | 0.36 | 0.56 | 1.08 | 1.07 |
| Ducting - Repair and Sealing | 3.95 | 5.54 | 12.55 | 12.00 |
| ENERGY STAR Home Design | 0.14 | 0.21 | 0.40 | 1.31 |
| Freezer - Remove Second Unit | 6.65 | 8.46 | 16.29 | 16.18 |
| Home Energy Management System | 0.86 | 0.86 | 2.11 | 8.48 |
| Insulation - Ceiling | 0.40 | 0.60 | 1.41 | 1.40 |
| Insulation - Ducting | 1.06 | 1.69 | 3.60 | 3.43 |
| Insulation - Foundation | 0.36 | 0.55 | 1.21 | 1.15 |
| Insulation - Infiltration Control | 4.95 | 7.51 | 18.68 | 18.28 |
| Insulation - Radiant Barrier | 1.45 | 2.20 | 5.34 | 5.17 |
| Insulation - Wall Cavity | 0.08 | 0.12 | 0.33 | 2.53 |
| Insulation - Wall Sheathing | 0.68 | 1.02 | 2.96 | 11.23 |
| Pool Pump - Timer | 0.12 | 0.21 | 0.41 | 0.80 |
| Pool/Spa cover | 6.97 | 11.60 | 23.59 | 18.39 |
| Refrigerator - Remove Second Unit | 7.56 | 9.62 | 18.48 | 18.27 |
| Roofs - High Reflectivity | 0.88 | 1.33 | 3.00 | 2.83 |
| Room AC - Removal of Second Unit | 5.10 | 6.72 | 13.55 | 13.37 |
| Thermostat - Clock/Programmable | 1.88 | 2.56 | 6.33 | 6.29 |
| Water Heater - Desuperheater | 0.16 | 0.20 | 0.41 | 0.39 |
| Water Heater - Drainwater Heat Recovery | 0.13 | 0.20 | 0.45 | 0.43 |
| Water Heater - Faucet Aerators | 1.59 | 2.20 | 5.28 | 4.99 |
| Water Heater - Low-Flow Showerheads | 5.10 | 7.07 | 17.27 | 16.31 |
| Water Heater - Solar System | 0.65 | 0.82 | 1.70 | 1.61 |
| Water Heater - Thermostat Setback | 1.33 | 1.80 | 4.56 | 4.31 |
| Windows - High Efficiency/ENERGY STAR | 0.41 | 0.64 | 1.63 | 26.56 |
| Windows - Install Reflective Film | 2.26 | 3.52 | 6.83 | 6.54 |
| **Total** | **58.30** | **83.27** | **182.43** | **216.24** |

Table 8-3 and Figure 8-2 shows the distribution of the savings by the type of measure. The measures that prevent wasted energy account for 37% of the potential savings in 2014, and about 27% in 2016.

***Table 8-3 Commercial Realistic Achievable Savings by Source***

| | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Total Cumulative Net Savings (GWh)** | | | |
| Measures Associated with Wasted Energy | 73.8 | 94.4 | 119.4 |
| All other Measures | 123.7 | 224.9 | 315.0 |
| **Total Potential Savings** | **197.5** | **319.3** | **434.4** |
| **Savings (% of total)** | | | |
| Measures Associated with Wasted Energy | 37% | 30% | 27% |
| All Other Measures | 63% | 70% | 73% |
| **Total Potential Savings** | **100%** | **100%** | **100%** |

***Figure 8-2 Commercial Realistic Achievable Savings by Source***

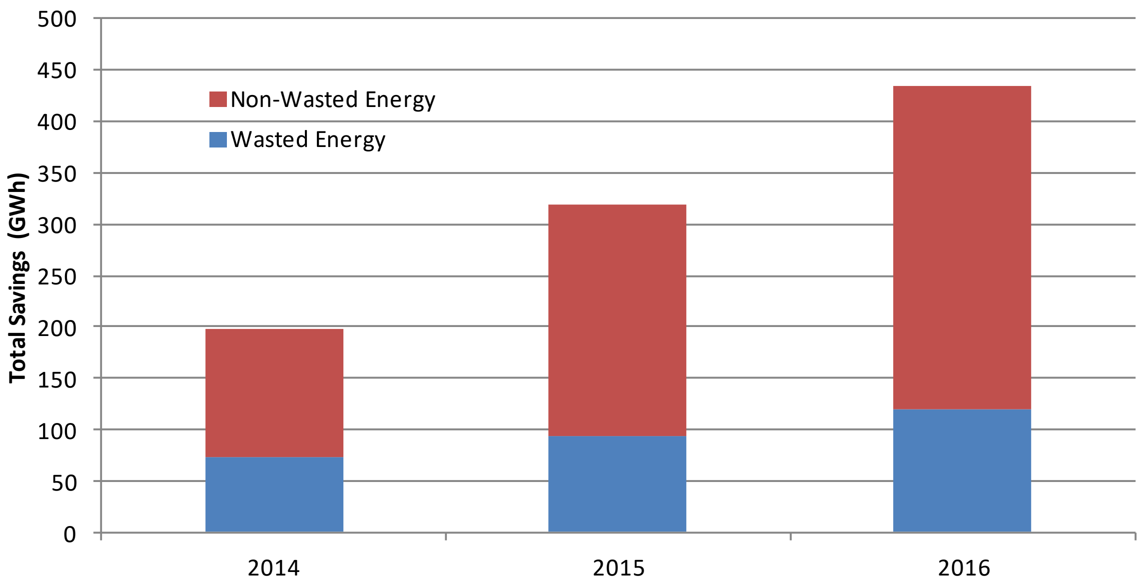



Table 8-4 shows the net cumulative savings for 2016 for each level of potential for the commercial sector. If a measure has savings only for technical potential, then it is not cost effective.

***Table 8-4 Commercial Cumulative Savings from Measures Associated with Wasted Energy by Level of Potential (2016)***

| Measures Associated with Wasted Energy | Realistic Achievable | Maximum Achievable | Economic | Technical |
|---|---|---|---|---|
| Air-Cooled Chiller - Chilled Water Variable-Flow System | - | - | - | 0.18 |
| Air-Cooled Chiller - Maintenance | 0.81 | 1.36 | 2.14 | 2.14 |
| Commissioning - HVAC | 1.14 | 1.31 | 1.96 | 1.95 |
| Commissioning - Lighting | 2.87 | 3.94 | 6.49 | 6.48 |
| Electronics - Monitor Power Management | 5.89 | 7.02 | 10.97 | 10.97 |
| Electronics - Smart Power Strip | 0.40 | 0.47 | 0.71 | 0.71 |
| Energy Management System | 19.17 | 24.67 | 41.28 | 54.60 |
| Exterior Lighting - Bi-Level Fixture | - | - | - | 3.50 |
| Exterior Lighting - Daylighting Controls | 0.45 | 0.73 | 1.26 | 9.43 |
| Grocery - Display Case Motion Sensors | - | - | - | 3.72 |
| Heat Pump - Maintenance | 0.15 | 0.29 | 0.46 | 0.46 |
| HVAC - Occupancy Sensors | 0.54 | 0.64 | 1.11 | 6.97 |
| Interior Fluorescent - Bi-Level Fixture | - | - | - | 11.51 |
| Interior Fluorescent - Delamp and Install Reflectors | - | - | - | 17.95 |
| Interior Lighting - Daylighting Controls | 23.28 | 26.69 | 47.14 | 55.19 |
| Interior Lighting - Occupancy Sensors | 1.83 | 2.15 | 3.78 | 32.27 |
| Interior Lighting - Timeclocks and Timers | - | - | - | 16.71 |
| Lodging - Guest Room Controls | 1.24 | 1.43 | 2.56 | 2.56 |
| Non-HVAC Motors - Variable Speed Control | 1.27 | 1.62 | 2.76 | 2.76 |
| Pool Pump - Timer | 0.01 | 0.02 | 0.03 | 0.03 |
| Refrigerator - Decommissioning | 5.88 | 8.83 | 13.93 | 13.72 |
| Refrigerator - Variable Speed Compressor | - | - | - | 3.87 |
| Retrocommissioning - HVAC | 2.58 | 3.08 | 4.82 | 18.82 |
| Retrocommissioning - Lighting | 6.88 | 9.53 | 15.84 | 23.66 |
| RTU - Maintenance | 6.99 | 11.82 | 18.78 | 18.78 |
| Thermostat - Clock/Programmable | 3.09 | 3.39 | 6.08 | 6.16 |
| Vending Machine - Controller | 0.68 | 0.81 | 1.43 | 1.43 |
| Ventilation - CO2 Controlled | 6.04 | 8.41 | 13.94 | 13.94 |
| Ventilation - Variable Speed Control | 14.32 | 19.42 | 32.69 | 36.65 |
| Water Heater - Faucet Aerators | 0.73 | 0.87 | 1.60 | 1.60 |
| Water Heater - Install Timer | 0.25 | 0.28 | 0.42 | 1.23 |
| Water Heater - Low Flow Showerheads | 2.15 | 2.57 | 4.72 | 4.72 |
| Water Heater - Pre-Rinse Spray Valve | 2.52 | 3.30 | 6.03 | 6.03 |
| Water-Cooled Chiller - Chilled Water Variable-Flow System | - | - | - | 0.23 |
| Water-Cooled Chiller - Maintenance | 1.59 | 2.69 | 4.25 | 4.25 |
| Water-Cooled Chiller - VSD on Fans | 6.65 | 9.62 | 15.82 | 15.86 |
| **Total** | **119.38** | **156.96** | **263.00** | **411.06** |

Table 8-5 and Figure 8-3 show the distribution of the savings by the source. The measures associated with wasted energy account for almost half of the potential savings in 2014, and about 45% in 2016.

***Table 8-5 Industrial Realistic Achievable Savings by Source***

| Total Cumulative Net Savings (GWh) | 2014 | 2015 | 2016 |
|---|---|---|---|
| **Total Cumulative Net Savings (GWh)** | | | |
| Measures Associated with Wasted Energy | 86.7 | 114.7 | 151.3 |
| All Other Measures | 95.2 | 136.1 | 184.7 |
| **Total Potential Savings** | **181.8** | **250.9** | **336.0** |
| **Savings (% of total)** | | | |
| Measures Associated with Wasted Energy | 48% | 46% | 45% |
| All Other Measures | 52% | 54% | 55% |
| **Total Potential Savings** | **100%** | **100%** | **100%** |

***Figure 8-3 Industrial Realistic Achievable Savings by Source***

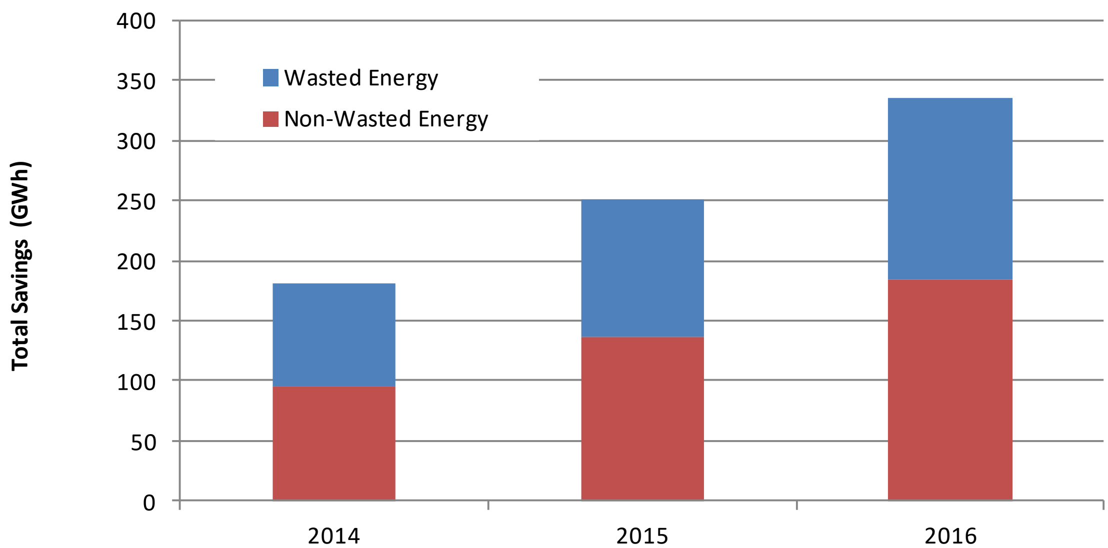



Table 8-6 shows the net cumulative savings for 2016 for each level of potential for the industrial sector. If a measure is shown, but does not show any savings, that indicates that the measure was not cost-effective.

***Table 8-6 Industrial Cumulative Savings from Measures Associated with Wasted Energy by Level of Potential (2016)***

| Measures Associated with Wasted Energy | Realistic Achievable | Maximum Achievable | Economic | Technical |
|---|---|---|---|---|
| Air-Cooled Chiller - Chilled Water Variable-Flow System | - | - | - | 0.18 |
| Air-Cooled Chiller - Maintenance | 0.81 | 1.36 | 2.14 | 2.14 |
| Commissioning - HVAC | 1.14 | 1.31 | 1.96 | 1.95 |
| Commissioning - Lighting | 2.87 | 3.94 | 6.49 | 6.48 |
| Electronics - Monitor Power Management | 5.89 | 7.02 | 10.97 | 10.97 |
| Electronics - Smart Power Strip | 0.40 | 0.47 | 0.71 | 0.71 |
| Energy Management System | 19.17 | 24.67 | 41.28 | 54.60 |
| Exterior Lighting - Bi-Level Fixture | - | - | - | 3.50 |
| Exterior Lighting - Daylighting Controls | 0.45 | 0.73 | 1.26 | 9.43 |
| Grocery - Display Case Motion Sensors | - | - | - | 3.72 |
| Heat Pump - Maintenance | 0.15 | 0.29 | 0.46 | 0.46 |
| HVAC - Occupancy Sensors | 0.54 | 0.64 | 1.11 | 6.97 |
| Interior Fluorescent - Bi-Level Fixture | - | - | - | 11.51 |
| Interior Fluorescent - Delamp and Install Reflectors | - | - | - | 17.95 |
| Interior Lighting - Daylighting Controls | 23.28 | 26.69 | 47.14 | 55.19 |
| Interior Lighting - Occupancy Sensors | 1.83 | 2.15 | 3.78 | 32.27 |
| Interior Lighting - Timeclocks and Timers | - | - | - | 16.71 |
| Lodging - Guest Room Controls | 1.24 | 1.43 | 2.56 | 2.56 |
| Non-HVAC Motors - Variable Speed Control | 1.27 | 1.62 | 2.76 | 2.76 |
| Pool Pump - Timer | 0.01 | 0.02 | 0.03 | 0.03 |
| Refrigerator - Decommissioning | 5.88 | 8.83 | 13.93 | 13.72 |
| Refrigerator - Variable Speed Compressor | - | - | - | 3.87 |
| Retrocommissioning - HVAC | 2.58 | 3.08 | 4.82 | 18.82 |
| Retrocommissioning - Lighting | 6.88 | 9.53 | 15.84 | 23.66 |
| RTU - Maintenance | 6.99 | 11.82 | 18.78 | 18.78 |
| Thermostat - Clock/Programmable | 3.09 | 3.39 | 6.08 | 6.16 |
| Vending Machine - Controller | 0.68 | 0.81 | 1.43 | 1.43 |
| Ventilation - CO2 Controlled | 6.04 | 8.41 | 13.94 | 13.94 |
| Ventilation - Variable Speed Control | 14.32 | 19.42 | 32.69 | 36.65 |
| Water Heater - Faucet Aerators | 0.73 | 0.87 | 1.60 | 1.60 |
| Water Heater - Install Timer | 0.25 | 0.28 | 0.42 | 1.23 |
| Water Heater - Low Flow Showerheads | 2.15 | 2.57 | 4.72 | 4.72 |
| Water Heater - Pre-Rinse Spray Valve | 2.52 | 3.30 | 6.03 | 6.03 |
| Water-Cooled Chiller - Chilled Water Variable-Flow System | - | - | - | 0.23 |
| Water-Cooled Chiller - Maintenance | 1.59 | 2.69 | 4.25 | 4.25 |
| Water-Cooled Chiller - VSD on Fans | 6.65 | 9.62 | 15.82 | 15.86 |
| **Total** | **119.38** | **156.96** | **263.00** | **411.06** |

## About EnerNOC Utility Solutions Consulting

EnerNOC Utility Solutions Consulting is part of EnerNOC Utility Solutions group, which provides a comprehensive suite of demand-side management (DSM) services to utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, implementing those programs, and measuring program results.

EnerNOC Utility Solutions delivers value to our utility clients through two separate practice areas – Program Implementation and EnerNOC Utility Solutions Consulting.

- Our Program Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
- The EnerNOC Utility Solutions Consulting team provides expertise and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; evaluation, measurement and verification; and regulatory support.

The EnerNOC Utility Solutions Consulting team has decades of combined experience in the utility DSM industry. The staff is comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view our experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

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