ILLINOIS PUBLIC SECTOR AND LOW INCOME HOUSING ENERGY EFFICIENCY POTENTIAL STUDY

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1.0 Executive Summary

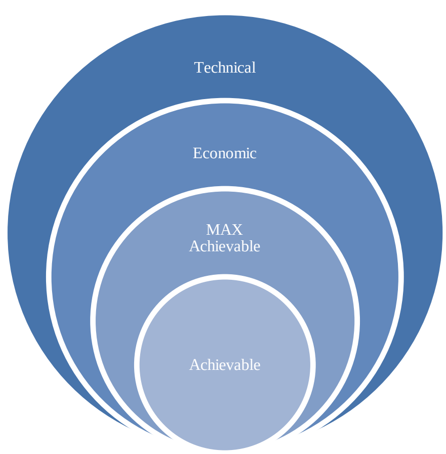
1.1 Background

Section 220 ILCS 5/8-103A of Illinois Compiled Statutes requires that the three-year Energy Efficiency Portfolio Plan include "an analysis of additional cost-effective energy efficiency measures that could be implemented by customer class, absent the [rate cap] limitations…." To fulfill that mandate the Department of Commerce and Economic Opportunity ("the Department") engaged the Energy Resources Center (ERC) located at the University of Illinois at Chicago to prepare an energy efficiency potential study for the sectors served under its plan. The study is an update to a similar study completed by ERC in June of 2013 for the Department's previous three-year plan. The study will be submitted to the Illinois Commerce Commission (ICC) in September 2016 along with the Department's new three-year Energy Efficiency Portfolio Plan covering the period June 2017-May 2020.

1.2 Approach

The US Environmental Protection Agency (EPA) defines an energy efficiency potential study as "[..] a quantitative analysis of the amount of energy savings that either exists, is cost-effective, or could be realized through the implementation of energy efficiency programs and policies." For the purpose of this study, four levels of potential will be examined: "Technical Potential", "Economic Potential", "Maximum Achievable Potential" and "Program Achievable Potential". That is, the study will estimate the energy savings that are technologically feasible, the savings that are cost effective, the maximum savings that are possible given real-world barriers, and, finally, the savings that are likely given actual program budgets and designs.

Figure 1: Different Types of Potential



The study will focus on estimating the potential for energy efficiency for the two primary market sectors served by the Department's Illinois Energy Now programs — public sector facilities and low-income households. Both of these sectors can further be broken down to allow for a more accurate depiction of the potential for energy efficiency. Public sector facilities have been broken down into the following 14 sub-sectors:

- Airports
- Community Colleges
- Correctional Facilities
- K-12 Schools
- Libraries
- Medical Facilities
- Municipal Facilities
- Park District Facilities
- Police and Fire Stations
- Public Works Facilities
- State/Federal Facilities
- State Universities
- Street Lighting
- Water and Wastewater Treatment Facilities

Low-Income households are defined as those with incomes at or below 150% of the federal poverty level. For the analysis the sector has been broken down into two categories by housing type:

- Single family
- Multi-family

The study covers the timeframe of program years 2017 through 2022, the six years that would be encompassed by the next two three-year Energy Efficiency Portfolio plans. The potential study does not attempt to repeat the market assessment survey used to characterize energy end use consumption and efficiency measure saturation for the previous study conducted three years ago. Instead, this study builds on the previous primary data collection and updates it in several ways to create a revised assessment of energy efficiency potential. The update takes into account new data from utilities and other sources as available, the installation of energy efficiency measures by program participants during the past three years, additional surveys collected for this study, the measure costs and energy savings algorithms from the most current Technical Reference Manual, and research on emerging technologies and behavioral energy savings potential.

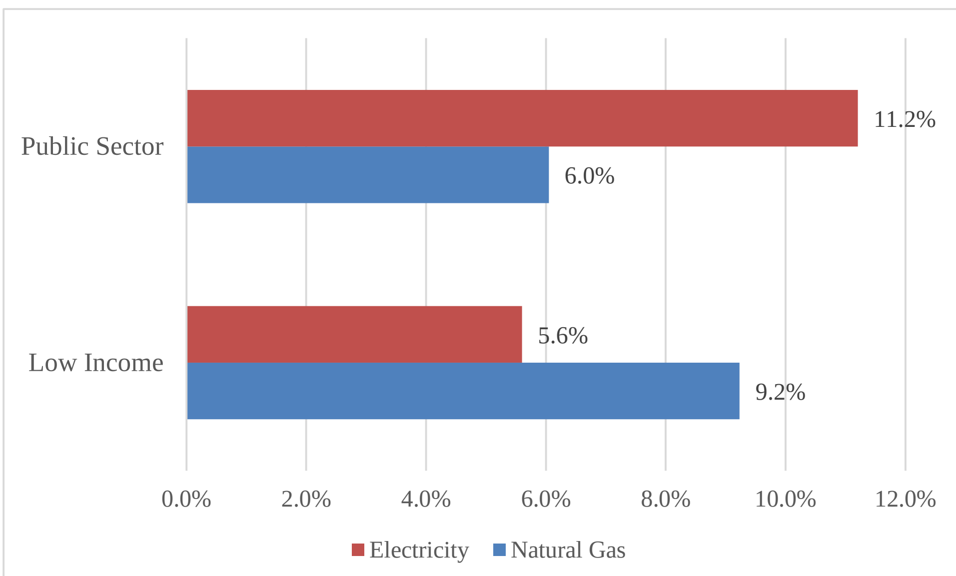
1.3 Results

The two sectors served by the Department's Illinois Energy Now energy efficiency programs account for about 17% of electricity consumption and 15% of natural gas consumption across the utility territories eligible for Energy Efficiency Portfolio incentives, as detailed in Table 1 shown in Figure 2.

Table 1: Base Energy Consumption – Public and Low Income Sectors

Sector	Electricity (MWh)	Gas (1,000 therms)
Public Sector	14,061,437	571,880
Low Income	7,028,804	872,955
Total	20,863,459	1,447,186

Figure 2: Low-Income Electricity and Natural Gas Consumption - Percent of Statewide Total of All Sectors



1.4 Public Sector

The following two figures show the distribution of electricity and natural gas consumption in the Public Sector by energy using system.

Figure 3: Public Sector - Total Electricity Consumption by System (MWh)

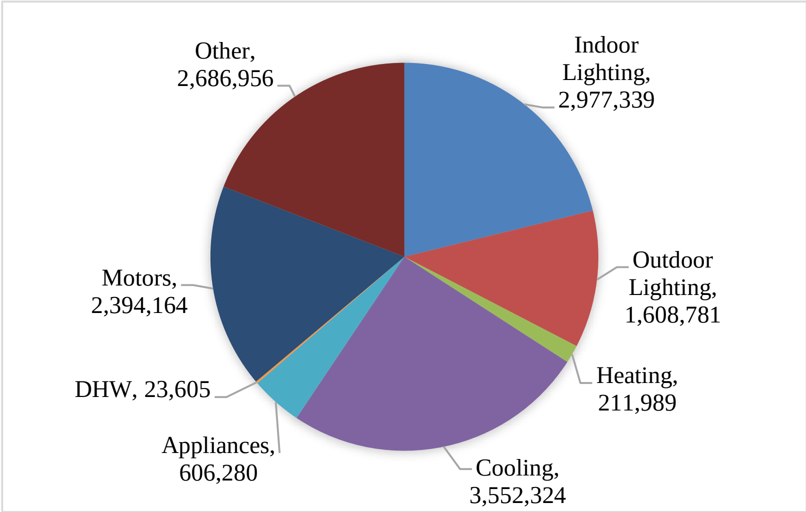
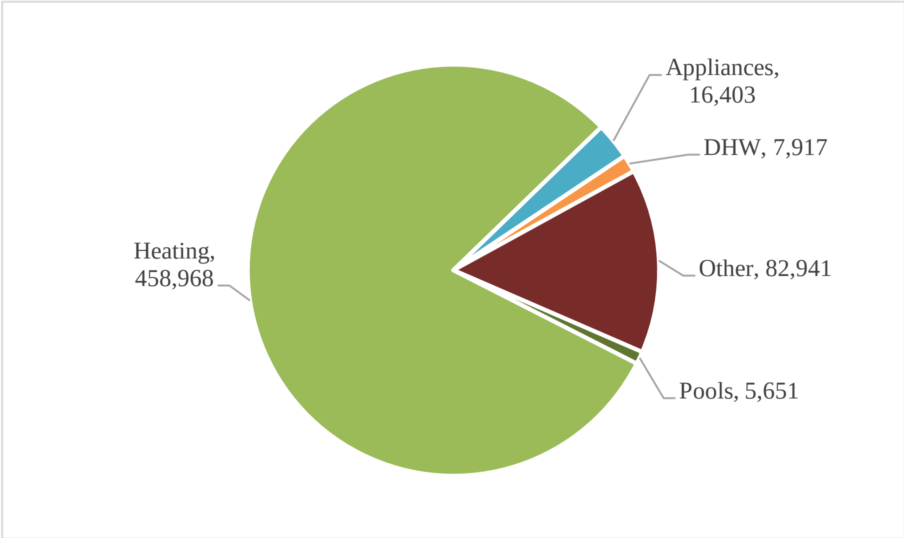


Figure 4: Public Sector - Total Natural Gas Consumption by System (1,000 therms)



The table and two figures below show the technical and economic potential for electricity efficiency in each one of the 14 sub-sectors analyzed in the study.

Table 2. Public Sector - Electric Energy Efficiency Potential Summary

Facility Type	Sector Consumption (MWh)	Technical Electric %	Technical MWh	Economic Electric %	Economic MWh
Airports	428,811	12.6%	53,992	11.2%	48,108
Community Colleges	402,601	18.1%	73,055	12.1%	48,847
Correctional Facilities	592,723	28.0%	165,868	19.4%	115,048
K-12 Schools	2,019,604	37.2%	750,333	27.4%	553,172
Libraries	159,506	43.5%	69,408	31.0%	49,432
Medical	280,905	27.0%	75,836	18.3%	51,386
Municipal	4,977,102	33.6%	1,671,786	22.6%	1,123,154
Park District	422,141	26.2%	110,810	16.1%	68,154
Police/Fire Stations	163,060	28.6%	46,707	25.8%	42,066
Public Works	127,011	36.6%	46,476	18.7%	23,809
State/Federal	1,099,365	31.1%	341,670	19.6%	215,887
State Universities	893,593	22.3%	199,640	18.4%	164,725
Street Lighting	1,331,027	52.4%	697,489	28.0%	373,100
Water & Wastewater	1,163,988	32.0%	372,100	26.4%	307,569
TOTAL	**14,061,437**	**33.2%**	**4,675,170**	**22.6%**	**3,184,456**

On average the Public Sector has a technical potential of about 33% and an economic potential of about 23% for electric efficiency gains. Municipal buildings, schools, and street lighting have the greatest potential in absolute terms, but all sub-sectors show significant potential for energy efficiency. Lighting and HVAC end use measures have the highest electric economic potential. Lighting measures like High Performance T8 and T5 fixtures will still provide opportunities for very cost-effective savings in lighting, an area where about 80% of the electric savings were captured in the period PY5-7. Compared to the previous Potential Study published in 2013, advancements in LED technology have significantly brought down the cost of the technology, making it a mainstream product manufactured and distributed by a wide variety of vendors. While new LED fixtures can reduce consumption by another 30-70%, a new, lowered baseline has led to a reduction in claimable savings on a per unit basis, effectively ruling out T12 fixtures and introducing T8 fixtures as the new baseline for new lighting fixtures. Retrofit T8 lamps applied to the remaining (although declining) stock of T12 fixtures will still provide cost-effective savings. The loss of savings achievable via new LED fixtures is offset by an increasing amount of HVAC measures like Demand Control Ventilation (DCV), which is becoming more mainstream and contributes largely to the HVAC economic potential calculated in this study. In the previous study, savings from DCV were not as important since savings were estimated on a custom basis based on secondary research. The measure is now part of the IL TRM which standardizes the savings estimated for the measure and it is now easy for program implementers to promote the measure and acquire TRM-approved savings.

Figure 5. Public Sector - Technical Electric Energy Efficiency Potential by Sector

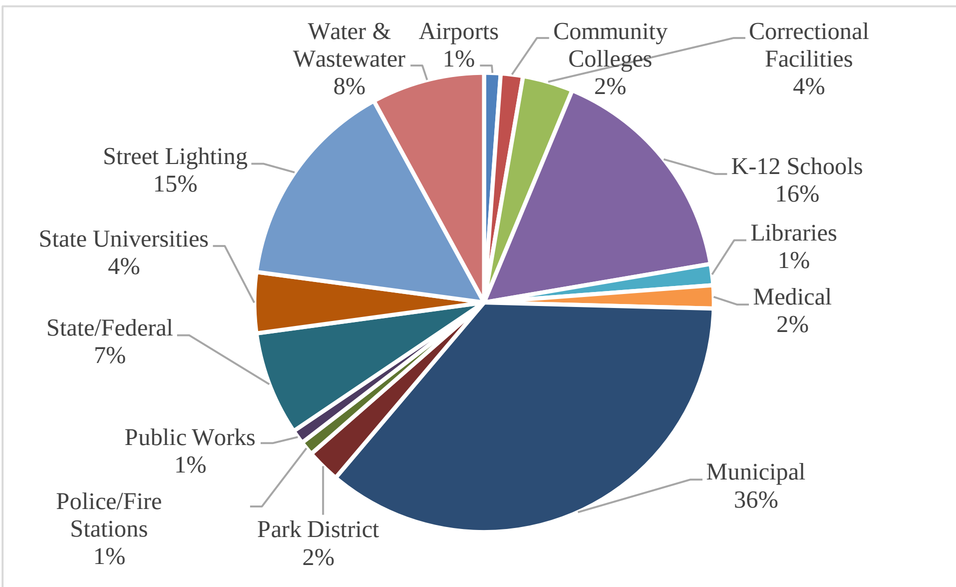


Figure 6. Public Sector - Economic Electric Energy Efficiency Potential by Sector

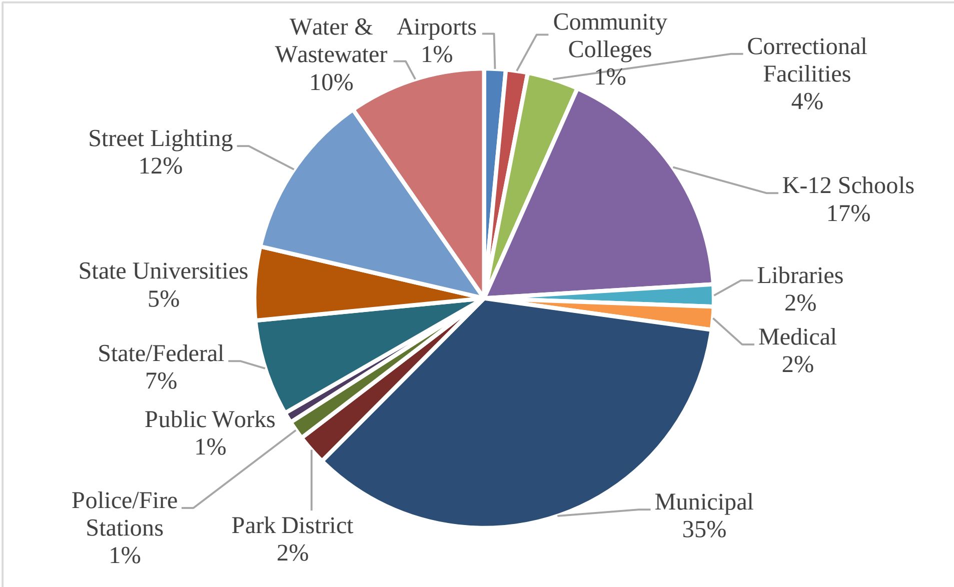
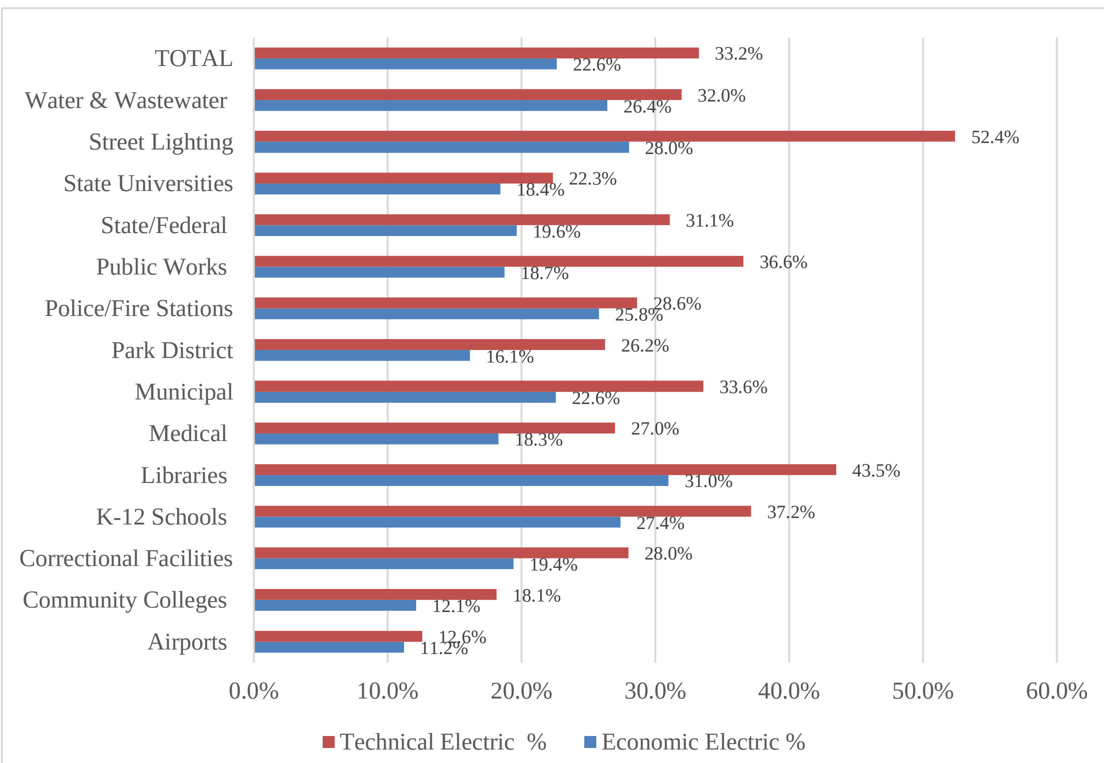


Figure 7. Public Sector - Electric Energy Efficiency Potential Summary



The following table and figures summarize the technical and economic potential for natural gas energy efficiency in each one of the 14 sub-sectors analyzed in the study.

Table 3. Public Sector - Natural Gas Efficiency Potential Summary

Facility Type	Sector Consumption (1,000 therms)	Technical Natural Gas %	Technical (1,000 therms)	Economic Natural Gas %	Economic (1,000 therms)
Airports	12,950	32.7%	4,238	18.6%	2,411
Community Colleges	17,164	35.5%	6,086	25.3%	4,341
Correctional Facilities	58,246	21.9%	12,758	14.7%	8,576
K-12 Schools	117,908	39.4%	46,446	32.4%	38,154
Libraries	7,391	27.6%	2,037	16.6%	1,225
Medical	18,172	21.5%	3,900	19.3%	3,501
Municipal	91,913	24.0%	22,076	16.0%	14,696
Park District	27,104	24.3%	6,580	20.2%	5,488
Police/Fire Stations	6,021	24.9%	1,500	19.6%	1,178
Public Works	6,905	20.4%	1,411	14.0%	968
State/Federal	45,561	20.7%	9,421	14.0%	6,392
State Universities	103,774	28.6%	29,672	17.9%	18,589
Street Lighting					
Water & Wastewater	58,772	28.6%	16,800	20.0%	11,769
TOTAL	**571,880**	**28.5%**	**162,925**	**20.5%**	**117,287**

On average the Public Sector has a technical potential of about 29% and an economic potential of about 21% for natural gas energy efficiency. Schools, universities, and municipalities have the greatest potential in absolute terms, but all sub-sectors show significant potential for energy efficiency. On the gas side, central heating systems and controls (like DCV) still dominate the economic potential, while a new family of smart technologies such as smart thermostats is coming to the market and shows potential to reduce behavior-related energy waste. Boiler room maintenance measures along with Energy Recovery Ventilator (ERV) and Demand Control Ventilation (DCV) have significant contributions to the natural gas economic potential. ERV was not evaluated in the previous study while DCV was evaluated based on secondary research, and didn't show as much potential as it has now proven to deliver.

Both ERV and DCV are new additions to the IL-TRM, thus standardizing the calculation of their associated savings and minimizing the associated risk borne by program administrators, which increases the likelihood of implementation and diversifies the savings contribution. These measures provide high energy savings for relatively low costs.

Figure 8. Public Sector - Technical Natural Gas Efficiency Potential by Sector

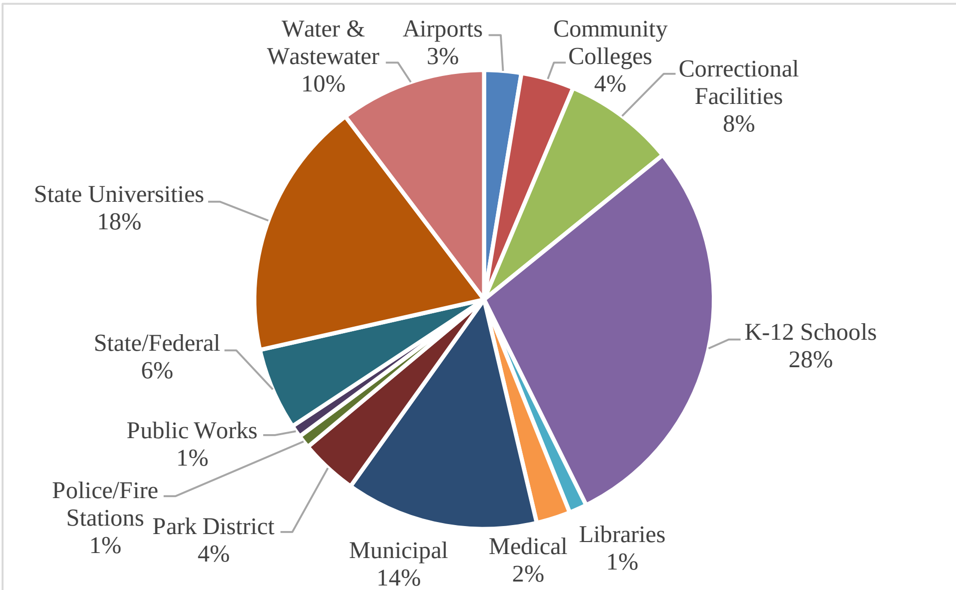


Figure 9. Public Sector - Economic Natural Gas Efficiency Potential by Sector

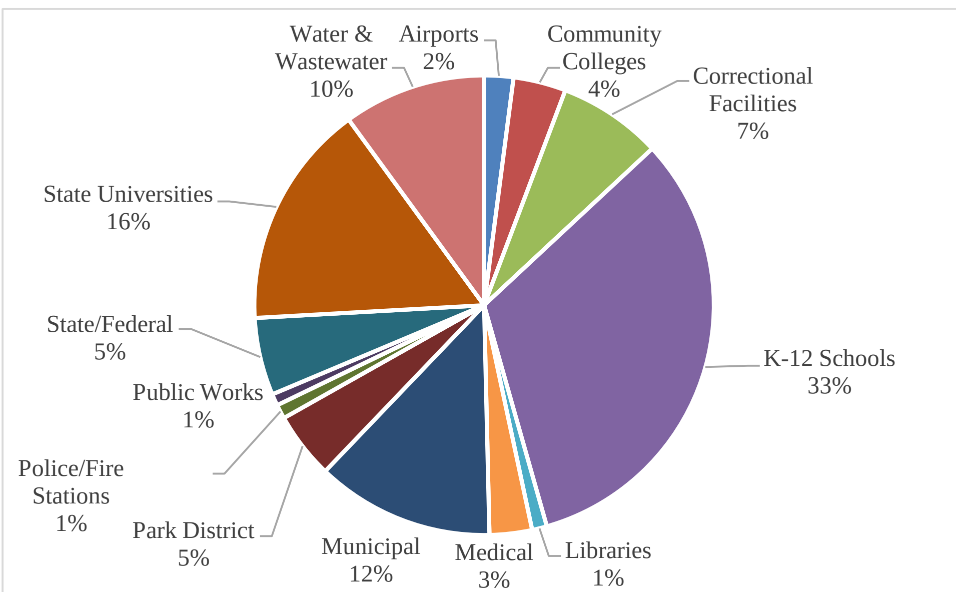
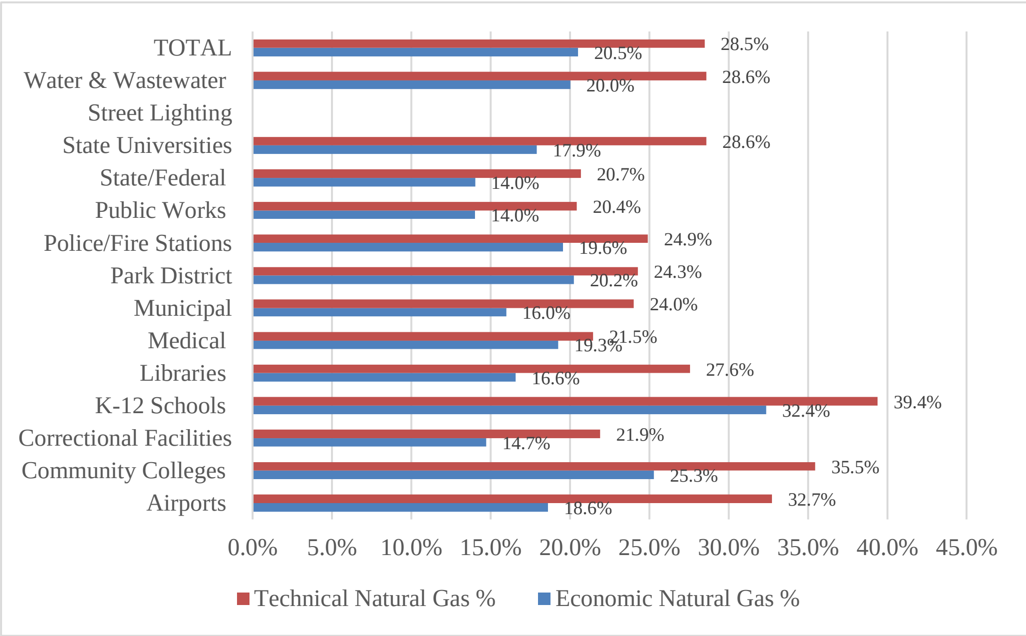


Figure 10. Public Sector - Natural Gas Efficiency Potential Summary



1.5 Low Income

Results for the low-income sector are shown below.

Figure 11. Low-Income - Total Electricity Consumption by System (MWh)

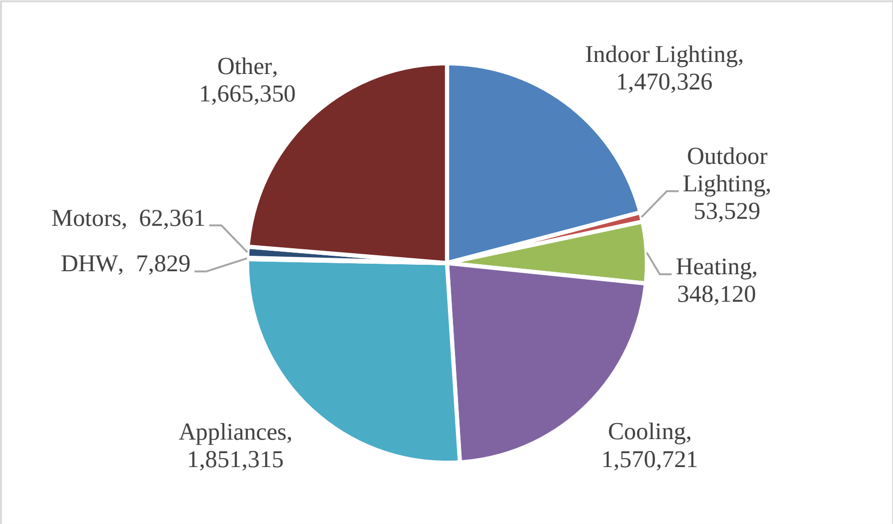


Figure 12. Low-Income - Total Natural Gas Consumption by System (1,000 therms)

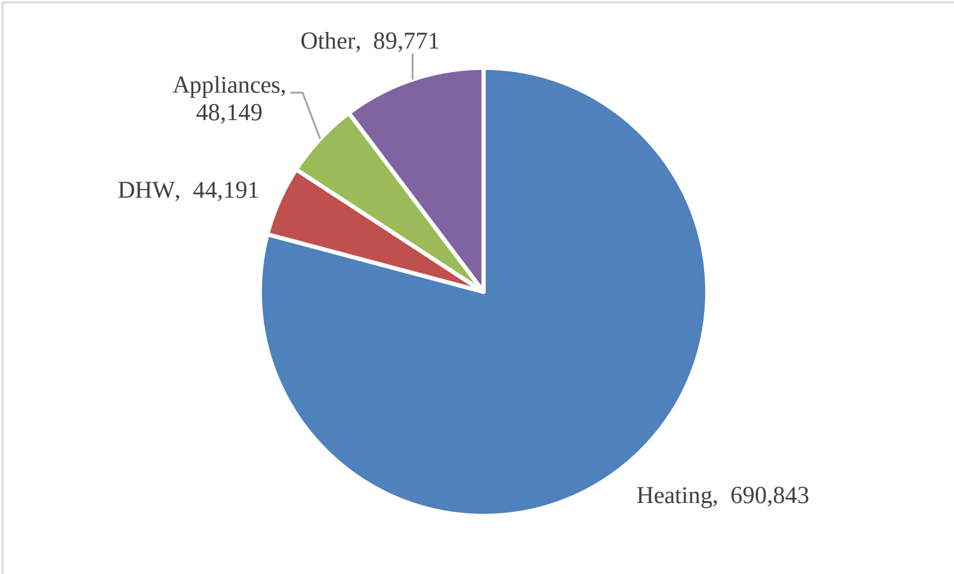
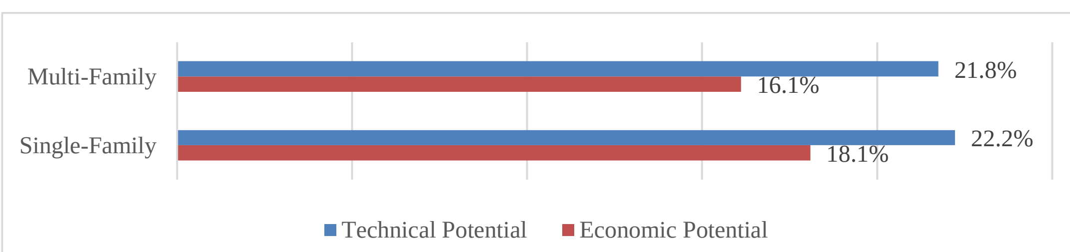


Table 4. Low-Income Sector Electric Energy Efficiency Potential Summary

Facility Type	Sector Consumption (MWh)	Technical Electric %	Technical MWh	Economic Electric %	Economic MWh
Single-Family	4,141,004	22.2%	920,262	18.1%	749,252
Multi-Family	2,887,800	21.8%	628,099	16.1%	465,257

Figure 13. Low-Income Sector Electric Energy Efficiency Potential Summary

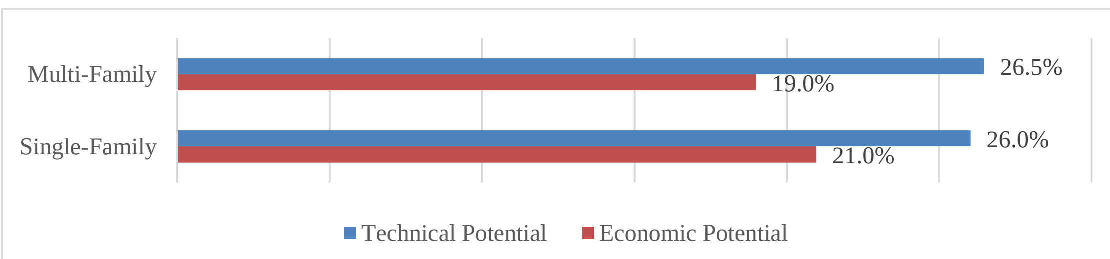


In single family units, lighting measures like Energy Star CFLs and LED bulbs and fixtures contribute the most to the electric economic potential, and multi-family units' electric economic potential is achieved through upgrades in linear fluorescent lighting and controls. New baseline shifts have reduced claimable savings for both screw-in bulbs and linear fluorescent lamps. But advancements in LED technology have led to a reduction in its installation costs and mainstream adoption of the technology. HVAC measures like heat pump systems and programmable thermostats also contribute towards the electric economic potential, while more advanced measures like smart thermostats still have too high a cost to be included in the economic potential.

Table 5. Low-Income Sector Natural Gas Efficiency Potential Summary

Facility Type	Sector Consumption (1000 Therms)	Technical Natural Gas %	Technical 1000 Therms	Economic Natural Gas %	Economic 1000 Therms
Single-Family	564,390	26.0%	146,908	21.0%	118,315
Multi-Family	308,564	26.5%	81,688	19.0%	58,599

Figure 14. Low-Income Sector Natural Gas Efficiency Potential Summary



Furnace and boiler upgrades contribute largely to the natural gas economic potential in both single-family units and multi-family units. HVAC controls like boiler controls and programmable thermostats also add to the economic potential for multi-family units.

1.6 Achievable Potential

Achievable potential is calculated based on the planned implementation of energy efficiency programs by the Department for the timeframe 2017-2020, assuming a similar trajectory of budget spending for the timeframe 2020-2022. Savings vary year over year according to baseline changes and budgets shifting to different energy efficiency measures, together with the assumption that certain technologies (such as LED lighting) will be going down in price over time. Achievable potential uses a diffusion model calibrated on historical performance of the Department's programs. In determining maximum achievable potential, financial incentives are set to cover 100% of the incremental cost and market conditions are set to be the most favorable possible. The achievable potential for the public sector can be seen below for the years 2017-2022.

Table 6. Achievable Potential by Year for Public Sector

Year	2017	2018	2019	2020	2021	2022
Program Electric Achievable Potential %	0.86%	0.89%	0.90%	0.85%	0.86%	0.86%
Program Natural Gas Achievable Potential %	0.68%	0.68%	0.68%	0.66%	0.68%	0.64%
Maximum Electric Achievable Potential %	3.38%	3.53%	3.55%	3.36%	3.40%	3.41%
Maximum Natural Gas Achievable Potential %	3.58%	3.60%	3.56%	3.48%	3.56%	3.35%

The cumulative achievable potential for the public sector, assuming budgets for the period 2020-2022 will remain the same as those for the period 2017-2019, can be seen below:

Table 7. Cumulative Achievable Potential by Year for Public Sector

Year	2017	2018	2019	2020	2021	2022
Cumulative Program Electric Achievable Potential %	0.86%	1.75%	2.65%	3.50%	4.36%	5.23%
Cumulative Program Natural Gas Achievable Potential %	0.68%	1.37%	2.05%	2.71%	3.39%	4.03%
Cumulative Maximum Electric Achievable Potential %	3.38%	6.91%	10.46%	13.83%	17.23%	20.64%
Cumulative Maximum Natural Gas Achievable Potential %	3.58%	7.18%	10.73%	14.22%	17.78%	21.13%

The achievable potential for the low-income can be seen below for the years 2017-2022:

Table 8. Achievable Potential by Year for Low-Income Sector

Year	2017	2018	2019	2020	2021	2022
Program Electric Achievable Potential %	0.27%	0.22%	0.21%	0.20%	0.19%	0.18%
Program Natural Gas Achievable Potential %	0.21%	0.21%	0.20%	0.20%	0.20%	0.18%
Maximum Electric Achievable Potential %	3.06%	2.55%	2.39%	2.26%	2.13%	2.04%
Maximum Natural Gas Achievable Potential %	1.10%	1.09%	1.08%	1.06%	1.05%	1.04%

The cumulative achievable potential for low-income, assuming budgets for the period 2020-2022 will remain the same as those for the period 2017-2019, can be seen below:

Table 9. Cumulative Achievable Potential by Year for Low-Income Sector

Year	2017	2018	2019	2020	2021	2022
Cumulative Program Electric Achievable Potential %	0.27%	0.49%	0.70%	0.90%	1.08%	1.26%
Cumulative Program Natural Gas Achievable Potential %	0.21%	0.41%	0.61%	0.82%	1.01%	1.20%
Cumulative Maximum Electric Achievable Potential %	3.06%	5.61%	8.00%	10.26%	12.40%	14.44%
Cumulative Maximum Natural Gas Achievable Potential %	1.10%	2.19%	3.26%	4.33%	5.38%	6.42%

1.7 Analysis and Recommendations

Electric Energy Efficiency programs in Illinois have been active for 8 years at the time of this study. During those years, most of the electric savings were achieved via lighting upgrades, including a large portion of custom lighting and lighting controls. In the future, lighting upgrades will still constitute the majority of cost-effective energy savings, led by solid state lighting technologies (LED) whose improved lighting efficacy allows for a further energy reduction of 30-50% when compared to the ubiquitous fluorescent lighting. With rapidly declining costs, LEDs will be the leading technology of the 2017-2020 portfolio. At the same time other measures will have to become more important in the programs, given that new lighting savings will be based on a lower baseline and more installed measures will be required to achieve the same amount of kWh savings. In many sectors, it was found that cooling energy reduction potential was on par with that of lighting, but given the higher initial cost of cooling measures, such measures would need to be coupled with advanced controls such as demand control ventilation and smart thermostats to generate cost-effective energy savings.

At the time of this study, the fiscal situation of the Illinois Public Sector has worsened with the State budget impasse, leading to deferred maintenance and lack of resources for capital projects. This means that the needs for the Department administered portfolio of programs will be higher than ever, and there will likely be aggressive competition for funding from the cash depleted Public Sector. New programs will need to be performance-based and designed to move beyond the "low hanging fruit". It should be noted as well that, while many sub-sectors participated at rates of 20-50%, some such as State and Federal facilities participated at low rates, providing an opportunity for targeting of future programs.

The advent of new smart technologies provides opportunities for programs to address behavioral waste, although not in the typical bill insert format employed by utilities, since the Department does not bill customers. Lighting occupancy sensors have been a popular measure in the programs, and new technologies such as Advanced Power Strips and Smart Thermostats are expected to increase in popularity as well. Other emerging technologies such as wi-fi enabled lightbulbs and wi-fi power outlets will create new opportunities to save energy while improving comfort. Pilots may make sense during the 2017-2020 timeframe, even if their full implementation is likely to occur beyond 2020.

Gas programs have been in place for 5 years at the time of this study. Gas consumption is dominated by space heating applications and, not surprisingly, results show great potential for space heating system upgrades. The analysis shows that retirement of central heating plants is not naturally occurring in the market, with old equipment still in service and worsening deferred maintenance and “patchwork” quick fixes due to existing budget constraints. Thus far, gas program savings were achieved via a combination of upgrades and maintenance of central heating systems, with a high percentage of custom applications. Future cost-effective savings can be achieved by coupling capital intensive measures with advanced controls both in the form of smart technologies and demand control ventilation to reduce the heating needs and provide an opportunity for equipment downsizing.

Low Income programs are limited in size by budget constraints, since 100% of the incremental and often 100% of the full measure cost are necessary to move the market. With the CFL approaching sunset and revised algorithms (TRM v5.0) that reduce savings for insulation and air sealing, programs that address a comprehensive set of measures with LED lightbulbs will be the most successful. Without CFLs “lifting” the programs’ cost-effectiveness will remain an issue for direct install deep retrofit programs. Given that the programs historically touched only a small portion of customers, the increase in budget expenditures by the Department for Low-Income programs is a welcome and necessary step to help the sector, particularly given that the number of low income households has increased since the time of the last study in 2013.

2.0 Project Description

2.1 Purpose

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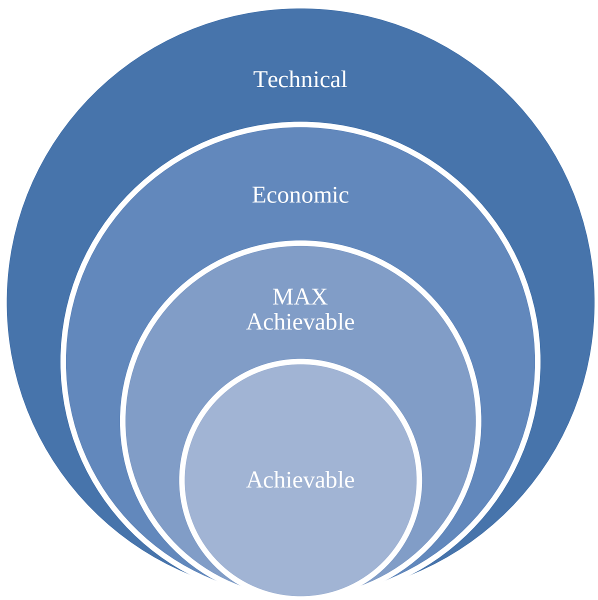
2.2 Types of Energy Efficiency Potential

The US Environmental Protection Agency (EPA) defines an energy efficiency potential study as "[..] a quantitative analysis of the amount of energy savings that either exists, is cost-effective, or could be realized through the implementation of energy efficiency programs and policies." For the purpose of this study, we will use the following definitions of "Technical Potential", "Economic Potential", "Maximum Achievable Potential" and "Program Achievable Potential"

- **Technical Potential** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a "snapshot" in time assuming immediate implementation of all technologically feasible energy savings measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.
- **Economic Potential** refers to the subset of technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them.

- **Maximum Achievable Potential** is the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficient equipment). Maximum achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.
- **Program Achievable Potential** refers to the efficiency potential possible given specific program funding levels and designs. Often, program achievable potential studies are referred to as "achievable" in contrast to "maximum achievable." In effect, they estimate the achievable potential from a given set of programs and budgets.

Figure 15. Different Types of Potential



2.3 Market Sectors Reviewed

DCEO programs serve two primary market sectors — Public Sector facilities and low-income housing. Both of these sectors can further be broken down to allow for a more accurate depiction of the potential for energy efficiency. The Public Sector encompasses a wide range of facilities with differing characteristics, but within common end-use types these facilities display great similarities in the types of energy using equipment and opportunities for energy efficiency. Public sector facilities have been broken down into the following 14 sub-sectors:

- Airports
- Community Colleges
- Correctional Facilities
- K-12 Schools
- Libraries
- Medical Facilities
- Municipal Facilities
- Park District Facilities
- Police and Fire Stations
- Public Works Facilities
- State/Federal Facilities
- State Universities
- Street Lighting
- Water and Wastewater Treatment Facilities

Low-Income households are defined as those with incomes of 150% of the federal poverty rate or lower. For the analysis the sector has been broken down into two categories by housing type:

- Single family
- Multi-family

Generally, the energy consumption patterns and opportunities for energy efficiency differ between the two.

2.4 Updated Energy Efficiency Potential Model

Due to the availability of robust primary data collected for the 2013 Potential Study, this energy efficiency potential study does not attempt to repeat the market assessment survey used to characterize energy end use consumption and efficiency measure saturation for the previous study. Instead, this study builds on the previous primary data collection and updates it in several ways to create a revised assessment of energy efficiency potential. This potential study update includes the following steps:

1. **Literature review**. The first step includes analysis of potential studies completed in the timeframe 2013-2016 in the US and Western Europe, looking for best practices and emerging trends in the analysis of energy efficiency potential.

2. **Update base energy consumption.** Electric and natural gas usage data for each of the public sub-sectors was updated with more current data from utilities, when available, and from actual billing data for state-related facilities (public universities, correctional facilities, and state buildings). Base consumption data for low income households was updated based on the American Community Survey 2013, Illinois Commerce Commission annual reports on electric and natural gas sales, and selected data provided by utilities.
3. **Review original modeling of energy using equipment by each public and residential sub-sector.** The original study, completed in 2013, modeled facilities in each public sub-sector based on 687 assessments of energy consuming equipment (mostly collected through facility site visits conducted by ERC and its subcontractors), 99 energy assessments conducted through the Smart Energy Design Assistance Center, supplemented by EIA data on medical facilities from the Commercial Building Energy Consumption Survey (CBECS) and a street lighting study from the Illinois Coalition for Responsible Outdoor Lighting. Residential facilities were modeled using 69 site surveys and 90 site surveys (Single-Family and Multi-Family respectively) from the EIA Residential Energy Consumption Survey (RECS). This collection of data represents a market saturation baseline that ERC "transformed" to 2016 using a combination of EEPS program participation data and surveys collected from Public Sector and Low-Income customers.
4. **Update model of energy consumption and measure saturation for each sub-sector.** Energy consuming equipment saturation was updated using two sources of data:
   - The Department's Illinois Energy Now Database, which documents energy efficiency measures that have been installed by program participants using EEPS funding in each sub-sector during the past three program years. This data source serves primarily to update the baseline for program participants.
   - Additional survey data collected from a randomly selected portion of each sub-sector customers. Due to the State's budget impasse, traditional methods that were used in 2013 for primary data collection and that were dependent on customer's collaboration were not as effective and sometimes not feasible, lowering the response rate. For that reason, assumptions had to be made for non-participants by generalizing findings in sub-sectors where data collection was richer, rather than estimating individual impacts on each sub-sectors. However, this has only a marginal effect on the overall potential study estimate, given the nature of the public and low-income sectors in Illinois, both capital-constrained.
5. **Update measure data for each sub-sector.** Measure lists, measure costs, energy savings calculations, including any changes in federal or State standards have been incorporated into the efficiency potential model, based on version 5 of the Technical Reference Manual (TRM). For measures outside the TRM, best-practice engineering assumptions were used.
6. **Update economic assumptions.** Avoided costs, discount rate, and assumptions about non-energy benefits were reviewed and updated as necessary, with input from the utilities.

In addition research was conducted on emerging technologies and behavioral energy savings to provide an estimate based on secondary resources of the technical and economic potential of those two measures. In particular, trends that were evaluated from analyzing emerging technologies informed the shift in budgets for the achievable potential analysis, including projected reduction in costs for certain measures such as LED lights and Heat Pumps whose price is expected to go down. Behavioral savings were included as a percentage of technology-based technical potential energy savings based on estimates reported in the studies analyzed during the literature review.

After step 6, using the updated model of energy efficiency potential and the updated baseline market saturation, the following steps were carried out to analyze energy efficiency potential for the time period 2017-2022, encompassing the next two 3-year planning periods:

7. **Calculate Technical Potential**. The technical energy reduction potential was calculated for each facility-type by considering the efficiency of each system and comparing it to the highest efficiency system available on the market. Energy savings were calculated using the methodology outlined in step 4. The sum of the energy reduction potential for each system provided the total technical energy efficiency potential for that sector.
8. **Calculate Economic Potential**. The economic energy reduction potential for facilities in each sub-sector was modeled in a similar manner, but in this case various levels of energy efficient equipment available on the market were considered. The Total Resource Cost Test (TRC) was calculated for each measure level and the level with the highest potential savings that still passed the TRC was considered as the economic potential for that system.
9. **Calculate Maximum Achievable Potential.** The maximum achievable potential was calculated for the Public Sector and Low Income Sector as a whole, rather than by sub-sector. Savings were calculated using adoption curves, based on a diffusion model, for each energy efficiency measure that is or will be offered by the Illinois Energy Now suite of programs. The adoption curves take into account of both end of life achievability as well as retrofit achievability based on incentive level, natural replacement levels, and market barriers that determine maximum saturation. In determining maximum achievable savings, incentives are assumed to be 100% of incremental costs and no budget caps are applied.
10. **Calculate Program Achievable Potential.** Again, the program achievable is calculated for each of the main sectors, public and low income. In this case, program achievability levels are determined taking into account assumed incentive rates, budget caps, market size, measure life, and adoption curves to determine how many measures could be implemented for a given program.

2.5 Limitations of the Study

Due to the difficulty of capturing all necessary data for studies of this type, exacerbated by the State's budget impasse, a number of assumptions had to be made to ensure a complete model of energy consumption in the two sectors served by the Department's Illinois Energy Now programs. While the study sought to use the best available data, reasonable alternative assumptions would yield somewhat different results. For example:

- Different assumptions about avoided costs, discount rates, and non-energy benefits would result in greater or lesser estimates of energy efficiency potential.
- The list of measures included in the study represents most commercially available measures and some emerging technologies, but the list is not exhaustive and other measures or program delivery mechanisms could have been evaluated.
- The study uses the assumptions and algorithms from TRM v 5.0, effective June 1st 2016 until May 31st 2017, and best-practice engineering principles when measures are not included in the TRM. Other assumptions are possible and the TRM is corrected or updated on a yearly basis, including errata and algorithmic updates that vary calculated energy savings.
- The study used a randomized sample of the market to represent the mix and saturation of energy using equipment in the Public and Low Income sectors, but no sample can completely eliminate response bias.
- Utility consumption data was available only from certain utilities and sometimes only for certain sub-sectors. When data was not available for particular territories or sectors, it was extrapolated using other current or past data.

3.0 Population Calculations

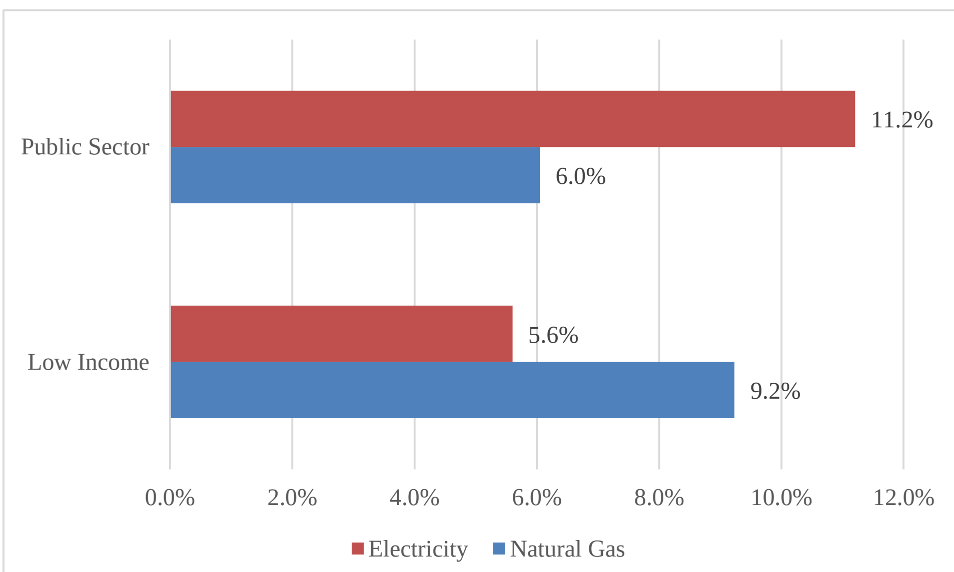
The Public Sector uses approximately 14.1 million MWh of electricity annually and 571 million therms of natural gas, while low income households, defined as those households with incomes at or below 150% of the federal poverty level, use 7.0 million MWh and 873 million therms. In total, these two sectors account for 16.8% of electricity and 15.2% of natural in the participating utility territories. Below are highlights of base energy consumption by the Public and Low Income sectors, followed by a discussion of patterns of energy efficiency in each of those sectors during the past three program years.

Table 10. Base Energy Consumption – Public and Low Income Sectors

Sector	Electricity (MWh)	Gas (1,000 therms)
Public Sector	14,061,437	571,880
Low Income	7,028,804	872,955
Total	21,090,241	1,444,835

Figure 16. Low-Income Electricity and Natural Gas Consumption

Percent of Statewide Total of All Sectors)



3.1 Base Energy Consumption – Public Sector

Electric and natural gas consumption for the 14 sub-sectors of the Illinois Public Sector were extrapolated from data provided by the utilities for some sectors and by the facilities for other sectors. Municipal facilities and k-12 schools are the largest users of electricity in the Public Sector. Schools and universities, followed by municipalities use the most natural gas.

Table 11. Public Sector Electric Energy Consumption

Sector	Consumption (MWh)
Airports	428,811
Community Colleges	402,601
Correctional Facilities	592,723
K-12 Schools	2,019,604
Libraries	159,506
Medical	280,905
Municipal	4,977,102
Park District	422,141
Police/Fire Stations	163,060
Public Works	127,011
State/Federal	1,099,365
State Universities	893,593
Street Lighting	1,331,027
Water & Wastewater	1,163,988
Total	**14,061,437**

Figure 17. Public Sector Electric Energy Consumption by Sector

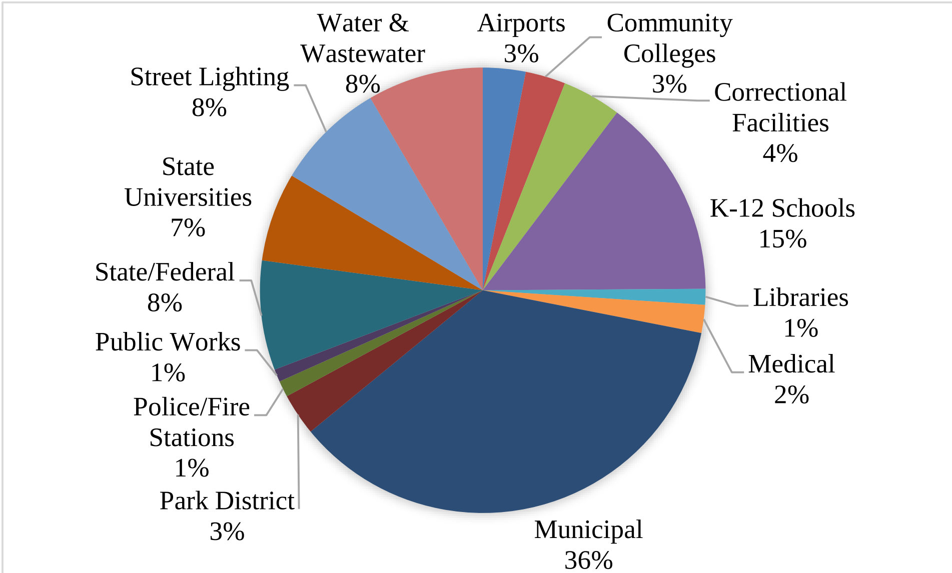
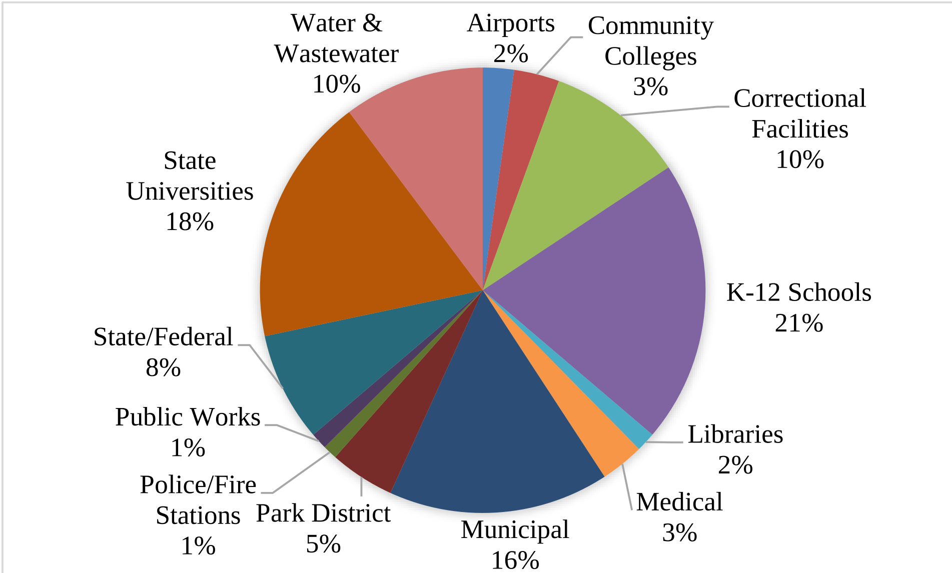


Table 12. Public Sector Natural Gas Consumption

Sector	Consumption (1000 therms)
Airports	12,950
Community Colleges	17,164
Correctional Facilities	58,246
K-12 Schools	117,908
Libraries	7,391
Medical	18,172
Municipal	91,913
Park District	27,104
Police/Fire Stations	6,021
Public Works	6,905
State/Federal	45,561
State Universities	103,774
Street Lighting	-
Water & Wastewater	58,772
Total	**571,880**

Figure 18. Public Sector Natural Gas Consumption by Sector



3.2 Program Participation and Savings – Public Sector

During the past three program years, each of the 14 sub-sectors participated in the Department's Illinois Energy Now Programs. Through the Department's programs the Public Sector achieved gross energy savings of 312,000 MWh and 12 million therms over Program Year 5 to Program Year 7 (referred to as PY5-7 hereafter). (Note: These only include savings reported in the Illinois Energy Now Database. Savings from Retro-commissioning and spillover from market transformation programs are not included since with the data available it was not possible to breakout the impact by sub-sector). The participation rate varies greatly across the various sub-sectors. The majority of state university campuses and community colleges participated in the energy efficiency programs along with more than a third of schools, municipal governments, park districts, and wastewater plants. On the other hand, some sectors like state and federal facilities and street lighting do not show meaningful participation. Additional detail is provided on participation by each of the sub-sectors in the introductions to each sub-sector analysis in Chapter 6.

Table 13. Participation in Illinois Energy Now Programs by Public Sub-sector

Sector	Participation
Airports	69%
Community Colleges	53%
Correctional Facilities	46%
K-12 Schools	35%
Libraries	12%
Medical	14%
Municipal Government	34%
Parks	29%
Police & Fire	22%
Public Works	7%
State /Federal	2%
State Universities	73%
Streetlights	4%
Water & Wastewater	34%

Note: Participation rates calculated either as a percentage of total population of the sub-sector or of a random sample surveyed, except airports. See individual sections in chapter 4.

Schools, municipalities and universities have achieved the greatest electricity and gas savings. Water treatment plants also achieved significant electricity savings and public medical facilities (a small sector) achieved significant natural gas savings.

Figure 19. Proportion of Energy Savings achieved by Public Sub-sector over PY5-7 of the EEPS programs

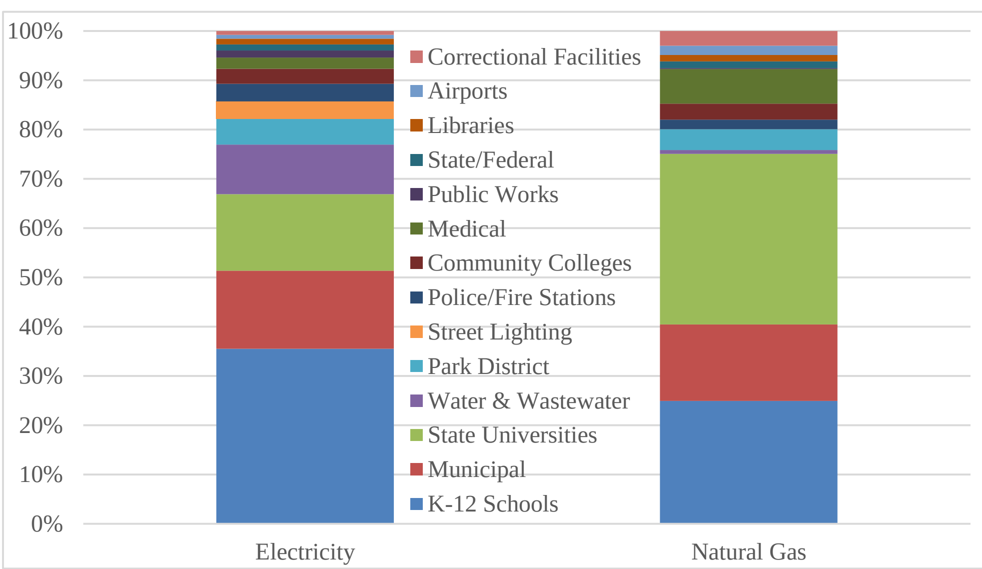


Figure 20. Public Sector Electricity Savings by Measure

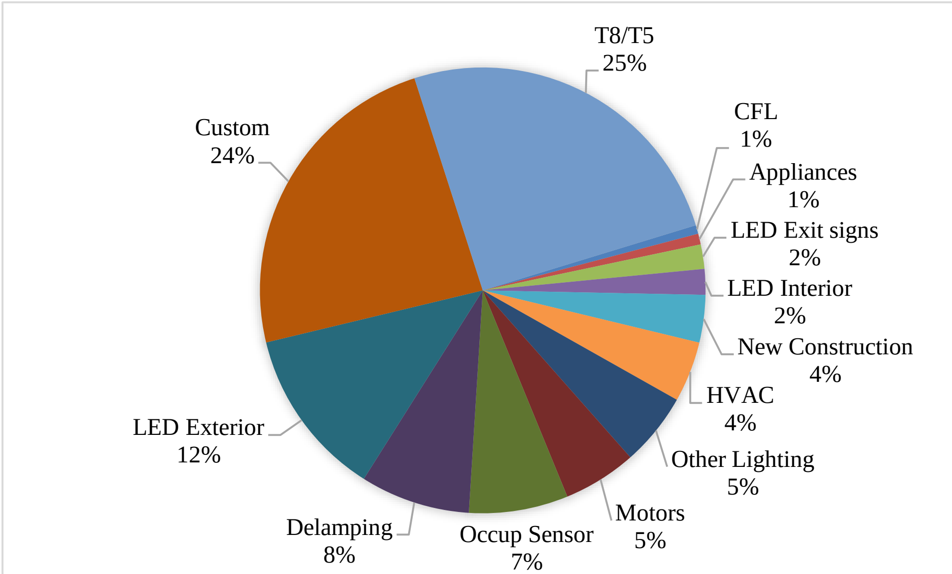


Figure 21. Public Sector Natural Gas Savings by Measure

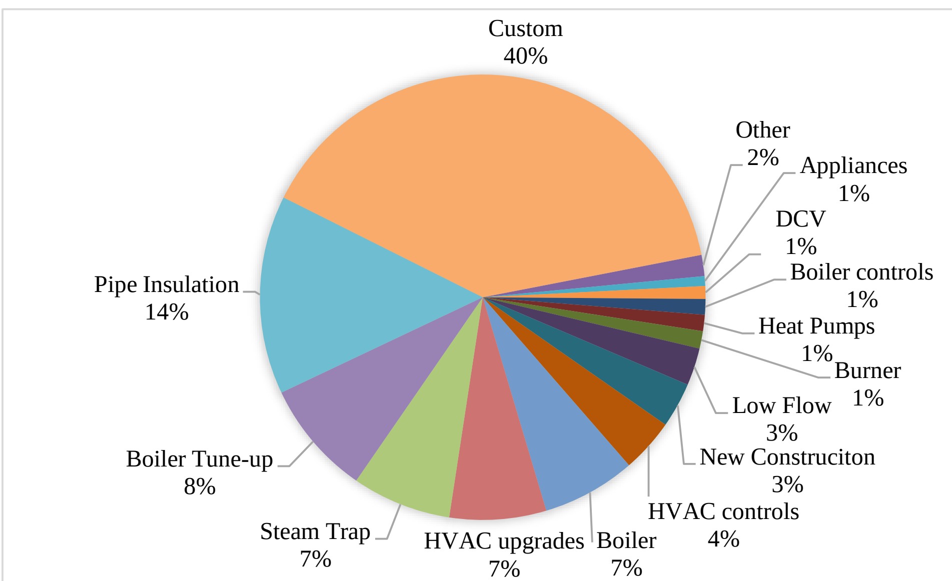
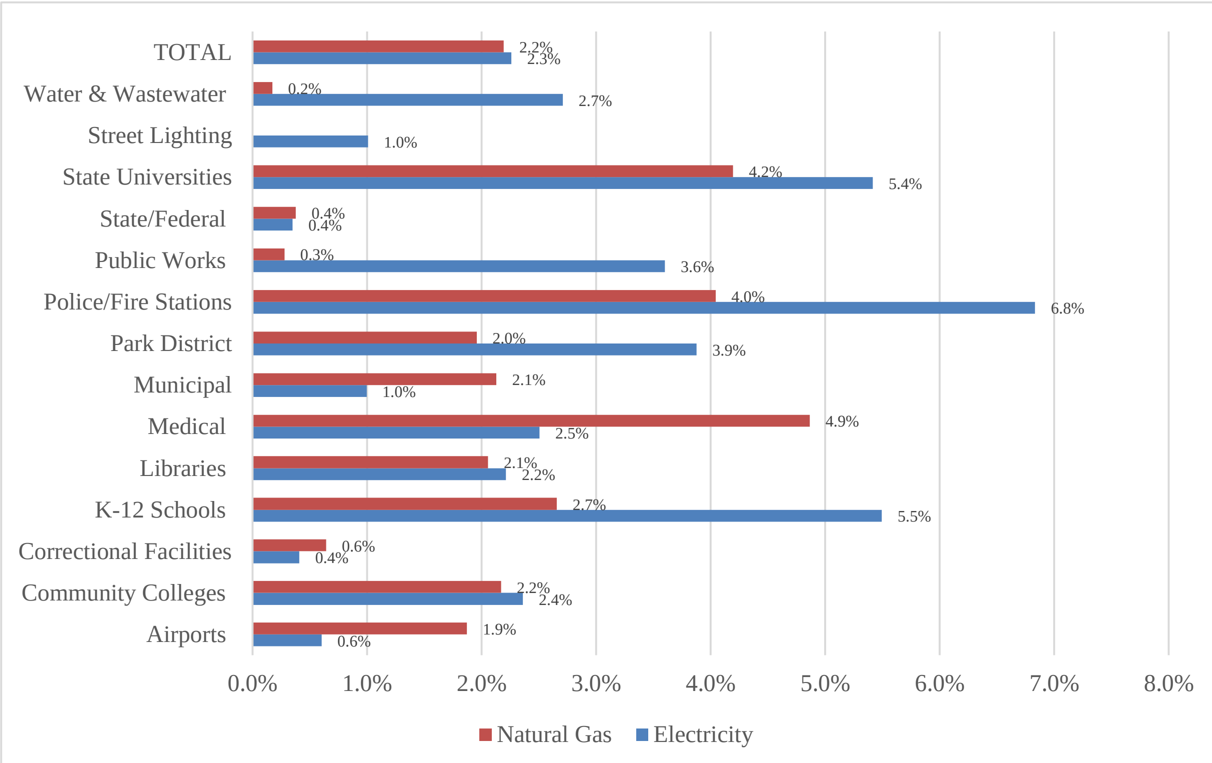


Figure 22. Electric and Natural Gas Savings by Sector (EY5/GY2-EY&/GY4)



3.3 Program Participation and Savings – Low Income

Energy consumption by low income households was estimated from the US Census American Community Survey, from data published by the Illinois Commerce Commission on annual electric and natural gas sales, and selected data provided by utilities.

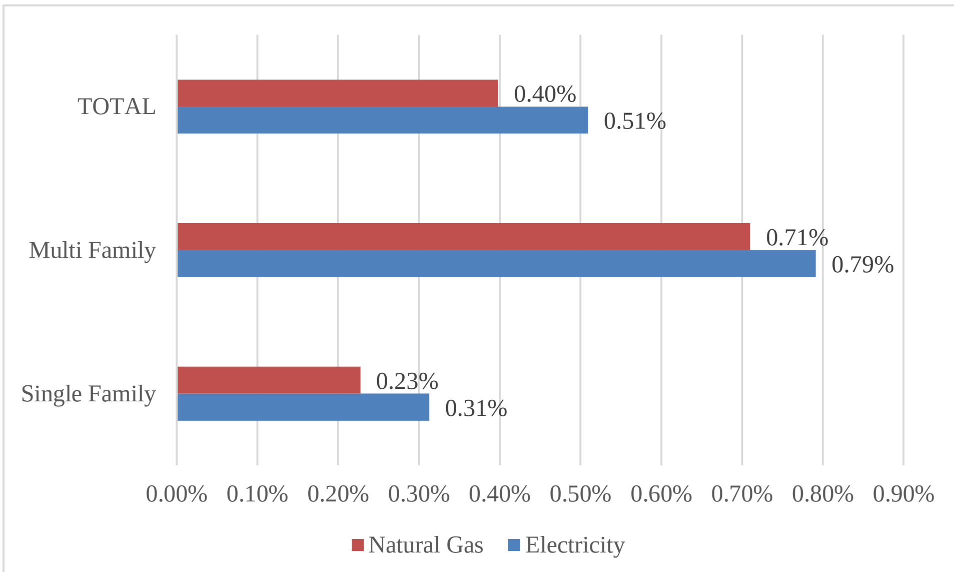
Table 14. Low-Income Electricity and Natural Gas Consumption

Sector	Electricity (MWh)	Natural Gas (1,000 therms)
Single-Family	4,141,004	564,390
Multi-Family	2,887,800	308,565
Total	7,028,804	872,955

Table 15. Percent Energy Savings EY5/GY2-EY7/GY4, Single family vs. Multi-family

Sector	Energy Savings	
	Electricity (MWh)	Natural Gas (1000 therms)
Single family	12,950	1,283
Multi-family	22,851	2,191
Total	35,801	3,474

Figure 23. Percent Savings Single vs. Multi-family EY5/GY2-EY7/GY4



Nearly 20% of the electric savings and 7% of the natural gas savings were from new construction or gut rehab of affordable housing for low income households, through completion of 393 units of single-family and 3,260 units of multi-family housing that met the Department's program standards. A wide range of measures were installed under programs that provided incentives for retrofit measures. Approximately 40% of electric savings were from lighting measures, dominated by CFLs but also an increasing proportion of LEDs, 30% of savings were from building envelope measures, and the remainder of savings were spilt between appliance and heating/cooling measures.

Figure 24. Low Income Electricity Savings by Measure

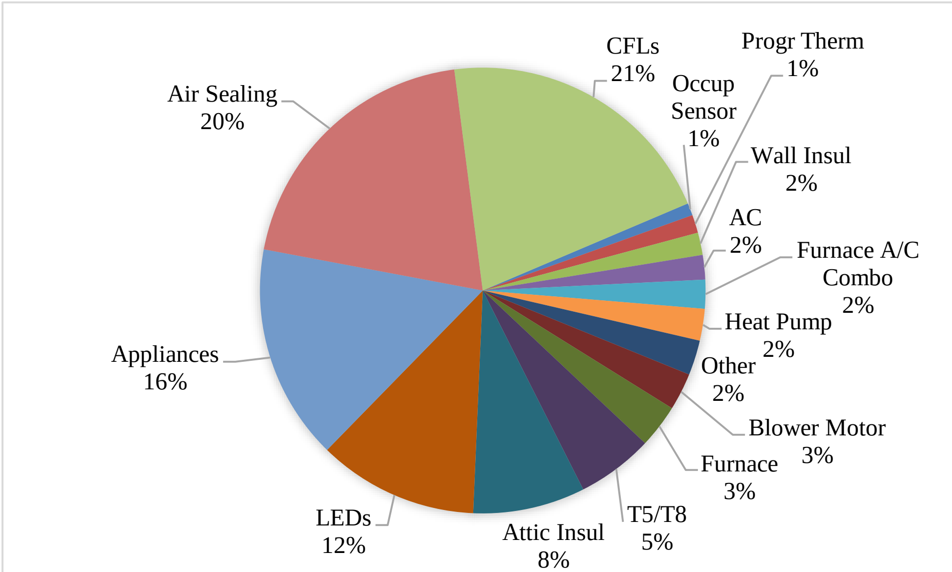
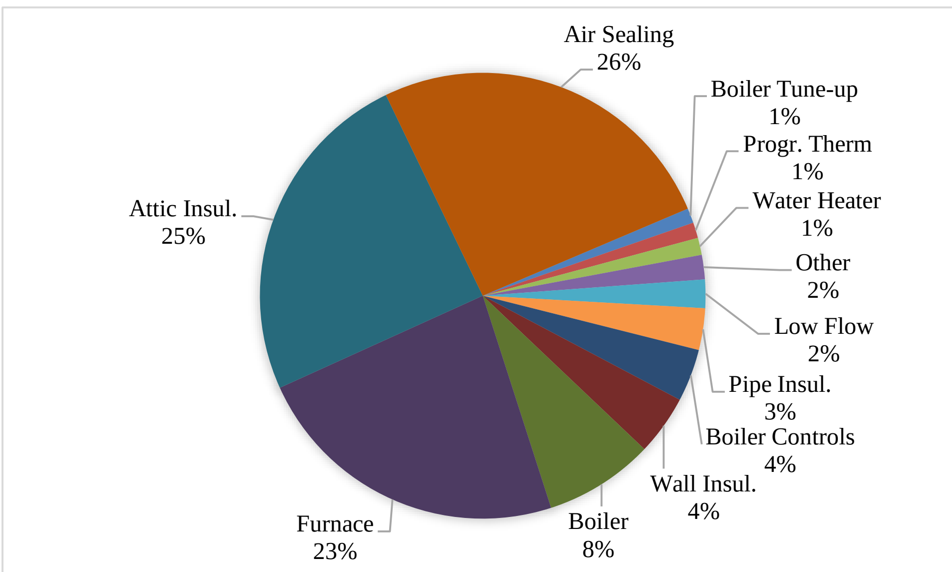


Figure 25. Low Income Natural Gas Savings by Measure



4.0 Technical and Economic Potential – Public Sector

This chapter presents the model results for the Public Sector, with sections on each of the 14 public sub-sectors. Each section describes an individual sub-sector and its population. This is followed by a description of the recent history of the respective sector's participation in the Department's Illinois Energy Now energy efficiency programs, focusing on the last three program years – PY5 through PY7 of electric programs and PY2 through PY4 of the gas programs. The sub-sector's base energy use by measure type is then presented. Finally, the estimated Technical and Economic potential for electric and natural gas efficiency is depicted in graphs and tables, concluding with discussion and recommendations.

4.1 Airports

There are 108 public use airports in Illinois, however over 96% of all enplanements at these facilities occur at the Chicago O'Hare and Chicago Midway airports. Hardly more than a handful of other airports offer regularly-scheduled commercial service – primarily Rockford, Peoria, Bloomington, Springfield, Champaign, Quad Cities, and Midamerica – accounting for well over 99% of all enplanements in Illinois. The remaining airports provide general aviation services. Airports account for about 3.0% of Public Sector electricity consumption and 2.3% of Public Sector natural gas consumption. Any assumptions were extrapolated from the ratio of enplanements of facilities with known energy data to facilities without.

Table 16. Participation of Airports in Energy Efficiency Programs

	Number of Airports	Operations	Enplanements	Energy (MWh)**
Participating	12	1,203,998	32,171,831	295,602
Total Airports*	108	3,553,598	40,690,788	428,811
Participation (%)	11.1%	33.9%	79.1%	68.9%

*FAA - number of public use airports, operations, and enplanements. **Based on actual consumption of largest airports and estimated consumption for smaller airports.

Though only a small number of airports participated in the Illinois Energy Now programs, the combined energy use of the participating airports covers more than two-thirds of airport energy use within the state, and nearly 80% of enplanements, since Chicago's O'Hare was one of the participating airports. Electric efficiency measures installed by the 12 airports included custom projects, both interior and exterior lighting and ventilation improvements. Natural gas measures were primarily custom projects. In total, airports achieved about 0.8% of total Public Sector electricity savings and 1.9% of natural gas savings.

Figure 26. Airports – Electric Efficiency Measure Savings EY5/GY2-EY7/GY5

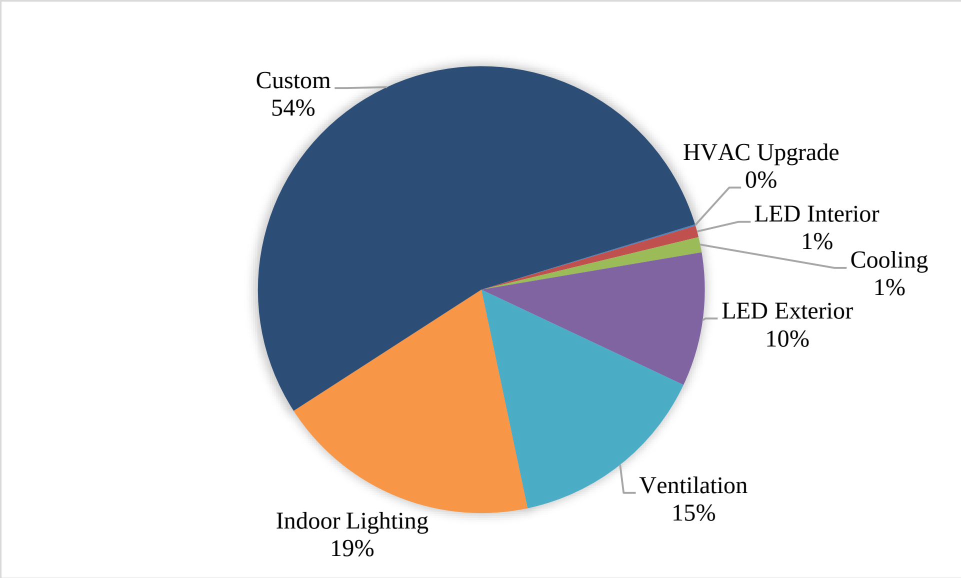
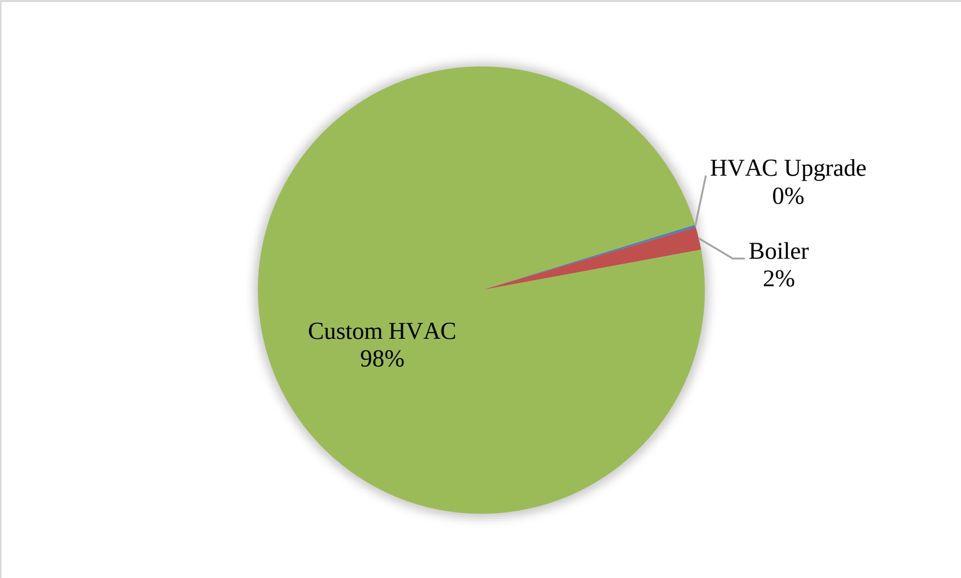


Figure 27. Airports – Natural Gas Efficiency Measure Savings EY5/GY2-EY7/GY5



The following figures break out the estimated energy consumption by system for airports. Lighting, cooling, and motors all use significant amounts of electricity at airports, while heating consumes more than 95% of the natural gas consumption.

Figure 28. Airports - Total Electricity Consumption (MWh)

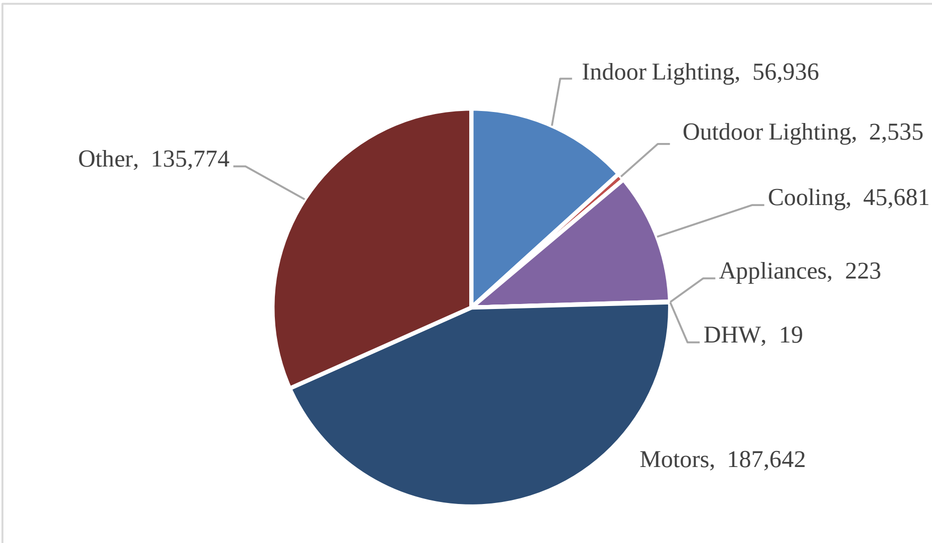
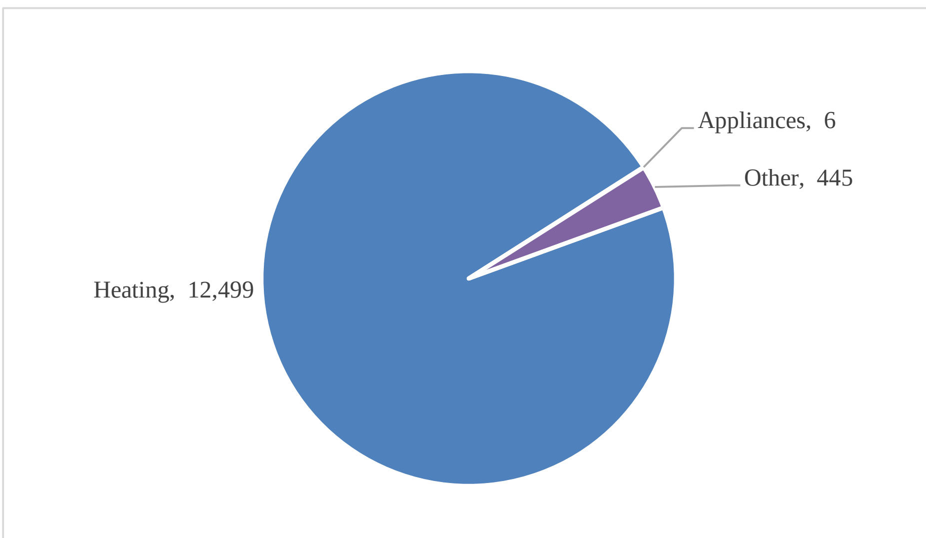


Figure 29. Airports - Total Natural Gas Consumption (1,000 Therms)

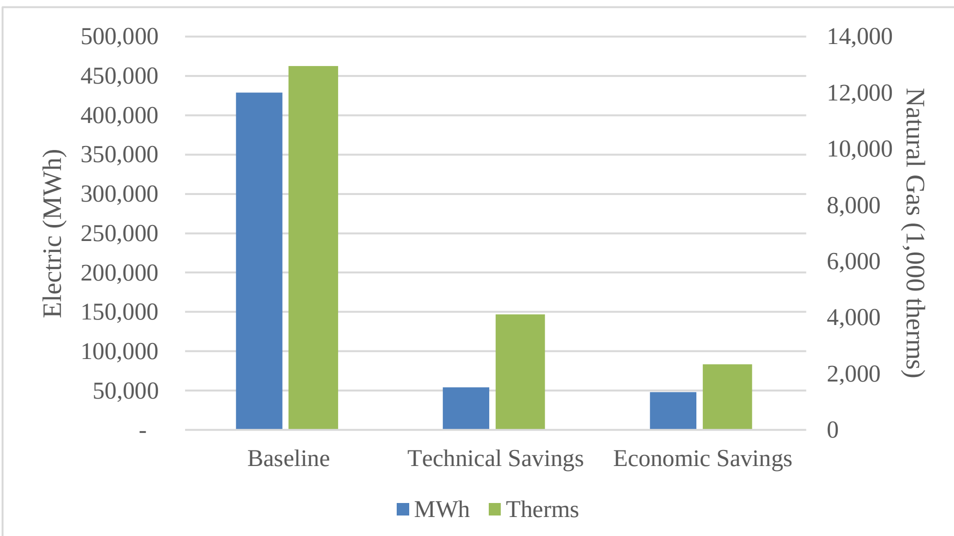


The table and graph below present the technical and economic reduction potential for airports as a percent of total sub-sector base consumption and in total MWh of electricity and thousand therms of natural gas.

Table 17. Airports - Technical and Economic Potential

Category	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	428,811	13%	54,009	11%	48,115
Natural Gas (1,000 therms)	12,950	32%	4,115	18%	2,341

Figure 30. Airports - Total Consumption and Savings Potential



The following figures present the break out of technical energy efficiency potential by measure for airports.

Figure 31. Airports – Electricity Technical Reduction Potential (MWh)

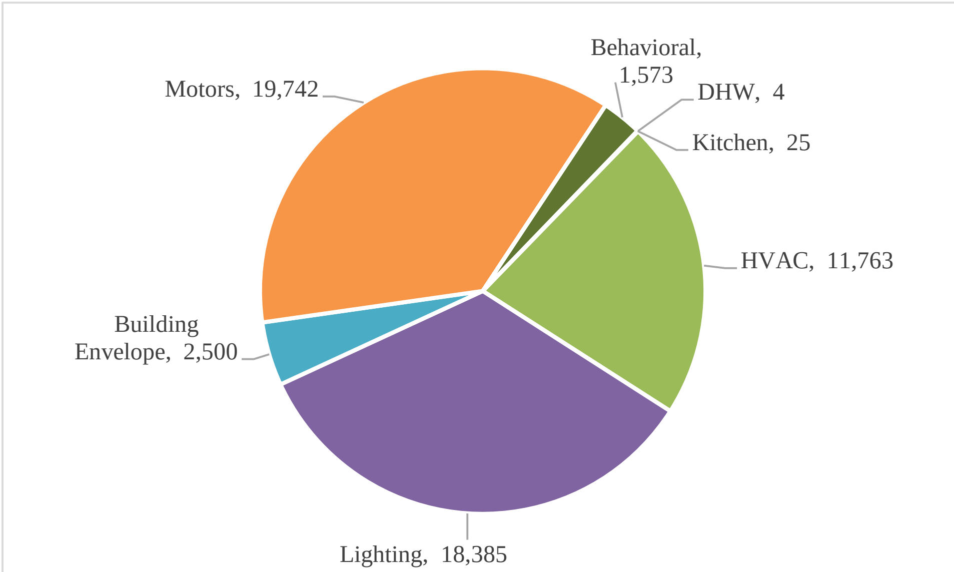
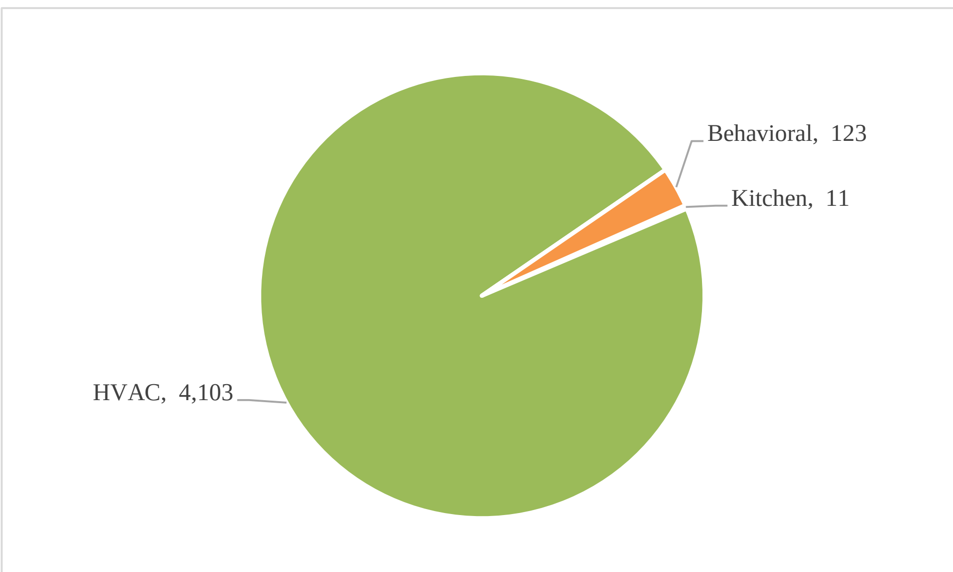


Figure 32. Airports - Natural Gas Technical Potential (1,000 therms)



The next two graphs display the economic energy reduction by measure for airports.

Figure 33. Airports – Electricity Economic Potential (MWh)

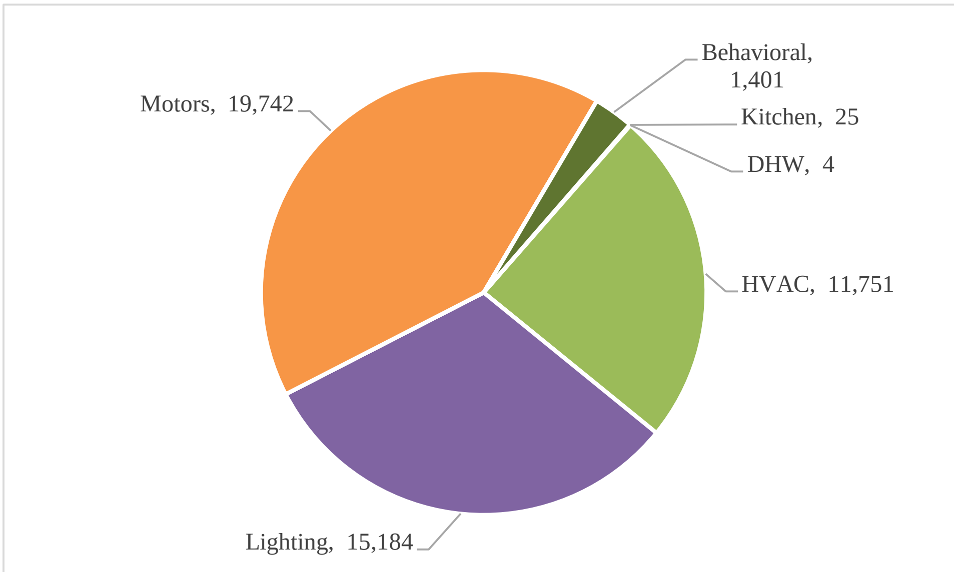
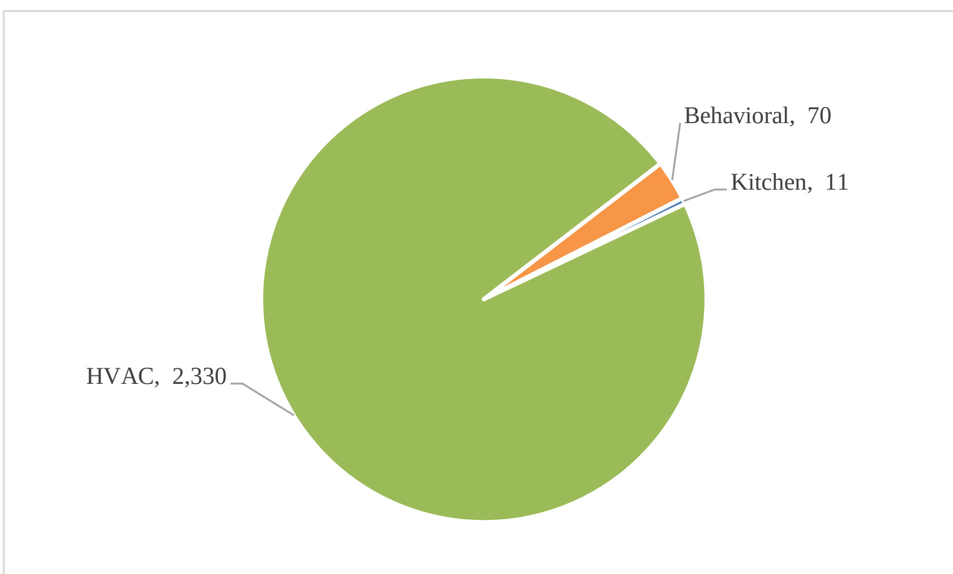


Figure 34. Airports - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Airports:

The reduction potential for airports is characterized by advanced indoor lighting technologies, such as LEDs or Induction lighting, due to the high hours of operation of the sector. Motors represent a large source of potential energy savings as well, given their large share of energy consumption. Motors are found throughout airports as they are used in ventilation, conveying packages and material, pumps, and other mechanical systems. Other potential can be found on the natural gas side in improved space heating technologies. Many airports are still utilizing steam boiler systems and could benefit from retrofitting their systems with modular, condensing boilers.

At the time of this study, advanced lighting technology is limited for runway lighting. As such, the economic potential for runway lights was not considered.

4.2 Community Colleges

Illinois has 39 public community college districts and a total of 48 community colleges. Two districts – City Colleges of Chicago and Illinois Eastern Community Colleges – encompass several colleges. Most of the colleges are eligible for incentives under the Illinois Energy Now Portfolio of programs, unless served by electric cooperative or municipal utilities. As shown in Section 3.0, community colleges represent 2.9% of Public Sector electricity consumption and 2.3% of natural gas consumption.

During the past three program years, 25 of the districts and 28 of the colleges have participated in DCEO Illinois Energy Now incentive programs. Colleges accounted for 2.9% of Public Sector savings and 3.3% of Public Sector natural gas savings accomplished by the Department energy efficiency programs.

Table 18. Community Colleges – Population and Participation in EE Programs

	No. of Districts	No. of Colleges
Participating in Energy Efficiency Programs	25	28
Total Population	39	48
Percent	64.1%	58.3%

Note: 53% of random sample participated in incentive programs.

As shown below, community colleges participated aggressively in the New Construction Program and achieved significant electricity savings through exterior LED lighting, as well as indoor fluorescent lamps, LED lighting and HVAC upgrades, including VFDs and heat pumps. Colleges reduced natural gas consumption primarily through HVAC and boiler system upgrades, including tune-ups and steam trap replacements.

Figure 35: Community Colleges - Electric Savings EY5/GY2-EY7/GY4

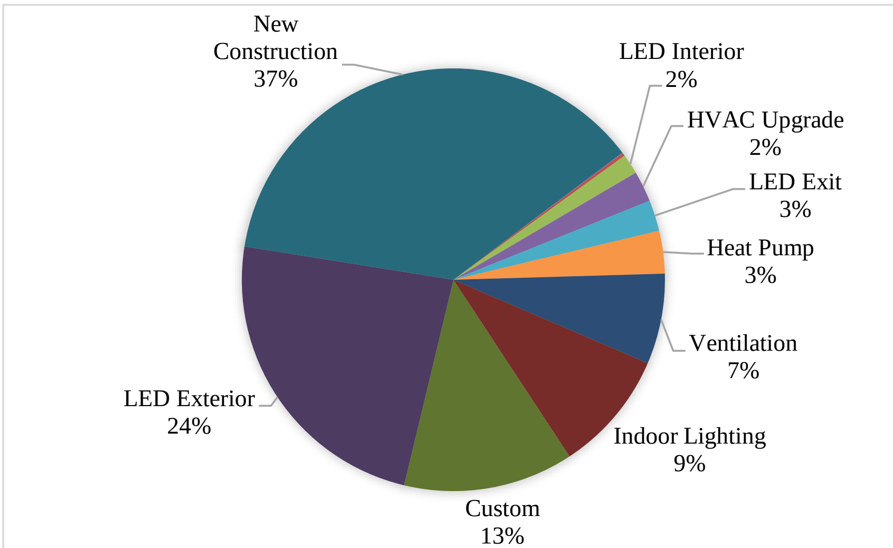
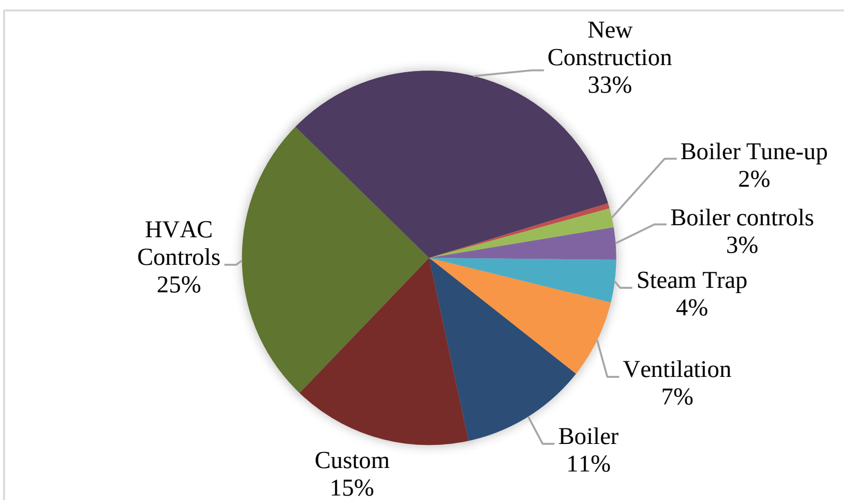


Figure 36: Community Colleges - Natural Gas Savings EY5/GY2-EY7/GY4



The following figures break out the estimated energy consumption by system for community colleges. Cooling is the largest electric load, while space heating is the largest natural gas load.

Figure 37. Community Colleges - Total Electricity Consumption (MWh)

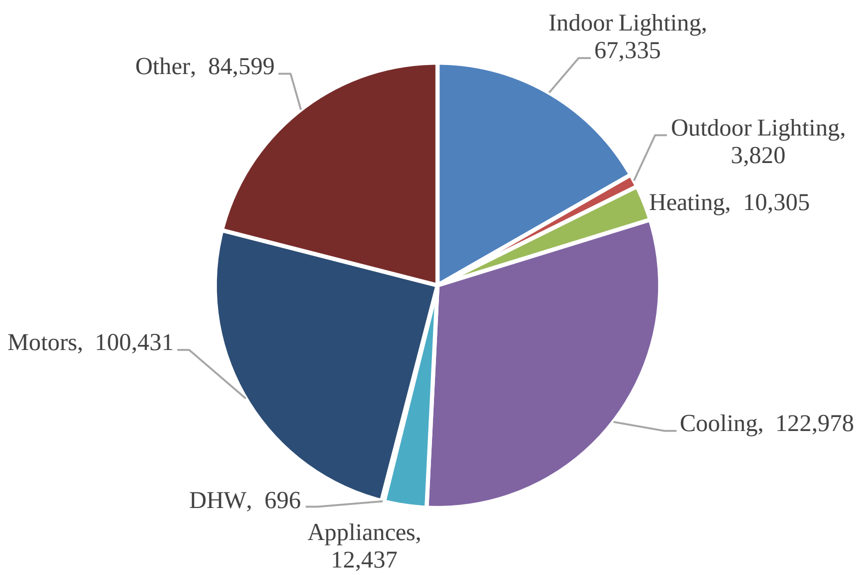
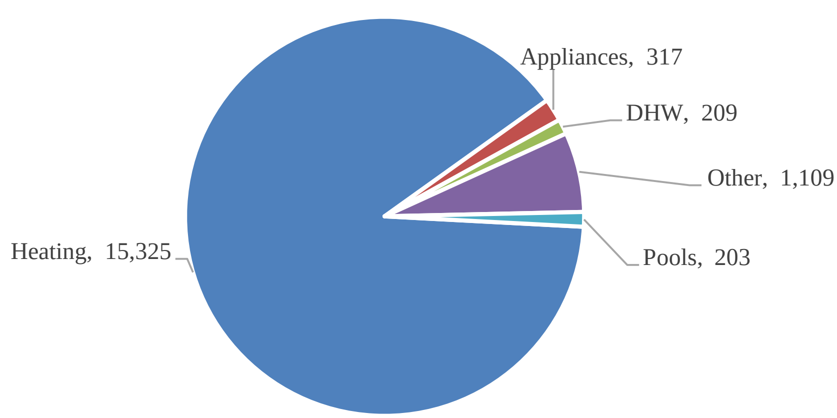


Figure 38. Community Colleges - Total Natural Gas Consumption (1,000 therms)

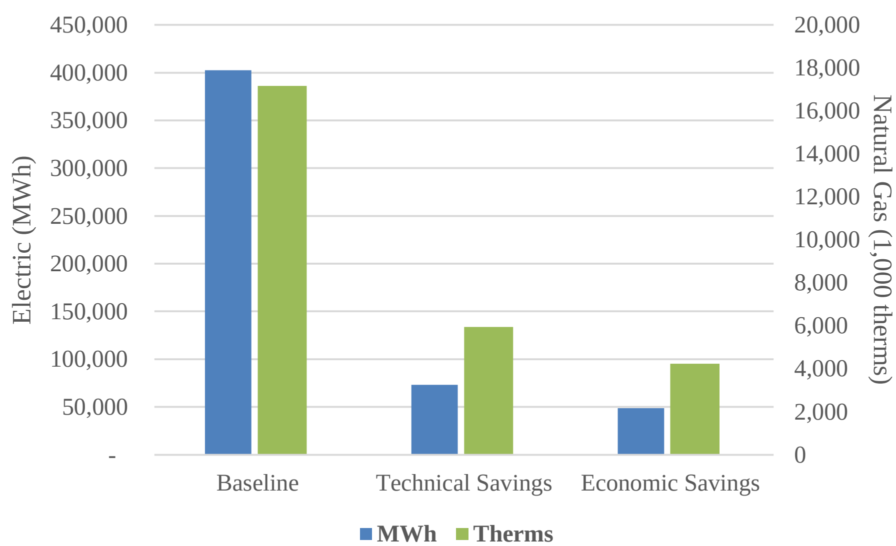


The following table and graph summarize the percent savings for the technical and economic efficiency potential, and show the total electric and gas savings potential for each compared to the total consumption of community colleges.

Table 19. Community Colleges - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	402,601	18%	73,055	12%	48,847
Natural Gas (1,000 therms)	17,164	35%	5,938	25%	4,231

Figure 39. Community Colleges - Total Consumption and Savings Potential



The following figures break down the technical energy potential by measure for community colleges.

Figure 40. Community Colleges - Electricity Technical Potential (MWh)

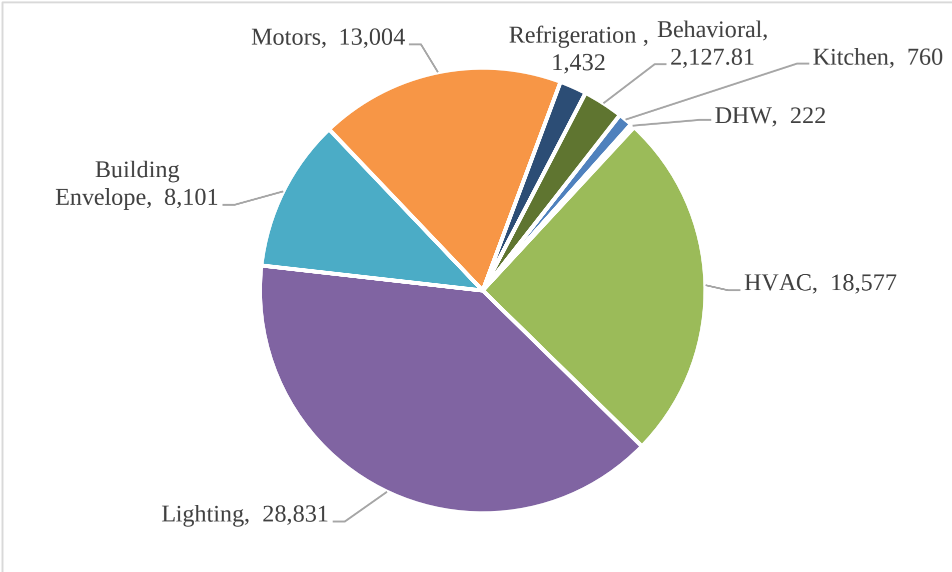
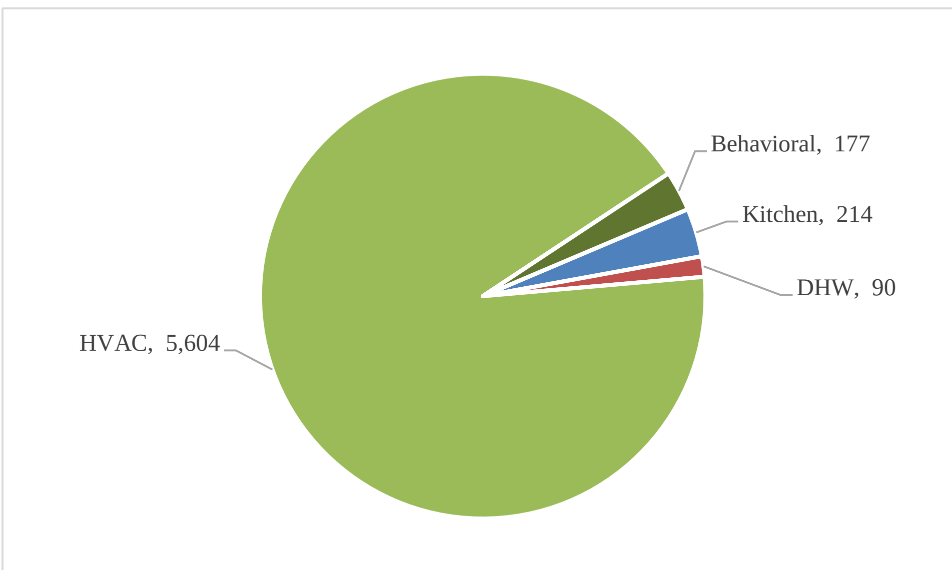


Figure 41. Community Colleges - Natural Gas Technical Potential (1,000 therms)



The following figures show the economic potential for electric and natural gas efficiency by measure for community colleges.

Figure 42. Community Colleges - Electricity Economic Potential (MWh)

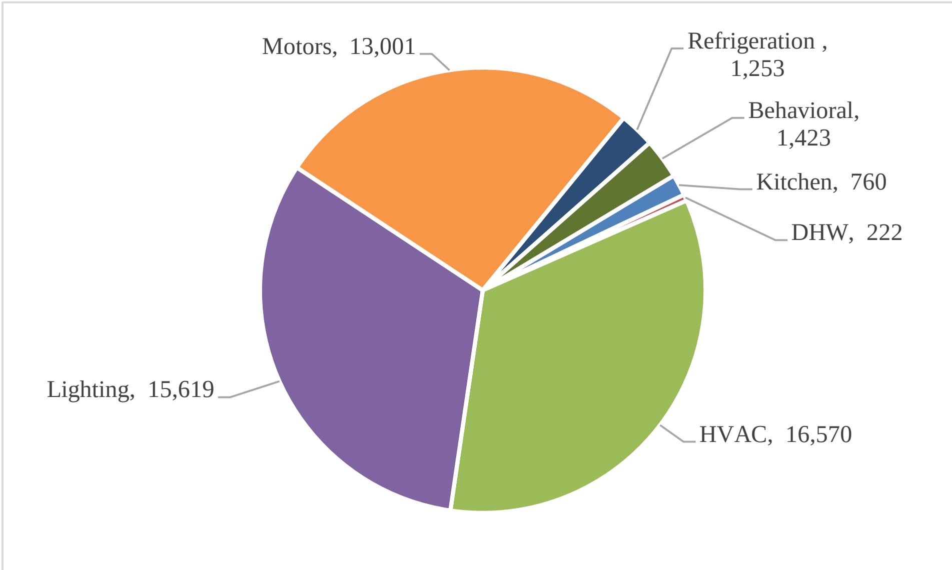
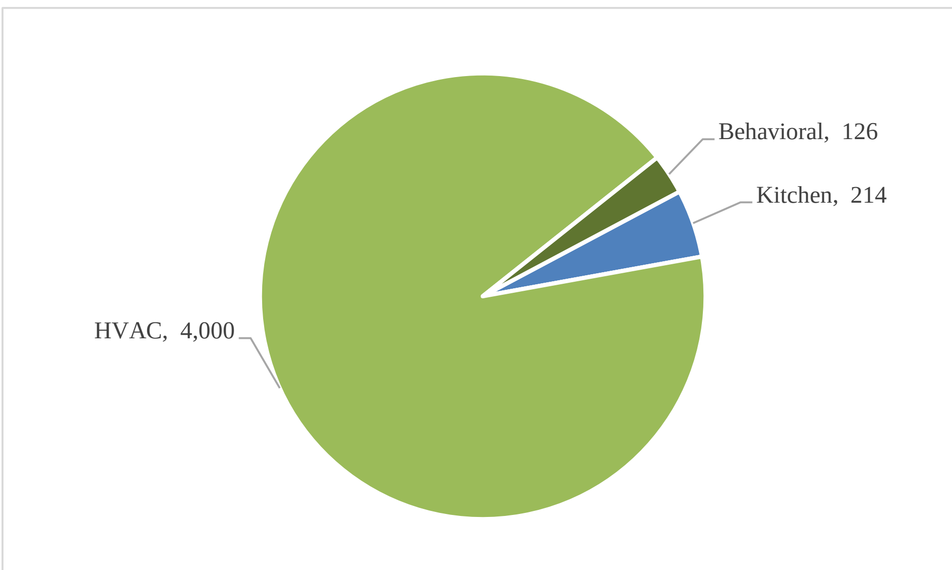


Figure 43. Community Colleges - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Community Colleges:

On the electric side, lighting has the largest energy reduction potential accounting for roughly 40% of the savings. However, when looking at the economic potential, improvements to cooling systems slightly edge out lighting for most available savings. This is due to many community colleges having a centralized chilled water system supplemented by peripheral rooftop/packaged units that were installed during expansions/additions of the campus at different points in time. Ensuring that such a system can meet the demands of the campus with very different cooling requirements throughout the facility is difficult and inefficient. Systems could be centralized, upgraded with more efficient technologies and downsized as the result of a facility-wide re-design.

Indoor and outdoor lighting represent another opportunity that should be addressed by offering incentives on advanced lighting technologies, but also on a whole facility lighting re-design that takes advantage of the latest automation controls coupled with energy efficient fixtures and dimmable fixtures in common areas.

On the gas side, both consumption and potential are dominated by space heating. Similar to cooling systems, centralized hydronic boilers are supplemented by less efficient rooftop/packaged units. Many pieces of equipment are also old or being used beyond their rated lifespans and should be replaced with upgraded equipment. A whole building re-design approach with centralized efficient technology and improved automation could harness the technological and behavioral waste currently present in the market. Additional behavioral savings could be captured through training of maintenance and teaching staff and use of dashboards.

4.3 Correctional Facilities

The Illinois Department of Corrections (IDOC) has 26 correctional facilities located throughout the state. Most are eligible for incentives under the Energy Efficiency Portfolio of programs. Correctional facilities are large users of energy due to continuous operating hours and lighting requirements for security reasons. As shown in Section 3.0, correctional facilities account for 4.2% of Public Sector electricity consumption and 10.1% of natural gas consumption.

During the past three program years 16 of the correctional facilities carried out 25 projects with assistance from the Department's Illinois Energy Now incentive programs. Corrections accounted for 0.8% of Public Sector electricity savings and 3.0% of Public Sector gas savings accomplished under the DCEO programs.

Table 20. Participation of Correctional Facilities in Energy Efficiency Programs

Participation	Number
No. of EE Projects	25
Participating Facilities	16
Total Correctional Facilities in State	26

Note: 46% of random sample participated in incentive programs.

As shown below, correctional facilities improved electric efficiency predominantly by upgrading indoor lighting and exit signs (93% of electricity savings) and kitchen equipment (6% of electricity savings). Corrections reduced natural gas consumption through custom projects, boiler tune-ups and upgrades, and new hot water and kitchen equipment.

Figure 44. Correctional Facilities – Energy Efficiency Savings EY5/GY2-EY7/GY5

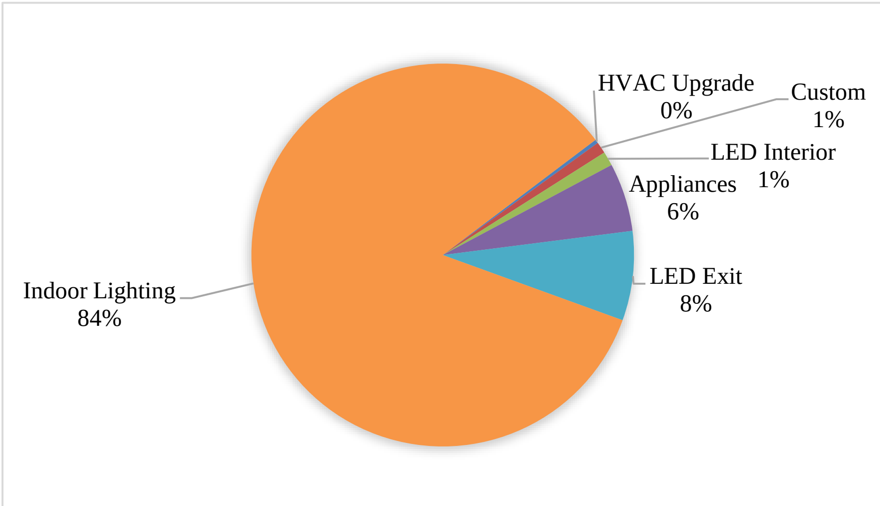
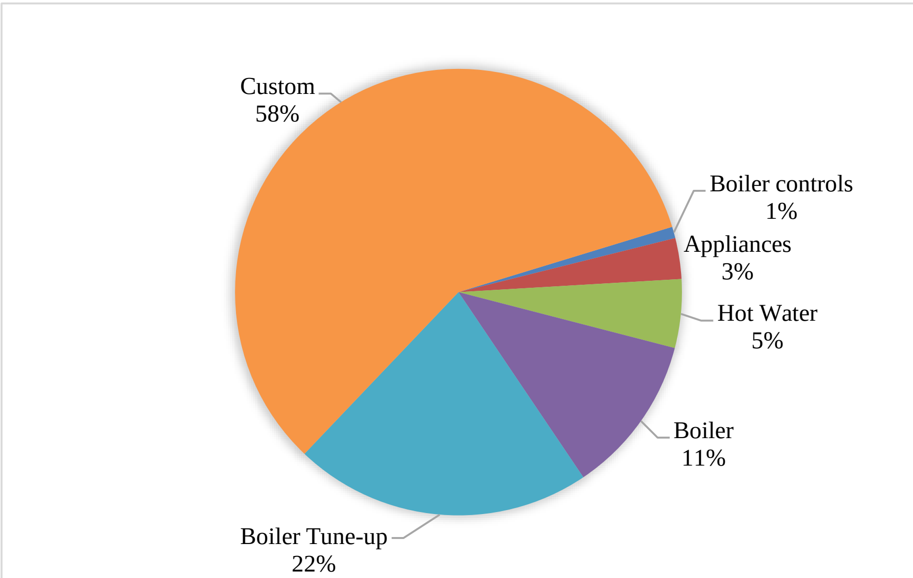


Figure 45. Correctional Facilities – Natural Gas Savings EY5/GY2-EY7/GY5



The following figures break out the estimated energy consumption by system for correctional facilities. While lighting uses the greatest share of electricity, the range of energy using equipment is much broader. Heating/HVAC equipment dominate natural gas use.

Figure 46. Correctional Facilities - Electricity Consumption (MWh)

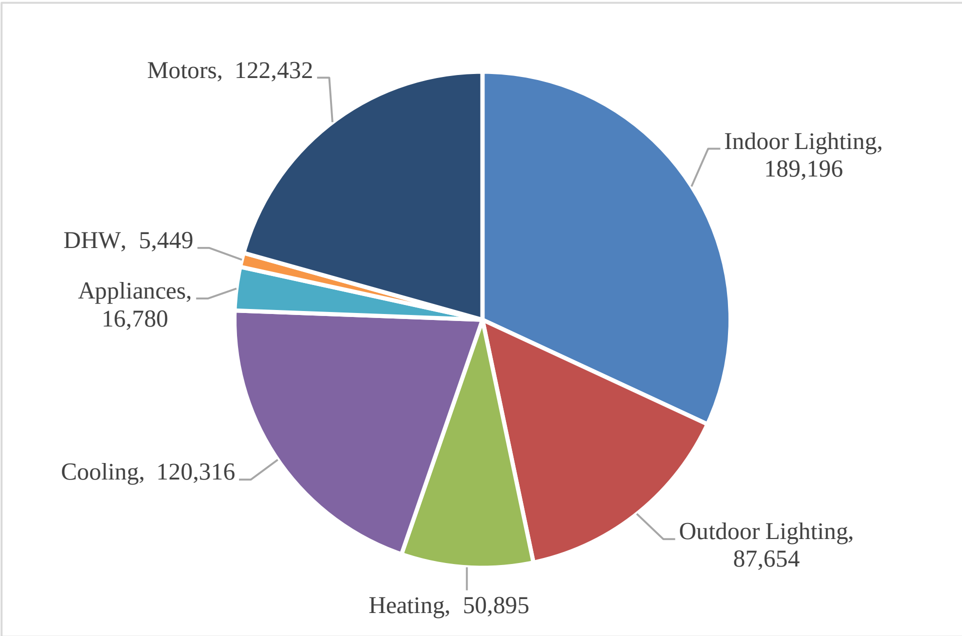
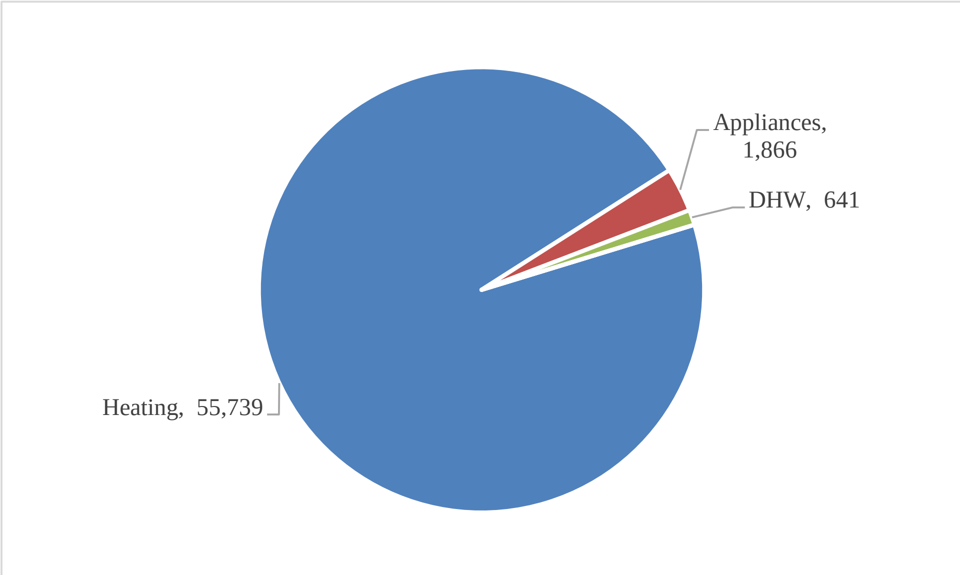


Figure 47. Correctional Facilities - Natural Gas Consumption (1,000 therms)

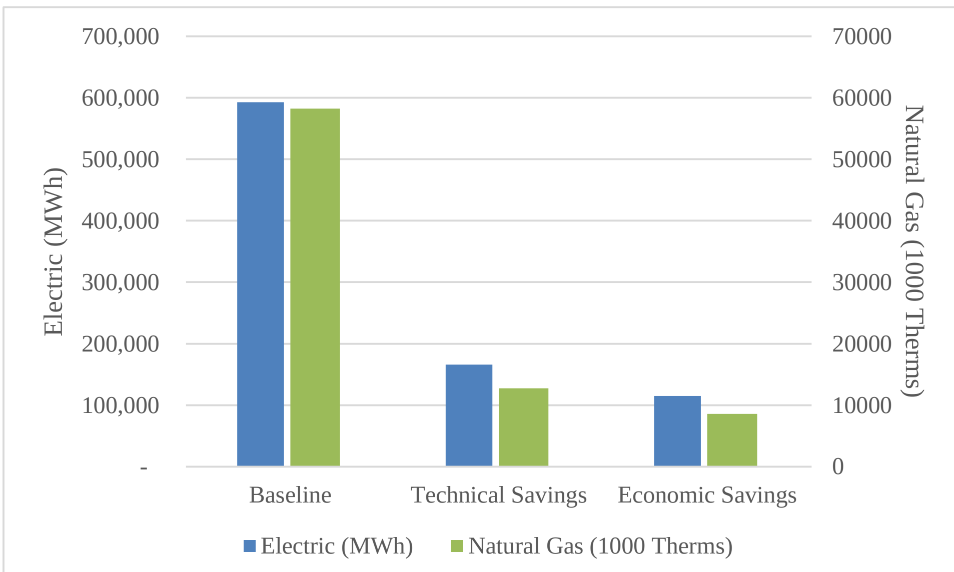


The following table and graph summarize the percent savings for the technical and economic reduction potential, and show the total savings potential for each compared to the total consumption determined for correctional facilities.

Table 21. Correctional Facilities - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	592,723	28%	165,868	19%	115,047
Natural Gas (1,000 therms)	58,246	22%	12,758	15%	8,576

Figure 48. Correctional Facilities - Total Consumption and Savings Potential



The following figures show the technical potential for electric and natural gas savings by measure for correctional facilities.

Figure 49. Correctional Facilities – Electricity Technical Reduction Potential (MWh)

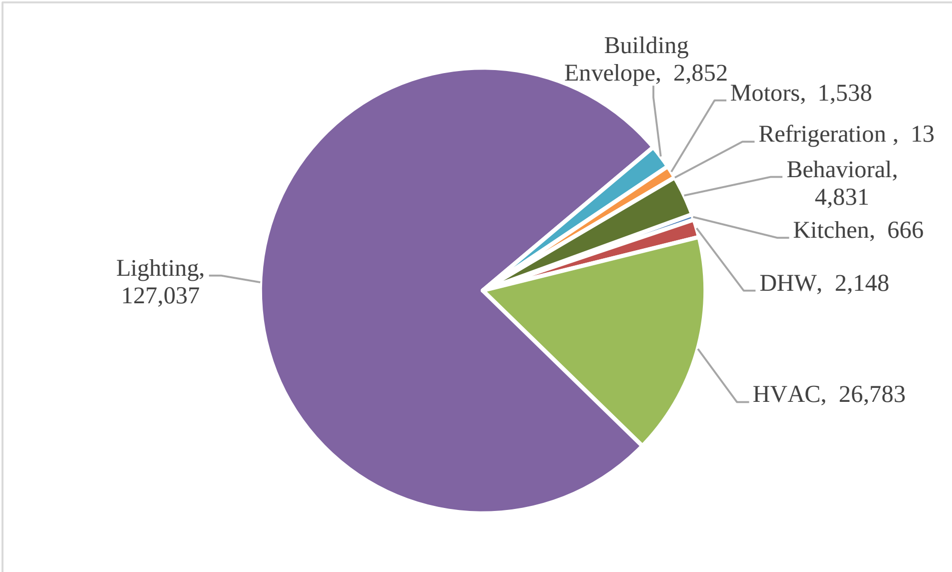
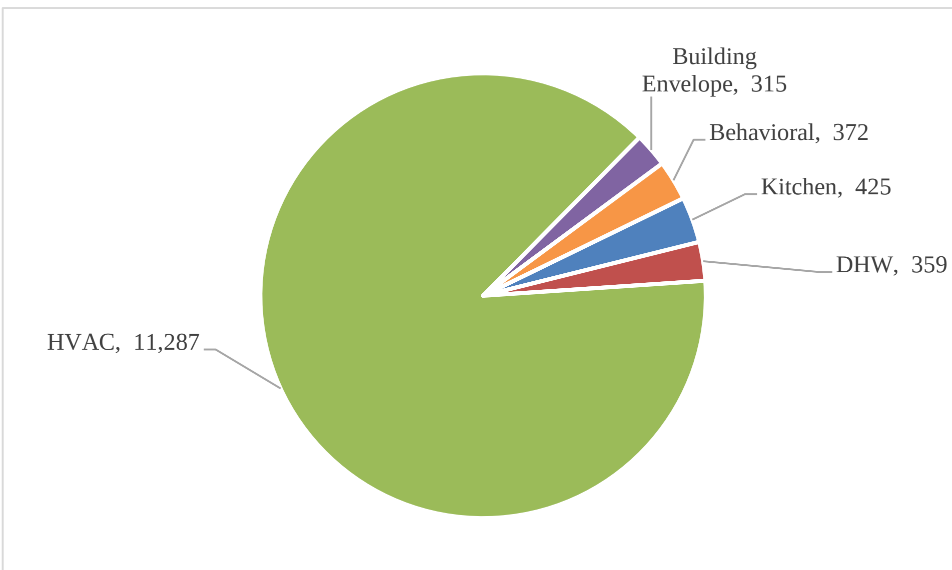


Figure 50. Correctional Facilities - Natural Gas Technical Potential (1,000 therms)



The following figures break down the economic potential for electricity and natural gas savings by measure for correctional facilities.

Figure 51. Correctional Facilities – Electricity Economic Potential (MWh)

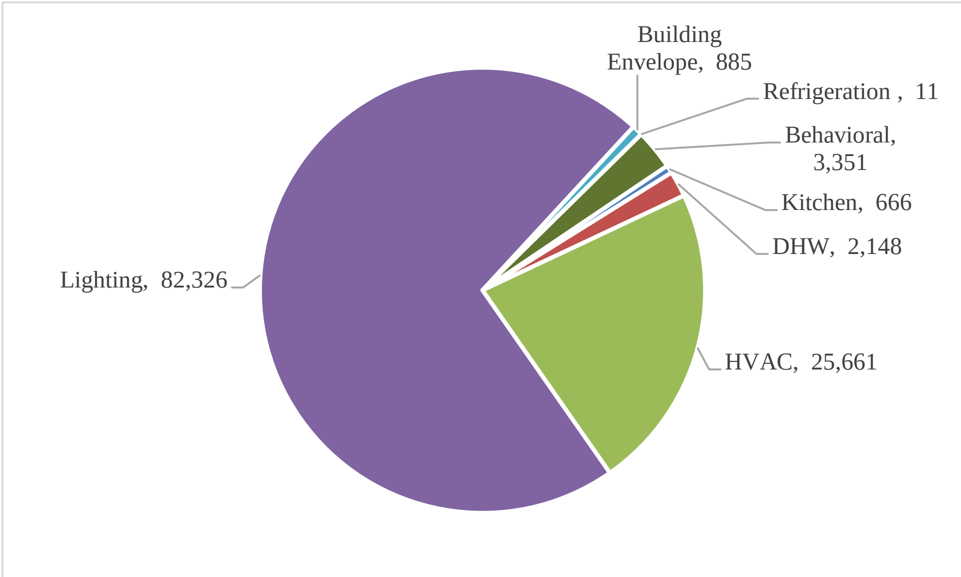
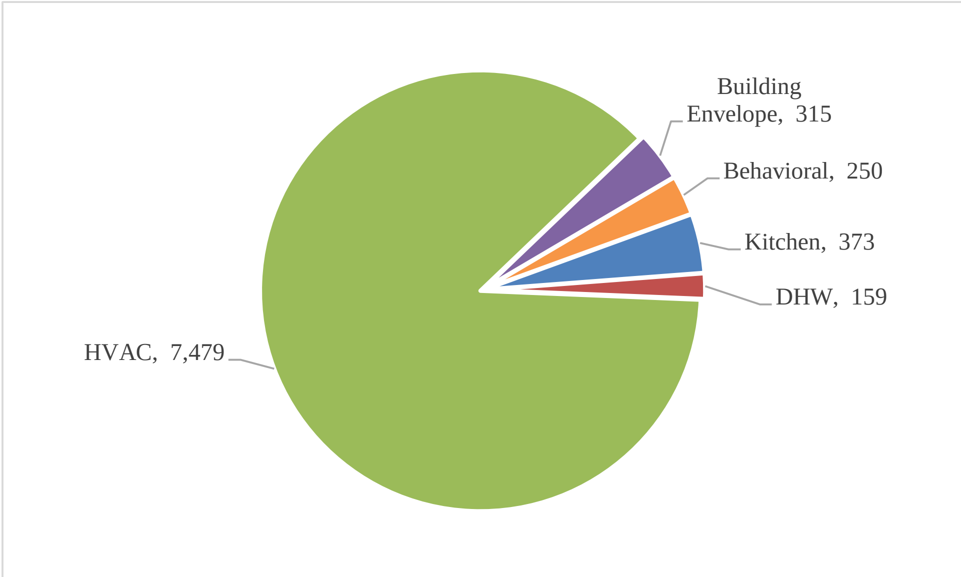


Figure 52. Correctional Facilities - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Correctional Facilities:

Lighting measures represent the bulk of the energy efficiency potential due to the long hours of use for both indoor and outdoor lighting fixtures. For security reasons there are special lighting requirements for outdoor spaces and capturing the reduction potential may benefit from a specific advanced outdoor lighting program.

Correctional facilities also present large indoor spaces lit 24/7. Due to the long hours of use these spaces can cost-effectively implement linear LED fixtures or interior induction fixtures to capture the energy reduction potential.

On the natural gas side, both consumption and potential are dominated by space heating with large, centralized steam boilers representing the majority of installations. Many of these natural gas steam boilers were converted from coal over 20 years ago, meaning that the main vessel, refractory, exhaust and piping system if 50 years of age or more, causing system efficiency to suffer. Steam traps typically represent a waste of 10-15% of system efficiency due to losses of live steam in the condensate return when continuous maintenance practices aimed at identifying and replacing failed traps are not in place. The energy reduction potential can be captured with boiler upgrades, such as more efficient burners or advanced controls with oxygen trim controls, and proper maintenance practices, regular tune-ups and continuous steam trap surveys and replacements.

4.4 K-12 Schools

Illinois has approximately 4,650 schools within 875 public school districts. Most public K-12 schools are eligible for incentives under the Illinois Energy Now Portfolio of programs. As shown in Section 3.0, K-12 schools represent 14.4% of Public Sector electricity consumption and 20.5% of natural gas consumption.

During the past three program years 1,622 schools, or 35% of the population, have participated in the Department's Illinois Energy Now incentive programs. K-12 schools accounted for 5.5% of Public Sector savings and 2.7% of Public Sector gas savings accomplished under the Department's programs.

Table 22: K-12 Schools - Population and Participation in EE Programs

	No. of Districts	No. of Schools
Participating	365	1,622
Total Population	875	4,650
Percent Participating	41.7%	34.9%

Note: In addition to school facilities approximately 150 district offices and administration buildings & 15 school bus facilities participated

As shown below, schools installed a wide range of energy efficient equipment. Indoor lighting accounts for the most significant portion of electric savings comes from LED replacements, particularly for exterior purposes starting to make inroads. On the gas side boiler tune ups and boiler replacements provided the greatest natural gas savings with other HVAC-related improvements accounting for the remainder energy savings.

Figure 53. K-12 Schools – Electric Measure Savings EY5-GY2-EY7-GY5

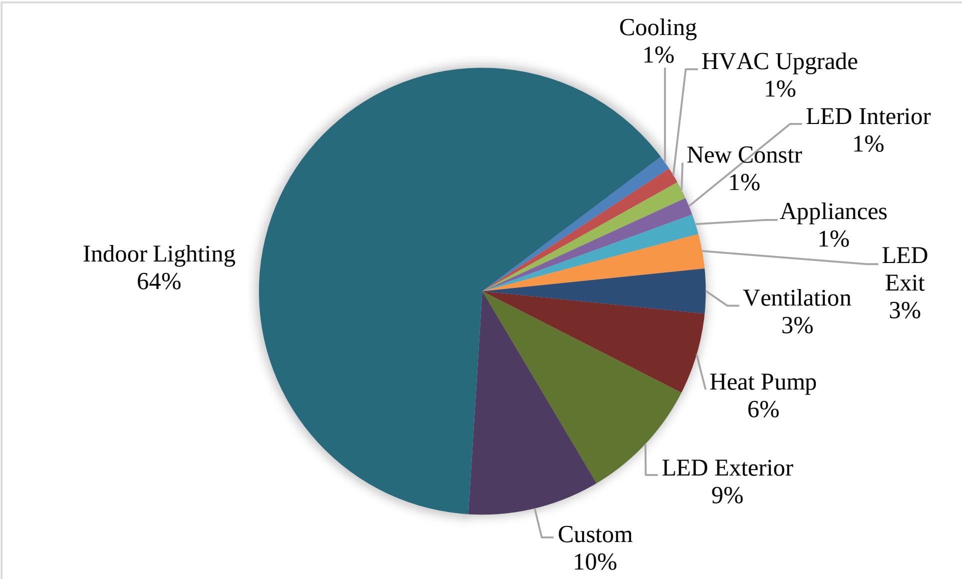
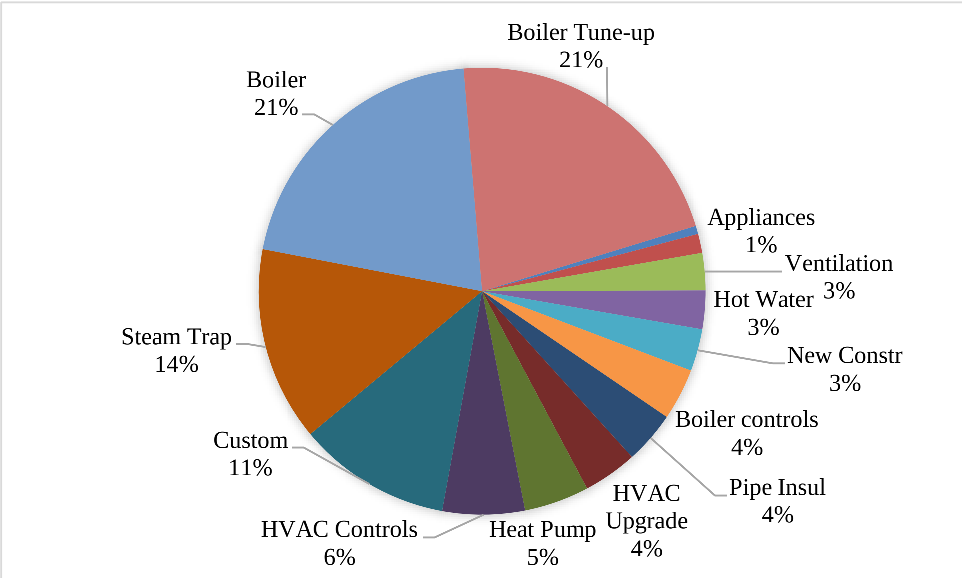


Figure 54. K-12 Schools – Natural Gas Measure Savings EY5-GY2-EY7-GY5



The following figures break down the estimated energy consumption by system for K-12 schools. Lighting and cooling are the largest electricity consumers. Heating is the predominant use of natural gas but pools, hot water, and kitchens also use natural gas.

Figure 55. K-12 Schools – Electricity Consumption by System (MWh)

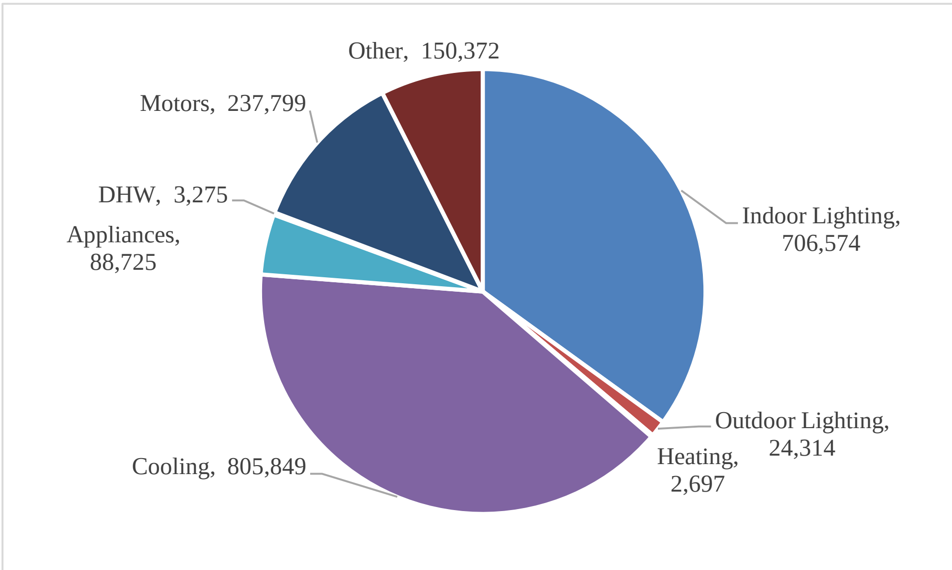
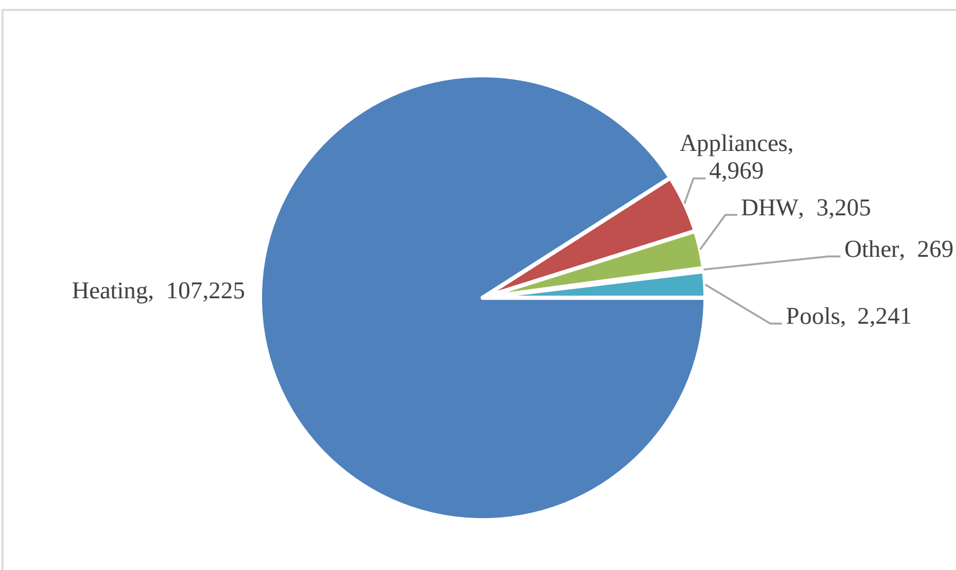


Figure 56. K-12 Schools – Natural Gas Consumption by System (1,000 therms)

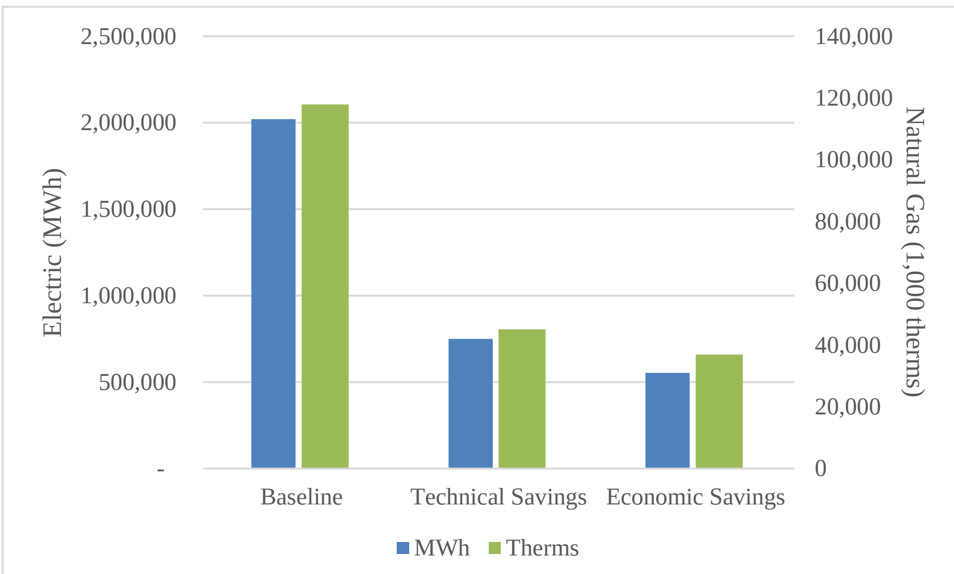


The table and graph below present the technical and economic reduction potential for K-12 schools as a percent of total sub-sector base consumption and in total MWh of electricity and thousand therms of natural gas.

Table 23: K-12 Schools - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	2,019,604	37%	750,333	27%	553,172
Natural Gas (1,000 therms)	117,908	38%	45,056	31%	36,922

Figure 57. K-12 Schools - Total Consumption and Savings Potential



The figures below show the technical potential for electricity and natural gas savings in k-12 schools.

Figure 58. K-12 Schools – Electricity Technical Potential (MWh)

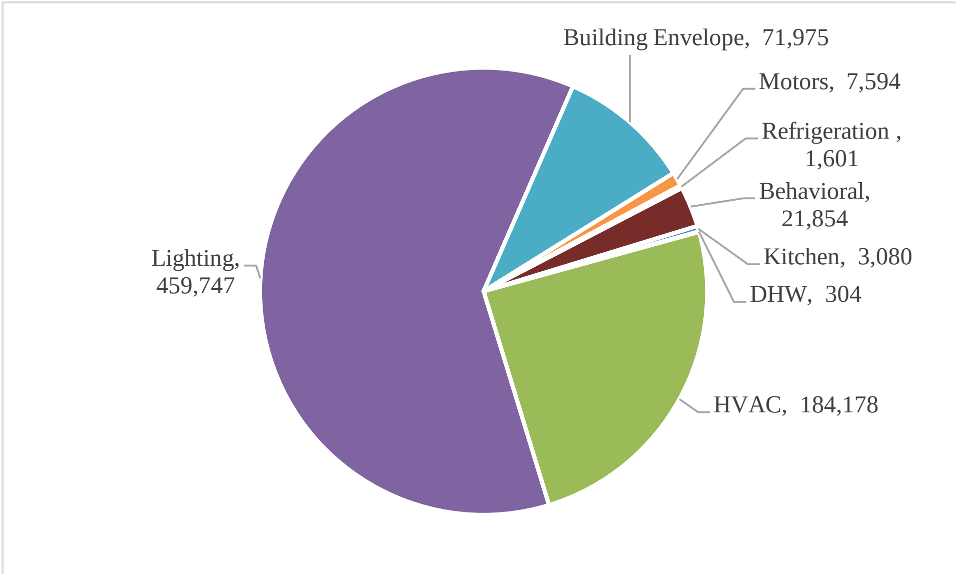
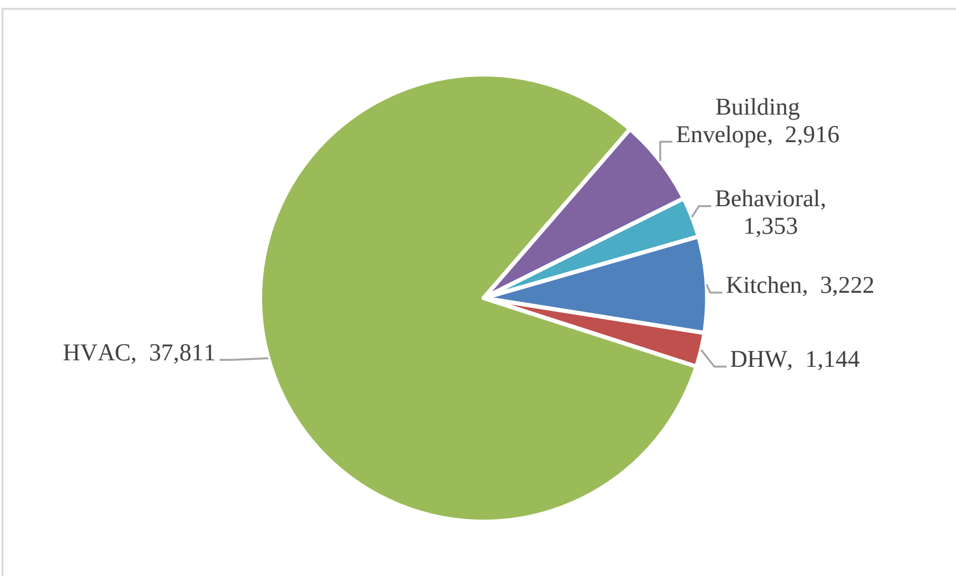


Figure 59. K-12 Schools - Natural Gas Technical Potential (1,000 therms)



The figures below show the economic potential for electricity and natural gas savings in k-12 schools.

Figure 60. K-12 Schools - Electricity Economic Potential (MWh)

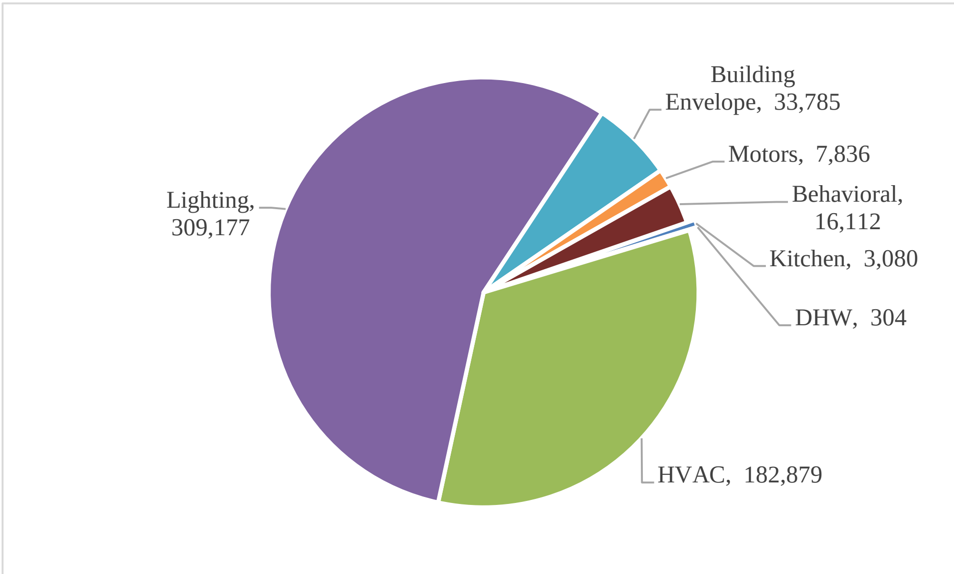
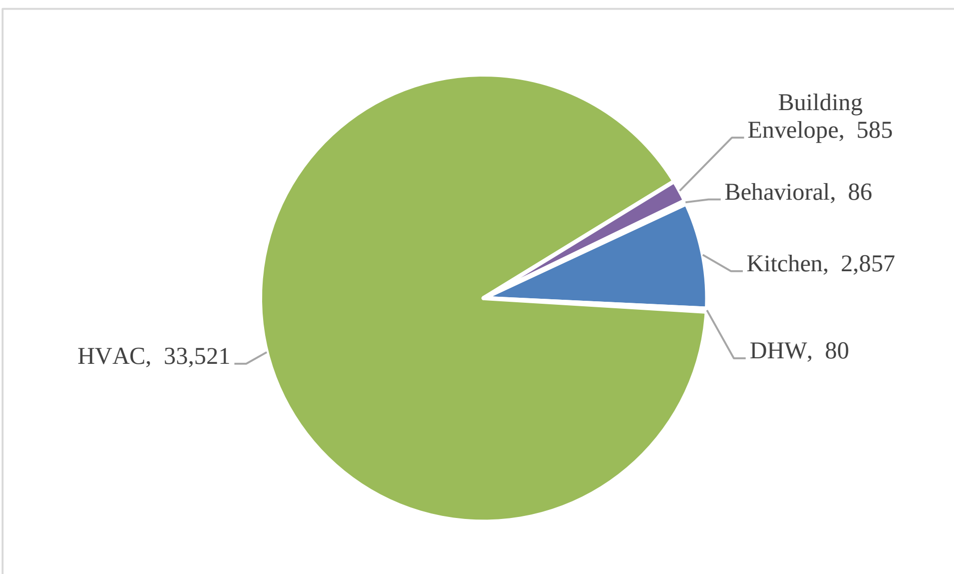


Figure 61. K-12 Schools - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations:

The largest opportunity for energy savings in schools still proves to be in indoor lighting where there is potential for reduced wattage T8 lamps and new linear LED fixtures. Automated controls and occupancy sensors also show great potential and could be coupled with dimmable fixtures to further reduce the energy consumption. Advanced lighting fixtures such as LEDs and induction could be used on outdoor, gymnasium, pool and dining hall lighting applications. Additionally, a large portion of lighting in K-12 schools is not yet controlled by occupancy sensors. A number of schools have the distinct characteristic of being closed over the summer. There is still opportunity to take advantage of potential savings by ensuring more energy systems are shut during this three month unoccupied period.

On the gas side, consumption and potential are dominated by space heating applications stemming from very old boiler systems. Space heating represents more than 90% of natural gas consumption. Maintenance, replacement, and automated controls for HVAC systems could help reduce space heating consumption.

4.5 Libraries

Illinois has 806 public libraries with the City of Chicago encompassing several different branches. As shown in Section 3.0, libraries represent 1.1% of Public Sector electricity consumption and 1.4% of natural gas consumption.

During the past three program years 98 of the libraries have participated in the Department's Illinois Energy Now incentive programs. Libraries accounted for 1.1% of Public Sector electric savings and 1.4% of Public Sector gas savings accomplished under the Department's programs.

Table 24. Community Colleges – Population and Participation in EE Programs

	No. of Libraries
Participating in EE Programs	98
Total Population	806
Percent	12.2%

As shown below, libraries achieved significant electricity savings through indoor fluorescent and LED lighting, exterior LED lighting and HVAC upgrades. Libraries reduced natural gas consumption primarily through HVAC and boiler system upgrades including tune-ups and steam trap replacements.

Figure 62. Libraries – Electricity Savings EY5/GY2-EY7/GY4

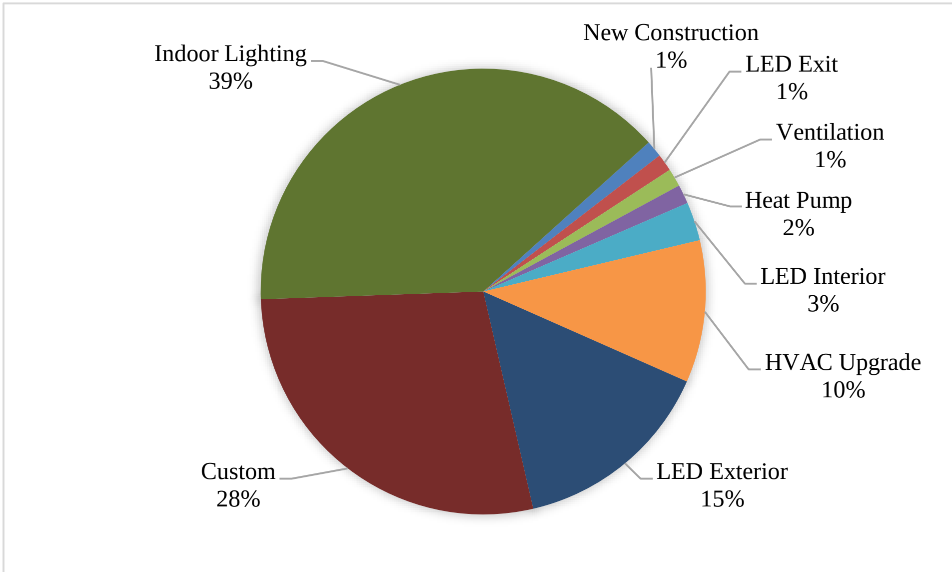
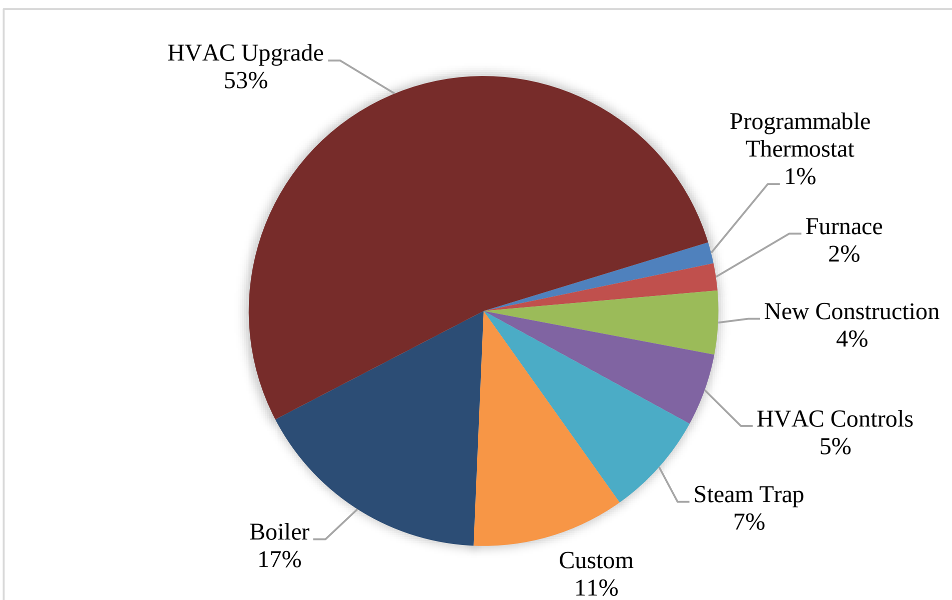


Figure 63. Libraries – Natural Gas Savings EY5/GY2-EY7/GY4

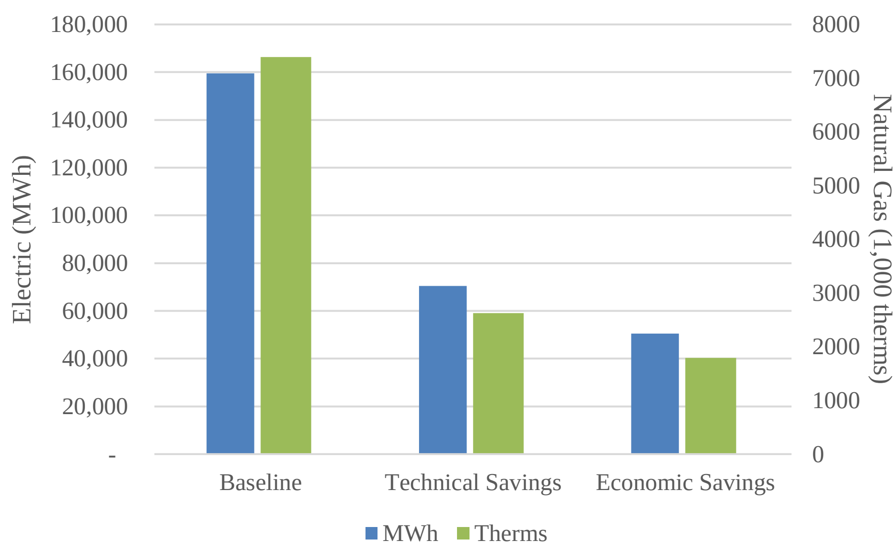


The following table and graph, present the technical and economic savings potential for libraries.

Table 25. Libraries - Technical and Economic Savings Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	159,506	44%	70,421	32%	50,445
Natural Gas (1,000 therms)	7,391	35%	2,623	24%	1,791

Figure 64. Libraries - Total Consumption and Savings Potential



The following figures break out the technical energy efficiency potential by measure for libraries.

Figure 65. Libraries - Electricity Technical Potential by Measure (MWh)

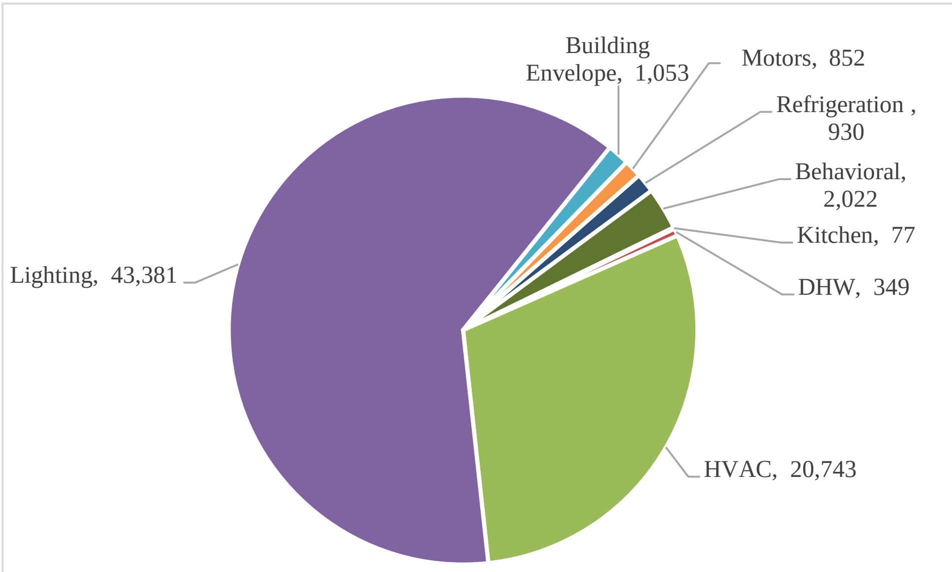
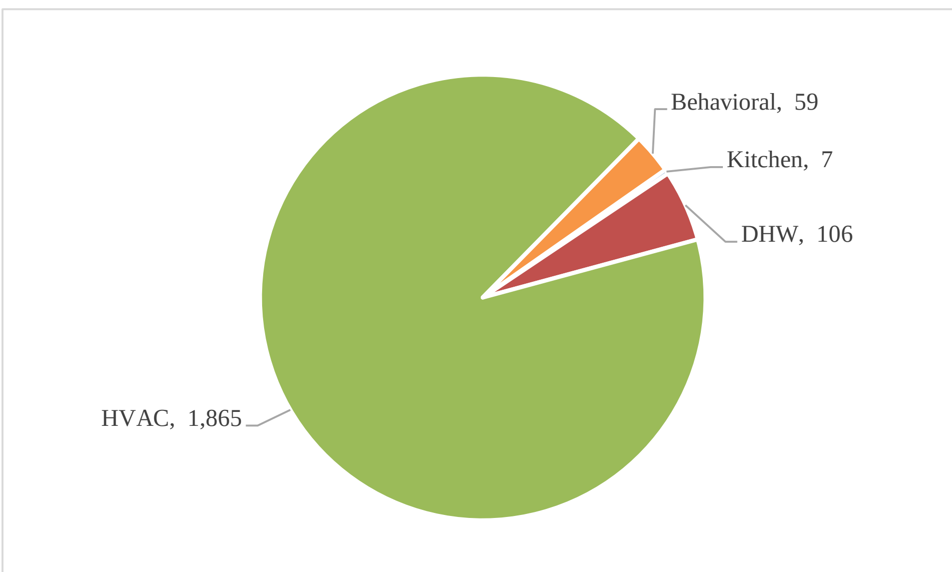


Figure 66. Libraries - Natural Gas Technical Potential by Measure (1,000 therms)



The following figures present the economic energy reduction potential by measure for libraries.

Figure 67. Libraries - Electricity Economic Potential by Measure (MWh)

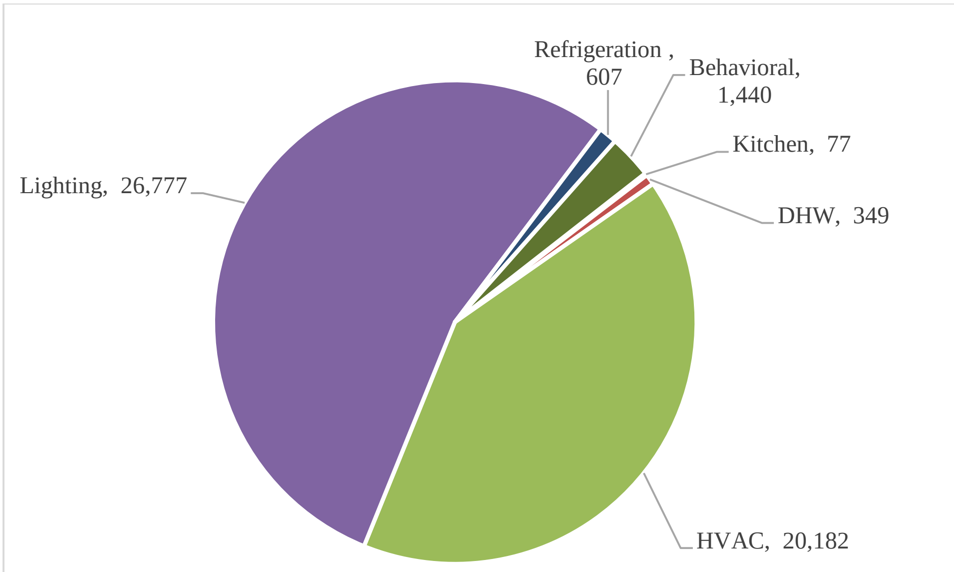
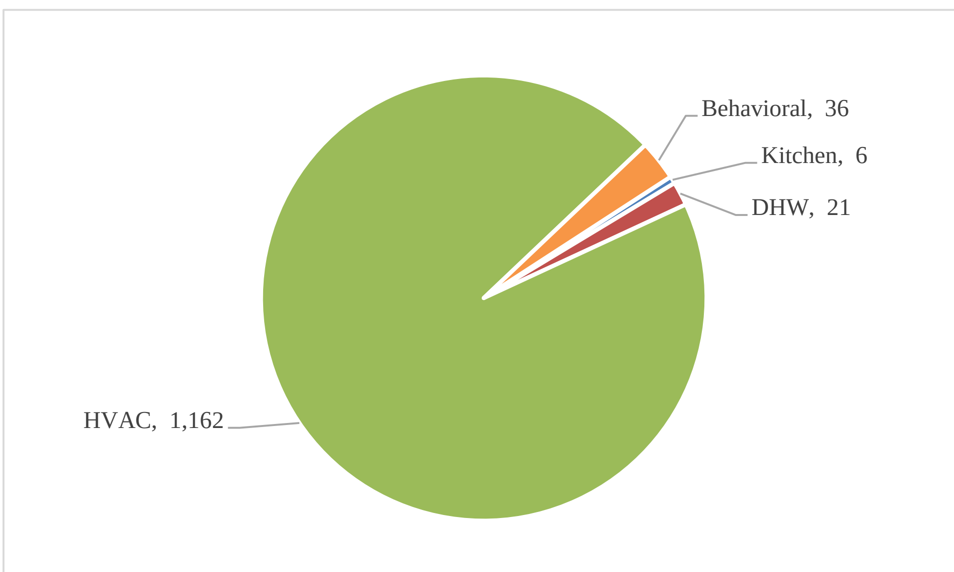


Figure 68. Libraries - Natural Gas Economic Potential by Measure (1,000 therms)



Considerations and Recommendations for Libraries:

The largest opportunity for electric savings in libraries is indoor and exterior lighting followed by HVAC upgrades. Significant savings can be achieved by replacing outdated linear fluorescent fixtures with higher efficiency fixtures and outdoor lighting applications such as metal halide fixtures with LED lighting. Training of staff in such things as following Energy Star guidelines for temperature settings and shutting off lights and equipment when not in use can help to capture behavioral savings as well.

On the natural gas side, consumption and potential are dominated by space heating applications. Equipment upgrades such as RTU or furnace replacements are required to realize savings.

4.6 Medical Facilities

There are 24 publicly owned community hospitals and 5 Veterans' Affairs (VA) hospitals in Illinois. Their size range, based on the number of licensed beds the hospital holds, is as follows:

Table 26. Population of Public Medical Facilities by Size Range

Number of Beds	Number of Hospitals	No. of Facilities participating in EEPS
More than 400	4	1
100 - 399	9	1
1 - 99	16	2

These hospitals account for 2.0% of Public Sector electricity consumption and 3.2% of natural gas consumption statewide.

During the timeframe PY5-7, only four hospitals (representing ~14% of the population by number of hospitals) participated in the DCEO Illinois Energy Now incentive programs, presenting an opportunity to tap into an under-served market. The completed hospital projects represent 2.3% of Public Sector electricity savings over that time period and 7.0% of natural gas savings. The vast majority of savings were from custom natural gas and electric projects, with additional kitchen-related, ventilation, and lighting savings.

Figure 69. Medical Facilities – Electricity Savings EY5/GY2-EY7/GY4

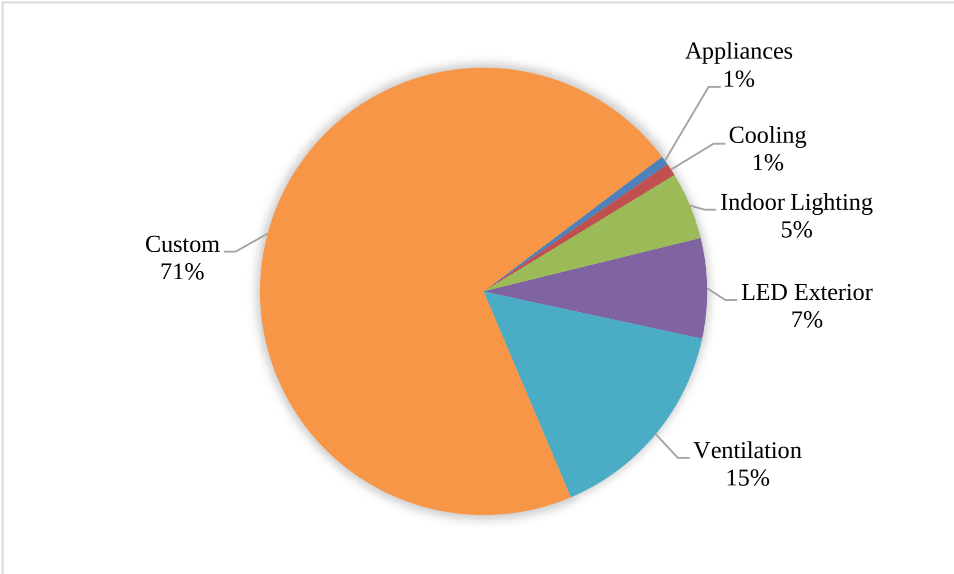
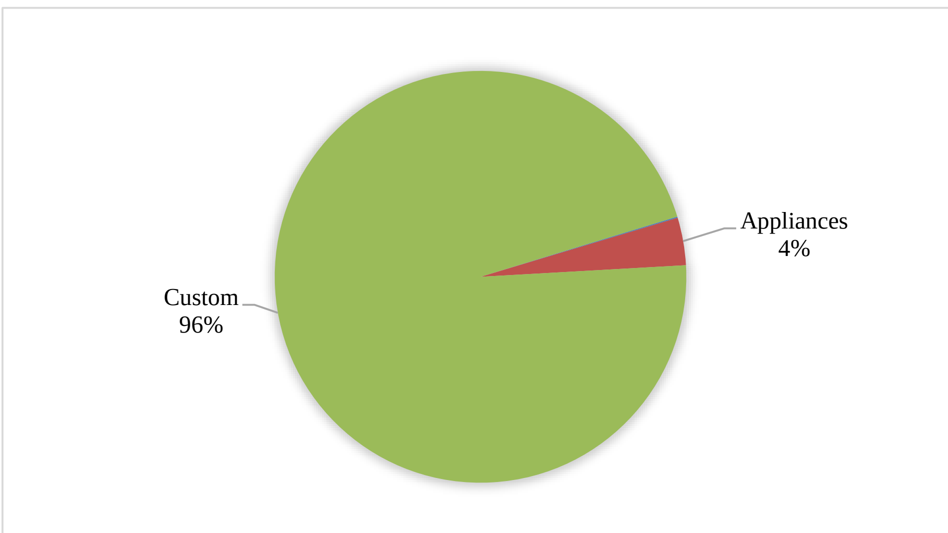


Figure 70. Medical Facilities – Natural Gas Savings EY5/GY2-EY7/GY4



The following figures summarize the energy consumption by system for medical facilities. Hospitals use large amounts of electricity for cooling, lighting and motors, while they use natural gas predominantly for heating.

Figure 71. Medical Facilities - Total Electricity Consumption (MWh)

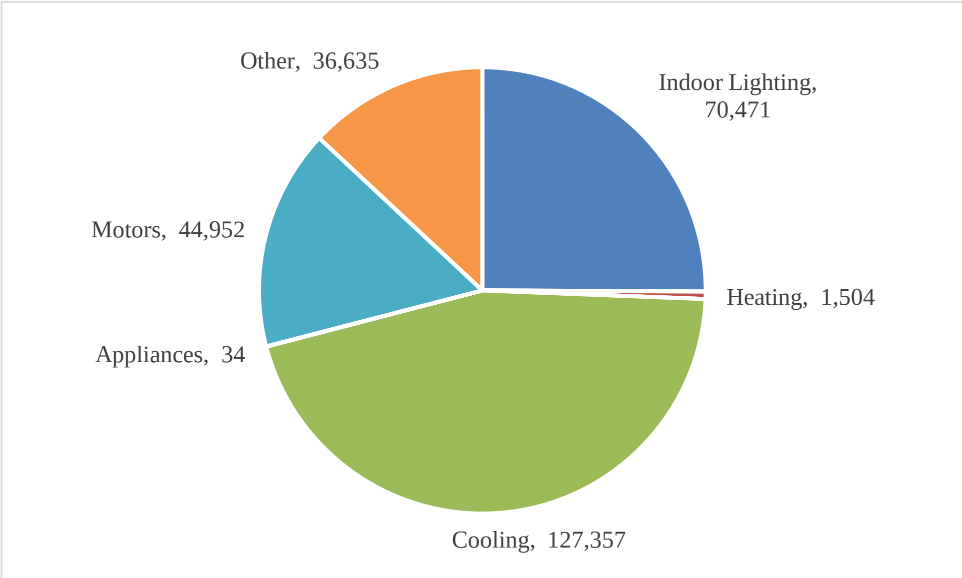
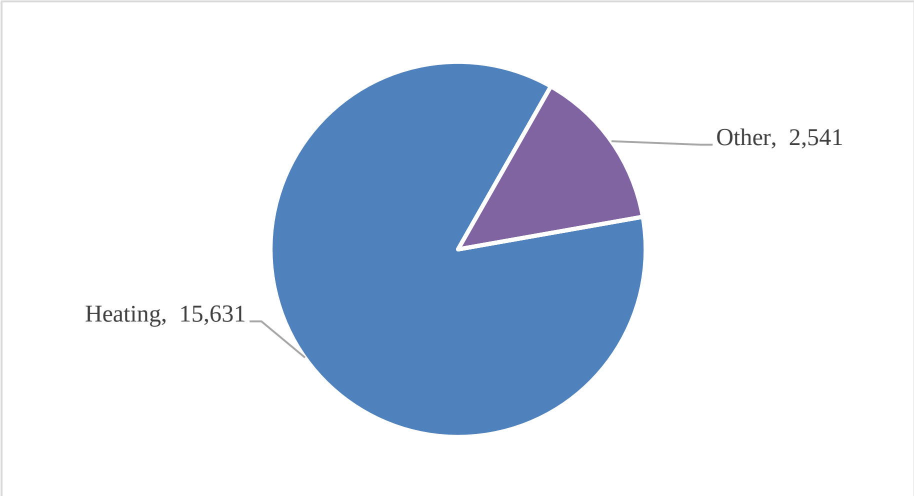


Figure 72. Medical Facilities - Total Natural Gas Consumption (1,000 Therms)

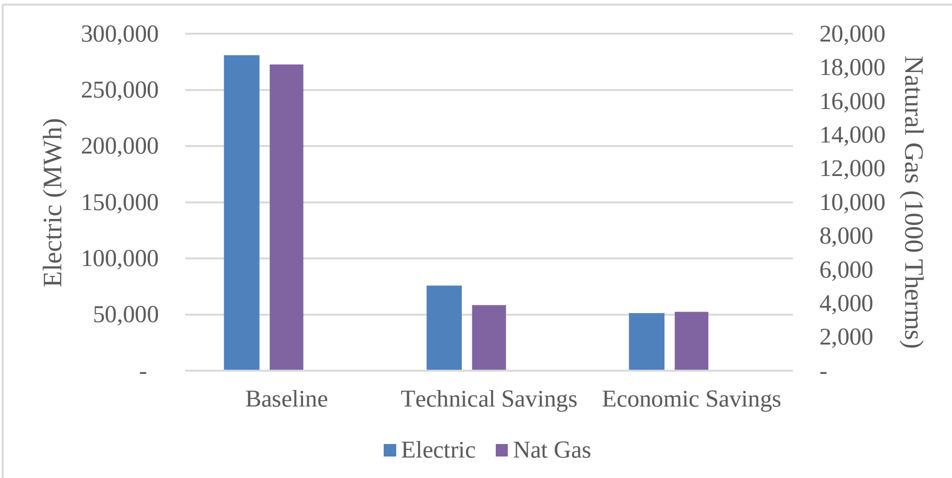


The following table and graph summarize the technical and economic potential for electric and natural gas efficiency in Medical facilities, both in percentage terms and MWhs and thousands of therms.

Table 27. Medical Facilities - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	280,953	27%	75,836	18%	51,386
Natural Gas (1,000 therms)	18,172	21%	3,901	19%	3,502

Figure 73. Medical Total Consumption and Savings Potential



The following figures present the technical energy reduction potential by measure for medical facilities.

Figure 74. Medical Facilities – Electricity Technical Potential (MWh)

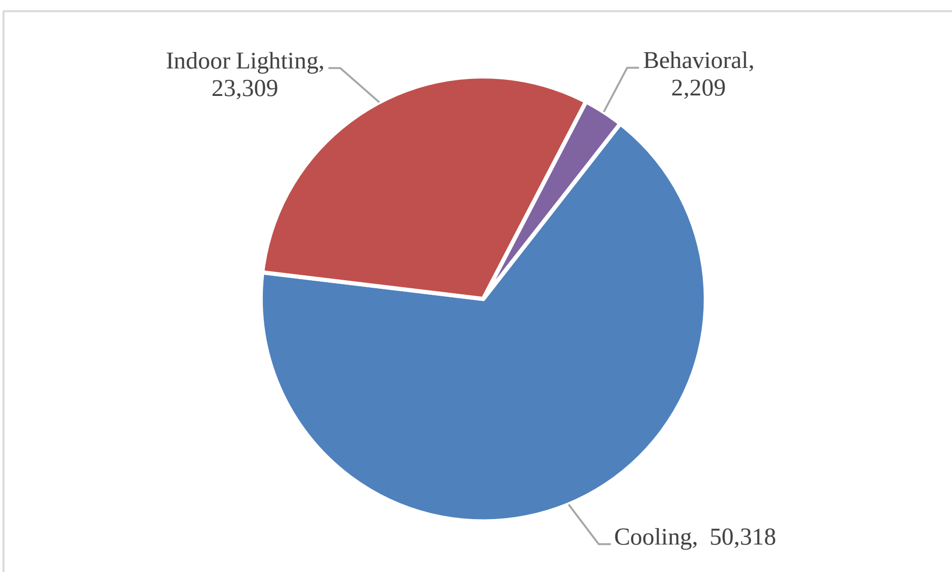
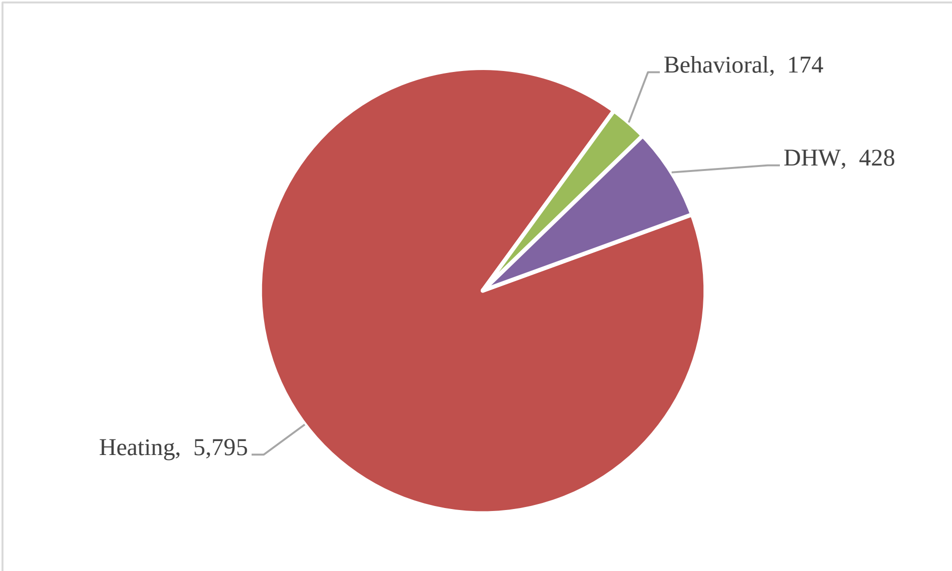


Figure 75. Medical Facilities - Natural Gas Technical Potential (1000 therms)



The following figures characterize the economic energy efficiency potential by measure for medical facilities.

Figure 76. Medical Facilities - Electricity Economic Potential (MWh)

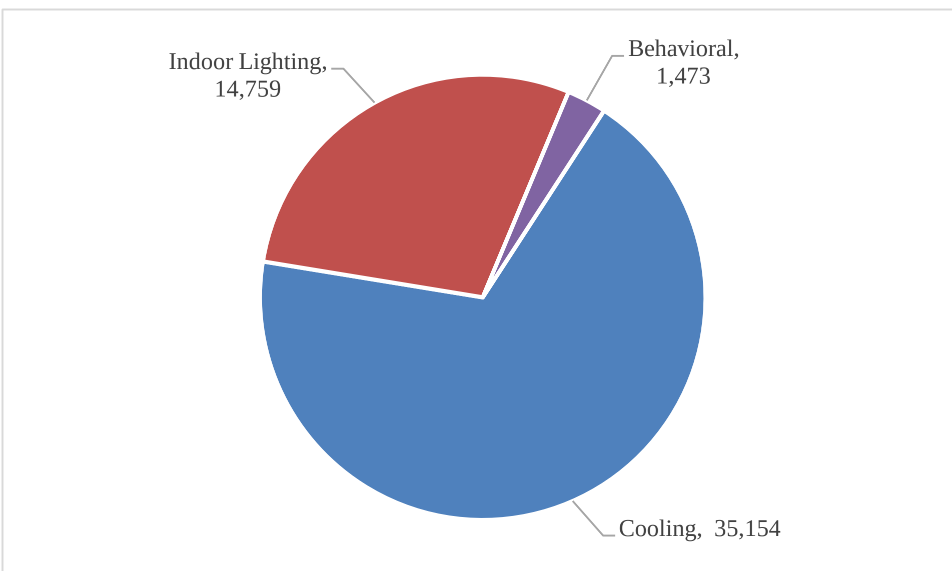
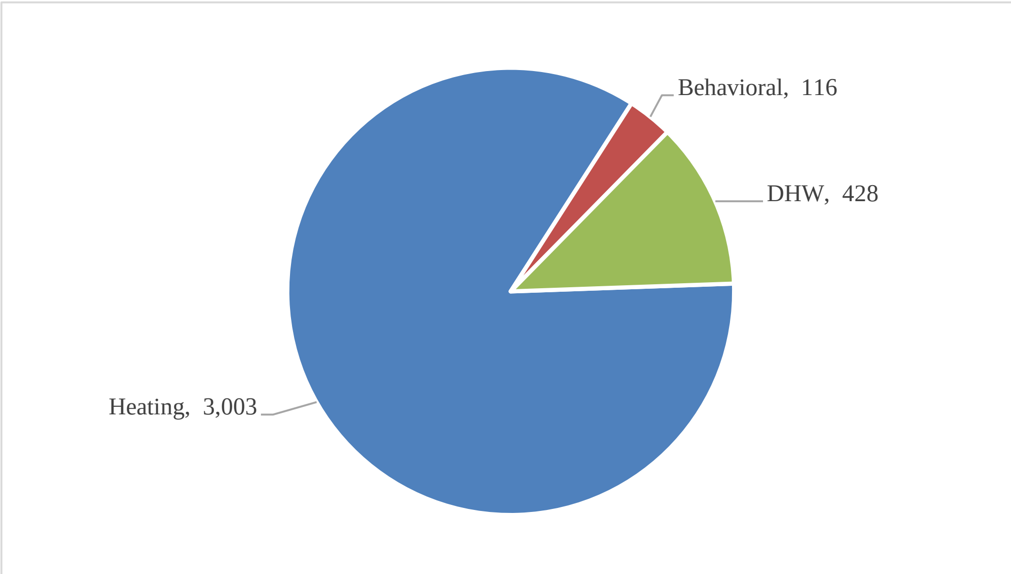


Figure 77. Medical Facilities - Natural Gas Economic Potential (1000 Therms)



Considerations and Recommendations for Medical Facilities:

Data for Medical Facilities was not as robust as in other sectors; therefore, the scope of the potential was narrowed to the systems that had available data. This is due to the small population of public hospitals and the lack of historical participation in the IL EEPS programs. Though many hospitals were contacted, much of their energy system information was not readily available. It should also be noted that medical facilities have special lighting, equipment and ventilation needs, making it difficult to judge where there is potential for energy savings.

Nevertheless, indoor lighting can be upgraded using advanced lighting technologies, and cooling and ventilation requirements could be met with more efficient centralized equipment and more extensive maintenance best practices. Thanks to the higher use, medical facilities can cost effectively implement the more advanced lighting technologies such as LED and induction lighting.

On the gas side, space heating shows the highest potential. Large Air Handling Units (AHU) and large boilers dominate the market and upgrading these custom designed packaged units is very difficult and expensive, but lifetime savings justify the investment. Laminar flow restrictors, considered part of the domestic hot water savings in the previous graphs, are a popular but still uncommon technology for this sector due to their large potential for natural gas savings. Laminar flow restrictors do not have a significant penetration into the Illinois market and have been included in the study of this sector.

Behavioral energy savings can be easily implemented at low cost although savings are not significant. Many hospitals illuminate empty patient rooms during the times when a patient is in physical therapy or generally out of the room. Other changes to energy behavior in hospitals might be more difficult to accomplish, as most nurses and staff maintain machine operation during downtimes in case of emergency. Additionally, patient comfort is considered paramount to energy costs within a hospital.

The sector is also a good candidate for Combined Heat and Power (CHP) applications with 24/7 steady operations and constant need throughout the year of both heating and cooling. Installation of absorption chillers would help to offset the summer peak demand and electric consumption while maintaining the efficiency of the CHP system to the maximum achievable level. Heating needs could be met by capturing the waste heat produced by the CHP system.

4.7 Municipal Facilities

The state of Illinois has the most units of local government in the U.S., some entities have multiple facilities and others only have a few buildings. Most of the municipal facilities are eligible for incentives under the Illinois Energy Now Portfolio of programs, unless served by electric cooperatives or municipal utilities. In many cases, facilities that are eligible for incentives do not have the necessary staff to apply for the incentive programs, and require additional assistance from the Department's Illinois Energy Now programs. As shown in Section 3.0, municipal facilities represent 35.4% of Public Sector electricity consumption and 16.0% of natural gas consumption.

During the PY5-7 timeframe a total of 344 facilities and approximately 34% of a random sample of municipal facilities surveyed have participated in the Department's Illinois Energy Now incentive programs. Municipal facilities accounted for 15.9% of Public Sector electric savings and 15.5% of Public Sector gas savings accomplished under the DCEO programs.

Table 28. Municipal Facilities - Participation in EE Programs

Local Govt. Unit	No. Participating	Total in State
City	66	324
Village	107	956
Town	4	19
Township	92	1,432
County	37	102
Transit Authorities	6	*
Planning Commissions	3	*
Muni. Corp/Special Districts	29	*
TOTAL	344	

*Illinois has more than 3,200 special districts, including many included in other sub-sectors (such as park districts, airport authorities, etc.).

As shown below, municipal facilities participated aggressively in the indoor lighting program and achieved significant electricity savings through indoor fluorescent and LED lighting, as well as exterior LED lighting upgrades, VFDs and heat pumps. Municipalities reduced natural gas consumption primarily through HVAC and boiler system upgrades, including tune-ups and steam trap replacements.

Figure 78. Municipal Facilities – Electric Savings EY5/GY2-EY7/GY4

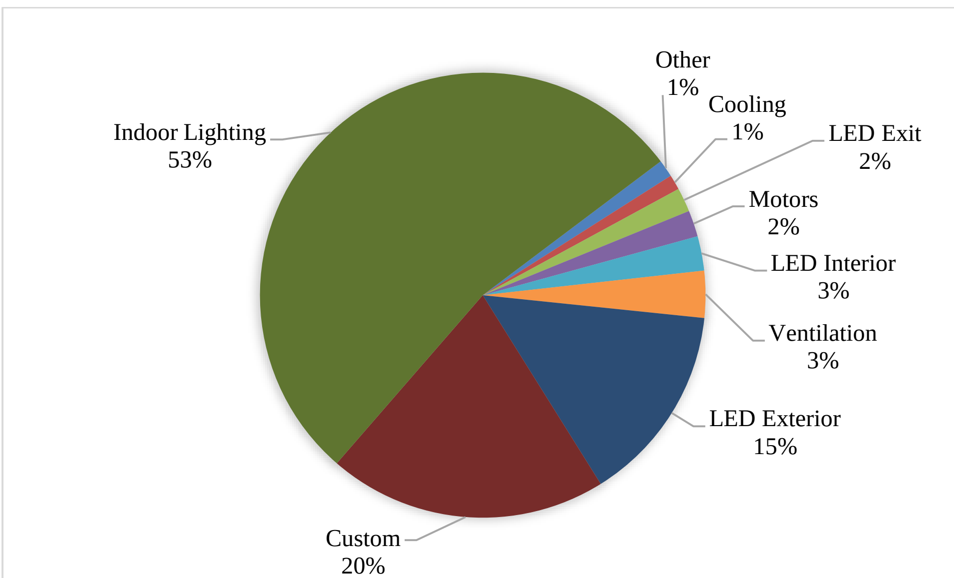
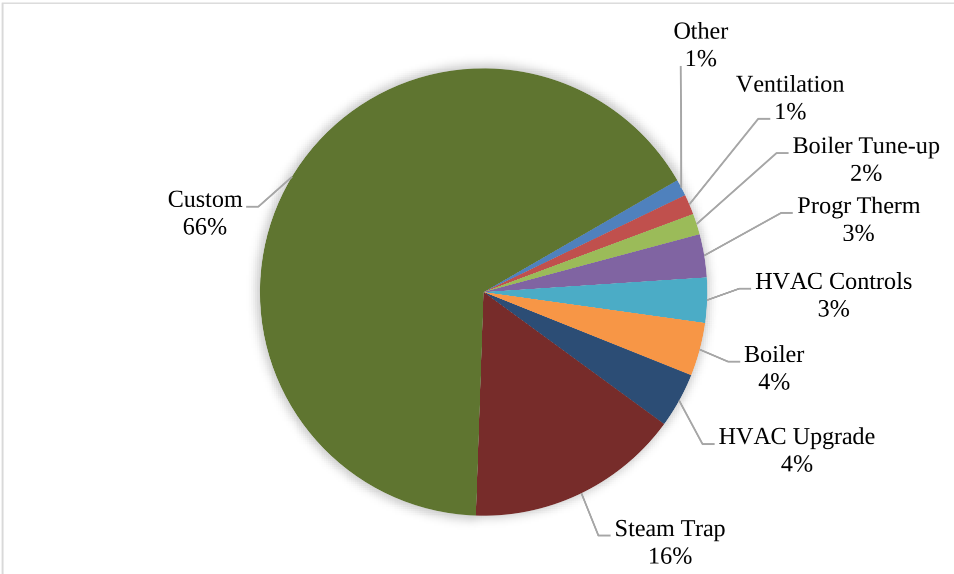


Figure 79. Municipal Facilities –Natural Gas Savings EY5/GY2-EY7/GY4



The following figures provide estimates of energy consumption by system for municipal facilities.

Figure 80. Municipal Facilities - Total Electric Energy Consumption (MWh)

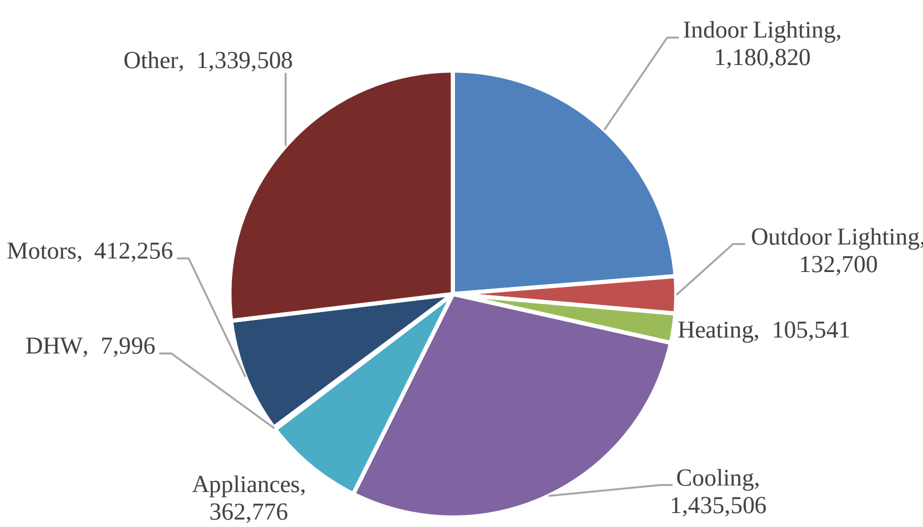
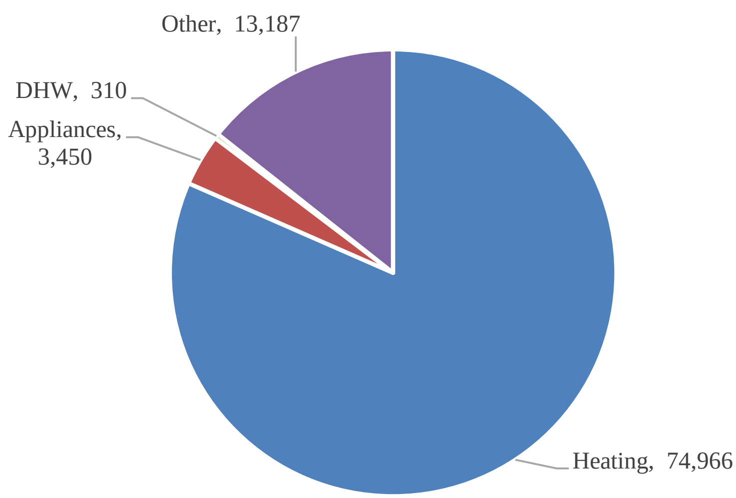


Figure 81. Municipal Facilities - Total Natural Gas Energy Consumption (1,000 therms)

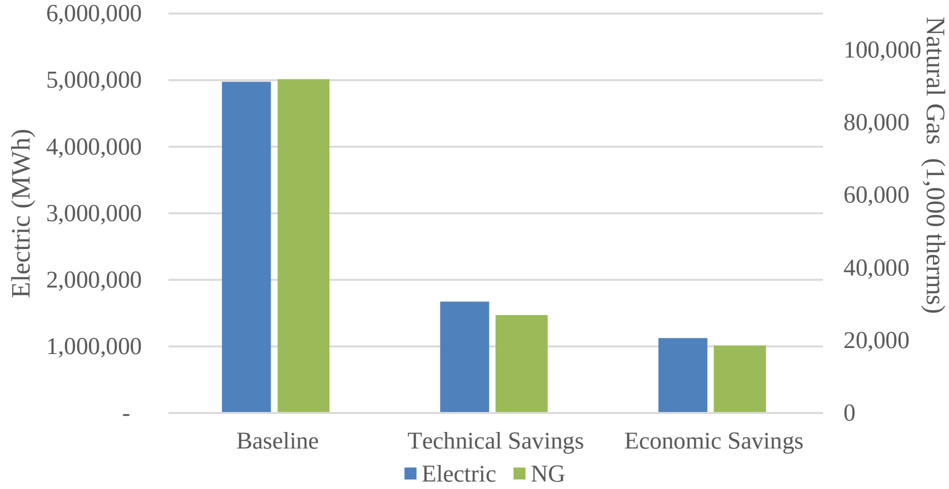


The following table and graph, present the technical and economic savings potential for municipal facilities.

Table 29. Municipal Facilities - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	4,977,102	34%	1,671,786	23%	1,123,154
Natural Gas (1,000 therms)	91,913	29%	26,834	20%	18,476

Figure 82. Municipal Facilities - Total Consumption and Savings Potential



The following figures represent the technical energy reduction breakdown by measures for municipal facilities.

Figure 83. Municipal Facilities – Electricity Technical Potential

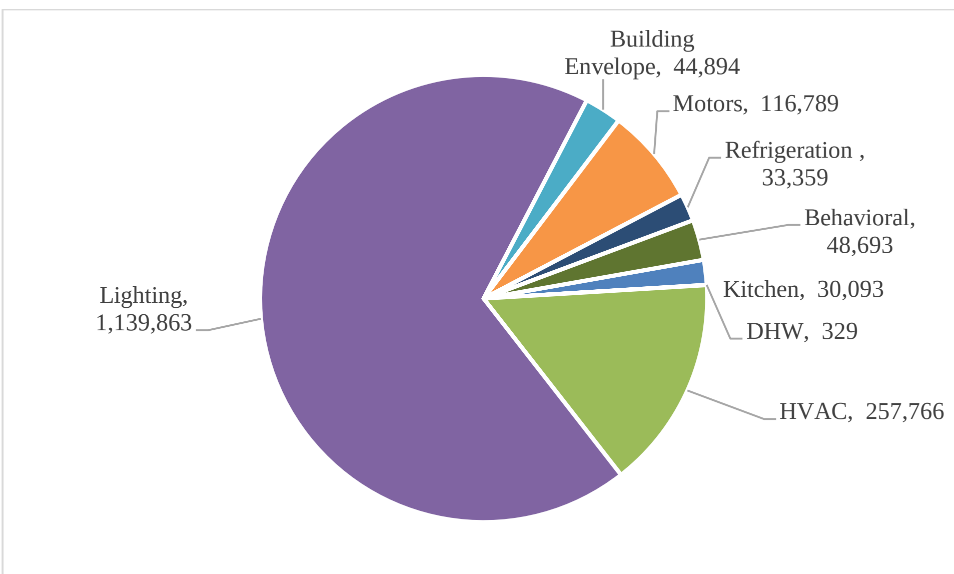
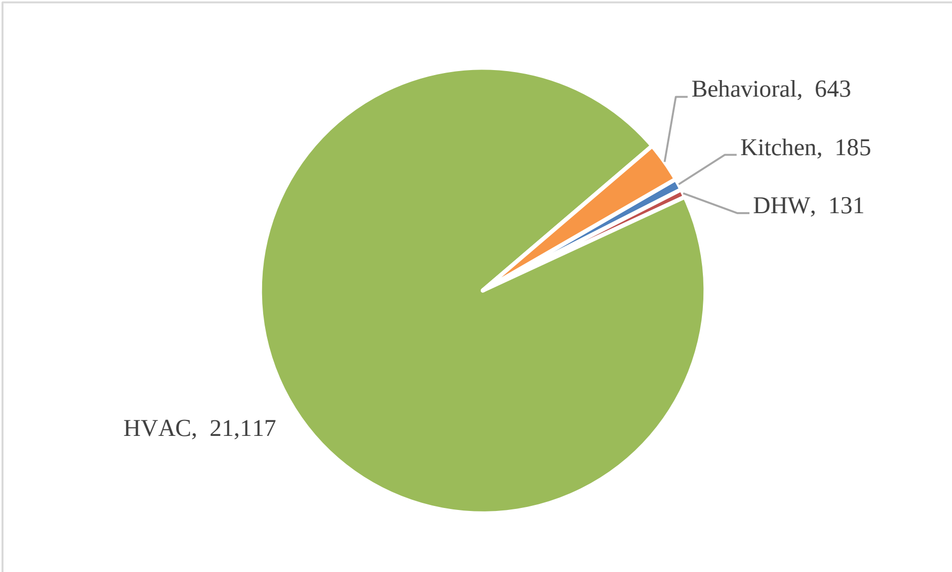


Figure 84. Municipal Facilities - Natural Gas Technical Potential (1,000 therms)



The following figures present the economic energy reduction potential by measure for municipal facilities.

Figure 85. Municipal Facilities - Electricity Economic Potential (MWh)

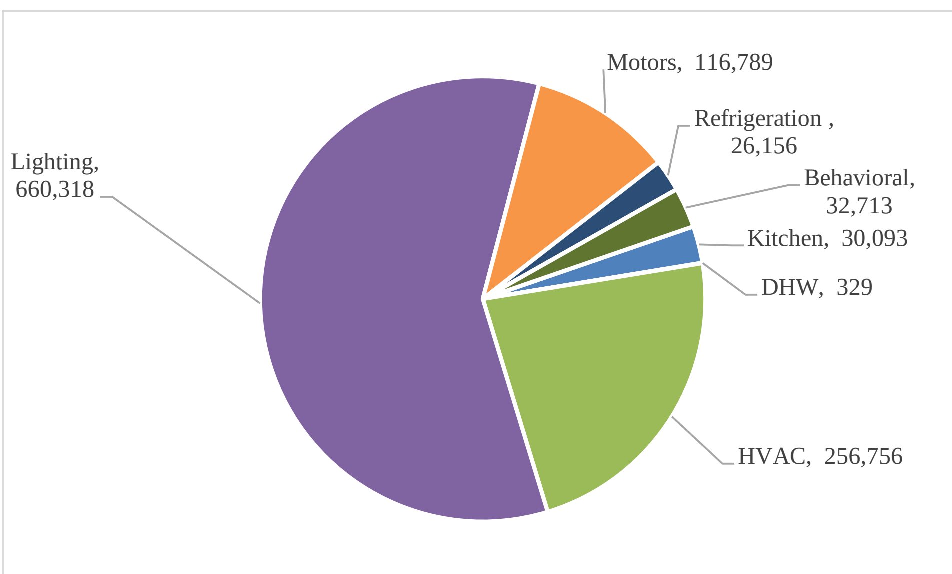
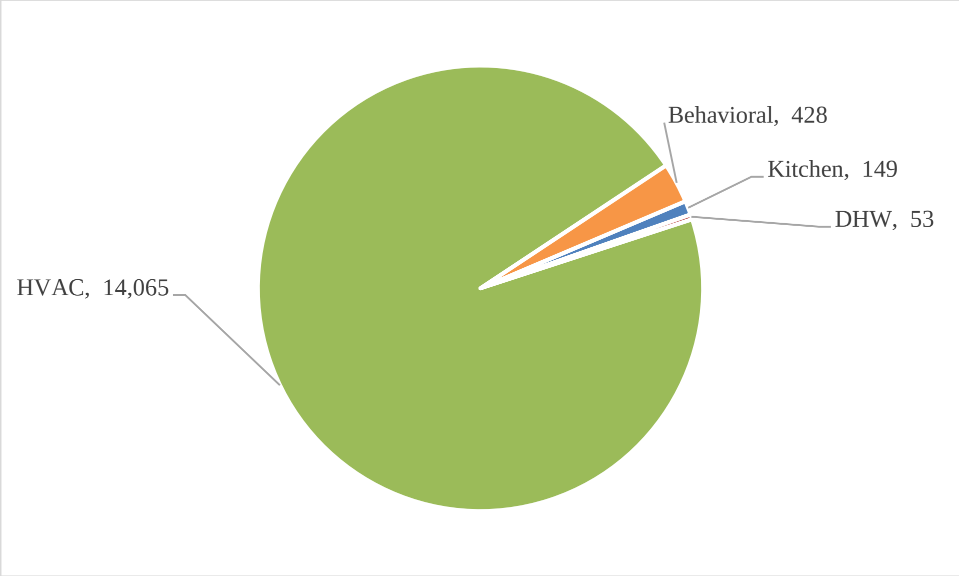


Figure 86. Municipal Facilities - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations:

Municipalities show one of the most diverse energy reduction potential in the Public Sector, reflecting the diverse energy use of the sub-sector itself. The largest savings opportunity is in indoor lighting where there is still a very significant potential for LED, induction or reduced wattage T8 lamps to retrofit standard T8 and T12 fixtures. Automated controls and occupancy sensors also show great potential and could be coupled with dimmable fixtures to further reduce the energy consumption. On outdoor applications, LED and induction lighting fixtures could be used.

While there is limited potential for equipment upgrades on the cooling side, simple low-cost to no-cost behavioral changes such as temperature set-back at night and during unoccupied times and/or correct use of programmable thermostats should be implemented to capture extremely cost-effective energy savings.

On the gas side, consumption and potential are dominated by space heating applications. Equipment upgrades are necessary to reduce consumption in the sector, but it should be noted that there are also opportunities for improving kitchen-related equipment.

4.8 Park Districts

Illinois has a total of about 370 sites that comprise districts, forest preserves, recreation associations and village or township parks. All the sites are eligible for incentives under the Illinois Energy Now Portfolio of programs that are located in participating utility territories. As shown in Section 3.0, these sites represent 3.0% of Public Sector electricity consumption and 4.7% of natural gas consumption.

During the past three program years, 100 districts, 3 forest preserves, 4 recreation associations and 56 village or township parks have participated in the Illinois Energy Now incentive programs. Parks accounted for 5.2% of Public Sector electric savings and 4.2% of Public Sector natural gas savings accomplished under the Department's programs.

Table 30: Park Districts – Breakdown of Facilities Participating in EE Programs

	No. of Sites
Districts	100
Forest Preserves	3
Recreation Associations	4
Village or Township Parks	56
Total Participating in Energy Efficiency Programs	163

Table 31. Park Districts – Population and Participation in EE Programs

	No. of Sites
Participating in Energy Efficiency Programs	107
Total Population	370
Percent	28.9%

Note: The number of village or township parks is unknown, so participation is calculated based on the participation rate of park districts, forest preserves, and recreation associations based on population numbers from the Illinois Association of Park Districts.

As shown below, park districts reduced energy consumption through indoor lighting like most subsectors, but also achieved electricity savings through exterior LED lighting, HVAC upgrades and participation in the New Construction Program. Park districts natural gas consumption reduction comes primarily from HVAC and boiler system upgrades including tune-ups and steam trap replacements.

Figure 87. Park Districts – Electricity Savings EY5/GY2-EY7/GY4

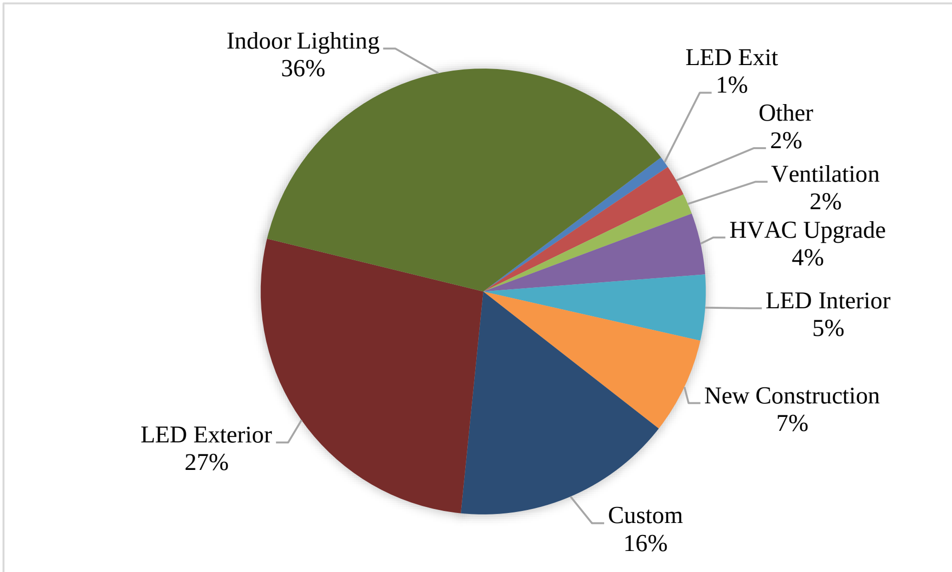
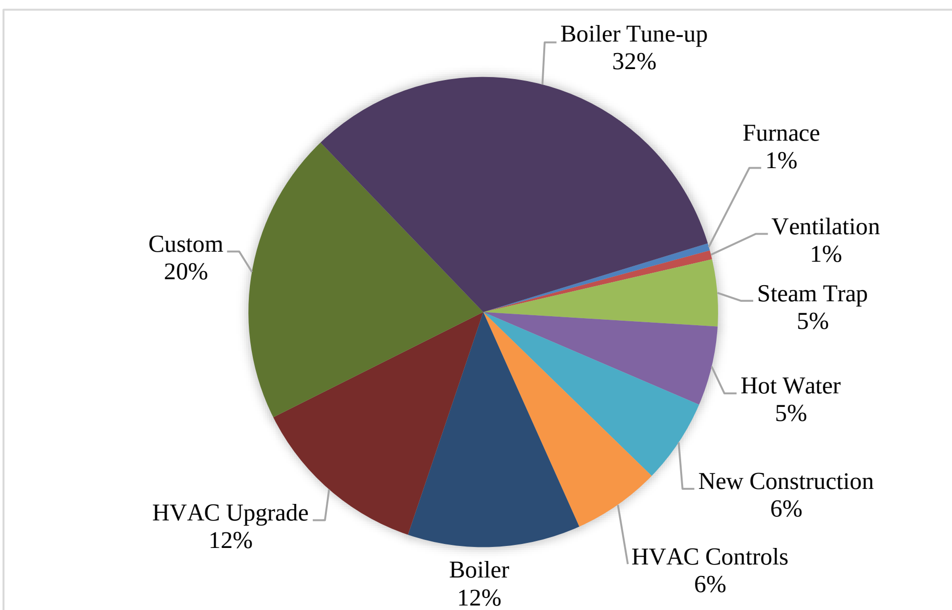


Figure 88. Park Districts – Natural Gas Savings EY5/GY2-EY7/GY4



The following graphs break out the estimated energy consumption by system for park facilities. While lighting electricity consumption is significant, cooling is the largest electrical load in park facilities. Heating/HVAC equipment dominates natural gas use but large amounts of gas are also used for pools and kitchen facilities.

Figure 89. Park Districts – Electricity Consumption (MWh)

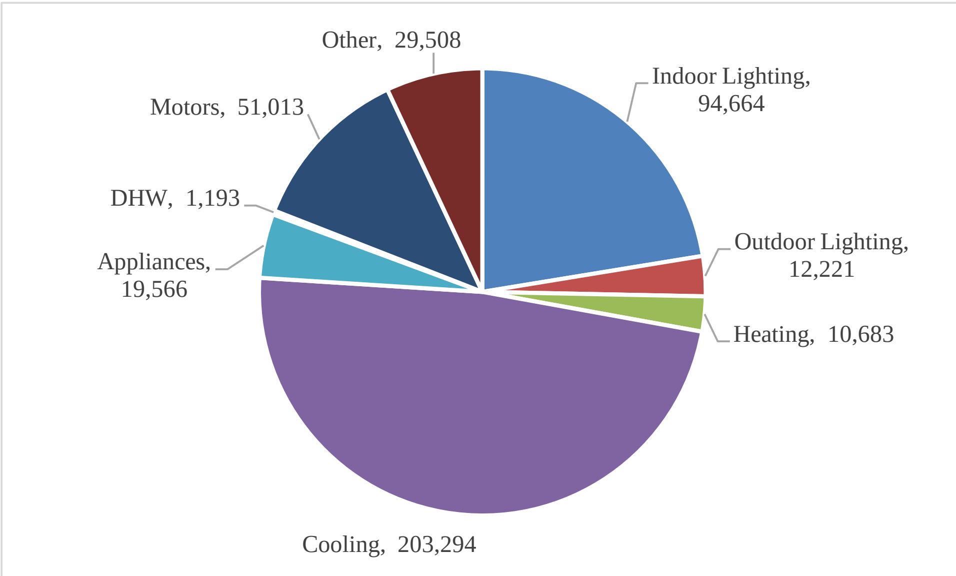
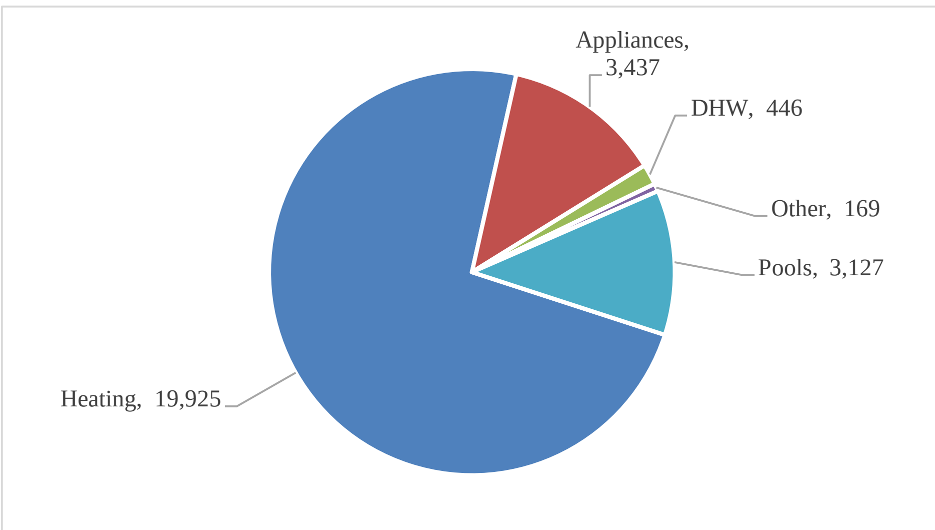


Figure 90. Park Districts – Natural Gas Consumption (MWh)

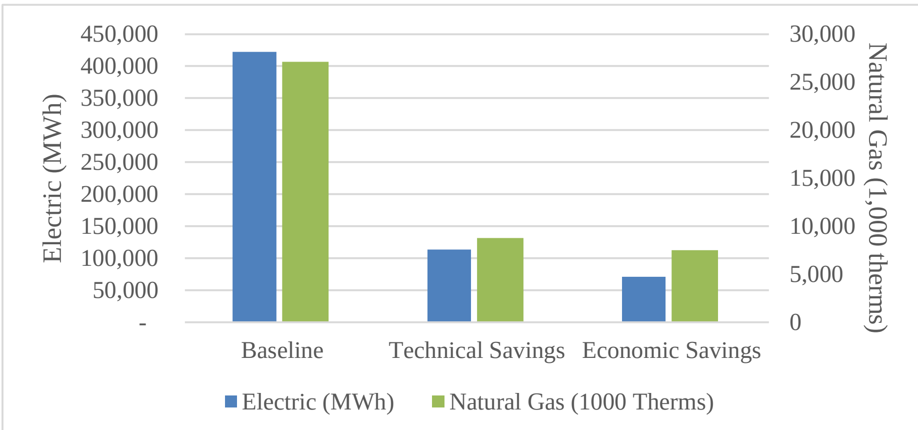


The following table and graph, represent the technical and economic savings potential for park districts.

Table 32. Park Districts - Technical and Economic Savings Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	422,141	27%	113,540	17%	70,884
Natural Gas (1,000 therms)	27,104	32%	8,756	28%	7,489

Figure 91. Park Districts - Total Consumption and Savings Potential



The following figures present the technical energy reduction potential by measure for park districts.

Figure 92. Park Districts - Electricity Technical Potential (MWh)

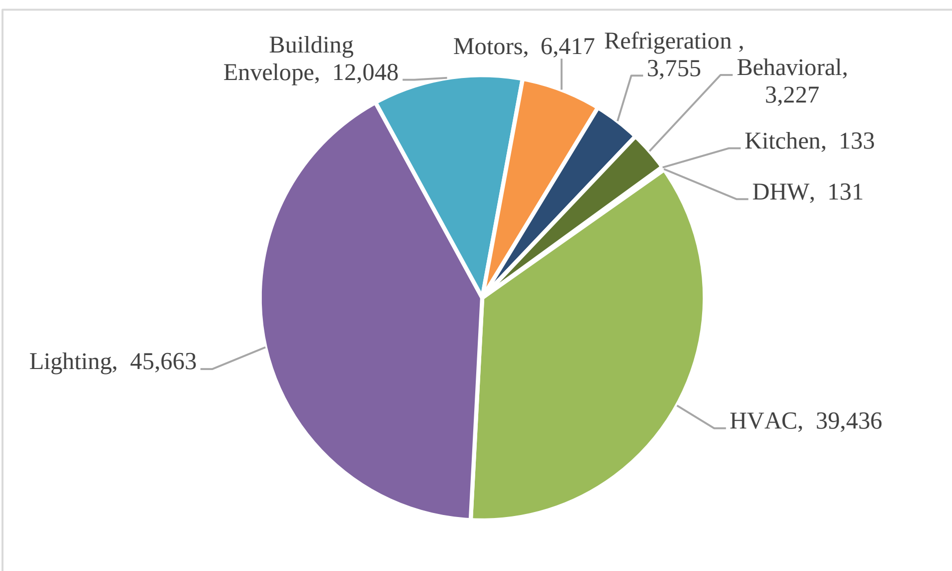
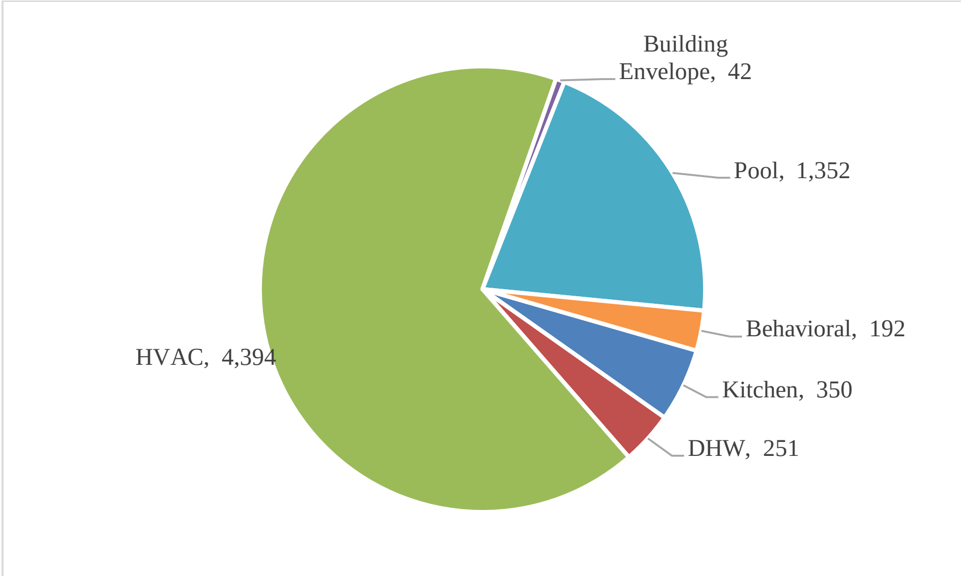


Figure 93. Park Districts - Natural Gas Technical Potential (1,000 therms)



The following figures represent the economic energy reduction breakdown by measure for park districts.

Figure 94. Park Districts Electricity Economic Potential by Measure (MWh)

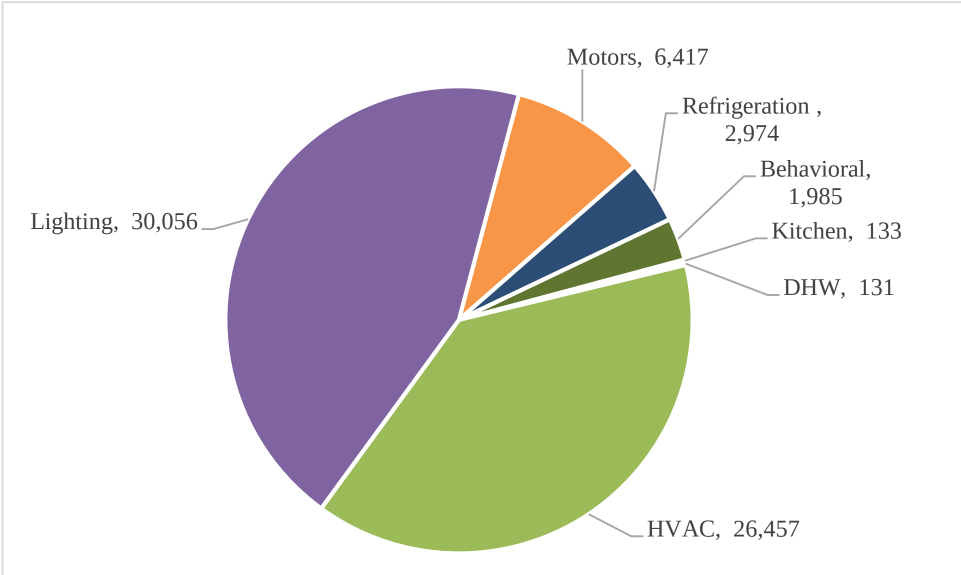
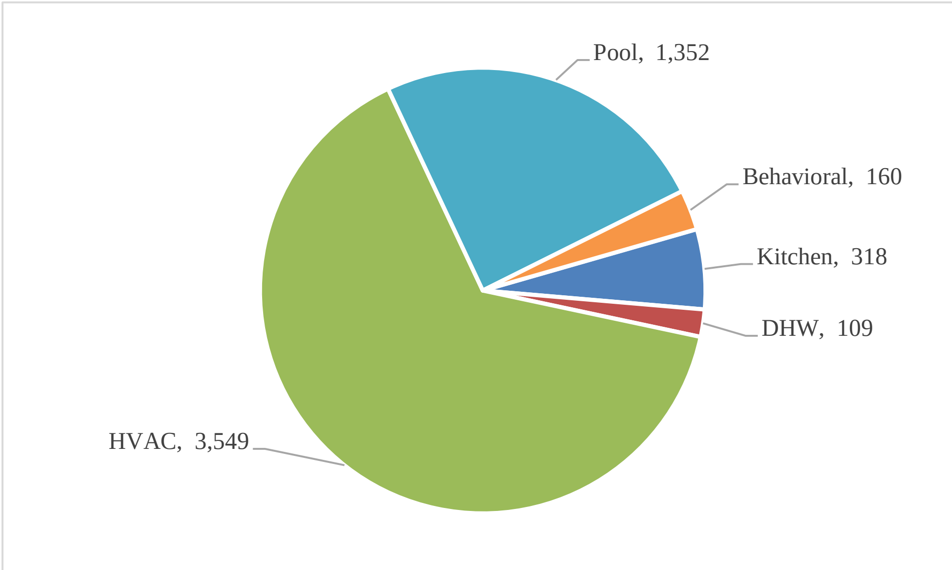


Figure 95. Park Districts - Natural Gas Economic Potential by Measure (1,000 therms)



Considerations and Recommendations:

The largest opportunity for electric savings in parks is indoor and exterior lighting closely followed by HVAC applications. Significant savings can be achieved by replacing outdated linear fluorescent fixtures with higher efficiency fixtures and outdoor lighting applications such as metal halide fixtures with LED lighting.

On the natural gas side, consumption and potential are dominated by space heating applications. To realize both cooling and heating related savings equipment upgrades such as thermostats, RTU, furnace or condensing unit replacements are required.

In addition facilities with indoor pools can realize natural gas savings by installing pool covers, higher efficiency dehumidifiers and pool heating equipment. These facilities would especially benefit from advice regarding desirable balance between pool temperature and natatorium space temperature.

4.9 Police and Fire Stations

Illinois has a total of 1,869 police and fire stations. Most of the stations are eligible for incentives under the Illinois Energy Now Portfolio of programs unless served by electric cooperative or municipal utilities. As shown in Section

3.0, police and fire departments represent 1.2% of Public Sector electricity consumption and 1.0% of natural gas consumption.

During the past three program years a total of 233 stations overall, and approximately 22% of the random sample of police and fire departments have participated in the Illinois Energy Now incentive programs. These departments accounted for 3.6% of Public Sector electric savings and 1.9% of Public Sector natural gas savings accomplished under the Department's programs.

Table 33. Police and Fire Stations - Participation in EE Programs

Department	Total Departments in State	Participation	No. of Sites
Fire	1,091	141	247
Police	778	74	96
Joint Police/Fire	-	18	24
Total	1869	233	367

As shown below, police and fire stations participated aggressively in the lighting program and achieved significant electric savings through indoor lighting and exterior LED lighting, as well as new construction, and custom upgrades. Police and Fire Stations reduced natural gas consumption primarily through HVAC and boiler system upgrades, including tune-ups and boiler controls.

Figure 96. Police and Fire – Electricity Savings EY5/GY2-EY7/GY4

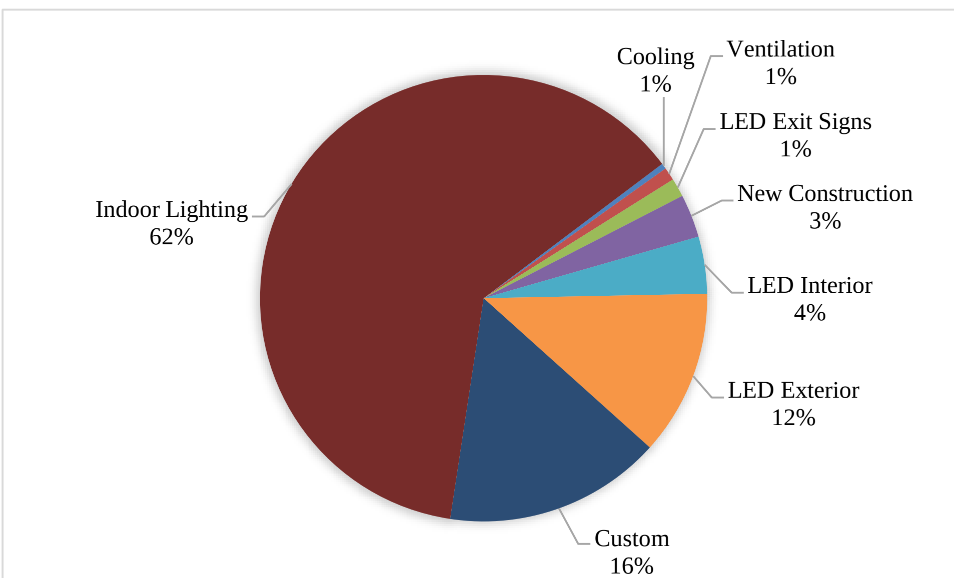
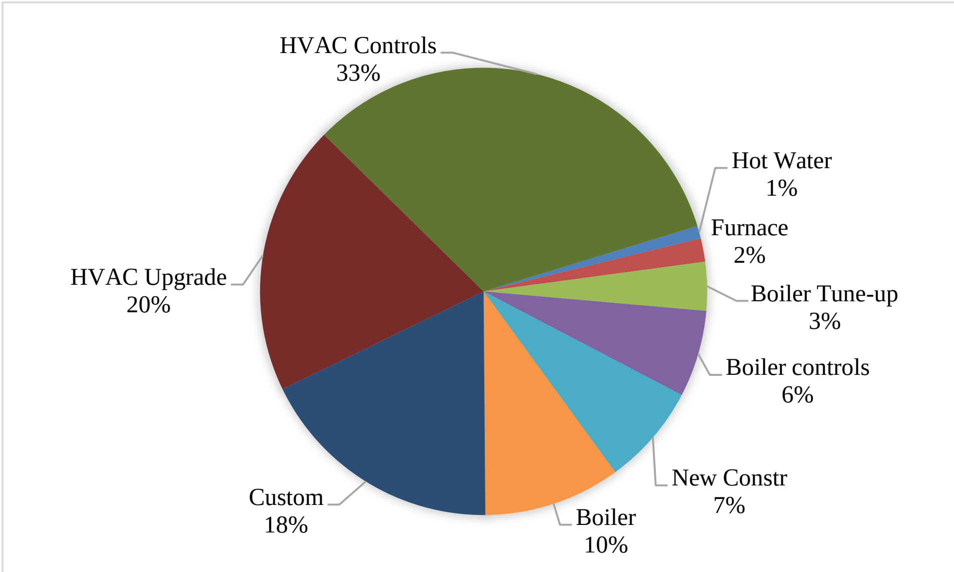


Figure 97. Police and Fire – Natural Gas Savings EY5/GY2-EY7/GY4



The following figures display the breakdown of energy consumption by system for police and fire stations. Cooling and heating demand, given the 24-hour, 365-day operation of most stations, dominate the electric and natural gas demand of the stations.

Figure 98. Police and Fire - Total Electric Consumption (MWh)

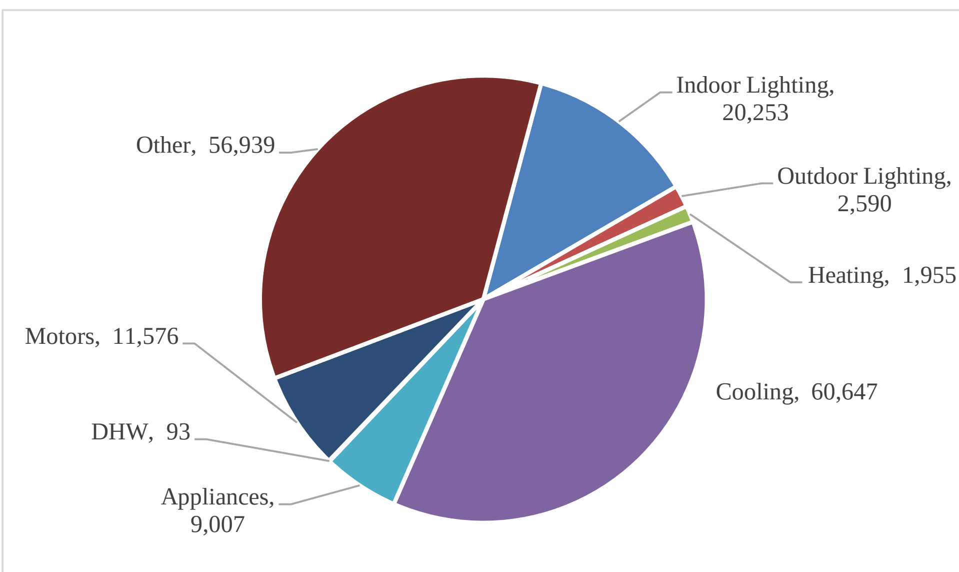
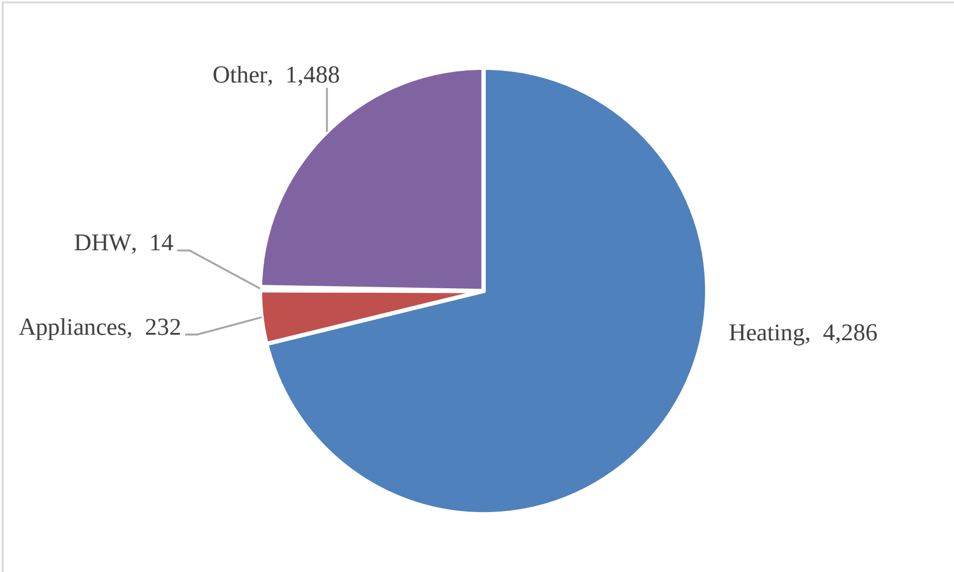


Figure 99. Police and Fire - Total Natural Gas Consumption (1,000 therms)

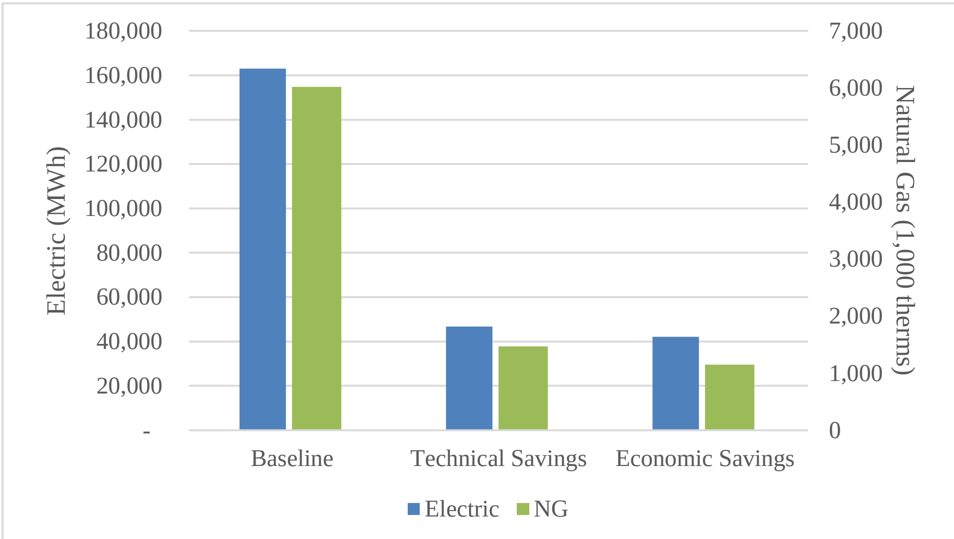


The following table and graph denote the percent savings for the technical and economic reduction potential and show the total savings potential for each compared to the total consumptions determined for police and fire stations.

Table 34. Police and Fire - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	163,060	29%	46,708	26%	42,066
Natural Gas (1,000 therms)	6,021	24%	1,467	19%	1,152

Figure 100. Police and Fire - Total Consumption and Savings Potential



The following figures show the technical potential for energy efficiency by measure in police and fire stations.

Figure 101. Police and Fire - Electricity Technical Potential (MWh)

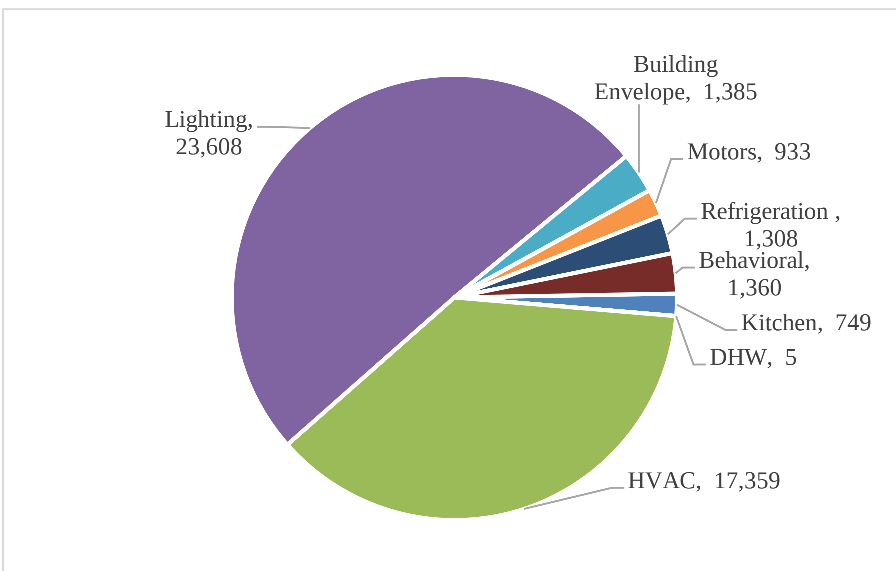
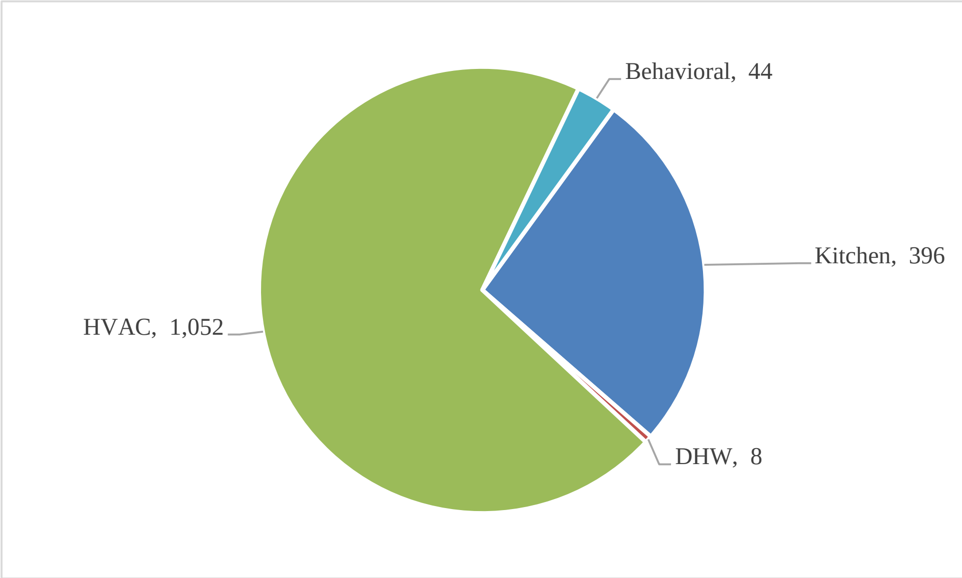


Figure 102. Police and Fire - Natural Gas Technical Potential (1,000 therms)



The following figures display the estimated the economic potential for energy efficiency by measure for police and fire stations.

Figure 103. Police and Fire - Electricity Economic Potential (MWh)

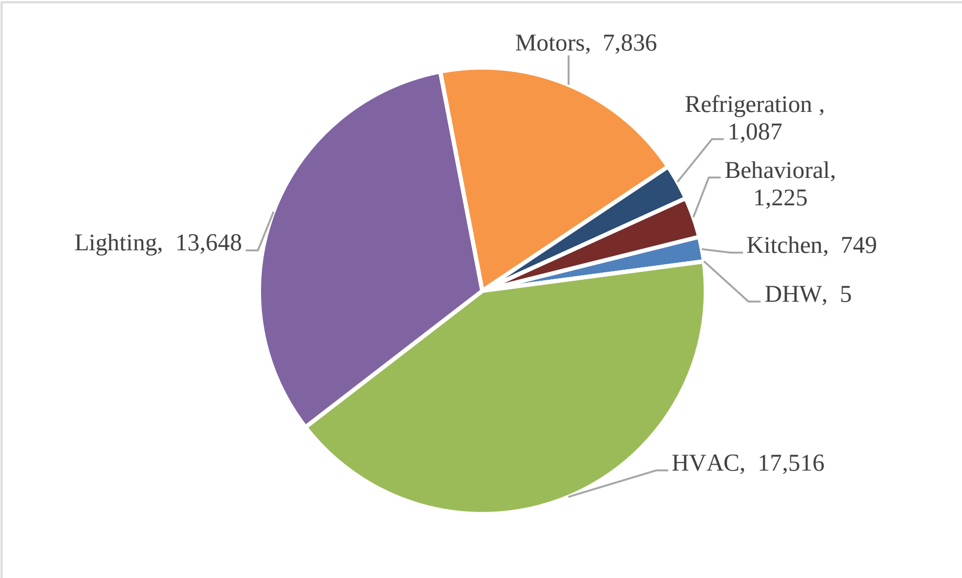
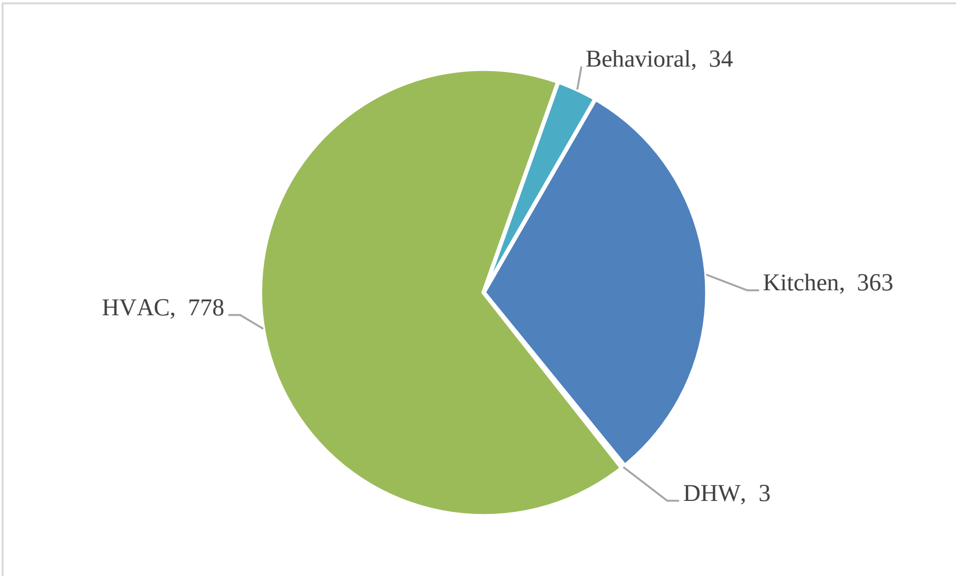


Figure 104. Police and Fire - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Police and Fire Stations:

The electric potential is dominated by waste related to cooling. The savings potential achievable through equipment upgrades is increased by the high hours of operation that characterize the sector. There is also potential for indoor lighting upgrades where, due to high hours of use, lighting technologies such as linear LEDs can be used in place of linear fluorescent lights currently installed. For outdoor applications, lighting technologies such as LED or Induction can also be used to capture and realize the savings.

On the natural gas side, savings potential is once again dominated by space heating applications, particularly hydronic boilers, but potential for kitchen-related and behavioral savings is also significant. Temperature set points were found to be outside the Energy Star recommendations and could be changed without sacrificing occupants' comfort, producing no cost behavioral energy savings. There is also an opportunity for advanced controls such as building automation systems with multiple zones since facilities tend to be fully occupied only during normal business hours and are only partially occupied at nighttime. This means that unoccupied space is heated and conditioned when not needed.

4.10 Public Works

Illinois has the greatest number of local governmental units among the states, and many of the larger cities, villages, and towns of Illinois have public works departments. Their facilities are eligible for incentives under the Illinois Energy Now Portfolio of programs unless served by electric cooperatives or municipal utilities. As shown in Section 3.0, public works account for 0.9% of Public Sector electricity consumption and only 1.2% of natural gas consumption.

During the PY5-7 timeframe 91 cities, towns and villages that have public works departments have participated in the Department's Illinois Energy Now incentive programs. Public works accounted for 1.5% of Public Sector electric savings and 0.2% of Public Sector natural gas savings accomplished under the Department's programs.

As shown below, public works participated aggressively in the lighting Program and achieved significant electricity savings through indoor lighting, as well as exterior LED lighting and custom upgrades. Public works reduced natural gas consumption primarily through HVAC upgrades, new construction, HVAC tune-ups and HVAC controls.

Figure 105. Public Works – Electricity Savings EY5/GY2-EY7/GY4

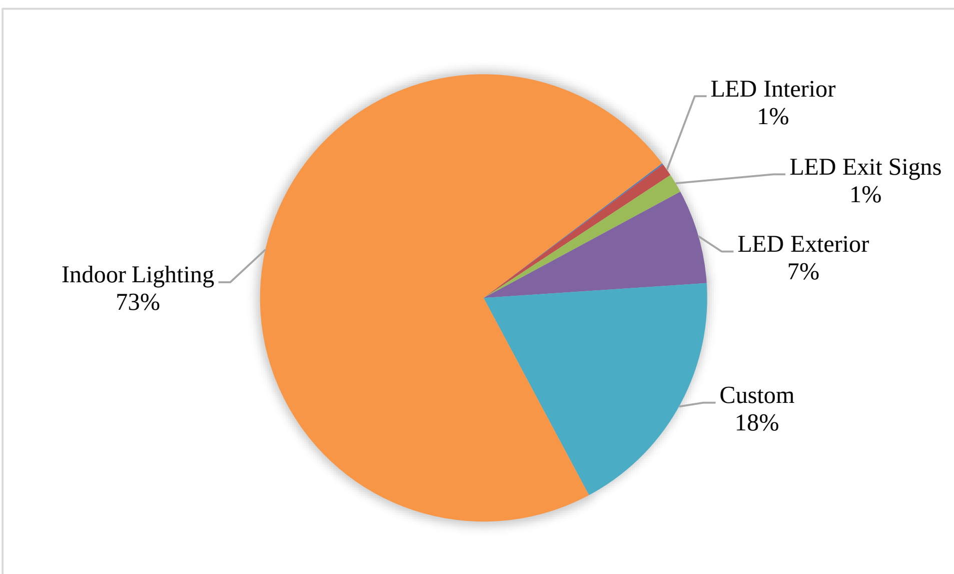
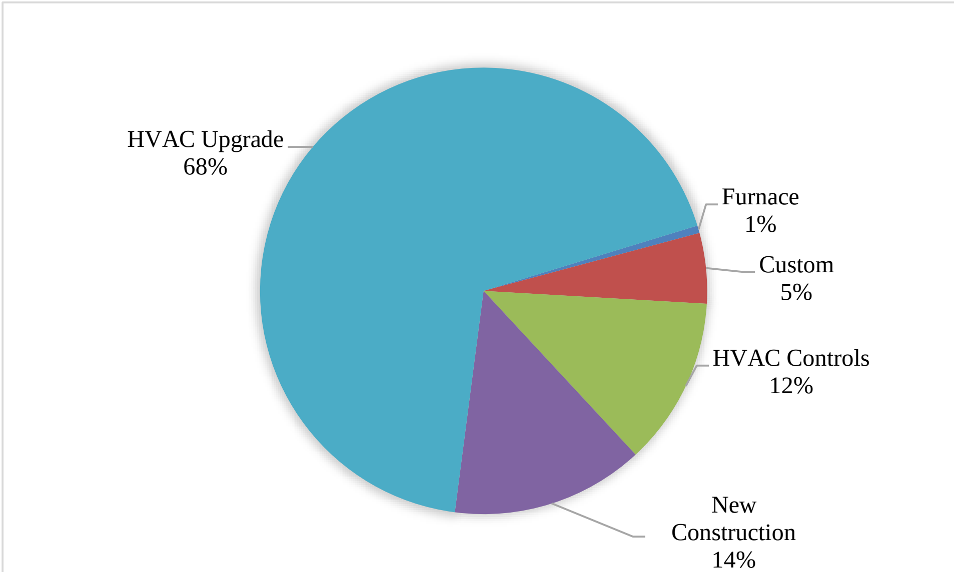


Figure 106. Public Works – Natural Gas Savings EY5/GY2-EY7/GY4



The following figures represent the estimated energy consumption by system for public works facilities. Cooling and lighting loads are the largest for electricity and space heating for natural gas.

Figure 107. Public Works - Total Electricity Consumption (MWh)

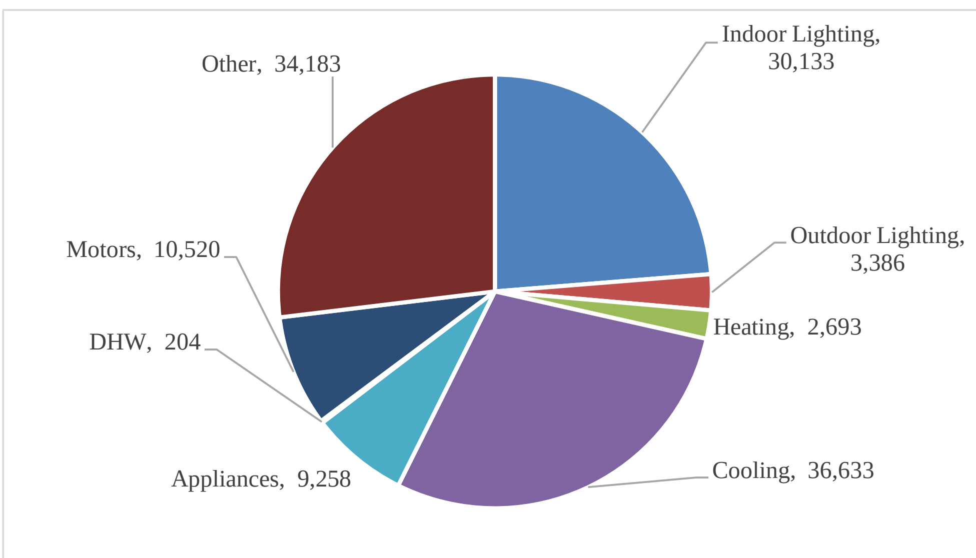
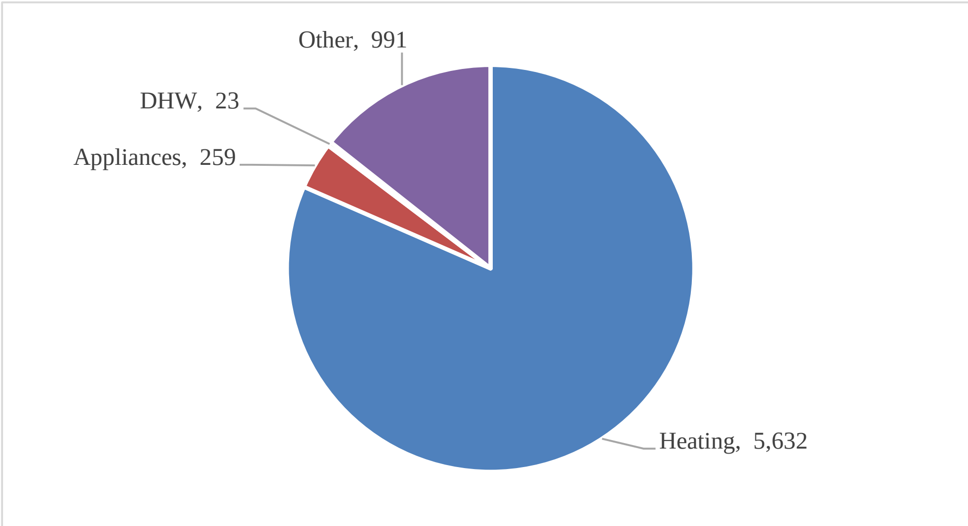


Figure 108. Public Works - Total Natural Gas Energy Consumption (1,000 therms)

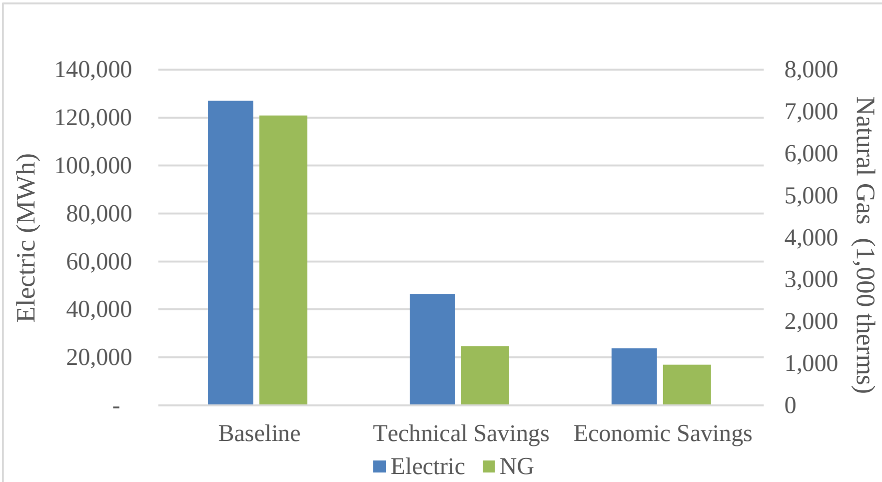


The following table and graph summarize the technical and economic potential for energy efficiency in public works facilities by percentage reduction from base consumption and in absolute terms.

Table 35. Public Works - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	127,011	37%	46,476	19%	23,809
Natural Gas (1,000 therms)	6,905	20%	1,411	14%	968

Figure 109. Public Works - Total Consumption and Savings Potential



The following figures present the technical energy potential by measure for public works facilities.

Figure 110. Public Works – Electricity Technical Potential (MWh)

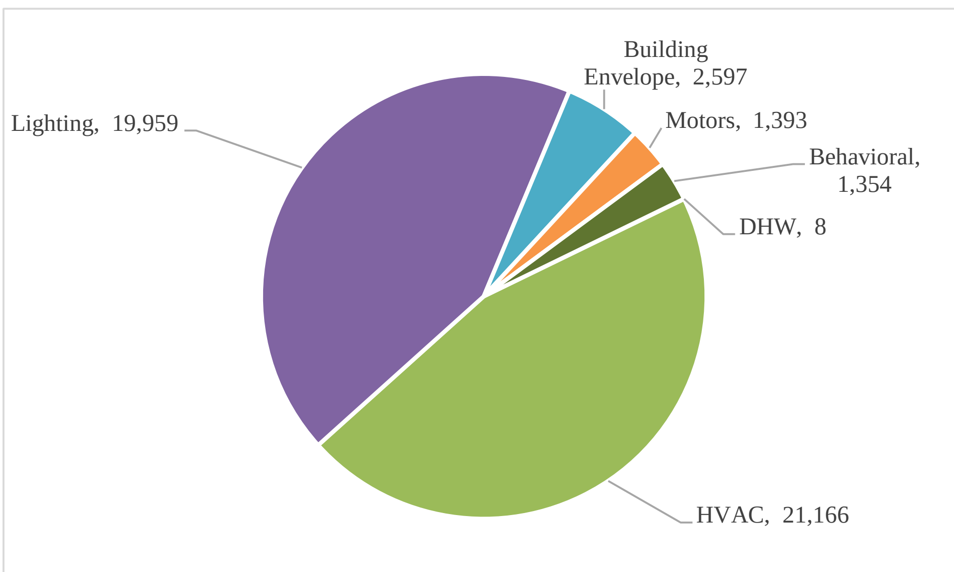
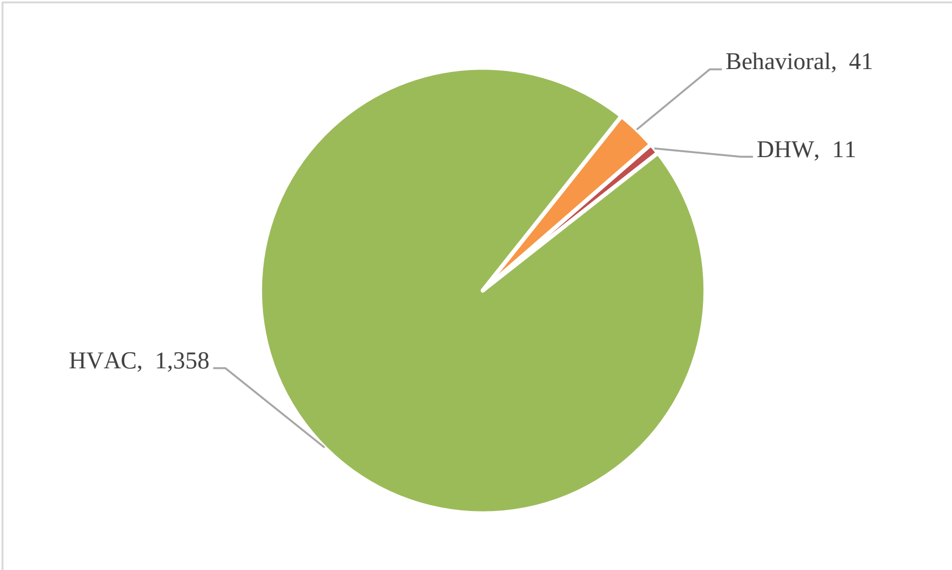


Figure 111. Public Works - Natural Gas Technical Potential (1,000 therms)



The following figures represent the economic energy reduction breakdown by measure for public works facilities.

Figure 112. Public Works - Electricity Economic Potential (MWh)

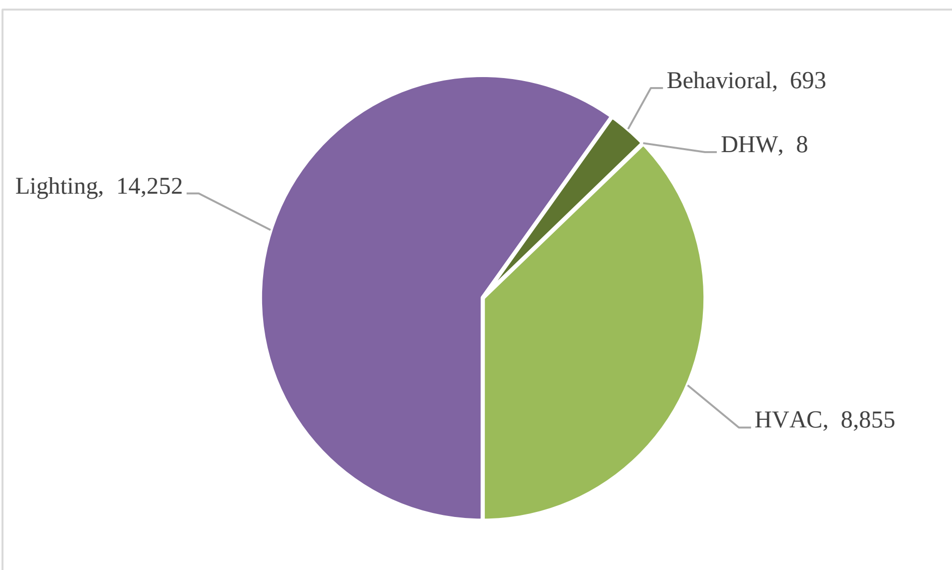
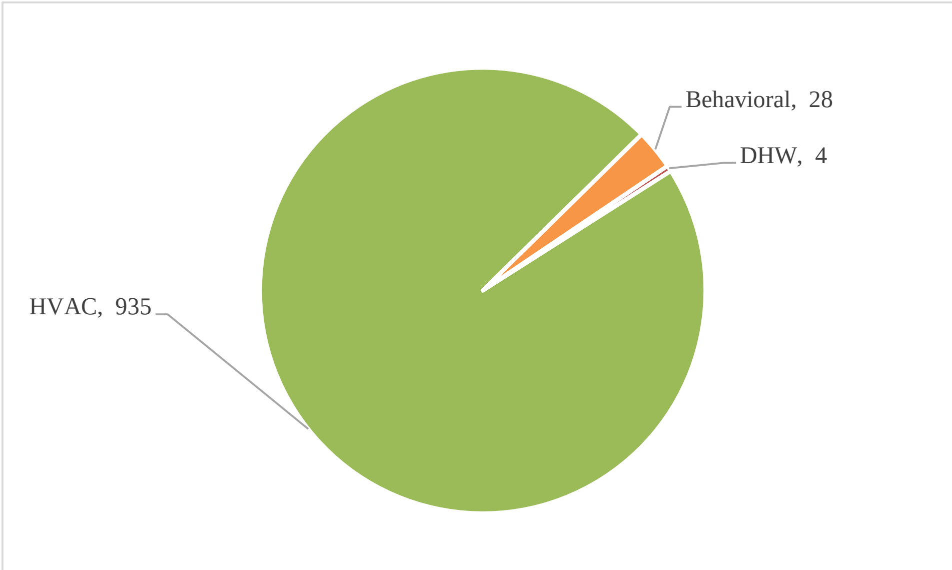


Figure 113. Public Works - Natural Gas Economic Potential (1,000 MWh)



Considerations and Recommendations for Public Works Facilities:

The economic potential is dominated by lighting applications, with 60% of the overall savings. There is also significant technical potential for HVAC applications, although it is not all cost-effective given current energy prices.

On the natural gas side, most of the consumption and most of the savings potential is represented by space heating applications. Additional savings can be achieved by upgrading kitchen and hot water equipment and training staff to turn off equipment or systems when not needed for no-cost behavioral change.

4.11 State and Federal Facilities

State and federal governments in Illinois own and manage more than 100 million square feet of offices and other facilities (excluding universities). These facilities use more than one million MWh of electricity and 45 million therms of natural gas. They account for 7.8% of electricity use within the Public Sector and 7.9% of natural gas.

Participation in Illinois Energy Now programs by State and Federal facilities has been relatively low when compared with their importance from an energy consumption point of view. During the PY5-7 timeframe only 20 projects in federal facilities and 23 projects in state facilities received funding from the DCEO Illinois Energy Now incentive programs. The projects accounted for only 1.2% of Public Sector electricity savings and 1.4% of Public Sector gas savings accomplished under the Department's programs.

As shown below, state and federal facilities reduced electricity consumption primarily by upgrading indoor lighting, but also through exterior lighting, custom projects and new construction. State and federal facilities reduced natural gas consumption through new construction projects, as well as boiler and custom upgrades.

Figure 114. State/Federal – Electricity Savings EY5/GY2-EY7/GY5

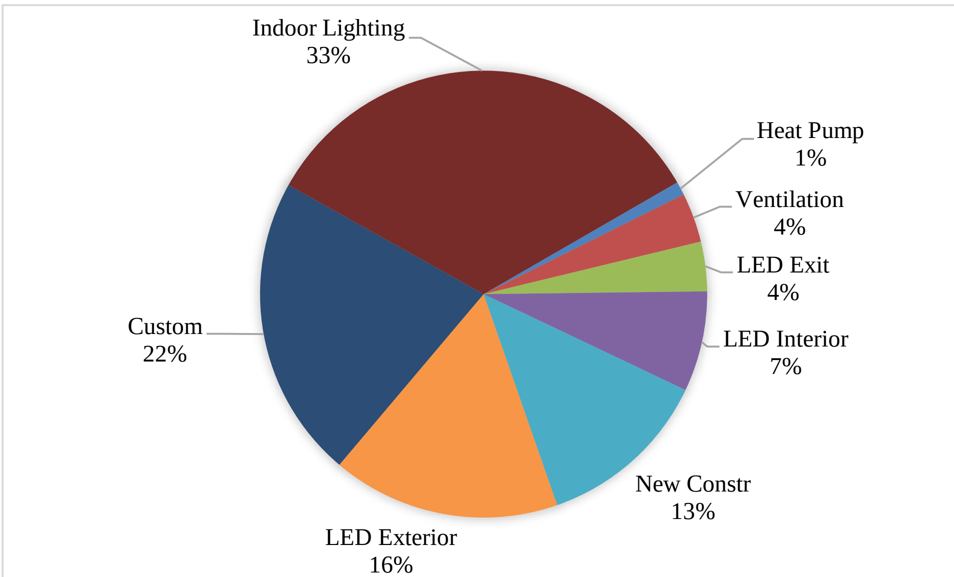
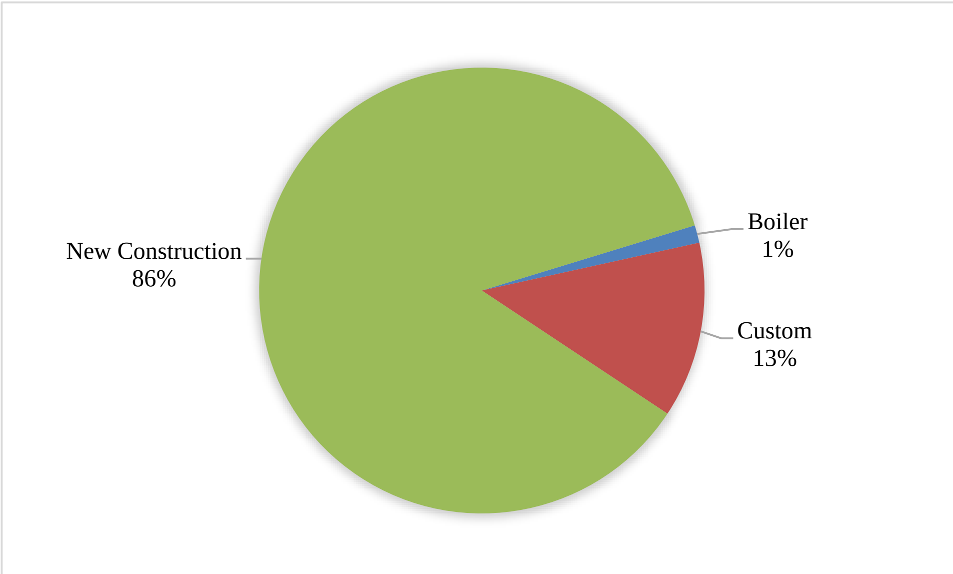


Figure 115. State/Federal – Natural Gas Savings EY5/GY2-EY7/GY5



The following figures break out the estimated energy consumption by system for State and federal facilities. Given the diversity of facilities, ranging from state parks to mental health care facilities, the energy consuming equipment in state and federal facilities is quite diverse. On the other hand, HVAC equipment uses the vast majority of natural gas.

Figure 116. State/Federal - Electricity Consumption (MWh)

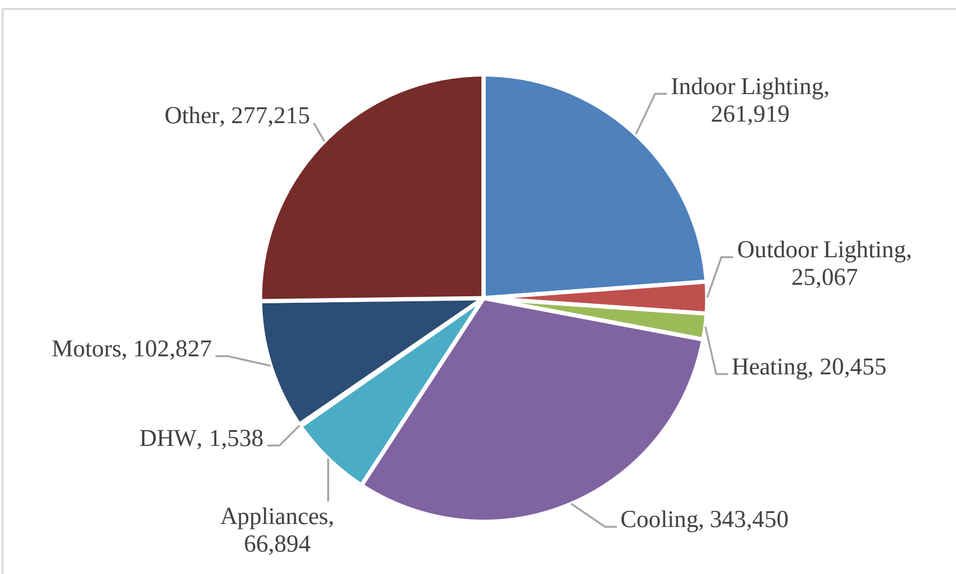
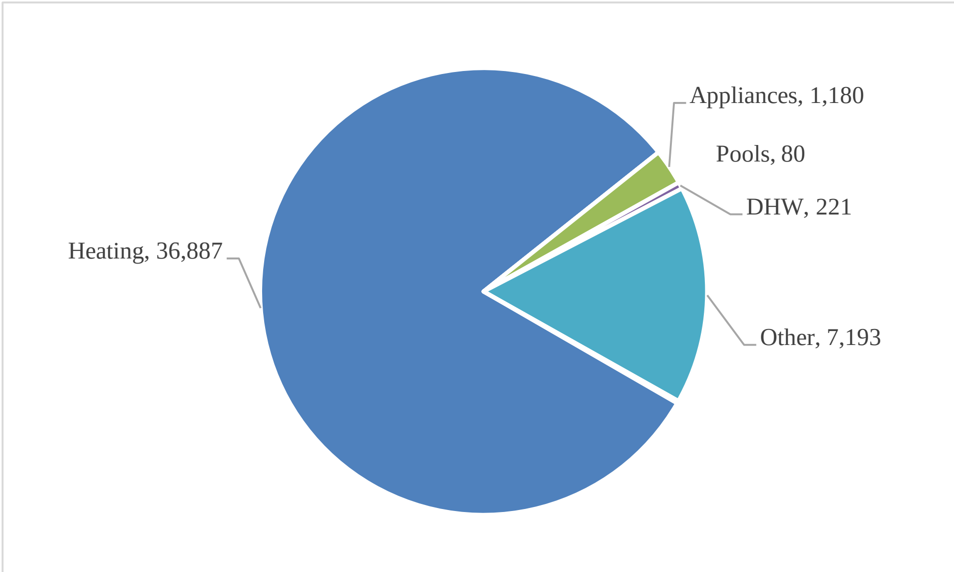


Figure 117. State/Federal - Natural Gas Consumption (1,000 therms)

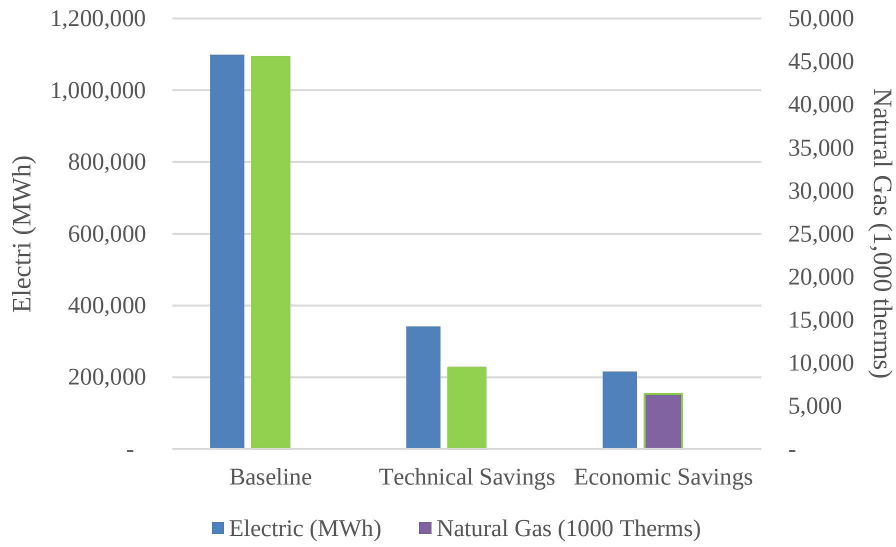


The following table and graph summarize the percent savings for the technical and economic reduction potential, and show the total savings potential for each compared to the total consumption determined for state and federal facilities.

Table 36. State/Federal - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	1,099,365	31%	341,670	20%	215,887
Natural Gas (1,000 therms)	45,561	21%	9,421	14%	6,392

Figure 118. State/Federal - Total Consumption and Savings Potential



The following figures show the technical potential for electricity and gas savings by measure for state and federal facilities.

Figure 119. State/Federal – Electricity Technical Reduction Potential (MWh)

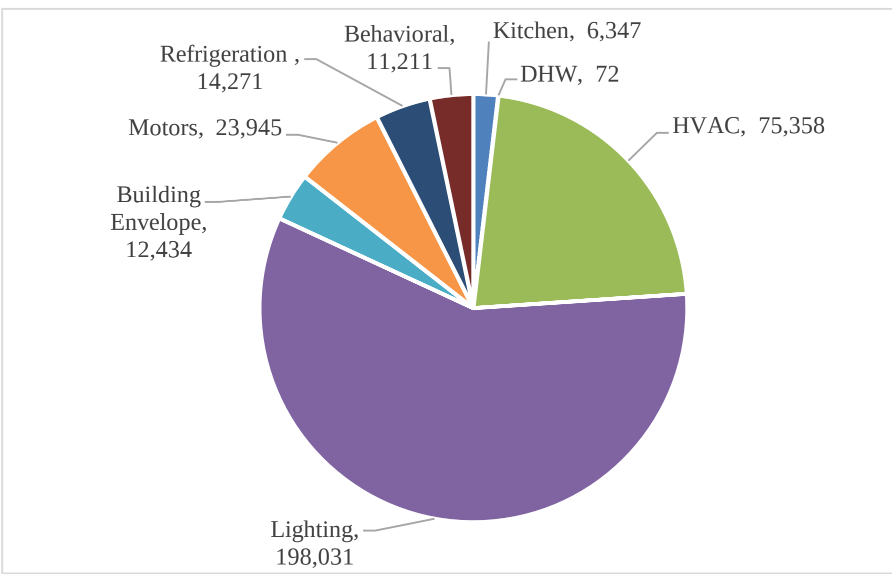
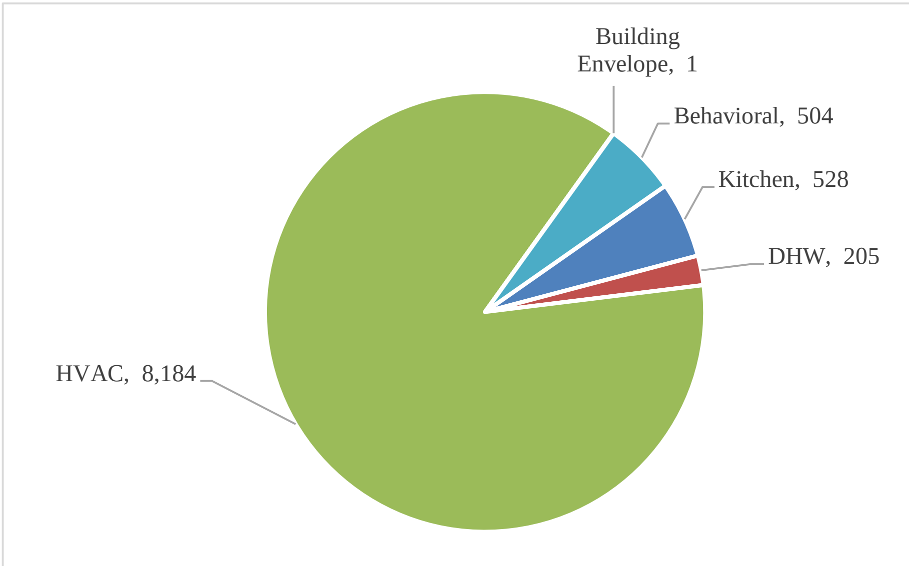


Figure 120. State/Federal - Natural Gas Technical Potential (1,000 therms)



The following figures break down the economic potential for electricity and natural gas savings by measure for state and federal facilities.

Figure 121. State/Federal – Electricity Economic Potential (MWh)

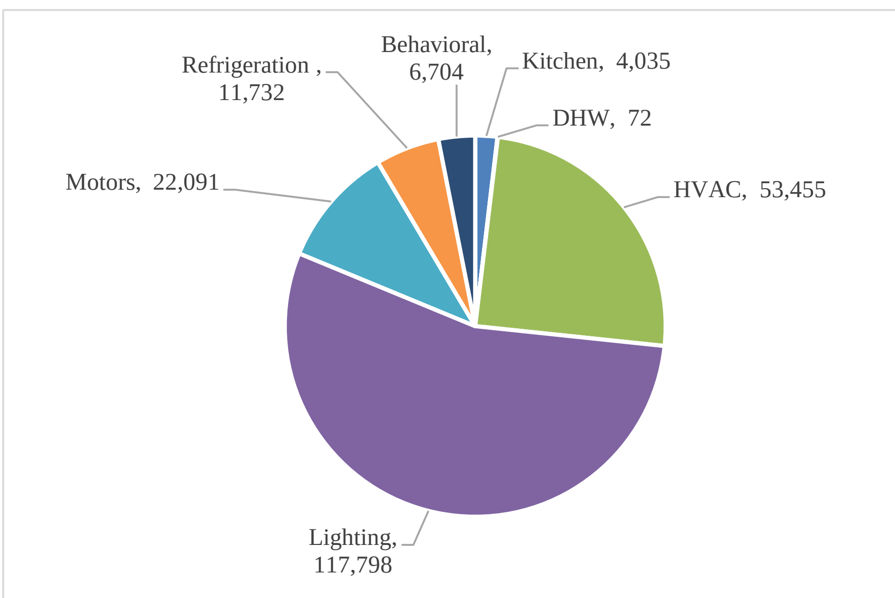
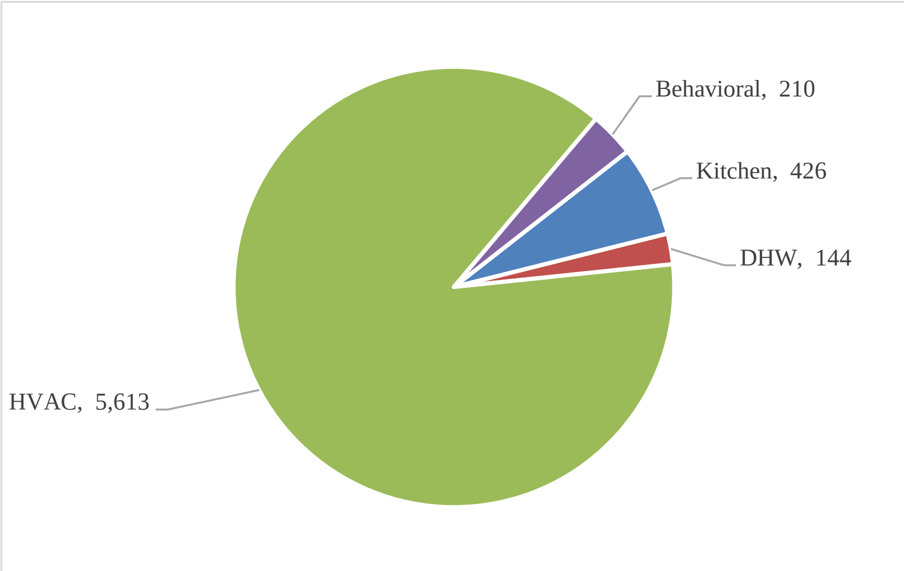


Figure 122. State/Federal - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for State/Federal Facilities:

State and federal facilities in Illinois have large untapped energy efficiency potential and show low participation in the Illinois Energy Now programs when compared with their share of energy consumption. About half of the economic electric efficiency potential comes from lighting improvements, but motors and HVAC (cooling) present significant potential as well. HVAC systems are the greatest opportunity for natural gas efficiency. Behavioral change could also help to reduce energy consumption in state and federal facilities.

The low participation rate by State facilities is largely attributable to procurement issues. In particular, since the Department's rebates often go into General Revenue or a revolving fund at the Department of Central Management Services (CMS), individual agencies do not directly benefit financially from spending funds on energy efficiency. The Department should continue to work with CMS, Office of Management and Budget, and the Governor's Office to ensure that agencies are incentivized in some manner to participate in Illinois Energy Now energy efficiency programs.

Federal agencies have their own goals and incentives and may not realize that they are also eligible for State incentives. Increasing their participation may require outreach to selected agencies and facilities.

4.12 State Universities

Illinois has 13 public university campuses which serve an estimated student population of 180,000. Most of the Universities are eligible for incentives under the Illinois Energy Now portfolio of programs, with a few exceptions. For example, the University of Illinois in Springfield is not eligible for electric incentives since it is served by a municipal electric utility, but it is eligible for gas incentives since it is located in Ameren Illinois' gas territory. As shown in Section 3.0, Universities represent 6.4% of Public Sector electricity consumption and 18.1% of natural gas consumption.

As shown in the table below, public universities were very active in the Illinois Energy Now programs, showing high participation rates and large projects. 9 of the 13 (12 eligible for electric funding) university campuses received incentives from the EEPS programs. They accounted for 15.5% of total Public Sector electricity savings and 34.6% of natural gas savings.

Table 37. Universities - Participation in Energy Efficiency Programs

Participated in EEPS Programs	Did NOT participate in EEPS Programs
University of Illinois - Chicago	Governors State University
Chicago State University	Northeastern Illinois University
Northern Illinois University	Southern Illinois University - School of Medicine
Southern Illinois University - Carbondale	University of Illinois - Springfield
Southern Illinois University - Edwardsville	
University of Illinois - Urbana-Champaign	
Eastern Illinois University	
Illinois State University	
Western Illinois University	

As shown below, state universities claimed over 50% of their electric savings via the custom incentive program, including retro-commissioning projects. Significant savings were also achieved via the indoor lighting incentives and the new construction program. Natural gas savings were mostly split between custom projects and pipe insulation.

Figure 123: State Universities - Electric Savings EY5/GY2-EY7/GY4

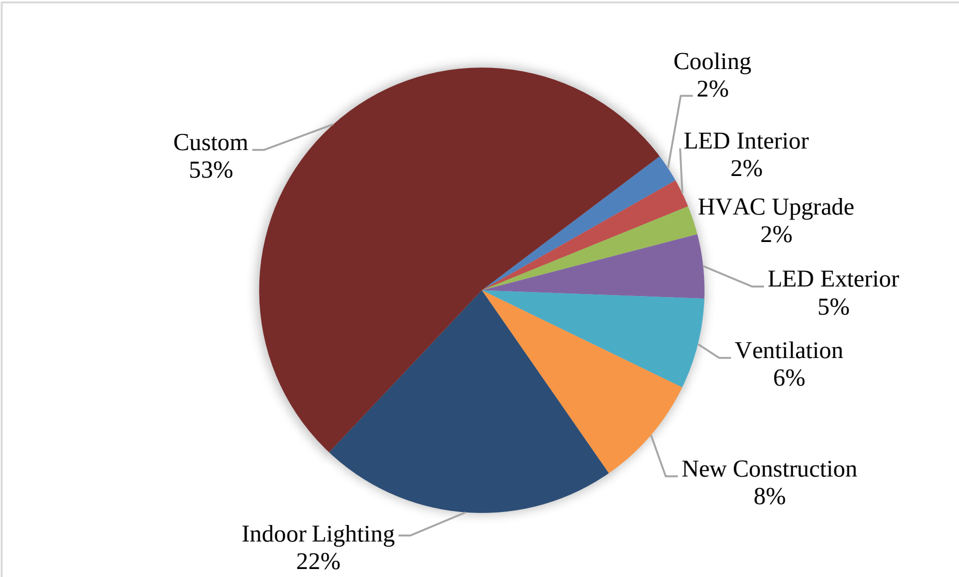
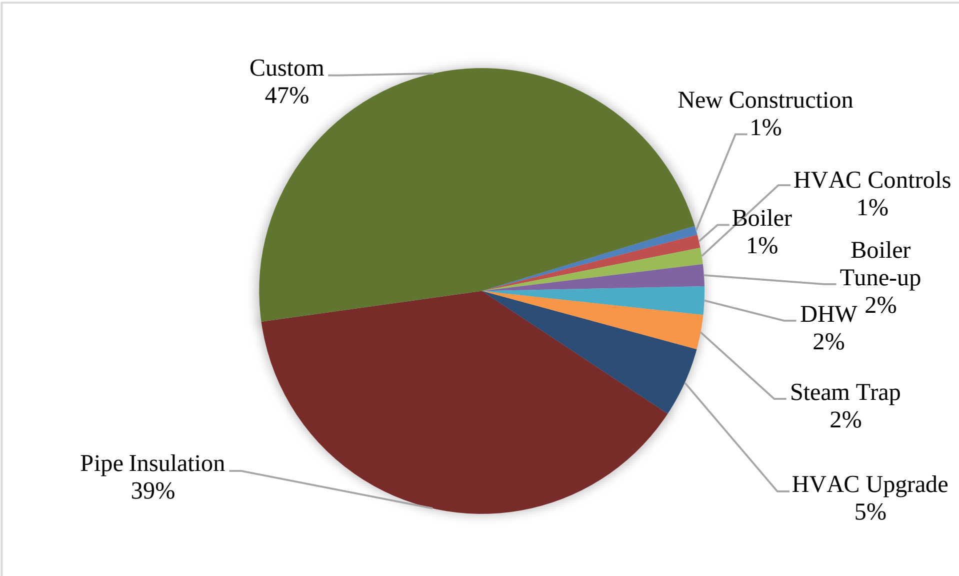


Figure 124: State Universities - Natural Gas Savings EY5/GY2-EY7/GY4



The following figures summarize the estimated energy consumption by system for state universities. Lighting and cooling are the largest electric end uses and space heating and hot water are the largest natural gas end uses.

Figure 125. State Universities - Total Electricity Consumption (MWh)

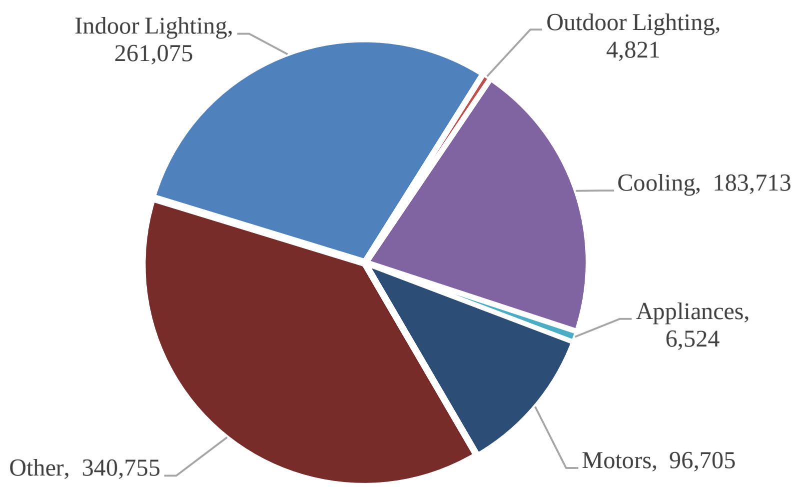
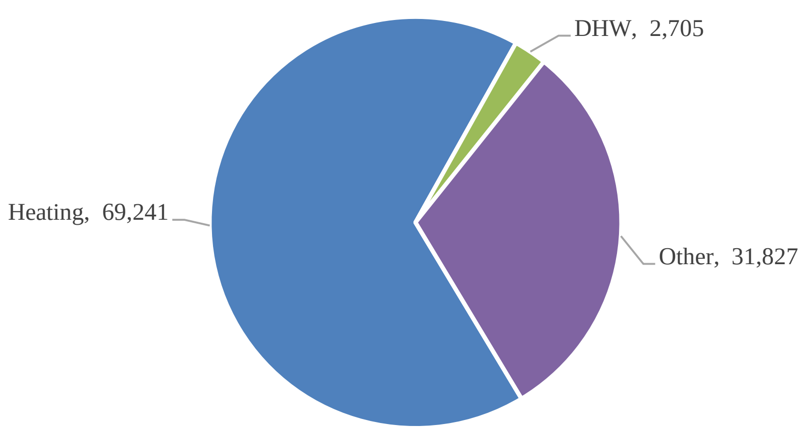


Figure 126. State Universities - Total Natural Energy Consumption (1,000 therms)

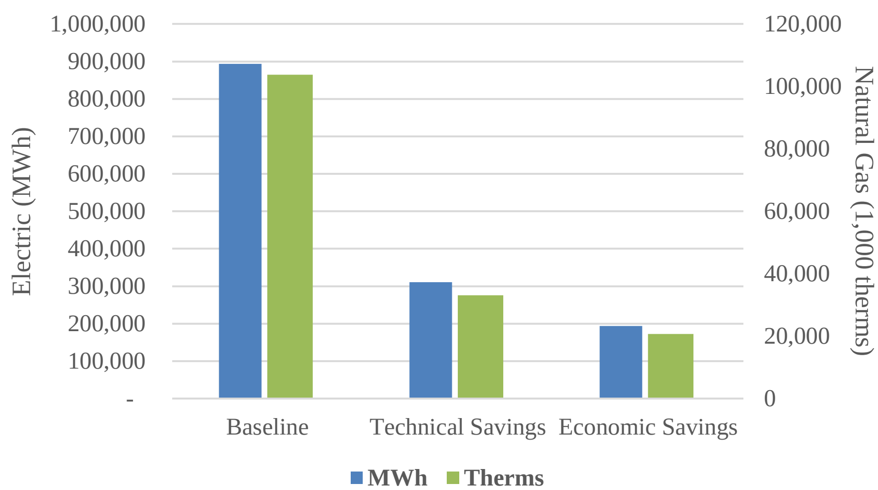


The following table and graph summarize the technical and economic potential for electricity and natural gas savings at state universities.

Table 38. State Universities - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	893,593	35%	310,968	22%	193,666
Natural Gas (1,000 therms)	103,774	32%	33,092	20%	20,732

Figure 127. State Universities - Total Consumption and Savings Potential



The following figures represent the technical energy reduction potential by measure for state universities facilities.

Figure 128. State Universities - Electricity Technical Potential (MWh)

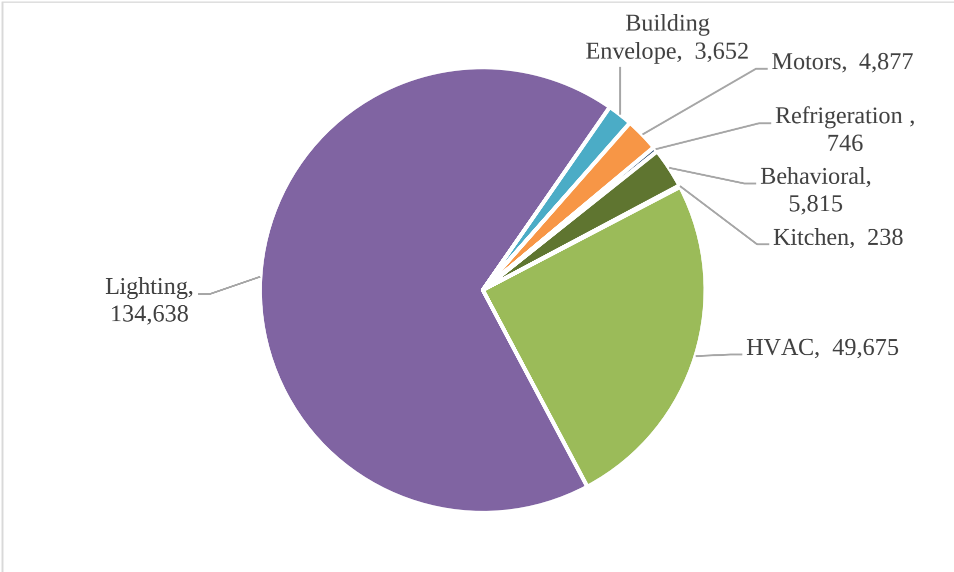
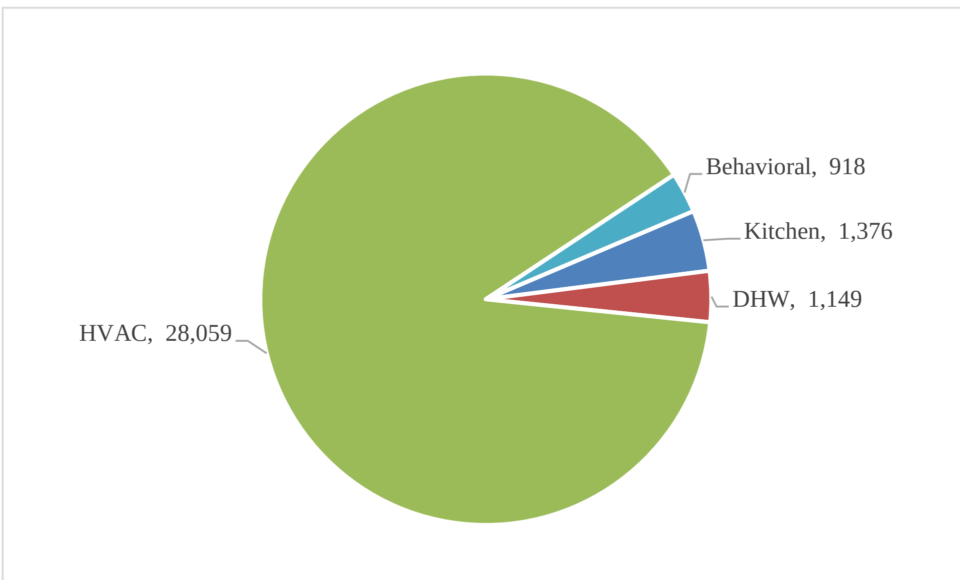


Figure 129. State Universities - Natural Gas Technical Potential (1,000 therms)



The following figures detail the economic energy reduction potential by measure for universities.

Figure 130.State Universities - Electricity Economic Potential (MWh)

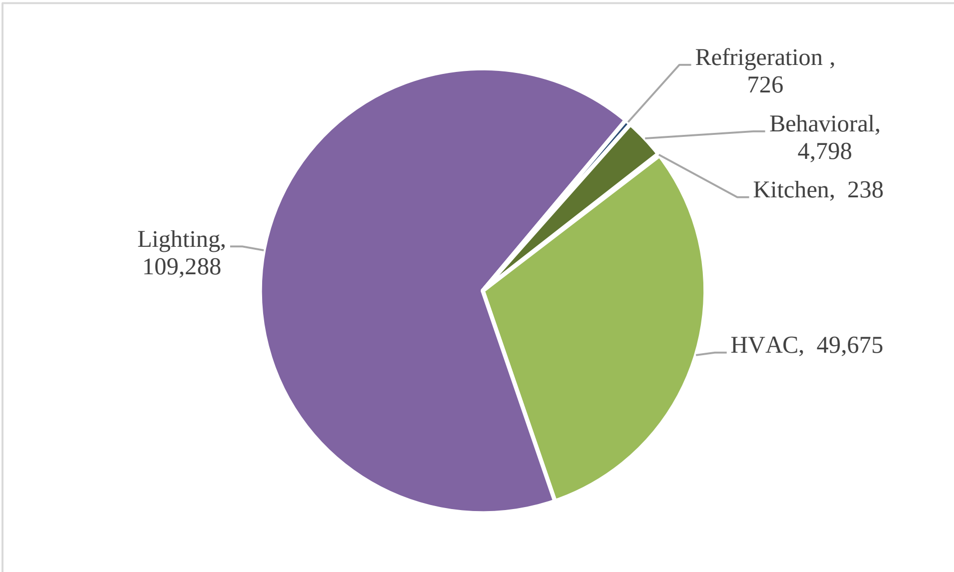
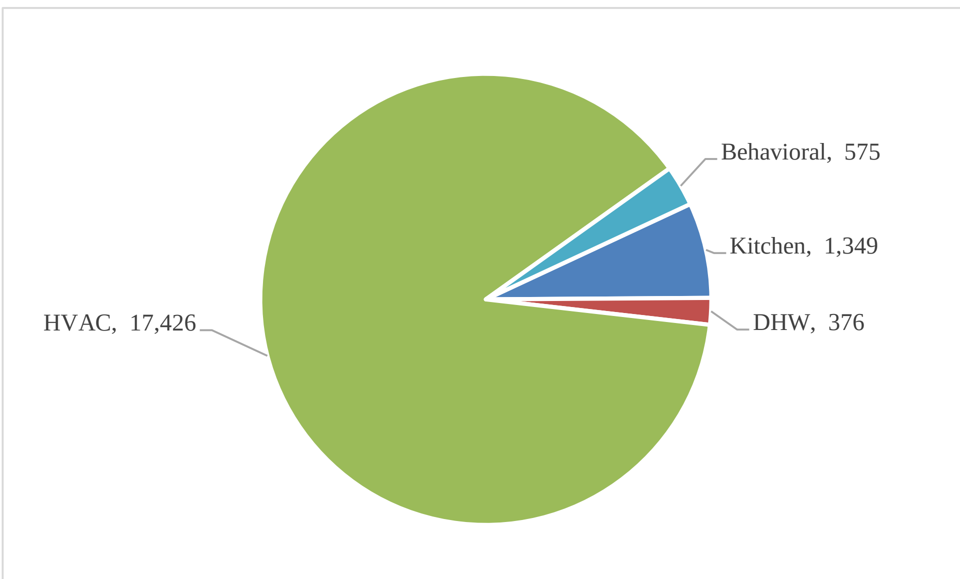


Figure 131. State Universities - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for State Universities:

Lighting accounts for the largest portion of technical potential, with HVAC upgrades and motor improvements being the next highest categories. Lighting and HVAC upgrades represent the clear majority of economically viable savings. Lighting fixtures and lamps in dorms and other residential-type buildings can be upgraded to LEDs in common areas where they will have the greatest impact economically with the shortest paybacks. Academic and office buildings on campus mainly show potential for linear fluorescent upgrades simply due to hours of operation. Exterior lighting on all building types should be upgraded to LED. Finally, instead of simply swapping existing technologies with newer, more efficient technologies a whole building redesign should be considered to maximize the savings potential and decrease cooling needs and over-lighting regardless of facility type.

On the natural gas side, most of the potential is still represented by space heating technologies. Maintenance personnel currently enforce temperature setbacks but there is always the opportunity for smart controls that automatically sense occupancy and change temperature set points accordingly. Many pieces of equipment are past their effective useful life and should be replaced with new and upgraded equipment.

Public Universities could also institute training programs in dorms for students or RAs in order to maximize behavioral savings potential. In dorms where students use a lot of energy and occupancy sensors are not practical, training students to turn off lights, appliances, and computers when they are not present can produce a significant amount of savings. Public Universities can also set campus wide policies that reduce energy consumption and institute training programs for maintenance staff and even the teaching staff.

The sector is also a good candidate for Combined Heat and Power (CHP) applications with high hours of steady operations and constant need throughout the majority of the year of both heating and cooling capacity. The installation of absorption chillers would help to offset the summer peak demand and electric consumption while maintaining the efficiency of the CHP system to the maximum achievable level. Heating needs could be met by capturing the waste heat produced by the CHP system.

4.13 Street Lighting

Improving the energy efficiency of street lighting in Illinois is a challenge given the complicated mix of utility, municipal, and State ownership and a range of electric tariff and utility franchise structures. Street lighting uses more than 1.3 million MWhs each year or about 9.5% of total Public Sector electricity consumption.

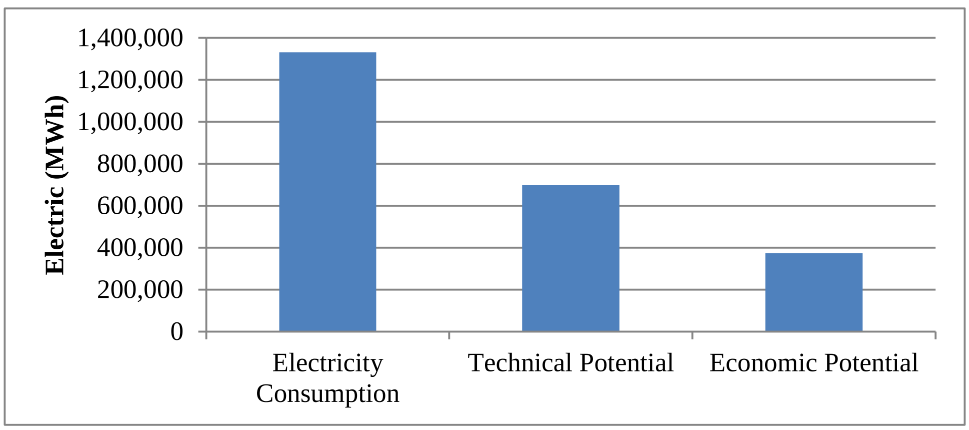
During the past three program years, approximately 45 cities and villages in Illinois used Illinois Energy Now Incentives to replace street lights with more efficient lamps and fixtures, primarily LED and induction. The 70 projects accounted for 3.6% of total Public Sector energy efficiency savings.

The following table and graph show the technical and economic potential for reducing energy consumption in street lighting, both in absolute and percentage terms.

Table 39. Street Lighting Technical and Economic Potential Percentages

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	1,331,027	52.4%	697,489	28.0%	373,100
Natural Gas	N/A	N/A	N/A	N/A	N/A

Figure 132. Street Lighting - Total Consumption and Savings Potential



Considerations and Recommendations for Street Lighting:

This analysis shows a very significant potential for advanced street lighting applications. It is estimated that there are about 1,000,000 fixtures in Illinois, of which about 25% are Utility owned and 75% municipality owned. The sector uses more than 1,300 GWh and there is potential to half that consumption while improving light quality and consequently safety of the streets (using white light, which has better Color Rendering Index (CRI) than the current yellowish street lighting).

Viable technologies are both LEDs and Induction fixtures. Both will improve light quality, reduce consumption and dramatically decrease maintenance costs. Whether solid state lighting or Induction lighting is chosen, a full scale test of the new fixtures should be performed before expanding the project to the whole community. Given the tremendous potential for transforming street lighting in Illinois it probably makes sense for the Department to develop a special program that targets the sector in the future. However, also given the complicated ownership structure of street lighting, the program would require coordination and partnership with the Illinois' electric utilities.

4.14 Wastewater Treatment Facilities

There are over 857 public wastewater treatment facilities in Illinois, with a combined treatment capacity of approximately 4,371 million gallons of wastewater per day (MGD). The Metropolitan Water Reclamation District of Greater Chicago's three largest plants represent 43% of this capacity. These facilities are outliers in the state as 86% of Illinois' treatment facilities have treatment capacities of 5 MGD or lower, as shown in the following table:

Table 40. Wastewater Treatment Facilities – Size Range

Treatment Capacity (MGD)	Number of Facilities
Less than 1	566
1 – 5	167
5 - 10	63
More than 10	61

Wastewater treatment plants account for 8.3% of Public Sector electricity consumption and 10.6% of natural gas consumption. Generally there is little in the wastewater process that requires thermal energy save for anaerobic digestion, in which the tanks need to be kept at a specific temperature that is typically above 90°F. In Illinois, approximately 89 facilities utilize anaerobic digestion tanks, the majority of which are in northern Illinois. When the total natural gas consumption is broken down by area, it can be seen that northern Illinois wastewater treatment facilities comprise 7.68% of Public Sector natural gas consumption while the southern Illinois facilities comprise 2.89%. Additionally, the northern Illinois facilities tend to be larger due to their proximity to the metropolitan area of Chicago, and thus have greater building heat requirements.

The wastewater market sector has a participation rate of 34% within the Illinois Energy Now programs, though most funding is provided for building upgrades rather than process-related improvements. Using the project descriptions for the custom measures funded by the Illinois Energy Now programs to determine what types of measures were installed by the wastewater facilities, it was found that nearly 70% of all standard and custom measures have been lighting upgrades while 20% of measures have been motors and pumps, which, as shown by the following figures, constitute the largest demand for electricity within the facilities. In total, wastewater facilities accomplished 10.3% of Public Sector electricity savings and 0.8% of natural gas savings.

Figure 133. Wastewater Treatment Facilities – Electricity Savings EY5/GY2-EY7-GY4

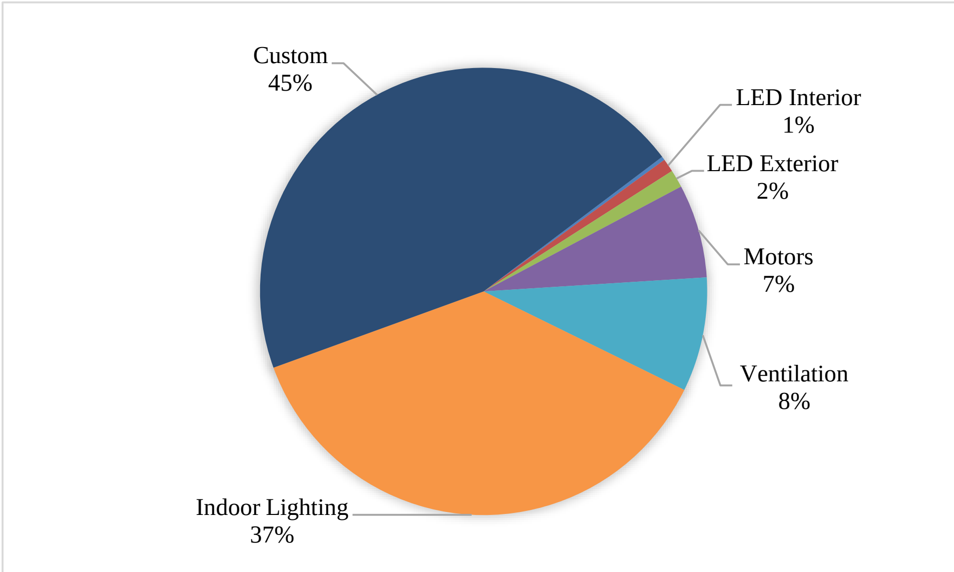
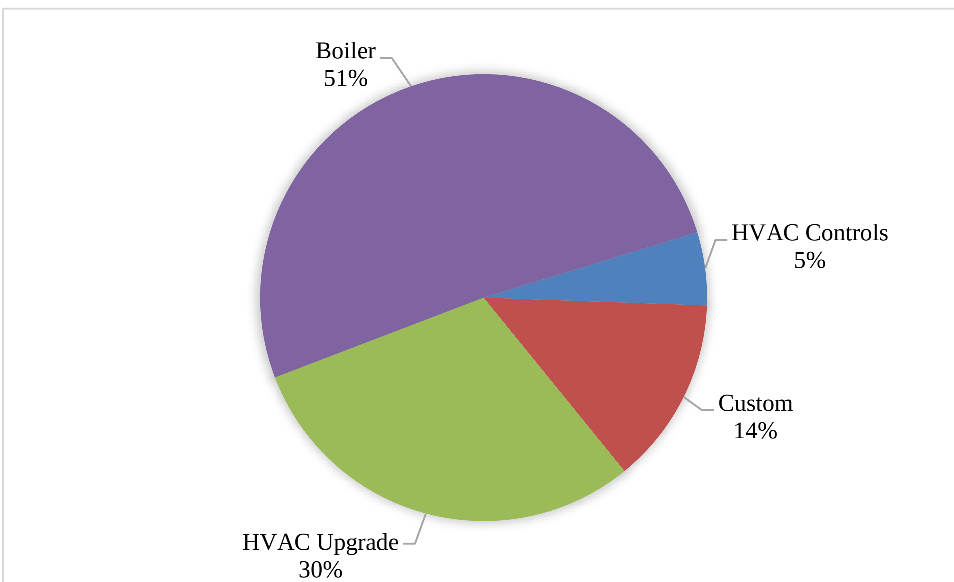


Figure 134. Wastewater Treatment Facilities – Natural Gas Savings EY5/GY2-EY7-GY4



The following figures show the distribution of energy consumption by system in the wastewater facilities. Electricity consumption is dominated by motors and natural gas consumption by heating and "other", much of which is process-related.

Figure 135. Wastewater Treatment Facilities - Total Electric Energy Consumption (MWh)

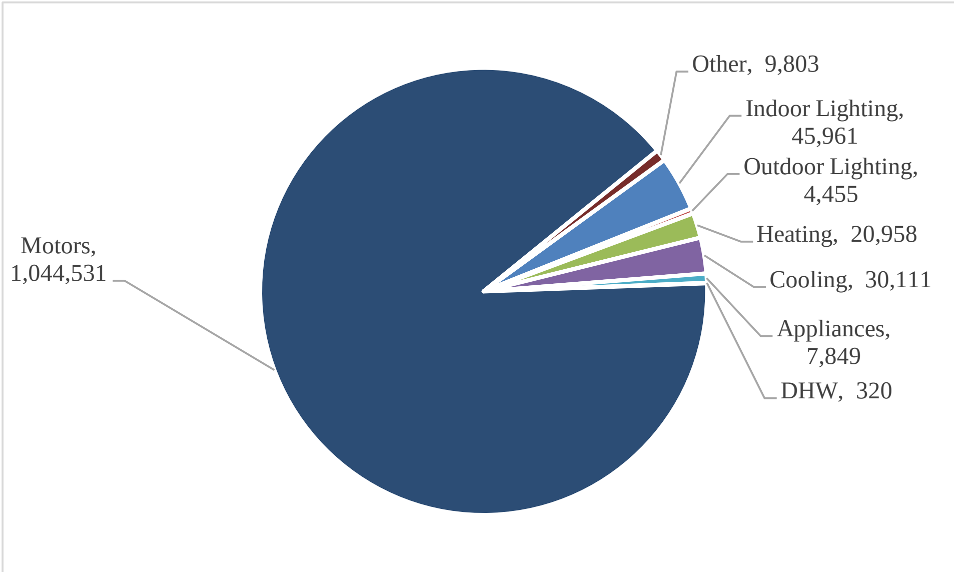
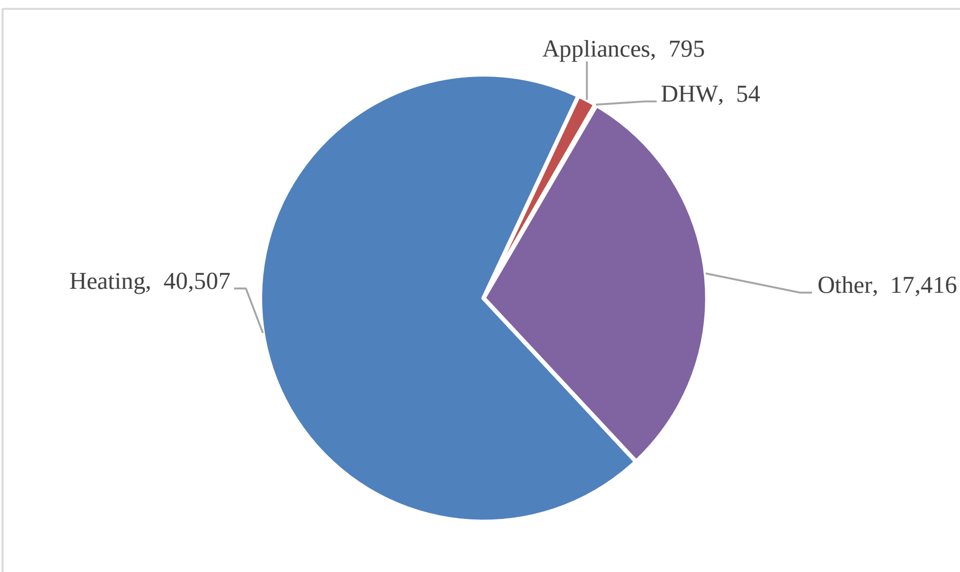


Figure 136. Wastewater Treatment Facilities - Total Natural Gas Energy Consumption (1,000 therms)

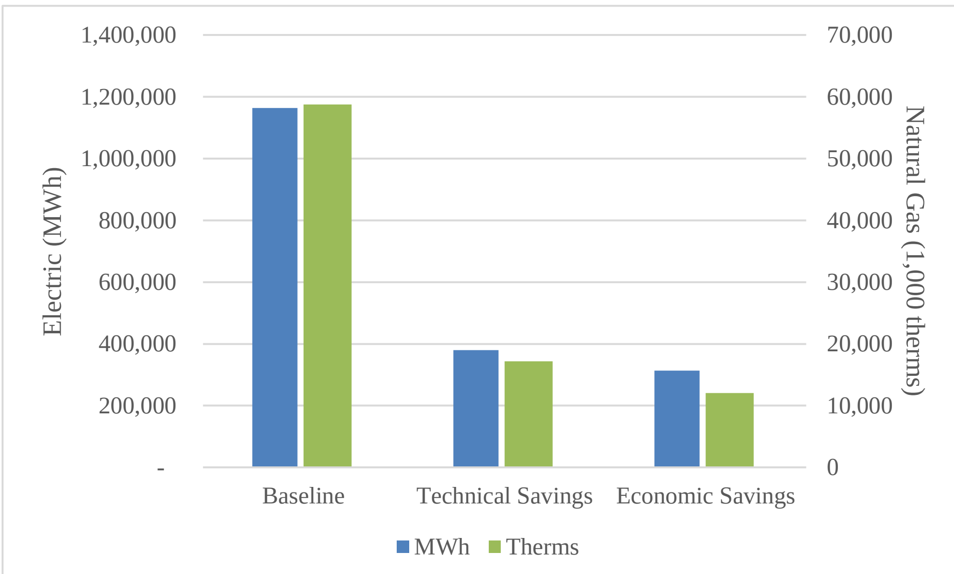


The following table and graph summarize the percent savings for the technical and economic reduction potential, and show the total savings potential for each compared to the total consumption determined for waste water treatment facilities.

Table 41. Wastewater Treatment Facilities - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	1,163,988	33%	379,440	27%	313,458
Natural Gas (1,000 therms)	58,772	29%	17,162	20%	12,031

Figure 137. Wastewater Treatment Facilities - Total Consumption and Savings Potential



The following figures show the breakdown of technical energy efficiency potential by measure for wastewater treatment facilities.

Figure 138. Wastewater Treatment Facilities - Electricity Technical Potential (MWh)

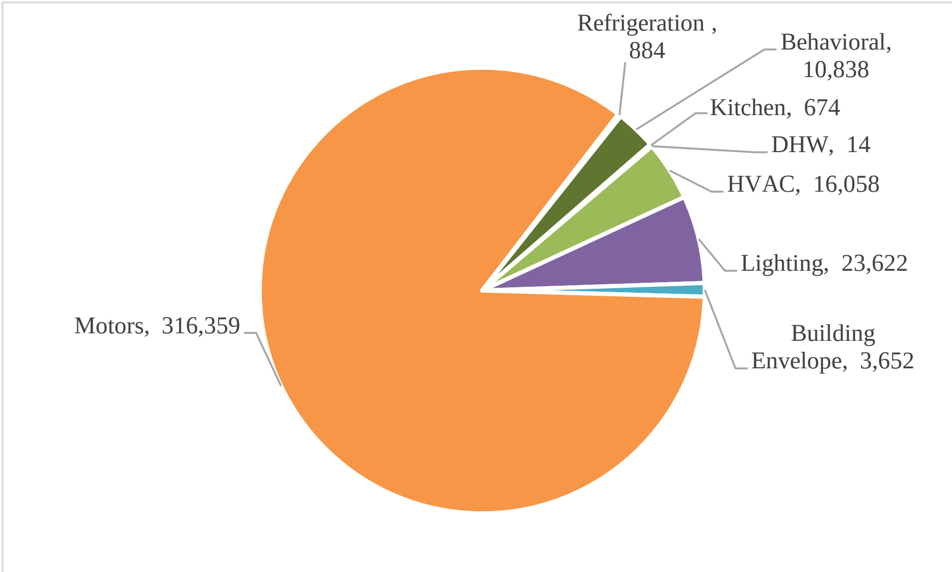
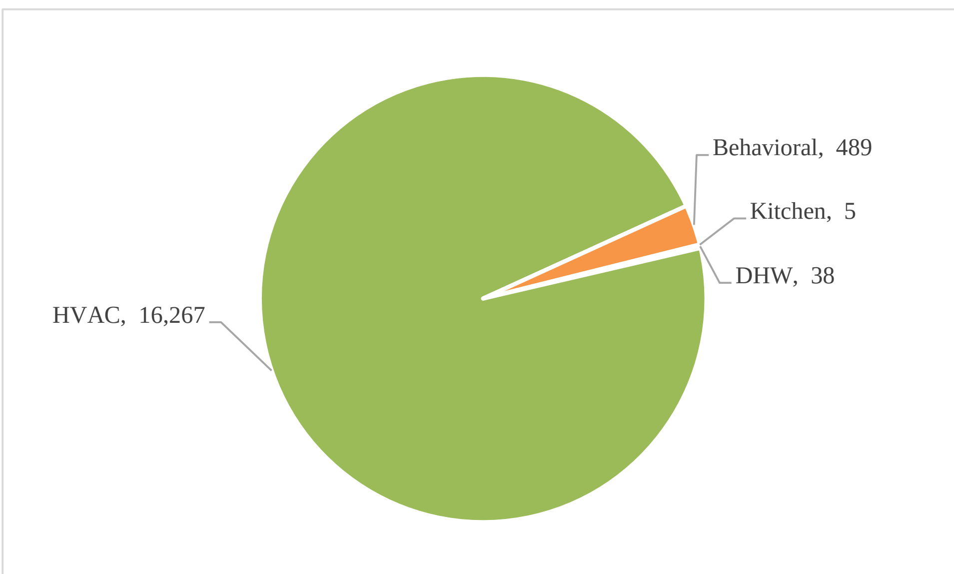


Figure 139. Wastewater Treatment Facilities - Natural Gas Technical Potential (1,000 therms)



The following figures represent the economic energy reduction breakdown by measure for waste water treatment facilities.

Figure 140. Wastewater Treatment Facilities – Electricity Economic Potential (MWh)

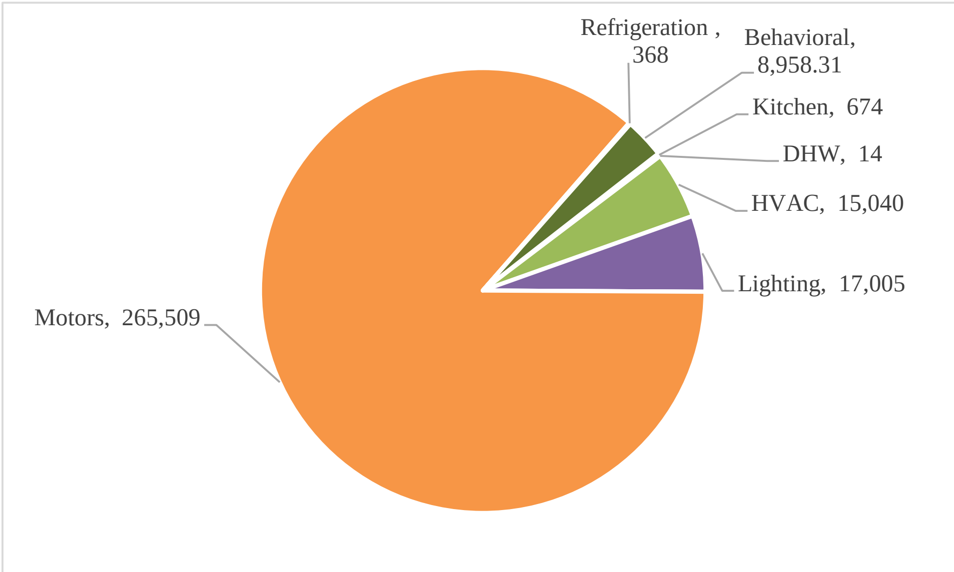
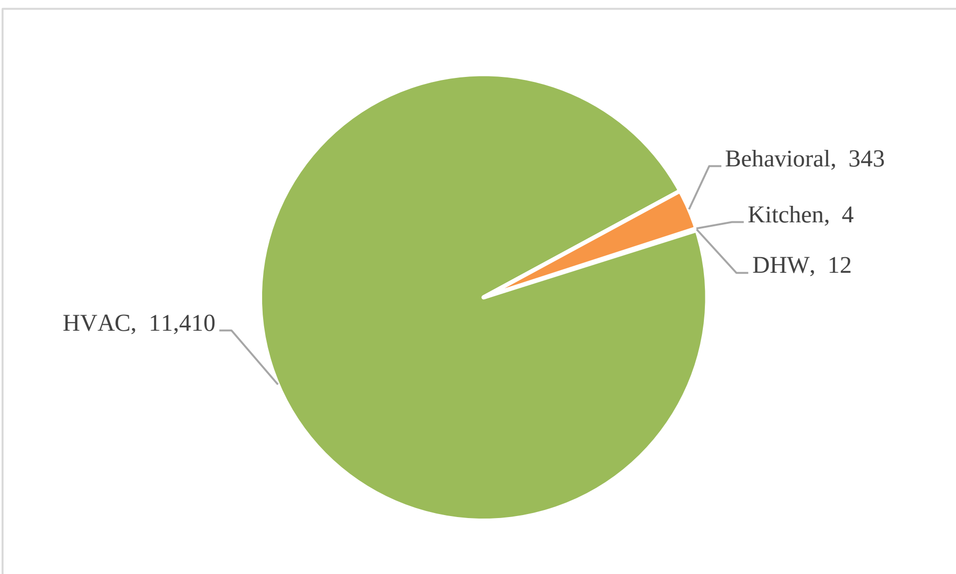


Figure 141. Wastewater Treatment Facilities - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Waste Water Treatment Facilities:

Motors represent approximately 90% of electricity consumption of Wastewater Treatment facilities. Unlike other sectors the wastewater sector requires motors for the treatment process as well. Motors are used for, but not limited to, providing oxygen to the process, pumping wastewater throughout the facility, and distributing chemicals and polymers. As older motors begin to fail and need replacement there is an opportunity to replace the motor with a newer, more efficient model rather than repair the existing motor. This is not a practical means of achieving energy efficiency, though, due to the time scale of motor replacement and the high initial capital cost that presents a barrier for outright replacement for the sole sake of reducing energy costs. Variable frequency drives are a popular energy efficiency measure for treatment facilities, since influent flow rates change constantly. Though a majority of the energy efficiency measures applied for were VFD installations, the sheer number of motors within the sector compared to the small number of energy efficiency projects shows that VFDs are still an underutilized measure. Indoor and outdoor lighting, in this sector, represent a small fraction of the potential savings.

The motor category also represents the aeration equipment used to oxygenate the wastewater, which is often the highest single consumer of electricity within a treatment facility. The combination of technologies such as high-speed turbo blowers, advanced Dissolved Oxygen (DO) controls, and ultra-fine bubble diffusers can reduce the facility's aeration electric consumption by 50%, or approximately 30% of a typical treatment facility's total electric consumption.

Each facility is different and has different needs and optimization strategies, but extensive case studies conducted by EPA suggest that at least 46% of the savings potential could be captured by custom-type process upgrades. A holistic approach on the Wastewater Treatment process is necessary to identify and address the savings opportunities. Some facilities are taking the lead in energy efficiency and are achieving very significant results, getting close to "net zero" energy consumption thanks to their own production of biogas that fuels CHP systems or anaerobic digester heating systems.

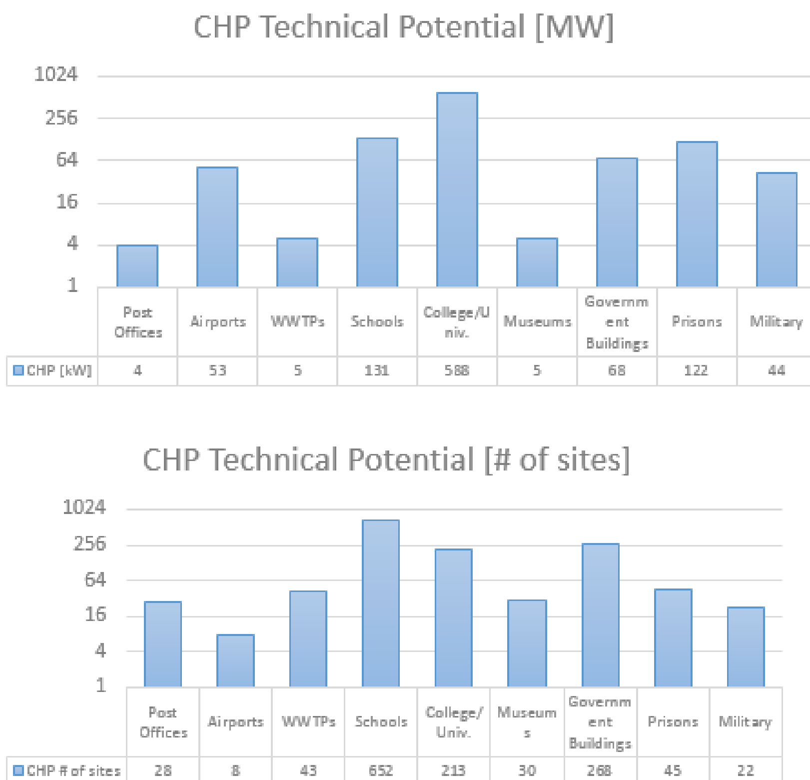
On the natural gas side, consumption and potential are dominated by process heating and space heating while other process-related uses represent about 30% of the energy consumption. One way to reduce natural gas consumption destined to heating applications is the installation of a CHP system. Wastewater Treatment plants with anaerobic digesters have a constant need throughout the year for both electricity and process heating, and both needs could be met by the on-site production of electricity and thermal energy that would otherwise be wasted in the atmosphere. Several Wastewater Treatment facilities have already implemented CHP systems, oftentimes co-firing natural gas with biogas produced on-site. There are techniques and technologies that can increase the production of biogas and can improve the sludge processing capabilities of the Wastewater Treatment plant, and those technologies could be coupled with the installation of a CHP system to further reduce natural gas consumption.

4.15 Combined Heat and Power

Combined heat and power (CHP) is a system that simultaneously generates electricity and useful thermal energy (such as steam, hot water, or chilled water). CHP is allowed under the Illinois Energy Efficiency Portfolio and is addressed in the Technical Reference Manual. The US Department of Energy recently completed a study that estimates the technical potential for CHP by state, broken out by various sectors and size classes. The study includes an assessment of the technical potential for CHP by several types of public entities. DOE is working on a follow-up study to analyze the economic potential for CHP. No attempt will be made here to conduct that analysis ahead of the very detailed DOE study. Instead, based on a set of assumptions, an example of the potential energy efficiency gains from Public Sector CHP projects in Illinois is provided for illustrative purposes.

For Public Sector applications the DOE study found 1.02 GW of potential over 1,300 potential sites, with colleges/universities, schools, and prisons having the most potential sites. The following figures show a summary of the CHP technical potential in MW and # of sites. The Technical Reference Manual allows electricity savings to be counted towards Energy Efficiency Portfolio targets and, depending on the system efficiency, natural gas savings as well. Systems must have a total system efficiency of 60% or more and at least 20% of the system's total useful energy output must be in the form of useful thermal energy. A system that meets the minimum requirements can count 65% of the useful annual electricity output as electricity savings.

Figure 142. Public Sector – CHP Technical Potential



Source: *Combined Heat and Power (CHP) Technical Potential in the United States*, U.S. Department of Energy, March 2016

Using several assumptions – 90% of the technical potential located in eligible utility territories, 4,500 to 7,500 annual operating hours depending on the type of facility, and the minimum eligible efficiency – the technical potential for electricity savings from the public sector is about 4.25 million MWh. CHP has higher hurdles than other technologies because of its capital costs and technical complexity, although at times public entities are able to tolerate a longer payback period than the private sector. Making one additional assumption, that 10% of the technical potential for Illinois Public Sector CHP is achievable, results in approximately 425,000 MWh potential savings. This compares to the estimate of 3.2 million MWh of economic potential for electric efficiency from the total Public Sector. Public Sector CHP would also achieve natural gas savings, but the countable savings are highly dependent on the project configuration.

The Department ran a Public Sector CHP Pilot Program during the current plan cycle. The program had its submittal period in the summer/fall of 2015 and received 17 applications, which in combination proposed to install more than 30 MW. The program selected 7 projects for the funding period and has continued to draw strong interest even as the budget has stalled the program for 2016.

5.0 Technical and Economic Potential - Low-Income Sector

Results for the low-income sector energy efficiency potential analysis are detailed in the following sections. Results stem from review of energy consuming system questionnaires and from the Residential Energy Consumption Survey (RECS) database.

5.1 Low-Income Single-Family

The low-income single family market has 498,526 electric customers, and 422,264 natural gas customers. The low-income single family sector used 4,141,004 MWh, and 564,390 thousand therms in the previous year. The following figures represent the determined energy consumption by system breakdown for low-income single family homes.

Figure 143. Low-Income Single Family - Total Electricity Consumption (MWh)

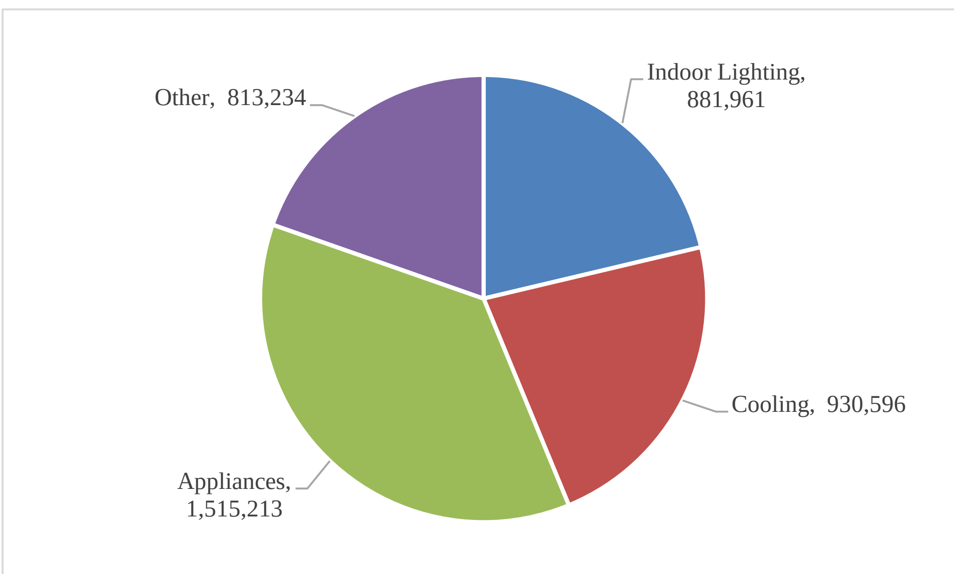
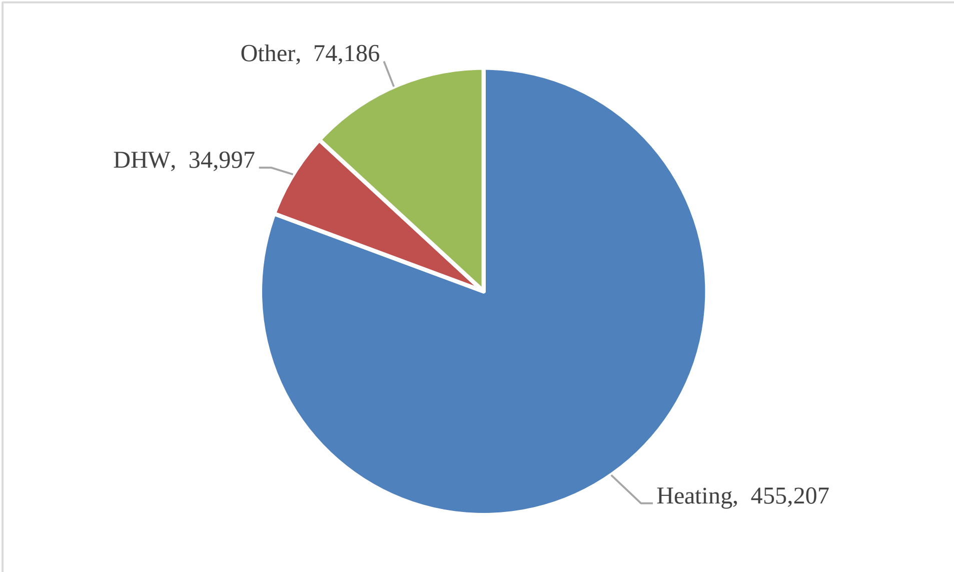


Figure 144. Low-Income Single Family - Total Natural Gas Consumption (1000 Therms)

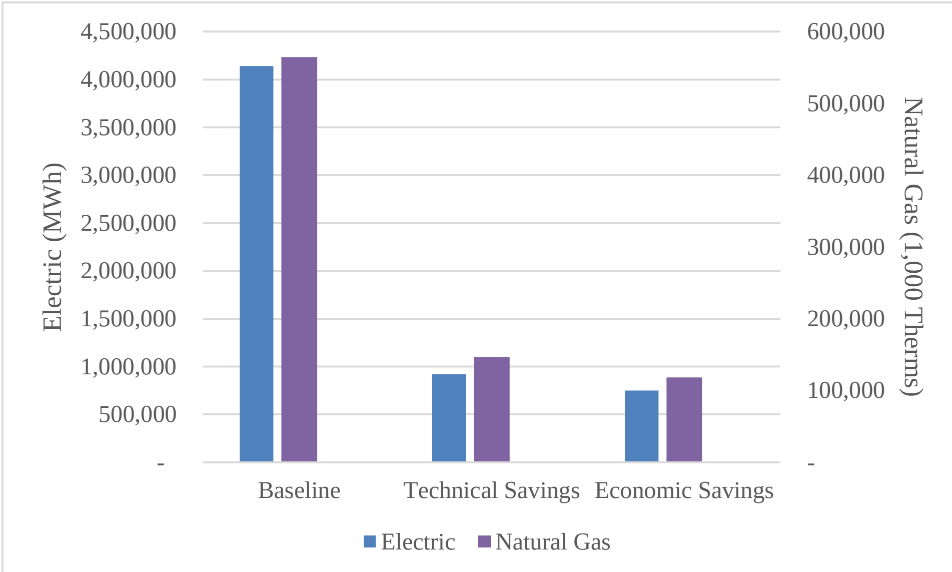


The following table and graph present the percent savings for the technical and economic reduction potential, and show the total savings potential (in MWh and 1000 therms) for each compared to the total consumption determined for low-income single family homes.

Table 42. Low-Income Single Family - Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	4,141,004	22.2%	920,262	18.1%	749,252
Natural Gas (1,000 therms)	564,390	26.0%	146,908	21.0%	118,315

Figure 145. Low-Income Single Family - Total Consumption and Savings Potential



The following figures represent the technical energy reduction breakdown by measure for low-income single family homes.

Figure 146. Low-Income Single Family - Electricity Technical Potential (MWh)

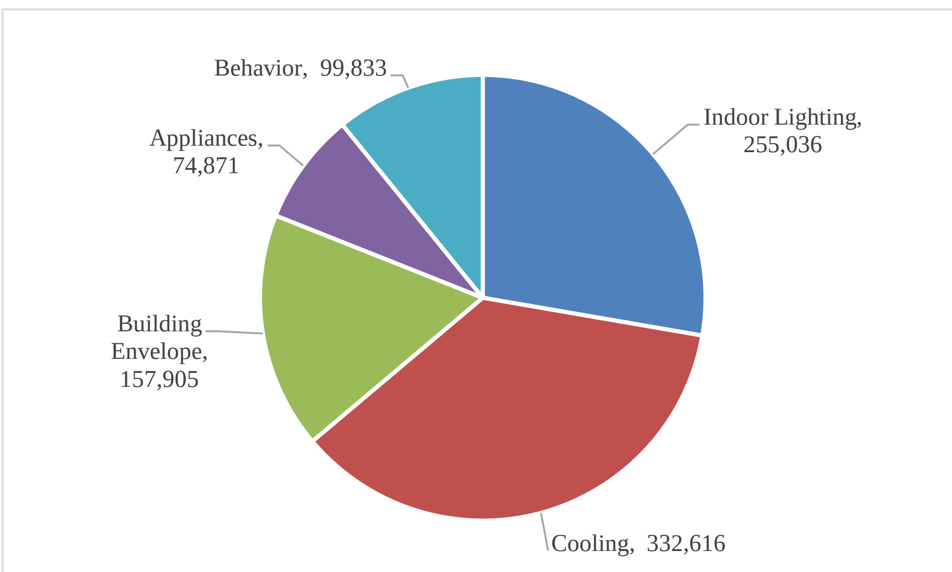
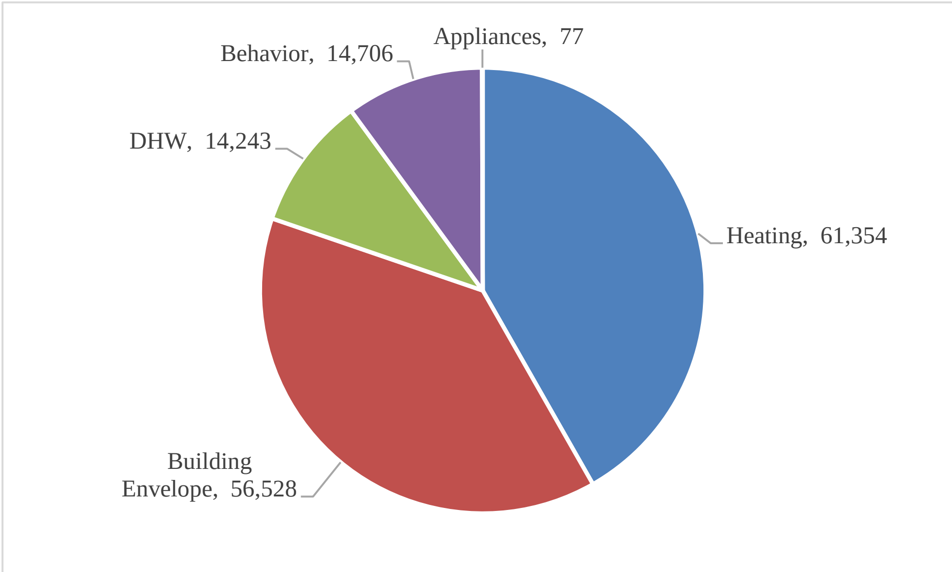


Figure 147. Low-Income Single Family - Natural Gas Technical Potential (1,000 therms)



The following figures represent the economic energy reduction breakdown by measure for low-income single family homes.

Figure 148. Low-income Single Family – Electricity Economic Potential (MWh)

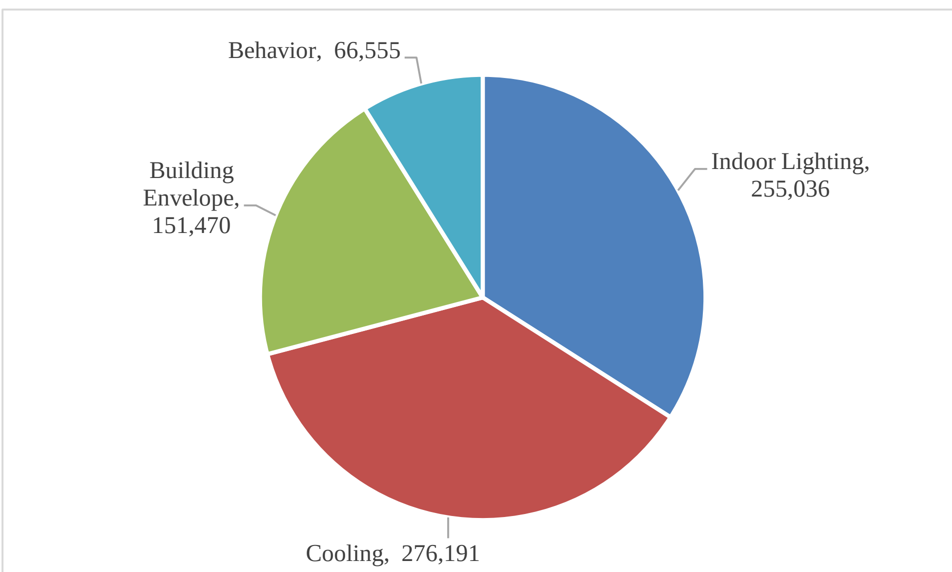
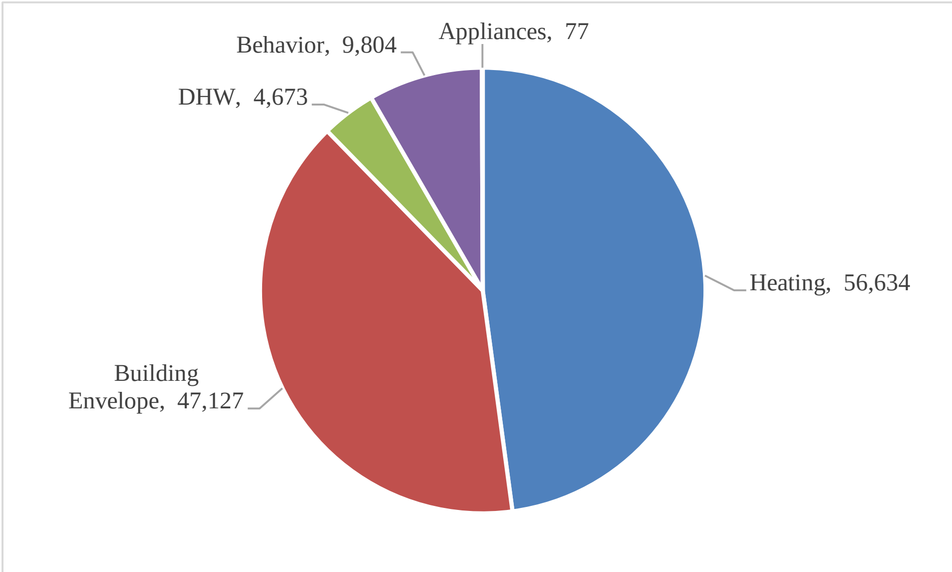


Figure 149. Low-Income Single Family – Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Low-Income Single-Family Households:

The Low Income Single Family sector is currently served by the Department's whole building programs aimed not only at reducing energy consumption, but also improving lifestyle and comfort of financially distressed families and, in those cases where the family is paying for their bills, alleviate the financial burden by lowering the utility bills.

It should be noted that financial incentives do not work in the same way as in other sectors, because it is common for these families to not be the primary payee for the energy bills, or pay only a fixed amount for their energy needs. This poses a challenge to capture behavioral waste (and also technological potential), because non-financial benefits such as environmental concerns and quality of life have to be used to induce a change in behavior. The Illinois Science and Energy Innovation Foundation has an ongoing iSMART study to try different approaches to capture behavioral savings in low income housing through education or smart technologies. One of the driving aspects of the study is to promote energy awareness for the residents to better understand the costs associated with running various appliances in their homes. Energy awareness efforts include providing photocell controlled LED nightlights and discussing opportunities for daylight harvesting with residents. One building in the study received advanced power strips and was educated on plug load management. The study should help inform future behavioral change efforts in low income housing.

Lighting and air conditioning show the largest economic potential. The analysis predicts a shift from CFL to LED bulbs over the next 3 years. This shift is expected due to the higher lumen efficacy of LEDs in combination with falling prices, and is reflected by the measures inclusion in the TRM.

Natural gas savings can be achieved by upgrading heating systems, incorporating programmable thermostat controls, and improving the building envelope. Further savings can be reached by upgrading domestic hot water systems and fixtures.

It should be noted that cost effectiveness requirements do not apply to the Low Income sector although the economic analysis was performed with consideration to TRC values.

5.2 Low-Income Multi-Family

The low-income multifamily sector has 545,208 electric customers, and 352,305 natural gas customers. The multifamily sector has many less natural gas customers due to instances of buildings providing all heating and domestic hot water to residents. Low-income multifamily sector consumed 2,887,800 MWh, and 308,564 thousand therms in the previous year. The following figures present the estimated energy consumption by system breakdown for low-income multifamily homes.

Figure 150. Low-Income Multifamily - Total Electricity Consumption (MWh)

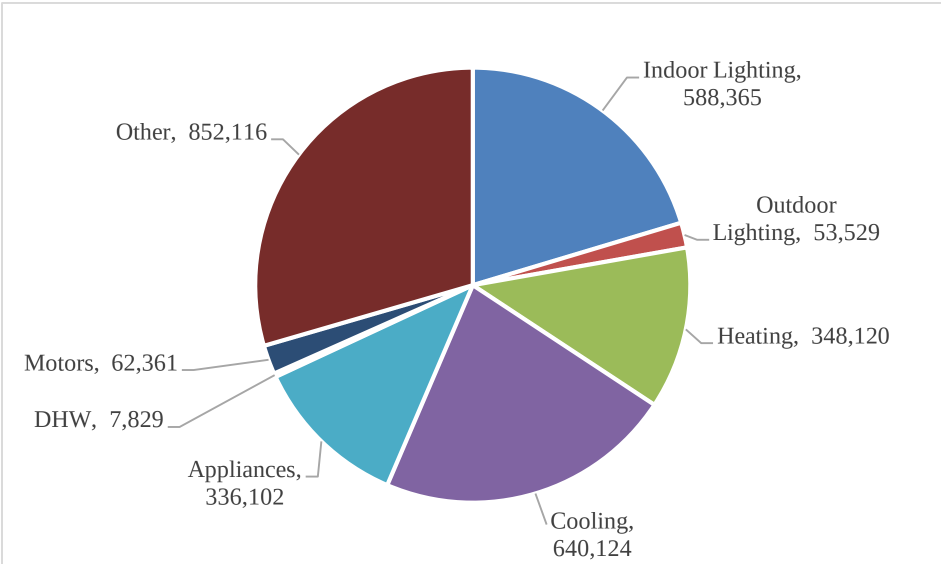
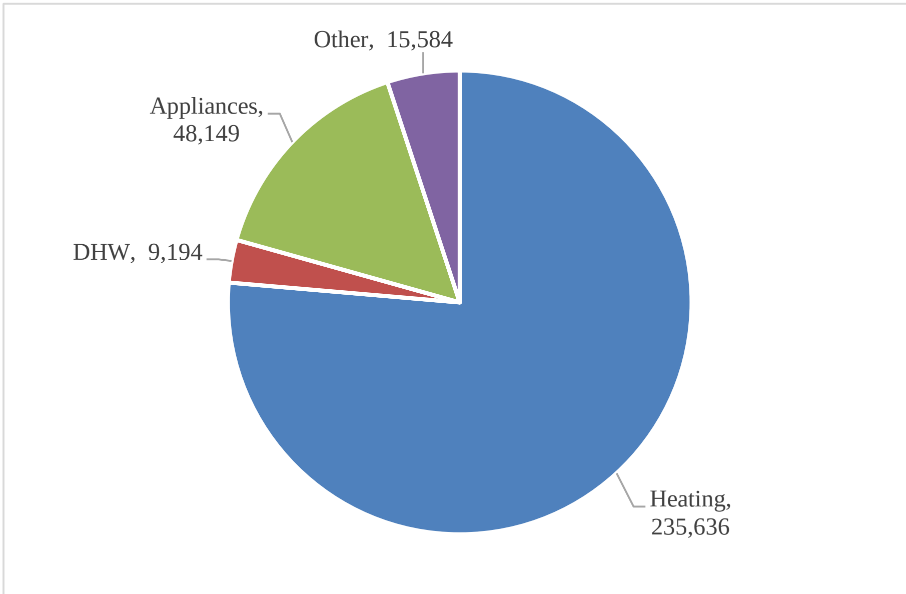


Figure 151. Low-Income Multifamily - Total Natural Gas Consumption (1000 therms)

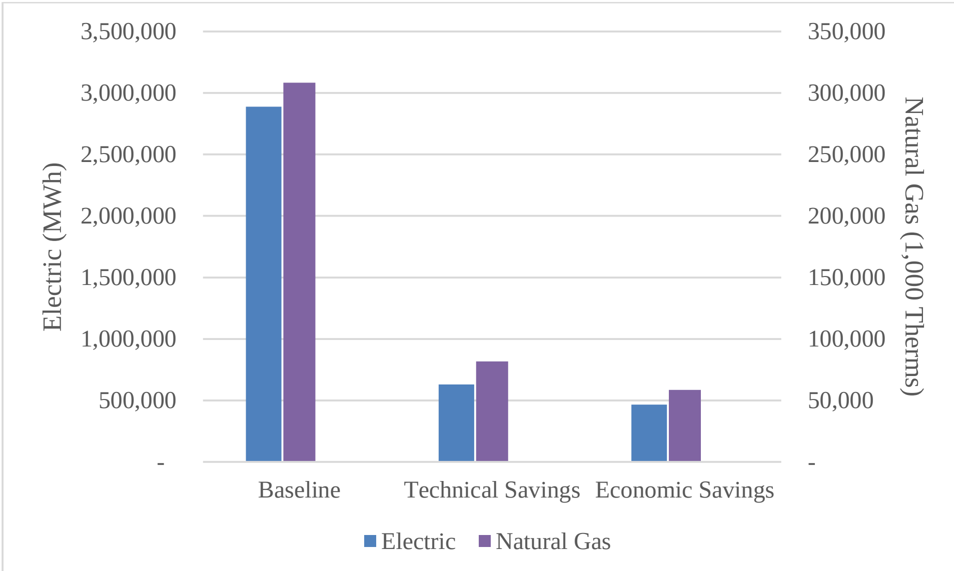


The following table and graph denote the percent savings for the technical and economic reduction potential, and show the total savings potential in MWhs and 1000 therms for each compared to the total consumption determined for low-income multifamily homes.

Table 43. Low-Income Multifamily Technical and Economic Potential

	Total Consumption	Technical	Technical Potential	Economic	Economic Potential
Electric (MWh)	2,887,800	21.8%	628,099	16.1%	465,257
Natural Gas (1,000 therms)	308,564	26.5%	81,688	19.0%	58,599

Figure 152. Low-Income Multifamily - Total Consumption and Savings Potential



The following figures represent the technical energy reduction breakdown by measure for low-income multifamily homes.

Figure 153. Low-Income Multifamily - Electricity Technical Potential (MWh)

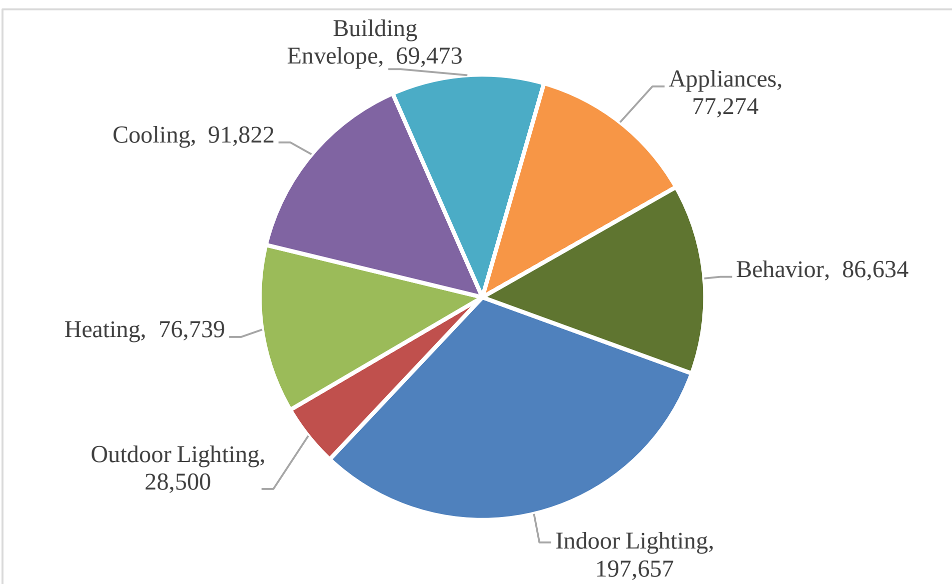
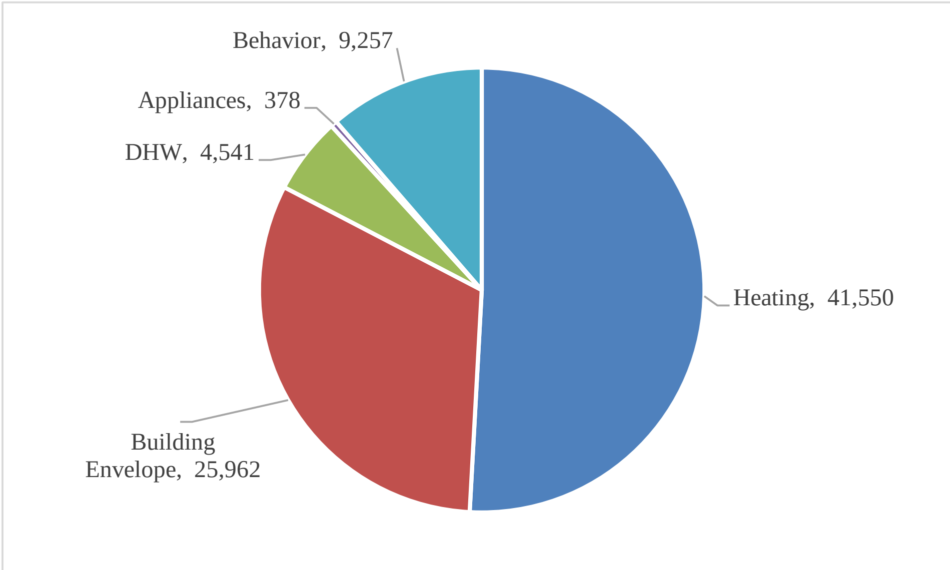


Figure 154. Low-Income Multifamily - Natural Gas Technical Potential (1,000 therms)



The following figures represent the economic energy reduction breakdown by measure for low-income multifamily homes.

Figure 155. Low-Income Multifamily – Electricity Economic Potential (MWh)

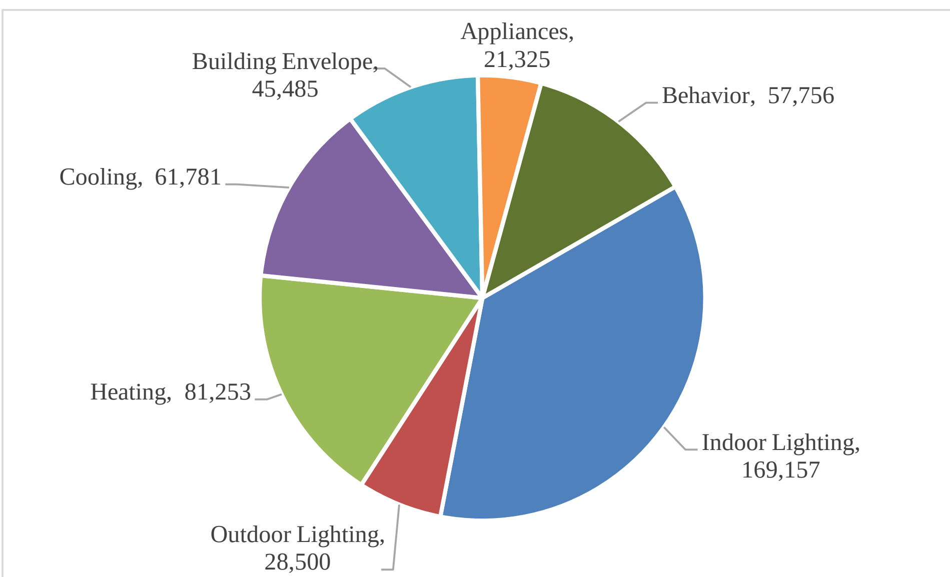
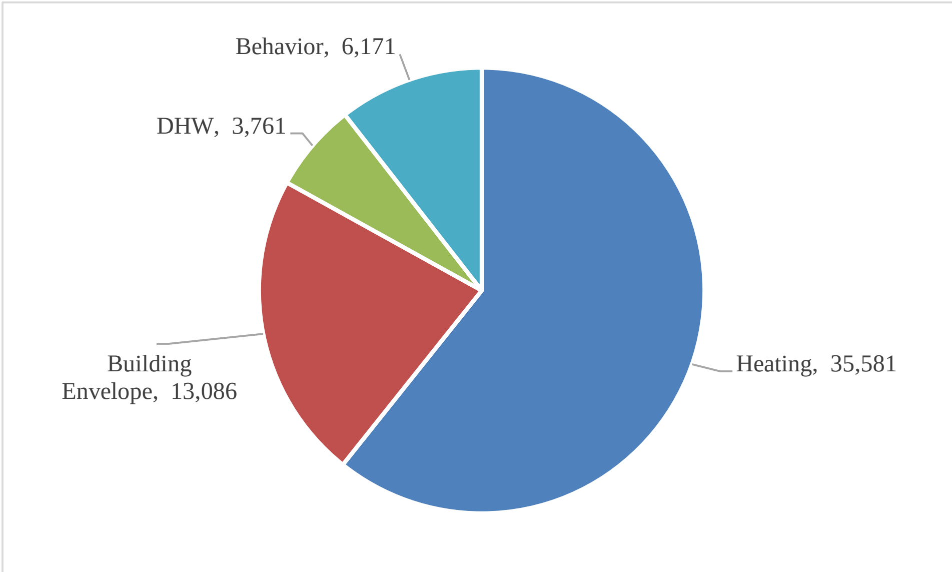


Figure 156. Low-Income Multifamily - Natural Gas Economic Potential (1,000 therms)



Considerations and Recommendations for Low-Income Multi-family Households:

Similar considerations to the Single-Family Low-Income sub-sector apply to the Multi-Family sub-sector. In particular, financial incentives are not the best motivator for the residents considering instances where residents pay a fixed rate utility cost or the property management pays the utility costs. Direct install programs are the best energy efficiency delivery method for reaching residents in this situation. Financial incentives remain a successful motivator for property owners who have a limited budget to make upgrades to building systems. Indoor lighting shows the highest economic potential; the analysis predicts a shift from CFL bulbs to LEDs over the course of the next 3 years. This shift is expected due to the higher lumen efficacy of LEDs in combination with falling prices, and is reflected by the measures inclusion in the TRM. Mostly through-the-wall or window units, with lower efficiencies than rooftop units or chilled water centralized systems, meet the cooling requirements of the Low-Income Multi-Family sector.

On the natural gas side, space heating applications, mainly boilers, coupled with behavioral waste represent almost 75% of the savings potential. Once again educational initiatives on energy efficiency and energy conservation could help to cost-effectively capture some of the savings potential related to behavior, but significant financial resources would be required to capture the potential savings from boiler replacements.

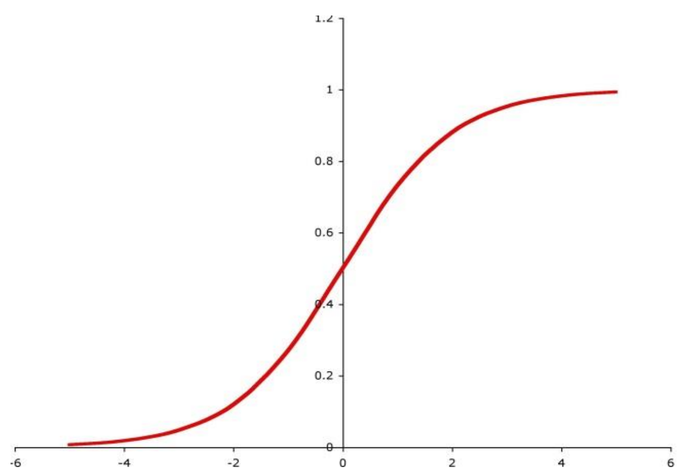
6.0 Achievable Potential

Achievable potential was calculated for the Public and Low-Income sectors as a whole, since the model takes into account the implementation of actual efficiency programs, with their measure mix, implementation costs and market diffusion, rather than technological and economic assumptions for individual measures as was the case for Economic and Technical Potentials.

The achievable potential takes into account real world market barriers that prevent the adoption of energy efficiency, such as market acceptance of new technologies and willingness to change behavior, the ability of trade allies and contractors to reach customers, or financial constraints that customers face at the time of purchase that may limit their ability to choose between different technologies.

This market behavior was represented using a Diffusion Model that replicates the likelihood of adoption of a measure given market conditions and economic incentives, leading to the development of a series of “S-curves” named so because of the characteristic shape. The function represents the growth, or diffusion, of a certain technology in the market. The initial stage of the curve is approximately exponential; then, as adoption moves from “early-adopters” to the majority of customers, the growth slows and, at maturity, the growth stops. Each measure currently offered or that could be offered by the Department through energy efficiency programs was modeled using this function, and different S-curves were associated to different incentive levels and market conditions for every measure. The model interprets unfavorable market conditions and low incentive levels with lower adoption rates, and favorable market conditions and high incentive levels with higher adoption rates. An example of the standard S-curve is shown below.

Figure 157. Standard Sigmoid Function or “S-curve”



Each S-curve was calibrated to reflect historical market adoption rates given the Department's incentive levels.

Two levels of Achievable potential are discussed in the following sections: Maximum Achievable Potential and Program Achievable Potential. Maximum Achievable Potential refers to the energy reduction potential that could be achieved without budget limitations, offering 100% of the incremental cost necessary to purchase and install the efficient measure, but still within real world limitations, such as market adoption rates, equipment turnover, ability to reach out to the market and willingness to adopt the new technology. Program Achievable Potential refers to the energy reduction potential that can be achieved given budget constraints and optimizing incentive levels to maximize participation with respect to savings realized (with a limited budget, higher incentives increase participation potential but obviously decrease the number of installed measures).

Two factors were considered in determining how much of the population could adopt the proposed measure: retrofit potential and end-of-life replacement potential. Retrofit potential refers to the ability of retiring currently functioning equipment which is close to or past the effective useful life but still functioning and operational. Retrofit potential varies by measure and by incentive level with respect to the full cost of the measure implementation, which is the cost that the customer would have to pay to install the energy efficient technology. Capital intensive, lower payback measures where the incremental cost is only a small portion of the full cost (hydronic boilers for example) are less likely to be retrofitted than less capital intensive, higher payback measures where the incremental cost represents a higher portion of the full cost of the measure (T8 to LED lighting retrofit for example). End-of-life replacement potential refers to the ability of influencing customers during the decision making process of replacing a unit deemed to be retired within a certain timeframe, or as a consequence of equipment failure. When that happens, the customer may contact a contractor or perform their own research to replace the equipment, and financial incentives can sway the decision towards the highest efficient cost-effective measure available on the market. In end-of-life replacements, the lifetime of the measure comes into play to determine the natural market turnover, and incentive levels and program design determine the percentage of equipment turnover that can be reached by energy efficiency programs. The combination of retrofit potential and end-of-life replacement potential represent the percentage of the market that could adopt the energy efficient measure.

6.1 Public Sector Achievable Potential

The achievable potential for the Public Sector, including a Net-To-Gross set at 80% for the purposes of this analysis, can be seen below for the years 2017-2022:

Table 44. Achievable Potential by Year for Public Sector

Year	2017	2018	2019	2020	2021	2022
Program Electric Achievable Potential %	0.86%	0.89%	0.90%	0.85%	0.86%	0.86%
Program Natural Gas Achievable Potential %	0.68%	0.68%	0.68%	0.66%	0.68%	0.64%
Maximum Electric Achievable Potential %	3.38%	3.53%	3.55%	3.36%	3.40%	3.41%
Maximum Natural Gas Achievable Potential %	3.58%	3.60%	3.56%	3.48%	3.56%	3.35%

The cumulative achievable potential for the Public Sector, assuming budgets for the period 2020-2022 will remain the same as those for the period 2017-2019, can be seen below:

Table 45. Cumulative Achievable Potential by Year for Public Sector

Year	2017	2018	2019	2020	2021	2022
Cumulative Program Electric Achievable Potential %	0.86%	1.75%	2.65%	3.50%	4.36%	5.23%
Cumulative Program Natural Gas Achievable Potential %	0.68%	1.37%	2.05%	2.71%	3.39%	4.03%
Cumulative Maximum Electric Achievable Potential %	3.38%	6.91%	10.46%	13.83%	17.23%	20.64%
Cumulative Maximum Natural Gas Achievable Potential %	3.58%	7.18%	10.73%	14.22%	17.78%	21.13%

6.2 Low-Income Sector Achievable Potential

The achievable potential for the low-income can be seen below for the years 2017-2022:

Table 46. Achievable Potential by Year for Low-Income Sector

Year	2017	2018	2019	2020	2021	2022
Program Electric Achievable Potential %	0.27%	0.22%	0.21%	0.20%	0.19%	0.18%
Program Natural Gas Achievable Potential %	0.21%	0.21%	0.20%	0.20%	0.20%	0.18%
Maximum Electric Achievable Potential %	3.06%	2.55%	2.39%	2.26%	2.13%	2.04%
Maximum Natural Gas Achievable Potential %	1.10%	1.09%	1.08%	1.06%	1.05%	1.04%

The cumulative achievable potential for low-income, assuming budgets for the period 2020-2022 will remain the same as those for the period 2017-2019, can be seen below:

Table 47. Cumulative Achievable Potential by Year for Low-Income Sector

Year	2017	2018	2019	2020	2021	2022
Cumulative Program Electric Achievable Potential %	0.27%	0.49%	0.70%	0.90%	1.08%	1.26%
Cumulative Program Natural Gas Achievable Potential %	0.21%	0.41%	0.61%	0.82%	1.01%	1.20%
Cumulative Maximum Electric Achievable Potential %	3.06%	5.61%	8.00%	10.26%	12.40%	14.44%
Cumulative Maximum Natural Gas Achievable Potential %	1.10%	2.19%	3.26%	4.33%	5.38%	6.42%

7.0 Analysis and Recommendations

Electric Energy Efficiency programs in Illinois have been active for 8 years at the time of this study. In those years, incentives were focused on replacing existing technologies with new energy efficient technologies. Based on an analysis of electric program year 5 / gas program year 2 (EPY5 / GPY2, or simply PY5) through electric program year 7 / gas program 4 (EPY7 / GPY4, or simply PY7) of the Department's energy efficiency programs, most of the electric savings were achieved via lighting upgrades, including a large portion of custom lighting and lighting controls. In the future, lighting upgrades will still constitute the majority of cost-effective energy savings, led by solid state lighting technologies (LED), whose improved lighting efficacy allows for a further energy reduction of 30-50% when compared to the ubiquitous fluorescent lighting. The simplicity of the measure, combined with its rapidly declining payback thanks to virtually maintenance free operation for 60,000 hours or more will make it the leading technology of the 2017-2020 portfolio. At the same time other measures will have to become more important in the programs, given that new lighting savings will be based on a lower baseline and more installed measures will be required to achieve the same amount of kWh savings.

At the time of this study, the fiscal situation of the Illinois Public Sector has unfortunately aggravated, with a long-standing State budget impasse which worsened the tightening of Operation and Maintenance (O&M) budgets, deferred maintenance practices and lack of resources allocated for capital projects. Together with a tighter federal fiscal policy, this means that the needs for the Department administered portfolio of programs will be higher than ever, and there will likely be aggressive competition for funding from the cash depleted public sector.

This scenario is both a threat and an opportunity. It threatens fairness in the sense that access to programs will become harder for cash strapped organizations, allowing richer entities to leverage funding and implement projects while leaving poorer ones behind. It also provides an opportunity to design incentive programs that require higher performance in order to participate i.e. energy efficiency markets become more mature since the "low hanging fruit" is taken care of leaving only more capital intensive projects that result in more savings per project. It should be noted that while participation in the programs was significant, usually in the 20-50% range, participation by sub-sector greatly varies leaving an opportunity to work with entities that haven't participated in the programs. For example, State and Federal participation rate was only 2%.

Programs will start to address behavior, not in the typical billing insert format employed by Utilities, since the Department doesn't bill customers, but more so with the advent of smart technologies that address energy conservation and reduce behavioral waste. Lighting occupancy sensors have been a popular measure in the programs, and new technologies such as Advanced Power Strips and Smart Thermostats. Emerging technologies such as wi-fi enabled lightbulbs and wi-fi power outlets will create new opportunities to save energy while improving comfort. These technologies combined with the smart grid may provide a whole new avenue for energy programs based on feedback and energy consumption analysis. Pilots may arise during the 2017-2020 timeframe, but their implementation will likely occur beyond 2020 and both results and successful approaches are still uncertain.

Gas programs have been in place for 5 years at the time of this study. Gas consumption is dominated by space heating applications and, not surprisingly, results show great potential for space heating system upgrades. The analysis shows that retirement of central heating plants is not naturally occurring in the market, with old equipment still in service and worsening deferred maintenance and “patchwork” quick fixes due to existing budget constraints. Over the PY5 through PY7 timeframe, gas savings were achieved via a combination of upgrades and maintenance of central heating systems, with a high percentage of custom applications.

Low Income programs are limited in size by budget constraints, since 100% of the incremental and in several cases 100% of the full measure cost are necessary to move the market. With the CFL approaching sunset and revised algorithms (TRM v5.0) that reduce savings for insulation and air sealing, programs that address a comprehensive set of measures with LED lightbulbs will be the most successful. Without CFLs “lifting” the programs’ cost-effectiveness will remain an issue for direct install, deep retrofit programs. Given that the programs historically touched only a small portion of customers, the increase in budget expenditures by the Department in Low-Income programs is a welcome and necessary step to help the sector. Unfortunately, due to external economic factors and internal State budget issues, the size of the Low-Income sector has significantly increased since the time of the last study in 2013.

In many sectors, it was found that cooling energy reduction potential was on par with that of lighting, but current adoption rates are low. This is due to the higher initial cost of cooling measures, which can be coupled with advanced controls such as demand control ventilation and smart thermostats to reduce cooling needs and generate cost-effective energy savings while downsizing the central equipment.

On the gas side, hydronic boilers for heating applications dominate the market. It has been found that aging units and poor maintenance practices characterize the market. Long-lived capital-intensive equipment shows a lower return on investment, but changing these units for higher efficiency technology is cost-effective over the lifetime of the measure. These capital intensive measures, as is the case for cooling, can be coupled (or preceded by) advanced controls both in the form of smart technologies and demand control ventilation to reduce the heating needs and provide an opportunity for equipment downsizing.