Delaware Statewide
Commercial & Industrial End Use & Saturation Study

Submitted to the Delaware Department of Natural Resources and Environmental Control

Submitted By Nexant, Inc.

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1 EXECUTIVE SUMMARY

1.1 OVERVIEW

Opinion Dynamics Corporation (ODC) and subcontractor Nexant, Inc. (Nexant),– have been contracted by the Delaware Department of Natural Resources and Environmental Control (DNREC) to perform an end use and saturation study (baseline study) of the commercial and industrial (non-residential) facilities in the State of Delaware. Primary data was collected for this study from March through May 2012. This report documents the findings of that study, which can be utilized for future energy efficiency program planning in the state.

This study evaluates the characteristics of the energy using equipment and building stock present in Delaware. Nexant used its experience performing previous baseline studies, energy efficiency program planning, and evaluations to identify output parameters that will be integral to future resource planning and energy efficiency activities in Delaware.

While a number of end use studies have been conducted on national and broad regional levels, there is a notable absence of data specific to Delaware. To overcome this hurdle, Nexant conducted a survey of commercial and industrial facilities to gather accurate data that is specific to Delaware. In order to maximize the reliability of the survey, Nexant opted to gather information through customer site visits. Therefore, the results of this study rely mainly upon primary research conducted in the form of on-site customer visits performed by trained Nexant engineers. A review of available secondary sources was also performed in an effort to streamline and complement primary research efforts in addition to filling in gaps – either in the presence or quality of data.

1.2 METHODOLOGY

To accurately meet the objectives of this study, Nexant designed an approach which melded the results of both primary and secondary data sources. The study began with an assessment of the nonresidential market in Delaware through a review of the Hoover's database[1] of commercial businesses in the state. Coupled with other sources of secondary data, Nexant established an estimated representation of the current segmentation of the nonresidential marketplace based on each building type's share of kWh consumption. Once segmented, a sampling plan was developed to provide a representative sample stratified by estimated energy consumption. This sample provided the basis for conducting primary research.

On-site surveys were targeted at the customer segments which provide a representative sample of Delaware businesses. Likewise, the energy end uses included in this study were selected to encompass typical building energy-using equipment. Moreover, the end uses encompass the typical energy efficiency measures in typical energy efficiency programs. Finally, to provide statistically relevant results that can be reasonably applied to the C&I population of Delaware, Nexant designed

[1] Hoover's is a subsidiary of Dun & Bradstreet and maintains a current database of business information from across the U.S and the world. See www.hoovers.com.

the study sample using a stratified random sampling approach to produce findings with a 90% confidence level and a 10% margin of error (90/10) for average characteristics of the entire non-residential population (commercial and industrial combined) across the state. The sample size was not large enough, nor was it intended, to provide sector or segment specific results across the state.

To achieve this level of statistical rigor, this study evaluated the characteristics of Delaware's building stock by performing 69 commercial and industrial on-site customer surveys. These surveys were designed to inventory the current energy using equipment with regards to type, fuel, efficiency, saturations and operating conditions, as well as document the characteristics of the buildings themselves.

1.3 OVERVIEW OF FINDINGS

This study evaluates non-residential customers from across the state of Delaware. Sample participants came from a broad cross-section of Delaware regions and utility territories. Sixty-five percent (65%) of study participants were from New Castle County, followed by Kent County (22%) and Sussex County (13%). Seventy-one percent (71%) of study participants were Delmarva customers (the largest investor owned utility in the state), with the remaining participants coming from various municipal utilities and the Delaware Electric Cooperative. Because this study presents findings on building premises, energy findings presented below do not include transmission, substation, irrigation or lighting rate classes. Through on-site surveys and secondary research, Nexant was able to characterize the saturation, operating conditions, and the efficiency level for the major end uses of a building. Results are presented below.

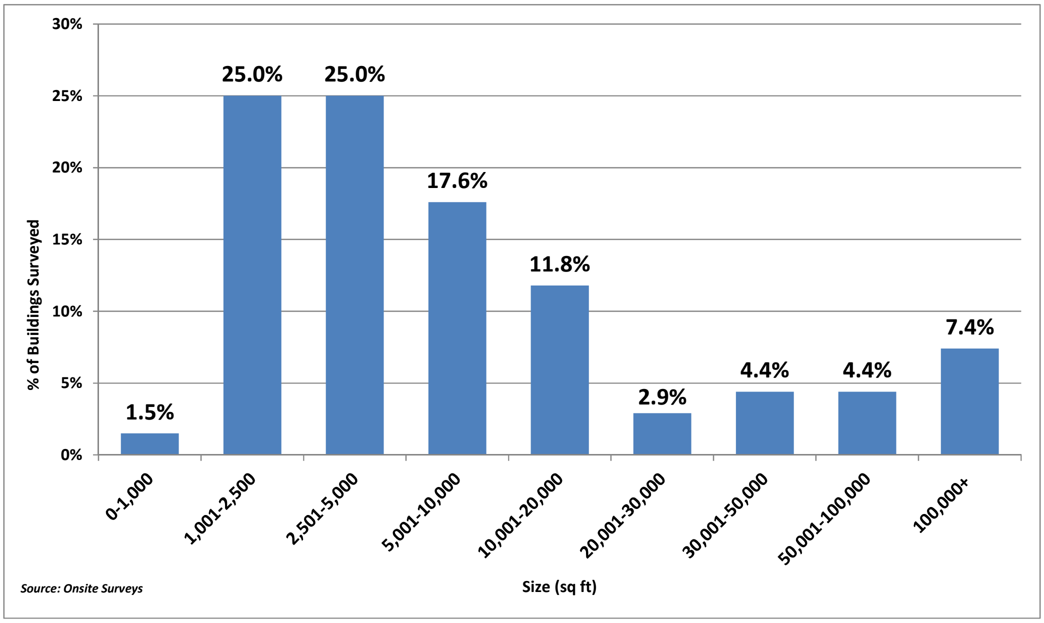
1.3.1 Building Characteristics

By nature, commercial and industrial buildings are heterogeneous. While residential buildings typically have the same types of energy using equipment (appliances, furnace, etc.) and are generally the same size, commercial and industrial facilities can vary significantly in design, types of installed equipment, and size. Nevertheless, some general conclusions can be drawn about the general make-up of non-residential buildings in Delaware.

Figure 1-1 shows the distribution of building size for all commercial and industrial buildings surveyed. Fifty percent (50%) of the buildings visited were between 1,000 ft^2 and 5,000 ft^2. Just over seven percent (7.4%) of the surveyed premises were very large, at more than 100,000 ft^2—due in large part to the control for large buildings utilized in the sampling plan[1].

[1] Without a control for large premises there would likely be very few, if any, large buildings in the stratified random sample as small premises comprise the vast majority of the building stock based on a number of premises metric.

Figure 1-1: Building Size Distribution of Buildings Surveyed (n=69)



S*ource: On-site surveys*

Table 1-1 through Table 1-3 provide an overview of additional characteristics of buildings in the commercial and industrial sector. The average number of occupants during business hours is 69.2. The average number of floors per premise is 1.7, with the average size of the building being just over 30,000 ft^2. Just over seventeen percent (17.4%) of surveyed buildings were commissioned upon construction[1] , while only 1.4% of the buildings across the non-residential sector have been re-commissioned in the previous ten years, with 1.4% being LEED certified[2]. The average R-value of walls is 13.8 across all building types in Delaware.

Table 1-1: Building Characteristics

Parameter	Unit	Non-Residential	n-values
Avg. Age	Years	40.3	59
Avg. # of Occupants	-	69.2	68
Avg. # of Floors	-	1.7	63
Avg. Size	ft^2	30,691	69

Source: On-site Surveys

[1] Commissioning refers to the process of verifying that all building systems (HVAC, lighting, etc.) are functioning properly and as intended by the architect and builder.
[2] LEED certification is a "green" building certification program developed by the U.S. Green Building Council.

Table 1-2: Building Efficiency Levels

Parameter	Non-Residential	n-values
Percentage Building Commissioned	17.4%	69
Percentage Re-commissioned in last 10 Years	1.4%	69
Percentage Buildings LEED Certified	1.4%	69

Source: On-site Surveys

Table 1-3: Building Window and Wall Characteristics

Parameter	Non-Residential	n-values
Glazing Percentage of Walls	15.2%	66
Percentage Double Paned	54.8%	62
Percentage Metal Framed	67.2%	64
Avg. Wall Insulation (R-value)	13.8	20

Source: On-site Surveys

1.3.2 Saturation & Fuel Share

Table 1-4 shows the saturations of different end uses in both the commercial and industrial sector along with fuel shares of those end uses. Saturation as defined in this report is the percentage of buildings with a given end use present[1]. In some cases, saturation is also given for equipment types, in which case it refers to the percentage of buildings that have a specific equipment type present in buildings with the relevant end use. Space cooling is present in the vast majority of the buildings surveyed (98.8%) with cooking and refrigeration present in 20.6% and 24.6% of the buildings respectively. Fuel share is an important metric for energy efficiency program planning, as it provides program planners insight into the potential for energy savings for equipment that can be powered by different fuels. Electricity and natural gas provide roughly the same share of fuel for space heating at 43.4% and 48.7% respectively. Water heating is primarily fueled by electricity at 75.4% in the state. Electricity fuels about 55% of cooking equipment.

[1] Saturation, as defined in non-residential baseline studies, varies slightly from that defined in residential baseline studies. Residential studies define saturation as the total number of equipment type present (e.g. total refrigerators) divided by total buildings – which can provide a value of more than 100%. However, due to the heterogeneous nature of commercial buildings and the large number of certain equipment types present (e.g. dozens of window-wall A/C units in a hotel), this report makes the simplification of using "saturation" inter-changeably with what the residential report defines as "penetration". That is, the percentage of buildings with a given end use/equipment type present, regardless of number of equipment type per building.

Table 1-4: End use Saturations and Fuel Shares

End Use	Saturation	Fuel Share				
		Electric	Natural Gas	Fuel Oil	Other(2)	n-values(3)
Lighting	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Space Heating	100.0%	43.4%	48.7%	2.7%	5.3%	69 / 113
Space Cooling	98.8%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Plug Load	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Refrigeration	24.6%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Cooking	20.6%	54.8%	39.8%	0.0%	5.4%	69 / 93
Water Heating	89.9%	75.4%	18.8%	5.8%	0.0%	69 / 69
Other(1)	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a

Source: On-site Surveys
(1) "Other" End Use includes pumps and misc. equipment
(2) "Other" fuel share includes LPG, wood, and misc. fuels
(3) "Saturation" n-values / "fuel share" n-values

1.3.3 End Use Findings Summary

Understanding baseline energy consumption characteristics of the end use equipment is important for program planners. For example, if a certain energy efficiency measure (e.g. T8 Plus linear florescent lighting) is found to have significant saturation in the marketplace, then it may be unwise to develop a rebate program around that measure since there is limited potential for energy savings. Below, the key findings from the major building end uses are summarized.

1.3.3.1 HVAC System

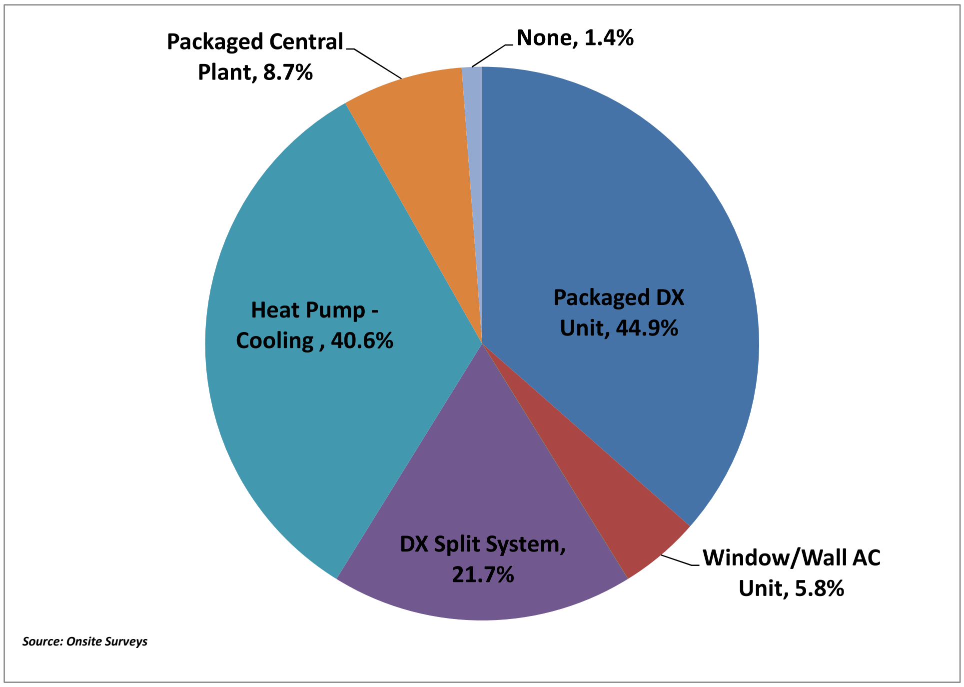
HVAC systems generally represent roughly 40% of a commercial buildings energy usage[1]. Figure 1-2 shows the prevalence of different types of cooling systems across the state. Space cooling saturation findings are presented as the percentage of buildings with a given system type present. For example, if a building had one chiller (counted as part of the packaged central plant category), but also 35 window wall A/C units, data was counted as simply two system types present in one building. Counts were then divided by the total number of buildings surveyed (69) so that a meaningful "none" category could be presented (note: many buildings have multiple cooling systems present so percentages may add up to more than 100%). Packaged DX (Direct Expansion)[2] units were present in the largest share of buildings (44.9%)[3]. Heat pumps were also found to have a large presence in the market and were found in 40.6% of surveyed buildings. Also of note is that only one of the 69 surveyed buildings (1.4%) had no cooling systems installed.

[1] Commercial Building Energy Consumption Survey (CBECS). EIA. 2003

[2] Direct Expansion, or DX, refers to a type of air conditioning system that relies on compressive refrigeration; a process in which cooling is effected by the vaporization and expansion of a liquid refrigerant. Heat is extracted from air by an evaporator coil and is rejected by a condenser.

[3] Please refer to Appendix D for definitions of space heating and cooling technology types

Figure 1-2: Saturation of Cooling Equipment in Non-Residential Buildings[1] (n=69)



(1) Percentages add up to more than 100% because buildings may have multiple systems

Figure 1-3 shows the prevalence of different types of heating systems across the state, presented statewide. Space heating findings are presented by equipment type as a percentage of total heating systems (thus percentages will add up to 100%). Again, heat pumps were found in a sizeable share of buildings – both heat pumps and packaged single zone systems comprised 30% of surveyed systems. Unit heat, furnace, and central plant systems each comprised 13% of surveyed systems.

Table 1-5 and Table 1-6 provide cooling and heating parameter findings. Of particular note, is that the average DX cooling system has a SEER value of 11.6, with 6.3% being controlled by an energy management system (EMS). The average heating system has an average heating efficiency of 84.1%, with 9.1% controlled by an EMS.

Figure 1-3: Heating Systems by Percentage of Equipment Type (n=84)

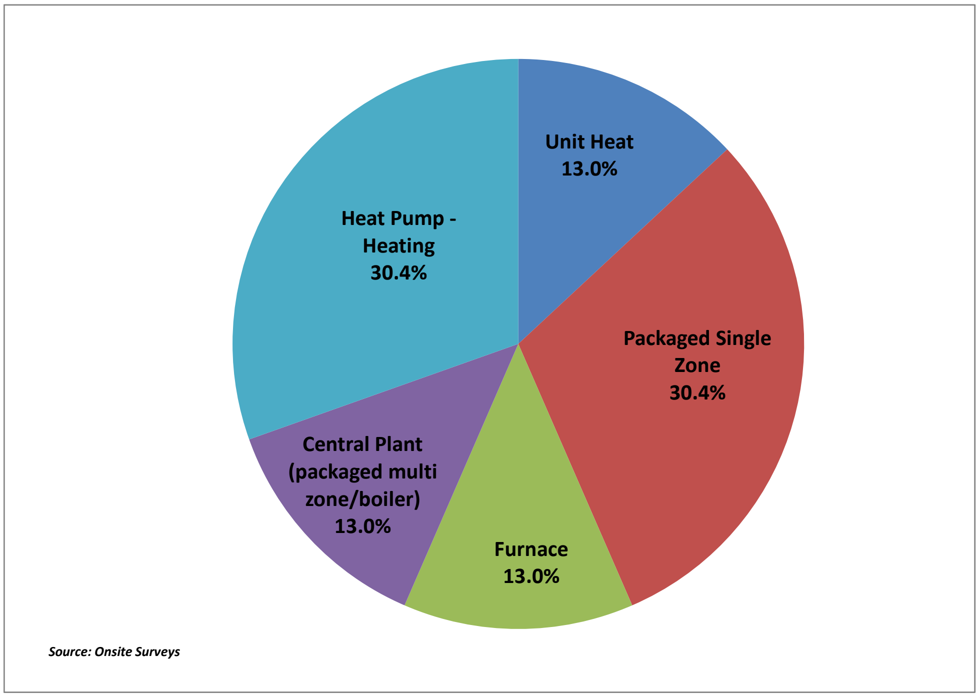


Table 1-5: DX Cooling Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	10.1	44
Avg. Cooling Capacity (tons)	5.4	51
Avg. Cooling Efficiency (SEER/EER)	11.6/9.5	30 / 14
Percentage Programmable	3.2%	69
Percentage with EMS	6.3%	69

Source: On-site Surveys

Table 1-6: Heating Equipment Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	9.7	47
Avg. Heating Capacity (Btu/hr)	88,604	26
Avg. Heating Efficiency (%)	84.1%	13
Percentage Programmable	3.0%	69
Percentage with EMS	9.1%	69

Source: On-site Surveys

1.3.3.2 Lighting

Lighting is another significant end use in terms of energy consumption for the non-residential sector and typically represents about 20-30% of energy consumption according to the Department of Energy's (DOE) Commercial Building Energy Consumption Survey (CBECS). Data was collected based on a count of the number of fixtures and the number of lamps per fixture basis. The number of fixtures was multiplied by its corresponding lamps per fixture to come up with a total count of lamps. Findings, therefore, are presented based on a percentage of lamps.

Figure 1-4 shows the installed lighting systems broken out by percentage of technology type throughout the state (based on the count of total lamps). Linear Florescent lighting represents over 90% of all lamps in commercial and industrial facilities. Interestingly, substantially more CFLs were found than incandescent lighting in buildings. All told CFLs represented just over 60% of all screw-based sockets in Delaware commercial and industrial facilities. LED lighting still represents only a small fraction of lighting at 0.2%. Figure 1-5 shows the break-down of florescent lamp types. Just under half (44%) are T-8 lamps, and 30% are T-12 lamps. T-8 Plus lamps are only installed in a small fraction (3%) of the linear fluorescent fixtures across Delaware. It was also found that 20.3% of buildings have had significant lighting upgrades in the past five years. Finally, Table 1-7 and Table 1-8 show the transition to more efficient lighting for those buildings that had a lighting upgrade performed in the previous five years.

Figure 1-4: Installed Lighting Systems by Percentage of Technology Type (n=69)

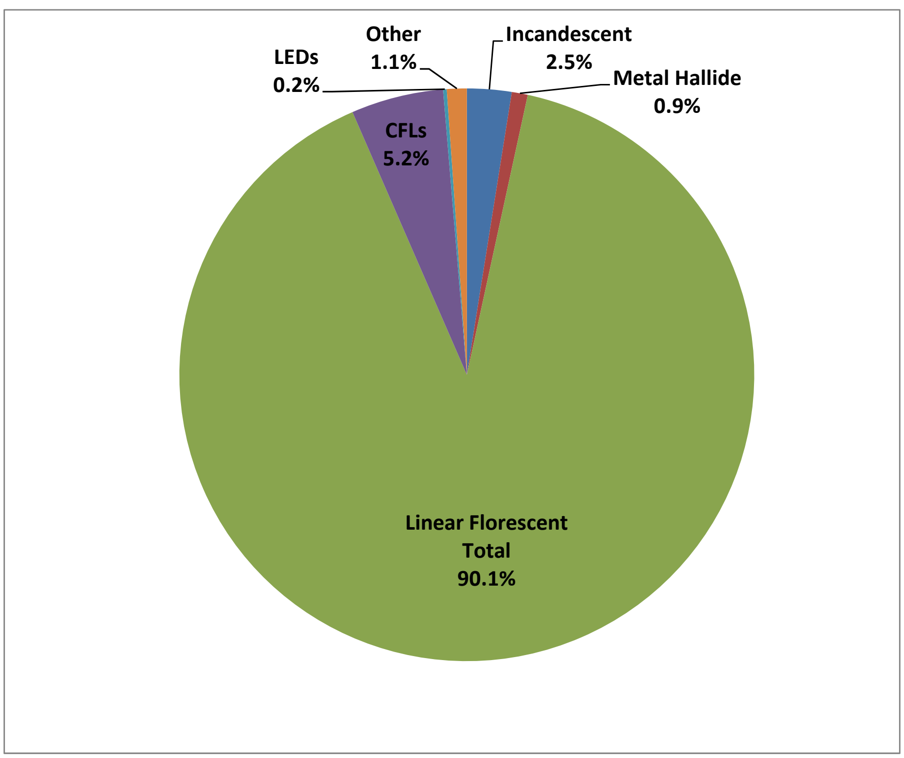


Figure 1-5: Linear Florescent Lighting by Percentage of Lamp Type (n=69)

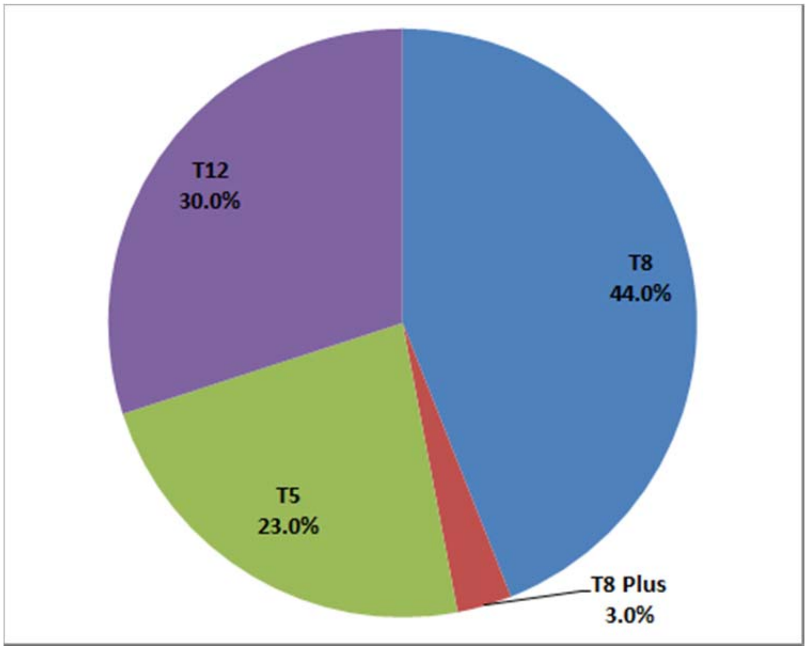


Table 1-7: Comparison of Screw-Based Bulbs in Facilities with and without a Lighting Upgrade (n=69)

Screw-Based	No Upgrades	Upgrade
Incandescent (% of sockets)	37.5%	15.6%
CFL (% of sockets)	62.5%	84.4%

Table 1-8: Comparison of Linear Florescent Lamps in Facilities with and without a Lighting Upgrade (n=69)

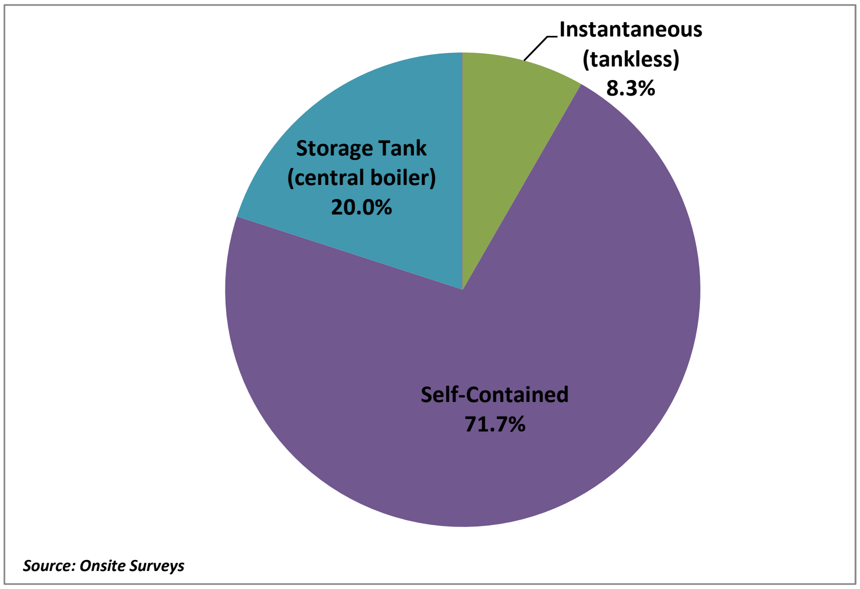
Linear Florescent	No Upgrades	Upgrades
T12 (% of GSFL)(1)	44.4%	10.4%
T8 (% of GSFL)	54.1%	28.5%
T8 Plus (% of GSFL)	1.4%	6.0%
T5 (% of GSFL)	0.1%	55.1%

(1) GSFL = general service fluorescent lighting

1.3.3.3 Water Heating

As noted above, the majority of non-residential facilities (89.9%) have water heaters installed. Findings are presented as the percentage share for water heating equipment types for buildings with installed water heating. Figure 1-6 shows that 71.7% of installed water heating systems are self-contained units, followed by storage tank associated with a central boiler and tankless systems at 20% and 8.3% respectively.

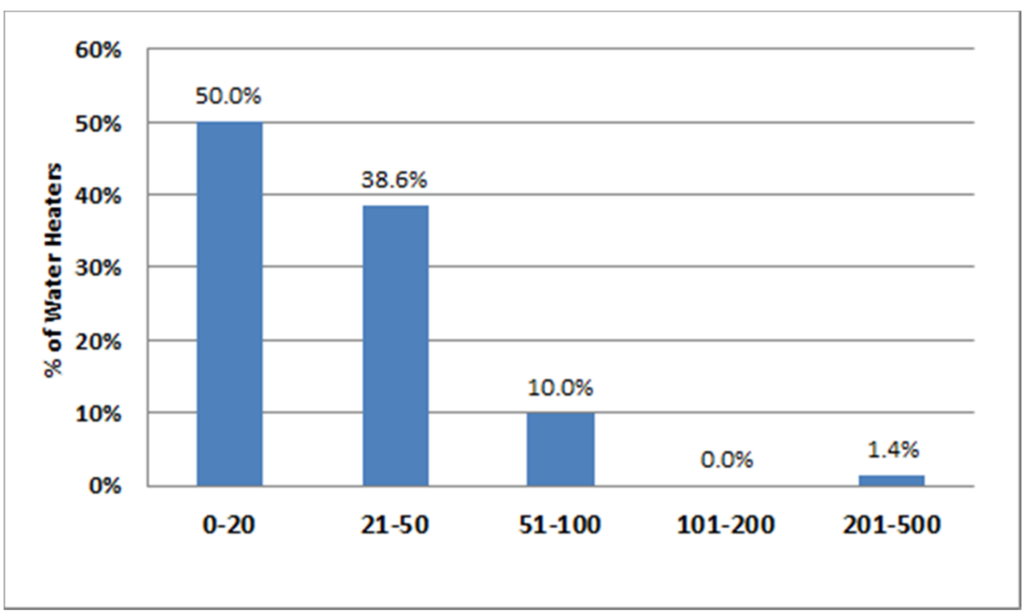
Figure 1-6: Percentage Share of Equipment Types in Buildings w/ Water Heating[1] (n=69)



(1) For all water heating fuel types

Figure 1-7 shows the distribution of system capacity for all non-residential buildings surveyed. The large majority (88.6%) of systems are less than 50 gallons. More than half (75.4%) of all systems are electric.

Figure 1-7: Water Heating Tank Capacity Distribution (n=70)

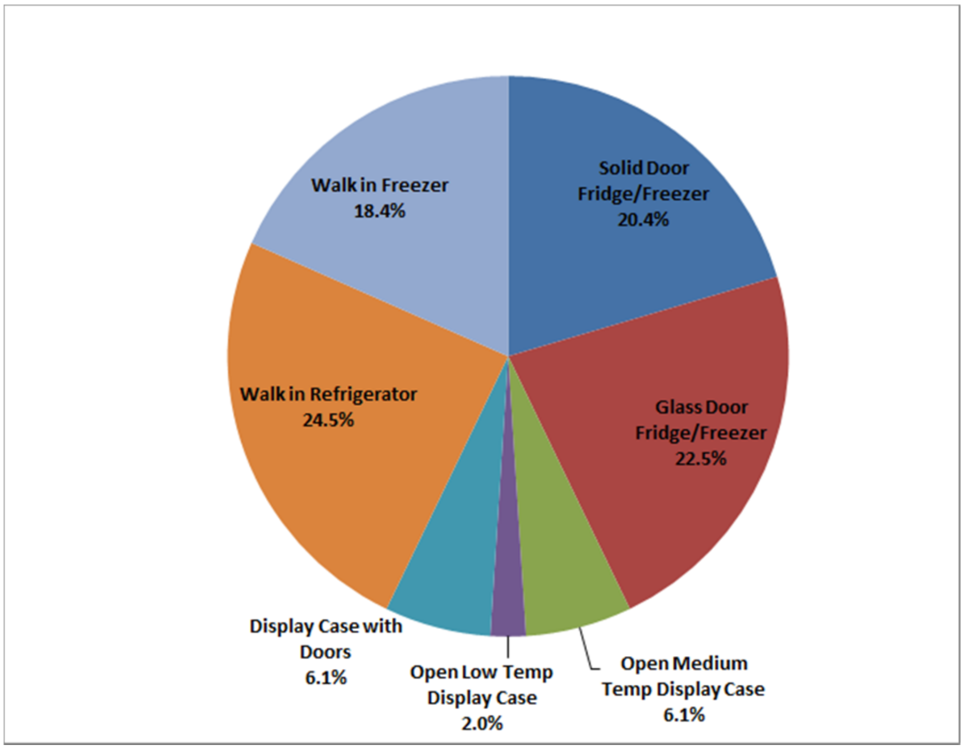


1.3.3.4 Refrigeration

While refrigeration systems are not present in the majority of buildings in Delaware (saturation of only 24.6%), the systems can be energy intensive and consume a large amount of energy on a per square foot basis – especially for certain commercial segments such as grocery.

Figure 1-8 details the percentage share of equipment types installed in those buildings with commercial refrigeration equipment present. Solid door fridge/freezers, Walk in Freezers, Walk in Refrigerators and Glass Door Fridge/Freezers are split fairly equally in the non-residential sector.

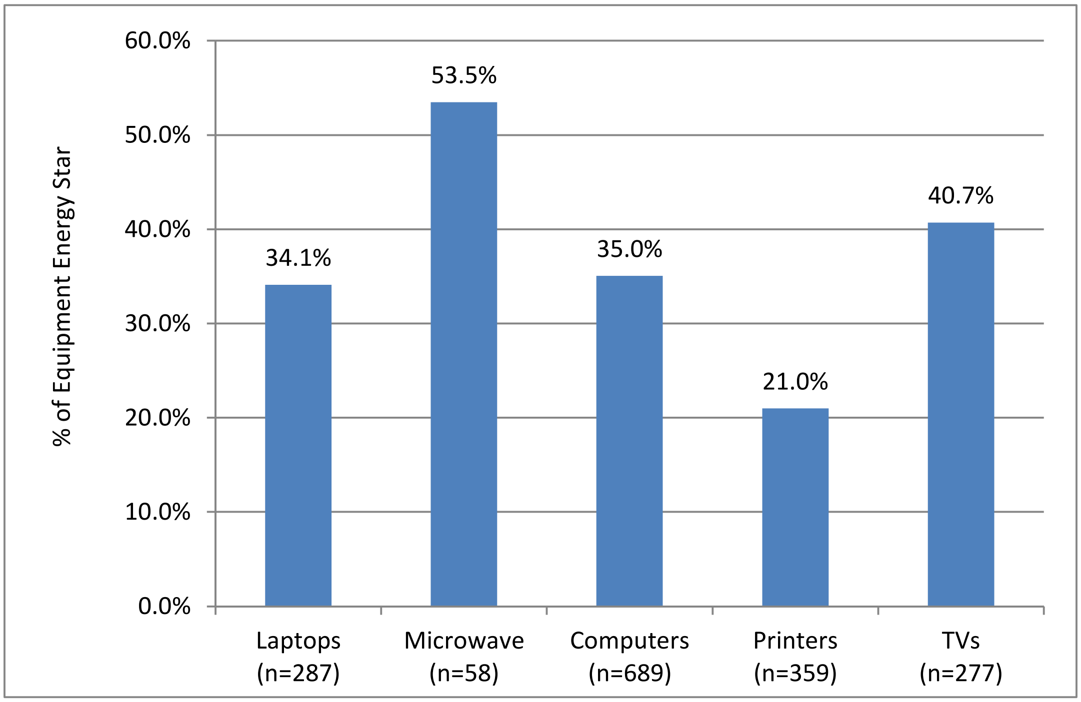
Figure 1-8: Refrigeration Systems by Percentage of Equipment Type (n=49)



1.3.3.5 Plug Load

Figure 1-9 shows the percent of equipment installed that is Energy Star for relevant equipment types in the non-residential sector. All equipment types show room for additional energy star penetration with energy star products reaching a saturation of at most 53.5%.

Figure 1-9: Percent of Plug Load Equipment that is Energy Star



1.3.4 Implications for Future Program Planning

As noted earlier, baseline research characterizes the type and efficiency levels of equipment that are installed in customer homes and businesses and thus helps program administrators make educated decisions about the energy end uses and equipment that can be most effectively targeted with energy efficiency programs. The following are some of the key findings from this baseline research that may have implications for future program planning in the State of Delaware.

- **Heat Pumps:** There is a noticeably high saturation of heat pumps in the marketplace. This suggests that the climate in Delaware favors this type of efficient heating and cooling equipment.
- **Cooling Efficiency:** The average SEER efficiency value for DX cooling systems across the state is 11.6 – being below the minimum code standard for new units, this represents opportunities for program savings.
- **Thermostats**: There is still a high saturation (42.2%) of manual thermostats in the marketplace, suggesting opportunities for these types of programs.
- **CFLs:** have reached a sizeable saturation in the marketplace with 60.3% of all observed screw-based sockets already converted. Opportunities for future savings from CFLs are still

available, though more limited; especially with the tighter efficiency standards that will force traditional incandescent bulbs out of the market for most lighting applications[1].

- **LEDs:** have only reached a saturation of 0.2% of all installed lighting. As prices continue to come down in the coming years, and efficiencies improve, there may be significant opportunity for savings.
- **T12 and T8 lamps:** still dominate the percentage of installed florescent lighting. The high presence of T8s (44%) suggest the market is naturally converting to these lamps without program influence. Moreover, the new lighting standards being phased-in during 2012 will effectively remove T12 lamps from the marketplace, making T8 lamps the new baseline. Future commercial lighting programs will need to take into account lower savings potentials with a more efficient T8 baseline and may need to consider targeting more advanced lamps and lighting system technologies.
- **Lighting Controls:** There is still a significant share of fixtures (90.3%) under manual switch control, indicating opportunities for occupancy sensors or timers.
- **Water Heater Fuel Share**: A significant share of water heaters (75.4%) are fueled by less-efficient electric means (as opposed to natural gas). This suggests an opportunity for fuel switching programs.
- **Refrigeration Measures:** Many refrigeration efficiency measures have a low saturation in the marketplace (namely LED lights for displays, anti-sweat controls, night covers, etc.).
- **Energy Star Plug Load:** Energy Star equipment was not found in a sizeable share of buildings, indicating opportunities for energy star programs (especially for computers and printers).

[1] The Energy Independence and Security Act (EISA) of 2007 established higher efficiency standards for lighting sold in the United States. T12 florescent lamps and traditional incandescent light bulbs will effectively be phased out of production from 2012 to 2014.

2 INTRODUCTION

2.1 OVERVIEW

In December of 2011, the Delaware Department of Natural Resources and Environmental Control (DNREC) selected Opinion Dynamics Corporation (ODC) and its subcontractor Nexant, Inc. (Nexant) to conduct a state-wide evaluation of its existing portfolio of energy efficiency programs. In addition to the evaluation, DNREC opted to have ODC and Nexant conduct an end use and saturation study to provide baseline characterization of the marketplace which can be used for future energy efficiency program planning. While a few end use studies have been conducted on a national level, there is a notable absence of data specific to Delaware. To overcome this hurdle, Nexant conducted a survey of Delaware commercial and industrial customers to gather accurate data that is specific to Delaware[1].

In order to maximize the reliability of the survey Nexant gathered information through customer site visits. Therefore, the results of this study rely mainly upon primary research conducted in the form of on-site customer surveys. A review of available secondary sources was also performed in an effort to streamline and compliment primary research efforts in addition to filling in gaps – either in the presence or quality of data. This baseline study not only provides useful insights into the manner in which energy is consumed in the state, but also provides program planners with the necessary information to develop cost-effective energy efficiency programs in the future.

2.2 STUDY GOALS

The study is designed to serve as a stand-alone end use study, supplying information useful for energy efficiency program development, system planning and obtaining a general understanding of the energy using equipment present in Delaware[2]. With consideration for these ultimate uses of this research, the following goals have been identified for this study:

- Select a representative random sample of commercial and industrial customers appropriately stratified by sub-sector for participation in the baseline study
- Profile commercial and industrial (C&I) electric customers at the sector and end use level.
- Determine the current saturation of energy using equipment in C&I facilities.
- Determine the current saturation of energy efficiency measures in the C&I sectors.
- Determine average baseline levels of annual energy use for lighting, space cooling, plug loads, HVAC and water heating by end use.
- Determine the percent of energy using equipment by end use that is already efficient.

[1] Nexant also conducted the on-site visits for the residential sector. However, ODC performed all the data analysis and report writing. See ODC's Residential Baseline Report for residential findings.

[2] Findings from baseline studies can also provide key inputs (such as fuel share, saturation and efficiency levels) for energy efficiency market potential studies.

Using these objectives as a framework, Nexant designed this study to provide reasonable, defensible results to inform and facilitate improved program planning.

2.3 ORGANIZATION OF THE REPORT

The remainder of this report includes the following sections:

- Section 3 – Study Methodology
- Section 4 – Statewide Non-Residential Findings
- Appendices – *On-site Survey Instrument, Recruitment Letter, Telephone Script, End Use Descriptions, Mapping Tables*

3 METHODOLOGY

3.1 OVERVIEW

To accurately meet the objectives of this study, Nexant designed an approach which melded the results of both primary and secondary data sources. The study began by obtaining a complete list of all commercial businesses in the State of Delaware from Dun & Bradstreet's Hoover's[1]. Nexant then reviewed various end use studies such as the "2012 Pennsylvania Statewide Commercial and Industrial End Use and Saturation Survey" and the "2006 California Commercial End use Survey" to provide a benchmark for analysis before conducting on-site surveys to gather the equipment and facility characteristics of Delaware non-residential customers.

Results in this study are presented at varying levels of resolution with varying levels of confidence for different data points. Where possible, the number of sample points ("n-values") is provided to aid the reader with identifying the level of confidence with each finding. A total of 69 site surveys stratified by commercial segment were planned across the state for the entire non-residential sector. The sample size was not large enough, nor was it intended, to provide sector or segment specific results across the state.

3.2 CUSTOMER DATA CHARACTERIZATION

The first step in this study was to evaluate the commercial and industrial business data obtained from the Hoover's database in order to appropriately structure a representative sample and direct the study's research and focus. The Hoover's databases includes information such as business type, standard industrial classification (SIC) and North American industry classification system (NAICS) industry codes, contact information, building square footage, number of employees, and revenue for all non-residential customers in the state.

3.2.1 Segments

In order to achieve maximum resolution in this study, Nexant worked with DNREC to define appropriate segment divisions for the commercial sector. The sample and survey design was then based off of these segments. These segments are shown in Table 3-1 below.

[1] Hoover's is a subsidiary of Dun & Bradstreet and maintains a current database of business information from across the U.S and the world. See www.hoovers.com

Table 3-1: Non-Residential Segments Defined in Study

Non-Residential Segments
Industrial/Manufacturing
Education
Grocery
Health
Lodging
Office
Restaurant
Retail
Warehouse
Misc.

The sample is thus designed to capture a state-wide, statistically representative sample of building types (segments) in the State of Delaware. Additionally, from an equipment and energy usage perspective, it is expected that the difference between a large facility and a small facility can be significant. For example, the equipment saturations and energy use intensity found in a convenience store will likely vary significantly from that found in a supermarket. To account for variations of this sort, Nexant further stratified the segments into large and small buildings (based on building square footage) to capture the full spectrum of facilities when defining the sample.

3.2.2 Premise Counts

To accurately describe building energy consumption, it was important to remove non-premise buildings from the Hoover's database of businesses. Nexant found that when samples were initially selected, a large number of non-building type businesses were included in the sample. After numerous phone calls, these businesses were linked to sole-proprietor small businesses such as a plumbing contractor that did not occupy a formal commercial or industrial facility (typically they ran their business from their home). To remove these business-types from the sample, Nexant assessed the types of businesses with only 1-3 employees listed in the Hoover's database. Upon further research and phone calls to these businesses, it was found that the vast majority of these businesses were indeed sole-proprietors without an appropriate commercial/industrial facility for which an on-site survey could be performed. Therefore, Nexant opted to remove all businesses with one to three employees from the potential sample pool of participants.

3.2.3 SIC Mapping

The next step involved utilizing the SIC/NAICS industry codes provided by the Hoover's database to determine building and/or business type for each record. Nexant was able to use the SIC and NAICS data to assign records to the commercial and industrial segments (e.g. office, restaurant, retail, etc.). For the industrial sector this was a straightforward process since industrial segments are defined as

business types. However, segments for the commercial sector in this study are defined by building type rather than the business types classified by SIC code. For example, while a SIC code may categorize an office headquarters for a restaurant chain as restaurant business/industry type, our study classifies that building as an office to match the use of the facility. To bridge this gap, Nexant assigned each SIC code to a building type by adopting the SIC-building type mapping used by the *California Commercial End Use Survey*[1]. This mapping key was adjusted to ensure that building types are consistent with the definitions used in this study. After the initial mapping exercise, extensive research was performed to confirm proper building type mapping of the largest facilities (based on square footage since we assumed these also consumed the largest share of energy) along with various random records to verify, and in some cases correct, the SIC mapping exercise.

3.2.4 Segmentation Exercise

The first step in designing a representative sample is to develop an understanding of the fractional share of sector energy consumption for each segment (e.g. office, retail, etc.). Typically for these types of studies utility customer billing data is available. This enables proper segmentation of the market using actual customer energy consumption (based on annual kWh consumption). However, for the purpose of this study, utility customer billing data was not available. Therefore, Nexant devised an approach which provided a reasonable estimation of the segmentation of the non-residential market. This approach is detailed below.

Step 1: Research was conducted from other recent regional and national studies to establish a benchmark segmentation of the market. Nexant reviewed market segmentation findings from a number of reports including the *"2009 Delaware Energy Consumption Study"* prepared by the Delaware Sustainable Energy Utility*, "2012 Pennsylvania Statewide Commercial and Industrial End Use and Saturation Survey"* prepared by Nexant, and the *"2003 Commercial Building Energy Consumption Survey (CBECS)"* prepared by Itron, Inc.

Step 2: Each record in the Hoover's database was mapped to an appropriate segment/building type (as described in **Section 3.2.3**).

Step 3: Using the Hoover's database, total square footage was calculated for each segment/building type by summing the square footage of all businesses in each segment.

Step 4: Total energy consumption (kWh) was calculated for each segment/building type by multiplying each segment's total square footage by a benchmark energy use intensity[2] (see equation below).

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[1] See *California Commercial End Use Survey* prepared by Itron, Inc. March, 2006.

[2] EUI values were used from the *2012 Pennsylvania Statewide Commercial and Industrial End Use and Saturation Study* performed in Nexant, Inc. Specifically, EUIs calculated from primary data collected in the PennPower utility territory were used due to the similar geographic, climate and demographic nature of the PennPower territory and the State of Delaware.

Equation 1: *Segment Energy Consumption (kWh) = Segment Total Square Footage X EUI (kWh/ft^2)*

Step 5: Divide each segment's energy consumption by the estimated total energy consumption in the state to obtain market segmentation based on fractional share of total energy consumption.

3.2.5 Sampling Approach

To produce a defensible end use survey, Nexant aimed to gather data at a 90% confidence level with a precision interval of 10% (90/10). With a very large population, 90/10 confidence can generally be achieved with a minimum random sample size of 68 customers (See **Section 3.6** for more details). Nexant planned to survey a total of 70 customers across the state (53 commercial and 17 industrial) providing a confidence/precision target of 90/10 for the non-residential sector. The next step was to allocate the nine commercial segments/strata (education, grocery, health, lodging, office, retail, restaurant, warehouse and misc.) among the 53 available commercial surveys. Nexant assessed the segment distribution based on an estimated kWh consumption based on the approached detailed in **Section 3.2.4**. As a secondary source of data, total floor space (square footage) and total number of businesses were also used to triangulate an appropriate segmentation. With this approach it was possible to ensure that each segment was properly represented in the sample by using a proportional allocation method primarily based on electricity consumption.

With these segments clearly defined, Nexant was able to allocate the number of site visits. Table 3-2 shows the actual number of site visits conducted by field engineers for each segment.

Table 3-2: Surveys Completed

Segment	Site Visits
Industrial	14
Education	3
Grocery	3
Health	5
Lodging	2
Office	18
Restaurant	5
Retail	9
Warehouse	3
Misc.	7
Total Completed	**69**
Confidence/Precision	90/10

Nexant further controlled for 50% 'large' and 50% 'small' businesses in each segment to ensure our sample wasn't biased towards small customer records (since a disproportionate number of customer records are small). Given the absence of record-specific energy consumption data, Nexant

elected to use a square footage driven cut-off point defined as the median square footage size of buildings for each segment. Table 3-3 shows the cut-off level for each segment.

Table 3-3: Large/Small Sample Cut-Off (based on median building square footage)

Segment	Median Cut-off (ft^2)
Industrial	3,777
Education	5,897
Grocery	3,477
Health	5,596
Lodging	7,603
Office	3,857
Restaurant	4,000
Retail	4,498
Warehouse	5,205
Misc.	3,966

3.3 PRIMARY DATA COLLECTION

On-site surveys conducted by trained field engineers were the primary method for collecting relevant data on the energy-using characteristics of commercial and industrial facilities in Delaware. This section provides an overview of the methodology for recruiting, collecting, and analyzing the primary data summarized in this report.

3.3.1 Recruitment

The first step in the survey process was to design a phone recruitment script designed to introduce the study to the customer, explain the on-site surveys and ask for participation. The telephone recruitment process involved calling from a stratified random sample of commercial and industrial facilities throughout Delaware. Candidates were procured from a database of 18,154 commercial businesses in Delaware purchased from Hoover's. A stratified random sample of approximately 1,200 businesses was pulled from this list for recruitment. If a candidate volunteered to participate, Nexant callers gathered basic premise data (number of structures, building size, age, occupants, etc.) and information on the presence of major end uses. This information was used to determine the expected length of the site visit and help prepare the on-site engineer. Nexant would attempt to contact customers a maximum of three times before considering a record not part of the study. Letters were also developed on DNREC letterhead to send to inquiring customers to verify the validity of the study. The phone script and introduction letter are included in **Appendix B** and **Appendix C** respectively.

3.3.2 On-site Survey

On-site surveys provide highly accurate data because information is collected by trained engineers with experience identifying and describing building systems. In order to maximize the effectiveness of each site visit and provide results with a high level of detail, Nexant designed the on-site survey to be as comprehensive as possible. The on-site survey gathers data on the presence of each end use studied as well as its fuel type and efficiency level.

One of the major challenges in conducting on-site data was ensuring that building systems are accurately and consistently categorized. This was of particular concern when evaluating commercial HVAC systems due to their variability and complexity. Engineers were trained and instructed how best to categorize and record system types and parameters. A desk review was also performed of all 69 completed surveys by a single engineer to further ensure consistency. The complete on-site survey is included in **Appendix A**.

A commercial on-site survey typically lasted between one to three hours, depending primarily on the building size and complexity of building systems. Industrial facilities took between two and six hours, again depending on size and complexity of the facility. To encourage participation, a $50 gift card was offered to small business customers who permitted a site visit. Following the site visit all data were entered into an Access database for analysis.

3.3.3 End Uses

The study categorized energy using equipment in the state of Delaware into appropriate end uses. The types of end uses included in this report are consistent with those typically studied in national or regional surveys. Table 3-4 displays the end uses included in this study.

Table 3-4: Commercial and Industrial End Uses Evaluated

C&I End Uses
Space Heating
Space Cooling
Ventilation
Water Heating
Lighting
Plug Load
Cooking
Refrigeration
Process Loads
Other

3.3.4 Survey Results

Nexant contacted 1,192 businesses across the state, connected with 671 and performed a total of 69 site visits with an average recruitment rate of 9.7%. Table 3-5, below, shows the number of customers involved in this survey.

Table 3-5: Overall Survey Results

State Customers	Businesses Contacted	Businesses Connected with	Surveys Completed	Recruitment Rate
Total	**1,192**	**671**	**69**	**9.7%**

Source: Call Lists

Additionally, participants were recruited from a broad and representative cross-section of regions and utility types across the state. Table 3-6 and Table 3-7 below show the distribution of customers based on County and on utility-type.

Table 3-6: Survey Participants by County

County	Participants	Share of Surveys
Kent	15	21.7%
New Castle	45	65.2%
Sussex	9	13.0%
Grand Total	**69**	-

Source: Call Lists

Table 3-7: Survey Participants by Utility

Utility	Participants	Share of Surveys
City of Dover	10	14.5%
City of Lewes	1	1.4%
City of Milford	1	1.4%
Delaware Electric Coop	3	4.3%
Delmarva Power	48	71.0%
Town of Middletown	4	5.8%
Town of Smyrna	1	1.4%
Grand Total	**69**	-

Source: Call Lists

3.4 SECONDARY DATA COLLECTION

The data collection and mining effort included a search of available secondary sources in an effort to streamline primary research efforts and identify gaps – either in the presence or quality of data. Where appropriate, secondary data was used to calibrate primary data findings and provide more robust results.

3.4.1 Data Sources

Nexant examined a number of existing end use and energy consumption studies including:

- U.S. Energy Information Administration's 2003 Commercial Building Energy Consumption Survey (CBECS)
- U.S. Energy Information Administration's 2006 Manufacturing Energy Consumption Survey (MECS)
- 2012 Pennsylvania Statewide Commercial and Industrial End Use & Saturation Study
- 2009 Delaware Energy Consumption Study
- California Energy Commission's California Commercial End Use Survey (CEUS)
- ASHRAE 90.1 Standards
- Manufacturer Catalogs

Each secondary data source provided valuable information with which to compare Nexant findings. For example, additional desk research was performed to utilize HVAC nameplate information collected on-site to report efficiency characteristics of that end use.

3.5 DATA ANALYSIS

Following the collection of primary and secondary data, Nexant calculated the output values involved in this end use study and evaluated them within a statewide context. These values included building characteristics, end use saturations, fuel shares, and efficiency shares.

3.5.1 Data Validation & Review

Due to the heterogeneous nature of commercial and industrial buildings, significant effort was expended to ensure on-site data collected by field engineers was reported in a consistent and accurate manner. Unclear or questionable data points provided by field engineers were highlighted in the data entry process and later reviewed by a single engineer. Building types were also verified to ensure buildings were consistently categorized in the appropriate segment for later analysis.

To check for bias in the sample, Nexant compared the segment total square footage share in the sample with that of the full population across the state. In other words, Nexant sought to ensure that the share of commercial floor space and estimate electricity consumption by office buildings in the full population was similar to the share of commercial floor space and electricity consumption by office buildings in the sample. Our analysis showed that the segment floor space and consumption shares between the population and sample were close enough to provide reasonable assurances that a representative sample was obtained for the study.

3.6 UNCERTAINTY

As with any survey or statistical analysis, the results in this report are subject to a certain degree of uncertainty. Practical constraints make it impossible for Nexant to survey the entire population of

Delaware commercial and industrial businesses, necessitating the selection of a small sample population from which to collect data. When using a sample to make predictions about a population, factors of uncertainty are introduced, primarily based on the size of the sample and the existence of biases within the sample.

The uncertainty can be described by the confidence level and margin of error, targeted in this report for the state-wide non-residential sector at 90% and 10% respectively. This means that if this study were repeated multiple times, 90% of the studies would have results within ±10% of the results in this study. The sample size required to achieve these levels of confidence with a large population is given by Equation 3.2, below.

Equation 3.2

$$n = \frac{t^2 \times (p)(1-p)}{d^2}$$

Where:
n = Sample size
t = Value for selected confidence level, 90% corresponds to 1.645
p = Expected proportion of responses. Maximum possible proportion of 0.5 yields maximum sample size
d = Margin of error, 0.1

Using this equation, it can be found that the minimum sample size required to achieve 90/10 confidence is 68. Nexant's targeted sample size of 70 customers from commercial and industrial sectors is sufficiently large to achieve this level of confidence. As can be shown by the equation above, a sample size greater than 68 will result in an increased level of confidence and a smaller margin of error.

With considerations for sample size it is important to note that the more general findings in this report have the highest confidence, while the confidence decreases as results become more specific. For example, if 50 customers out of 69 C&I sample points across the state have central cooling, this saturation can be reported with a confidence level of approximately 90/10 due to the sample of 69 data points (more than 68). However, the percent of central cooling systems that are of a particular technology type will have greater uncertainty because the sample size of central cooling is only 50 (less than 68). Additionally, the amount of uncertainty increases even more when trying to say something about any one commercial segment due to the limited sample points (it is for this reason that even though data could be reported by segment, results are only presented at the non-residential sector level for this study to ensure statistically significant results).

To assist the reader in identifying the level of certainty associated with each finding, an "n-value" (or number of observations/sample points) for each table and figure has been included, where possible. As described above the fewer the number of sample points (n-values), the greater degree of uncertainty. The reader, therefore, should be mindful of the increased uncertainty of findings which are derived from less than 68 sample points.

Another factor that can influence the uncertainty of the results is the extent to which the sample is representative of the population as a whole. Though samples are stratified and selected randomly, it is possible that the sample contains some type of bias which can influence the overall results[1].

Where possible, Nexant took steps to ensure that biases were minimized in the sample. Samples were selected randomly from the customer database in a manner which minimized the potential for human error or other biases. After gathering data, Nexant then analyzed the sample and compared the customers with known statistics about the population in an attempt to verify and calibrate the survey results. With these steps taken, Nexant believes that the results of the survey can be used to make reasonable assumptions about the characteristics of the overall customer base included in this study.

[1] One such example is a sample with a high prevalence of retail customers who are busy during the holidays (and thus unavailable for a site visit), potentially resulting in a lower than average energy consumption.

4 STATEWIDE COMMERCIAL & INDUSTRIAL FINDINGS

4.1 INTRODUCTION

This section presents results of the on-site survey and the findings of the subsequent data analysis for the non-residential sector in the State of Delaware. Data was collected primarily from the 69 on-site surveys conducted by Nexant engineers. Secondary data was used to fill in data gaps when deemed appropriate. All findings, except those in the lighting end-use, are presented by premise[1]. As such the reader should be mindful that the saturation of certain large-scale system types such as chillers may appear low when presented in this manner (as a single chiller can service a very large share of floor stock).

4.2 STATEWIDE NON-RESIDENTIAL BUILDING & END USE FINDINGS

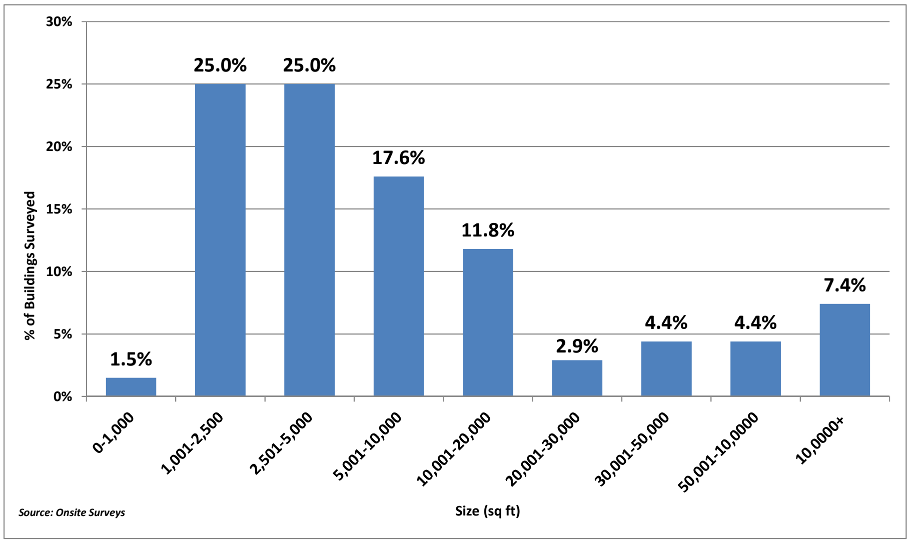
The findings presented below are primarily derived from on-site survey data, with adjustments made for bias where appropriate. Saturations and fuel shares are presented first, followed by a discussion of non-residential building characteristics and findings for each of the major end uses studied.

4.2.1 Building Characteristics

Error! Reference source not found. shows the distribution of building size for all commercial and industrial buildings surveyed. Fifty percent (50%) of the buildings visited were between 1,000 ft^2 and 5,000 ft^2. A substantial portion (7.4%) of surveyed buildings were very large at more than 100,000 ft^2.

[1] Premise is defined as a single building, facility, or business-occupied suite in larger complex. Not included in premises are non-building electric accounts such as street lighting, utility/telecommunication structures, or other misc. electric loads.

Figure 4-1: Building Size Distribution of Buildings Surveyed(1) (n=69)



Source: On site surveys

Error! Reference source not found. through **Error! Reference source not found.** provide an overview of additional characteristics of buildings in the commercial and industrial sector. Average number of occupants during business hours was 69.2. The average number of floors per premise is 1.7 with the average size of the building being just over 30,000 ft^2. Only 1.4% of the buildings across the non-residential sector have been re-commissioned[1] in the previous ten years, with 1.4% being LEED certified[2]. The average R-value of walls is 13.8 across all building types in Delaware.

Table 4-1: Building Characteristics

Parameter	Unit	Non-Residential	n-values
Avg. Age	Years	40.3	59
Avg. # of Occupants	-	69.2	68
Avg. # of Floors	-	1.7	63
Avg. Size	ft^2	30,691	69

Source: On-site Surveys

[1] Commissioning refers to the process of verifying that all building systems (HVAC, lighting, etc.) are functioning properly and as intended by the architect and builder.
[2] LEED certification is a "green" building certification program developed by the U.S. Green Building Council.

Table 4-2: Building Efficiency Levels

Parameter	Non-Residential	n-values
Percentage Building Commissioned	17.4%	69
Percentage Re-commissioned in last 10 Years	1.4%	69
Percentage Buildings LEED Certified	1.4%	69

Source: On-site Surveys

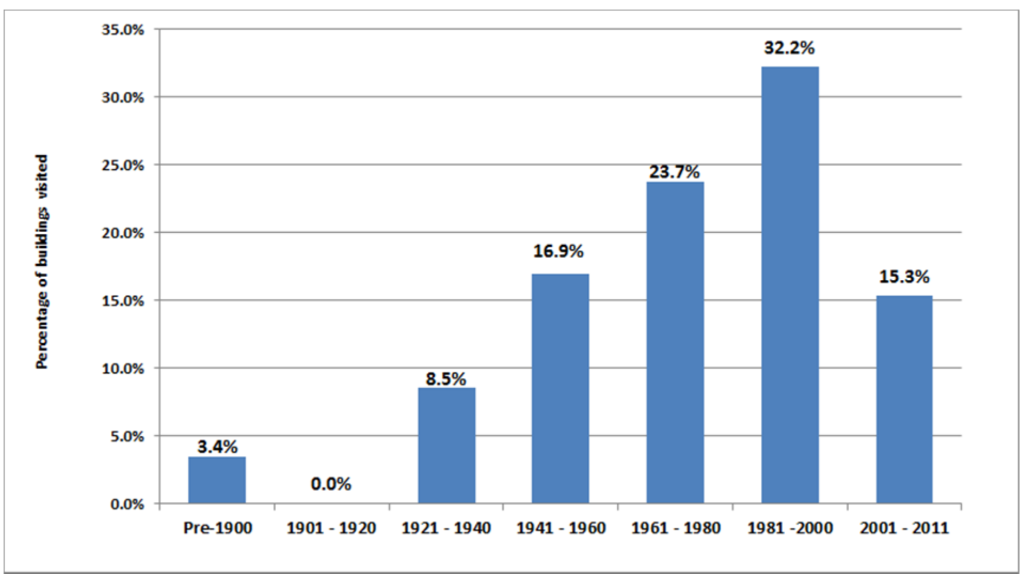
Table 4-3: Building Window and Wall Characteristics

Parameter	Non-Residential	n-values
Glazing Percentage of Walls	15.2%	66
Percentage Double Paned	49.3%	62
Percentage Metal Framed	62.3%	64
Avg Wall Insulation (R-value)	13.8	20

Source: On-site Surveys

Error! Reference source not found. illustrates the years buildings were constructed across the state. Delaware has a slightly older building stock when compared to other parts of the U.S. with an average building age of 40.3 years. Just over half of the building stock in Delaware was constructed between 1960 and 2000.

Figure 4-2: Year of Building Construction for Surveyed Buildings (n=59)



Source: Onsite Surveys

4.2.2 End Use Saturations & Fuel Shares

Table 4-4 shows the saturations of different end uses in both the commercial and industrial sector along with fuel shares of those end uses. Saturation as defined in this report is the percentage of buildings with a given end use present[1]. In some cases, saturation is also given for equipment types, in which case it refers to the percentage of buildings that have a specific equipment type present in buildings with the relevant end use. Space cooling is present in the vast majority of the buildings surveyed (98.8%) with cooking and refrigeration present in 20.6% and 24.6% of the buildings respectively. Fuel share is an important metric for energy efficiency program planning, as it provides program planners insight into the potential for energy savings for equipment that can be powered by different fuels. Electricity and natural gas provide roughly the same share of fuel for space heating at 43.4% and 48.7% respectively. Water heating is primarily fueled by electricity at 75.4% in the state. Electricity fuels about 55% of cooking equipment.

Table 4-4: End use Saturations and Fuel Shares

End Use	Saturation	Fuel Share				
		Electric	Natural Gas	Fuel Oil	Other[(2)]	n-values[(3)]
Lighting	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Space Heating	100.0%	43.4%	48.7%	2.7%	10.6%	69 / 113
Space Cooling	98.8%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Plug Load	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Refrigeration	24.6%	100.0%	0.0%	0.0%	0.0%	69 / n/a
Cooking	20.6%	54.8%	39.8%	0.0%	5.4%	69 / 93
Water Heating	89.9%	75.4%	18.8%	5.8%	0.0%	69 / 69
Other[(1)]	100.0%	100.0%	0.0%	0.0%	0.0%	69 / n/a

Source: On-site Surveys
(2) "Other" End Use includes motors, pumps and misc. equipment
(3) "Other" fuel share includes LPG, wood, and misc. fuels
(3) "Saturation" n-values / "fuel share" n-values

4.2.3 Heating, Ventilation & Cooling (HVAC)

HVAC systems generally represent roughly 40% of commercial building energy usage[2]. While cooling load is fueled exclusively with electricity, heating systems can be fueled by electricity, natural gas or other fuels. Figure 4-3 shows the fuel share breakdown for space heating for all non-residential buildings in the state. Natural gas and Electricity are the primary fuel used for space heating, fueling 48.7% and 43.4% of surveyed systems respectively.

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[1] Saturation, as defined in non-residential baseline studies, varies slightly from that defined in residential baseline studies. Residential studies define saturation as the total number of equipment type present (e.g. total refrigerators) divided by total buildings – which can provide a value of more than 100%. However, due to the heterogeneous nature of commercial buildings and the large number of certain equipment types present (e.g. dozens of window-wall A/C units in a hotel), this report makes the simplification of using "saturation" inter-changeably with what the residential report defines as "penetration". That is, the percentage of buildings with a given end use/equipment type present.

[2] Commercial Building Energy Consumption Survey (CBECS). EIA. 2003

Figure 4-3: Space Heating Fuel Share (n=113)

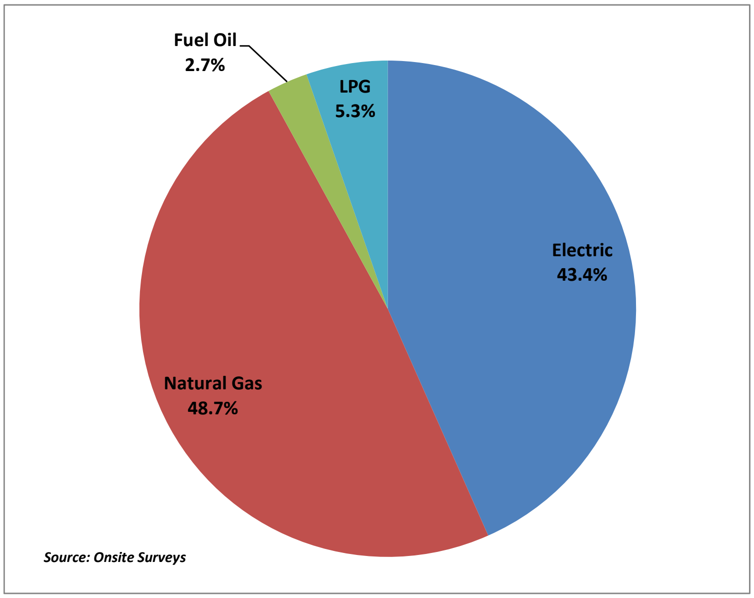
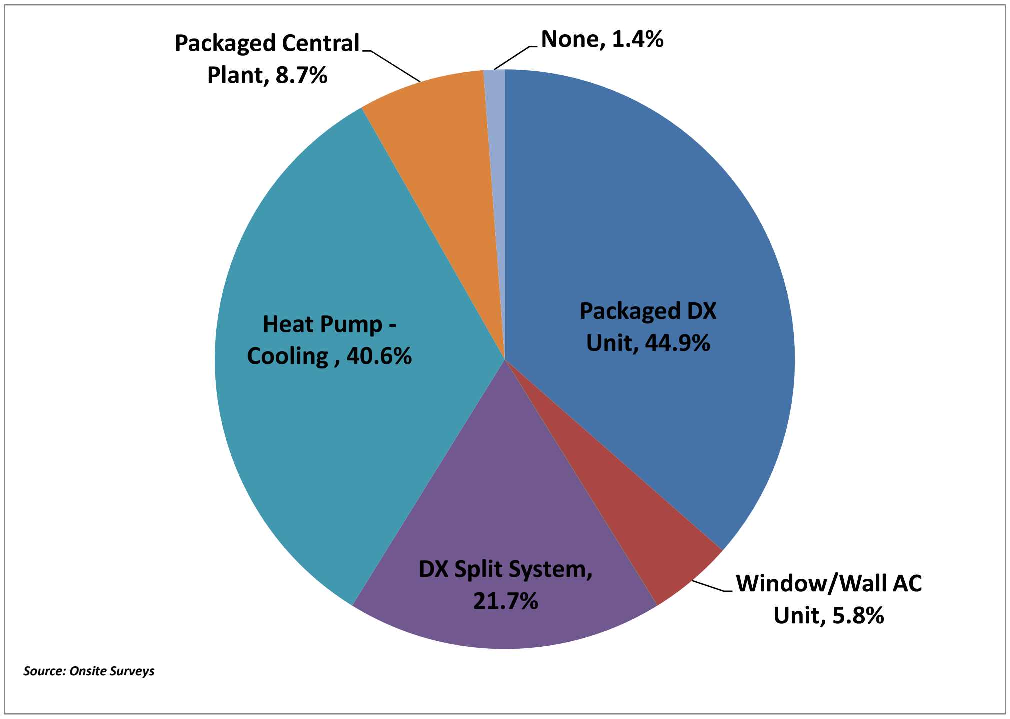


Figure 4-4 shows the prevalence of different types of cooling systems across the state. Space cooling saturation is presented as the percentage of buildings with a given system type present. For example, if a building had one chiller (counted as part of the packaged central plant category), but also 35 window wall A/C units, data was counted as simply two system types present in one building. Counts were then divided by the total number of buildings surveyed (69) so that a meaningful "none" category could be presented (note: many buildings have multiple cooling systems present so percentages may add up to more than 100%). Packaged DX (Direct Expansion)[1] System Units were present in the largest share of buildings (44.9%)[2]. Heat Pumps were also found to have a large presence in the market and were found in 40.6% of surveyed buildings. Also of note is that only one of the 69 surveyed buildings (1.4%) had no cooling system installed.

[1] Direct Expansion, or DX, refers to a type of air conditioning system that relies on compressive refrigeration; a process in which cooling is effected by the vaporization and expansion of a liquid refrigerant. Heat is extracted from air by an evaporator coil and is rejected by a condenser.

[2] Please see Appendix D for definitions of space heating and space cooling technology types.

Figure 4-4: Saturation of Cooling Equipment in Non-Residential Buildings[1] (n=69)



(1) Percentages add up to more than 100% because buildings may have multiple systems

Table 4-5 summarizes some of the key parameters of cooling systems in the commercial and industrial sectors. The average age of cooling systems in the state is 10.1 years, with an average cooling capacity of 5.4 tons. The average SEER value for DX cooling systems in Delaware is 11.6. The penetration of programmable thermostats is 3.2%. On average energy management systems (EMS) were found in 6.3% of the buildings surveyed.

Table 4-5: DX Cooling Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	10.1	44
Avg. Cooling Capacity (tons)	5.4	51
Avg. Cooling Efficiency (SEER/EER)	11.6/9.5	30 / 14
Percentage Programmable	3.2%	69
Percentage with EMS	6.3%	69

Source: On-site Surveys

Figure 4-5 show the prevalence of different types of heating systems across the state. Space heating findings are presented by equipment type as a percentage of total heating systems (thus percentages will add up to 100%). Again, Heat Pumps were found in a sizeable share of buildings –

both heat pumps and Packaged Single Zone systems comprise 30% of surveyed systems. Unit Heat, Central Plants and Furnace systems comprise 13% of surveyed systems.

Figure 4-5: Heating Systems by Percentage of Equipment Type (n=84)

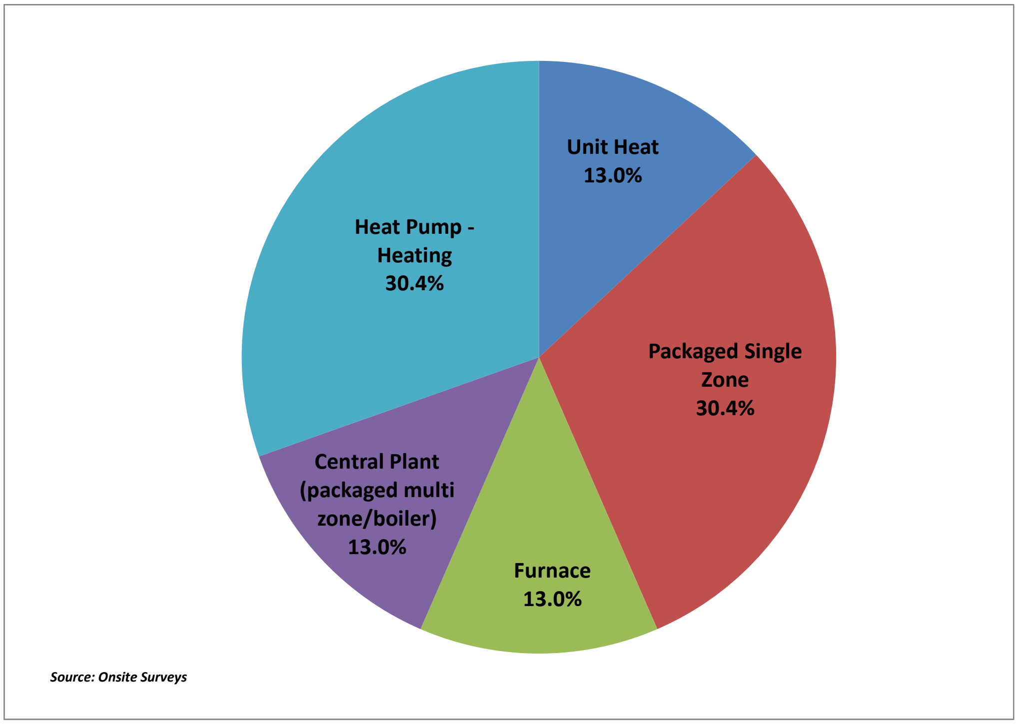


Table 4-6 summarizes some of the key parameters of heating systems (excluding boilers) in the commercial and industrial sectors. Table 4-7 presents the same parameters for just boilers. The average age of heaters and boilers in non-residential buildings across the state is 9.7 and 21.3 years, respectively. The average heating efficiency of heating equipment is 84.1%. A high percentage of boilers are controlled by EMS (58%).

Table 4-6: Heating Equipment Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	9.7	47
Avg. Heating Capacity (Btu/hr)	88,604	26
Avg Heating Efficiency (%)	84.1%	13
Percentage Programmable	3.0%	69
Percentage with EMS	9.1%	69

Source: On-site Surveys

Table 4-7: Boiler Heating Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	21.3	8
Avg. Heating Capacity (Btu/hr)	2,727,115	11
Avg Heating Efficiency (%)	80.0%	3
Percentage Programmable	25.0%	12
Percentage with EMS	58.0%	12

Source: On-site Surveys

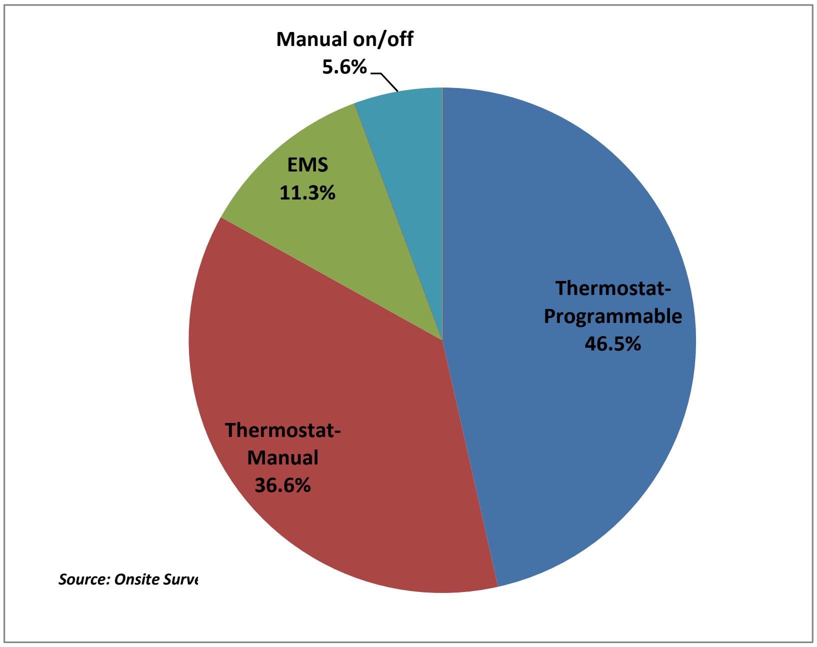
Table 4-8 and Figure 4-6 summarize some of the key parameters of temperature controls and illustrate the prevalence of different types of controls in the commercial and industrial sectors. While there are a relatively high percentage of systems using programmable thermostats (46.5%), very few are utilizing temperature reset controls (4.3%) during times of non-occupancy.

Table 4-8: HVAC Control Parameters

Parameter	Non-Residential	n-values
Pct. Using Reset Controls	4.3%	47
Avg. Heating Set Back Points (Occupied/Unoccupied)	69.0/ 61.7	77
Avg. Cooling Set Back Points (Occupied/Unoccupied)	72.5/ 78.4	92

Source: On-site Surveys

Figure 4-6: Temperature Controls by Percentage of Equipment Type (n=118)



4.2.4 Lighting

Lighting is another significant end use in terms of energy consumption for the non-residential sector and typically represents about 20-30% of energy consumption according to CBECS. Table 4-9 shows that 20.3% of buildings have been upgraded in the past year and that the average lighting power density (LPD) is 1.28 watts/ft^2. Table 4-10 and Table 4-11show the transition to more efficient lighting for those buildings that had a lighting upgrade performed in the previous five years.

Table 4-9: Lighting Parameters

Parameter	Non-Residential	n-values
Pct. of buildings that upgraded lighting in last 5 years	20.3%	69
Average LPD (w/ft^2)	1.25	69
Avg. # of Fixtures/Building	204.3	69

Data was collected based on a count of the number of fixtures and the number of lamps per fixture basis. The number of fixtures was multiplied by its corresponding lamps per fixture to come up with a total count of lamps. Findings, therefore, are presented based on a percentage of lamps. Figure 4-7 shows the saturation of lighting systems throughout the state. Linear Florescent lighting represents over 90% of all lamps in commercial and industrial facilities. Interestingly, substantially more CFLs were found than incandescent lighting in buildings. All told CFLs represent just over 60% of all screw-based sockets in Delaware commercial and industrial facilities. LED lighting still

represents only a small fraction of lighting at 0.2%. Figure 4-8 shows the break-down of florescent lamp types. Just under half (44%) are T-8 lamps, and 30% are T-12 lamps. T-8 Plus lamps (defined as lower wattage lamps) are only installed in a small fraction (3%) of the linear fluorescent fixtures across Delaware.

Figure 4-7: Installed Lighting Systems by Percentage of Technology Type (n=69)

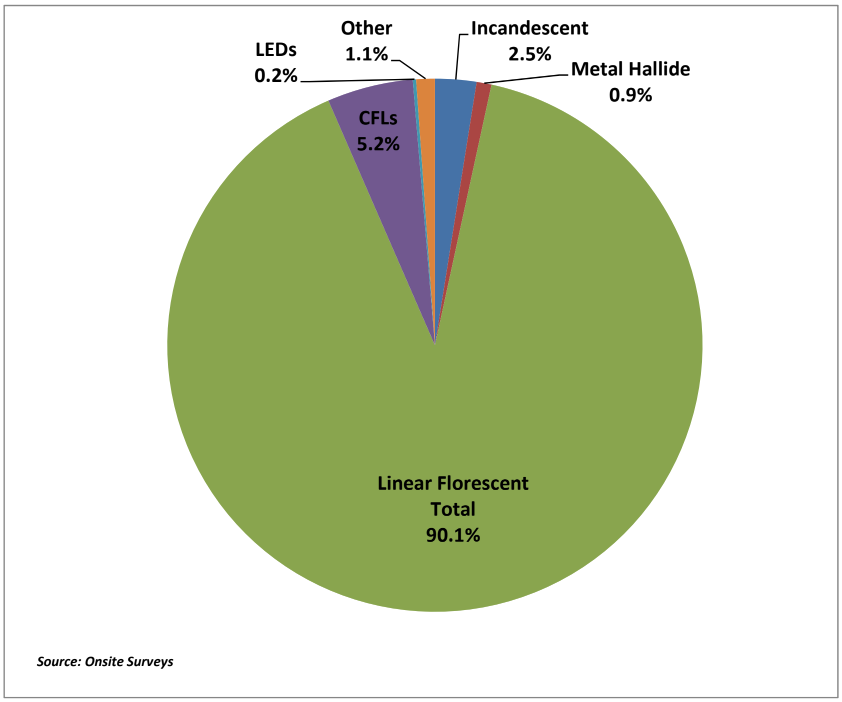
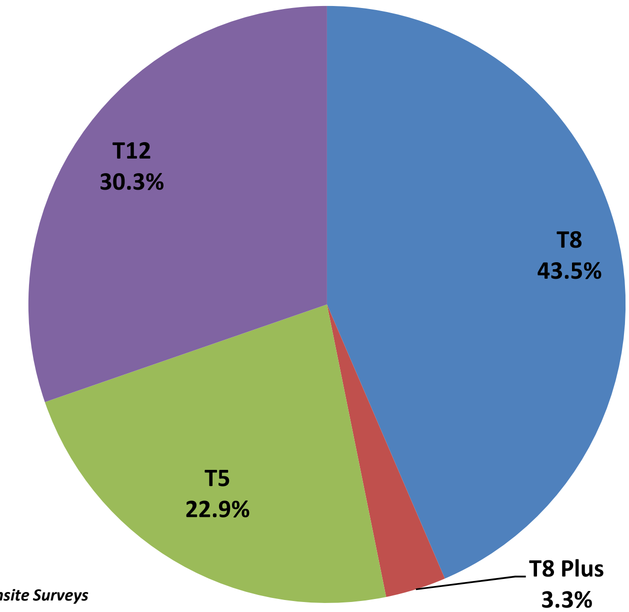


Figure 4-8: Linear Florescent Lamp Types Distribution (n=69)



Source: Onsite Surveys

Table 4-10: Comparison of Screw-Based Bulbs in Facilities with and without a Lighting Upgrade (n=69)

Screw-Based	No Upgrade	Upgrade
Incandescent (% of sockets)	37.5%	15.6%
CFL (% of sockets)	62.5%	84.4%

Table 4-11: Comparison of Linear Florescent Lamps in Facilities with and without a Lighting Upgrade (n=69)

Linear Florescent	No Upgrade	Upgrade
T12 (% of GSFL)[(1)]	44.4%	10.4%
T8 (% of GSFL)	54.1%	28.5%
T8 Plus (% of GSFL)	1.4%	6.0%
T5 (% of GSFL)	0.1%	55.1%

[(1)] GSFL = general service florescent lamps

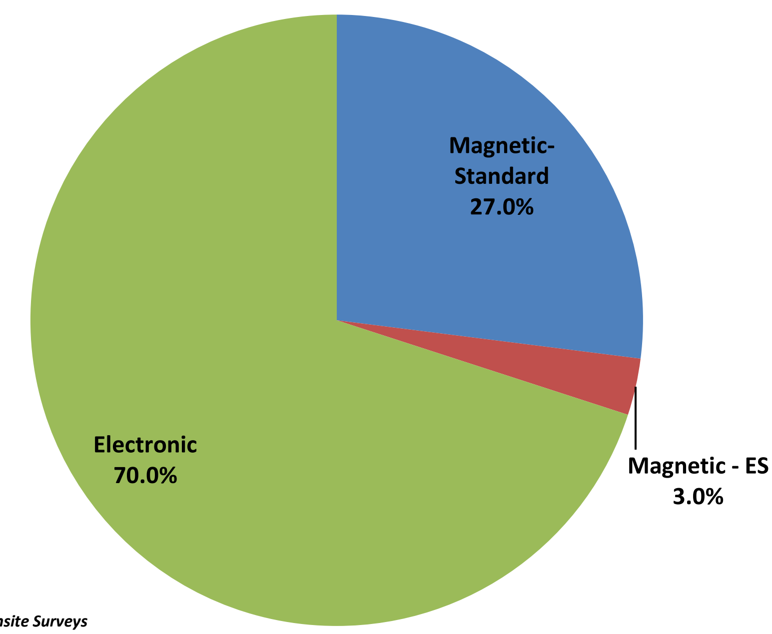
Table 4-12 shows the distribution of different control types and shows that the majority (86.3%) of lighting is controlled by a manual on/off switch, with less than 5% being controlled by either timers (2.1%) or occupancy sensors (3.3%),suggesting that lights may not be turned off during non-occupancy hours. Figure 4-9 through Figure 4-10 show additional characteristics of lighting within the non-residential sector in Delaware. The presence of electronic ballasts generally follows the presence of the more efficient T-8, T8 Plus and T5 lamps. The majority of exit signs contain CFL bulbs (66.6%) with LEDs found in almost 20% of exit signs.

Table 4-12: Lighting Controls by Percentage of Equipment Type (% of Fixtures)

Control Type	Non-Residential
Manual - Switch	86.3%
Manual Circuit Breaker	4.0%
Dimmer	1.7%
Timer	2.1%
Occupancy Sensor	3.3%
Day Lighting Controls	0.5%
Energy Management System	1.4%
None/Continuous	0.7%
n-value	69

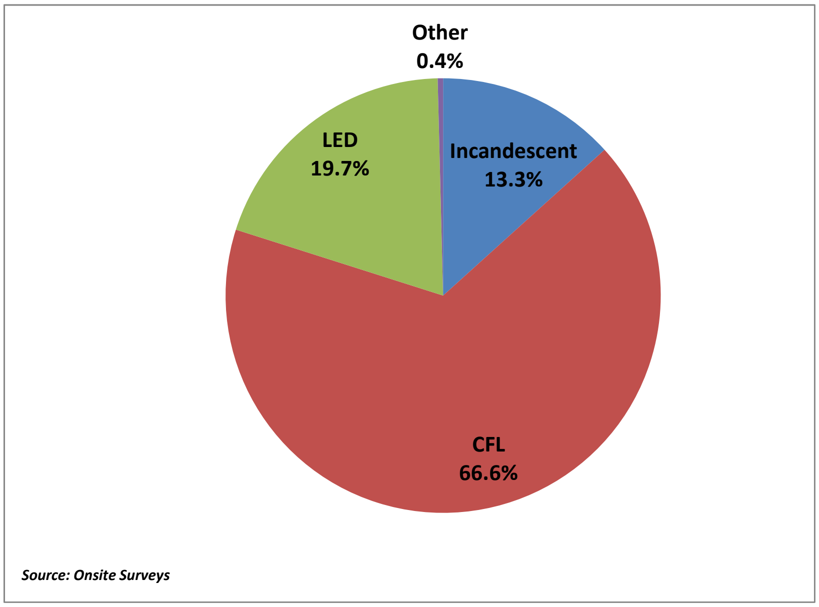
Source: On-site Surveys

Figure 4-9: Linear Florescent Lamp Ballasts by Percentage of Equipment Type (% of Fixtures) (n=69)



Source: Onsite Surveys

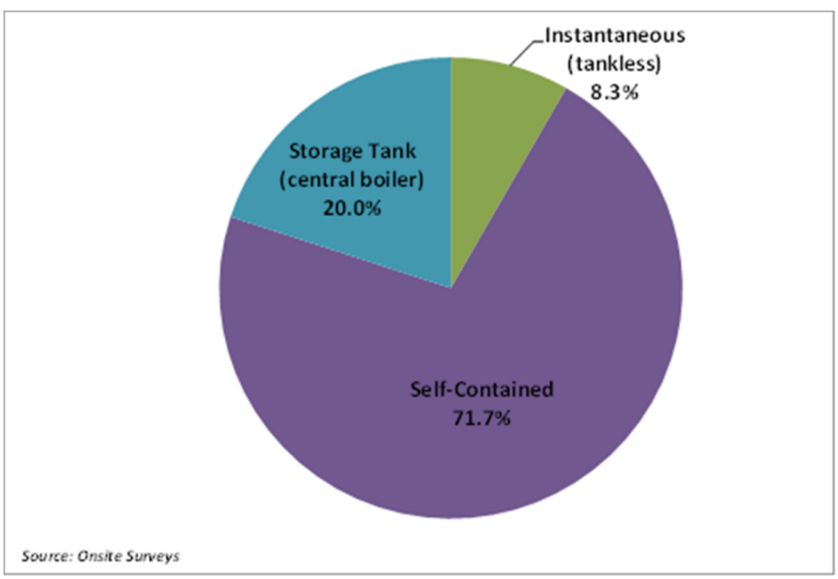
Figure 4-10: Exit Sign Bulbs by Percentage of Equipment Type (n=69)



4.2.5 Water Heating

As noted in Table 4-4, the majority of non-residential businesses (89.9%) have water heaters. Findings are presented as the percentage share for water heating equipment types for buildings with installed water heating. Figure 4-11 shows that 71.7% of installed water heating systems are self-contained units, followed by storage tank associated with a central boiler and tankless systems at 20% and 8.3% respectively.

Figure 4-11: Percentage Share of Equipment Types in Buildings w/ Water Heating [(1)] (n=69)



[(1)] *For all water heating fuel types*

Table 4-13 displays the parameters of water heating units in the state. Less than 6% of the water heater systems have tank wraps installed and the average efficiency of systems across all non-residential systems is an efficiency factor (EF) of 87.6.

Figure 4-12 and Figure 4-13 show the fuel share and distribution of system capacity respectively for all non-residential buildings. The majority (75.4%) of all systems are electric, followed by natural gas at 18.8%. Half (50%) of the water heating systems have a tank capacity of less than 20 gallons.

Table 4-13: Water Heating Parameters

Parameter	Non-Residential	n-values
Avg. Age (Yrs)	8.8	47
Pct w/tank wrap	5.8%	69
Pct w/pipe wrap	23.2%	69
Pct w/setback(1)	1.4%	69
Avg Tank Capacity (Gal)	32.4	61
Avg Efficiency (EF)	87.6	7
Avg Input Capacity (kW)	16.5	49

Figure 4-12: Water Heating Fuel Share (n=69)

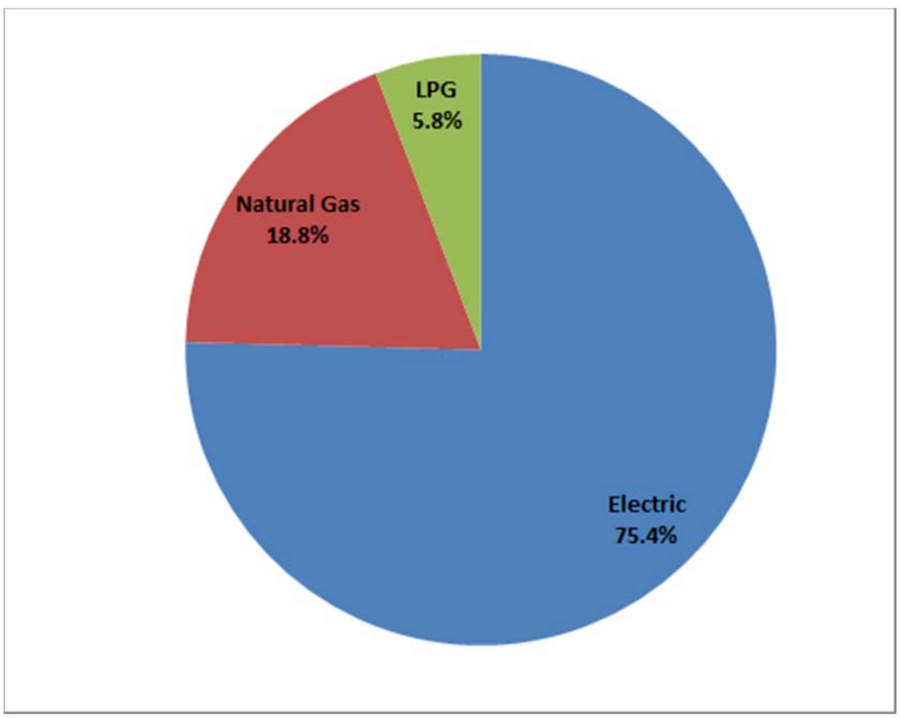
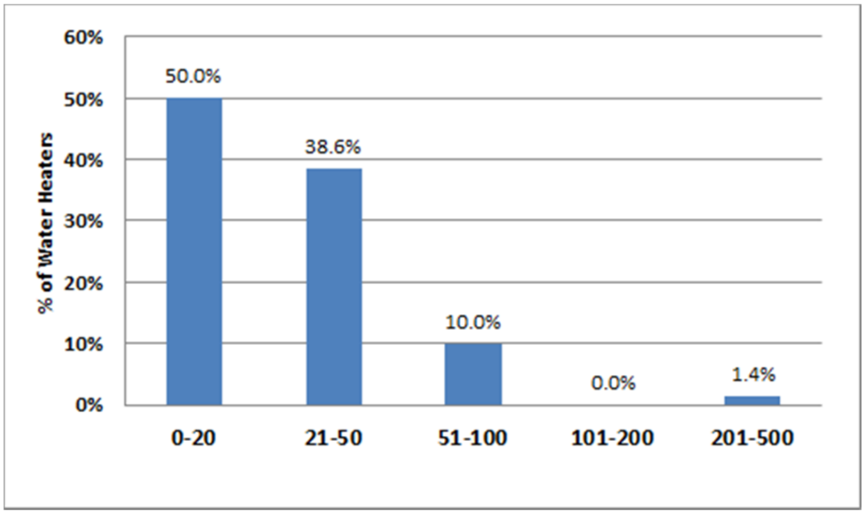


Figure 4-13: Non-Residential Water Heating Tank Capacity Distribution (n=70)



4.2.6 Refrigeration

As shown in Table 4-4 refrigeration systems are not present in the majority of buildings in Delaware (saturation of only 24.6%). The systems, however, can be energy intensive and consume a large amount of energy on a per square foot basis – especially for commercial segments such as grocery.

Figure 4-14 illustrates the type of equipment installed in those buildings with commercial refrigeration equipment present. Solid door fridge/freezers, Walk in Freezers, Walk in Refrigerators and Glass Door Fridge/Freezers are split fairly equally in the non-residential sector. Table 4-14 shows the saturation of different types of measures in place for buildings with refrigeration equipment.

Figure 4-14: Refrigeration Systems by Percentage of Equipment Type (n=49)

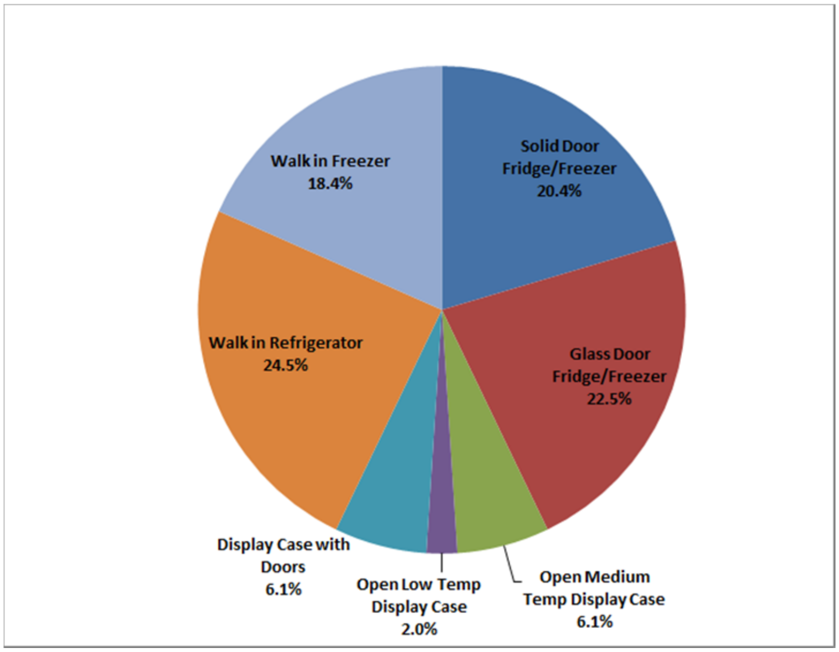


Table 4-14: Saturation of Efficiency Measures in Buildings with Refrigeration Equipment

Measure	Saturation
Anti-Sweat Heating Control	17.7%
LED Lights for Displays	0.0%
VFD's on Compressors	5.9%
ECM Motors	11.8%
Demand Defrost Controls	11.8%
Floating Head Pressure	0.0%
High Efficiency Evaporators	5.9%
Night Covers	11.8%
Evap. Fan Controls	0.0%
System Commissioned	5.9%
Applicable for Re-Commission	5.9%
Heat Recovery	0.0%
Special Doors	0.0%

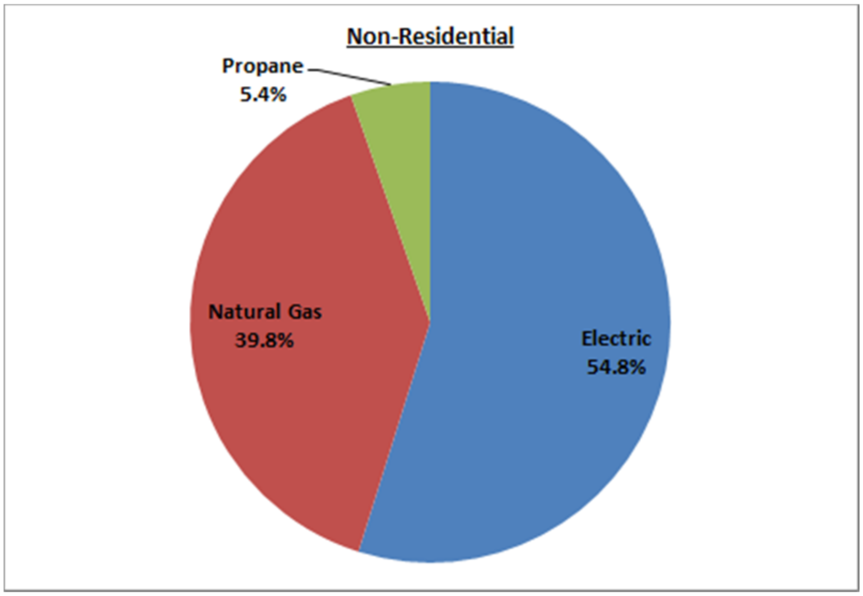
Source: On-site Surveys

4.2.7 Commercial Cooking Equipment

Error! Reference source not found. shows the fuel share of cooking equipment across all non-residential buildings. Electricity fuels the largest share (54.8%) of cooking equipment, followed by natural gas at 39.8%.

Table 4-15 shows the saturation of cooking equipment in Delaware businesses.

Figure 4-15: Cooking Fuel Share for Non-Residential Buildings[1] (n=93)



[1] *Excluding residential-style microwaves*

Table 4-15: Saturation of Equipment in Buildings with Commercial Cooking Equipment

Type	Non-Residential
Standard Oven	64.3%
Convection Oven	85.7%
Range	85.7%
Fryer	71.4%
Hot Food	71.4%
Steam Cooker	21.4%
Griddle	50.0%
Pizza Oven	28.6%
Warming Table	71.4%
Heat Lamp	21.4%
Soup Pot	35.7%
Continuous Toaster	21.4%
Microwave	50.0%
n-value	14

Source: On-site Surveys

4.2.8 Plug Load

Figure 4-16 shows the percent of equipment installed that is Energy Star for relevant equipment types in the non-residential sector. All equipment types show room for additional penetration of

energy star equipment. Table 4-16 shows the percentage of sites with at least one piece of each plug load equipment type. Table 4-17 shows the average number of each plug load type per site.

Figure 4-16: Percent of Equipment that is Energy Star

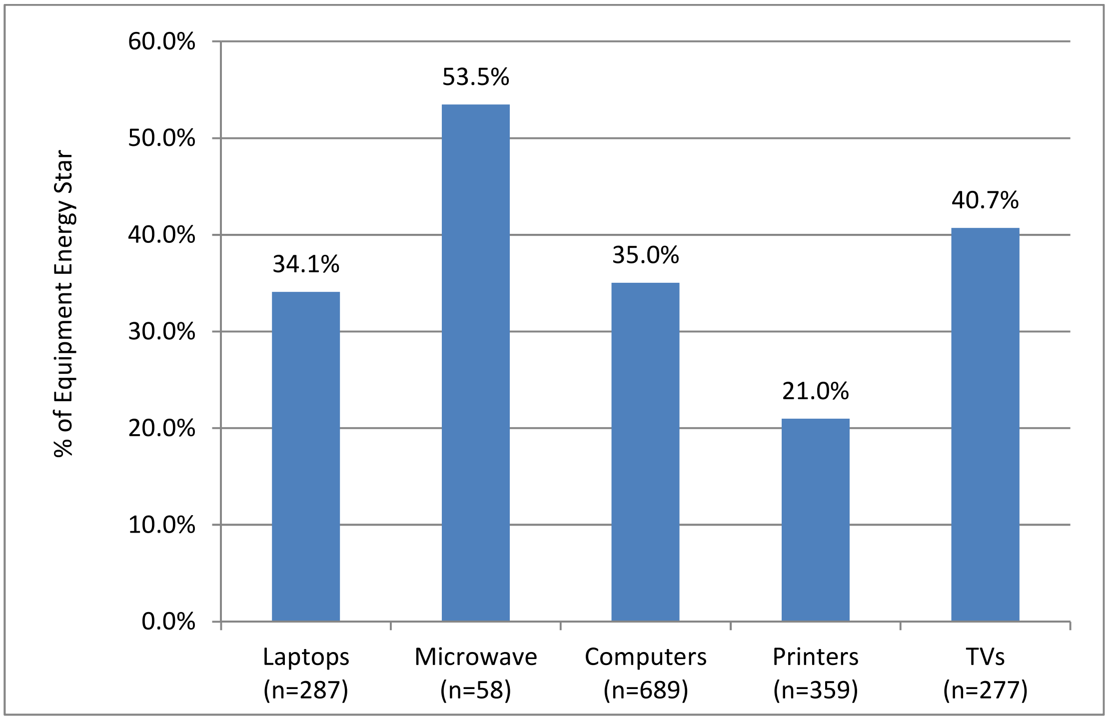


Table 4-16: Percentage of Sites with One or More Pieces of Plug Load Equipment

Type	Non-Residential
Air Purifiers	24.6%
All-in-one	78.3%
Beverage Machines	40.6%
Coffee Makers	63.8%
Fax Machines	33.3%
Laptops	53.6%
Microwave	84.1%
Paper Shredder	44.9%
Computers	91.3%
Photocopiers	33.3%
Printers	68.1%
Residential Style Refrigerators	78.3%
Scanners	24.6%
Secondary Monitors	27.5%
Security Cameras	43.5%
Servers	52.2%
Snack Machine	21.7%
Space Heaters	37.7%
TVs	53.6%
Water Coolers	60.9%
Other	24.6%
n-value	69

Source: On-site Surveys

Table 4-17: Average Number of Plug Load Equipment per Site

Type	Non-Residential
Air Purifiers	0.6
All-in-one	2.1
Beverage Machines	2.1
Coffee Makers	5.5
Fax Machines	1.0
Laptops	7.8
Microwave	9.9
Paper Shredder	1.9
Computers	10.9
Photocopiers	1.3
Printers	7.6
Residential Style Refrigerators	4.7
Scanners	1.5
Secondary Monitors	3.7
Security Cameras	6.5
Servers	1.6
Snack Machine	1.1
Space Heaters	3.4
TVs	7.5
Water Coolers	1.7
Other	1.8
n-value	69

Source: On-site Surveys

5 CONCLUDING REMARKS & IMPLICATIONS FOR FUTURE PROGRAM PLANNING

Baseline research helps program administrators make educated decisions about the energy end uses and equipment that can be most effectively targeted with energy efficiency programs. Baseline research can also be used to characterize the type and efficiency levels of equipment that are installed in customer homes and businesses. These data serve to confirm program planning assumptions and may also be useful in evaluating energy savings impacts once programs are established. According to the National Energy Efficiency Best Practices Study's Portfolio Best Practices Report, "Objective baseline research reinforces the credibility of the portfolio and its underlying programs with diverse stakeholders and improves the accuracy of savings estimates, cost effectiveness calculations, and goals.[1]"

Implications for Future Program Planning

Key findings from the study that may have implications on future program planning efforts are detailed below.

- **Heat Pumps:** There is a noticeably high saturation of heat pumps in the marketplace. This suggests that the climate in Delaware favors this type of efficient heating and cooling equipment.
- **Cooling Efficiency:** The average SEER efficiency value for DX cooling systems across the state is 11.6 – being below the minimum code standard for new units, this represents opportunities for program savings.
- **Thermostats**: There is still a high saturation (42.2%) of manual thermostats in the marketplace, suggesting opportunities for these types of programs.
- **CFLs:** have reached a sizeable saturation in the marketplace with 60.3% of all screw-based sockets already converted. Opportunities for future savings from CFLs are still available, though more limited; especially with the tighter efficiency standards that will force traditional incandescent bulbs out of the market for most lighting applications[2].
- **LEDs:** have only reached a saturation of 0.2% of all installed lighting. As prices continue to come down in the coming years, and efficiencies improve, there may be significant opportunity for savings.
- **T12 and T8 lamps:** still dominate the percentage of installed florescent lighting. The high presence of T8s (44%) suggest the market is naturally converting to these lamps without program influence. Moreover, the new lighting standards being phased-in during 2012 will effectively remove T12 lamps from the marketplace, making T8 lamps the new baseline. Future commercial lighting programs will need to take into account lower savings potentials with a more efficient T8 baseline and may need to consider targeting more advanced lamps and lighting system technologies.
- **Lighting Controls:** There is still a significant share of fixtures (90.3%) under manual switch control, indicating opportunities for occupancy sensors or timers.

[1] National Energy Efficiency Best Practices Study. Volume P1: Portfolio Best Practices Report. Itron Inc. 2008. Pg. P1-48.

[2] The Energy Independence and Security Act (EISA) of 2007 established higher efficiency standards for lighting sold in the United States. T12 florescent lamps and traditional incandescent light bulbs will effectively be phased out of production from 2012 to 2014.

- **Water Heater Fuel Share**: A significant share of water heaters (75.4%) are fueled by less-efficient electric means (as opposed to natural gas). This suggests an opportunity for fuel switching programs.
- **Refrigeration Measures:** Many refrigeration efficiency measures have a low saturation in the marketplace (namely LED lights for displays, anti-sweat controls, night covers, etc.).
- **Energy Star Plug Load:** Energy Star equipment was not found in a sizeable share of buildings, indicating opportunities for energy star programs (especially for computers and printers).

The results of this baseline study effort provide detailed and contemporary information across the State of Delaware regarding baseline energy equipment saturations as well as equipment energy efficiency levels. It was through the use of on-site data collection that Nexant was able to collect reasonably accurate information regarding not only the type of equipment installed in non-residential facilities throughout the state, but also the efficiency level of various major equipment types or end-uses. The study also collected valuable information on the building characteristics such as square footage, glazing types, and more. Finally, the contemporary nature of the data collection effort (Nexant data collection occurred during the spring of 2012) will provide up-to-date information for DNREC and other utility program planners to design and implement cost-effective energy efficiency programs in the future for the residents and businesses in the State of Delaware.

Commercial On-site Survey

Nexant/***DNREC***

General Info (Complete before visit):

Company Name: ______________________ Unique ID ______________

Contact Name: ______________________ ★ **# of Buildings onsite:** ______________

Contact Phone Number: ______________________ ★ **# of Bldgs surveyed:** ______________

Address: ______________________ No. Electric Meters: ______________

City, State, Zip: ______________________ ★ Annual kWh: ______________

Engineer: ______________________ No. Gas Meters ______________

Site Visit Date: ______________________ ★ Annual CCF : ______________

Site Visit Time: ______________________

Notes: ______________________

____

____

____

____

Survey Key

N/A = Not Applicable

NX = Not Available

★ = Highest Priority Data Points

General Info

★ 1. Please provide details about the number of electric meters listed above:

Electric Meters	Facility Zone Served (Office, Warehouse, etc)	Annual kWh	Meter Number (if accessible)
#1			
#2			
#3			
#4			

2. Do you have any other energy service providers? Y / N

3. Is this Facility Leased? Y / N

★ 4. How many people on average occupy this building during **business** hours? ____________

During **non-business** hours? ____________

1. When is this building occupied? [Check appropriate season and corresponding months]

All Year			Summer Only			Winter Only			Other Seasonal		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

2. What is the weekly occupancy schedule of this building?

Schedule 1

Day	Business Hours	Closed All Day?	Open 24 Hours?
Sunday	From: ____ To: ____	□	□
Monday	From: ____ To: ____	□	□
Tuesday	From: ____ To: ____	□	□
Wednesday	From: ____ To: ____	□	□
Thursday	From: ____ To: ____	□	□
Friday	From: ____ To: ____	□	□
Saturday	From: ____ To: ____	□	□

3. Does your facility have more than one occupancy schedule (second shift, retail holiday schedule)? Y / N
(If yes, fill out tables below otherwise leave blank)

4. When does the alternative schedule apply? [Check appropriate season and corresponding months]

All Year			Summer Only			Winter Only			Other Seasonal		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Schedule 2

Day	Business Hours	Closed All Day?	Open 24 Hours?
Sunday	From: ____ To: ____	□	□
Monday	From: ____ To: ____	□	□
Tuesday	From: ____ To: ____	□	□
Wednesday	From: ____ To: ____	□	□
Thursday	From: ____ To: ____	□	□
Friday	From: ____ To: ____	□	□
Saturday	From: ____ To: ____	□	□

1. When does third alternative schedule apply? [Check appropriate season and corresponding months]

All Year				Summer Only			Winter Only			Other Seasonal	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Schedule 3

Day	Business Hours	Closed All Day?	Open 24 Hours?
Sunday	From: ____ To: ____	□	□
Monday	From: ____ To: ____	□	□
Tuesday	From: ____ To: ____	□	□
Wednesday	From: ____ To: ____	□	□
Thursday	From: ____ To: ____	□	□
Friday	From: ____ To: ____	□	□
Saturday	From: ____ To: ____	□	□

2. Of the following options, what is the **PRIMARY** use of your building? [Only check ***ONE*** appropriate space]

Education	Grocery	Health	Lodging	Office	Restaurant	Retail	Warehouse	Industrial	Multifamily	Other

3. If Other: Please describe: ____

4. Of the following options, what is the **SECONDARY** use of your building? [Leave *blank* if no secondary use exists]

Education	Grocery	Health	Lodging	Office	Restaurant	Retail	Warehouse	Industrial	Multifamily	Other

5. If Other: Please describe: ____

6. If Hospital: How many beds does this facility have? ____________

7. If Restaurant: What is the average number of customer meals served per day? ____________

8. If Lodging: How many rooms are offered? ____________

Building Information

1. What is the year of ***original*** building construction? ____________
2. How large is this building in square feet, not including any parking garages? ____________ ft^2
3. If this building has an interior parking garage, how large is it? ____________ ft^2
4. How many floors is this building (excluding the basement)? ____________
5. Have there been any renovations/additions since date of original construction? Y / N
    a. What year did renovations/additions occur? ____________
    b. What is the approximate ft^2 of additions? ____________ ft^2
6. Was this building commissioned upon original construction? Y / N
7. When was the last time this building was commissioned? ____________
8. What level of LEED certification does this building have?
(1=certified, 2=silver, 3=gold, 4=platinum, 5=Not LEED Certified) ____________

★ **Lighting**

1. Please select **ONE** number for each space.

Lighting								
Lighting Configuration (Interior)								
Lamp Type (see below)	Length in ft (if Applicable)	Lamp Wattage	# of Fixtures	Lamps/ Fixture	Ballast Type (See Below)	Control Type (See Below)	Zone #	Description

Zone #	Sq Footage (per zone)	W/ft^2 (per zone)

Lamp Type	
1=Incandescent	7=LED
2=Metal Hallide	8=T8
3=High Pressure Sodium	9=T9
4=Mercury Vapor	10=T10
5=T5	12=T12
6=Neon (Cold Cathode)	13=CFL
O=Other	

Control Type
1=Switch (Manual on/off)
2=Circuit Breaker
3=Dual Level Switch
4=Dimmer Switch
5=Timer
6=Motion/Occupancy Sensor
7=Daylighting Controls
8=Energy Management System
9=None/Continuous

Ballast Type
1=Magnetic Standard
2=Magnetic-ES
3=Electronic
4=Electronic Dimming
5=Emergency

1.

Exterior Lighting						
Lighting Configuration (Exterior)						
Lamp Type (see below)	Length in ft (if Applicable)	Lamp Wattage	# of Fixtures	Lamps/ Fixture	Ballast Type (See Below)	Control Type (See Below)

Lamp Type	
1=Incandescent	7=LED
2=Metal Hallide	8=T8
3=High Pressure Sodium	9=T9
4=Mercury Vapor	10=T10
5=T5	12=T12
6=Neon (Cold Cathode)	13=CFL
O=Other	

Ballast Type
1=Magnetic Standard
2=Magnetic-ES
3=Electronic
4=Electronic Dimming
5=Emergency

Control Type
1=Switch (Manual on/off)
2=Circuit Breaker
3=Dual Level Switch
4=Dimmer Switch
5=Timer
6=Motion/Occupancy Sensor
7=Daylighting Controls
8=Energy Management System
9=None/Continuous

2. What is the **primary** lighting application? _____________
(1=standard interior lighting, 2=high-bay)

★3. What is the estimated interior lighting power density for the building[s]? _____________ W/f
(Use data from previous page to calculate! Add all zones w/ft^2)

4. Are bi-level lighting controls used in stairways? Y / N

5. Does this facility have lit exit signs? Y / N

Exit Signs	
Lamp type	# of signs
Incandescent	
Compact Fluorescent	
LED	
Other	
Don't Know	

HVAC System

1. Does this building have a Single Zone HVAC System? Y / N

SINGLE-ZONE HVAC SYSTEM				
★		System 1	System 2	System 3
System Type	*(See Table Below)*			
Zone Description				
Regular Maintenance?	*(Circle One)*	Y / N	Y / N	Y / N
Percent of Building	*(%)*			
Age	*(Years)*			
Temperature Control Type	*(See Table Below)*			
Number of Identical Units				
Manufacturer/Model Name ★				
Model Number ★				
Serial Number				
Use rows below to enter additional Manufacturer/Model Information for multi-component split systems				
Manufacturer/Model Name #2				
Model Number #2				
Serial Number #2				
Cooling Data:				
Rated Cooling Capacity ★	*(Tons)*			
Performance Rating ★	*(Circle One)*	EER SEER	EER SEER	EER SEER
Performance Rating Value				
Heating Data:				
Rated Heating Output	Circle Correct Units for given number!!	Btu/h kW	Btu/h kW	Btu/h kW
Fuel Type ★	*(See Table Below)*			
Efficiency	*(%)*			
Compressors:				
Quantity				
HP or Volts/Phase/FL Amps				
Supply Fans:				
Motor HP				
Motor Efficiency	*(%)*			
Insulated Duct	*(Circle One)*	Y / N	Y / N	Y / N
Air-to-Air Heat Recovery	*(Circle One)*	Y / N	Y / N	Y / N
Economizer	*(Circle One)*	Y / N	Y / N	Y / N

Single-Zone HVAC System Types		
Packaged Systems	**Split Systems**	**Unitary**
1=Packaged DX Unit - Heating and Cooling	8=Conventional - CU & Blower/Furnace	13=Evaporative Cooler
2=Packaged DX Unit - Cooling Only	9="Aquatherm" - CU & H_2O Source Heat Pump	14=Unit Heater
3=PTAC / Window A/C	10=Ductless A/C	15=Electric Fan Coil / Air Handler
4=PTAC w/ Heating	11=Split System Heat Pump	16=Electric Baseboard Radiator
5=MAU w/ Heating	12=Ground Source Heat Pump	17=Infrared Radiant Heater
6=MAU w/ Evap. Cooling		
7=MAU w/ Heating & Cooling		

Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

Table 3 - Fuel Types
1=Electric
2=Natural Gas
3=Fuel Oil
4=LPG
5=Purchase HW or Steam
6=Wood
7=Other (Make Note)

1. Does this building have a Multi-Zone HVAC System? Y / N

★ If Yes: (Circle One) **Central Air Distribution (pg 8)** or **Steam/Water Distribution (pg 10)**

MULTI-ZONE HVAC SYSTEM				
Central Air Distribution				
★		System 1	System 2	System 3
Air Distribution System Type:	*(See Table 1 Below)*			
Main Air Supply/Return System	*1=Built-up Packaged DX Unit 2=Central AHU*			
Regular Maintenance?	*(Circle One)*	Y / N	Y / N	Y / N
Percent of Building	*(%)*			
Age	*(Years)*			
Temperature Control Type	*(See Table 2 Below)*			
Number of Identical Units				
Supply Fans:				
Volume Control	*1=Discharge Damper 2=Inlet Vain 3=VFD*			
Motor HP				
Volts/Phase/FL Amps				
Motor Efficiency	*(%)*			
Return Fans:				
Volume Control	*1=Discharge Damper 2=Inlet Vain 3=VFD*			
Motor HP				
Volts/Phase/FL Amps				
Motor Efficiency	*(%)*			
Terminal Reheat Type	*1=Elec 2=Water 3=Steam 4=None*			
Evaporative Cooling	*(Circle One)*	Y / N	Y / N	Y / N
Insulated Duct	*(Circle One)*	Y / N	Y / N	Y / N
Air-to-Air Heat Recovery	*(Circle One)*	Y / N	Y / N	Y / N
Economizer	*(Circle One)*	Y / N	Y / N	Y / N

Table Continued On Next Page

Table 1 - Multi-Zone Central Air Distribution Systems
1=Constant Volume - Single Duct System
2=Constant Volume - Single Duct System w/ Reheat
3=VAV - Single Duct System
4=VAV - Single Duct System w/ Reheat
5=VAV - Single Duct System w/ Fan-Powered Boxes & Reheat
6=VAV - Dual Duct System
7=VAV - Dual Duct System w/ Reheat
8=VAV - Dual Duct System w/ Fan-Powered Boxes & Reheat
9=Under Floor Air Distribution
10=Under Floor Air Distribution w/ Reheat
11=Under Floor Air Distribution w/ Fan-Powered Boxes & Reheat

Table 2- Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

MULTI-ZONE HVAC SYSTEM CONTINUED				
For Central Air Handling Units Only				
Cooling Coil?	(Circle One)	Y / N	Y / N	Y / N
Heating Coil?	(Circle One)	Y / N	Y / N	Y / N
Heating Coil Type	1=Elec 2=Water 3=Steam 4=None			
For Built-up Packaged DX Units Only				
Equipment Data: ★				
Manufacturer/Model Name				
Model Number				
Serial Number				
Cooling Data: ★				
Rated Cooling Capacity	(Tons)			
Performance Rating	(Circle One)	EER SEER	EER SEER	EER SEER
Performance Rating Value				
Heating Data: ★				
Rated Heating Output	Circle Correct Units for given number!!	Btu/h kW	Btu/h kW	Btu/h kW
Fuel Type ★	(See Table 3 Below)			
Efficiency	(%)			
Compressors:				
Quantity				
HP or Volts/Phase/FL Amps				

Table 3 - Fuel Types
1=Electric
2=Natural Gas
3=Fuel Oil
4=LPG
5=Purchase HW or Steam
6=Wood
7=Other (Make Note)

MULTI-ZONE HVAC SYSTEM				
Central Water/Steam Distribution				
		System 1	System 2	System 3
System Type:	*1=Two-pipe 2=Four-pipe*			
Steam or Hot Water Heating?	*1=Water 2=Steam*			
Antifreeze in loop?	*(Circle One)*	Y / N	Y / N	Y / N
Regular Maintenance?	*(Circle One)*	Y / N	Y / N	Y / N
Percent of Building	*(%)*			
Age	*(Years)*			
Temperature Control Type	*(See Table Below)*			
Terminal Systems:				
Unit Type:	*(See Table Below)*			
Number of Identical Units				
For Heat Pumps Only				
Manufacturer/Model Name:				
Model Number				
Serial Number				
Cooling Data:				
Rated Cooling Capacity (if applicable)	*(Tons)*			
Performance Rating ★	*(Circle One)*	EER SEER	EER SEER	EER SEER
Performance Rating Value				
Heating Data:				
Rated Heating Output	Circle Correct Units for given number!!	Btu/h kW	Btu/h kW	Btu/h kW
Fuel Type ★	*(See Table Below)*			
Efficiency	*(%)*			
Compressors:				
Quantity				
HP or Volts/Phase/FL Amps				
Supply Fan:				
Motor HP				
Motor Efficiency	*(%)*			

Table 1 - Multi-Zone Central Air Distribution Systems
1=Constant Volume - Single Duct System
2=Constant Volume - Single Duct System w/ Reheat
3=VAV - Single Duct System
4=VAV - Single Duct System w/ Reheat
5=VAV - Single Duct System w/ Fan-Powered Boxes & Reheat
6=VAV - Dual Duct System
7=VAV - Dual Duct System w/ Reheat
8=VAV - Dual Duct System w/ Fan-Powered Boxes & Reheat
9=Under Floor Air Distribution
10=Under Floor Air Distribution w/ Reheat
11=Under Floor Air Distribution w/ Fan-Powered Boxes & Reheat

Table 2- Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

Table 3 - Fuel Types
1=Electric
2=Natural Gas
3=Fuel Oil
4=LPG
5=Purchase HW or Steam
6=Wood
7=Other (Make Note)

Central HVAC System –Boiler

1. Does this system have a Boiler Y / N

Central HVAC System-Boiler				
★		System 1	System 2	System 3
Fuel Type	*(See Table Below)*			
Heating Zone Description				
Regular Maintenance	*(Circle One)*	Y / N	Y / N	Y / N
Percent of Building	*(%)*			
Age	*(Years)*			
Temperature Control Type	*(See Table Below)*			
Manufacturer ★				
Model Name				
Model Number				
Serial Number				
Input Capacity	*(Btu/h)*			
Efficiency	*(%)*			
Number of Identical Boilers ★				
Number of Units on Standby				
Hot Water Pumps ★				
Quantity				
Motor HP				
Motor Efficiency				
Temperature Control Type	*(See Table Below)*			
Capacity Control Type	*1=Constant Speed* *2=Variable Speed*			
Heating Pipes Insulated	*(Circle One)*	Y / N	Y / N	Y / N
Number of Units on Standby				

Fuel Types
1=Electric
2=Natural Gas
3=Fuel Oil
4=LPG
5=Purchase HW or Steam
6=Wood
7=Other (Make Note)

Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

Central HVAC System – Chiller

1. Does this system have a Chiller Y / N

Central HVAC System-Chiller				
★		System 1	System 2	System 3
Chiller Type	*(See Table Below)*			
Zone Description				
Regular Maintenance	*(Circle One)*	Y / N	Y / N	Y / N
Percent of Building	*(%)*			
Age	*(Years)*			
Temperature Control Type	*(See Table Below)*			
Manufacturer ★				
Model Name				
Model Number				
Serial Number				
Rated Cooling Capacity	*(Tons)*			
Performance Rating	*(Circle One)*	EER - IPLV - kW/ton	EER - IPLV - kW/ton	EER - IPLV - kW/ton
Performance Rating Value				
Compressor:				
Design Full Load KW *(or)*				
Volts/Phase/FL Amps				
Number of Identical Chillers ★				
Number of Units on Standby				
Heat Rejection System				
Condenser Type	*(See Table Below)*			
Capacity Control	*1=Fixed Temp 2=Floating Temp 3=Head Pressure*			
Fan Control	*1=Constant 2=Cycle 3=Pony Motor 4=Two-Speed 5=Variable Speed*			
Water Side Economizer	*(Circle One)*	Y / N	Y / N	Y / N
Temperature Control Type	*(See Table Below)*			
Condenser Fans:				
Quantity				
HP				
Motor Efficiency	*(% or S,H,P)*			

Chiller Types	
1=Centrifugal	5 = Absorption, Hot Water
2=Reciprocating	6 = Absorption, Natural Gas
3=Rotary	7 = Absorption, Steam
4=Scroll	8 = Other

Condenser Types
1=Air Cooled Condenser
2=Cooling Tower
3=Evaporative Cooler

Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

Central HVAC System -Chiller (Continued)

Chilled Water Pumps				
Pump Use	*1=Primary* *2=Secondary*			
Quantity				
Motor HP				
Motor Efficiency				
Capacity Control	*1=Constant Speed* *2=Variable Speed*			
Temperature Control Type	*(See Table Below)*			
Number of Units on Standby				
Condenser Water Pumps				
Quantity				
Motor HP				
Motor Efficiency				
Capacity Control	*1=Constant Speed* *2=Variable Speed*			
Temperature Control Type	*(See Table Below)*			
Number of Units on Standby				

Temperature Control Types
1=Thermostat-Programmable
2=Thermostat-Manual
3=EMS
4=Always on
5=Manual on/off
6=Time Clock

★

HVAC Controls

1. Is **Heating** system set to a single temperature? (No control schedule used) Y / N
   a. If so, What is the set temperature? ________° F

2. If "*No*" to #36, please fill out schedule below.

Heating set-points and schedules:

	System 1		System 2		System 3		System 4	
	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)
Occupied								
Unoccupied								

3. **Heating** Months (for system lock-out or reset)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

4. Does the **heating system** employ temperature reset controls? Y / N

5. Is **Cooling** system set to a single temperature? (No control schedule used) Y / N
   a. If so, What is the set temperature? ______°F

6. If "*No*" to #40, please fill out schedule below.

Cooling set-points and schedules:

	System 1		System 2		System 3		System 4	
	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)	Time (# hrs/day)	Temp (°F)
Occupied								
Unoccupied								

7. **Cooling** Months (for system lock-out or reset)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Domestic Hot Water

1. Does this building have domestic water heating? Y / N

Domestic Water Heating				
★		System 1	System 2	System 3
Water Heater Type	*(See Table Below)*			
Fuel Type	*(See Table Below)*			
Age	*(Years)*			
Location	*(Conditioned or Unconditioned)*			
★				
Tank Wrap	*(Circle One)*	Y / N	Y / N	Y / N
Pipe Wrap	*(Circle One)*	Y / N	Y / N	Y / N
Circulation Pump	*(Circle One)*	Y / N	Y / N	Y / N
Continuously Circulating	*(Circle One)*	Y / N	Y / N	Y / N
Set-Point	*(°F)*			
Is a Setback Used	*(Circle One)*	Y / N	Y / N	Y / N
Manufacturer ★				
Model Name				
Model Number				
Serial Number				
Tank Capacity ★	*(Gal)*			
Input Capacity	Circle Correct Units for given number!!	KW / Btu/hr	KW / Btu/hr	KW / Btu/hr
Recovery	*(Gal/hr)*			
Efficiency	*(EF)*			
Heating Pipes Insulated	*(Circle One)*	Y / N	Y / N	Y / N
Is Drain Water Heat Recovery Used	*(Circle One)*	Y / N	Y / N	Y / N

Water Heater Types
1=Heat Pump
2=Heat Recovery
3=Instantaneous (Tankless)
4=Self-Contained (Conventional)
5=Storage Tank (Central Boiler)
6=Other (Make Note)

Fuel Types	
1=Electric	5=Purchase HW or Steam
2=Natural Gas	6=Wood
3=Fuel Oil	7=Other (Make Note)
4=LPG	

Number of faucets with given flow rate:

	<0.5 GPM	0.5 to 1.5 GPM	1.5 to 3.0 GPM	>3.0 GPM
Number				
Motion Controllers? (# that have M.C.)				

Plug Loads

Appliances: *If there is **more than one** type used in the building note the average age, average frequency of use, and the % of the total Quantity that are Energy Star.*

	★Quantity	(Average) Age (years)	Frequency of Use (**Hrs/wk**)	★% that are Energy Star
1. Air purifiers/Dehumidifiers				%
2. All-in-one (printer/copier/scanner/fax)				%
3. Beverage Machine				%
4. Coffee Maker				%
5. Fax Machine				%
6. Laptops				%
7. Microwave				%
8. Paper Shredder				%
9. Personal Computers				%
10. Photocopiers				%
11. Printers				%
12. Residential Style Refrigerators				%
13. Scanners				%
14. Secondary Monitors				%
15. Security Cameras				%
16. Servers				%
17. Snack Machines				%
18. Space Heaters				%
19. Television				%
20. Water coolers				%
21. Other:____________________				%

22. Is a network computer energy management system used? Y / N

23. Are any vending machine controllers used? Y / N

1. Does this building have a washer and/or dryer? Y / N

	Commercial		Residential	
	Washer	Dryer	Washer	Dryer
Type (Majority) (1=front load, 2=top load)				
Quantity				
Age (years) [Avg]				
Manufacturer				
Model Name				
Loads per week (Avg)				
% that are Energy Star	%	%	%	%
Dryer fuel type (1=electric, 2=natural gas, 3=propane)	--		--	
Efficiency (MEF)				

2. Does this building have residential style dishwashers? Y / N

Age (years)	
Quantity	
Manufacturer	
Model Name	
Model Number	
Loads per week (average)	
% that are Energy Star	%
Efficiency (EF)	

Commercial Kitchen

1. Does this building have any **COMMERCIAL** kitchen equipment? Y / N

Which equipment is present? *If there is* ***more than one*** *type used in the building, note the most common fuel, average age, average frequency of use, and the % of the total Quantity that are Energy Star.*

	★ Fuel	Quantity ★	Average Age (years)	Frequency of Use (hrs/wk)	★ % that are Energy Star
2. Standard Oven	E / G / P				%
3. Convection Oven	E / G / P				%
4. Range	E / G / P				%
5. Fryer	E / G / P				%
6. Hot food holding cabinet	E / G / P				%
7. Electric Steam Cooker	E / G / P				%
8. Griddle	E / G / P				%
9. Pizza Oven	E / G / P				%
10. Warming Table	E / G / P				%
11. Heat Lamps	E / G / P				%
12. Soup Pots	E / G / P				%
13. Continuous Toaster	E / G / P				%
14. Microwave	E / G / P				%

15. Is any other cooking equipment present? Y / N

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Type					
Quantity					
Average Age (years)					
Fuel	E / G / P	E / G / P	E / G / P	E / G / P	E / G / P
Usage (Hrs/wk)					

1. Are commercial dishwashers used? Y / N

2. Is the dishwasher a low-temp system? Y / N

3. Does the dishwasher have a booster heater? Y / N

4. Booster heater details:

	System 1	System 2	System 3
Age (years)			
Fuel	E / G / P	E / G / P	E / G / P
Manufacturer			
Model Name			
Model Number			

Refrigeration

5. Does this building have any commercial refrigeration equipment? Y / N
(Non-residential-style refrigerators)

Refrigeration equipment details:★
(Types: 1=Solid Door Refrigerator/Freezer, 2=Glass Door Refrigerator/Freezer, 3=Open Medium Temp Display Case, 4=Open Low Temp Display Case, 5=Display case with doors)

	Type	Size (Cu. Ft)	Qty	Stand alone?	Avg. Age (years)	% Energy Star
System 1						%
System 2						%
System 3						%
System 4						%
System 5						%
System 6						%
System 7						%
System 8						%
System 9						%
System 10						%

Walk-ins on next page

Refrigerated space details: ★
(Types: 1=Walk-in Refrigerator, 2=Walk-in Freezer, 3=Refrigerated Warehouse, 4=Freezer Warehouse)

	Type	Model #	Size (Sq. Ft)	Qty	Avg. Age (years)	Lighting (Fluorescent, LED, Incand, None)	Compressor (hp)
System 1							
System 2							
System 3							
System 4							
System 5							
System 6							
System 7							
System 8							
System 9							
System 10							

If a multiplex compressor system is used describe it below:

	Age (years)	Qty Compressor	Compressor (hp)
System 1			
System 2			
System 3			
System 4			

1. Are anti-sweat heater controls used on display case doors? Y / N
2. What type of lights do display cases have? ____________
   (1=fluorescent, 2=LED)
3. Are VFDs used on compressors? Y / N
4. Are ECM Motors in use? Y / N
5. Are demand defrost controls used? Y / N
6. Are floating head pressure controllers used? Y / N
7. Are high-efficiency evaporator fans used? Y / N

1. Are night covers used on open display cases? Y / N
2. Are evaporator fan controls used? Y / N
3. Has this refrigeration system been commissioned? Y / N
4. Would re-commissioning be appropriate for this system? Y / N
5. Is a heat recovery system used? Y / N
6. Do any display cases have special doors that don't require anti-sweat heat? Y / N
7. Does this building have any ice makers? Y / N

Ice maker details:

	Capacity (lbs/hr)	Qty	Stand alone?	Age (years)	% Energy-Star?
Ice Maker 1			Y / N		%
Ice Maker 2			Y / N		%
Ice Maker 3			Y / N		%

Water

8. Does this building have any irrigation systems connected to the electric meter? Y / N

Irrigation Pump Details:

	Unit 1	Unit 2	Unit 3
Size of land being irrigated (ft^2)			
Age (years)			
Manufacturer			
Model Number			
Serial Number			
Size (hp)			
RPM			
Enclosure Type (1=ODP, 2=TEFC)			
Efficiency (%)			
Control Type: (1=Manual, 2=Timer, 3='Smart' Controller,			

Does this building have a pool? Y / N

1. What type of fuel is used to heat the pool? [Check one]

Electricity	
Natural Gas	
Propane	
Other	

2. Pool pump details:

	Pump
Age (years)	
Manufacturer	
Model Number	
Serial Number	
Size (hp)	
RPM	
Enclosure Type (1=ODP, 2=TEFC)	
Efficiency (%)	

3. How is the pool pump controlled?

Runs continuously	
Timer	
VSD	
Other	

4. When is the pool used?

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Motors/Engines (Process Related)

1. Does facility have Motors or Engines that are process related? Y / N

	Description	Qty.	Service Type (Below)	Control Type (Below)	hp	NEMA Type (Below)	Nom. Eff. %	Drive Type (Below)	Duty Type (Below)	Avg Age (yrs)	Avg. Run hrs/wk
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Service Type
1=Pump
2=Fan/Blower
3=Material Handling/Conveyor
4=Machine Tool
5=Grinding/Milling
6=Escalator
7=Passenger Elevator
8=Freight Elevator
9=Separation
0=Other__________

Control Type
1=Throttled
2=Mechanical VSD
3=Electronic VSD
4=Constant Speed
5=Two Speed

NEMA Type
ODP = Open Drip Proof
TEFC = Totally Enclosed Fan
OT= _______________

Drive Type
1=AC
2= DC w/ SCR
3=DC w/ MGS
4=Nat. Gas Driven
5=Fossil Fuel Driven
6=Steam Driven

Duty Type
1=Constant
2=Variable
3=Intermittent

Air Compressors

1. Does this Facility have Air Compressors? Y / N

2. Does the facility have a leak Reduction Maintenance Program? Y / N

	Description	Compressor Type (below)	Application Type (below)	Control Type (below)	Hp	Quantity	Nom. Efficiency %	Drive Type (below)	Avg. run hrs per wk	Air Dryer
1										Y / N
2										Y / N
3										Y / N
4										Y / N
5										Y / N
6										Y / N
7										Y / N
8										Y / N
9										Y / N
10										Y / N

Compressor Type
1= Reciprocating (2-stage, Double-acting)
2=Reciprocating (single-stage, Double-acting)
3=Reciprocating (2-stage, Single-acting)
4=Reciprocating (Single-stage, Single-acting
5=Rotary Screw (2-Stage)
6=Centrifugal
O:Other ______________

Application Type
1=Cleaning
2=Drive Tools
3=HVAC Pneumatic
O=Other_________

Control Type
1=Start/Stop
2=Load/Unload
3=VSD Throttling
O=Other__________

Drive Type
1 =AC
2= DC w/ SCR
3=DC w/MGS
4=Nat gas driven
5=Fossil driven
6=Steam driven

Other Process Loads

1. Does this building have any other process loads? Y / N

2. Briefly describe each process load: (*Include Product Produced if applicable*)

	Description
Process 1	
Process 2	
Process 3	
Process 4	
Process 5	
Process 6	
Process 7	
Process 8	

Process Load Details

	Qty	Avg. Age (years)	Mfg	Model Number	Primary Fuel Type (see table below)	Secondary Fuel Type (see table below)	Avg run hrs per wk	Avg. Unit Capacity KW	Avg Unit Capacity Btuh
Process 1									
Process 2									
Process 3									
Process 4									
Process 5									
Process 6									
Process 7									
Process 8									

Fuel Types	
1=Electricity	5=Wood
2=Natural Gas	6=Purchased Steam
3=Propane	7=Purchased HW
4=Fuel Oil	8=Other (Make Note)

Ventilation

1. Is an indoor parking garage with ventilation present? Y / N
2. If yes, how large is the parking garage? ____________ ft^2
3. If yes, is the garage ventilation system controlled with CO sensors? Y / N
4. For interior spaces, is any demand-controlled ventilation system employed? Y / N
5. Are ventilation hoods used? Y / N
6. Are any demand based controls used on the ventilation hoods? Y / N
7. Are the ventilation hoods variable volume? Y / N
8. Is make-up air provided directly at the ventilation hood? Y / N

Renewable Energy

9. Does this building have any renewable energy systems? Y / N
10. If so what type? ____________
11. What is the nameplate capacity of the system (kW)? ____________

Envelope

1. Please include info. about the ***majority*** of the building: **ONLY Select *ONE*** option for each section

Building Envelope		
Walls		
Surface Type (Majority)	*1=Brick* *2=Concrete* *3=Concrete Block* *4=Wood* *5=Metal*	
Framing Type (Majority)	*1=Metal* *2=Wood*	
★ Insulation Type (Majority)	*1=Batt/Blown* *2=Rigid* *3=None* *4=Unknown*	
★ Estimated R-Value (Average)		
Windows		
% of Wall Area (on average)	*(%)*	
Layers of Glazing (Majority)	*(1,2,3)*	
Glazing Type (Majority)	*1=Clear* *2=Reflective* *3=Tinted* *4=Low E* *5=Gas Filled*	
Frame Type (Majority)	*1=Metal* *2=Wood* *3=Vinyl*	
Window Type (Majority)	*1=Fixed* *2=Operable*	
Roofs		
Total Roof Area	*(Ft^2)*	
Roof Type (Majority)	*1=Flat* *2=Pitched*	
Surface Material (Majority)	*1=Built-up* *2=Cool Roof* *3=Membrane* *4=Metal* *5=Shingles/Flat*	
Deck Material (Majoirty)	*1=Concrete* *2=Metal* *3=Wood*	
Insulation Type (Majority)	*1=Batt/Blown* *2=Rigid* *3=None* *4=Unknown*	
Skylights	*(Circle One)*	Y / N
Green Roof	*(Circle One)*	Y / N
Floors		
Floor Type (Majority)	*1=Basement* *2=Crawl* *3=Slab* *4=Unconditioned*	
Material Type (Majority)	*1=Concrete* *2=Metal* *3=Wood* *4=Other*	
Insulation Type (Majority)	*1=Batt/Blown* *2=Rigid* *3=None* *4=Unknown*	

Appendix A

Lighting								
Lighting Configuration (Interior)								
Lamp Type (see below)	Length in ft (if Applicable)	Lamp Wattage	# of Fixtures	Lamps/ Fixture	Ballast Type (See Below)	Control Type (See Below)	Zone #	Description

Zone #	Sq Footage (per zone)	W/ft^2 (per zone)

Ballast Type
1=Magnetic Standard
2=Magnetic-ES
3=Electronic
4=Electronic Dimming
5=Emergency

Control Type
1=Switch (Manual on/off)
2=Circuit Breaker
3=Dual Level Switch
4=Dimmer Switch
5=Timer
6=Motion/Occupancy Sensor
7=Daylighting Controls
8=Energy Management System
9=None/Continuous

Lamp Type	
1=Incandescent	7=LED
2=Metal Hallide	8=T8
3=High Pressure Sodium	9=T9
4=Mercury Vapor	10=T10
5=T5	12=T12
6=Neon (Cold Cathode)	O=Other

Notes:

<DATE>

<COMPANY NAME>
<MAILING ADDRESS>
<MAILING CITY, STATE, ZIP>

Dear Facilities Manager:

Your company has been randomly chosen as a potential participant in a state-wide study by the Delaware Department of Natural Resources and Environmental Control (DNREC) to gather information on the energy equipment installed in commercial facilities. The goal of this research is to provide improved energy efficiency rebate programs in the future.

This letter is with regard to the facility located at:

<SITE ADDRESS, CITY, STATE, ZIP>

You are being contacted by Nexant (the contractor conducting this research for DNREC) to ask your willingness to participate in both the study and for permission to conduct an on-site survey at your facility. If you agree to the on-site survey, a trained Nexant engineer will visit your facility to gather additional information about your electrically-powered equipment.

All data collected during this research will be kept anonymous and will be used only in the aggregate to provide information for more effective energy efficiency programs in the future.

Your participation in this survey is encouraged, but is entirely optional. If you have any questions or concerns, please contact me at 302.735.3495 or via email at Bahareh.vanBoekhold@state.de.us.

Best regards,

Bahareh van Boekhold
Department of Natural Resources and Environmental Control
Division of Energy and Climate
1203 College Park Drive, Suite 101
Dover, DE 19904

Baseline Commercial & Industrial Phone Survey

General Info (Complete before Phone Survey):

Company Name: ______________________

Contact Name: ______________________

Contact Phone Number: ______________________

Address: ______________________

City, State, Zip: ______________________

Nexant ID ______________________

1st Contact Attempt

Interviewer: ____________

Date: ____________

Spoke With: ____________

Notes: ____________

____

____

2nd Contact Attempt

Interviewer: ____________

Date: ____________

Spoke With: ____________

Notes: ____________

____

____

Phone Message (voicemail):

Hello, my name is ***<Nexant Caller's Name>*** and I am calling on behalf of The Delaware Department of Natural Resources and Environmental Control. We are working with the State of Delaware to conduct a state-wide study to better understand how businesses in Delaware use energy with the goal of providing improved energy efficiency rebate programs in the future.

Please give me a call back at ***<Nexant Caller's phone number>*** so we can talk a bit more about the program and see if you would be interested in participating.

Thank you, and have a good day.

~~~~~~
~~~~~~

Introduction (live person):

Hello, my name is ***<Nexant Caller's Name>*** and I am calling on behalf of **The Delaware Department of Natural Resources and Environmental Control**. I am calling because we are conducting a state-wide study to better understand how businesses use energy. May I speak with ***<CONTACT NAME/"a Facilities Manager"/"a Manager On Duty">***?

[If Unavailable] Is there a better time for me to call back? *[Record time]* Is there someone in particular I should ask for?

AFTER LOCATING PROPER CONTACT: *[Repeat Introduction if necessary]* Hello, my name is ***<Nexant Caller's Name>*** and I am calling on behalf of The Delaware Department of Natural Resources and Environmental Control. We are working with the State of Delaware to conduct a state-wide study to better understand how businesses in Delaware use energy with the goal of providing improved energy efficiency rebate programs in the future.

As part of the study, we are asking certain businesses if they would allow one of our trained engineers to conduct an on-site survey to gather information on the different energy using equipment – such as the lighting and HVAC systems. Site visits typically last an average of 1 ½ - 2 hours. Depending on the size of your facility, it could take a bit longer, however it is not mandatory that someone escort our engineer around at all times, unless you feel it is necessary. However, someone would need to be accessible to our engineer should they have a question regarding your facility. Would you be willing to let one of our engineers come to your building for this purpose?

a) *'Yes':* Thank you for your participation. If you have a few minutes, I'd like to ask you some questions about the energy systems in your building. This will take approximately 10 to 15 minutes. *[Proceed to scheduling and survey]*

b) *'No':* Thank you for your time, have a great day. *[Terminate call]*

Do you have time to speak now?

a) 'Yes': [Proceed to scheduling and survey].

b) 'No': Would there be a better time to call back?

b1) *'Yes': [Get time and date*: ____________________.] Someone will call you back on ________. Thank you for your time.

General Information

1. Before we begin, I would like to confirm your name and contact information. I have you listed as *[Read company name and address]*. Is this correct?
   a. Yes *[Proceed to question 2.]*
   b. No *[Record correct name and address]*

   ____

   ____

____

____

2. Can you please provide your email address so that we can send you a confirmation notice of your scheduled survey time?

____

3. Our records show ***<Utility Name>*** is your electrical provider, is that correct?
   a. Yes *[Proceed to question 4.]*
   b. No *[Record correct utility]*

____

4. Could you please provide the name of your gas utility as well?
   a. *[Record correct utility]*

____

General Scheduling

1. Our Engineers will be in your area between <START DATE> and <END DATE>. Are there any dates/times during this time period that do **NOT** work for you so we know not to schedule you then? *[Record UNAVAILABLE time and date _______________________________].* Are there any dates/times that works **BEST** for your schedule during this period? *[Record PREFERRED time and date _______________________________].* We will do our best to accommodate your preferred date and time and you should expect to receive an email within the next 48-72 hours confirming your exact date and time. The email will also include my contact information if for any reason you need to cancel or reschedule. It will also include a number to **The Delaware Department of Natural Resource and Environmental Control** in case you have any questions before, during or after the onsite survey. We will also give you a courtesy reminder call 24 hours before your scheduled visit. When our engineer arrives he/she will provide you with proper identification from Nexant and **The DNREC**. It will be necessary to have a knowledgeable facilities manager available to assist the engineer at all times.

Do you have just a few more minutes for some additional questions we can give to our engineers before the visit?

a) *'Yes':* Great! *[Proceed to Phone Survey/Building Information]*
b) *'No':* No problem, I have just a few quick questions to determine how long our engineer will need to be onsite and then I'll let you go. *[Ask #1, #2, and #7 of Phone Survey/Building Information to determine estimated visit time and then Skip to "Additional Information"]*

Phone Survey/Building Information

1. Of the following options, what is the primary use of your building? *[Check appropriate space]*

Education	______________
Grocery	______________
Health	______________
Lodging	______________
Office	______________
Restaurant	______________
Retail	______________
Warehouse	______________
Multifamily	______________
Industrial	______________
Other	______________

2. How many buildings are on your premises? *[Record # of bldgs.]____.]* How large is [are] the building[s] on this account?

	Square Ft
Primary Building	______________
Building 2	______________
Building 3	______________
Building 4	______________
Building 5	______________

3. How many floors does [do] the building[s] have?

	Floors
Primary Building	______________
Building 2	______________
Building 3	______________
Building 4	______________
Building 5	______________

4. What is the primary type and fuel of the heating system in the building[s]?
(Type: 1=Boiler, 2=Furnace, 3=Rooftop Unit, 4=Unit Heater)
(Fuel:1=Electric, 2=Natural Gas, 3=Propane, 4=Oil, 5=Wood, 6=Other)

	Heating Type	Fuel
Primary Building	______________	______________
Building 2	______________	______________
Building 3	______________	______________
Building 4	______________	______________
Building 5	______________	______________

5. What is the primary type of cooling system in the building[s]?
(1=Rooftop Unit, 2=Split system, 3=Chiller, 4=Through-the-wall AC, 5=Heat pump)
(If rooftop unit, will there be access for the site visit?)

	Cooling Type
Primary Building	______________
Building 2	______________
Building 3	______________
Building 4	______________
Building 5	______________

6. What is the primary type of lighting in the building[s]?
(1=Fluorescent, 2=Incandescent, 3=High Intensity Discharge)

Primary Building	______________
Building 2	______________
Building 3	______________
Building 4	______________
Building 5	______________

7. Does this building [do these buildings] have any commercial kitchen equipment?

	Commercial Kitchen
Primary Building	Y / N
Building 2	Y / N
Building 3	Y / N
Building 4	Y / N
Building 5	Y / N

8. Does this building [do these buildings] produce any renewable energy?

	Renewable
Primary Building	Y / N
Building 2	Y / N
Building 3	Y / N
Building 4	Y / N
Building 5	Y / N

Additional Information

Thank you for your help. I have just a couple more questions and comments.

1. Based on your facility size, we expect the site visit to last ***<NUMBER OF HOURS>***
2. Who will be the contact for this visit? *[Record Contact Name and Alternate Phone #]*
3. We will need access to the mechanical rooms, rooftop, or basement where the equipment is located? Will that be possible? Y / N
4. Will any safety equipment be required to conduct a walk-through, such as hard hats, safety glasses, ear plugs, steel-toed boots? Y / N

5. Are there any other important bits of information we should let our engineer know prior to the visit?

6. If you have access to blueprints of your facility, please have it available for the engineer when he arrives, it will expedite the time in your business.

Thank you again for agreeing to participate in the study – have a great day!

Estimated Time of Visit

Commercial Facilities	
Size (sq. ft.)	Time Est.
< 25000	~ 1 hour
25,000 - 50,000	~ 2 hours
50,000 - 100,000	~ 3 hours
100,000 - 200,000	~ 4 hours
* Grocery Stores last 2 hours plus * Commercial Kitchen add 1 hour	
Industrial Facilities	
Size (sq. ft.)	Time Est.
< 250,000	~ 3-4 hours
> 250,000	4 - 8 hours

Appendix D COMMERCIAL END USE & HVAC CATEGORY DEFINITIONS

Space Cooling

- **Packaged DX Units**
  Definition: Packaged DX systems are self-contained, weatherproof units incorporating a fan, compressor, condenser, and evaporator coil for cooling. Commonly referred to as "rooftop units".
- **Window Wall, A/C Unit**
  Definition: Small terminal heating/cooling units mounted directly below or within a window opening or in openings cut through the exterior wall of each served space.
- **Evaporative Cooling**
  Definition: Evaporative coolers, or "swamp coolers," consist of units that cool air through the evaporation of water (phase transition of liquid water to water vapor), as opposed to typical air conditioning systems which use vapor-compression or absorption refrigeration cycles.
- **DX Split System**
  Definition: Split systems consist of an outdoor unit incorporating the compressor and condenser and an indoor unit that contains the cooling and heating coils and the circulating fan; insulated refrigerant tubing and control wiring connect the two parts.
- **Heat Pump, Cooling**
  Definition: Heat pumps are electrically powered heating and cooling units. For cooling, the normal compressive (DX) refrigeration cycle is used to absorb and transfer heat to the outdoors.
- **Packaged Central Plant**
  Definition: Central air distribution system or chilled water distribution system with cooling generated by a central chilled water plant or a built-up, multi-zoned DX packaged system.

Space Heating

- **Unit Heat**
  Definition: A stand-alone (independently-controlled) electric or natural gas-fired heating unit serving a single zone or space (examples would be electric baseboard radiators, suspended gas-fired unit heaters in a warehouse, electric fan coils, etc.)
- **Packaged Single Zone**
  Definition: Packaged single zone systems are self-contained, weatherproof units (typically roof-mounted) incorporating a fan and a direct-fired furnace section or staged electric heating coils.
- **Furnace**
  Definition: An indoor-mounted heating system containing a circulation fan and a fuel-fired heating section (typically natural gas-fired).
- **Heat Pump, Heating**
  Definition: Heat pumps are electrically powered heating and cooling units. For heating, heat energy is drawn from the outdoor air by reversing the cooling cycle and switching the heat

exchange functions of the condenser and evaporator. Both air source and water source heat pumps are included.

- **Central Plant (packaged multi-zone/boiler)**
  Definition: Central air distribution system or hot water distribution system with heating generated by a central boiler plant or a central air handling unit equipped with heating coils. Multi-zone air distribution systems commonly feature staged electric or water-source re-heating elements for zone temperature control.

HVAC Auxiliary
Definition: Non-heating and cooling energy use from HVAC system. HVAC air distribution fan motor energy for DX air conditioning/heat pump systems, heating systems. Also included are electrical pumping loads in chilled and hot water systems.

Interior Lighting
Definition: All lighting that is contained within the building shell.

Exterior Lighting
Definition: All lighting which is outside the shell of the building

Plug Loads
Definition: Any electrical equipment that is plugged into a wall outlet or electrical plug, and isn't contained within another category. Office equipment such as fax machines, computers, printers, and copiers are included within this energy end use.

Refrigeration
Definition: Energy that is consumed by refrigerators (both self-contained and those with remote mounted compressors).

Other
Definition: Electric consumption segment not specifically identified in this study. A heterogeneous category composed largely of process and motor loads.

Cooking
Definition: All energy consumed by cooking equipment.

Water Heating
Definition: All energy that is used for domestic water heating (potable water)

Appendix E BUILDING TYPE MAPPING TABLES

The mapping table on the following page shows the assignment of building type to segments used in our sample design and analysis. To come up with the building types listed, Nexant assigned each SIC code obtained from the Hoover's database to a building type by adopting the SIC-building type mapping used by the *California Commercial End use Survey*[1].

[1] *California Commercial End-Use Survey*. Prepared for the California Energy Commission by Itron, Inc. March 2006.

Segment Mapping Table	
Building Type	Segment
Ag & Pumping	Industrial
Construction	Industrial
Education	Education
Fishing	Industrial
Forestry	Industrial
Grocery	Grocery
Health	Health
Lodging	Lodging
Mfg: Apparel	Industrial
Mfg: Chemicals and Allied Products	Industrial
Mfg: Electronic Equipment	Industrial
Mfg: Fabricated Metal Products	Industrial
Mfg: Food	Industrial
Mfg: Furniture and Fixtures	Industrial
Mfg: Ind and Com Machinery	Industrial
Mfg: Industrial	Industrial
Mfg: Leather	Industrial
Mfg: Lumber and Wood Products	Industrial
Mfg: Measurement and Control Equipment	Industrial
Mfg: Misc Mfg	Industrial
Mfg: Paper and Allied Products	Industrial
Mfg: Petroleum Refining and Related Industries	Industrial
Mfg: Primary Metals	Industrial
Mfg: Printing	Industrial
Mfg: Rubber and Mixed Plastics	Industrial
Mfg: Stone Clay Glass and Concrete	Industrial
Mfg: Textile	Industrial
Mfg: Tobacco	Industrial
Mfg: Transportation Equipment	Industrial
Mining & Extraction	Industrial
Misc	Misc
National Security	Misc
No SIC Code	Unclassified
Office	Office
Residential	Remove
Restaurant	Restaurant
Retail	Retail
TCU	Misc
Unclassified	Unclassified
Warehouse	Warehouse
Prison	Misc
Other Institutional	Misc
Other Industrial	Industrial

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