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Ohio Edison Company, The Cleveland Electric Illuminating  
Company, and The Toledo Edison Company for Approval  
of Their Energy Efficiency and Peak Demand  
Reduction Program Portfolio Plans for 2017 through 2019

List of exhibits being filed: Volume I

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BEFORE THE PUBLIC UTILITIES COMMISSION OF OHIO

- - -

In the Matter of the :  
Application of Ohio Edison :  
Company, The Cleveland :  
Electric Illuminating :  
Company, and The Toledo :  
Edison Company for : Case No. 16-0743-EL-POR  
Approval of Their Energy :  
Efficiency and Peak Demand :  
Reduction Program Portfolio:  
Plans for 2017 through 2019:

- - -

PROCEEDINGS

before Mr. Richard Bulgrin, Attorney Examiner, at the  
Public Utilities Commission of Ohio, 180 East Broad  
Street, Room 11-D, Columbus, Ohio, called at  
10:00 a.m. on Monday, January 23, 2017.

- - -

VOLUME I

- - -

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# **FirstEnergy Ohio Operating Companies Market Potential Study**

APRIL 2016

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## 1.0 EXECUTIVE SUMMARY

The following report presents the results of an Energy Efficiency and Peak Demand Reduction Market Potential Study (hereinafter referred to as the "Market Study") that was conducted by Harbourfront Group, Inc. ("Harbourfront") for the three FirstEnergy Ohio operating companies, Ohio Edison Company ("OE" or "Ohio Edison"), The Cleveland Electric Illuminating Company ("CEI" or "The Illuminating Company") and The Toledo Edison Company ("TE" or "Toledo Edison") (hereinafter collectively referred to as the "Companies"). The Market Study is an important tool used to help inform and design the Companies' 2017-2019 Energy Efficiency and Peak Demand Reduction Plan (hereinafter referred to as "EEPDR") ultimately required under Ohio law.<sup>1</sup> The Harbourfront study team worked with Company staff during the development of this Market Study, the results of which were used by the Companies when developing their 2017-2019 Energy Efficiency and Peak Demand Reduction Plans ("Proposed Plans").

Two scenarios were examined in this Market Study: 1) a Base Case that assumes a standard package of program incentives adopted by those customers who indicated through surveys that they had a high level of interest in participating in such programs; and 2) a High Case that assumes a more aggressive package of program incentives and marketing to draw in additional customers who indicated through the same surveys that they would "consider" participating in such programs. In the High Case, utility costs and incentives are increased to reflect the additional effort required to obtain the higher participation levels. Both scenarios produce cost effective portfolios based on a review of the Total Resource Cost ("TRC") test. And, under both scenarios, sufficient market potential exists for the Companies to achieve the EEPDR levels as set forth in the Proposed Plans.

Harbourfront calculated the maximum technical potential based on a top-down approach that builds on end-use intensities ("EUIs") and unit energy consumptions ("UECs") presented in Sections 8.3. The total maximum technical potential was estimated to be approximately 37.5% of current kWh consumption. This represents the weighted average of the three utility customer classes: Residential; Commercial; and Industrial.

The Base Case results from the Market Study reveal an achievable potential for energy efficiency-related reductions over a base case annual energy forecast of 26.4% for OE, 21.9% for TE and 23.7% for CEI by 2031. The High Case results from the Market Study reveal an achievable potential for energy reductions of 33.0% for OE, 26.6% for TE and 28.8% for CEI during this same time period. These achievable potential estimates are the result of a careful analysis of commercially viable technologies, stated customer intentions as gathered from statistically valid surveys, and cost effectiveness testing. The percentage savings values shown above represent a best estimate, by Company, of EEPDR market potential based on currently available information. It is possible that, during the process of program design and initial implementation, some of these estimates may change as more information becomes available. Moreover, because these calculations forecast 15

<sup>1</sup> On September 12, 2014, Substitute S.B. 310 ("S.B. 310") became effective, revising, among other things, Chapter 4928 of the Ohio Revised Code ("R.C."). The amendment included the revision of the statutory percentage benchmark reductions in energy consumption and peak demand originally established in Am. Sub S.B. 221 ("S.B. 221"). These benchmarks are set forth in R.C. 4928.66(A)(1)(a) and (b). For the period January 1, 2017 through December 31, 2019 ("Plan Period"), the Companies are required to achieve incremental annual savings of one percent of the baseline and are required to achieve peak demand reductions based on an additional seventy-five hundredths of one percent reduction from the 2016 requirements.

years into the future, it is anticipated that technologies will evolve over time that will impact the projections. This Market Study is based upon laws currently in effect and did not anticipate or assume any potential changes to standards or other Federal or State statutory requirements. Finally, because of the difficulty in projecting with any certainty the number of customers who may elect to opt-out of participation in the programs as allowed by R.C. 4928.66, the Market Study also assumed there would be none. As opt-outs occur, they will reduce Achievable Potential, but will also have a corresponding reduction in the Companies' EEPDR statutory mandates.

The potential savings resulting from Transmission and Distribution (T&D) upgrades are not included in this Market Study.

Table 1-1 through Table 1-9 demonstrate the results of the Market Study in terms of its impact on energy and peak savings that the Achievable Cumulative Potential Energy and Peak savings (in MWh and percent and MW and percent, respectively) would have on the Companies' forecasts, in each year over the period 2017-2031. Table 1-1 through Table 1-3 are for OE, Table 1-4 through Table 1-6 are for CEI, and Table 1-7 through Table 1-9 are for TE.

The Achievable Cumulative Potential MWh and MW results are compared against the baseline forecast to arrive at the Achievable Cumulative Potential percentage savings each year.

**Table 1-1: State Energy Efficiency Mandates and Achievable Potential OE-Base Case**

Year	Mandates Cumulative (%)	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	24,288,362	1,262,995	1,917,441	7.9%
2018	6.2%	23,278,651	1,495,781	2,305,936	9.9%
2019	7.2%	22,437,475	1,720,156	2,703,460	12.0%
2020	8.2%	21,739,519	1,937,551	3,061,913	14.1%
2021	10.2%	21,506,883	2,367,689	3,468,677	16.1%
2022	12.2%	21,264,911	2,792,987	3,664,178	17.2%
2023	14.2%	21,057,418	3,214,135	3,859,680	18.3%
2024	16.2%	20,940,477	3,632,945	4,055,181	19.4%
2025	18.2%	20,849,207	4,049,929	4,250,683	20.4%
2026	20.2%	20,770,035	4,465,330	4,446,185	21.4%
2027	22.2%	20,698,205	4,879,294	4,641,686	22.4%
2028		20,636,761	4,879,294	4,837,188	23.4%
2029		20,590,901	4,879,294	5,032,689	24.4%
2030		20,558,284	4,879,294	5,228,191	25.4%
2031		20,529,257	4,879,294	5,423,692	26.4%

Source: Harbourfront Model

**Table 1-2: State Energy Efficiency Mandates and Achievable Potential OE-High Case**

Year	Mandates Cumulative (%)	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	24,288,362	1,262,995	2,026,407	8.3%
2018	6.2%	23,242,328	1,495,418	2,523,868	10.9%
2019	7.2%	22,328,509	1,718,703	3,030,359	13.6%
2020	8.2%	21,521,587	1,933,919	3,497,751	16.3%
2021	10.2%	21,179,993	2,357,519	4,013,024	18.9%
2022	12.2%	20,829,216	2,774,103	4,258,571	20.4%
2023	14.2%	20,532,558	3,184,754	4,504,118	21.9%
2024	16.2%	20,346,084	3,591,676	4,749,665	23.3%
2025	18.2%	20,204,769	3,995,771	4,995,212	24.7%
2026	20.2%	20,075,552	4,397,282	5,240,759	26.1%
2027	22.2%	19,953,676	4,796,356	5,486,306	27.5%
2028		19,842,187	4,796,356	5,731,852	28.9%
2029		19,746,281	4,796,356	5,977,399	30.3%
2030		19,663,619	4,796,356	6,222,946	31.6%
2031		19,584,547	4,796,356	6,468,493	33.0%

Source: Harbourfront Model

**Table 1-3: State Peak Demand Reduction Mandates and Achievable Reductions OE-Base and High Cases**

Year	Baseline Peak Forecast (MW)	State Peak Reduction Mandate (%)	Achievable Base Case Peak Reduction (MW)	Achievable High Case Peak Reduction (MW)	Achievable Base Case Peak Reduction (%)	Achievable High Case Peak Reduction (%)
2017	5,164	5.50%	289	307	5.6%	5.9%
2018	5,236	6.25%	350	386	6.7%	7.4%
2019	5,243	7.00%	411	466	7.8%	8.9%
2020	5,260	7.75%	469	542	8.9%	10.3%
2021	5,293		532	623	10.0%	11.8%
2022	5,319		561	659	10.5%	12.4%
2023	5,367		590	695	11.0%	12.9%
2024	5,430		619	731	11.4%	13.5%
2025	5,489		648	767	11.8%	14.0%
2026	5,542		677	803	12.2%	14.5%
2027	5,584		706	839	12.6%	15.0%
2028	5,619		735	875	13.1%	15.6%
2029	5,654		764	912	13.5%	16.1%
2030	5,689		794	948	13.9%	16.7%
2031	5,725		823	984	14.4%	17.2%

Source: Harbourfront Model

**Table 1-4: State Energy Efficiency Mandates and Achievable Potential CEI-Base Case**

Year	Mandates Cumulative (%)	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	18,534,041	963,770	1,480,965	8.0%
2018	6.2%	17,951,339	1,143,284	1,774,356	9.9%
2019	7.2%	17,367,109	1,316,955	2,073,393	11.9%
2020	8.2%	16,738,438	1,484,339	2,317,785	13.8%
2021	10.2%	16,488,777	1,814,115	2,613,581	15.9%
2022	12.2%	16,253,764	2,139,190	2,731,893	16.8%
2023	14.2%	16,087,726	2,460,944	2,850,205	17.7%
2024	16.2%	15,995,085	2,780,846	2,968,516	18.6%
2025	18.2%	15,962,866	3,100,103	3,086,828	19.3%
2026	20.2%	15,947,694	3,419,057	3,205,140	20.1%
2027	22.2%	15,942,003	3,737,897	3,323,451	20.8%
2028		15,944,576	3,737,897	3,441,763	21.6%
2029		15,960,453	3,737,897	3,560,074	22.3%
2030		15,985,325	3,737,897	3,678,386	23.0%
2031		16,011,064	3,737,897	3,796,698	23.7%

Source: Harbourfront Model



**Table 1-5: State Energy Efficiency Mandates and Achievable Potential CEI-High Case**

Year	Mandates Cumulative (%)	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	18,534,041	963,770	1,550,723	8.4%
2018	6.2%	17,928,086	1,143,051	1,913,873	10.7%
2019	7.2%	17,297,350	1,316,024	2,282,668	13.2%
2020	8.2%	16,598,921	1,482,014	2,596,793	15.6%
2021	10.2%	16,279,510	1,807,604	2,962,047	18.2%
2022	12.2%	15,974,847	2,127,101	3,109,791	19.5%
2023	14.2%	15,752,602	2,442,153	3,257,535	20.7%
2024	16.2%	15,617,188	2,754,497	3,405,279	21.8%
2025	18.2%	15,555,535	3,065,607	3,553,023	22.8%
2026	20.2%	15,510,931	3,375,826	3,700,767	23.9%
2027	22.2%	15,475,808	3,685,342	3,848,511	24.9%
2028		15,448,949	3,685,342	3,996,255	25.9%
2029		15,435,394	3,685,342	4,143,999	26.8%
2030		15,430,834	3,685,342	4,291,742	27.8%
2031		15,427,140	3,685,342	4,439,486	28.8%

Source: Harbourfront Model

Table 1-6: State Peak Demand Reduction Mandates and Achievable Reductions CEI-Base and High Cases

Year	Baseline Peak Forecast (MW)	State Peak Reduction Mandate (%)	Achievable Base Case Peak Reduction (MW)	Achievable High Case Peak Reduction (MW)	Achievable Base Case Peak Reduction (%)	Achievable High Case Peak Reduction (%)
2017	3,900	5.50%	224	237	5.7%	6.1%
2018	3,954	6.25%	272	297	6.9%	7.5%
2019	3,972	7.00%	320	357	8.0%	9.0%
2020	4,004	7.75%	361	411	9.0%	10.3%
2021	4,043	7.75%	409	472	10.1%	11.7%
2022	4,081	7.75%	428	495	10.5%	12.1%
2023	4,117	7.75%	447	518	10.9%	12.6%
2024	4,160	7.75%	466	542	11.2%	13.0%
2025	4,202	7.75%	485	565	11.5%	13.5%
2026	4,239	7.75%	504	589	11.9%	13.9%
2027	4,267	7.75%	523	612	12.3%	14.3%
2028	4,292		542	636	12.6%	14.8%
2029	4,317		561	659	13.0%	15.3%
2030	4,342		580	683	13.4%	15.7%
2031	4,368		599	706	13.7%	16.2%

Source: Harbourfront Model

**Table 1-7: State Energy Efficiency Mandates and Achievable Potential TE-Base Case**

Year	Mandates Cumulative %	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	10,526,035	547,354	755,346	7.2%
2018	6.2%	10,302,696	650,381	906,467	8.8%
2019	7.2%	10,074,334	751,124	1,060,158	10.5%
2020	8.2%	9,783,821	848,962	1,186,945	12.1%
2021	10.2%	9,701,474	1,042,992	1,340,994	13.8%
2022	12.2%	9,607,611	1,235,144	1,415,428	14.7%
2023	14.2%	9,530,145	1,425,747	1,489,863	15.6%
2024	16.2%	9,479,718	1,615,341	1,564,298	16.5%
2025	18.2%	9,476,047	1,804,862	1,638,733	17.3%
2026	20.2%	9,477,939	1,994,421	1,713,168	18.1%
2027	22.2%	9,482,703	2,184,075	1,787,603	18.9%
2028		9,491,196	2,184,075	1,862,037	19.6%
2029		9,504,279	2,184,075	1,936,472	20.4%
2030		9,521,363	2,184,075	2,010,907	21.1%
2031		9,540,746	2,184,075	2,085,342	21.9%

Source: Harbourfront Model

**Table 1-8: State Energy Efficiency Mandates and Achievable Potential TE-High Case**

Year	Mandates Cumulative %	Baseline Forecast (MWh)	State Mandate Cumulative Reduction (MWh)	EE Achievable Cumulative Potential (MWh)	EE Achievable Cumulative Potential (%)
2017	5.2%	10,526,035	547,354	791,492	7.5%
2018	6.2%	10,290,648	650,260	978,760	9.5%
2019	7.2%	10,038,187	750,642	1,168,596	11.6%
2020	8.2%	9,711,528	847,757	1,331,504	13.7%
2021	10.2%	9,593,044	1,039,618	1,521,530	15.9%
2022	12.2%	9,463,099	1,228,880	1,614,326	17.1%
2023	14.2%	9,355,481	1,415,990	1,707,122	18.2%
2024	16.2%	9,280,821	1,601,606	1,799,917	19.4%
2025	18.2%	9,258,789	1,786,782	1,892,713	20.4%
2026	20.2%	9,242,320	1,971,628	1,985,509	21.5%
2027	22.2%	9,228,722	2,156,203	2,078,305	22.5%
2028		9,218,855	2,156,203	2,171,101	23.6%
2029		9,213,577	2,156,203	2,263,896	24.6%
2030		9,212,300	2,156,203	2,356,692	25.6%
2031		9,213,322	2,156,203	2,449,488	26.6%

Source: Harbourfront Model

Table 1-9: State Peak Demand Reduction Mandates and Achievable Reductions TE-Base and High Cases

Year	Baseline Peak Forecast (MW)	State Peak Reduction Mandate (%)	Achievable Base Case Peak Reduction (MW)	Achievable High Case Peak Reduction (MW)	Achievable Base Case Peak Reduction (%)	Achievable High Case Peak Reduction (%)
2017	2,260	5.50%	124	129	5.5%	5.7%
2018	2,266	6.25%	147	158	6.5%	7.0%
2019	2,282	7.00%	170	188	7.5%	8.2%
2020	2,295	7.75%	191	214	8.3%	9.3%
2021	2,309	7.75%	214	243	9.3%	10.5%
2022	2,319	7.75%	225	256	9.7%	11.0%
2023	2,328	7.75%	236	270	10.1%	11.6%
2024	2,339	7.75%	247	283	10.6%	12.1%
2025	2,354	7.75%	258	297	11.0%	12.6%
2026	2,371	7.75%	269	310	11.3%	13.1%
2027	2,388	7.75%	280	323	11.7%	13.5%
2028	2,406		291	337	12.1%	14.0%
2029	2,424		302	350	12.4%	14.4%
2030	2,444		312	364	12.8%	14.9%
2031	2,464		323	377	13.1%	15.3%

Source: Harbourfront Model

Figure 1-1 EEPDR Affected Sales Forecast (Base Case-High Case) – OE

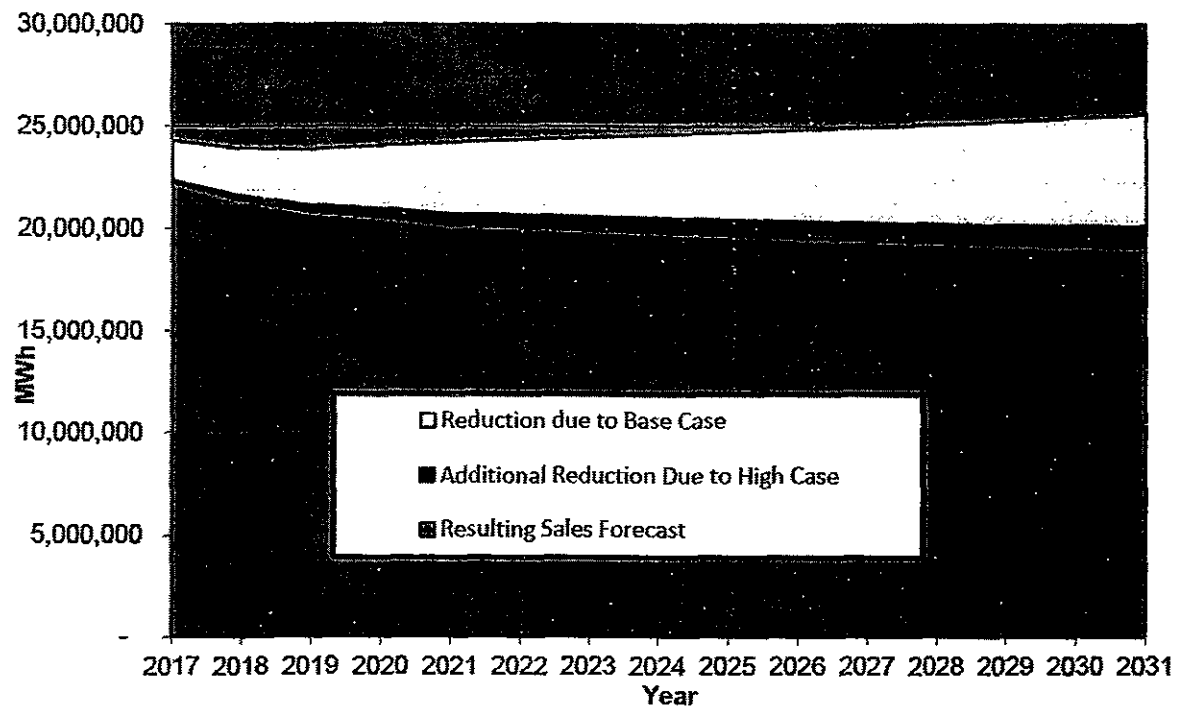


Figure 1-2 EEPDR Affected Sales Forecast (Base Case-High Case) – CEI

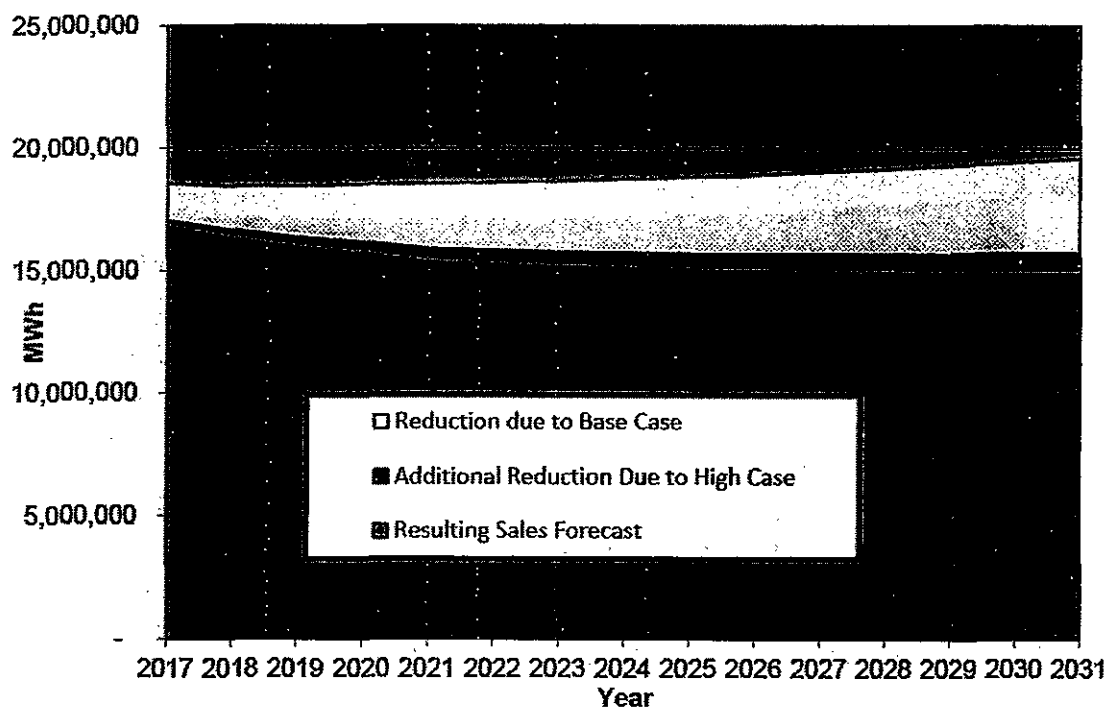


Figure 1-3 EEPDR Affected Sales Forecast (Base Case-High Case) -- TE

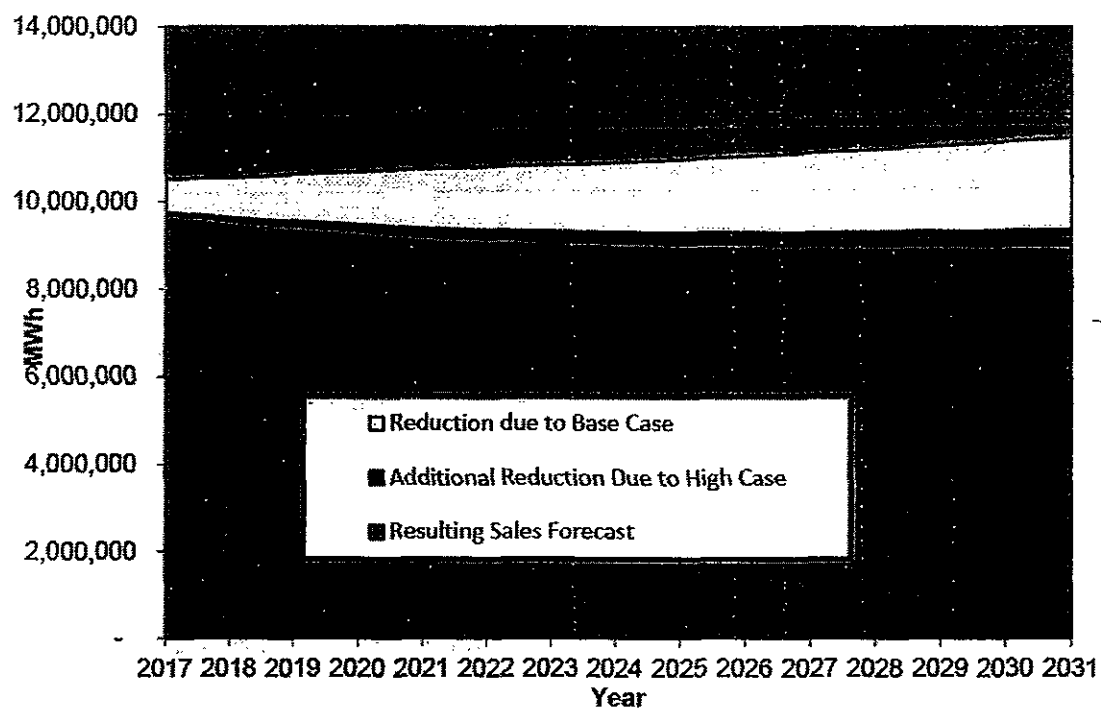




Figure 1-4 EEPDR Affected Sales Forecast with Technical Economic and Achievable Energy Savings Decrements – OE

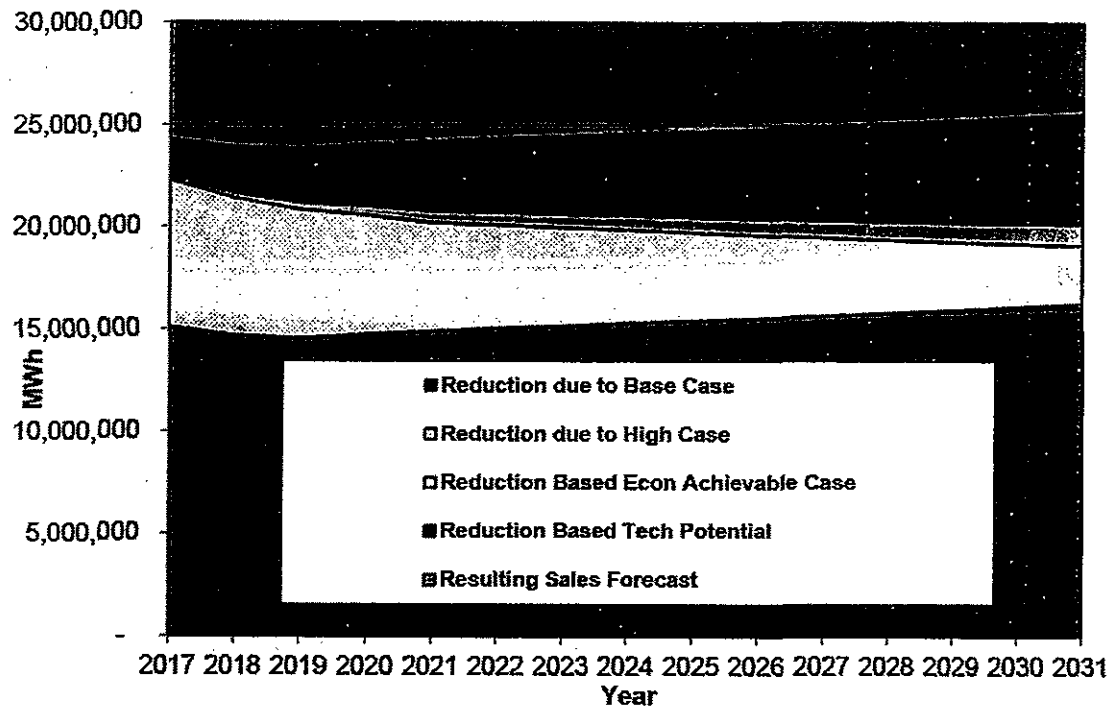


Figure 1-5 EEPDR Affected Sales Forecast with Technical Economic and Achievable Energy Savings Decrements – CEI

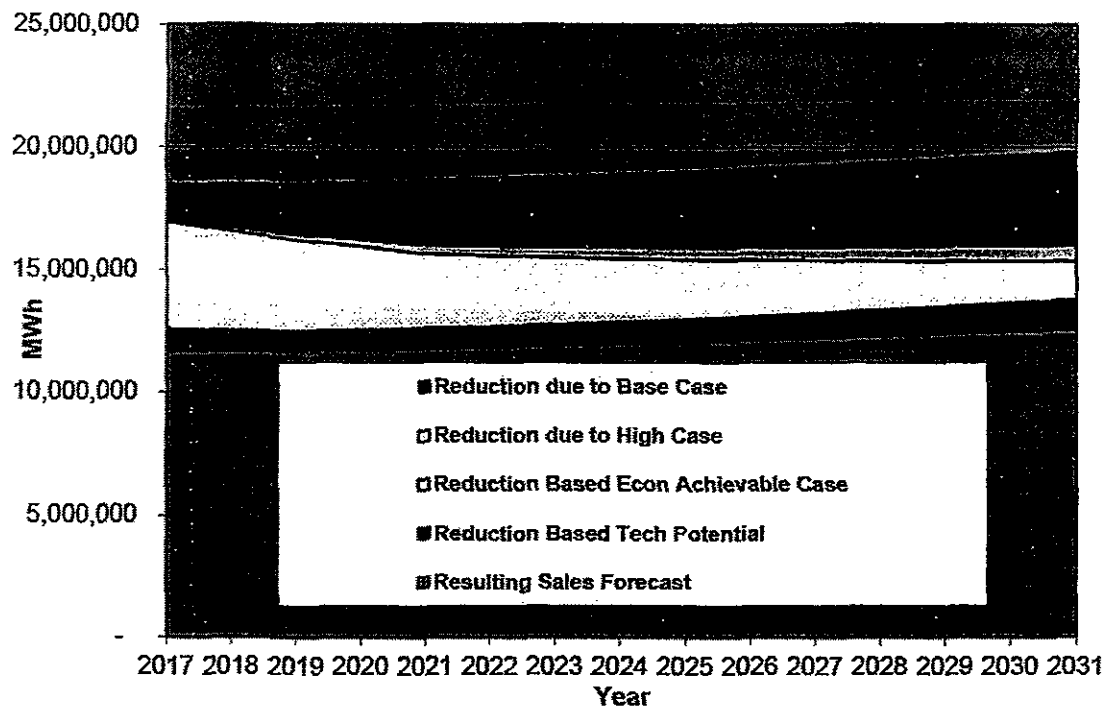
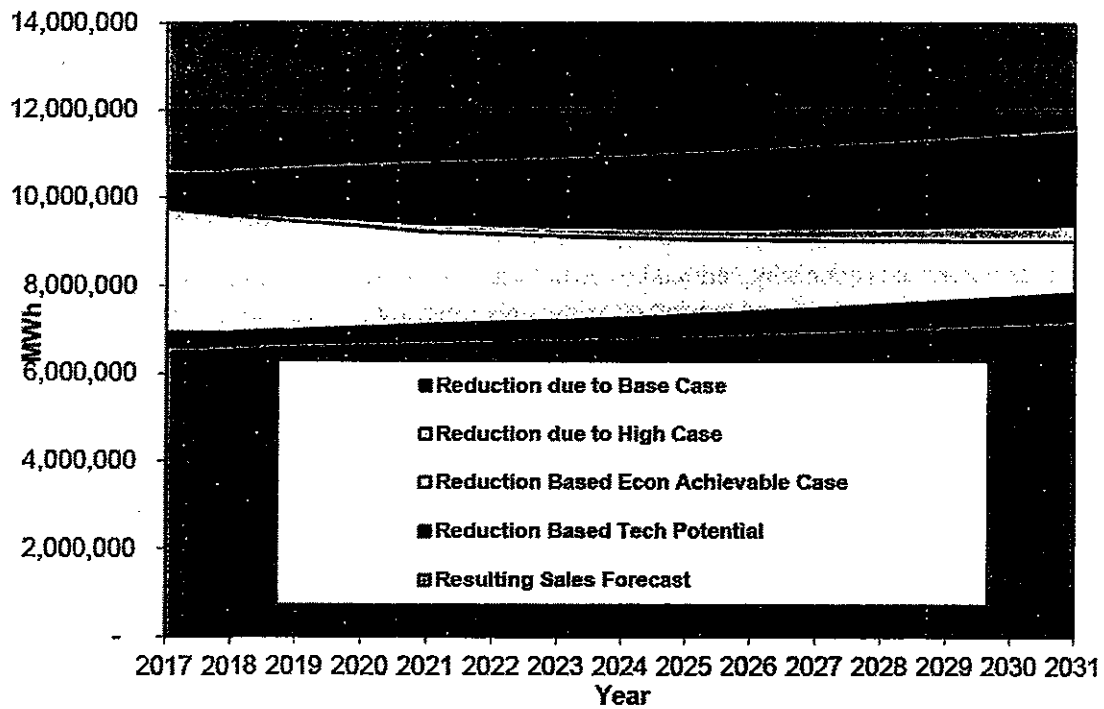


Figure 1-6 EEPDR Affected Sales Forecast with Technical Economic and Achievable Energy Savings Decrements – TE



## 2.0 INTRODUCTION

### 2.1 PURPOSE OF THE STUDY

This Market Study presents an analysis of energy efficiency and peak demand reduction potential in the Companies' respective service territories as of March 31, 2016.

Reliably estimating the economic potential for energy efficiency sets the upper success limit of the programs designed and implemented to achieve that potential given the set of most current available information. New, as well as existing, programs have been modified and informed through a continuous stream of communication between Company and Harbourfront personnel.

Energy savings potential is generally defined by the nationwide energy efficiency community as consisting of technical, economic, and market or achievable potential. As required by the Ohio Administrative Code, this assessment includes the following:

1. Analysis of *technical* potential<sup>2</sup> – Each electric utility shall survey and characterize the energy-using capital stock located within its certified territory and quantify its actual and projected energy use and peak demand. Based upon the survey and characterization, the utility shall conduct an analysis of the technical potential for energy efficiency and peak-demand reduction obtainable from applying alternate measures.
2. Analysis of *economic* potential<sup>3</sup> – For each alternate measure identified in its assessment of technical potential, the electric utility shall conduct an assessment of cost-effectiveness using the total resource cost test.
3. Analysis of *achievable* potential<sup>4</sup> – For each cost-effective alternate measure identified in its analysis of economic potential, the utility shall conduct an analysis of achievable potential. This analysis shall consider the ability of the program design to overcome barriers to customer adoption, including, but not limited to, appropriate bundling of measures.
4. For each measure considered, the utility shall describe all attributes relevant to assessing its value, including, but not limited to potential energy savings or peak-demand reduction, cost, and non-energy benefits.<sup>5</sup>

### 2.2 APPROACH

The design of EEPDR reduction programs involves a parallel methodology that considers customer

<sup>2</sup> Ohio Administrative Code Section 4901:1-39-01(X) defines "Technical Potential" as "the reduction in energy usage or peak demand that would result if all homes and businesses adopted the most efficient measures, regardless of cost."

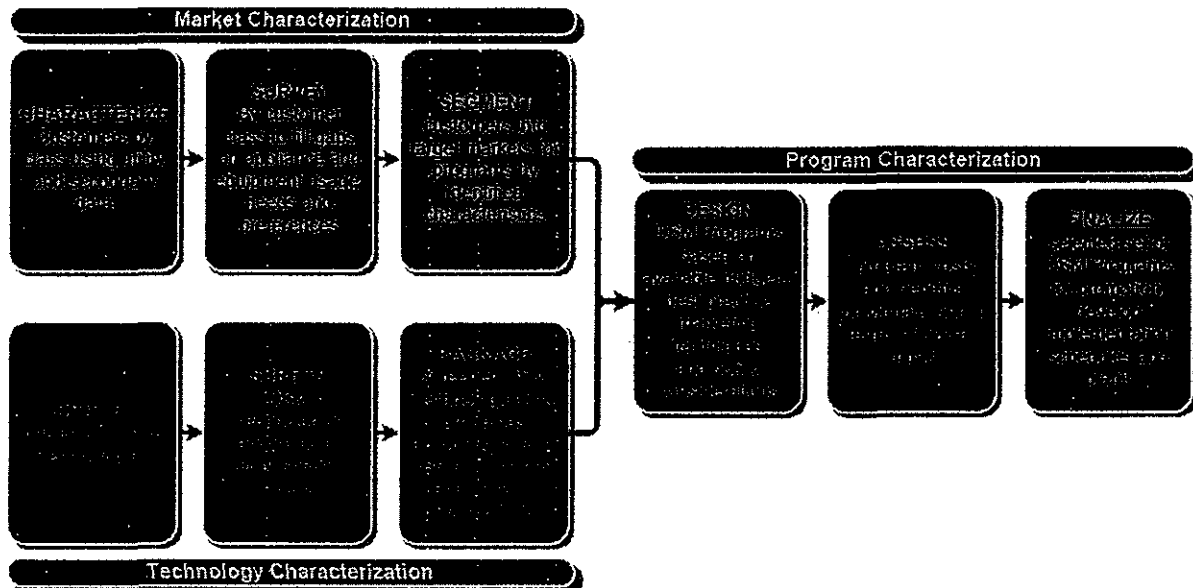
<sup>3</sup> Ohio Administrative Code Section 4901:1-39-01(H) defines "Economic Potential" as "the reduction in energy usage or peak demand that would result if all homes and businesses adopted the most efficient and cost-effective measures. Economic potential is a subset of the 'technical potential'."

<sup>4</sup> Ohio Administrative Code Section 4901:1-39-01(A) defines "Achievable Potential" as "the reduction in energy usage or peak demand that would likely result from the expected adoption by homes and businesses of the most efficient, cost-effective measures, given effective program design, taking into account remaining barriers to customer adoption of those measures. Barriers may include market, financial, political, regulatory, or attitudinal barriers, or the lack of commercially available product. "Achievable potential" is a subset of 'economic potential'."

<sup>5</sup> Ohio Administrative Code Section 4901:1-03(A)(1)-(4).

segments and preferences, appliance/end-use ownership and energy efficiency technologies and techniques that can be offered to customers to achieve energy savings. The left side of Figure 2-1 presents a generic schematic diagram of the analysis process that leads from this Market Study to actual program designs.

Figure 2-1 Methodology Describing Progression from Market Study to Program Design



The right side of the diagram summarizes the second phase of work that culminates in the Companies' Proposed Plans that are to be filed with the Public Utilities Commission of Ohio ("PUCO") on April 15, 2016.

Harbourfront employed a top-down approach for determining the technical potential and a bottom-up approach, on a measure-by-measure basis, for assessing the economic and market potential for energy efficiency and peak demand reduction.

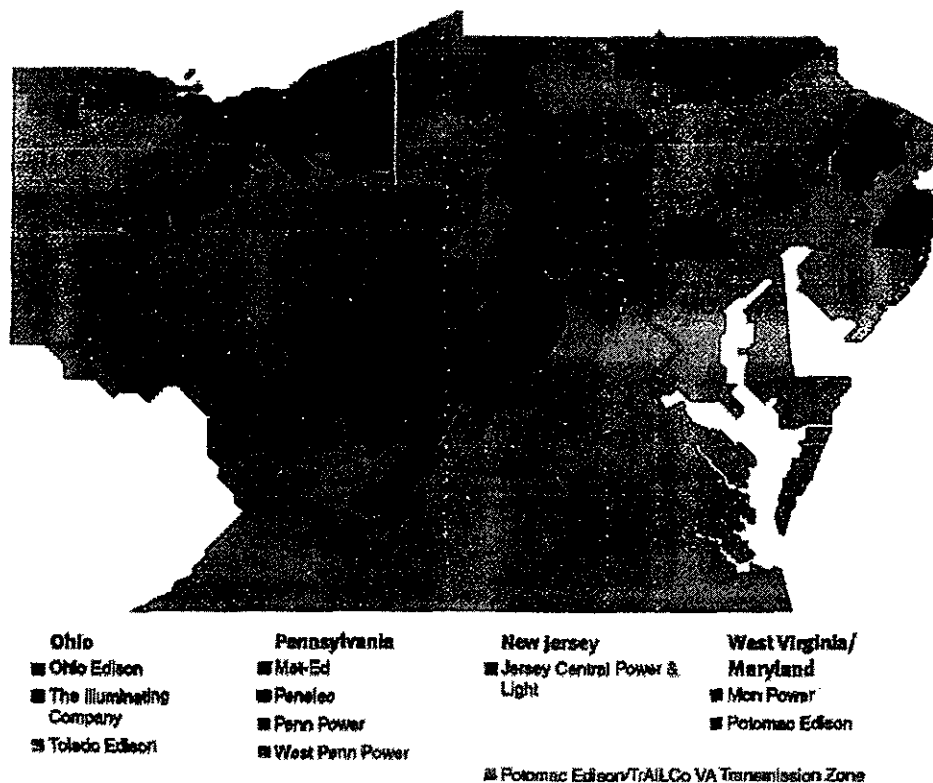
## 2.3 OVERVIEW OF FIRSTENERGY CORP

FirstEnergy Corp. ("FirstEnergy") is a diversified energy company headquartered in Akron, Ohio. FirstEnergy's 10 regulated distribution companies form one of the nation's largest investor-owned electric systems, based on serving 6 million customers within a nearly 65,000 square mile area of Ohio, Pennsylvania, West Virginia, New Jersey and Maryland. Stretching from the Ohio-Indiana border to the New Jersey shore, the companies operate a vast infrastructure of more than 194,000 miles of distribution lines and are dedicated to providing customers with safe, reliable and responsive service.

FirstEnergy's transmission operations include approximately 24,000 miles of lines and three regional transmission operation centers. All of FirstEnergy's transmission facilities operate as part of PJM Interconnection, LLC.

FirstEnergy's diverse generating fleet produces approximately 85 million megawatt-hours of electricity annually from a fleet of non-emitting nuclear, scrubbed coal, natural gas, and hydro plants. With nearly 500 megawatts of wind power under long-term contracts, FirstEnergy is one of the largest providers of renewable energy in the region.

Figure 2-2 FirstEnergy Service Territory Overview



In Ohio, FirstEnergy provides electric distribution service to over 2.1 million customers through OE, CEI and TE. OE serves approximately 1,039,100 electric utility customers over more than 6,000 square miles in northeast and central Ohio. CEI serves approximately 746,100 electric utility customers over more than 1,600 square miles in and around Cleveland, Ohio. TE serves approximately 308,200 electric utility customers over more than 2,300 square miles in northwest Ohio.

## 2.4 MARKET STUDY FEATURES UNIQUE TO OHIO OR THE COMPANIES

When developing this Market Study, the following factors, somewhat unique to Ohio and/or the Companies, were considered:

1. **Customer Action Program and Mercantile Customer Sited Projects** – R.C. 4928.66 allows for documented energy savings generated by customers from customer self-directed projects to be counted toward the statutory benchmark mandates. This Market Study therefore includes estimated potential savings from the Customer Action Program and the Mercantile Projects identified and projected by the Companies based on historic results.

2. **The Community Connections Program** – will continue at a higher funding level during the term of the Companies' Stipulated Fourth Electric Security Plan ("Stipulated ESP IV").<sup>6</sup> The Community Connections Program is a program that delivers comprehensive weatherization services to customers who qualify within 200% of the Federal Poverty Income Guidelines along with educational materials for maximum energy savings.<sup>7</sup>
3. **Effects of 2019-2021 transition of Residential Customers to Straight Fixed Variable Distribution Rates.** As part of the Stipulated ESP IV, the Companies have agreed to file a case before the Commission by April 3, 2017 that will propose a plan "...to transition to straight fixed variable (SVF) cost recovery for residential customers' base distribution rates, with a three-year phase-in, and cost recovery based on an allocation of 75 percent fixed costs and 25% variable costs." After evaluation of this potential rate structure change, Harbourfront has concluded that the short-term impact during the 2017-2019 period in which the Proposed Plans would be in effect would be negligible. And, in the longer term, price elasticity-related effects may have a small impact on residential energy efficiency measure adoption, however, in Harbourfront's opinion, such impact would be well within the estimation variances of any 15-year Achievable Potential forecast of EEDPR in the Companies' service territories<sup>8</sup>. Additional considerations are as follows:
  - a. In the short term, the decoupling mechanism shall be phased in beginning January 1, 2019 and reach the final 75% fixed cost-25% variable cost base distribution rate formula by the beginning of 2021. The decoupling mechanism may only impact the last year of the Proposed Plans.
  - b. This transition to straight- fixed variable rates may only affect the base distribution and lost distribution revenue components of the residential distribution rate. Commercial and industrial customers would be unaffected.
  - c. Even under Commission-envisioned straight fixed-variable rate on components of the residential distribution rate, residential customers participating in EEPDR programs would still enjoy the full EEPDR benefits of a lower generation and transmission rate component and a portion of the lower distribution rate component.

## 2.5 ORGANIZATION OF THE REPORT

Section 3.0 describes the methodology used to conduct the Market Study. Section 4.0 summarizes the characteristics of the Companies' customers as derived from publicly available Company data and surveys conducted by the Harbourfront study team. Section 5.0 presents information regarding a characterization of the market for energy efficiency services in the region based on

<sup>6</sup> The Companies' Stipulated ESP IV had several provisions related to EEPDR, all of which have been considered by Harbourfront when developing this Market Study. For a discussion of the Companies' most recent ESP, see, *In re the Application of [the Companies] for Authority to Provide for a Standard Service Offer Pursuant to R.C. 4928.143 in the Form of an Electric Security Plan*, Case No. 14-1297-EL-SSO, Opinion and Order (March 31, 2016).

<sup>7</sup> Pursuant to Ohio Administrative Code Section 4901:1-39-04 (B) the Proposed Plans must be cost effective on a portfolio basis.

<sup>8</sup> Additionally, other elasticities (cross price and income elasticities) could work to negate any potential "own price" elasticity effect.

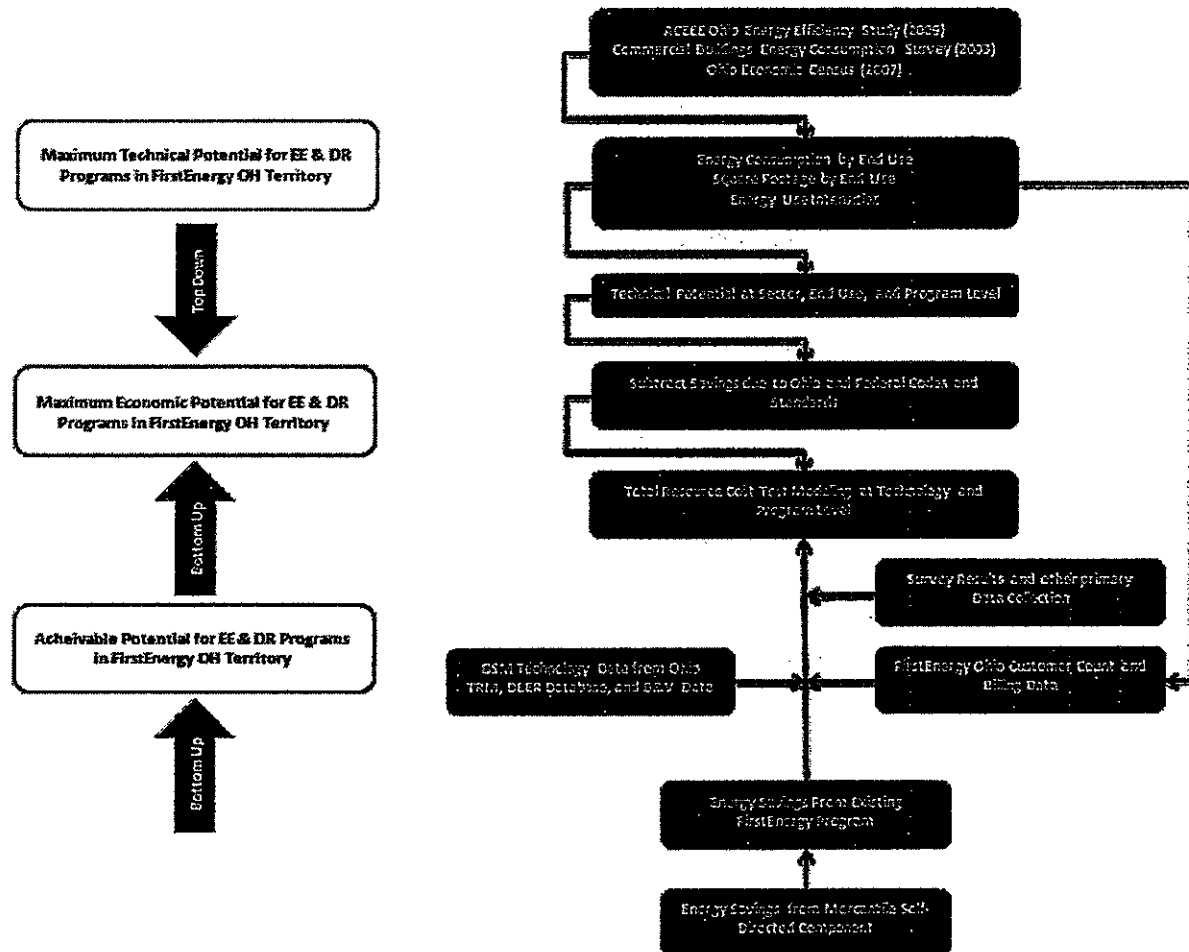
research conducted in Ohio during January-March 2016. Section 6.0 presents detailed results of two surveys – residential telephone and email surveys and a small and medium commercial business telephone survey. Section 7.0 presents the lists of energy efficiency technologies considered in this MPS. Section 8.0 presents the detailed results of the market potential for energy savings analyses resulting from the modeling of all data collected.



### 3.0 METHODOLOGY

The Market Study consists of a top-down review of Technical Potential and a bottom-up analysis of Economic and Market Potential. Figure 3-1 summarizes the elements of the Market Study components.

Figure 3-1 Market Potential Study Diagram



#### 3.1 HOW THE THREE LEVELS OF POTENTIAL ARE DETERMINED

The left side of the diagram in Figure 3-1 shows the three levels of energy efficiency potential, moving from largest to smallest, top to bottom. The right side of the diagram shows how the estimates of each of the three potential levels are estimated in this study.

Technical, economic and achievable potentials had been estimated for the State of Ohio by the American Council for an Energy Efficient Economy ("ACEEE") in a 2009 report entitled "Shaping Ohio's Energy Future: Energy Efficiency Works. In September 2015, ACEEE published another report entitled "New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030". These two studies served as references for Harbourfront's study team in the preparation of its analyses and findings.

Economic and achievable market potentials are determined from a bottom-up analysis that considers appropriate cost-effective technologies, customer counts by sector, consumption levels by sector, measure lives, incremental costs of energy efficient options over standard equipment, and a range of other detailed assumptions and data. Critical to both of these estimates are the assumed participation rates. More specifically, how many technologies can be predicted to be adopted each year by customer sector and end use? These figures were developed by Harbourfront by surveying customers in each of the Companies' respective service territories in order to assess the following:

- Current levels of measure adoption.
- Likelihood of adoption of measures in the near term.
- Interest levels and intentions regarding future program participation.

Data from residential telephone and email surveys, commercial telephone surveys and large customer account interviews were used to assess likely participation levels for each sector by Company to inform both the Base Case and High Case estimates. This method takes into account current economic conditions, customer self-reported actions already taken, and expressions of interest and intent.

All data on characteristics, technologies and likely participation or adoption behaviors were combined with the Companies' actual energy usage data for samples of customers by sector – Residential, Commercial, Industrial and Street Lighting. Actual historic program participation, as well as the Companies' cost and savings data, was also incorporated into the study.

### 3.2 EEPDR TECHNOLOGY DATA SOURCES

The following data sources were considered in the development of the key inputs used in this Market Study:

- California Deemed Energy Database ("DEER");
- ACEEE Market Potential Study for Ohio-(2009);
- ACEEE New Horizons for Energy Efficiency...Report No. U1507 (2015);
- Association of Energy Service Professionals publications and resources;
- Department of Energy QUick Energy Simulation Tool (eQUEST);
- Harbourfront Energy Efficiency Technologies Database;
- Ohio Technical Reference Manual ("TRM");
- Pennsylvania TRM;
- Evaluation, Measurement and Verification ("EM&V") work performed by ADM Associates Inc. ("ADM");
- ENERGY STAR Unit Shipment and Market Penetration Report-Calendar Year 2104 Summary;
- Presentation entitled "Energy Efficiency Program Ideas for Ohio" January 27, 2016, Environmental Law and Policy Center; and
- Ohio Stakeholder Collaborative Group.

Cost and savings data were considered from these sources for non-weather sensitive measures; data for weather-sensitive measures were simulated through eQUEST using building parameters outlined in TRM Appendix A, "Prototypical Building Energy Simulation Model Development".

**Customer Usage Data** – The Companies provided energy consumption data by customer sector for survey and analysis purposes to assess baseline usage levels from which energy savings could take place. Forecasts of usage were also provided and used as consistent with the baseline forecast. Harbourfront also performed a detailed analysis of energy consumption, square footage and energy use intensity by end use. The primary data sources for this analysis were U.S. Energy Information Administration's Commercial Building Energy Database ("CBECS"), State of Ohio Economic Census Data (2007) and Company customer data.

**Customer Characteristics, Behavior and Intentions** – Surveys were conducted of random statistical samples of residential and business customers. Completed residential Internet and telephone surveys totaled 1172 for OE, 1297 for CEI and 1311 for TE, and another 100 commercial telephone surveys per Company were completed (300 total). Fifty large, managed account, commercial-industrial customers were represented in the large C&I sector analysis and a census of street lights and estimates of traffic and pedestrian signals were combined to characterize the municipal lighting sector.

### 3.3 CUSTOMER ACTION AND MERCANTILE SAVINGS

The energy savings identified and validated from these customers will be applied to meet benchmark mandates. An estimated forecasting of EEPDR savings from these customers is included in the Market Study as part of the first three years of savings.

### 3.4 SAVINGS FROM PROGRAMS PREVIOUSLY FILED BY THE COMPANIES

Consistent with Ohio law, the Companies have submitted several EEPDR plans for prior plan periods that have been approved by the PUCO and implemented by the Companies. Results from the implementation of these approved programs were factored into this Market Study by taking the Companies' estimates of existing kWh and kW savings for the 2009-2015 timeframe and including those savings in the cumulative savings estimates, thus reducing the base case of the annual energy forecast through 2031.

Harbourfront conducted surveys in the beginning of 2016 that address the issue of current and past customer EEPDR activities. Based on these results, Harbourfront estimated the amount of EEPDR savings prior to 2016 and reduced future potential accordingly.

### 3.5 OTHER KEY REFERENCES USED IN THIS STUDY

The Harbourfront study team examined the following regarding the Market Study and lists below the assumptions used for the key study parameters referenced.

1. **Template for the Filing.** The filing document for the Market Study contains sections consistent with the required elements as shown in Section 4901:1-39-03 Ohio Administrative Code.
2. **Study Time Period.** The Market Study analyzes market potential through 2031, or for fifteen years from the beginning of 2017, although Ohio law only establishes energy

efficiency benchmarks through 2027. The scope of the Companies' Proposed Plans are for the period January 1, 2017 through December 31, 2019.

3. **Budget Cap.** There is no budget cap or constraint for the EEPDR budgets either annually or in total over the period.
4. **Renewables and Customer Renewable Energy Measures.** These are not part of the Market Study as they are addressed in other proceedings.
5. **List of Measures.** The analysis covers a comprehensive list of practically implementable measures included in the Ohio Technical Reference Manual. In addition to this, Harbourfront also examined a number of emerging technologies not included in the Technical Reference Manual. For this purpose, Harbourfront used its own list of EEPDR measures as well as DEER Database in the analysis. This list builds upon the list previously used by Black & Veatch in its 2012 Market Potential Study prepared for the Companies in Case Nos. 12-2190-EL-POR *et seq.*
6. **Economic Tests.** The TRC test was applied to the measures, programs and portfolio of programs in the Market Study as part of the Economic Potential. The Utility Cost Test and the Participant Tests are also included to provide reference.
7. **Avoided Costs.** The avoided generation capacity and energy supply costs are based on the Companies' forecast of energy and capacity utilized in Stipulated ESP IV. The avoided transmission and distribution capacity costs are based on the Avoided T & D Study performed by Harbourfront for the Companies.<sup>9</sup>
8. **Best Practices.** Prior to, and during the course of, the development of the Market Study, Harbourfront personnel conducted a comprehensive analysis of the resources listed in Section 3.2 to insure that the Proposed Plans have addressed a comprehensive set of end use technologies and programs that are currently being implemented by utilities in Ohio and nationally. In addition to reviewing information previously mentioned, Harbourfront reviewed best practice utility programs from states such as California, Pennsylvania, New York, and Vermont and paid special attention to information provided by Ohio Collaborative members. During this activity, Harbourfront took special note of increased focus on LEDs in residential and commercial applications, occupancy sensors and controls, higher efficiency heat pumps for space heat, water heat and clothes drying, smart strips and smart thermostats for both residential and commercial applications, and energy efficiency measures for manufactured homes.

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<sup>9</sup> April 2016 Avoided T & D Study performed by Harbourfront Group, Inc.

## 4.0 CUSTOMER CHARACTERIZATION

This section describes characteristics of the Companies' customers based upon publicly available data and from surveys conducted by the Harbourfront study team. The analysis determined the numbers and types of customers by Company that are available to participate in energy efficiency programs.

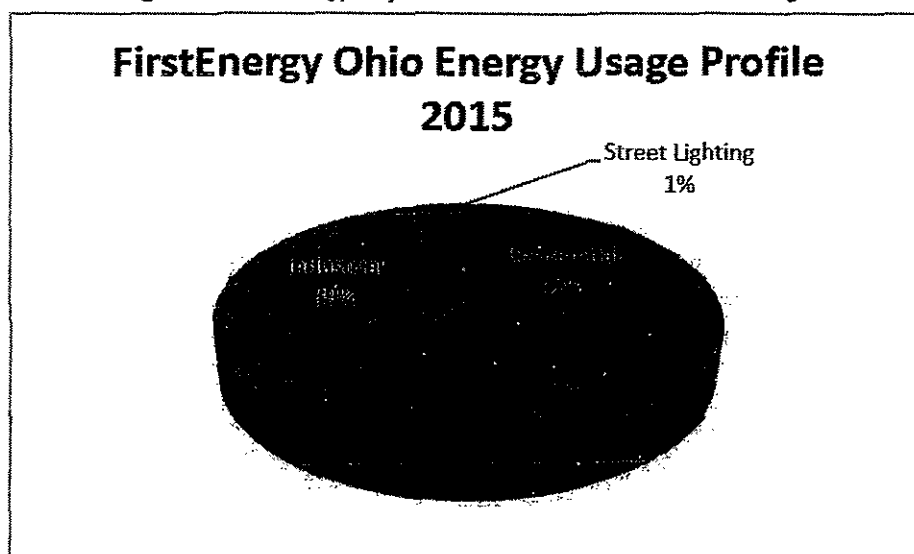
### 4.1 DATA SOURCES

Harbourfront utilized the Companies' 2015 FERC Form No. 1 information and primary data collected from customer surveys and interviews as the basis for the information in this chapter. Table 4-1 provides FERC Form No. 1 combined customer and sales information.

Table 4-1 FirstEnergy 2015 Ohio Customer & Sales Information

FirstEnergy Ohio Operating Information	Values
<b>Residential Customers</b>	1,853,377
Residential % of Total Customers	88.64%
Residential MWh per Customer	9.3
<b>Commercial Customers</b>	231,483
Commercial % of Total Customers	11.07%
Commercial MWh per Customer	65.6
<b>Industrial Customers</b>	2,498
Industrial % of Total Customers	0.12%
Industrial MWh per Customer	8,226
<b>Street Lighting Customers</b>	3,650
Street Lighting % of Total	0.17%
Street Lighting MWh per Customer	91.7
<b>2015 Electric Sales (MWh)</b>	53,248,148
<b>Total Customers</b>	2,091,008
<i>Source: 2015 FERC Form No. 1</i>	

Figure 4-1 FirstEnergy Projected Ohio Combined 2015 MWh Usage



The Harbourfront team also interviewed the account representatives who manage large commercial and industrial customer accounts with demands of more than 700kW. The account representatives generally have a very good understanding of their customers' energy consumption and usage patterns. The account managers provided valuable on-point information that has been incorporated into the analyses.

Harbourfront implemented a two-pronged approach for the Companies' National Account customers, using both surveys and interviews. National Account customers are typically commercial customers in terms of demand and energy consumption, and were included in Harbourfront's telephone surveys. Since the Companies have National Account representatives who provide a single point of contact for the customer and are knowledgeable of the customer's energy-related information, Harbourfront also interviewed these account representatives in order to gain further insight into these customers' usage characteristics.

## 4.2 CUSTOMERS AND MWH SALES BY COMPANY

The following tables and charts identify the number of customers, and sales by Company.

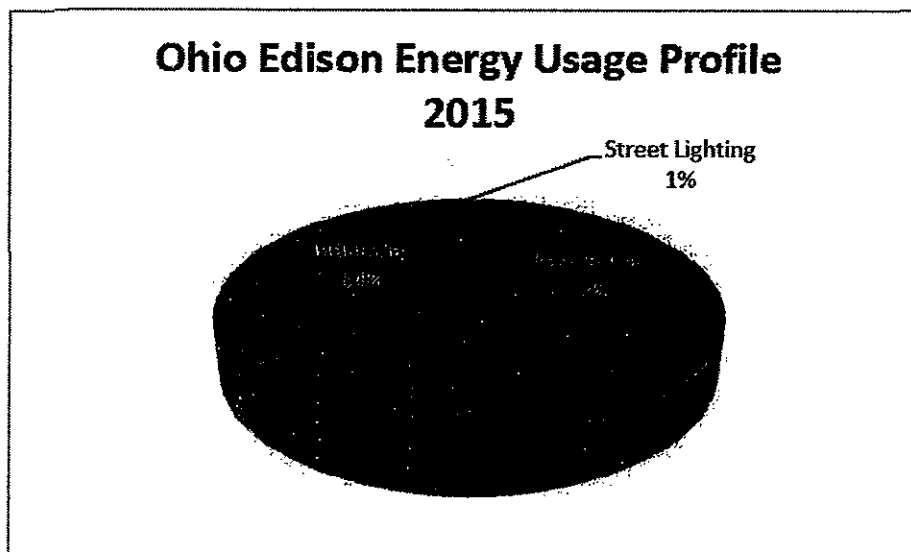
### Ohio Edison:

Table 4-2 Ohio Edison Operating Information

Ohio Edison Operating Information	
<b>Total Customers (2015)</b>	<b>1,037,216</b>
Residential Customers	921,461
Residential % of Total Customers	88.84%
Residential MWh per Customer	10.0
Commercial Customers	112,293
Commercial % of Total Customers	10.83%
Commercial MWh per Customer	59.3
Industrial Customers	1,341
Industrial % of Total Customers	0.13%
Industrial MWh per Customer	6,164
Street Lighting Customers	2,121
Street Lighting % of Total	0.20%
Street Lighting MWh per Customer	66.9
<b>2015 Electric Sales (MWh)</b>	<b>24,291,651</b>

Source: 2015 FERC Form No. 1

Figure 4-2 Ohio Edison Electricity Use (MWh)

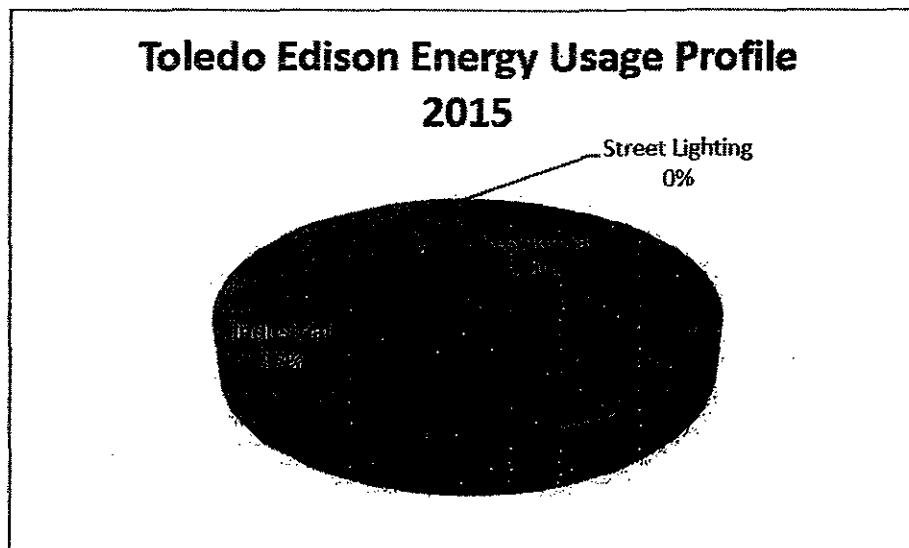


**Toledo Edison:**

Table 4-3 Toledo Edison Operating Information

Toledo Edison Operating Information	
<b>Total Customers (2015)</b>	<b>308,151</b>
Residential Customers	270,773
Residential % of Total Customers	87.87%
Residential MWh per Customer	9.1
Commercial Customers	35,827
Commercial % of Total Customers	11.63%
Commercial MWh per Customer	55.1
Industrial Customers	507
Industrial % of Total Customers	0.16%
Industrial MWh per Customer	11,753
Street Lighting Customers	1,044
Street Lighting % of Total	0.34%
Street Lighting MWh per Customer	49.3
<b>2015 Electric Sales (MWh)</b>	<b>10,454,511</b>
Source: 2015 FERC Form No. 1	

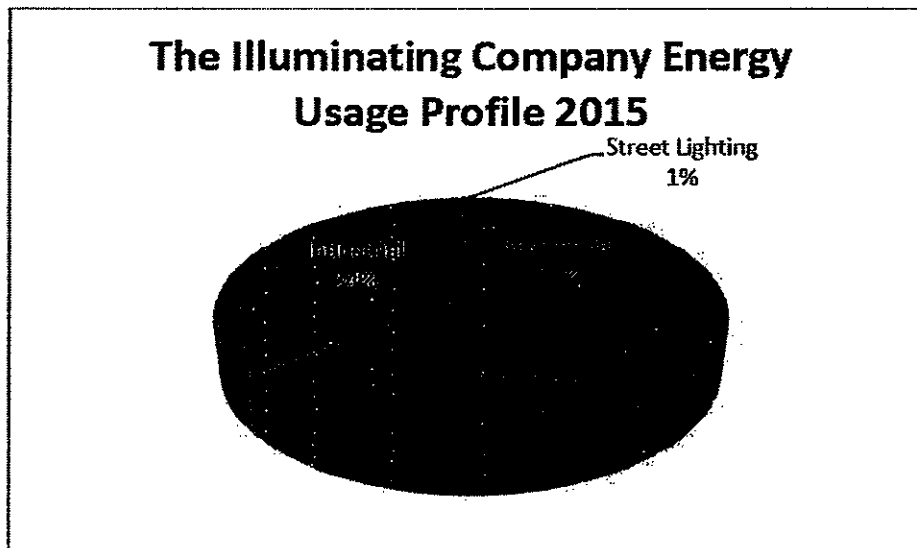
Figure 4-3 Toledo Edison Electricity Use (MWh)





**The Illuminating Company:****Table 4-4 The Illuminating Company Operating Information**

<b>The Illuminating Company Operating Information</b>	
<b>Total Customers (2015)</b>	<b>745,641</b>
Residential Customers	661,143
Residential % of Total Customers	88.67%
Residential MWh per Customer	8.3
Commercial Customers	83,363
Commercial % of Total Customers	11.18%
Commercial MWh per Customer	78.5
Industrial Customers	650
Industrial % of Total Customers	0.09%
Industrial MWh per Customer	9,727
Street Lighting Customers	485
Street Lighting % of Total	0.07%
Street Lighting MWh per Customer	291.3
<b>2015 Electric Sales (MWh)</b>	<b>18,501,986</b>
<i>Source: 2015 FERC Form No. 1</i>	

**Figure 4-4 The Illuminating Company Electricity Use (MWh)**

### 4.3 RESIDENTIAL SECTOR DESCRIPTION

This section of the Market Study presents a high-level overview of the Residential Sector in the Companies' service territories informed by three studies: (1) the 2016 survey conducted by Harbourfront in February 2016, which included 3,780 total Internet and email responses from customers of the three Companies' combined (2) the 2012 Residential Survey done by Black & Veatch, which included more than 500 responses from customers of each of the Companies; and (3) the 2010 Residential Survey conducted by Black & Veatch. The survey results underline a number of trends regarding energy efficiency. In general, the trends show an increasing number of customers who have already adopted particular energy efficiency measures and show continuing interest in expanding their use of these measures.

In a significant change to the methodology, responders in 2016 had an option of responding via the Internet. This led to a sample set that better represents the Companies' customers.<sup>10</sup>

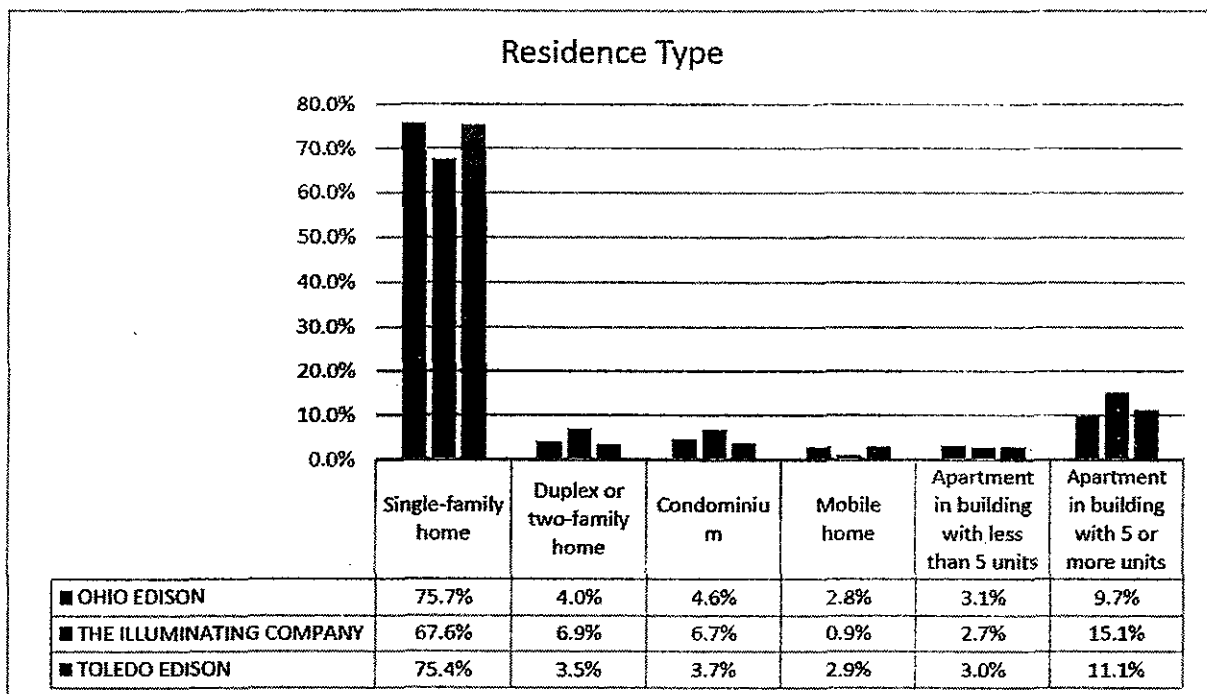
Table 4-5 Survey Household Age Comparison

Head of Household Age	US Census 2010-2014 American Community Survey	2016 Survey (combined online/phone)
<b>Under 25</b>	4.2%	3.9%
<b>25-44</b>	31.6%	32.3%
<b>45-64</b>	40.3%	38.3%
<b>65 +</b>	23.9%	17.3%
<b>(Don't know)</b>	-	8.3%

The results from the 2016 survey showed that 72.8% of the homes in the Companies' service territories are single-family homes, with the remaining distributed among duplexes, condominiums, mobile homes and apartment buildings:

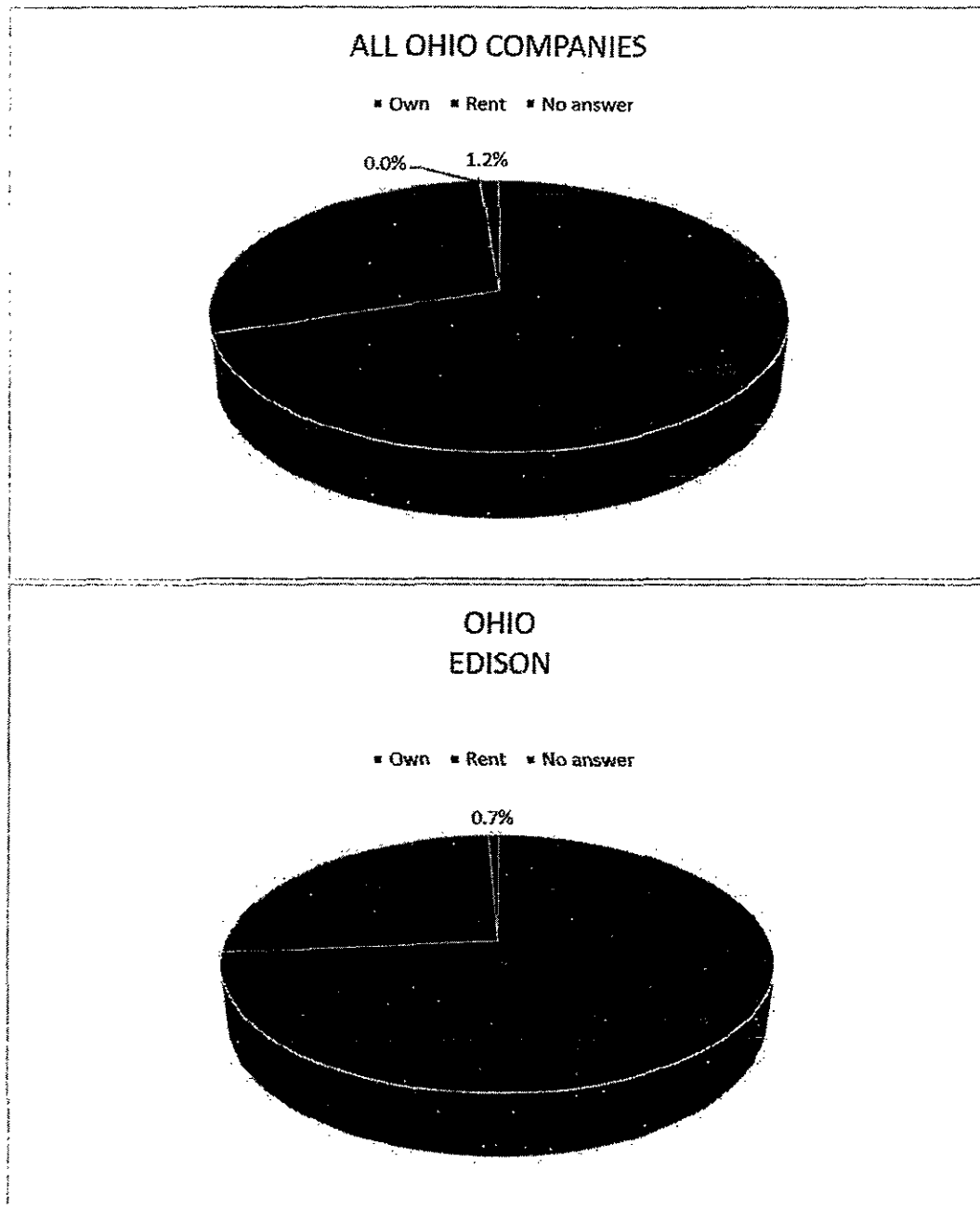
<sup>10</sup> In prior surveys where respondents could not respond via the computer, respondents tended to be older, providing a bias towards senior citizens.

Figure 4-5 Type of Housing: 2016 Harbourfront Survey



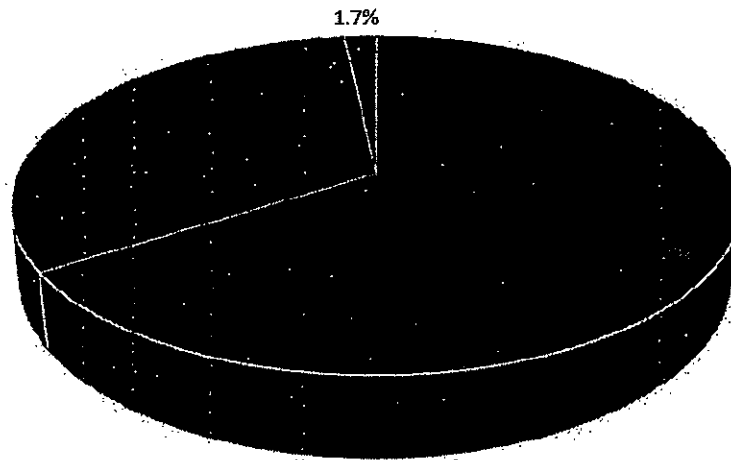
On average, 69.9% of respondents own their residence. Of the remainder, 28.9% rent a home and 1.2% did not provide an answer. Below is a summary of responses both on a total Company basis, as well as on an individual Company basis:

Figure 4-6 Home Ownership 2016 Harbourfront Survey



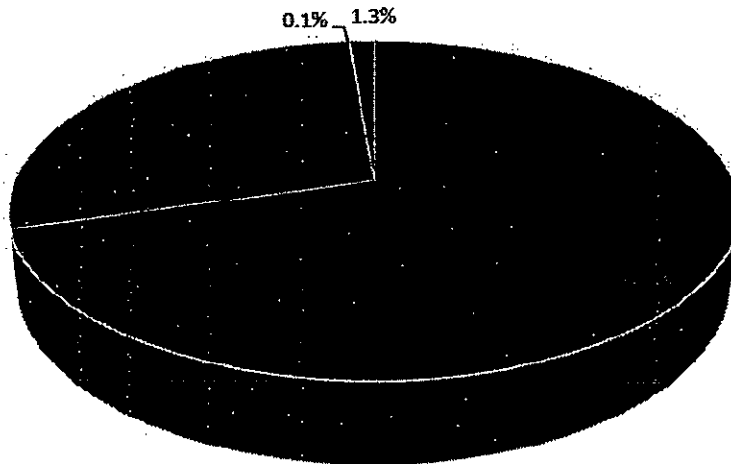
### THE ILLUMINATING COMPANY

■ Own ■ Rent ■ No answer



### TOLEDO EDISON

■ Own ■ Rent ■ No answer



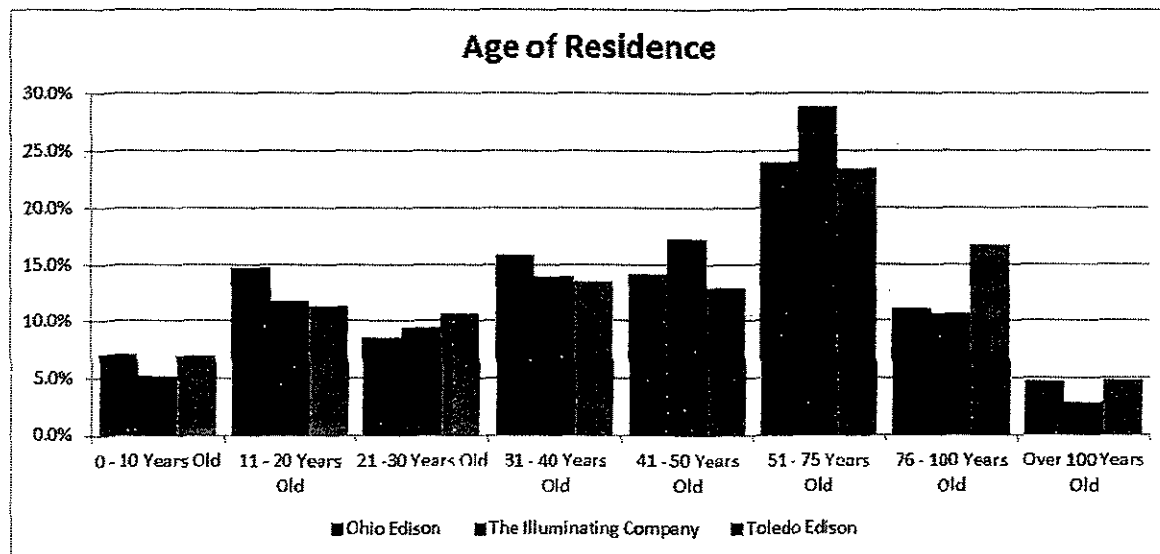
The primary space heating fuel/energy for homes in the Companies' service territories is natural gas (68.7%), followed by electricity (18.2%). Electric heaters take the lead in secondary space heating, constituting more than half (60%) of the secondary heaters used by respondents who had a second heater.

Natural gas is also the dominant fuel (61.7%) for residential water heating, followed by just over a quarter of respondents who have electric water heaters (25.7%):

Table 4-6 Primary Heating Fuel Usage 2016 Harbourfront Survey

	Total Ohio	OE	TE	CEI
<b>Space Heating Fuel/Energy</b>				
Electricity	18.2%	18.9%	18.8%	16.9%
Natural gas	68.7%	68.2%	67.6%	70.2%
Oil	1.3%	2.2%	0.5%	1.2%
Other	6.5%	6.9%	9.2%	3.5%
NA/None	0.3%	0.1%	0.7%	0.2%
Don't know	0.1%	0.2%	0.1%	0.2%
No answer	4.9%	3.5%	3.2%	7.9%
<b>Water Heating Fuel/Energy</b>				
Electricity	25.7%	30.6%	26.0%	20.8%
Natural gas	61.7%	60.4%	61.3%	63.4%
Other	2.6%	2.0%	4.8%	0.9%
NA/None	0.4%	0.2%	0.2%	0.9%
Don't know	0.7%	0.4%	0.5%	1.0%
No answer	8.9%	6.3%	7.2%	13.0%

Figure 4-7 Age of Residence 2016 Harbourfront Survey



Below is a summary of the 2016 residential appliance saturation results for several common household appliance or end-uses. Note that percentages are calculated using the total number of appliances in households, rather than the number of households with these appliances.

Table 4-7 Appliance and End Use Saturation Rates 2016 Residential Survey

Appliance Type	CEI		OE		TE	
	2016	2030	2016	2030	2016	2030
Electric Furnace	10%	11%	11%	11%	12%	13%
Heat Pump	2%	2%	3%	4%	1%	1%
Geothermal Heat	0%	0%	1%	2%	2%	3%
Total Electric Heat	12%	13%	15%	16%	14%	16%
Secondary Electric Heater	15%	14%	13%	13%	16%	16%
CAC	72%	77%	67%	72%	69%	78%
Heat Pump Cooling	2%	2%	2%	3%	1%	1%
Geothermal Cooling	0%	0%	1%	2%	2%	3%
Total CAC	74%	80%	70%	76%	72%	81%
Room Air Conditioner	46%	46%	44%	44%	51%	51%
Electric Water Heater	19%	20%	26%	28%	24%	26%
Electric Cooking	99%	102%	118%	121%	113%	116%
Second Refrigerator	21%	22%	13%	14%	15%	15%
Freezer	41%	41%	45%	44%	47%	46%
Dish Washer	61%	69%	56%	63%	56%	63%
Clothes washer	85%	85%	86%	86%	86%	86%
Electric Dryer	67%	67%	63%	63%	64%	65%
TV	100%	100%	100%	100%	100%	100%
Furnace Fans	78%	78%	76%	76%	77%	77%
Light	100%	100%	100%	100%	100%	100%
Misc	100%	100%	100%	100%	100%	100%

#### 4.4 COMMERCIAL CUSTOMERS

##### 4.4.1 Commercial and Small Manufacturing Class (<700 kW)

Table 4-8 shows the types of small businesses that responded to the 2016 Harbourfront survey by Company, in terms of percentages of respondents.

Table 4-8 Industry of Survey Respondents 2016 Harbourfront Survey

Industry Type	Total Ohio	OE	TE	CEI
Agriculture	3.3%	2.5%	6.0%	1.5%
Oil and Gas Production	0.7%	0.5%	0.5%	1.0%
Construction	5.5%	5.0%	6.5%	5.0%
Manufacturing	10.8%	11.5%	9.0%	12.0%
Wholesale Trade	1.2%	1.5%	2.0%	
Retail Trade	10.8%	7.5%	11.5%	13.5%
Transportation and Warehousing	4.3%	5.0%	4.5%	3.5%
Finance and Insurance	2.2%	3.0%	0.5%	3.0%
Real Estate	4.0%	2.5%	3.0%	6.5%
Professional Services	9.7%	8.0%	10.5%	10.5%
Waste Management and Remediation Services	1.5%	2.0%	1.0%	1.5%
Educational Services	3.7%	4.0%	5.0%	2.0%
Health Care and Social Assistance	8.2%	7.5%	7.0%	10.0%
Entertainment, Arts and Recreation	3.8%	4.5%	4.0%	3.0%
Hotel	0.7%	0.5%	1.0%	0.5%
Food Services or Grocery Store	7.2%	4.5%	9.0%	8.0%
Other	20.8%	28.5%	17.5%	16.5%
Don't know/Refused	1.7%	1.5%	1.5%	2.0%

Table 4-9 shows that the majority of businesses represented in the surveys have fewer than 100 employees, with the overall median number of employees in Ohio locations between five and nine.

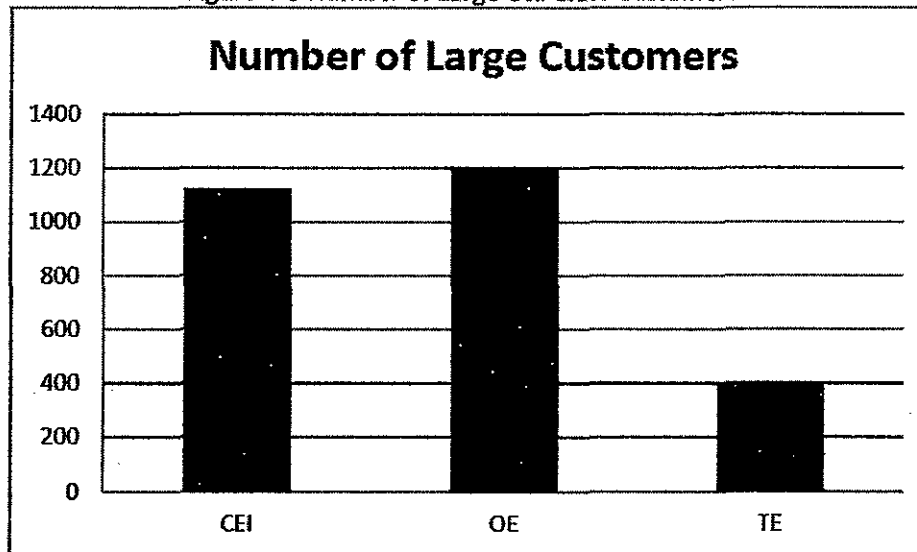
Table 4-9 Number of Ohio Employees 2016 Harbourfront Survey

Number of Employees	Total Ohio	OE	TE	CEI
One	12.5%	14.5%	11.0%	12.0%
2-4	31.2%	31.5%	29.5%	32.5%
5-9	23.5%	29.0%	23.5%	18.0%
10-19	12.7%	9.0%	13.5%	15.5%
20-99	12.3%	11.0%	16.0%	10.0%
100-499	5.0%	3.5%	4.0%	7.5%
Don't know/refused	1.2%	0.5%	1.5%	1.5%

##### 4.4.2 Large Commercial and Industrial Class (>700 kW)

The large commercial and industrial class of customers is characterized by having a billed demand of greater than 700kW. Figure 4-8 below shows the number of Large C&I Class customers by Company, based on Company data.



Figure 4-8 Number of Large C&I Class Customers <sup>11</sup>

Each of the three Companies dedicates a group of individuals to manage accounts that are typically greater than 700kW of billed peak demand. These individuals act as an interface between their customers and other areas within the Companies to help address a wide range of requests from their customers. Often, they work directly with the customers, or arrange for individuals with the necessary technical expertise to assist the customer in troubleshooting and discussing potential EEPDR savings opportunities.

<sup>11</sup> Data from the Companies.

The Companies' account representatives are one of several sources for information on the Companies' EEPDR programs and available rebates. They are a key factor in the Companies' efforts to help the large C&I accounts become more active in investigating and implementing EEPDR reduction measures. As additional input into the 2016 Market Study, Harbourfront conducted telephone interviews with 20 account representatives and surveyed 50 large C&I customers across the three Companies during February and March 2016.

While each of the customers in the greater than 700kW segment are unique in the products they manufacture or the services that they provide to other businesses or end-use customers, they have a number of common characteristics regarding their approach and behavior toward energy efficiency investment decision-making.

The top business categories in terms of peak demand were metals fabrication, including automobile manufacturing, primary metals, chemical manufacturing, medical centers, food processing and other manufacturing. It is likely that these categories of businesses continue to have high peak demand. In the 2016 interviews, most account representatives stated that, based on the activities of their customers, it appears that business has improved since the 2012 survey. Positive signs included expansion of facilities and staff, adding a new production run, adding another shift, and vacant commercial properties being investigated for development. Based on the survey responses, companies that are expanding are more likely to invest in energy efficient technologies for new construction or renovation. Account managers also stated that some businesses and municipalities struggle with having adequate cash or sources of capital to afford investing in energy efficient technologies, which may require adjustments to rebates in order to encourage EEPDR investments in these sectors.

Below is a list of the major business categories represented in the survey:

Table 4-10 Customer Business Categories

Customer Business Categories
Chemical & Allied Prod
Education
Electronic Mfg.
Entertainment
Food and Kindred Products
Health
Mining & Oil Gas Extract and Transportation
Paper Mills & Products
Primary Metals & Heavy Mfg.
Professional Offices
Refining & Plastics Mfg.
Large Retail
Transport Mfg.

Survey results indicate that large C&I customers will typically look for the shortest payback periods and often accept no more than a year of payback time for their capital investment in energy efficient

technologies. Small to medium-sized customers may be more flexible investing in technologies with payback periods in the one to two-year range, though still favoring the one-year or less payback. Municipalities and schools were the most flexible and, based on the survey results, it appears that some are willing to accept a payback of three to five years on their energy efficiency investments.

Programs that help increase awareness and educate customers about the Companies' future EEPDR programs and the benefits to customers, along with the purchase of more efficient products and financial incentives, aid in reducing peak demand in this class because of the short payback times that are desired for energy efficiency installations.

The survey results also generated the following observations:

- Generally large C&I customers tend to be aware that energy efficiency programs exist, but may not immediately recall specific program details and are hopeful that there will be similar programs in the future.
- Company account representatives' discussions and meetings with customers, providing monthly electronic newsletter, program administrators and trade organizations are historically effective media for conveying information about programs.
- Most of these customers do not have an internal dedicated energy manager, so the importance of the Companies' outreach is critical to helping educate and guide customers to making informed decisions regarding investing in energy efficiency measures, especially measures such as lighting modifications and motor upgrades, that could be relatively easy to implement.
- Large industrial customers, large commercial facilities, hospitals and universities generally have people on staff to focus on their company's processes and costs of operating the business including their electric bill.
- There are a significant number of customers in this group that have already installed energy efficiency measures such as lighting and motor upgrades, but cannot afford the time and effort to go back and research, prepare and submit the paperwork to receive credit exemptions or rebates.

Based on interviews with the account representatives, the most common findings among these business categories regarding energy efficiency are:

- While many customers have already made improvements in lighting and motors, etc. over the last several years (with the support of prior Company EEPDR program incentives), there continues to be opportunities for improvements in manufacturing processes, lighting, motors and behavioral improvements, particularly for the largest customers who are looking for higher potential energy efficiency savings. A key driver is their current electric bill and their desire to minimize that cost.
- Improvements to manufacturing processes require significant preplanning to accomplish. Therefore, these customers need to be informed of EEPDR programs as early as possible.
- As large C&I customers respond to increased demand for their products and services, the opportunity exists for improvements in energy efficiency, in new developments and in existing equipment, such as in lighting modifications and motor upgrades.
- Companies experiencing an uptick in their business may be adding additional staff, extending shift hours or adding additional shifts, adding new production runs or expanding their

physical facilities. All of these companies provide potential opportunities for EEPDR reduction and should be a focus for account representatives.

- Architects, engineers, equipment vendors and other facility and equipment influencers provide an additional resource for potential EEPDR reduction opportunities in the large C&I sector.

#### 4.4.3 National Accounts

There are approximately 250 customers that are designated as Company national account customers and each is managed by a Company national account representative that works across the three individual Company's boundaries. To obtain additional information regarding market potential in this sector, Harbourfront conducted telephone interviews with each of the Company national account representatives in February 2016.

The commonality among national accounts is that they are businesses that have a national presence and operate under the guidance of a corporate headquarters. National account businesses within FirstEnergy's service territories are either owned and operated by corporate headquarters or owned and operated by a franchisee. Company national account representatives focus their efforts on EEPDR related staff and decision makers at the national account's corporate headquarters.

In cases where the local customer site is owned and operated by corporate headquarters, all energy efficiency related decisions are made for and funded by headquarters. Typically, the focus of energy efficiency investments in local sites by corporate headquarters will be targeted on a priority basis to those locations where energy costs are higher and where the utility or State offers energy efficiency improvement programs and financial incentives.

In cases where the local customer site is owned by a franchisee, the corporate headquarters will typically offer the local owner the same energy efficiency information as it does to its corporate sites, however, all decisions and investments will be funded and made by the local owner. As a result, these franchisees may react more favorably to energy efficiency programs and incentives and will seek to implement measures that reduce their costs.

As with large C&I accounts, whether they are a site owned by a corporate entity or a franchisee, decisions to invest the capital and time in pursuing and implementing energy efficiency measures will be based on economics - specifically, costs and reasonable paybacks. As with other commercial customers, this group of customers requires that the process for implementing energy efficiency improvements be simple enough to understand and act on while running their businesses including:

- Being informed and educated about the Companies' future EEPDR programs and what can be done to improve their energy efficiency;
- Better understanding their energy usage and potential savings;
- Knowing how to get into the utility programs;
- Knowing how to get improvements implemented; and
- Knowing how to obtain their rebates.

The Companies' managed account representatives explain that there are three tiers of awareness and EEPDR implementation activity among the national accounts.

The first tier (Tier A) consists of those companies that are the most involved in making their properties as energy efficient as possible. These are typically those businesses that have as a goal

becoming more "Green" in their operations. They understand that EEPDR measures will help their bottom line in the long run and support their Green initiatives. These accounts typically have a dedicated energy manager, or a person who is accountable for energy budgets and reducing operating costs. They may have funds budgeted for EEPDR related capital improvements, performing energy audits and will include the impact on improving the environment in their EEPDR decision making process. While they may have already upgraded lighting and HVAC applications, there are still opportunities to upgrade motors and install energy optimizer support tools. These accounts have often chosen to implement EEPDR measures even when no utility supported rebate programs were available, since their usage is large enough to make their action justifiable, without additional rebates. The offer of utility energy efficiency rebates is a key tool for FirstEnergy in capturing additional energy efficiency savings among these customers. These accounts include combination gas station and convenience stores, high-end grocery stores, large department and box stores.

The second tier (Tier B) national account customers may investigate what EEPDR measures can do for them. However, even if they have corporate management backing, they typically don't have the capital funding for EEPDR projects and therefore as a group are typically not implementing energy efficiency measures. They need to be convinced that each project will provide a quick payback and demonstrated in a strong business case. These customers may have implemented some lighting upgrades utilizing FirstEnergy's prior EEPDR rebates. Customers in this category include the full range of national account business categories. Opportunities still exist for energy efficiency savings in lighting, motors, HVAC, compressors and energy monitoring applications.

The third tier (Tier C) national account customers are typically not actively investigating the benefits of EEPDR measures. Similar to the second tier, customers in this category include the full range of national account business categories. Often these companies do not have funds available to invest in EEPDR measures and are focused on the continuation of their businesses. These customers will be a difficult group of customers to convince to invest in EEPDR measures. The Companies' program rebates will be an important tool to move some of these companies to consider investing in energy efficiency measures. Opportunities exist for EEPDR savings in interior and exterior lighting, motors, HVAC, compressors and energy monitoring applications.

#### 4.4.4 Regional Governmental Accounts

Each of the three Companies also has area managers that are the primary point of contact for officials representing Counties, Cities, Townships, Villages, Co-ops and Authorities located in each Company's service territory. These individuals are one of several sources for information on the Companies' EEPDR programs. To obtain additional information regarding the market potential for this segment, Harbourfront conducted telephone interviews in early March 2016 with seven area managers throughout the Companies' service territories. Based on these interviews, the following observations were made:

- There are hundreds of governmental entities within the Companies' service territories. Typically, these entities do not have a dedicated individual that manages energy efficiency related issues, or has the responsibilities of monitoring and / or reducing energy costs.
- If there is someone, it typically will not be a dedicated person, but rather this task will be added to the duties of individuals such as the city manager, director of public works or village administrator.

- Many municipalities are very small and often have minimal full time employees who are tasked with the demands of managing a small government while covering their current costs without raising taxes or reducing the services they provide.
- Many municipalities lack the resources (knowledge, staff, and funding) to fully investigate EEPDR opportunities. Many have limited budgets and rely on grants to fund improvements. Smaller municipalities lack the knowledge and staff to seek out and apply for grants. They will often need assistance with the process of applying for the money, as well as the process of planning for and executing an energy efficiency capital project.
- Some municipalities have worked with consultants who specialize in EEPDR services and may offer a shared savings program.
- While rebates are always helpful, the local government still needs to raise money to make the improvements. Once EEPDR opportunities are identified and planned for, the EEPDR program needs to then be included in the appropriate future government capital budget cycle.
- Municipalities may differ in their levels of interest and activities regarding EEPDR. While some are investigating and pursuing new technologies to reduce energy costs (typical for larger cities such as Cleveland and Toledo), others may simply not have focused much effort on EEPDR initiatives to date.
- Counties and cities will generally have more governmental buildings, treatment plants, and other facilities than their smaller counterparts. Significant EEPDR opportunities may exist at treatment plants and other large governmental facilities, but in order to determine the scope of these opportunities, an energy audit or survey may be necessary. Typically, such facilities are replacing equipment such as motors when they break and may replace the broken equipment with the lowest cost motor that is available, which may be a standard efficiency motor rather than a more efficient one. When upgrades are planned, typically the new equipment will be energy efficient. Potential in this sector may be increased through focused educational materials and dedicated staff familiar with government budgeting processes.

## 5.0 MARKET CHARACTERIZATION

### 5.1 CHARACTERIZATION OF THE MARKET FOR ENERGY EFFICIENCY

An important aspect in determining the realization of the potential for energy efficiency program initiatives in a given region is to understand the extent of the retail market offerings for energy efficient appliances and end use equipment. The ready and widespread availability of a wide variety of energy efficient appliances, end use equipment and high efficiency lighting options insures that energy efficiency programs that target such products can reach achievable potential estimates that are developed. Harbourfront conducted product availability research of major appliances, end uses and lighting across the Companies' service territories through in-person visits to retailers in the Akron-Canton, Cleveland and Toledo areas. Harbourfront personnel also conducted Internet research of on-line store sites, and reviewed periodicals and print sources of current energy efficiency messaging to consumers at the stores visited. This work also included searches and summaries of local and national energy efficiency programs, energy audit programs, and other resources that a consumer in the specified area may access when looking to conserve energy.

Research results indicate that the availability of energy efficient appliances and end uses, especially lighting, in the Companies' service territories is increasing. Other observations from this research are as follows:

1. Onsite visits were made to 13 retail stores in the Akron-Canton, Cleveland and Toledo areas<sup>12</sup>. The onsite visits confirmed that the in-store displays for both CFL and LED bulb options were both extensive and eye catching. These displays were placed in high traffic areas and the display designs were colorful and appealing to the consumers. Pricing was clear and energy efficiency/electricity cost saving messaging was easy to identify. Additionally, in store displays demonstrated the brightness and color rendition of various CFL and LED product examples.
2. Below is a summary of the number of ENERGY STAR appliances available as a percentage of total numbers of appliances on the sales floor based on actual floor inventory:
  - a. Refrigerators over 22 cu. ft.: 68%
  - b. Refrigerators 22 cu. ft. and below: 29%
  - c. Freezers-Upright: 62 %
  - d. Freezers-Chest: 17%
  - e. Dishwashers: 91%
  - f. Clothes Dryers: 29%
  - g. Clothes Washers: 70%
3. Based on discussions with retail store sales personnel about customer preferences, it appears that shoppers did not often ask sales personnel to point out ENERGY STAR appliances – something that was more commonly asked in earlier years. During these discussions, sales personnel varied in their opinions as to why this was the case, concluding that customers either recognized the familiar ENERGY STAR signage or were more focused on appliance features or price, rather than efficiency ratings.

<sup>12</sup> Additional stores were contacted through telephone inquiries or reviewed via Internet websites.

4. Based on reviews of the ENERGY STAR information attached to the appliances, the following observations were made:
- Refrigerators* - the average difference in annual estimated kWh consumption between ENERGY STAR and non-ENERGY STAR refrigerators in the 22-28 cu ft. size range was between 60 and 150 kWh. However, the energy savings resulting from either size unit when compared to the devices that were being replaced would represent a significant annual kWh savings. According to a 2014 DOE estimate, approximately 80% of all refrigerators are ENERGY STAR certified. The survey results show a lower percentage of ENERGY STAR refrigerator availability than the DOE report, underscoring the need to continue refrigerator rebate programs to create additional demand for efficient refrigerators, especially in the smaller cu ft. sizes. Price comparisons between ENERGY STAR and Non-ENERGY STAR refrigerators indicated that ENERGY STAR appliances were more expensive. In the 18-24 cu. ft. size range, ENERGY STAR refrigerators were, on average, \$ 700 more expensive than their non-ENERGY STAR counterparts, and, for the Over-24-30 cu ft. category, the ENERGY STAR refrigerators were, on average, \$ 200 more expensive than their non-ENERGY STAR counterparts. These average price differences were estimated after reviewing a sample of each type of refrigerator in each of the two size categories. It was observed that the ENERGY STAR models, in the Over-24-30 cu ft. category, tended to have more features than the non-ENERGY STAR models.
  - Dish Washers* - virtually all dishwashers in the 13 stores visited were ENERGY STAR rated. These appliances use less water than earlier models, have soil sensors, more efficient jets, temperature control for heating water and better filtration, which removes food particles from wash water. Depending on the features, the ENERGY STAR dishwashers ranged in price from \$ 300-\$950. The few non-ENERGY STAR models found had selling prices in the \$250-\$300 range.
  - Electric Dryers* - compared to other appliances surveyed, electric dryers had the least amount of ENERGY STAR rated appliances available. However, many of the non-ENERGY STAR rated dryers were labeled as High Efficiency due to certain energy saving functions. These include temperature sensors, which use the temperature of dryer exhaust air to estimate when clothes are dry and automatically shut off the dryer, as well as moisture sensors, which shut off the dryer when the humidity of the exhaust air indicates the clothes are dry. (Older dryers use timed settings to dry clothes, which probably lead to over-drying by running the dryer when clothes may already be dry and needlessly using additional energy.) Insofar as costs were concerned, electric dryers varied in cost depending on capacity, features and energy efficiency. Non-ENERGY STAR electric dryers ranged in price from \$230 to \$1,530, while similar ENERGY STAR machines ranged in price from \$600 to \$1,800.
  - Washing Machines* - the majority of washing machines were ENERGY STAR rated. These units use less energy, and also use far less water than in the past (up to 50% less). In addition, spin cycles remove more water from garments, which allows for shorter drying times. The ENERGY STAR models observed during the in-store surveys ranged in price from \$500-\$1500, while the non-ENERGY STAR models ranged in price from \$360-\$1360.



- e. *Electric Water Heaters* –Only one ENERGY STAR electric water heater with a storage tank was noted and the cost was over \$2,400. However, there were a number of ENERGY STAR-rated tankless, on-demand electric water heaters, with an efficiency rating of 99.8%, that were either in stock or available online through the store’s website. There were both whole house models (costs ranged from \$300 to \$800) and point-of-use models (costs ranged from \$180-\$300). There were also several Heat Pump hot water heaters in 50 and 80-gallon storage tank sizes that ranged from \$1,000 for the 50 gallon models to \$1,500-\$1,800 for the 80 gallon models. For reference, standard, non-ENERGY STAR rated electric water heaters had an average cost in the \$300-\$400 range.

## 5.2 SUMMARY OF FINDINGS

The appliance availability research was conducted from December 2015 through March 2016 in the Companies’ service territories. The research suggests that consumers in these areas continue to have access to EEPDR information and high-efficiency appliances, both in-store and online. For example, all of the big box stores that carry large appliances had a relatively large inventory of ENERGY STAR qualified versions of all major appliances, except ENERGY STAR electric water heaters as previously noted. Further, in-store sales representatives are, on the whole, knowledgeable about energy efficient technology options. Most store representatives again recognized the ENERGY STAR rating system as a measure for appliance energy efficiency.

A review of the “ENERGY STAR Unit Shipment and Market Penetration Report - Calendar Year 2014 Summary” indicates that of the total units shipped in 2014, ENERGY STAR models dominated in most appliance categories. This is consistent with, and supports, Harbourfront’s findings in its Ohio-specific Retailer survey research. The following table provides a sampling of that information by major household appliance:

Table 5-1 U.S. ENERGY STAR Unit Shipment and Market Penetration-2014<sup>13</sup>

U.S. ENERGY STAR Unit Shipment and Market Penetration-2014		
Clothes Washers	6,067	69%
Computers (Notebooks)	40,539	93%
Dehumidifiers	2,003	89%
Dishwashers	6,346	92%
Freezers	536	29%
Multi-Function Printers	23,936	99%
Refrigerators	7,347	75%
Room Air Conditioners	2,981	50%
Central Air Conditioners	1,727	25%
Televisions (All- including LED))	35,102	99%
Televisions (LED)	34,284	100%
Electric Dryers, Electric Water Heaters	Not Reported	

### 5.2.1 Prices of EEPDR Measures

The appliance prices listed in this report are based on the State of Ohio Technical Reference Manual (TRM), Internet research, and telephone research. Discounts associated with in-store credit card use, on-line sales, and temporary price reductions, were not factored into these prices.

Harbourfront notes that stores generally had more permanent discount prices in addition to temporary sales and offers, and it was not always easy to distinguish these long-term discount prices from the original base price as store representatives tended to quote the current available price rather than the original manufacturer or store-recommended price. Competitor price matches further contributed to the difficulty in determining prices. Because many stores now refer to their online stores for a greater selection of products from what they have in-stock, Harbourfront also considered online store options in the pricing analysis.

<sup>13</sup> Table 5-1 contains information excerpted from an EPA publication entitled "ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2014 Summary"

## 6.0 CUSTOMER SURVEY RESULTS

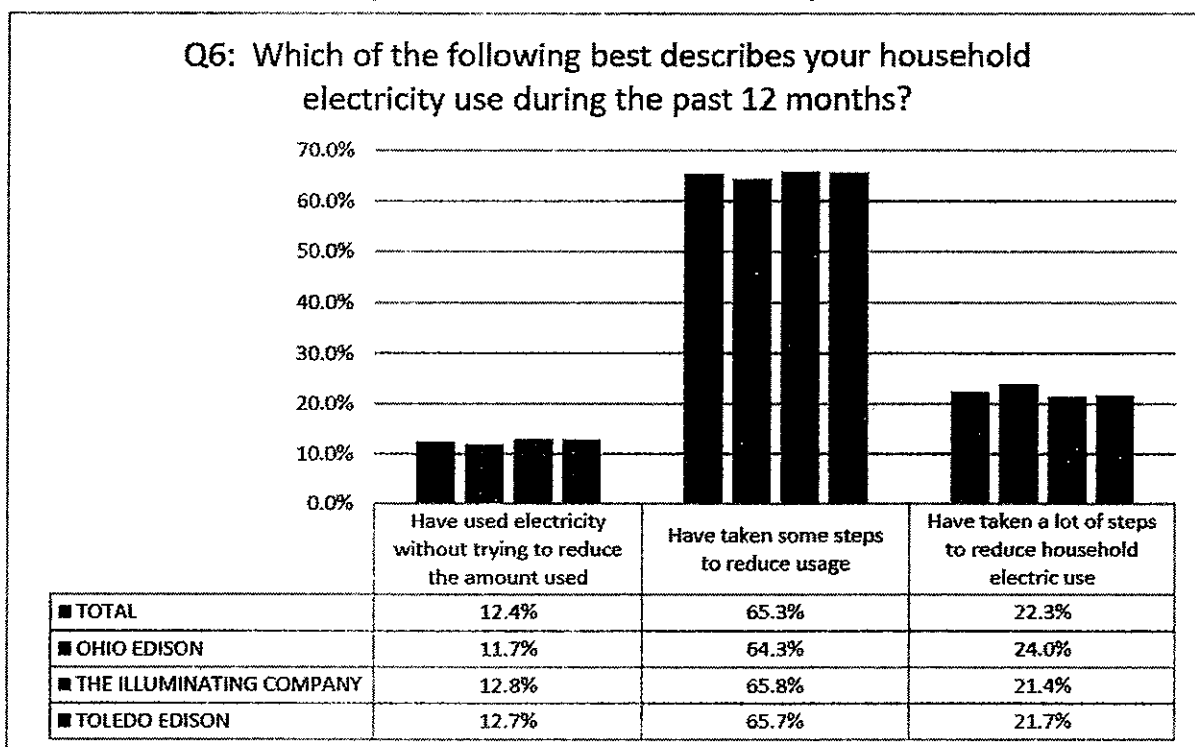
This chapter summarizes the highlights of the Residential Survey and the Commercial Telephone Surveys conducted by Triad Research Group (Triad) on behalf of Harbourfront. Both surveys were conducted in February 2016.

### Residential Mail Survey Results

#### 6.1.1 Level of Energy Efficiency Actions Taken and Intentions

Most respondents across all of the Companies have taken steps to conserve energy. About two thirds of all the respondents (65.3%) have taken some steps to reduce usage during the past 12 months and nearly the same percentage (62.8%) plan to do a little more over the next year.

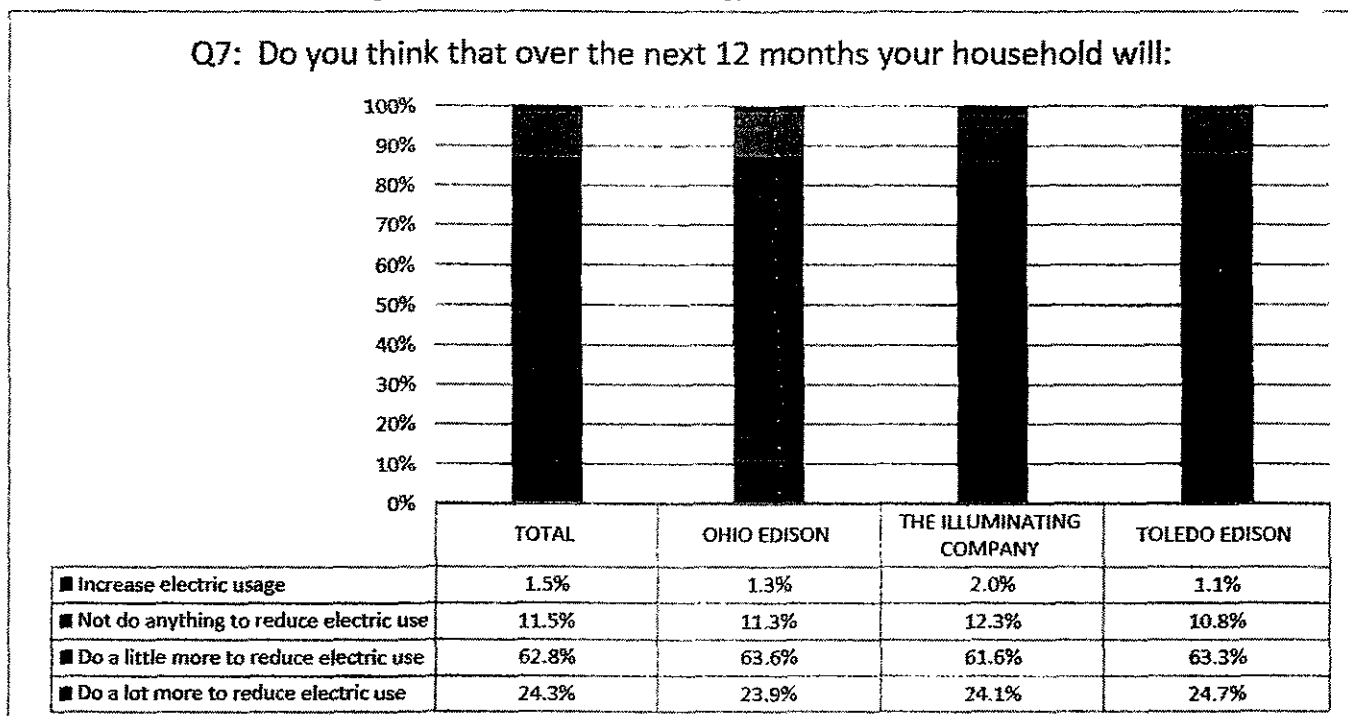
Figure 6-1 Residential – Household Electricity Use



Additionally, more than a fifth of respondents (22.3%) “have taken a lot of steps to reduce” their use of electricity in the past 12 months. OE leads CEI and TE for customers who have taken “a lot of steps.”

Compared to the share of households who have taken a lot of steps in the past 12 months, a comparable share of the total respondents (23.9%) reported they would “do a lot more to reduce electric use” over the next year as well.

Figure 6-2 Residential – Future Energy Behavior

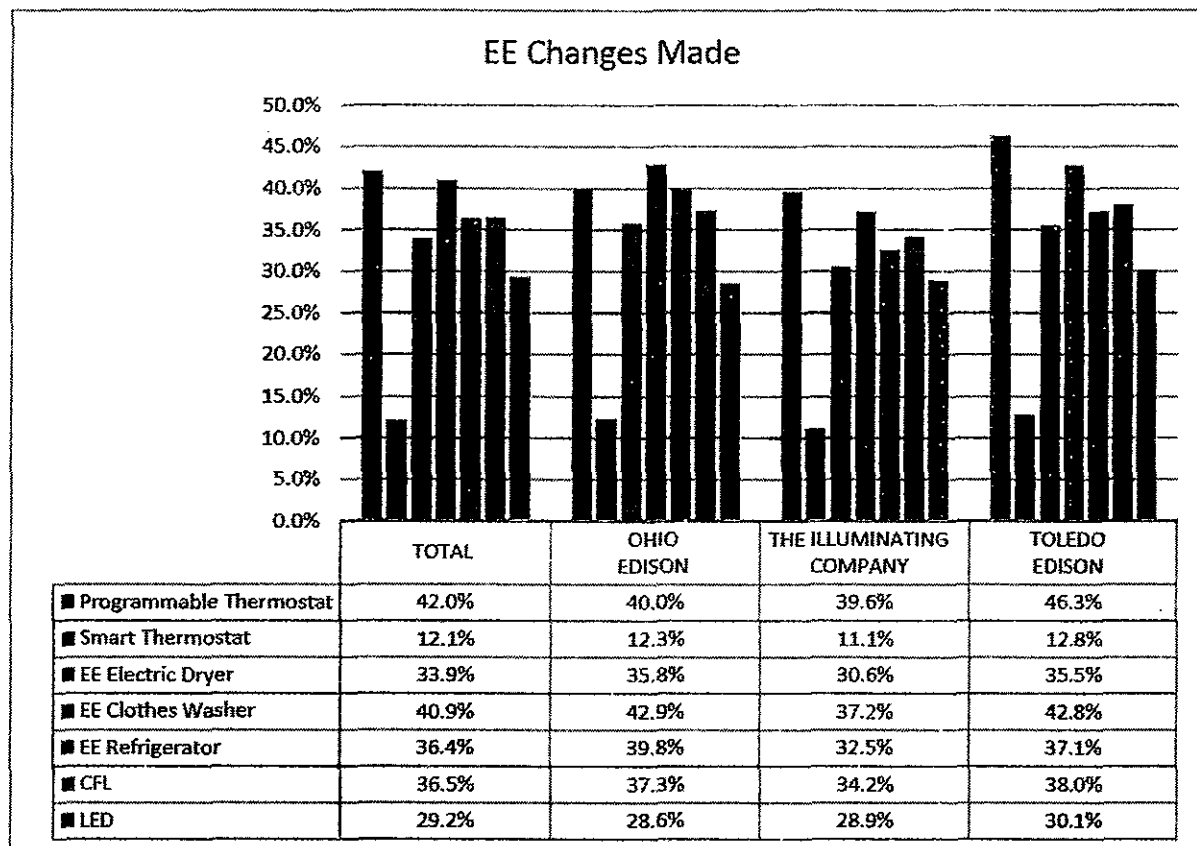


A combined 87.1% of respondents plan to do more over the next 12 months to use less electricity. Anxiety about the economy, concerns about the increasing cost of electricity, job stability and general concern for environment are provided as reasons for doing so.

The survey explored the specific types of changes, replacements, or modifications that the Companies' customers have already made, plan to make, or might consider making in terms of their home energy usage behaviors.

Overall, more respondents reported purchasing CFL bulbs (36.5%), programmable thermostats (42.0%), energy efficient refrigerators (36.4%), energy efficient clothes washers (40.9%), and energy efficient electric dryers (33.9%), compared to implementing other EEPDR measures in the last five years. The survey also shows that smart thermostats and LEDs are starting to penetrate the market successfully.

Figure 6-3 Residential – DSM/EE Changes Made



### 6.1.2 Energy Attitudes, Opinions and Behaviors

Customer perceptions about the cost of electricity have driven “organic” conservation efforts in the past. The cost of electricity and the environment are a concern to a majority of the respondents in the sample. Respondents were asked to rate their concerns about the cost of electricity and the environment using a 5 point scale where 1 equaled “Not At All Concerned” and 5 equaled “Very Concerned”. A combined 72.4% expressed some level of concern about the cost of electricity and 70.5% indicated concern about the environment. The concern over energy costs is less of a factor than in the prior survey, presumably because of current low fuel costs. The concern over the environment has increased since the last survey.

Figure 6-4 Residential – Concern about the Cost of Electricity

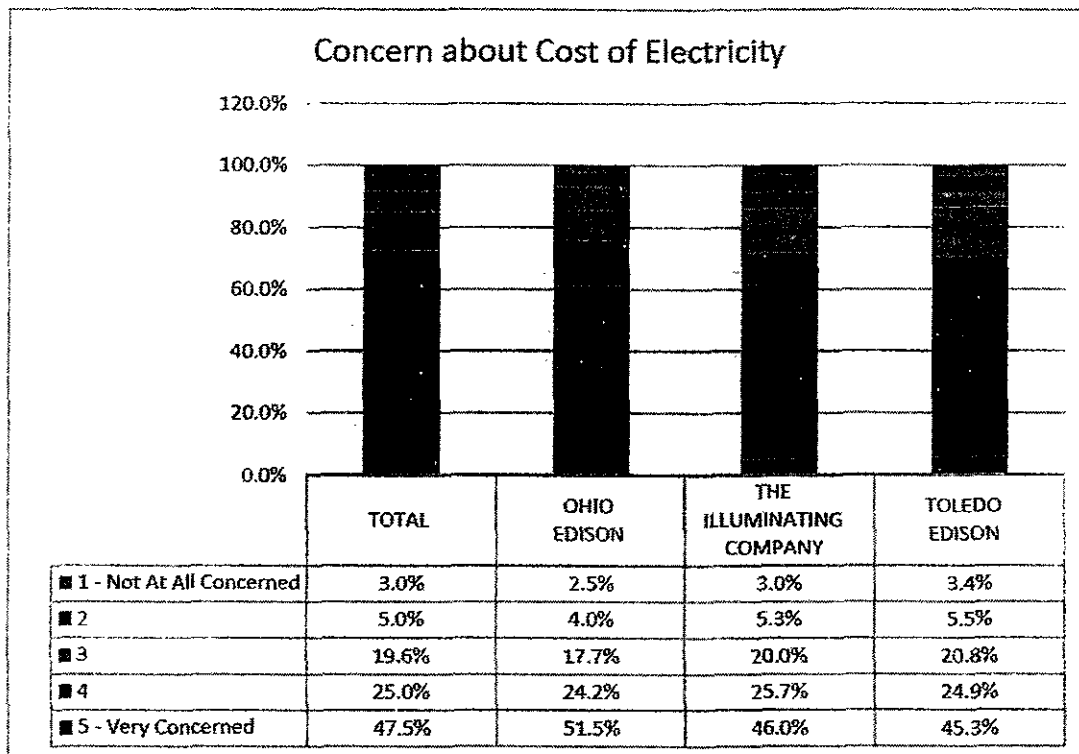
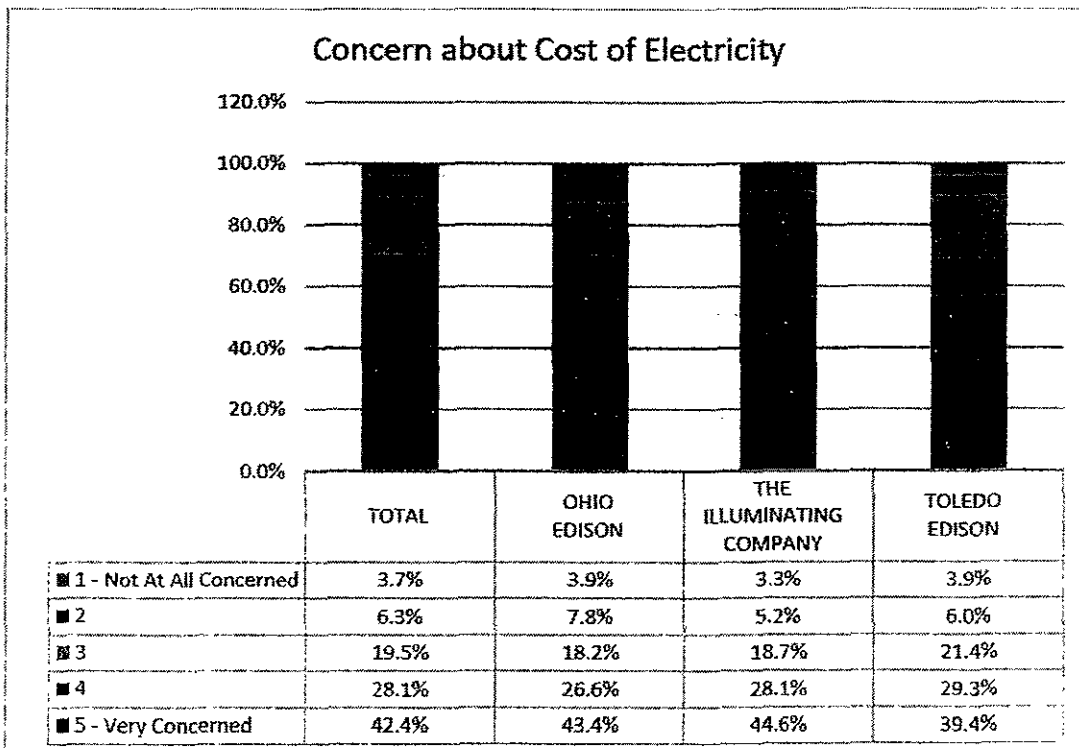


Figure 6-5 Residential – Concern about the Environment

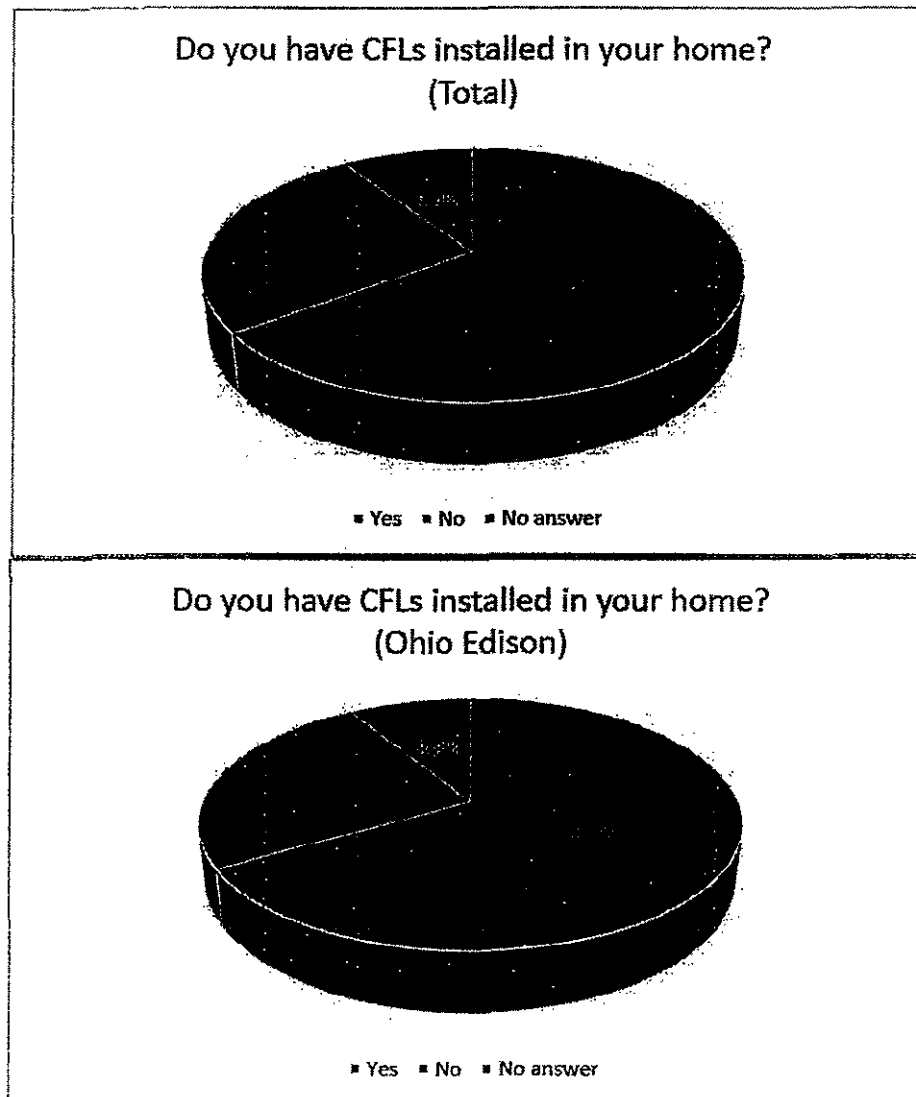


The data also suggests that respondent concern about the cost of electricity is causing a change in behavior. A little more than sixty percent of total respondents (60.4%) reported that the cost of electricity caused them to use it differently over the past years Appliance and Equipment Holdings and Information

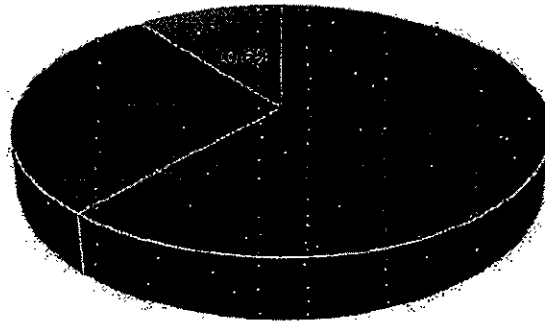
#### Indoor and Outdoor/Security Lighting

Nearly two-thirds (64.9%) of the respondents in each of the Companies' service territories have compact fluorescent light (CFL) bulbs installed in their homes. The median number of CFL bulbs installed in respondents' homes is four.

Figure 6-6 Residential – Percentage of CFL Ownership

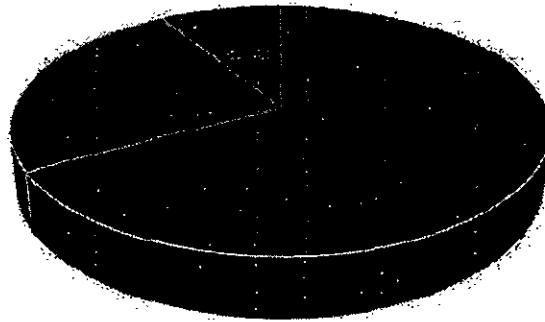


Do you have CFLs installed in your home?  
(The Illuminating Company)



■ Yes ■ No ■ No answer

Do you have CFLs installed in your home?  
(Toledo Edison)

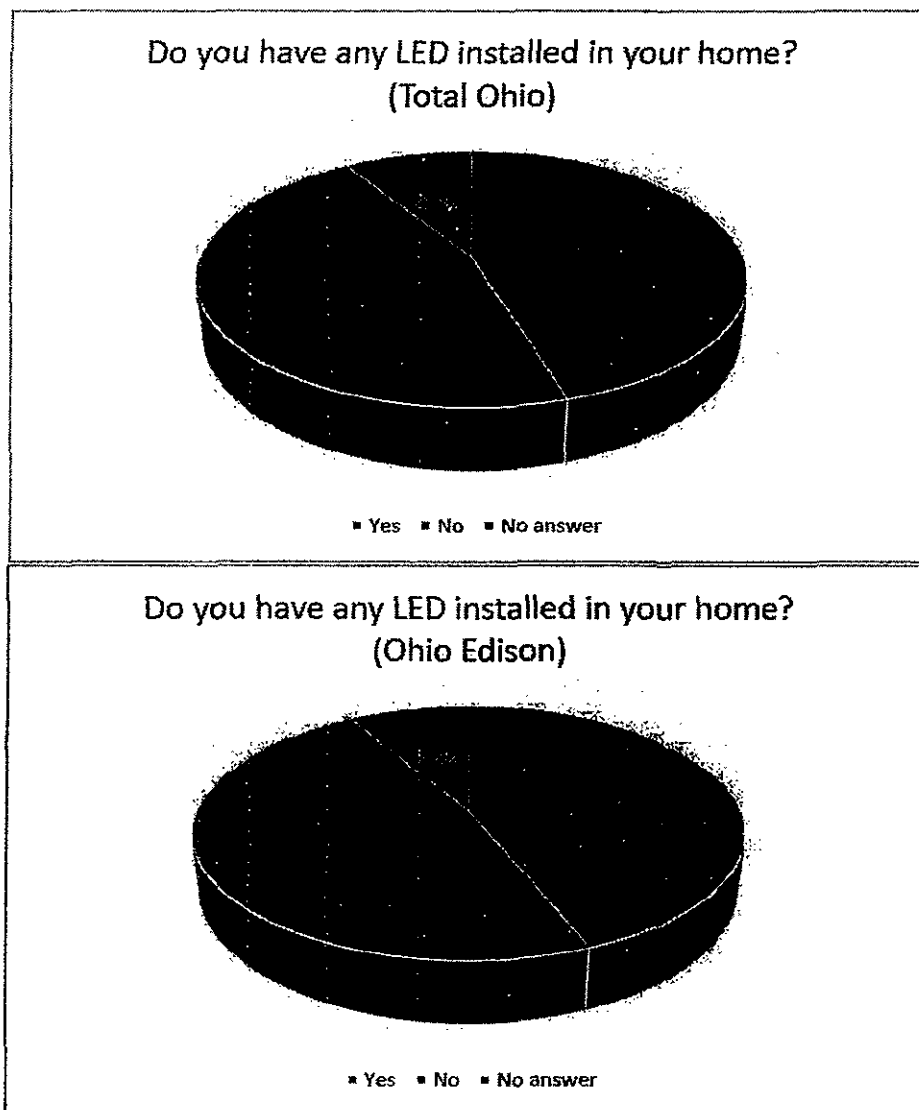


■ Yes ■ No ■ No answer

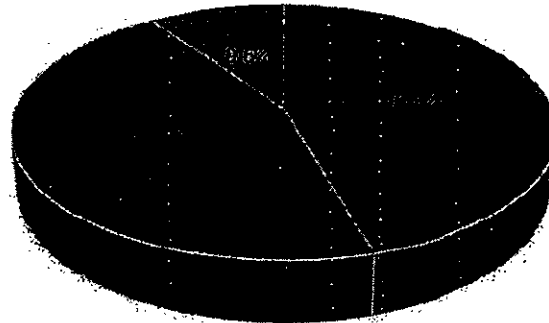
Approximately 45% of the homes have installed LEDs. The median number of LEDs installed in a home is five.



Figure 6-7 Residential – Percentage of LED Ownership

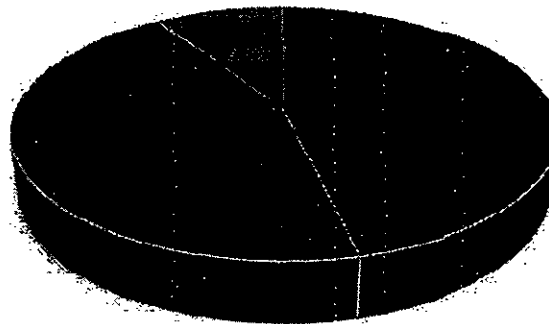


Do you have any LED installed in your home?  
(The Illuminating Company)



■ Yes ■ No ■ No answer

Do you have any LED installed in your home?  
(Toledo Edison)

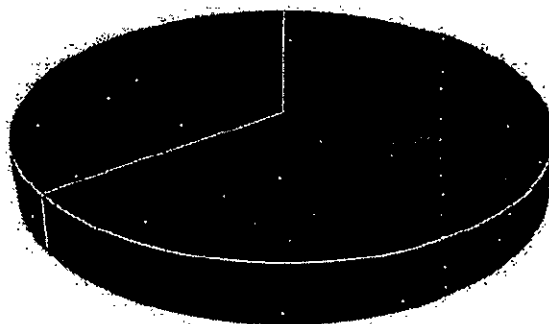


■ Yes ■ No ■ No answer

On average, 4.8 lights are on for more than four hours per day in respondent homes. More than half of the respondents overall in the Companies' service territories have outdoor/security lights. More respondents have outdoor security lighting in the Ohio Edison service territory (67.1%) than in Toledo Edison (63.3%) or the Illuminating Company (64.2%) service areas. All these numbers are up 2-6%, indicating growing preference for outdoor lights. The majority of customers with security lights have some combination of security lights that are operated by motion sensor (40.1%), switch (42.8%), and/or photocell (24.7%).

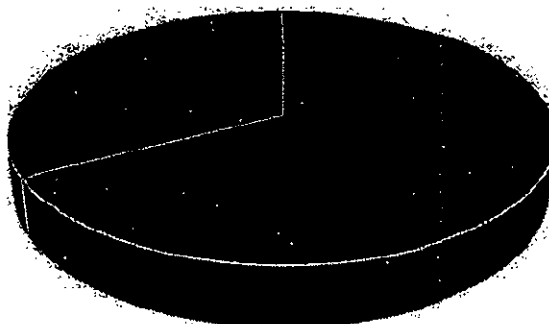
Figure 6-8 Residential – Percentage of Security Lights

Do you have outdoor/security lighting?  
Total Ohio



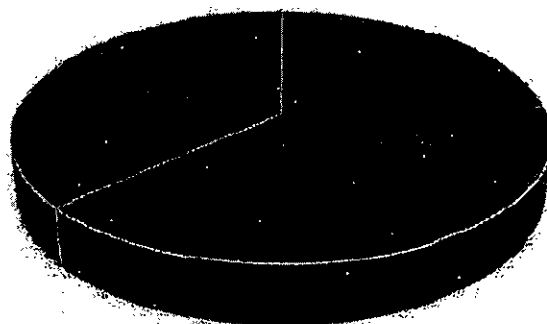
■ Yes ■ No

Do you have outdoor/security lighting?  
(Ohio Edison)



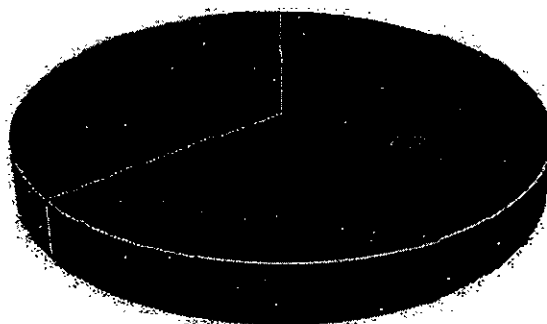
■ Yes ■ No

Do you have outdoor/security lighting?  
(The Illuminating Company)



■ Yes ■ No

Do you have outdoor/security lighting?  
(Toledo Edison)



■ Yes ■ No

### Refrigerators

Almost seventy-one percent (70.5%) of respondents have a refrigerator that is 10 years old or less. Although the majority of respondents do not own a second unit, one third reported that they have a second refrigerator. Almost eighty-two percent (81.6%) of the second refrigerators are used year round, while 13.5% are used part time, and 4.5% are unplugged and not in use. There was approximately a 5% increase in respondents who have a second refrigerator and reported using their second refrigerator year-round.

Figure 6-9 Residential – Age of Primary Refrigerator

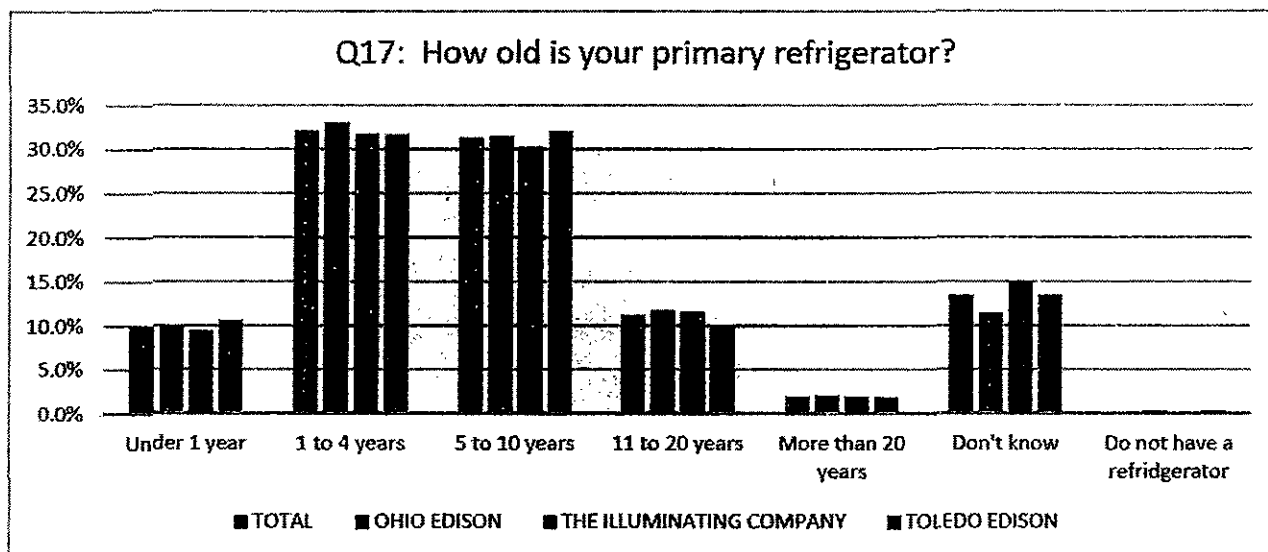
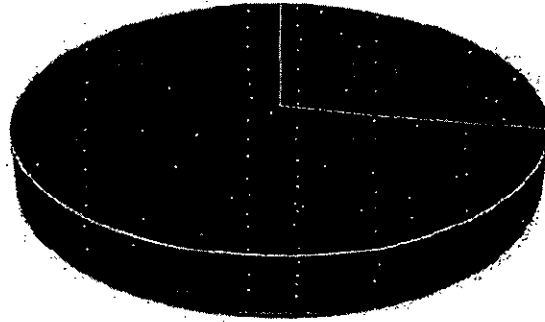


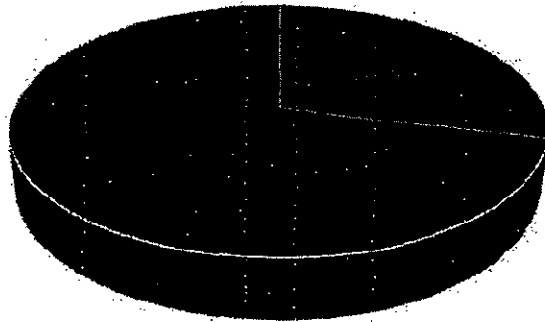
Figure 6-10 Residential – 2<sup>nd</sup> Refrigerator Ownership

Do you have an additional refrigerator?  
(Total Ohio)



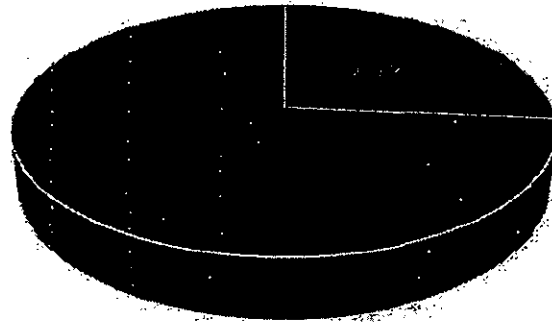
■ Yes ■ No

Do you have an additional refrigerator?  
(Ohio Edison)



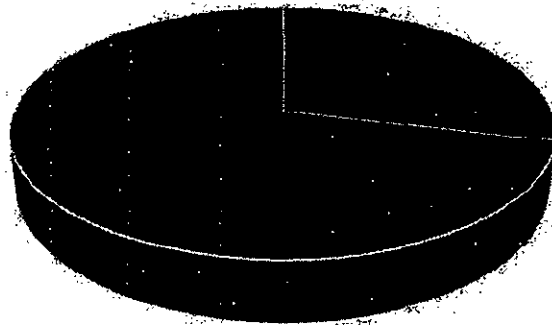
■ Yes ■ No

Do you have an additional refrigerator?  
(The Illuminating Company)



■ Yes ■ No

Do you have an additional refrigerator?  
(Toledo Edison)

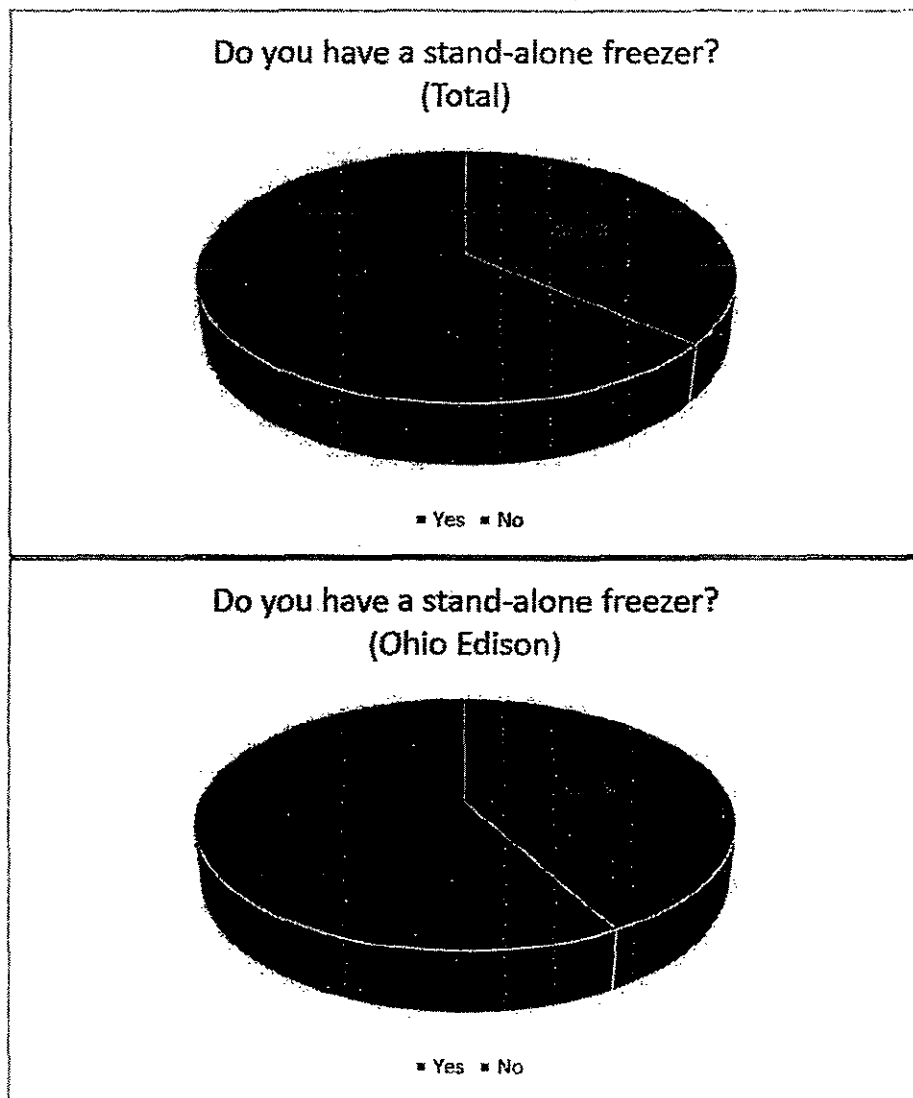


■ Yes ■ No

### Stand-Alone Freezers

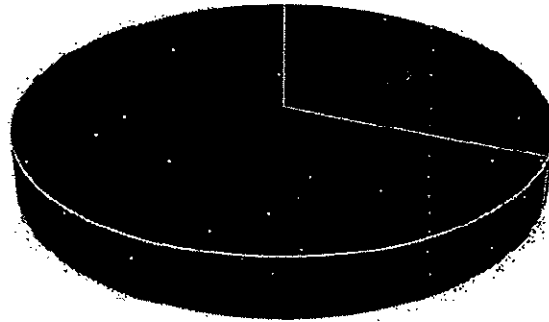
More than thirty-six percent (36.2%) of surveyed customers indicated that they own a stand-alone freezer. A higher percentage of customers in the Ohio Edison territory (42.1%) have stand-alone freezers compared to The Illuminating Company (31.2%) and Toledo Edison (36%). Of customers who have a stand-alone freezer, the vast majority operates it year-round (81.3% overall). Ensuring that these freezers are run efficiently could provide additional opportunities for energy savings.

Figure 6-11 Residential – Stand-Alone Freezer Ownership



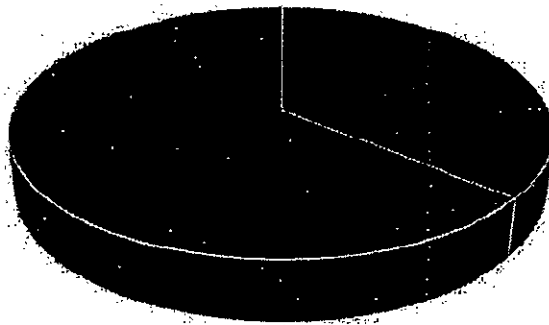


Do you have a stand-alone freezer?  
(The Illuminating Company)



■ Yes ■ No

Do you have a stand-alone freezer?  
(Toledo Edison)

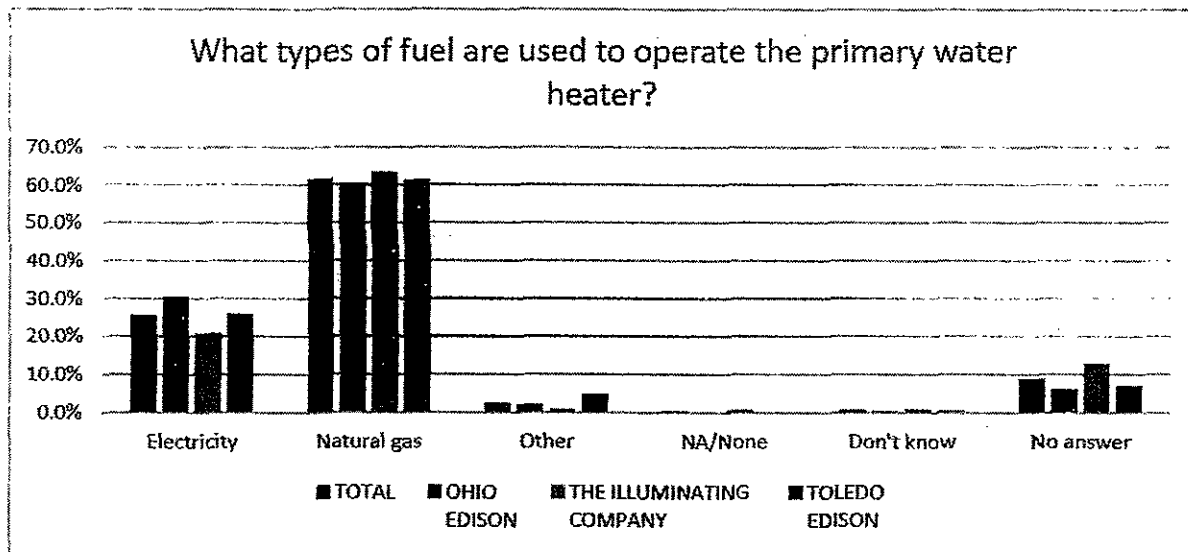


■ Yes ■ No

### Water Heating

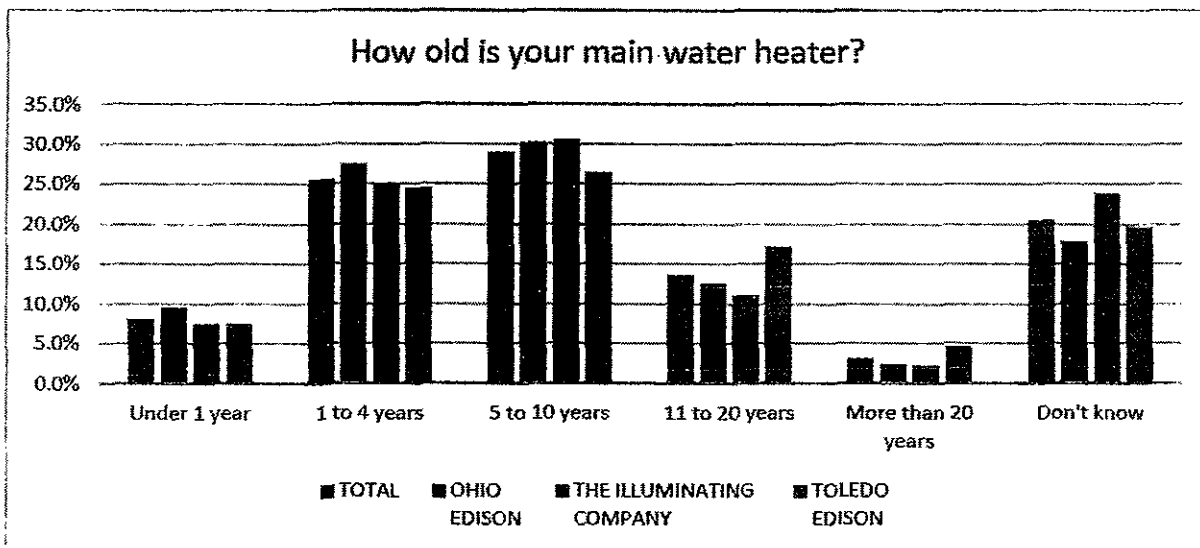
Natural gas and electricity are the two fuels cited most often for water heating. Overall, more respondents (61.7%) heat their water with natural gas than electricity (25.7%). The Companies may be able to improve the efficiency of the stock of electric water heaters their service territories by incentivizing the purchase of both high efficiency and hybrid electric water heaters.

Figure 6-12 Residential – Main Water Heating Fuel



Almost sixty-three percent (62.7%) of respondents said their water heater was 10 years old or less.

Figure 6-13 Residential – Age of Primary Water Heater



### Heating and Air Conditioning

System-wide, more respondents heat their homes with natural gas (68.7%) than any other fuel. Sixty-one percent (60.8%) of respondents reported that their primary heating system is a gas furnace (hot air). Less than half of respondent's main heating systems (47%) are 10 years old or less, 32.7 percent are over 10 years old, and 20.7 percent of residents do not know how the age of their primary heating system.

Figure 6-14 Residential – Fuel and Type of Heating System

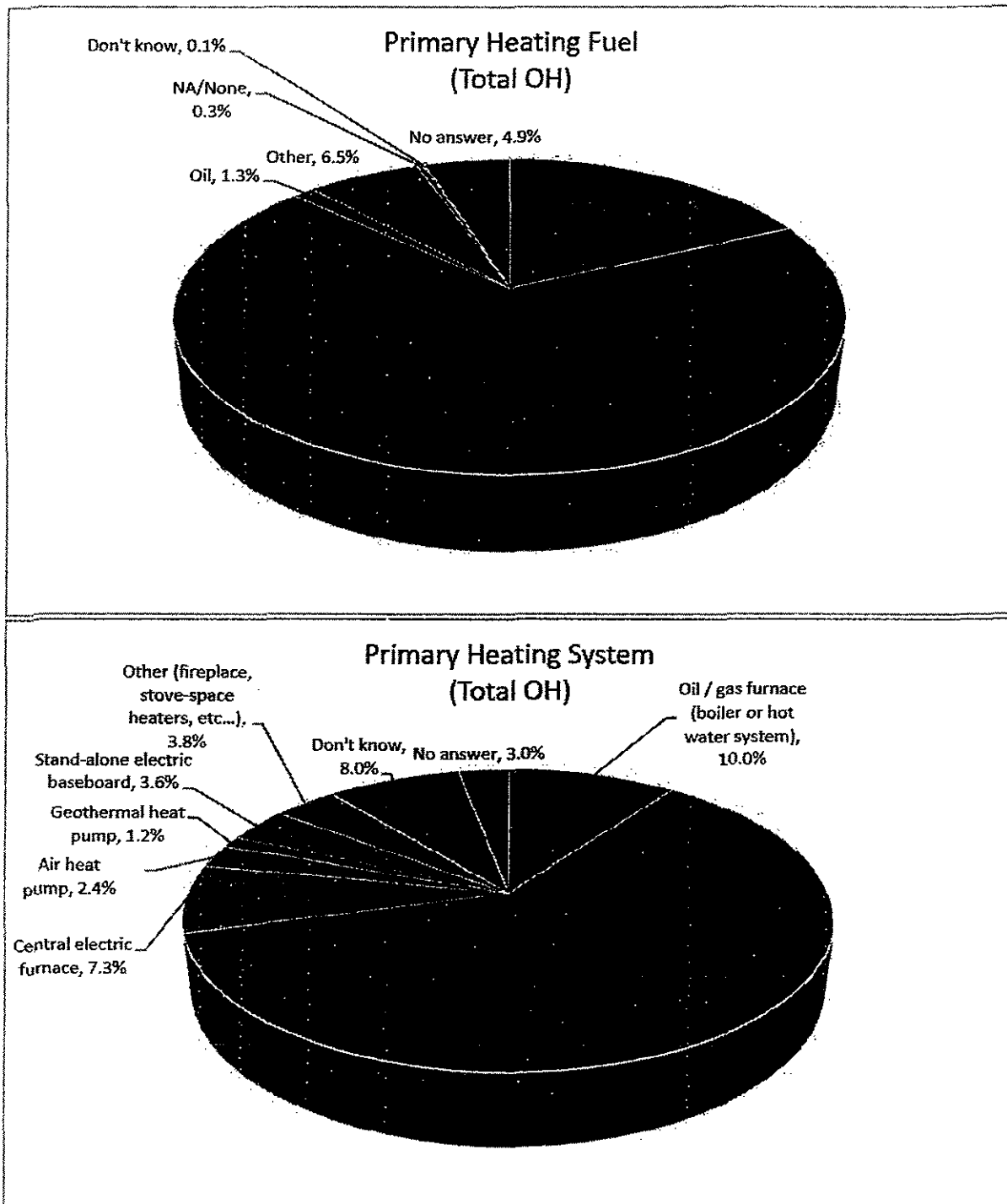
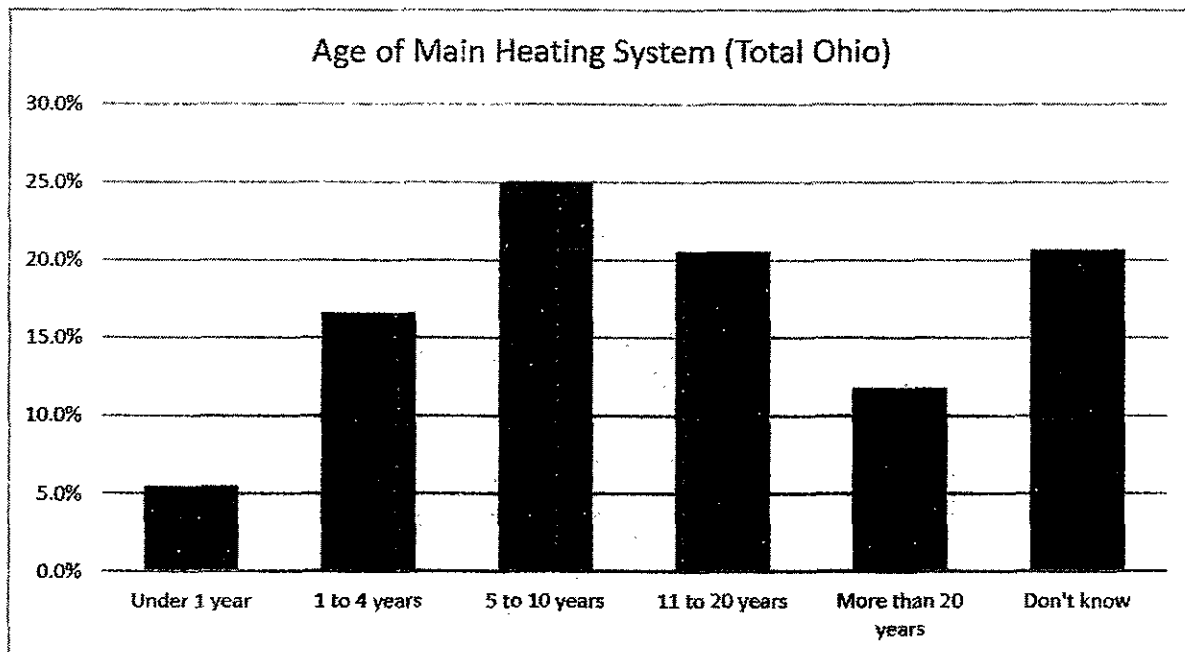


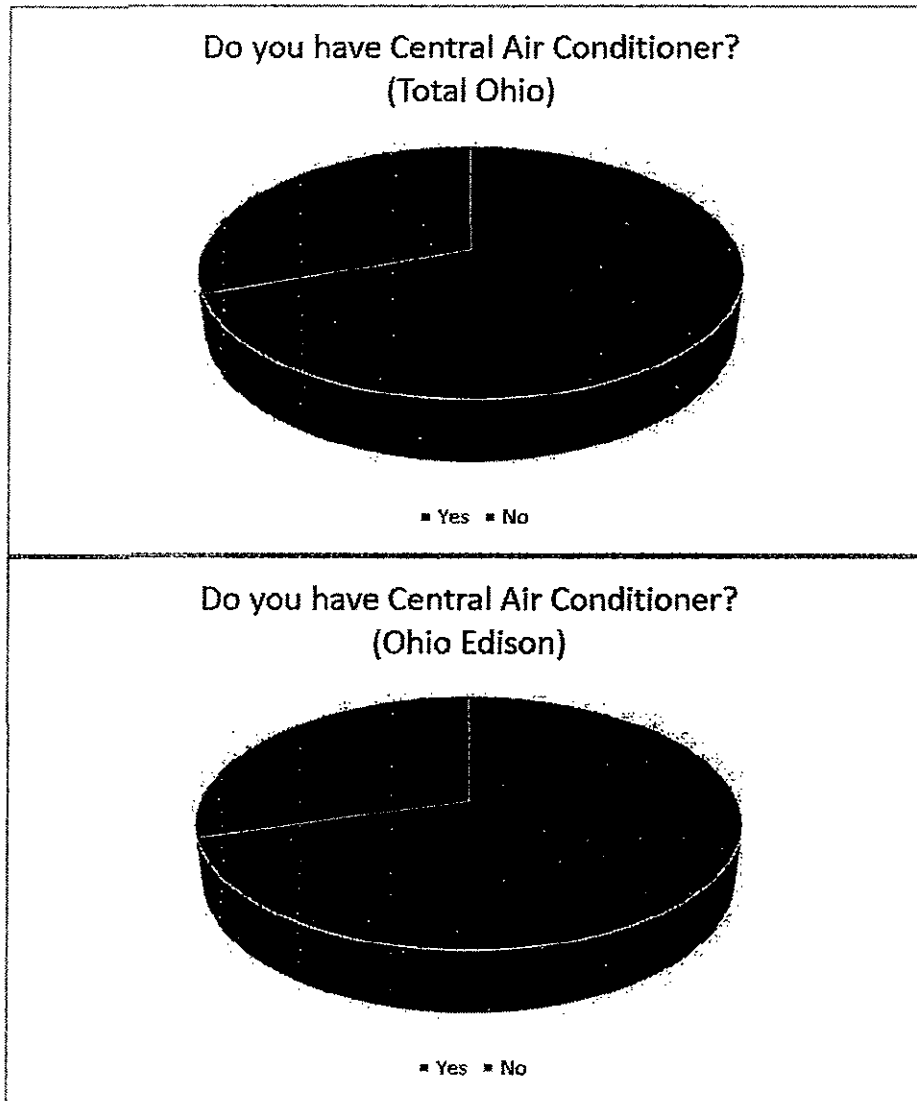
Figure 6-15 Residential – Age of Heating System



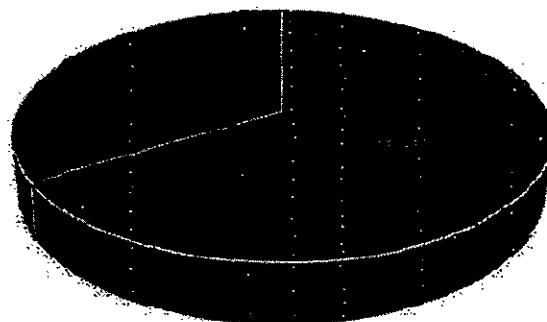
### Central Air Conditioning

Nearly seventy percent of respondents (69.4%) have central air conditioning. The vast majority of these (83.1%) are electric whole house AC units. Approximately one quarter of all respondents indicated that their units are 5 to 10 years old (27.2%); with another quarter of respondents reporting that their units were over 10 years old (24.8%).

Figure 6-16 Residential – Percentage of CAC

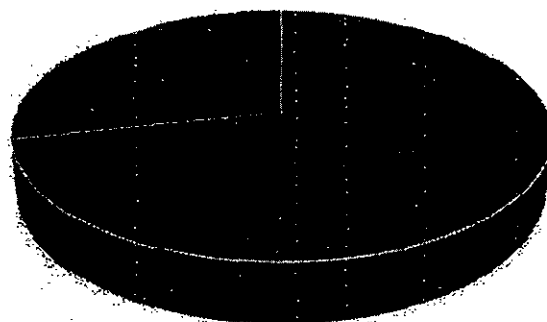


Do you have Central Air Conditioner?  
(The Illuminating Company)



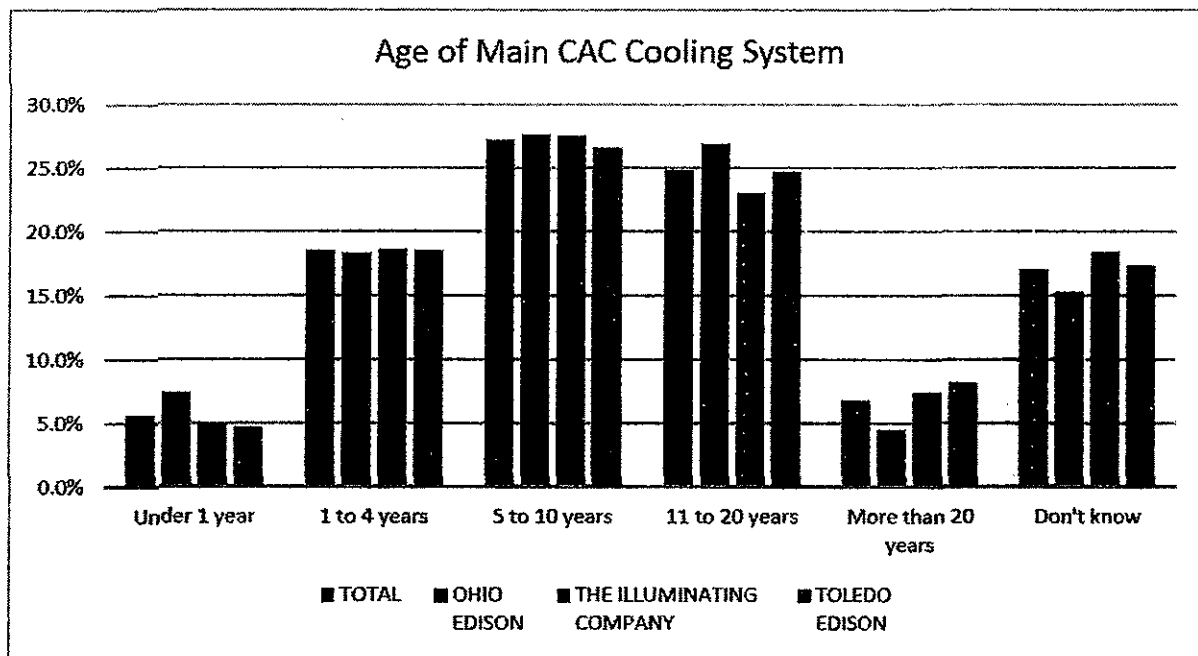
■ Yes ■ No

Do you have Central Air Conditioner?  
(Toledo Edison)



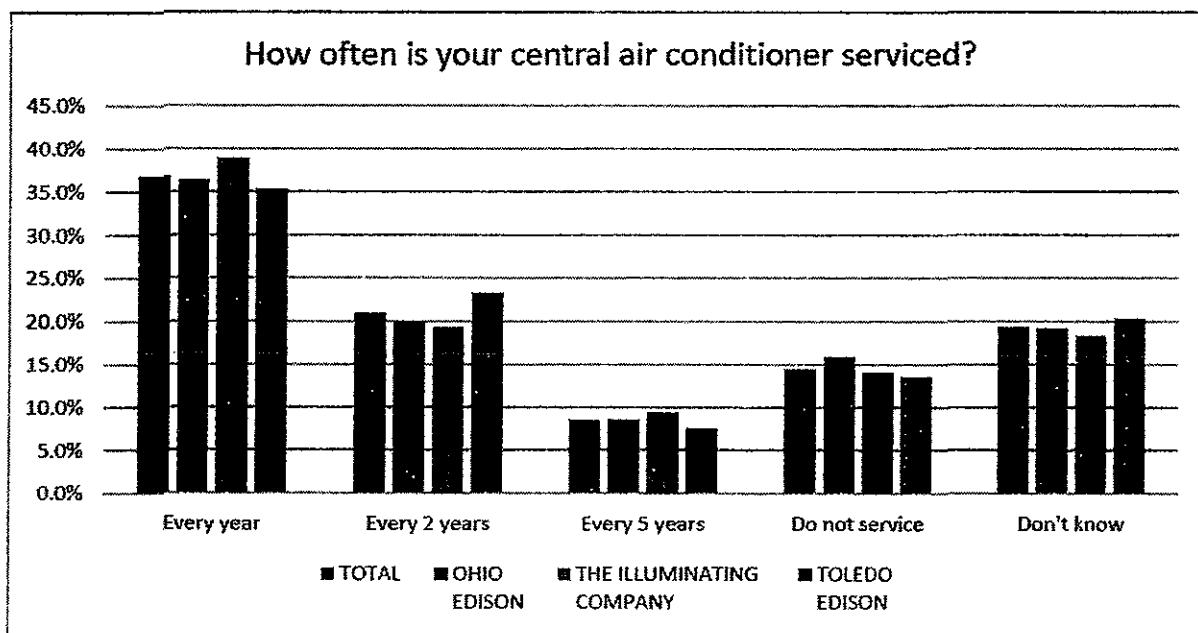
■ Yes ■ No

Figure 6-17 Residential – Age of Main CAC System



Almost thirty-seven (36.8%) percent of the respondents with central air conditioning have their units serviced every year, with more customers in The Illuminating Company servicing their units annually compared to customers in Ohio Edison and Toledo Edison.

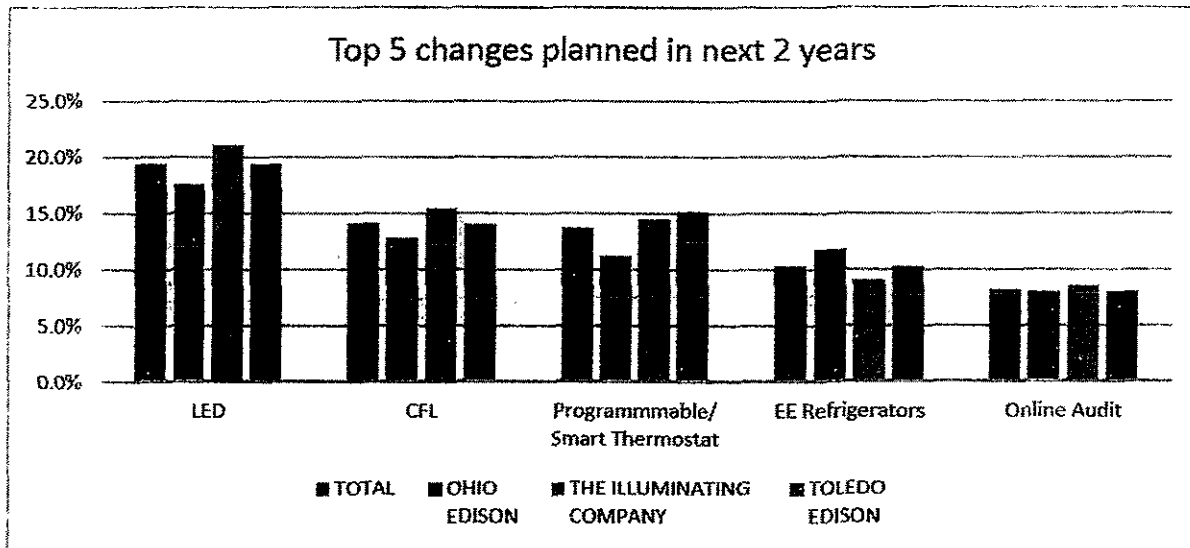
Figure 6-18 Residential – CAC Service Schedule



### Intentions to Purchase New Appliances or Equipment in Near Term

In general, survey respondents did not anticipate purchasing any major new appliances or energy efficient equipment in the near future. Of those who expressed intent to make such a purchase, LED's, CFLs, smart thermostats, and energy efficient refrigerators were the most popular:

Figure 6-19 Residential – Intentions to Purchase New Appliances



### Needs and Preferences Regarding Energy Use, Energy Conservation

Respondents demonstrated varying attitudes and opinions about energy conservation and demand side management measures. The survey asked respondents to rate their level of agreement with a series of statements using a 5 point scale where 1 = Completely Disagree and 5 = Completely Agree.

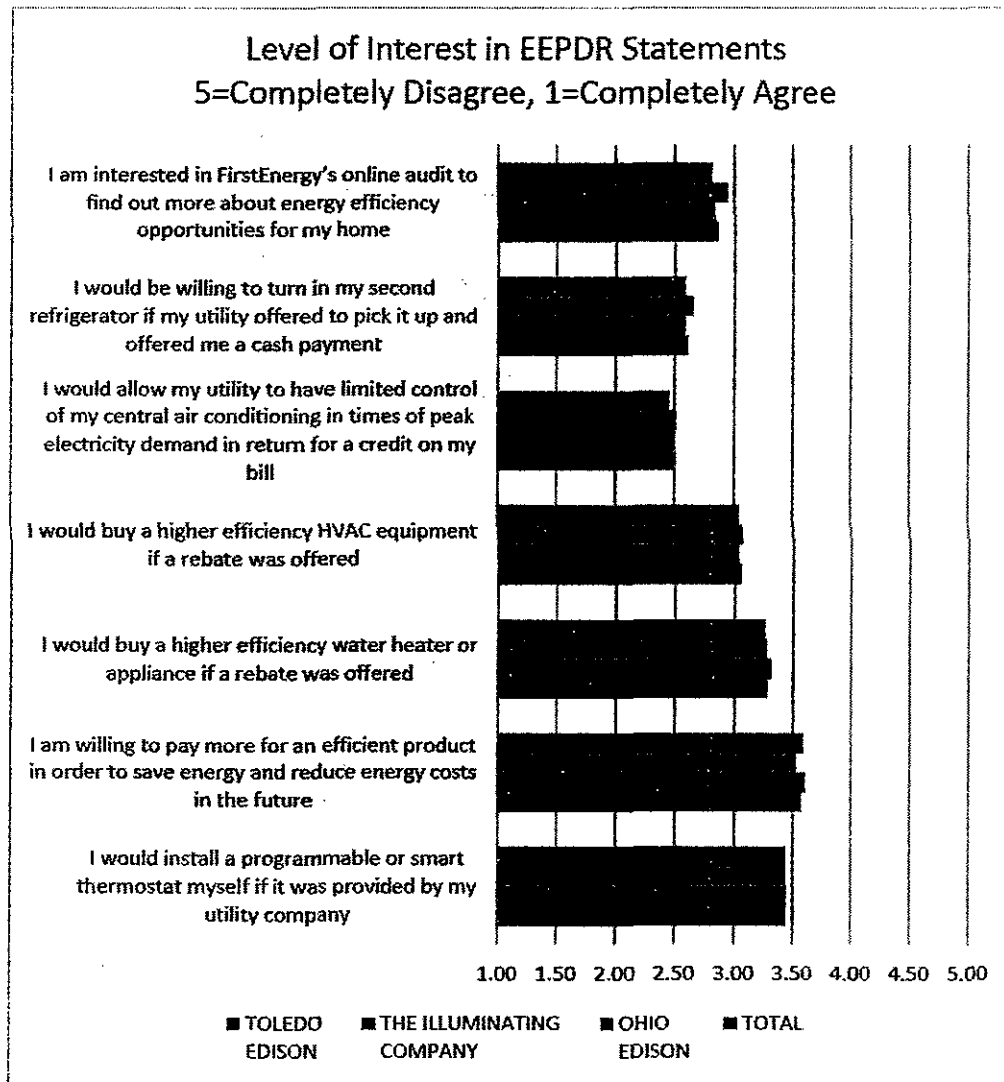
Respondents were presented with statements related to their acceptance of and willingness to adopt several EEPDR program measures.

- "I am willing to pay more for an efficient product in order to save energy and reduce energy costs in the future."
- "I would install a programmable thermostat myself if it was provided by my utility company."
- "I would buy a higher efficiency water heater or appliance if a rebate was offered."
- "I would allow my utility to have limited control of my central AC in times of peak electricity demand in return for a credit on my bill."
- "I would be willing to turn in my second refrigerator if my utility offered to pick it up and offered me a cash payment."
- "I am interested in FirstEnergy's Free Online Audit to find out more about energy efficiency opportunities for my home."



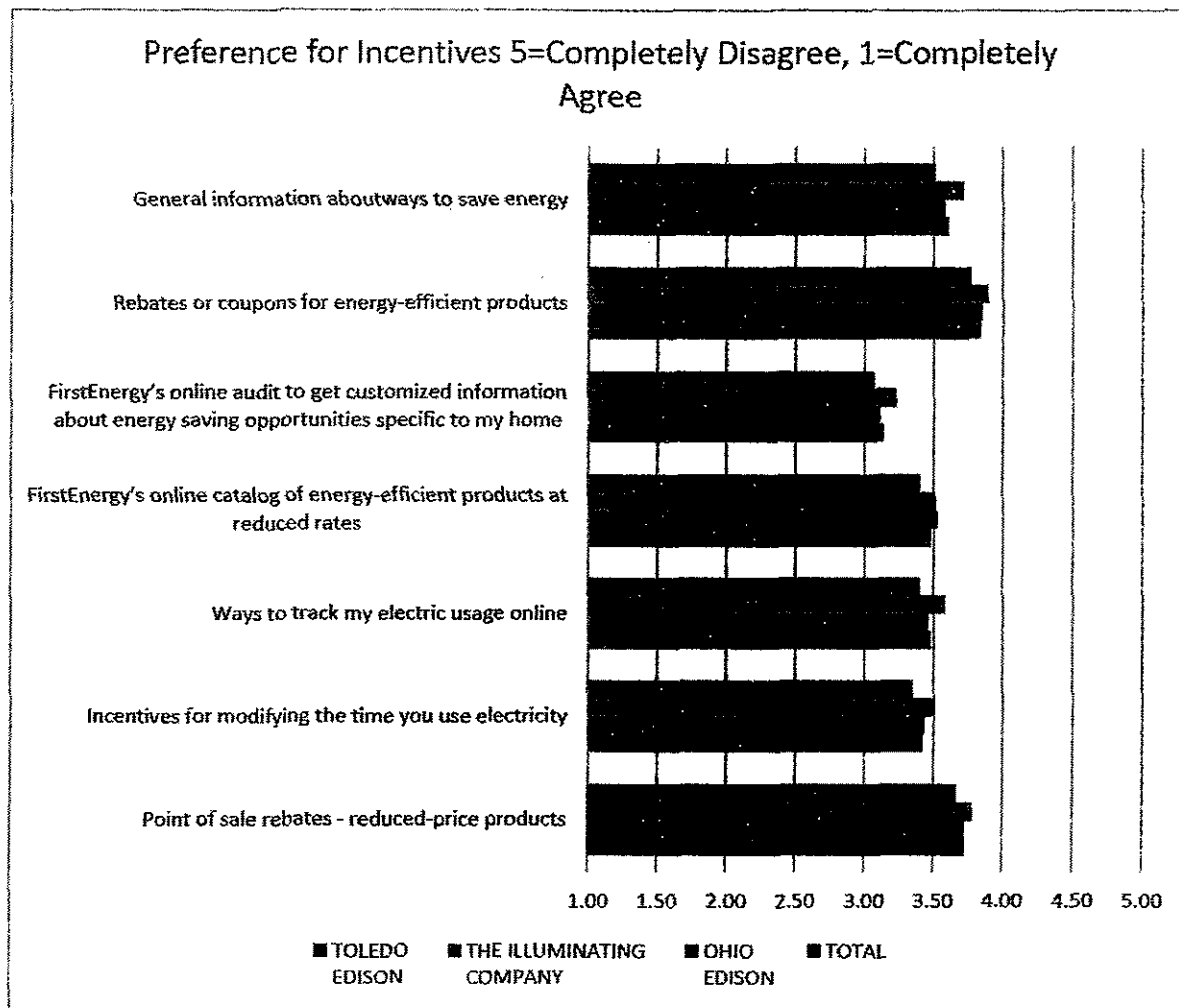
As shown in Figure 6-20, program measures related to programmable thermostats and energy efficient water heater rebates, received the highest levels of agreement.

Figure 6-20 Residential – Level of Agreement



The survey also assessed respondents' interest levels in several program delivery methods. Cash rebates, coupons, and general information received the highest mean interest ratings:

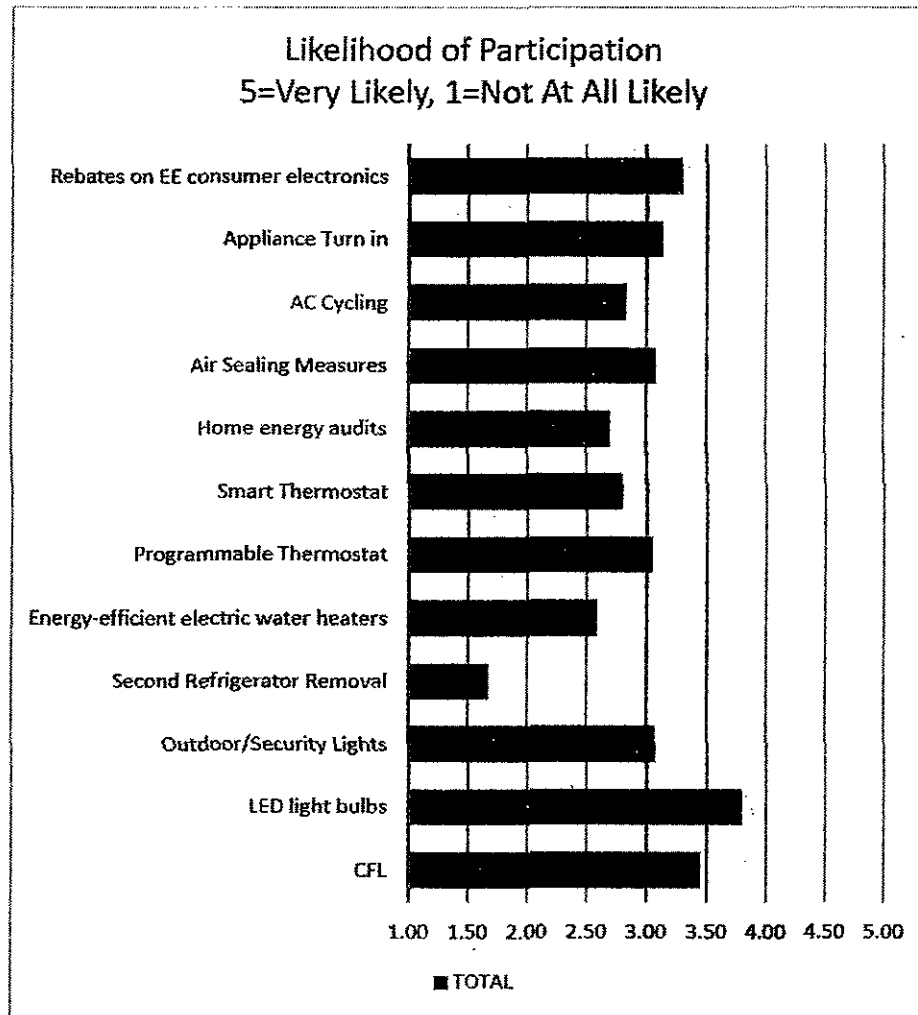
Figure 6-21 Residential – Likelihood of Customer Participation



### Reactions to Load Management and Rate Concepts

The data suggests that respondents would be more likely to participate in programs that provide LED's, CFL's, programmable thermostats and air sealing measures

Figure 6-22 Residential – Response to Load Management & Rate Concepts



## 6.2 COMMERCIAL CUSTOMER SURVEY RESULTS

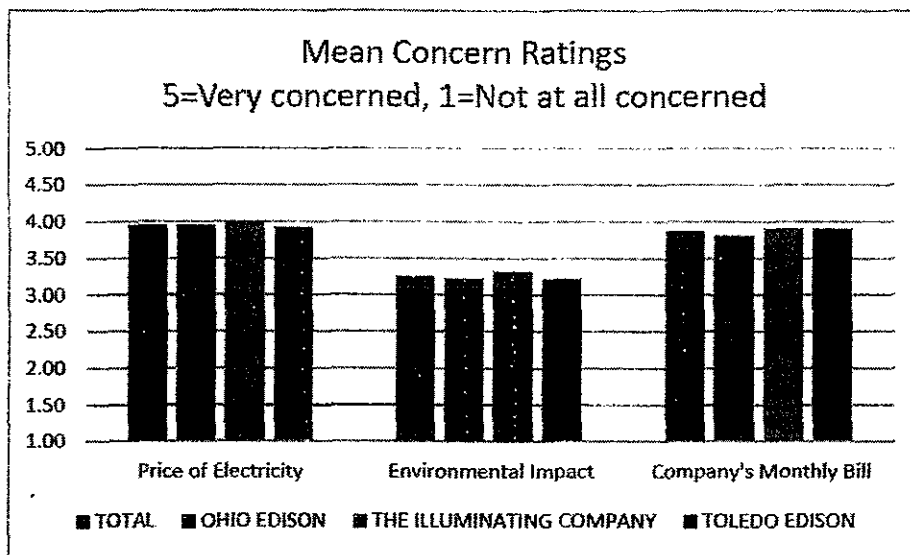
This section highlights the results from the telephone survey of 300 of the Companies' small to medium sized commercial and small manufacturing customers (100 each).

### 6.2.1 Findings

#### Energy Attitudes, Opinions and Behaviors

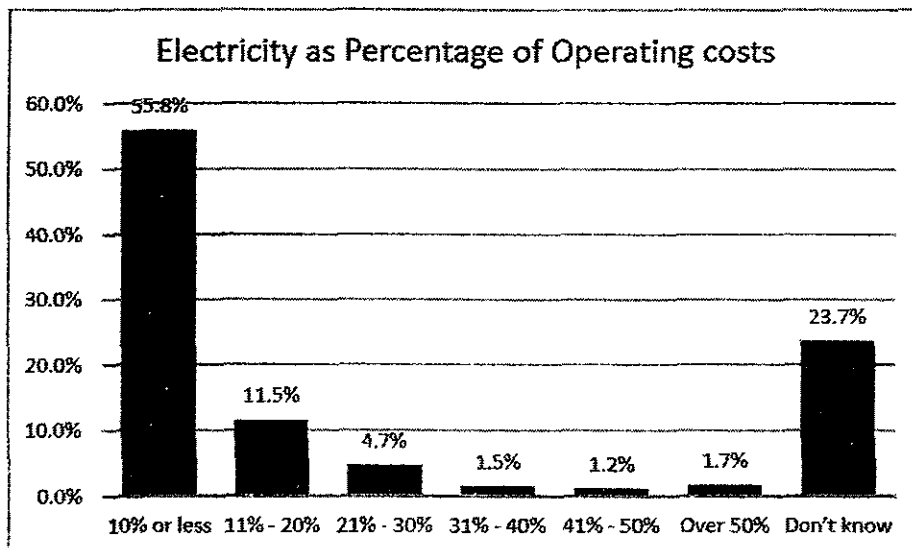
Using a 5-point scale where 1 equaled "Not At All Concerned" and 5 equaled "Very Concerned", respondents were asked to rate their concerns about the cost of electricity, the environmental impact of electricity consumption and their monthly electric bill.

Figure 6-23 Commercial – Customer Concerns



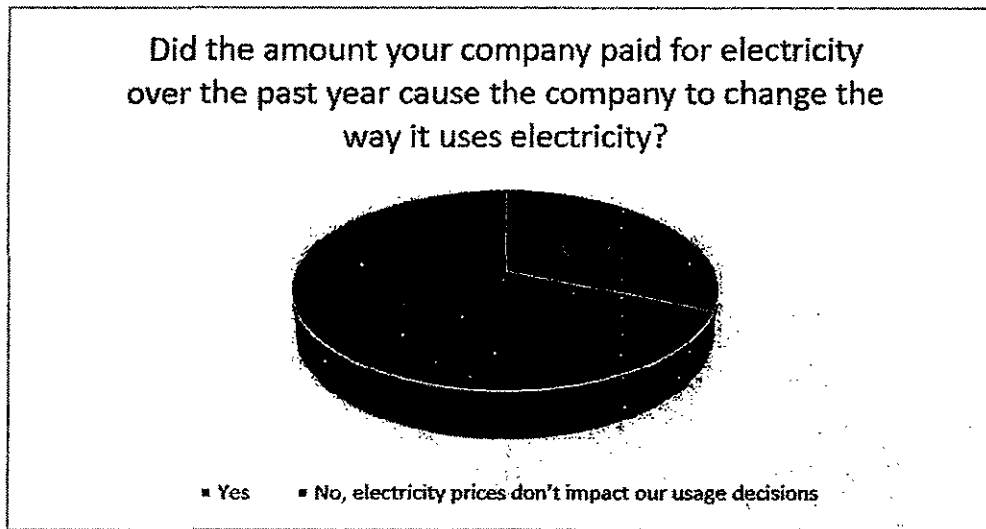
On average, commercial respondents are more concerned with the price of electricity and their monthly electric bill than they seem to be about the environment. More than half of the respondents (55.8%) indicated that electricity accounts for 10% or less of their operating costs.

Figure 6-24 Commercial – Customer Electricity Operating Costs



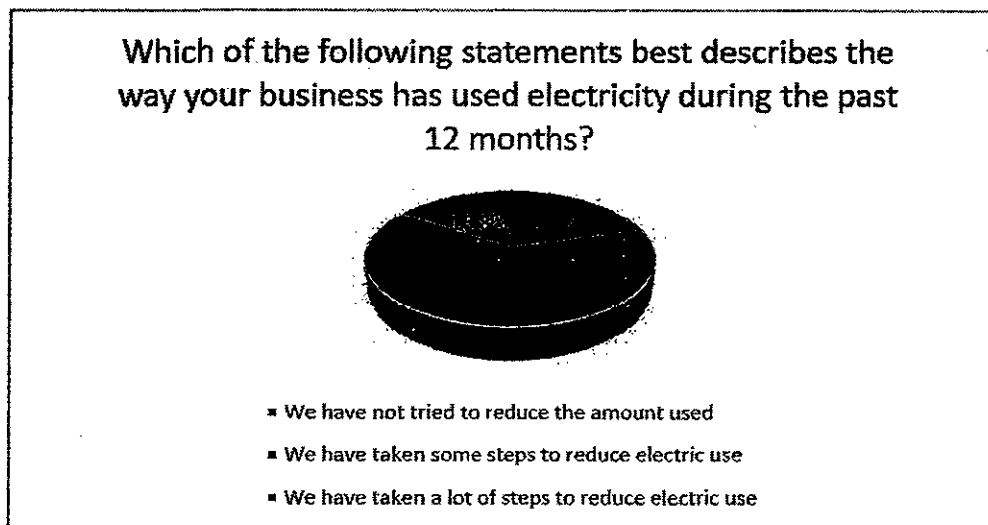
The highest single percentage of respondents reported that the cost of electricity has not yet caused them to use it differently, but that it is a concern for them. Almost a third (31.2%) of respondents reported that electricity prices have had an impact on their use of electricity in the past year and the rest (68.8%) responded that electricity costs do not impact their usage decisions.

Figure 6-25 Commercial – Impact of Electricity Prices on Usage



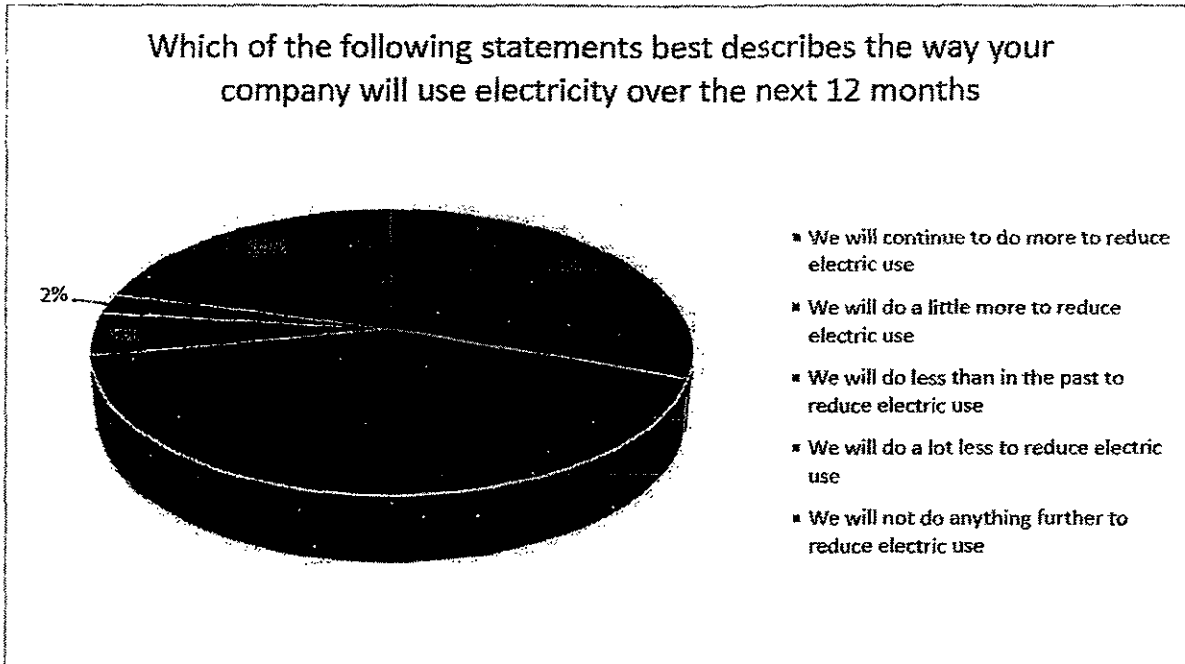
A combined 79.3% of the respondents have done something to reduce their electric use. Of this group, 61% have taken some steps to reduce their use, while 18.3% said they have done a lot.

Figure 6-26 Commercial – Electricity Usage for Past 12 Months



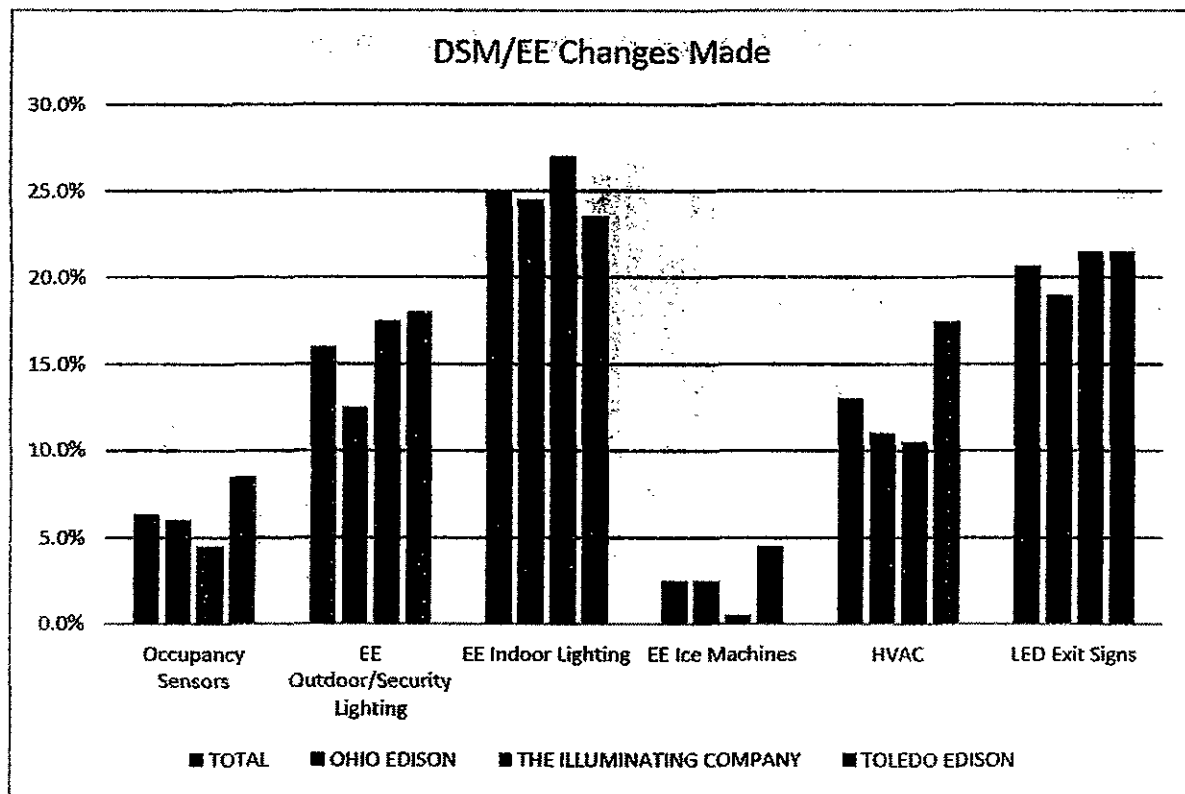
Going forward, almost three-quarters of the respondents (72%) reported that they would do something to save electricity. Of this group, 41.7% will do a little more and 30.3% said they would do a lot more.

Figure 6-27 Commercial – Electricity Usage for Next 12 Months



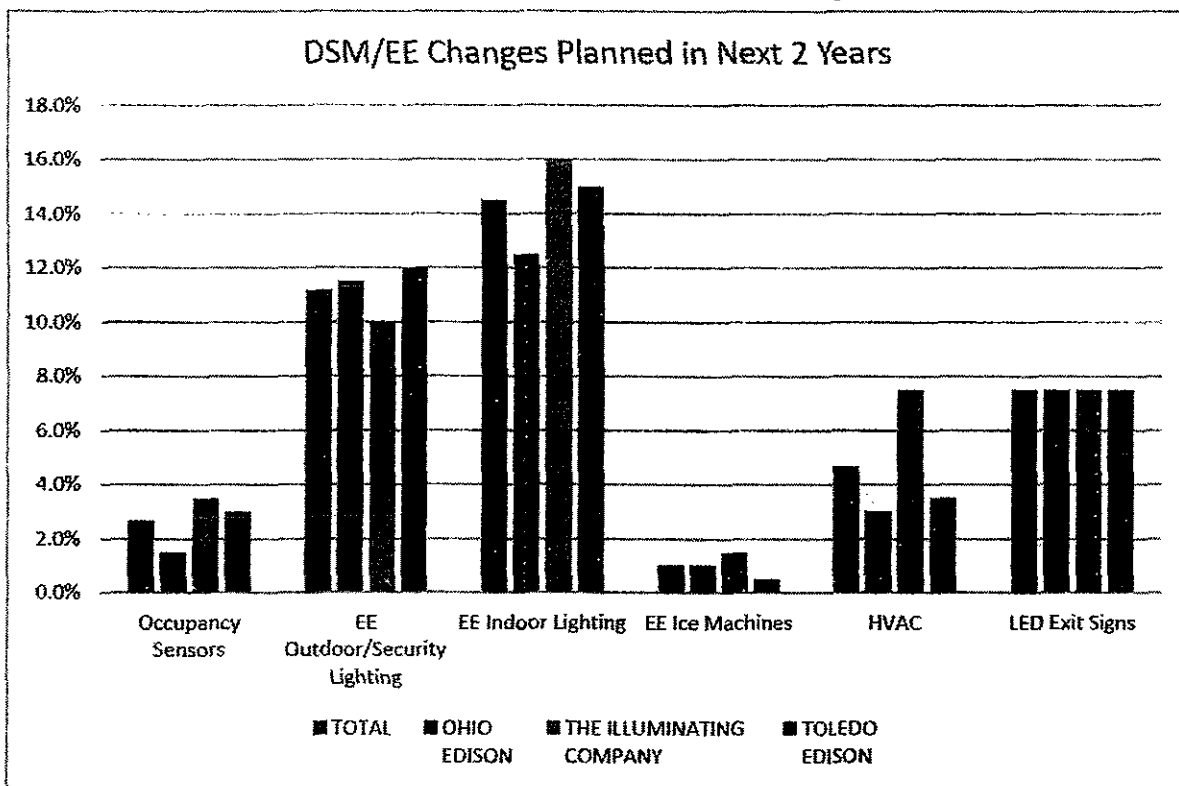
While a majority of the survey respondents have not made any changes to their business, some commercial respondents have already installed energy efficient indoor lighting (25%), outdoor security lighting (16%), and energy efficient LED exit signs (20.7%).

Figure 6-28 Commercial – DSM/EE Changes Made



Few respondents plan to make efficiency changes in the future. A little over eleven percent (11.2%) reported they would install energy efficient outdoor lighting in the next two years. Similarly, for energy efficient LED exit signs, less than eight percent (7.5%) of the commercial respondents indicated that they planned to install energy efficient LED exit signs in their buildings. Only about three percent (2.7%) of respondents answered that they planned to install occupancy sensors.

Figure 6-29 Commercial – DSM/EE Planned Changes

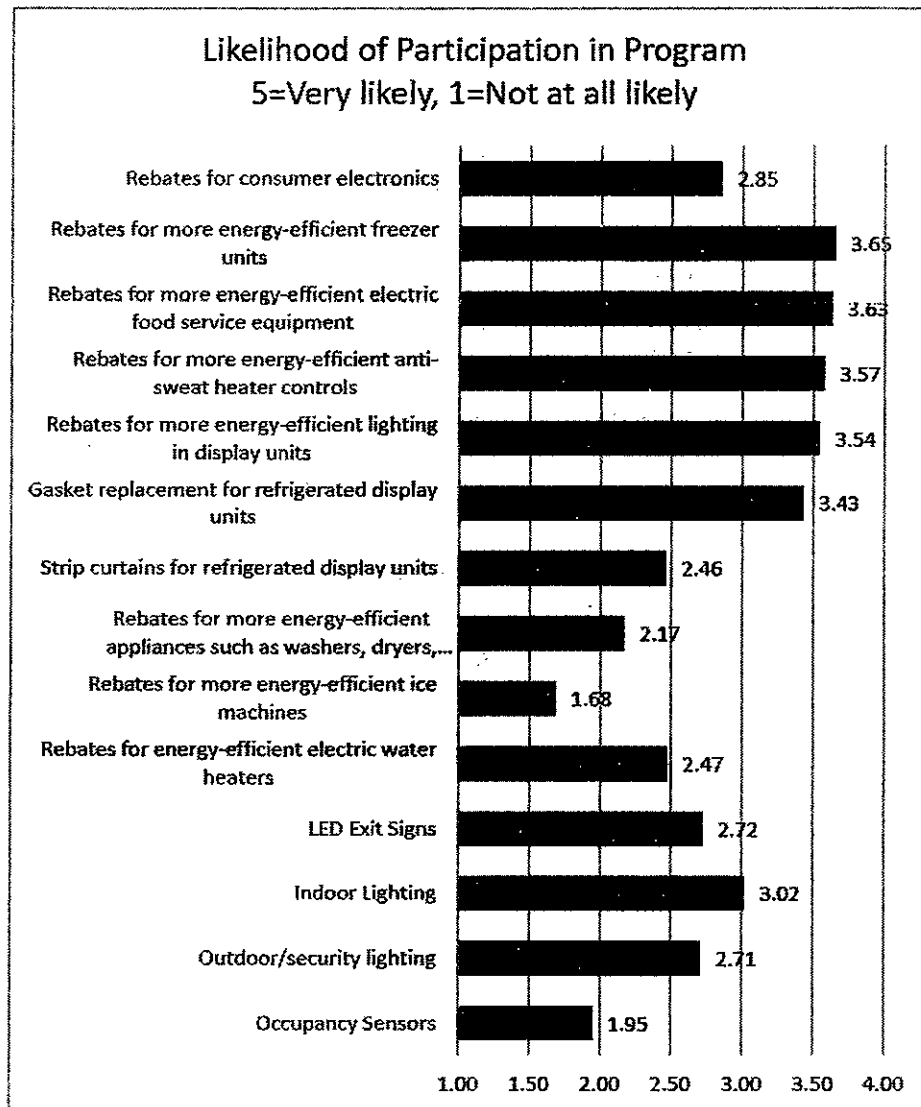


### Program Participation

Respondents were asked to rate the likelihood that they would participate in selected energy conservation programs. They were asked to use a five-point scale where 1= Not At All Likely and 5=Very Likely. Below are the results:

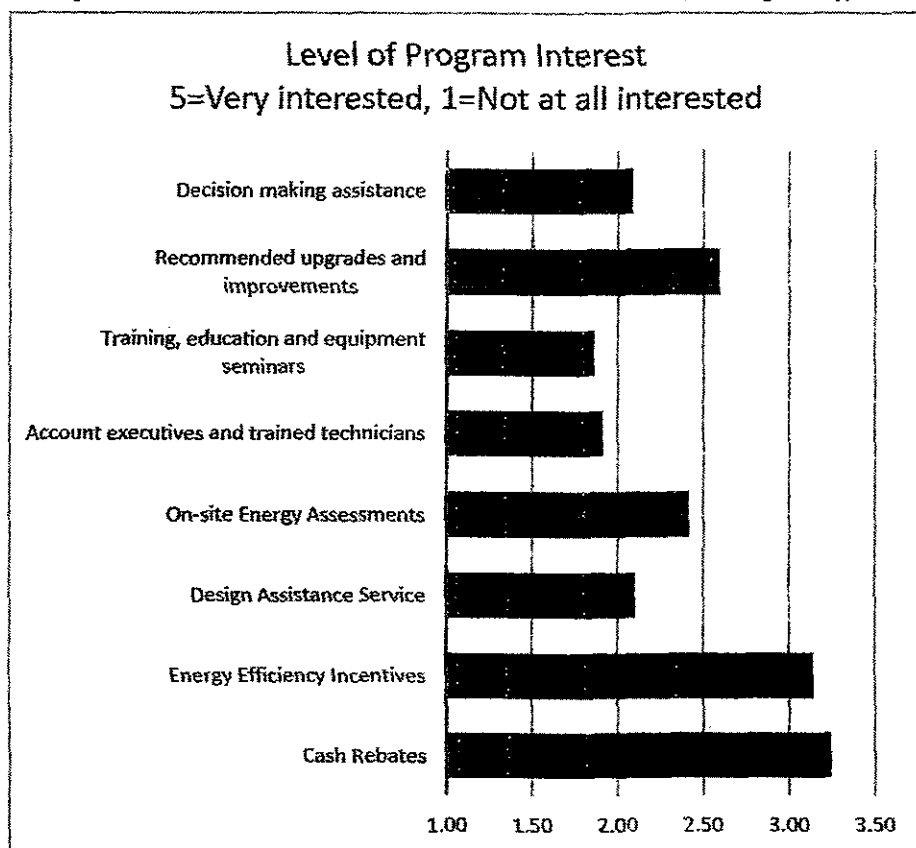


Figure 6-30 Commercial – Likelihood of Program Participation



The survey assessed respondents' interest levels in several program delivery methods. Cash rebates received the highest interest ratings.

Figure 6-31 Commercial – Mean Interest Levels in Select DSM/EE Program Types



## 7.0 ENERGY EFFICIENT TECHNOLOGIES

The Market Study considered a large number of both residential and non-residential EEPDR measures. Table 7-1 lists the number of technologies by end-use studied by the team.

Table 7-1 EEPDR Technologies Considered

Rate Class	Number Considered	Number Economic <sup>a</sup>
Residential	31	19
Commercial	34	25
Industrial	12	10

<sup>a</sup>All Measure Considered, but not all pass TRC

The evaluation started with a high-level screening process of Harbourfront's updated measure database to find the most applicable measures to screen in the Market Study Model. This preliminary screening was based on the previous Market Potential study plus additional measures that were identified as having potential in Ohio. Harbourfront personnel further screened the measure list based primarily on commercial availability, contribution to coincident summer peak load reduction, cost per kWh and/or kW saved. As a result of this screening, the following technologies were included in the modeling for this Market Study:

Table 7-2 EEPDR Technology/Measure List

Technology/Measure	Sub Program Category	Market Segment
Direct Load Control	Direct Load Control	Res
Behavioral	Behavioral	Res
Lighting Occupancy Sensors	Lighting	Res
CFL Lights POS	Lighting	Res
Plug Occupancy Sensors	Consumer Electronics	Res
POS TV	Consumer Electronics	Res
Residential Online Audit	Audits & Education	Res
Energy Efficiency Kit	EE Kits	Res
Energy Efficiency Kit-LED	EE Kits	Res
Schools Children Education	School Education	Res
Refrigerator/Freezer recycling	Appliance Turn In	Res
Room Air Conditioners recycling	Appliance Turn In	Res
Room Air Conditioners CEE TIER 3	HVAC	Res
CAC - SEER 16	HVAC	Res
EE Ground Source Heat Pump	HVAC	Res
HP Water Heater	Appliances	Res
Smart Thermostat Heat	Smart Thermostat	Res
Smart Thermostat CAC	Smart Thermostat	Res
Smart Thermostat DLC	Direct Load Control	Res
Clothes Washer CEE, Electric Water heater, Electric Dryer	Appliances	Res
Dehumidifiers 25-35 pints/day	Appliances	Res
Pump and Motor 2 Speed	Appliances	Res
Pump and Motor Variable Speed	Appliances	Res
Refrigerators-Freezers CEE TIER 2 - Side	Appliances	Res
Smart Strip plug outlet 5 plug	Appliances	Res
Residential New Construction - 30%	New Homes	Res
CAC - Maintenance	HVAC	Res
Kitchen Aerator	EE Kits	Res
Furnace Fans	HVAC	Res
Low Income Whole House (PA WARM)	LI - New Homes	LI RES
Current Community Connections	Community Connections	LI RES

Commercial and industrial technologies used in the model are listed in Table 7-3.

Table 7-3 DSM Technologies Commercial &amp; Industrial

Technology/Measure	Sub Program Category	Market Segment
Commercial, Industrial Audit - Sm&Md	Audits & Education - SCI	COM
Commercial, Industrial Audit - Large	Audits & Education - LCI	IND
Custom Building	Custom Buildings - SCI	COM
Commercial Appliance Turn-in	Appliance Turn In - SCI	COM
Exterior HID replacement above 175W to 100 HPS retrofit	Lighting - SCI	COM
LED Exit Signs Electronic Fixtures (Retrofit Only)	Lighting - SCI	COM
Lighting Design and Controls	Lighting - SCI	COM
Exterior HID replacement above 175W to 250W HID retrofit	Lighting - LCI	IND
LED Exit Signs Electronic Fixtures (Retrofit Only)	Lighting - LCI	IND
Lighting Design and Controls	Lighting - LCI	IND
LED Auto Traffic Signals 8"	Government Tariff Lighting	GOV
Street Lighting - 175 Mercury to 100 HPS	Government Tariff Lighting	GOV
AC 65,000 - 135,000 (10 Ton)	HVAC - SCI	COM
AC 240,000 - 760,000 (25 Ton)	HVAC - SCI	COM
Clothes Washer CEE, Electric Water heater, Electric Dryer	Appliances - SCI	COM
Dishwasher - Commercial	Appliances - SCI	COM
HVAC - Maintenance	HVAC - SCI	COM
Ductless Mini-Split HP	HVAC - SCI	COM
Anti Sweat Heater Controls	Food Service	COM
Clothes Dryer (Elec Heat Pump)	Appliances - SCI	COM
Efficient Dairy Equipment	Agricultural	COM
Custom - Refrigeration	Custom - SCI	COM
Refrigerators - Reach In	Food Service	COM
Freezers - Reach In	Food Service	COM
ENERGY STAR Ice Machines less than 500 lbs RC	Food Service	COM
Convection Oven	Food Service	COM
ENERGY STAR Steam Cookers 3 Pan	Food Service	COM
Hot Food Holding Cabinets	Food Service	COM
HP Water Heater	Appliances - SCI	COM
Commercial Smart Pump	Custom - SCI	COM
Commercial Smart Strip Plug Occupancy Sensors (Motion Sensor)	Appliances - SCI	COM
Pre Rinse Sprayers	Appliances - SCI	COM
Strip curtains for walk-ins - freezer	Food Service	COM
Beverage Vending Machine - Control	Food Service	COM
Window Film	HVAC - SCI	COM

Technology/Measure	Sub Program Category	Market Segment
Water-Cooled cent Chiller 150 - 300 ton 0.57 kW/ton with 0.46 kW/ton IPLV	HVAC - LCI	IND
High Efficiency Fans	Agricultural	COM
Window Film	HVAC - LCI	IND
Commercial Smart Strip plug outlet	Appliances - LCI	IND
Water Pumps with VFD's 1	Custom - LCI	IND
HVAC Fans with VFD's 1	Custom - LCI	IND
Air Compressors with VFD's 1	Custom - LCI	IND
Water Pumps with VFD's 5	Custom - LCI	IND
HVAC Fans with VFD's 5	Custom - SCI	COM
Air Compressors with VFD's 5	Custom - SCI	COM
Custom - VFDs < 10HP	Custom - LCI	IND

## 8.0 TECHNICAL POTENTIAL FOR ENERGY SAVINGS AND DEMAND REDUCTIONS

This section will highlight the results from the modeling and other analyses underlying this Market Study, and will provide:

1. Estimates of the potential demand reduction and energy savings for 15 years in the Companies' service territories;
2. The test results for cost-effectiveness for a wide variety of EEPDR measures;
3. The methodologies generally used for determining cost-effectiveness of individual measures;
4. Estimates of the costs of implementing all cost-effective EEPDR measures;
5. An identification of the technical data used to support estimated energy and demand savings attributed to each customer class; and
6. EE model outputs and resulting targeted savings and budgets per measure.

### 8.1 METHODOLOGY

Harbourfront calculated the maximum technical potential based on a top-down approach. It also created three model-based bottom-up scenarios: Economically Achievable Scenario (Economic Potential) and two Actual Achievable Scenarios, (Market Potential Base Case, Market Potential High Case). Each of the three scenarios are discussed later in this Section.

The EEPDR technologies and measures included within the scope of this Market Study were based on the various sources listed in Section 3.2 and were evaluated using the Harbourfront EEPDR Model (EE Model)<sup>14</sup>. The EE Model requires that inputs be formatted into unique measures and not included as part of a combined program. Once the results of each measure are calculated, Harbourfront aggregates the measures into groups/end-use types, which are then presented as programs.

### 8.2 MEASURE DATA

All estimated EEPDR savings are based on the various databases including: CA DEER, ACEEE, OH TRM ADM's direct EM&V, and PA TRM. All equipment costs and equipment lives are based on the TRM, publicly available data, and/or information provided by the Companies. The residential and commercial weather sensitive load savings are based on Ohio sources such as the OHIO TRM ADM's EM&V or ACEEE Reports or are calculated using eQuest simulations in accordance with TRM Appendix A.

Customer costs are based on the full incremental costs of a measure. Most measures are assumed to be replacements and not retrofitted; therefore, only the equipment costs are included. The installation costs are assumed to be the same for either the base equipment or the more efficient equipment, so the customer is not compensated for the install costs. In commercial lighting measures, installation costs for identified by square foot per the ACEEE report entitled "New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030".

<sup>14</sup> The model is licensed to FirstEnergy and remains the property of Harbourfront Group, Inc. FirstEnergy has full rights to obtain values from and utilize this model.

For each of the Companies, Harbourfront reviewed different Residential, Commercial and Industrial EEPDR programs that incorporated a total of 77 measures as summarized below:

Table 8-1 Programs Evaluated (By Class & Type)<sup>15</sup>

Rate Class	Number Considered	Number Economic <sup>+</sup>
Residential	31	19
Commercial	34	25
Industrial	12	10

<sup>+</sup>All Measure Considered in Plan, but not all pass TRC

### 8.3 MAXIMUM TECHNICAL POTENTIAL

There are a number of approaches to determine maximum technical potential. Harbourfront uses a top-down approach that builds on end-use intensities (EUIs) and unit energy consumptions (UECs) presented in this Section.

This approach determines three levels of energy consumption.

1. Assuming that every unit in the service area was a baseline unit, the resulting consumption would lead to Baseline EUIs/UECs.
2. Assuming Current Market Average EUIs/UECs. This average reflects the stock of units of all vintages and Efficiency levels in the market today.
3. Assuming every unit in the service area was converted to the most energy-efficient technology available, the resulting consumption would be Most Efficient EUIs/UECs.

$$\text{Max. Savings (\%)} = \frac{\text{Baseline EUI (or UEC)} - \text{Efficient EUI(or UEC)}}{\text{Baseline EUI (or UEC)}}$$

<sup>15</sup> All measures considered in the EEPDR Plan, but not all passed the TRC test.



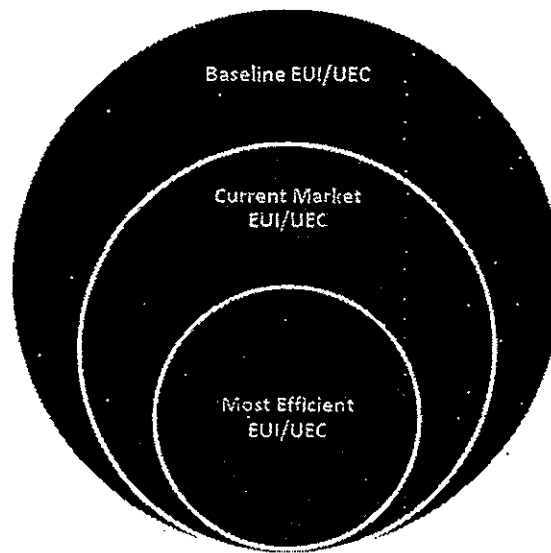


Figure 8-1 Energy Consumption Levels

The analysis of technical potential is based on the premise that at any point, market energy consumption lies in between the baseline consumption and most efficient consumption. Hence, the current state of market ( $\lambda$ ) can be assessed by solving one of the following equations for  $\lambda$ .

$$\text{Market Average EUI} = \lambda * \text{Efficient EUI} + (1 - \lambda) * \text{Baseline EUI}$$

Or

$$\text{Market Average UEC} = \lambda * \text{Efficient UEC} + (1 - \lambda) * \text{Baseline UEC}$$

Where  $\lambda$ : Proportion of fixtures/units in market that can be considered to be efficient.

Note that  $\lambda$  is a notional proportion calculated considering only two levels of efficiencies in the market, i.e. baseline and most efficient.

Once the current state of market is known, technical potential can be calculated using a simple formula.

$$\text{Technical Potential (\%)} = (1 - \lambda) * \text{Max. Savings (\%)}$$

### 8.3.1 Residential Technical Potential

Table 8-2 represents Harbourfront's estimate of the current market state and technical potential for major end uses. Residential technical potential calculations were performed using UECs by end use. A blanket potential of 33% of current kWh usage is used for miscellaneous loads.

Table 8-2 Residential Technical Potential (%) by End Use

End Use	Maximum Savings (%)	Current Market State (%)	1-2	Technical Potential (%)
Lighting	63.0%	18.6%	81.4%	51.3%
Elec Space Heating	77.9%	87.6%	12.4%	9.6%
Air Conditioning	38.1%	43.5%	56.5%	21.5%
Refrigerators	36.7%	-28.8%	128.8%	47.3%
Elec Water Heating	37.5%	51.5%	48.5%	18.2%
Dish washer	36.1%	90.5%	9.5%	3.4%
Freezers	10.1%	0.4%	99.6%	10.1%
Clothes Washer	63.2%	36.7%	63.3%	40.0%
Clothes Dryers	63.2%	53.1%	46.9%	29.6%
Misc Appliances / Plug Loads	N/A	N/A	N/A	33.0%

Harbourfront identifies residential lighting, refrigeration and air conditioning as the biggest saving opportunities on the residential side with a technical potential of 5.92%, 6.05% and 3.14% of the Companies' total residential sales, respectively.

Table 8-3 Residential Technical Potential by Company

End Use	CE	OE	TE	OH Total	% of Res Sales
Lighting	324,395	549,447	143,860	1,017,702	5.92%
Elec Space Heating	55,724	85,723	24,493	165,939	0.97%
Air Conditioning	164,214	287,202	87,239	538,655	3.14%
Refrigerators	369,600	518,186	151,606	1,039,392	6.05%
Elec Water Heating	63,441	136,957	33,268	233,666	1.36%
Dish washer	4,909	6,308	1,812	13,029	0.08%
Freezers	12,524	21,106	5,500	39,131	0.23%
Clothes Washer	140,818	201,650	56,268	398,736	2.32%
Clothes Dryers	68,810	96,473	28,666	193,950	1.13%
Misc Appliances / Plug Loads	505,910	941,433	224,413	1,671,756	9.73%
<b>Total Technical Potential</b>	<b>1,710,345</b>	<b>2,844,485</b>	<b>757,126</b>	<b>5,311,956</b>	<b>30.92%</b>
<b>Percent of total Sales</b>	<b>31.15%</b>	<b>30.85%</b>	<b>30.67%</b>	<b>30.92%</b>	

### 8.3.2 Small Commercial Customer Technical Potential

Table 8-4 represents Harbourfront's technical potential estimate for small commercial customers by end use. The commercial sector calculations are performed using EUIs. Again, a blanket potential of 33% of current kWh usage is used for miscellaneous loads.

Table 8-4 Commercial Technical Potential by End-Use

End Use	Maximum Savings (%)	Current Market State (%)	Tech. Potential	Tech. Potential (MWh)	% of OH Commercial Sales
Space Heating	46.6%	22.2%	36.2%	241,110	1.6%
Cooling	53.9%	14.7%	46.0%	909,381	6.0%
Ventilation	59.5%	14.4%	50.9%	901,247	5.9%
Water Heat	36.5%	28.4%	26.1%	85,189	0.6%
Lighting	42.3%	0.8%	42.0%	2,530,033	16.7%
Cooking	25.0%	66.6%	8.4%	7,097	0.0%
Refrigeration	40.0%	57.9%	16.8%	254,008	1.7%
Other Office Equipment	49.7%	5.2%	47.1%	139,103	0.9%
Computers	79.2%	5.2%	75.1%	556,217	3.7%
Misc / Other	33.0%	8.8%	30.1%	539,411	3.6%
Total				6,162,796	40.6%

The study indicates large opportunities in lighting and HVAC (space cooling and ventilation) programs. Together, these two end-uses have a technical potential amounting to 28.6% of present sales.

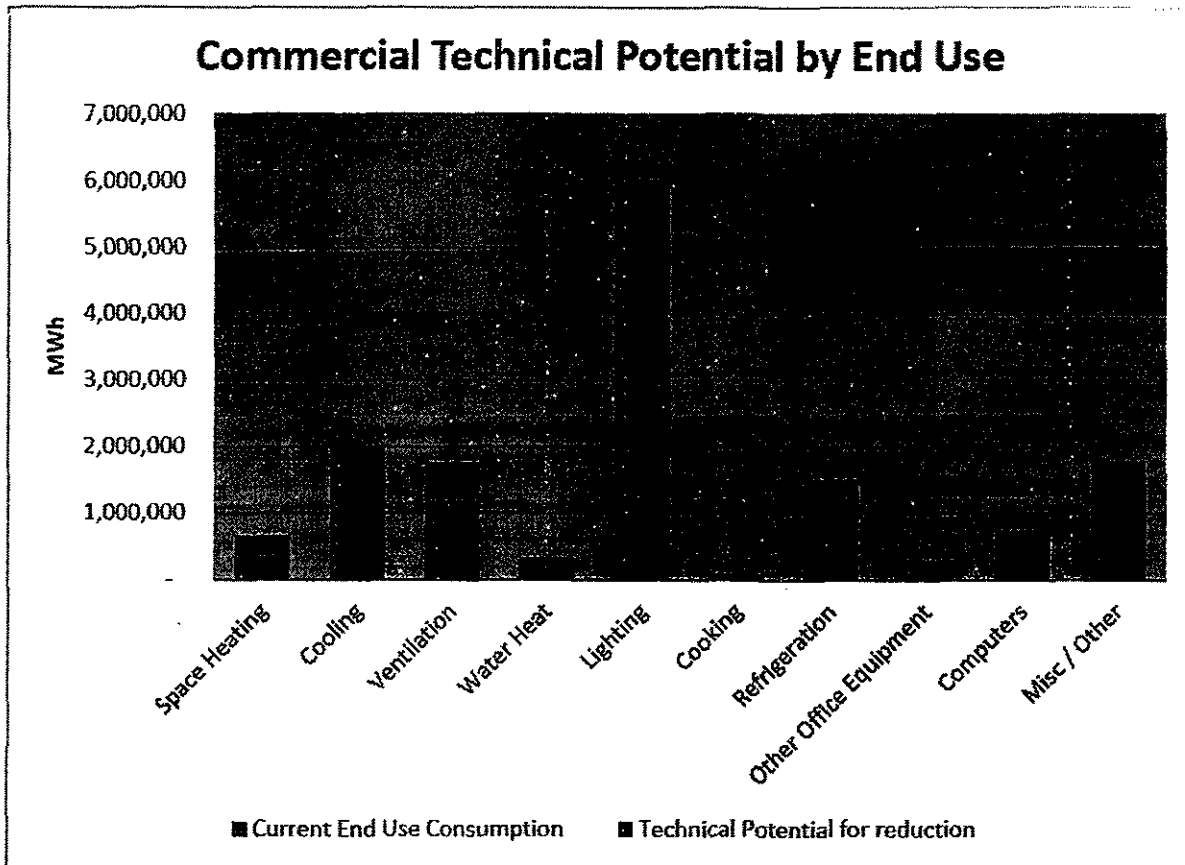


Figure 8-2 Commercial Potential by End Use

Table 8-5 represents technical potential by building type. The highest potential opportunity for reduction in energy consumption were found in educational buildings, at 45%. However, a comparatively small number of such facilities translate to savings of only 3.7% of total sales. Major savings can be achieved in office buildings and mercantile buildings at 10.7% and 6.5%, respectively, of total small commercial sales.

Table 8-5 Commercial Technical Potential by Building Type

Commercial Building Types (CBECS):	Technical Potential	Technical Potential (MWh)	% of OH Commercial Sales
Education	45.0%	563,332	3.7%
Food Sales	27.3%	177,291	1.2%
Food Service	31.9%	226,395	1.5%
Health Care	42.5%	525,097	3.5%
Inpatient	43.4%	364,469	2.4%
Outpatient	40.0%	158,216	1.0%
Lodging	39.9%	471,538	3.1%
Mercantile	39.6%	984,757	6.5%
Retail (Other Than Mall)	39.6%	302,672	2.0%
Enclosed and Strip Malls	39.6%	618,673	4.1%
Office	43.7%	1,621,118	10.7%
Public Assembly	43.5%	293,003	1.9%
Public order and safety	43.7%	146,340	1.0%
Religious Worship	37.6%	76,832	0.5%
Service	40.5%	223,855	1.5%
Warehouse and Storage	38.3%	588,496	3.9%
Other	40.5%	250,822	1.7%
Vacant	38.3%	79,746	0.5%
<b>Total</b>		<b>6,162,796</b>	<b>40.6%</b>

### 8.3.3 FirstEnergy Ohio Total Technical Potential

Below is a summary of the Companies' technical potential as a sales weighted average of individual class technical potentials.

Table 8-6 FirstEnergy Ohio Technical Potential

Sector	2015 Sale MWh	Technical Potential (%)	Technical Potential (MWh)
Residential	17,180,611	30.9%	5,311,956
Commercial	15,185,355	40.6%	6,160,329
Industrial	20,547,490	40.6%	8,335,616
Street Lighting	334,692	42.0%	140,430
<b>Total</b>	<b>53,248,148</b>	<b>37.5%</b>	<b>19,948,331</b>

## 8.4 ECONOMIC POTENTIAL

The Economic Potential scenario estimates the economically achievable potential and will accompany Harbourfront's Maximum Technical potential presentation as a bottom-up confirmation. Economic Potential took the 77 measures and used a premise based on obtaining all savings that are economically achievable for all of the Companies' customers. This scenario has a one-year time horizon where all savings are deemed theoretically obtainable from all subscribing customers. The scenario also factors in the Companies' customers who have already taken energy saving actions.

The number of assumed program recipients (participants) under the Economic Potential scenario is based on survey data, which accounts for those who stated they have already made the EEPDR change. This approach does not take into account equipment life but rather simulates that all equipment would be changed in the first year. Budgets are based on a cost per measure item using Base Achievable Case Assumptions.<sup>16</sup> For OE, there is a potential to save 9,179 GWh and 1,312MW. For CEI, there is a potential to save 5,896 GWh and 889 MW. For TE, there is a potential to save 3,557 GWh and 512 MW.

## 8.5 ACHIEVABLE POTENTIAL (BASE & HIGH CASE)

These scenarios have study periods from 2017-2031, the years in which the savings will be obtainable from all subscribing customers when they either need to replace equipment or have shown interest in installing an energy saving measure. These scenarios apply the results of the Companies' mail and telephone surveys. The residential achievable numbers were based on mail survey data, including the number of people who have a particular end-use, plus those who have indicated an interest in a particular program. There are two levels of interest based on the program parameters that follow: Option 1 includes people who responded "I plan to change" or responded "5 out of 5" in interest in a measure when asked on the survey. This option envisions programs that are designed to contribute to all measures, such that all measures have a positive payback period for the participants and have incentives that are also reasonable for the Companies. Option 2, includes people who responded "I am considering changing" and includes people who responded "4

<sup>16</sup> This study has two Market Achievable cases, Base and High. In the High Case, utility budgets for marketing and customer incentives are increased by measure unit to achieve the higher penetration. The Economic Potential study used the Base Case per measure utility costs.

out of 5" in interest in a measure. In this second option, it is assumed that the Companies will need to spend more money on both marketing and incentives.

For the commercial measures there are many repetitive programs such as the various types of motors that can be installed. Only some of the programs are used to evaluate the quantity of kWh and kW savings that a program can produce. These programs were chosen based on their general representation of the amount of savings that each can yield. These representative programs were matched to the survey data to quantify the number of items/equipment that could be installed.

## 8.6 GLOBAL ASSUMPTIONS:

Harbourfront's approach uses global assumptions within the EE Model. There are two types of inputs, for example, one-time inputs, such as inflation and annual inputs such as the forecasted number of residential customers.

Some of the global assumptions were as follows:

1. Number of Residential Customers as forecasted by the Companies;
2. Number of Commercial and Industrial Customers as forecasted by the Companies;
3. Number of Motors is based on the large commercial customer survey's inventory and data from existing programs in other states;
4. Free Riders and Spill Over percentages were set to cancel each other out;
5. Discount Rate = 8.48%;
6. Average Retail Rate: 10 cents (Supply and Distribution costs per kWh);<sup>17</sup>
7. The number of opt-out customers was set to zero; and
8. Current Efficiency standards were as deemed, with no adjustment for potential future changes.

## 8.7 SURVEY DATA

The survey results for the residential and commercial classes are presented in Section 6.0. There were specific questions asked in the surveys to identify customer participation in programs. The residential survey was conducted by mail and the small and mid-commercial survey was conducted by telephone. The two surveys were utilized in both of the achievable scenarios and applied to the appropriate customer groups. Some survey questions were more complex, such as: "how many CFL light bulbs do you have in service and how many hours are they on?" This information is used to identify how many CFL light bulbs exist in the service territory in order to exclude them from both the economically achievable and achievable scenarios as well as identify how many CFL lights will be beneficial to install.

## 8.8 MEASURE BUDGETS

Budgets were determined for each measure based on implementation, and administrative & general costs. The Implementation budgets are per unit cost. The measure per unit cost is based upon costs such as; utility personnel, supplies, vendor costs, and sales incentives paid to retailers. This number ranges from around \$1.11 per lamp to \$19,320 for the large Custom Building program.

<sup>17</sup> Source: EIA Publication dated March 24, 2016, "State Electricity Profiles-2014-Ohio-Retail Electricity Price (cents/kWh)"; <http://www.eia.gov/electricity/state/>

## 8.9 AVOIDED COSTS

The avoided generation capacity and energy supply costs are based on the Companies' forecast of capacity and energy prices utilized in Stipulated ESP IV.

The avoided transmission and distribution capacity costs are based on the Avoided T & D Study performed by Harbourfront for the Companies.<sup>18</sup>

## 8.10 SAVINGS MANDATES

The Companies' plans are required to meet various incremental kWh and kW saving per year until 2027 and 2020, respectively. As an example, the kWh savings mandates are based on the three previous years' sales and continue to grow until they reach 2% of the average of the three previous years of sales. This target is incremental, meaning that another "X"<sup>19</sup> percent of sales will be needed each year. The source of the calculations for both the kWh (22% by 2027) and kW (7.5% by the 2020 system peak) savings was the forecasts provided by the Companies for each service territory. This was the basis for the EEPDR requirement calculations.

## 8.11 ECONOMICALLY ACHIEVABLE RESULTS

Economically achievable potential starts with the programs that have passed the TRC test and uses a one-year time horizon where all savings are assumed to be obtainable from all participating customers. The following tables provide the results of the EE Models by Company. For the three Companies, economic potential ranges between 20% and 23% of peak demand. The largest of the three Companies, OE, could reduce its peak demand by 23%, with the smallest Company, CEI, reaching 20% reduction of its peak load. The energy savings associated with the economic potential programs varied between 35.9% for OE to 30.1% for CEI. While these reductions reflect programs that passed the TRC test, it does not reflect customer choice budgetary considerations or plan timeframe. In other words, while the programs are cost-effective, not all eligible customers will likely elect to participate.

Table 8-7 kW and MWh Savings – OE

Economically Achievable Results		
Electric Impacts/Savings		
	Peak MW	Usage MWh
Forecast Sales & Peak 2031	5,725	25,561,947
Economically Achievable	1,312	9,178,975
% Economically Achievable	22.9%	35.9%

<sup>18</sup> April 2016 Avoided T & D Study performed by Harbourfront Group, Inc.

<sup>19</sup> "X" indicates the percentage changes by year.



Table 8-8 kW and MWh Savings – CEI

Economically Achievable Results		
Electric Impacts/Savings		
	Peak MW	Usage MWh
Forecast Sales & Peak 2031	4,368	19,571,138
Economically Achievable	889	5,896,105
% Economically Achievable	20.4%	30.1%

Table 8-9 kW and MWh Savings – TE

Economically Achievable Results		
Electric Impacts/Savings		
	Peak MW	Usage MWh
Forecast Sales & Peak 2031	2,464	11,477,218
Economically Achievable	512	3,556,632
% Economically Achievable	20.8%	31.0%

The following tables present the costs associated with the programs included in the economic potential estimates for each Company. The implementation costs will vary and are a function of the unique programs for each Company. Similarly, the incentives reflect the specific measures and the number of participants in the program. Savings costs (program costs divided by savings) range from \$0.018 for TE and \$0.026 for CEI. Cost of capacity savings vary between \$173/kW for CEI and \$122/kW for TE.

Table 8-10 Utility Program Costs – OE

Utility Program Costs	
Overall Costs	
Category	Total
Implementation	\$106,016,874
Incentives	\$107,011,708
Total	\$213,028,582
Total Costs per kW & kWh Saved	
	Total
\$/kW	\$162.40
\$/kWh	\$0.023

Table 8-11 Utility Program Costs – CEI

Utility Program Costs	
Overall Costs	
Category	Total
Implementation	\$79,603,308
Incentives	\$74,986,116
Total	\$154,589,424
Total Costs per kW & kWh Saved	
	Total
\$/kW	\$173.80
\$/kWh	\$0.026

Table 8-12 Utility Program Costs – TE

Utility Program Costs	
Overall Costs	
Category	Total
Implementation	\$31,584,111
Incentives	\$31,015,521
Total	\$62,599,632
Total Costs per kW & kWh Saved	
\$/kW	\$122.26
\$/kWh	\$0.018

The avoided energy costs are expected to yield more than \$802 million in benefits, accounting for nearly 73% of total avoided costs of \$1.103 billion across the three companies.

Table 8-13 Avoided Costs – OE

Avoided Costs (Cumulative Electric)			
	Energy	Capacity	Total Benefits
Cumulative Total	\$397,650,600	\$147,349,863	\$545,000,463

Table 8-14 Avoided Costs – CEI

Avoided Costs (Cumulative Electric)			
	Energy	Capacity	Total Benefits
Cumulative Total	\$289,093,378	\$110,781,234	\$399,874,612

Table 8-15 Avoided Costs – TE

Avoided Costs (Cumulative Electric)			
	Energy	Capacity	Total Benefits
Cumulative Total	\$115,270,972	\$43,241,172	\$158,512,145

On an aggregate basis, all programs pass the TRC requirements with ratios for Companies ranging between 1.53 for CEI and 1.69 for OE. The incentive costs and program cost levels make the programs cost-effective from both the participant and utility perspectives.

Table 8-16 Cost Test Results – OE

Cost Test Results	
Tests	Total (All Years)
Utility Test	2.29
TRC Test	1.69
Participant Test	5.93

Table 8-17 Cost Test Results – CEI

Cost Test Results	
Tests	Total (All Years)
Utility Test	2.15
TRC Test	1.53
Participant Test	5.28

Table 8-18 Cost Test Results – TE

Cost Test Results	
Tests	Total (All Years)
Utility Test	2.21
TRC Test	1.62
Participant Test	5.81

The following tables show the cost-effectiveness of the programs included in the economic potential analysis. The Appliance Turn-in Program has the highest TRC values of all of the residential programs and this result was consistent across the three Companies.

Table 8-19 Summary of Measure Tests by Program – OE

Summary of Measure Tests by Program				
Sub Program Name	Class	Today's Value Utility Test	Today's Value TRC Test	Today's Value Participant Test
Direct Load Control	Res	1.01	0.69	0.62
Behavioral	Res	1.00	1.00	0.00
Lighting	Res	4.26	3.31	14.35
Consumer Electronics	Res	1.43	1.43	5.55
Audits & Education	Res	0.89	0.89	0.00
EE Kits	Res	1.16	2.14	0.00
School Education	Res	0.61	0.93	0.00
Appliance Turn In	Res	2.34	2.89	0.00
HVAC	Res	1.60	0.37	0.85
Smart Thermostat	Res	1.17	0.55	1.57
Appliances	Res	2.05	1.94	5.60
New Homes	Res	1.55	1.13	3.82
LI - New Homes	LI RES	0.49	0.36	2.15
Community Connections	LI RES	0.48	0.86	NA
Audits & Education - SCI	COM	0.73	0.86	10.52
Audits & Education - LCI	IND	2.57	2.96	42.67
Custom Buildings - SCI	COM	1.06	0.87	4.89
Appliance Turn In - SCI	COM	2.33	2.88	0.00
Lighting - SCI	COM	2.10	1.26	3.61
Lighting - LCI	IND	2.15	1.46	4.43
Government Tariff Lighting	GOV	8.58	1.59	2.36
HVAC - SCI	COM	2.95	1.39	2.28
Appliances - SCI	COM	2.21	1.83	6.28
Food Service	COM	2.52	2.33	9.07
Agricultural	COM	0.69	0.38	1.55
Custom - SCI	COM	6.02	5.26	22.32
Custom - LCI	IND	2.71	2.65	14.12
HVAC - LCI	IND	3.13	2.50	6.52
Appliances - LCI	IND	3.63	4.14	20.00
Mercantile Self Directed Projects	IND	27.33	27.33	NA
T&D Projects	IND	0.00	0.00	NA

Table 8-20 Summary of Measure Tests by Program – CEI

Summary of Measure Tests by Program				
Sub Program Name	Class	Today's Value Utility Test	Today's Value TRC Test	Today's Value Participant Test
Direct Load Control	Res	1.01	0.69	0.61
Behavioral	Res	0.91	0.91	0.00
Lighting	Res	4.39	3.48	15.62
Consumer Electronics	Res	1.50	1.50	5.91
Audits & Education	Res	0.89	0.89	0.00
EE Kits	Res	1.16	2.14	0.00
School Education	Res	0.61	0.93	0.00
Appliance Turn In	Res	2.35	2.91	0.00
HVAC	Res	1.61	0.37	0.82
Smart Thermostat	Res	1.16	0.54	1.55
Appliances	Res	1.98	1.89	5.61
New Homes	Res	1.89	1.38	4.32
LI - New Homes	LI RES	0.48	0.36	2.09
Community Connections	LI RES	0.50	0.90	NA
Audits & Education - SCI	COM	0.71	0.84	10.22
Audits & Education - LCI	IND	2.28	2.63	37.83
Custom Buildings - SCI	COM	0.96	0.79	4.44
Appliance Turn In - SCI	COM	2.11	2.61	0.00
Lighting - SCI	COM	2.12	1.25	3.57
Lighting - LCI	IND	2.14	1.47	4.48
Government Tariff Lighting	GOV	9.66	1.38	2.12
HVAC - SCI	COM	2.92	1.42	2.39
Appliances - SCI	COM	2.18	1.89	6.68
Food Service	COM	2.25	2.17	8.89
Agricultural	COM	0.60	0.33	1.35
Custom - SCI	COM	5.90	5.06	21.10
Custom - LCI	IND	2.71	2.65	14.12
HVAC - LCI	IND	2.91	2.33	6.32
Appliances - LCI	IND	3.63	4.14	20.00
Mercantile Self Directed Projects	IND	0.00	0.00	NA
T&D Projects	IND	0.00	0.00	NA

Table 8-21 Summary of Measure Tests by Program – TE

Summary of Measure Tests by Program				
Sub Program Name	Class	Today's Value Utility Test	Today's Value TRC Test	Today's Value Participant Test
Direct Load Control	Res	0.99	0.69	0.62
Behavioral	Res	0.88	0.88	0.00
Lighting	Res	4.37	3.46	15.44
Consumer Electronics	Res	1.51	1.51	6.01
Audits & Education	Res	0.89	0.89	0.00
EE Kits	Res	1.16	2.14	0.00
School Education	Res	0.61	0.93	0.00
Appliance Turn In	Res	2.23	2.74	0.00
HVAC	Res	1.60	0.37	0.85
Smart Thermostat	Res	1.16	0.54	1.56
Appliances	Res	2.09	1.98	5.52
New Homes	Res	1.38	1.01	3.28
LI - New Homes	LI RES	0.48	0.36	2.10
Community Connections	LI RES	0.46	0.84	NA
Audits & Education - SCI	COM	0.45	0.53	6.51
Audits & Education - LCI	IND	2.25	2.60	37.43
Custom Buildings - SCI	COM	0.97	0.79	4.48
Appliance Turn In - SCI	COM	2.01	2.45	0.00
Lighting - SCI	COM	2.06	1.16	3.28
Lighting - LCI	IND	2.14	1.48	4.50
Government Tariff Lighting	GOV	17.06	0.96	1.59
HVAC - SCI	COM	2.97	1.40	2.31
Appliances - SCI	COM	2.18	1.88	6.65
Food Service	COM	2.52	2.25	8.52
Agricultural	COM	0.66	0.36	1.48
Custom - SCI	COM	5.83	4.96	20.47
Custom - LCI	IND	2.71	2.65	14.12
HVAC - LCI	IND	2.83	2.26	6.19
Appliances - LCI	IND	3.62	4.13	20.00
Mercantile Self Directed Projects	IND	0.00	0.00	NA
T&D Projects	IND	0.00	0.00	NA

Table 8-22 through Table 8-24 summarize the measure costs by program.

Table 8-22 Summary of Measure Costs by Program – OE

Summary of Measure Costs by Program							
Program Name	Class	Participant Costs	Program Benefits	Total Avoid Costs Energy	Total Avoid Costs Capacity	Implementation Costs	Incentive Costs
Direct Load Control	Res	\$19,896,650	\$37,019,944	\$4,810,897	\$32,209,047	\$30,139,567	\$3,316,108
Behavioral	Res	\$0	\$6,488,888	\$5,241,340	\$1,247,548	\$6,517,971	\$0
Lighting	Res	\$12,465,861	\$89,191,403	\$75,659,029	\$13,532,374	\$7,974,596	\$6,470,737
Consumer Electronics	Res	\$3,621,945	\$10,794,348	\$8,789,190	\$2,005,158	\$327,822	\$3,621,945
Audits & Education	Res	\$0	\$4,331,572	\$3,429,592	\$901,981	\$4,863,325	\$0
EE Kits	Res	\$0	\$85,978,810	\$70,545,525	\$15,433,285	\$6,282,193	\$33,914,378
School Education	Res	\$0	\$7,349,082	\$6,102,762	\$1,246,321	\$3,816,786	\$4,074,002
Appliance Turn In	Res	\$0	\$165,209,052	\$125,983,814	\$39,225,238	\$43,401,316	\$13,672,510
HVAC	Res	\$328,895,602	\$138,637,363	\$97,088,451	\$41,548,912	\$2,693,297	\$41,942,028
Smart Thermostat	Res	\$11,908,669	\$9,182,092	\$8,347,736	\$834,356	\$1,883,146	\$2,977,167
Appliances	Res	\$9,680,233	\$38,116,185	\$22,070,582	\$16,045,603	\$1,291,481	\$8,634,350
New Homes	Res	\$20,818,336	\$42,137,250	\$30,267,428	\$11,869,822	\$5,940,073	\$10,621,600
LI - New Homes	LI RES	\$176,266	\$259,170	\$144,076	\$115,093	\$534,278	\$0
Community Connections	LI RES	\$475	\$5,654,730	\$4,740,350	\$914,380	\$1,258,668	\$5,287,500
Audits & Education - SCI	COM	\$7,789,713	\$37,002,614	\$31,154,627	\$5,847,987	\$19,845,133	\$15,579,427
Audits & Education - LCI	IND	\$910,676	\$17,584,666	\$14,775,414	\$2,809,253	\$3,200,883	\$1,821,353
Custom Buildings - SCI	COM	\$42,469,049	\$93,914,242	\$78,910,895	\$15,003,348	\$43,553,601	\$22,542,840
Appliance Turn In - SCI	COM	\$0	\$3,413,157	\$2,635,287	\$777,871	\$907,765	\$277,114
Lighting - SCI	COM	\$152,755,217	\$270,472,036	\$211,076,977	\$59,395,059	\$-3,942,600	\$66,306,104
Lighting - LCI	IND	\$37,371,542	\$82,066,927	\$63,112,729	\$18,954,197	\$-796,638	\$19,503,840
Government Tariff Lighting	GOV	\$2,629,692	\$3,014,182	\$2,585,398	\$428,784	\$-1,821,174	\$1,086,284
HVAC - SCI	COM	\$17,949,394	\$32,972,205	\$14,931,927	\$18,040,277	\$491,756	\$5,350,823
Appliances - SCI	COM	\$1,612,092	\$5,144,133	\$4,196,704	\$947,429	\$70,056	\$1,130,946
Food Service	COM	\$3,023,900	\$13,514,189	\$11,540,528	\$1,973,661	\$203,510	\$2,580,514
Agricultural	COM	\$3,361,989	\$2,277,868	\$2,085,490	\$192,378	\$1,943,685	\$683,331
Custom - SCI	COM	\$33,292,340	\$343,325,067	\$265,762,814	\$77,562,253	\$6,966,666	\$25,022,597
Custom - LCI	IND	\$144,045,801	\$1,028,787,274	\$777,958,889	\$250,828,385	\$109,283,350	\$135,210,567
HVAC - LCI	IND	\$13,280,811	\$60,945,345	\$28,715,869	\$32,229,476	\$2,663,599	\$8,410,561
Appliances - LCI	IND	\$19,949	\$195,375	\$165,943	\$29,432	\$665	\$26,599
Mercantile Self Directed Projects	IND	\$0	\$67,120,389	\$67,107,612	\$12,777	\$2,455,866	\$0
T&D Projects	IND	\$0	\$12,654,103	\$12,651,785	\$2,318	\$0	\$0



Table 8-23 Summary of Measure Costs by Program – CEI

Summary of Measure Costs by Program							
Program Name	Class	Participant Costs	Program Benefits	Total Avoid	Total Avoid	Implementation Costs	Incentive Costs
				Costs Energy	Costs Capacity		
Direct Load Control	Res	\$14,688,797	\$27,297,167	\$3,518,685	\$23,778,482	\$22,254,231	\$2,448,133
Behavioral	Res	\$0	\$4,463,107	\$3,605,034	\$858,073	\$4,882,086	\$0
Lighting	Res	\$9,431,480	\$73,442,359	\$62,298,146	\$11,144,213	\$6,579,437	\$5,082,371
Consumer Electronics	Res	\$1,953,653	\$6,127,942	\$5,017,030	\$1,110,912	\$177,709	\$1,953,653
Audits & Education	Res	\$0	\$3,217,533	\$2,547,533	\$670,000	\$3,612,524	\$0
EE Kits	Res	\$0	\$62,135,789	\$50,977,192	\$11,158,597	\$4,534,011	\$24,491,625
School Education	Res	\$0	\$5,356,394	\$4,448,011	\$908,383	\$2,781,872	\$2,969,345
Appliance Turn In	Res	\$0	\$126,041,033	\$95,371,274	\$30,669,759	\$32,883,521	\$10,428,453
HVAC	Res	\$216,817,679	\$91,793,289	\$61,310,474	\$30,482,815	\$1,897,917	\$27,612,536
Smart Thermostat	Res	\$8,105,012	\$6,160,971	\$5,586,575	\$574,396	\$1,281,665	\$2,026,253
Appliances	Res	\$4,873,020	\$19,022,123	\$11,128,766	\$7,893,357	\$801,192	\$4,409,853
New Homes	Res	\$15,066,254	\$37,222,965	\$24,726,272	\$12,496,693	\$4,298,838	\$7,686,864
LI - New Homes	LI RES	\$178,266	\$255,106	\$140,012	\$115,093	\$534,278	\$0
Community Connections	LI RES	\$475	\$5,865,282	\$4,916,866	\$948,427	\$1,258,668	\$5,287,500
Audits & Education - SCI	COM	\$5,330,934	\$24,713,799	\$20,709,797	\$4,004,002	\$13,581,129	\$10,661,868
Audits & Education - LCI	IND	\$423,947	\$7,258,183	\$6,098,646	\$1,159,537	\$1,490,106	\$847,894
Custom Buildings - SCI	COM	\$31,328,655	\$62,983,501	\$52,921,519	\$10,061,981	\$32,128,710	\$16,629,478
Appliance Turn In - SCI	COM	\$0	\$2,331,077	\$1,799,545	\$531,532	\$684,016	\$209,151
Lighting - SCI	COM	\$182,971,286	\$337,431,213	\$263,854,766	\$73,576,448	\$6,880,307	\$82,967,407
Lighting - LCI	IND	\$35,923,500	\$79,868,763	\$61,351,746	\$18,517,017	\$673,228	\$18,942,987
Government Tariff Lighting	GOV	\$2,290,487	\$2,328,114	\$2,021,074	\$307,041	-\$1,456,653	\$848,841
HVAC - SCI	COM	\$17,785,328	\$33,638,968	\$15,601,102	\$18,037,865	\$450,805	\$5,534,114
Appliances - SCI	COM	\$1,424,676	\$4,843,192	\$3,945,478	\$897,714	\$63,696	\$1,076,817
Food Service	COM	\$1,792,829	\$7,769,940	\$6,786,672	\$983,267	\$128,766	\$1,662,722
Agricultural	COM	\$2,991,809	\$1,737,131	\$1,637,224	\$99,907	\$1,716,630	\$577,874
Custom - SCI	COM	\$22,702,788	\$221,160,096	\$171,389,639	\$49,790,457	\$4,463,415	\$16,514,319
Custom - LCI	IND	\$72,282,845	\$516,250,179	\$390,383,344	\$125,866,836	\$54,838,887	\$67,849,283
HVAC - LCI	IND	\$7,822,312	\$32,977,336	\$18,663,189	\$16,314,147	\$1,352,209	\$4,992,418
Appliances - LCI	IND	\$10,011	\$98,040	\$83,271	\$14,769	\$341	\$13,347
Mercantile Self Directed Projects	IND	\$0	\$0	\$0	\$0	\$977,585	\$0
T&D Projects	IND	\$0	\$0	\$0	\$0	\$0	\$0

Table 8-24 Summary of Measure Costs by Program – TE

Summary of Measure Costs by Program							
Program Name	Class	Participant Costs	Program Benefits	Total Avoid Costs Energy Costs	Total Avoid Costs Capacity	Implementation Costs	Incentive Costs
Direct Load Control	Res	\$5,486,725	\$10,242,712	\$1,360,704	\$8,882,007	\$8,537,979	\$914,454
Behavioral	Res	\$0	\$1,652,863	\$1,335,085	\$317,778	\$1,881,521	\$0
Lighting	Res	\$3,314,941	\$25,515,668	\$21,643,957	\$3,871,711	\$2,285,262	\$1,777,013
Consumer Electronics	Res	\$742,839	\$2,359,669	\$1,934,420	\$425,249	\$78,924	\$742,839
Audits & Education	Res	\$0	\$1,231,002	\$974,666	\$256,337	\$1,382,122	\$0
EE Kits	Res	\$0	\$24,001,508	\$19,692,278	\$4,309,229	\$1,752,617	\$8,464,171
School Education	Res	\$0	\$2,059,744	\$1,710,435	\$349,309	\$1,069,739	\$1,141,830
Appliance Turn In	Res	\$0	\$48,754,368	\$36,890,876	\$11,863,492	\$13,746,451	\$4,033,866
HVAC	Res	\$101,070,876	\$42,694,611	\$29,728,551	\$12,966,060	\$849,495	\$12,941,349
Smart Thermostat	Res	\$3,572,453	\$2,734,701	\$2,482,939	\$251,762	\$564,920	\$893,113
Appliances	Res	\$2,651,237	\$10,654,455	\$5,947,953	\$4,706,501	\$357,451	\$2,364,151
New Homes	Res	\$6,478,822	\$11,692,244	\$8,072,863	\$3,619,382	\$1,848,595	\$3,305,521
LI - New Homes	LI RES	\$176,266	\$255,675	\$140,581	\$115,093	\$534,278	\$0
Community Connections	LI RES	\$475	\$5,476,828	\$4,591,215	\$885,613	\$1,258,668	\$5,287,500
Audits & Education - SCI	COM	\$3,077,938	\$9,057,700	\$7,614,304	\$1,443,396	\$7,841,379	\$6,155,876
Audits & Education - LCI	IND	\$443,773	\$7,516,687	\$6,315,853	\$1,200,835	\$1,559,793	\$687,547
Custom Buildings - SCI	COM	\$13,522,339	\$27,436,593	\$23,053,437	\$4,383,156	\$13,867,666	\$7,177,756
Appliance Turn In - SCI	COM	\$0	\$975,710	\$754,174	\$221,536	\$309,983	\$87,669
Lighting - SCI	COM	\$86,395,091	\$138,271,499	\$108,675,912	\$29,595,587	\$1,864,627	\$34,430,207
Lighting - LCI	IND	\$35,021,646	\$78,266,568	\$60,100,044	\$18,166,524	\$533,628	\$18,549,906
Government Tariff Lighting	GOV	\$1,784,821	\$1,305,369	\$1,179,815	\$125,554	\$913,248	\$494,875
HVAC - SCI	COM	\$6,283,727	\$11,633,841	\$5,299,312	\$6,334,530	\$171,837	\$1,872,557
Appliances - SCI	COM	\$683,359	\$2,312,354	\$1,682,085	\$430,268	\$30,855	\$515,142
Food Service	COM	\$1,043,452	\$4,395,062	\$3,736,613	\$658,449	\$65,834	\$840,448
Agricultural	COM	\$1,146,277	\$737,650	\$681,646	\$56,004	\$660,950	\$228,919
Custom - SCI	COM	\$13,864,404	\$130,968,396	\$101,546,479	\$29,421,917	\$2,635,269	\$9,917,320
Custom - LCI	IND	\$56,563,814	\$403,983,538	\$305,488,406	\$98,495,132	\$42,913,317	\$53,094,400
HVAC - LCI	IND	\$6,441,754	\$26,305,758	\$13,500,278	\$12,805,480	\$1,062,469	\$4,120,423
Appliances - LCI	IND	\$7,834	\$76,720	\$65,163	\$11,557	\$312	\$10,445
Mercantile Self Directed Projects	IND	\$0	\$0	\$0	\$0	\$977,585	\$0
T&D Projects	IND	\$0	\$0	\$0	\$0	\$0	\$0

Table 8-25 Savings for Total Economically Achievable by Program – OE

Summary of Lifetime Measure Savings for Total Economically Achievable by Program			
Program	Class	kW	MWh
Direct Load Control	Res	45,290	122,592
Behavioral	Res	13,869	113,863
Lighting	Res	22,182	1,789,431
Consumer Electronics	Res	4,324	200,999
Audits & Education	Res	4,394	75,437
EE Kits	Res	44,126	1,546,168
School Education	Res	3,563	133,756
Appliance Turn In	Res	87,800	2,918,795
HVAC	Res	43,795	2,793,994
Smart Thermostat	Res	1,173	186,895
Appliances	Res	24,199	542,473
New Homes	Res	13,331	795,948
LI - New Homes	LI RES	129	3,789
Community Connections	LI RES	1,672	109,817
Audits & Education - SCI	COM	6,568	819,279
Audits & Education - LCI	IND	3,155	388,552
Custom Buildings - SCI	COM	16,851	2,075,133
Appliance Turn In - SCI	COM	1,422	61,050
Lighting - SCI	COM	66,629	5,511,521
Lighting - LCI	IND	21,273	1,655,336
Government Tariff Lighting	GOV	650	62,161
HVAC - SCI	COM	22,240	408,476
Appliances - SCI	COM	1,403	101,202
Food Service	COM	2,650	274,392
Agricultural	COM	216	52,002
Custom - SCI	COM	87,179	7,430,358
Custom - LCI	IND	286,829	20,343,941
HVAC - LCI	IND	30,473	866,263
Appliances - LCI	IND	45	3,990
Mercantile Self Directed Projects	IND	41,111	3,176,907
T&D Projects	IND	5,708	450,000

Table 8-26 Savings for Total Economically Achievable by Program – CEI

Summary of Lifetime Measure Savings for Total Economically Achievable by Program			
Program	Class	kW	MWh
Direct Load Control	Res	33,436	90,173
Behavioral	Res	9,539	78,316
Lighting	Res	18,290	1,473,019
Consumer Electronics	Res	2,320	115,513
Audits & Education	Res	3,264	56,035
EE Kits	Res	31,904	1,117,283
School Education	Res	2,597	97,488
Appliance Turn In	Res	71,273	2,209,603
HVAC	Res	32,154	1,769,352
Smart Thermostat	Res	808	125,674
Appliances	Res	11,960	273,441
New Homes	Res	14,035	650,231
LI - New Homes	LI RES	129	3,682
Community Connections	LI RES	1,734	113,906
Audits & Education - SCI	COM	4,497	544,609
Audits & Education - LCI	IND	1,302	160,377
Custom Buildings - SCI	COM	11,301	1,391,686
Appliance Turn In - SCI	COM	972	41,689
Lighting - SCI	COM	82,510	6,888,555
Lighting - LCI	IND	20,785	1,609,445
Government Tariff Lighting	GOV	466	48,593
HVAC - SCI	COM	22,415	425,420
Appliances - SCI	COM	1,328	95,190
Food Service	COM	1,328	159,421
Agricultural	COM	112	40,330
Custom - SCI	COM	55,933	4,790,266
Custom - LCI	IND	143,932	10,208,683
HVAC - LCI	IND	15,506	494,610
Appliances - LCI	IND	22	2,002
Mercantile Self Directed Projects	IND	36,945	2,825,553
T&D Projects	IND	0	0

Table 8-27 Savings for Total Economically Achievable by Program – TE

Summary of Lifetime Measure Savings for Total Economically Achievable by Program			
Program	Class	kW	MWh
Direct Load Control	Res	12,489	34,148
Behavioral	Res	3,533	29,003
Lighting	Res	6,353	511,783
Consumer Electronics	Res	881	44,610
Audits & Education	Res	1,249	21,439
EE Kits	Res	12,321	431,602
School Education	Res	999	37,488
Appliance Turn In	Res	27,569	854,704
HVAC	Res	13,731	854,597
Smart Thermostat	Res	354	55,724
Appliances	Res	7,116	146,282
New Homes	Res	4,065	212,293
LI - New Homes	LI RES	129	3,697
Community Connections	LI RES	1,619	106,362
Audits & Education - SCI	COM	1,621	200,235
Audits & Education - LCI	IND	1,349	166,089
Custom Buildings - SCI	COM	4,923	606,240
Appliance Turn In - SCI	COM	405	17,471
Lighting - SCI	COM	33,200	2,830,555
Lighting - LCI	IND	20,392	1,576,753
Government Tariff Lighting	GOV	190	28,367
HVAC - SCI	COM	7,803	145,065
Appliances - SCI	COM	636	45,428
Food Service	COM	884	88,898
Agricultural	COM	63	16,930
Custom - SCI	COM	33,046	2,837,947
Custom - LCI	IND	112,632	7,988,646
HVAC - LCI	IND	12,193	398,589
Appliances - LCI	IND	18	1,567
Mercantile Self Directed Projects	IND	20,357	1,544,560
T&D Projects	IND	0	0

### 8.13 EEPDR ACHIEVABLE RESULTS

Achievable potential has been estimated by including measures that either passed the TRC or are important based on their potential impacts. The following tables present the Base and High Case results of this analysis by Company. The results are calculated on a year-by-year basis. However, the tables below only display the years 2017, 2021, 2026 and 2031.

#### The Base Case Tables:

For the Base Case, the Appliance Turn in Program accounts for the largest share of residential energy savings in both the achievable and economic market potential estimates. Among the commercial and industrial programs, the Custom Program is expected to have the largest savings impact.

Table 8-28 Base Case Summary of Measure Energy Savings by Program – OE

Base Case Summary of Measure Energy Lifetime Savings by Program					
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh
Direct Load Control	Res	584	2,920	4,611	6,303
Behavioral	Res	37,454	187,123	187,123	187,123
Lighting	Res	29,844	149,103	153,294	157,486
Consumer Electronics	Res	4,754	23,752	23,752	23,752
Audits & Education	Res	3,669	18,332	18,332	18,332
EE Kits	Res	32,290	161,321	203,871	246,421
School Education	Res	4,272	21,341	21,341	21,341
Appliance Turn In	Res	25,365	126,725	190,054	253,383
HVAC	Res	6,411	32,028	67,034	102,040
Smart Thermostat	Res	1,125	5,620	9,044	12,468
Appliances	Res	4,894	24,448	35,350	46,251
New Homes	Res	2,831	14,144	21,193	28,242
LI - New Homes	LI RES	27	188	188	188
Community Connections	LI RES	2,929	14,635	14,635	14,635
Audits & Education - SCI	COM	8,285	41,394	41,394	41,394
Audits & Education - LCI	IND	3,929	19,632	19,632	19,632
Custom Buildings - SCI	COM	11,809	58,998	88,404	117,810
Appliance Turn In - SCI	COM	529	2,642	3,958	5,275
Lighting - SCI	COM	41,580	207,738	242,252	276,766
Lighting - LCI	IND	11,442	57,164	66,662	76,159
Government Tariff Lighting	GOV	657	3,281	4,949	6,617
HVAC - SCI	COM	2,390	11,942	19,874	27,805
Appliances - SCI	COM	1,034	5,168	7,524	9,879
Food Service	COM	3,352	16,745	21,477	26,208
Agricultural	COM	368	1,837	3,301	4,764
Custom - SCI	COM	24,929	124,544	243,019	361,494
Custom - LCI	IND	44,159	220,622	419,808	618,994
HVAC - LCI	IND	3,838	19,177	28,778	38,378
Appliances - LCI	IND	11	53	79	106

Table 8-29 Base Case Summary of Measure Energy Savings by Program – CEI

Base Case Summary of Measure Energy Lifetime Savings by Program					
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh
Direct Load Control	Res	432	2,160	3,422	4,683
Behavioral	Res	25,266	126,231	126,231	126,231
Lighting	Res	26,060	130,200	133,152	136,105
Consumer Electronics	Res	3,381	16,892	16,892	16,892
Audits & Education	Res	2,677	13,375	13,375	13,375
EE Kits	Res	22,451	112,168	142,146	172,123
School Education	Res	3,009	15,035	15,035	15,035
Appliance Turn In	Res	20,479	102,314	153,478	204,641
HVAC	Res	3,883	19,398	40,429	61,460
Smart Thermostat	Res	722	3,606	5,804	8,001
Appliances	Res	2,703	13,502	19,039	24,576
New Homes	Res	2,313	11,554	17,313	23,072
LI - New Homes	LI RES	26	183	183	183
Community Connections	LI RES	3,038	15,180	15,180	15,180
Audits & Education - SCI	COM	5,836	29,158	29,158	29,158
Audits & Education - LCI	IND	1,719	8,586	8,586	8,586
Custom Buildings - SCI	COM	7,920	39,567	59,288	79,009
Appliance Turn In - SCI	COM	385	1,922	2,880	3,838
Lighting - SCI	COM	58,255	291,045	339,399	387,753
Lighting - LCI	IND	12,581	62,856	73,299	83,742
Government Tariff Lighting	GOV	513	2,565	3,869	5,173
HVAC - SCI	COM	2,631	13,146	21,907	30,668
Appliances - SCI	COM	911	4,551	6,663	8,776
Food Service	COM	1,895	9,466	10,973	12,480
Agricultural	COM	256	1,277	2,439	3,601
Custom - SCI	COM	16,064	80,259	156,310	232,361
Custom - LCI	IND	22,159	110,709	210,662	310,614
HVAC - LCI	IND	2,408	12,030	18,069	24,109
Appliances - LCI	IND	5	27	41	54

Table 8-30 Base Case Summary of Measure Energy Savings by Program – TE

Base Case Summary of Measure Energy Lifetime Savings by Program					
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh
Direct Load Control	Res	159	793	1,243	1,693
Behavioral	Res	9,338	46,651	46,651	46,651
Lighting	Res	8,790	43,914	44,962	46,011
Consumer Electronics	Res	1,292	6,457	6,457	6,457
Audits & Education	Res	991	4,952	4,952	4,952
EE Kits	Res	8,674	43,334	54,835	66,336
School Education	Res	1,155	5,768	5,768	5,768
Appliance Turn In	Res	7,561	37,773	56,662	75,551
HVAC	Res	1,888	9,433	19,632	29,831
Smart Thermostat	Res	335	1,675	2,695	3,715
Appliances	Res	1,374	6,866	9,862	12,859
New Homes	Res	755	3,772	5,653	7,533
LI - New Homes	LI RES	26	184	184	184
Community Connections	LI RES	2,837	14,175	14,175	14,175
Audits & Education - SCI	COM	2,130	10,640	10,640	10,640
Audits & Education - LCI	IND	1,766	8,825	8,825	8,825
Custom Buildings - SCI	COM	3,450	17,236	25,827	34,418
Appliance Turn In - SCI	COM	154	769	1,152	1,535
Lighting - SCI	COM	22,341	111,615	130,159	148,702
Lighting - LCI	IND	11,363	56,770	66,202	75,633
Government Tariff Lighting	GOV	300	1,497	2,258	3,020
HVAC - SCI	COM	832	4,157	6,944	9,731
Appliances - SCI	COM	434	2,171	3,196	4,221
Food Service	COM	990	4,948	6,192	7,437
Agricultural	COM	112	561	1,032	1,503
Custom - SCI	COM	9,601	47,965	93,118	138,271
Custom - LCI	IND	17,340	86,634	164,850	243,066
HVAC - LCI	IND	1,891	9,447	14,191	18,935
Appliances - LCI	IND	4	21	31	42

When the market potential for demand savings are analyzed for the residential programs, the Appliance Turn in Program is expected to produce the greatest level of savings. Again, for the commercial and industrial programs, the Custom Program will generate the largest demand savings of the programs in that sector.



Table 8-31 Base Case Summary of Demand Savings by Program – OE

Base Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	4,813	24,046	24,046	24,046
Behavioral	Res	4,276	21,361	21,361	21,361
Lighting	Res	3,155	15,763	18,202	18,841
Consumer Electronics	Res	653	3,264	3,264	3,264
Audits & Education	Res	601	3,002	3,002	3,002
EE Kits	Res	4,314	21,554	27,254	32,955
School Education	Res	533	2,664	2,664	2,664
Appliance Turn In	Res	5,409	27,023	41,948	56,874
HVAC	Res	1,750	8,741	17,263	25,785
Smart Thermostat	Res	73	364	585	807
Appliances	Res	2,266	11,319	16,987	22,654
New Homes	Res	667	3,330	4,990	6,650
LI - New Homes	LI RES	13	90	90	90
Community Connections	LI RES	334	1,671	1,671	1,671
Audits & Education - SCI	COM	934	4,665	4,665	4,665
Audits & Education - LCI	IND	449	2,241	2,241	2,241
Custom Buildings - SCI	COM	1,348	6,735	10,092	13,449
Appliance Turn In - SCI	COM	92	461	691	921
Lighting - SCI	COM	6,802	33,985	39,631	45,277
Lighting - LCI	IND	2,142	10,700	12,478	14,256
Government Tariff Lighting	GOV	64	322	485	649
HVAC - SCI	COM	1,476	7,375	13,179	18,983
Appliances - SCI	COM	126	628	956	1,283
Food Service	COM	223	1,113	1,862	2,611
Agricultural	COM	22	108	162	216
Custom - SCI	COM	3,984	19,903	39,368	58,833
Custom - LCI	IND	7,791	38,926	76,664	114,402
HVAC - LCI	IND	2,282	11,400	17,084	22,767
Appliances - LCI	IND	1	6	8	11

Table 8-32 Base Case Summary of Demand Savings by Program – CEI

Base Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	3,589	17,932	17,932	17,932
Behavioral	Res	2,884	14,410	14,410	14,410
Lighting	Res	2,755	13,765	14,075	14,384
Consumer Electronics	Res	464	2,318	2,318	2,318
Audits & Education	Res	438	2,190	2,190	2,190
EE Kits	Res	3,002	14,999	19,015	23,032
School Education	Res	376	1,877	1,877	1,877
Appliance Turn In	Res	4,637	23,168	36,182	49,196
HVAC	Res	1,208	6,037	11,885	17,732
Smart Thermostat	Res	48	239	385	530
Appliances	Res	1,140	5,693	8,486	11,278
New Homes	Res	702	3,506	5,254	7,001
LI - New Homes	LI RES	13	90	90	90
Community Connections	LI RES	347	1,733	1,733	1,733
Audits & Education - SCI	COM	677	3,385	3,385	3,385
Audits & Education - LCI	IND	196	980	980	980
Custom Buildings - SCI	COM	904	4,517	6,768	9,019
Appliance Turn In - SCI	COM	67	336	503	671
Lighting - SCI	COM	9,438	47,154	54,988	62,822
Lighting - LCI	IND	2,357	11,774	13,730	15,686
Government Tariff Lighting	GOV	46	230	347	464
HVAC - SCI	COM	1,537	7,680	13,655	19,631
Appliances - SCI	COM	113	563	856	1,148
Food Service	COM	72	359	590	822
Agricultural	COM	7	36	53	71
Custom - SCI	COM	2,555	12,767	25,232	37,697
Custom - LCI	IND	3,910	19,533	38,470	57,407
HVAC - LCI	IND	1,163	5,808	8,705	11,602
Appliances - LCI	IND	1	3	4	6

Table 8-33 Base Case Summary of Demand Savings by Program – TE

Base Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	1,280	6,393	6,393	6,393
Behavioral	Res	1,066	5,326	5,326	5,326
Lighting	Res	929	4,643	4,753	4,863
Consumer Electronics	Res	176	880	880	880
Audits & Education	Res	162	811	811	811
EE Kits	Res	1,159	5,792	7,333	8,874
School Education	Res	144	720	720	720
Appliance Turn In	Res	1,712	8,553	13,358	18,163
HVAC	Res	535	2,674	5,196	7,718
Smart Thermostat	Res	22	110	176	243
Appliances	Res	675	3,372	5,053	6,733
New Homes	Res	203	1,015	1,522	2,028
LI - New Homes	LI RES	13	90	90	90
Community Connections	LI RES	324	1,618	1,618	1,618
Audits & Education - SCI	COM	242	1,211	1,211	1,211
Audits & Education - LCI	IND	202	1,007	1,007	1,007
Custom Buildings - SCI	COM	394	1,968	2,948	3,929
Appliance Turn In - SCI	COM	27	134	200	267
Lighting - SCI	COM	3,502	17,494	20,400	23,307
Lighting - LCI	IND	2,130	10,640	12,408	14,176
Government Tariff Lighting	GOV	19	94	142	190
HVAC - SCI	COM	513	2,564	4,594	6,625
Appliances - SCI	COM	55	272	415	558
Food Service	COM	60	298	497	696
Agricultural	COM	5	26	39	52
Custom - SCI	COM	1,518	7,584	14,960	22,336
Custom - LCI	IND	3,059	15,285	30,104	44,923
HVAC - LCI	IND	910	4,549	6,817	9,085
Appliances - LCI	IND	0	2	3	4

The program and participant costs are shown for each Company in the tables below. The number of participants represents the total number of customers or the total number of items (i.e. CFL kits, Commercial Lighting Fixtures) in each program. Also, customers may participate in multiple programs in the year and will be counted in each program. Participant costs are derived based upon the expected mix of measures installed under the programs. Utility costs are higher in the first five years due to the initial use of direct load control programs to meet peak reduction goals.

Table 8-34 through Table 8-36 show the total costs by Company.

Table 8-37 through Table 8-39 show the breakdown of the utility costs by incentive and program costs.

Table 8-34 Base Case Achievable Results and Costs – OE

Base Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$11,472,472	\$11,472,497	\$1,784,788	\$1,784,788	NA
Participant Costs	\$49,248,030	\$49,265,657	\$26,695,219	\$26,695,219	\$513,227,596
Utility Costs	\$61,977,030	\$59,574,591	\$22,424,891	\$22,424,891	\$534,240,911
Total Costs (\$)	\$111,225,060	\$108,840,248	\$49,120,110	\$49,120,110	\$1,047,468,507

Table 8-35 Base Case Achievable Results and Costs – CEI

Base Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$14,391,177	\$14,391,202	\$2,282,693	\$2,282,693	NA
Participant Costs	\$45,832,840	\$45,850,466	\$19,294,684	\$19,294,684	\$422,146,291
Utility Costs	\$46,982,109	\$46,057,952	\$14,792,286	\$14,792,286	\$382,940,257
Total Costs (\$)	\$92,814,949	\$91,908,419	\$34,086,969	\$34,086,969	\$805,086,548

Table 8-36 Base Case Achievable Results and Costs – TE

Base Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$6,802,770	\$6,802,795	\$1,097,080	\$1,097,080	NA
Participant Costs	\$22,483,169	\$22,500,796	\$9,694,568	\$9,694,568	\$209,396,780
Utility Costs	\$24,646,684	\$23,722,527	\$8,348,080	\$8,348,080	\$206,821,077
Total Costs (\$)	\$47,129,853	\$46,223,322	\$18,042,648	\$18,042,648	\$416,217,858

Table 8-37 Base Case Utility Program Costs – OE

Base Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$31,711,377	\$29,308,938	\$10,942,886	\$10,942,886
Incentives	\$30,265,653	\$30,265,653	\$11,482,004	\$11,482,004
<b>Total Costs \$</b>	<b>\$61,977,030</b>	<b>\$59,574,591</b>	<b>\$22,424,891</b>	<b>\$22,424,891</b>

Table 8-38 Base Case Utility Program Costs – CEI

Base Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$20,644,691	\$19,720,534	\$6,610,325	\$6,610,325
Incentives	\$26,337,418	\$26,337,418	\$8,181,960	\$8,181,960
<b>Total Costs \$</b>	<b>\$46,982,109</b>	<b>\$46,057,952</b>	<b>\$14,792,286</b>	<b>\$14,792,286</b>

Table 8-39 Base Case Utility Program Costs – TE

Base Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$11,085,942	\$10,161,785	\$3,940,682	\$3,940,682
Incentives	\$13,560,742	\$13,560,742	\$4,407,398	\$4,407,398
<b>Total Costs \$</b>	<b>\$24,646,684</b>	<b>\$23,722,527</b>	<b>\$8,348,080</b>	<b>\$8,348,080</b>

The tables below show the results for the cost-benefit analysis for the individual program

Table 8-40 Base Case Summary of Measure Tests by Program – OE

Summary of Measure Tests by Program for Base Case Year 2026				
Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.81	1.20
Behavioral	Res	0.00	1.13	0.00
Lighting	Res	2.75	4.35	2.50
Consumer Electronics	Res	0.00	1.78	0.00
Audits & Education	Res	0.00	0.96	0.00
EE Kits	Res	2.04	2.53	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	3.60	2.98	0.00
HVAC	Res	3.02	0.46	0.87
Smart Thermostat	Res	1.95	0.64	1.57
Appliances	Res	4.26	2.20	6.91
New Homes	Res	2.41	1.27	3.82
LI - New Homes	LI RES	0.00	0.43	0.00
Community Connections	LI RES	0.00	1.03	0.00
Audits & Education - SCI	COM	0.00	0.94	0.00
Audits & Education - LCI	IND	0.00	3.21	0.00
Custom Buildings - SCI	COM	1.70	0.98	4.89
Appliance Turn In - SCI	COM	3.57	2.96	0.00
Lighting - SCI	COM	3.52	1.48	3.61
Lighting - LCI	IND	3.56	1.86	5.03
Government Tariff Lighting	GOV	14.89	1.89	2.36
HVAC - SCI	COM	5.64	2.10	3.44
Appliances - SCI	COM	3.67	2.14	6.17
Food Service	COM	6.66	2.70	7.94
Agricultural	COM	1.12	0.51	1.44
Custom - SCI	COM	9.74	4.96	21.59
Custom - LCI	IND	3.45	2.22	14.39
HVAC - LCI	IND	5.49	2.91	6.56
Appliances - LCI	IND	6.20	4.83	20.00

Table 8-41 Base Case Summary of Measure Tests by Program – CEI

Summary of Measure Tests by Program for Base Case Year 2026				
Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.80	1.20
Behavioral	Res	0.00	1.04	0.00
Lighting	Res	2.75	4.54	2.50
Consumer Electronics	Res	0.00	1.78	0.00
Audits & Education	Res	0.00	0.96	0.00
EE Kits	Res	2.04	2.53	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	3.62	2.99	0.00
HVAC	Res	3.01	0.46	0.84
Smart Thermostat	Res	1.92	0.63	1.55
Appliances	Res	4.27	2.01	7.14
New Homes	Res	2.92	1.54	4.32
LI - New Homes	LI RES	0.00	0.42	0.00
Community Connections	LI RES	0.00	1.07	0.00
Audits & Education - SCI	COM	0.00	0.92	0.00
Audits & Education - LCI	IND	0.00	2.85	0.00
Custom Buildings - SCI	COM	1.55	0.89	4.44
Appliance Turn In - SCI	COM	3.24	2.68	0.00
Lighting - SCI	COM	3.54	1.47	3.56
Lighting - LCI	IND	3.56	1.86	5.04
Government Tariff Lighting	GOV	16.79	1.64	2.12
HVAC - SCI	COM	5.39	2.00	3.08
Appliances - SCI	COM	3.57	2.22	6.75
Food Service	COM	6.12	2.41	7.10
Agricultural	COM	0.95	0.39	1.21
Custom - SCI	COM	9.55	4.67	20.33
Custom - LCI	IND	3.45	2.22	14.39
HVAC - LCI	IND	5.07	2.69	6.32
Appliances - LCI	IND	6.19	4.83	20.00

Table 8-42 Base Case Summary of Measure Tests by Program – TE

Summary of Measure Tests by Program for Base Case Year 2026				
Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.79	1.20
Behavioral	Res	0.00	1.00	0.00
Lighting	Res	2.75	4.50	2.50
Consumer Electronics	Res	0.00	1.79	0.00
Audits & Education	Res	0.00	0.96	0.00
EE Kits	Res	2.04	2.53	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	3.44	2.81	0.00
HVAC	Res	3.02	0.47	0.87
Smart Thermostat	Res	1.94	0.63	1.56
Appliances	Res	4.34	2.22	6.72
New Homes	Res	2.14	1.13	3.28
LI - New Homes	LI RES	0.00	0.42	0.00
Community Connections	LI RES	0.00	1.00	0.00
Audits & Education - SCI	COM	0.00	0.58	0.00
Audits & Education - LCI	IND	0.00	2.82	0.00
Custom Buildings - SCI	COM	1.56	0.90	4.48
Appliance Turn In - SCI	COM	3.07	2.51	0.00
Lighting - SCI	COM	3.45	1.37	3.27
Lighting - LCI	IND	3.56	1.86	5.04
Government Tariff Lighting	GOV	29.81	1.13	1.59
HVAC - SCI	COM	5.70	2.11	3.45
Appliances - SCI	COM	3.58	2.19	6.66
Food Service	COM	6.54	2.59	7.51
Agricultural	COM	1.05	0.46	1.34
Custom - SCI	COM	9.42	4.52	19.69
Custom - LCI	IND	3.45	2.22	14.39
HVAC - LCI	IND	5.03	2.67	6.26
Appliances - LCI	IND	6.16	4.80	20.00



The costs and benefits for the programs are shown below. These were the components used in the cost-effectiveness analysis to calculate the cost-benefit ratios described above.

Table 8-43 Base Case Summary of Measure Costs & Benefits – OE

Base Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	1,532,933	3,689,045	246,233	3,422,812	3,882,612	352,398
	2021		4,362,381	292,147	4,070,234	3,882,612	352,398
	2026		193,366	193,366	0	0	0
	2031	290,729	233,547	233,547	0	0	0
Behavioral	2017	0	2,000,416	1,615,818	384,598	2,269,580	0
	2021		2,565,198	2,137,754	427,443	2,269,580	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	1,357,480	12,636,476	10,718,582	1,917,894	2,097,024	796,211
	2021		15,038,207	12,727,101	2,311,107	2,097,024	796,211
	2026		557,408	479,123	78,286	138,399	105,164
	2031	315,493	669,693	580,769	88,924	138,399	105,164
Consumer Electronics	2017	549,999	1,720,662	1,408,346	312,316	605,871	549,999
	2021		2,058,223	1,672,120	386,103	605,871	549,999
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	592,386	469,031	123,355	790,009	0
	2021		761,067	588,656	172,411	790,009	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	8,412,547	6,903,662	1,508,885	4,027,176	3,322,403
	2021		10,184,377	8,235,167	1,949,211	4,027,176	3,322,403
	2026		3,243,684	2,663,723	579,962	1,061,770	876,406
	2031	0	3,960,090	3,305,393	654,697	1,061,770	876,406
School Education	2017	0	1,099,775	913,265	186,509	1,263,093	609,666
	2021		1,330,343	1,089,406	240,937	1,263,093	609,666
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	0	10,663,868	8,176,811	2,487,057	4,297,539	882,683
	2021		12,790,223	9,711,722	3,078,501	4,297,539	882,683
	2026		7,796,946	5,974,524	1,822,422	2,156,482	446,484
	2031	0	9,377,102	7,314,062	2,063,040	2,156,482	446,484
HVAC	2017	10,782,198	4,919,069	3,447,279	1,471,790	1,715,477	1,528,398
	2021		5,804,625	4,072,743	1,731,883	1,715,477	1,528,398
	2026		7,998,153	5,802,758	2,195,395	1,792,290	1,671,933
	2031	13,131,630	10,461,042	7,955,277	2,505,765	1,792,290	1,671,933
Smart Thermostat	2017	738,978	569,784	518,009	51,775	323,078	184,745
	2021		676,100	614,532	61,568	323,078	184,745
	2026		503,998	461,654	42,345	197,437	112,899
	2031	451,598	605,823	557,674	48,150	197,437	112,899
Appliances	2017	812,468	3,194,896	1,725,548	1,469,348	924,285	746,472
	2021		3,812,844	2,052,122	1,760,722	924,285	746,472
	2026		2,374,042	1,337,854	1,036,188	346,631	308,404
	2031	331,516	2,792,860	1,615,394	1,177,466	346,631	308,404
New Homes	2017	1,040,917	2,106,862	1,513,371	593,491	927,085	531,080
	2021		2,489,759	1,794,834	694,925	927,085	531,080
	2026		1,484,032	1,091,529	392,502	463,542	265,540
	2031	520,458	1,753,947	1,306,387	447,559	463,542	265,540

Base Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	1,107,453	5,260,613	4,429,212	831,401	5,513,112	2,214,906
	2021		6,226,470	5,252,975	973,496	5,513,112	2,214,906
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	3,397,524	7,513,139	6,312,872	1,200,268	5,674,862	1,803,430
	2021		8,892,371	7,486,965	1,405,406	5,674,862	1,803,430
	2026		5,346,993	4,553,202	793,791	2,837,431	901,715
	2031	1,698,762	6,354,597	5,449,459	905,138	2,837,431	901,715
Appliance Turn In - SCI	2017	0	221,634	171,123	50,511	89,510	18,032
	2021		264,704	203,218	61,486	89,510	18,032
	2026		159,431	124,895	34,537	44,755	9,016
	2031	0	192,019	152,890	39,129	44,755	9,016
Lighting - SCI	2017	15,599,893	27,604,602	21,541,068	6,063,533	6,431,471	6,766,436
	2021		32,646,934	25,547,535	7,099,399	6,431,471	6,766,436
	2026		6,520,669	5,184,028	1,336,641	1,071,912	1,127,739
	2031	2,599,962	7,735,524	6,211,370	1,524,154	1,071,912	1,127,739
HVAC - SCI	2017	784,895	2,107,547	954,574	1,152,973	402,802	355,776
	2021		2,494,614	1,132,476	1,362,138	402,802	355,776
	2026		2,346,354	1,036,373	1,309,982	253,563	231,487
	2031	575,787	2,737,607	1,244,706	1,492,901	253,563	231,487
Appliances - SCI	2017	146,757	466,323	382,987	83,336	112,200	105,377
	2021		554,372	454,691	99,681	112,200	105,377
	2026		337,693	277,137	60,557	56,794	53,499
	2031	74,561	404,294	335,469	68,825	56,794	53,499
Food Service	2017	264,635	1,195,388	1,030,543	164,846	261,217	239,176
	2021		1,420,854	1,225,403	195,452	261,217	239,176
	2026		765,617	614,568	151,049	71,559	65,38
	2031	132,348	912,443	740,554	171,890	71,559	65,381
Agricultural	2017	239,855	184,931	165,694	19,238	190,765	51,088
	2021		219,096	196,571	22,526	190,765	51,088
	2026		195,571	182,849	12,723	167,319	42,789
	2031	216,271	235,236	220,729	14,507	167,319	42,789
Custom - SCI	2017	2,098,111	16,104,892	12,563,720	3,541,172	1,742,586	1,365,676
	2021		19,044,586	14,897,708	4,146,878	1,742,586	1,365,676
	2026		21,849,072	17,249,923	4,599,149	1,515,884	1,143,135
	2031	1,547,535	25,889,611	20,645,380	5,244,231	1,515,884	1,143,135
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	129,470	2,499,989	2,100,601	399,388	790,917	258,939
	2021		2,958,926	2,491,279	467,647	790,917	258,939
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	3,192,851	8,011,512	6,104,466	1,907,046	1,898,397	1,869,809
	2021		9,472,775	7,239,803	2,232,972	1,898,397	1,869,809
	2026		1,888,125	1,467,720	420,404	316,400	311,635
	2031	532,142	2,236,126	1,756,751	479,375	316,400	311,635
Custom - LCI	2017	4,216,806	28,867,746	22,069,372	6,798,374	11,154,194	3,929,666
	2021		34,148,881	26,178,760	7,970,121	11,154,194	3,929,666
	2026		37,837,447	29,056,481	8,780,965	9,545,401	3,443,590
	2031	3,653,429	44,848,981	34,838,204	10,010,777	9,545,401	3,443,590

Table 8-44 Base Case Summary of Measure Costs &amp; Benefits – CEI

Base Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	1,143,154	2,732,575	180,083	2,552,492	2,895,877	262,794
	2021		3,248,956	213,662	3,035,294	2,895,877	262,794
	2026		144,199	144,199	0	0	0
	2031	216,805	174,163	174,163	0	0	0
Behavioral	2017	0	1,349,460	1,090,014	259,446	1,667,290	0
	2021		1,730,456	1,442,108	288,349	1,667,290	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	1,086,224	11,023,714	9,350,439	1,673,274	1,802,809	665,682
	2021		13,119,179	11,102,666	2,016,513	1,802,809	665,682
	2026		392,675	337,526	55,149	97,497	74,085
	2031	222,254	471,776	409,132	62,644	97,497	74,085
Consumer Electronics	2017	390,731	1,225,588	1,003,406	222,182	431,170	390,731
	2021		1,465,955	1,191,333	274,622	431,170	390,731
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	432,206	342,206	90,000	576,392	0
	2021		555,276	429,484	125,792	576,392	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	5,850,219	4,800,180	1,050,038	2,797,029	2,307,905
	2021		7,082,451	5,725,988	1,356,462	2,797,029	2,307,905
	2026		2,285,273	1,876,673	408,601	748,049	617,454
	2031	0	2,790,003	2,328,748	461,254	748,049	617,454
School Education	2017	0	774,824	643,423	131,401	889,887	429,528
	2021		937,267	767,519	169,747	889,887	429,528
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	0	8,657,016	6,595,270	2,061,746	3,472,966	716,423
	2021		10,394,698	7,833,558	2,561,140	3,472,966	716,423
	2026		6,352,752	4,820,273	1,532,479	1,744,250	363,390
	2031	0	7,635,624	5,901,092	1,734,532	1,744,250	363,390
HVAC	2017	6,793,064	3,083,107	2,071,423	1,011,683	1,097,565	969,468
	2021		3,638,155	2,447,255	1,190,899	1,097,565	969,468
	2026		4,990,328	3,480,637	1,509,691	1,117,551	1,038,821
	2031	8,206,769	6,498,932	4,775,770	1,723,162	1,117,551	1,038,821
Smart Thermostat	2017	479,944	364,826	330,813	34,013	209,829	119,986
	2021		432,903	392,456	40,447	209,829	119,986
	2026		322,646	294,828	27,818	128,229	73,325
	2031	293,299	387,780	356,148	31,632	128,229	73,325
Appliances	2017	443,365	1,641,742	912,126	729,616	530,817	412,927
	2021		1,960,939	1,085,622	875,318	530,817	412,927
	2026		1,196,025	684,016	512,009	175,004	154,645
	2031	164,442	1,407,525	825,681	581,844	175,004	154,645
New Homes	2017	753,313	1,861,148	1,236,314	624,835	670,932	384,343
	2021		2,197,874	1,466,248	731,625	670,932	384,343
	2026		1,304,931	891,700	413,231	335,466	192,172
	2031	376,656	1,538,419	1,067,223	471,196	335,466	192,172

Base Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	803,102	3,723,118	3,119,917	603,200	3,997,993	1,606,204
	2021		4,406,466	3,700,172	706,294	3,997,993	1,606,204
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	2,506,292	5,038,680	4,233,722	804,959	4,186,244	1,330,358
	2021		5,963,661	5,021,126	942,534	4,186,244	1,330,350
	2026		3,585,956	3,053,601	532,355	2,093,122	665,179
	2031	1,253,146	4,261,705	3,654,675	607,030	2,093,122	665,179
Appliance Turn In - SCI	2017	0	161,300	124,520	36,780	71,865	14,472
	2021		192,646	147,875	44,771	71,865	14,472
	2026		116,030	90,882	25,148	35,933	7,236
	2031	0	139,744	111,253	28,492	35,933	7,236
Lighting - SCI	2017	22,098,049	38,558,896	30,143,627	8,415,268	8,849,974	9,479,957
	2021		45,602,573	35,749,821	9,852,752	8,849,974	9,479,957
	2026		9,109,517	7,254,479	1,855,038	1,474,966	1,579,993
	2031	3,683,008	10,807,788	8,692,506	2,115,282	1,474,966	1,579,993
HVAC - SCI	2017	906,178	2,262,665	1,055,340	1,197,325	427,311	385,631
	2021		2,666,624	1,251,932	1,414,693	427,311	385,631
	2026		2,458,279	1,125,784	1,332,495	277,682	254,680
	2031	695,823	2,871,320	1,352,991	1,518,329	277,682	254,680
Appliances - SCI	2017	119,493	414,747	340,094	74,653	102,434	96,670
	2021		493,039	403,738	89,301	102,434	96,670
	2026		300,842	247,172	53,670	51,920	49,117
	2031	60,726	360,265	299,273	60,992	51,920	49,117
Food Service	2017	123,143	556,038	503,962	52,077	151,476	138,698
	2021		661,759	599,921	61,838	151,476	138,698
	2026		238,781	192,560	46,221	24,340	22,188
	2031	46,235	284,765	232,174	52,591	24,340	22,188
Agricultural	2017	196,811	113,402	107,044	6,358	150,810	37,924
	2021		134,455	127,011	7,444	150,810	37,924
	2026		142,154	137,949	4,205	144,391	35,500
	2031	190,798	171,709	166,914	4,794	144,391	35,500
Custom - SCI	2017	1,477,957	10,411,741	8,134,849	2,276,892	1,157,666	916,934
	2021		12,311,753	9,645,786	2,665,967	1,157,666	916,934
	2026		14,048,690	11,100,115	2,948,574	990,785	752,616
	2031	1,057,582	16,646,193	13,284,003	3,362,190	990,785	752,616
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	63,867	1,093,441	918,757	174,683	390,159	127,735
	2021		1,294,170	1,089,631	204,539	390,159	127,735
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	3,502,599	8,812,003	6,713,633	2,098,370	2,086,780	2,056,064
	2021		10,419,255	7,962,261	2,456,994	2,086,780	2,056,064
	2026		2,076,754	1,614,173	462,581	347,797	342,677
	2031	583,766	2,459,499	1,932,030	527,469	347,797	342,677
Custom - LCI	2017	2,116,013	14,485,967	11,074,512	3,411,455	5,597,226	1,971,924
	2021		17,136,065	13,136,622	3,999,443	5,597,226	1,971,924
	2026		18,987,005	14,580,675	4,406,329	4,789,926	1,728,009
	2031	1,833,307	22,505,425	17,481,971	5,023,454	4,789,926	1,728,009

Table 8-45 Base Case Summary of Measure Costs &amp; Benefits – TE

Base Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	407,549	978,949	68,952	903,997	1,062,569	93,689
	2021		1,163,932	81,810	1,082,122	1,062,569	93,689
	2026		51,409	51,409	0	0	0
	2031	77,294	62,091	62,091	0	0	0
Behavioral	2017	0	498,721	402,837	95,884	641,229	0
	2021		639,526	532,961	106,565	641,229	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	373,766	3,718,872	3,154,401	564,471	610,168	226,730
	2021		4,425,762	3,745,515	680,247	610,168	226,730
	2026		139,466	119,879	19,587	34,628	26,313
	2031	78,938	167,560	145,311	22,249	34,628	26,313
Consumer Electronics	2017	148,568	471,934	386,884	85,050	166,487	148,568
	2021		564,360	459,335	105,025	166,487	148,568
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	160,013	126,693	33,320	213,394	0
	2021		205,576	159,005	46,571	213,394	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	2,259,951	1,854,471	405,481	1,081,225	892,072
	2021		2,735,950	2,212,141	523,809	1,081,225	892,072
	2026		876,725	719,969	156,756	286,982	236,881
	2031	0	1,070,360	893,404	176,956	286,982	236,881
School Education	2017	0	297,255	246,844	50,411	341,398	164,785
	2021		359,574	294,452	65,122	341,398	164,785
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	0	3,196,051	2,434,882	761,169	1,364,389	264,493
	2021		3,837,580	2,892,041	945,539	1,364,389	264,493
	2026		2,345,349	1,779,578	565,771	685,062	134,158
	2031	0	2,818,968	2,178,601	640,367	685,062	134,158
HVAC	2017	3,164,517	1,455,583	1,013,484	442,099	516,105	456,738
	2021		1,718,360	1,197,481	520,879	516,105	456,738
	2026		2,341,450	1,693,547	647,903	523,566	487,797
	2031	3,811,987	3,056,783	2,317,306	739,477	523,566	487,797
Smart Thermostat	2017	221,523	169,575	153,964	15,611	96,849	55,381
	2021		201,217	182,653	18,564	96,849	55,381
	2026		149,983	137,215	12,768	59,185	33,844
	2031	135,375	180,272	165,754	14,518	59,185	33,844
Appliances	2017	230,808	916,141	479,047	437,094	261,986	211,500
	2021		1,093,604	569,767	523,837	261,986	211,500
	2026		671,116	364,957	306,159	95,988	85,936
	2031	93,063	788,657	440,774	347,883	95,988	85,936
New Homes	2017	323,941	584,612	403,643	180,969	288,516	165,276
	2021		690,613	478,714	211,899	288,516	165,276
	2026		410,813	291,130	119,683	144,258	82,638
	2031	161,971	484,908	348,437	136,471	144,258	82,638

Base Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	460,197	1,354,258	1,138,449	215,809	2,290,946	920,393
	2021		1,602,875	1,350,183	252,693	2,290,946	920,393
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	1,061,787	2,194,927	1,844,275	360,652	1,806,902	574,220
	2021		2,597,863	2,187,281	410,583	1,806,902	574,220
	2026		1,562,098	1,390,196	231,902	903,451	287,110
	2031	540,894	1,856,455	1,592,033	264,432	903,451	287,110
Appliance Turn In - SCI	2017	0	64,438	49,807	14,631	30,614	5,790
	2021		76,959	59,149	17,810	30,614	5,790
	2026		46,366	36,352	10,004	15,307	2,895
	2031	0	55,834	44,500	11,334	15,307	2,895
Lighting - SCI	2017	9,128,431	14,573,248	11,452,115	3,121,133	3,483,071	3,628,687
	2021		17,236,736	13,582,398	3,654,339	3,483,071	3,628,687
	2026		3,445,089	2,757,068	668,021	580,512	604,781
	2031	1,520,072	4,089,246	3,304,706	784,541	580,512	604,781
HVAC - SCI	2017	274,334	735,670	333,658	402,013	139,182	122,824
	2021		870,684	395,839	474,845	139,182	122,824
	2026		824,653	365,609	459,044	88,288	80,530
	2031	203,115	962,189	439,036	523,153	88,288	80,530
Appliances - SCI	2017	58,819	199,658	163,418	36,240	49,501	46,670
	2021		237,327	193,992	43,336	49,501	46,670
	2026		146,427	120,180	26,246	25,159	23,772
	2031	29,952	175,328	145,501	29,828	25,159	23,772
Food Service	2017	77,320	338,148	294,192	43,957	78,046	71,490
	2021		402,037	349,908	52,129	78,046	71,490
	2026		201,153	161,108	40,045	19,159	17,520
	2031	36,623	239,729	194,161	45,568	19,159	17,520
Agricultural	2017	78,320	53,819	49,152	4,667	61,311	15,997
	2021		63,779	58,314	5,465	61,311	15,997
	2026		60,722	57,636	3,086	55,851	14,039
	2031	72,904	73,162	69,642	3,519	55,851	14,039
Custom - SCI	2017	921,250	6,216,133	4,863,954	1,352,178	704,247	561,497
	2021		7,350,568	5,767,305	1,583,264	704,247	561,497
	2026		8,336,737	6,592,165	1,744,571	594,926	454,122
	2031	648,404	9,878,483	7,889,192	1,989,291	594,926	454,122
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	66,351	1,123,854	944,312	179,542	405,329	132,701
	2021		1,330,167	1,119,939	210,228	405,329	132,701
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	3,161,962	7,960,032	6,063,710	1,896,322	1,888,821	1,856,937
	2021		9,411,889	7,191,471	2,220,418	1,888,821	1,856,937
	2026		1,875,953	1,457,913	418,040	314,803	309,489
	2031	526,994	2,221,678	1,744,998	476,680	314,803	309,489
Custom - LCI	2017	1,655,853	11,335,768	8,666,187	2,669,581	4,380,022	1,543,099
	2021		13,409,561	10,279,859	3,129,702	4,380,022	1,543,099
	2026		14,857,985	11,409,880	3,448,104	3,748,282	1,352,227
	2031	1,434,626	17,611,270	13,680,244	3,931,026	3,748,282	1,352,227

**The High Case Tables:**

The Base Case market potential analysis is repeated for the High Case Scenario. For the High Case Scenario, the assumption of participation levels is broadened to also include customers who indicated that they were likely to participate in the program or install the equipment. In addition, the program budgets are increased to reflect greater marketing requirements and higher incentive rates (in order to lure the "likely to participate" to actually participate in programs).

Not surprisingly, the higher participation assumptions lead to greater savings than the Base Case and an increase of roughly 24% to 27%. However, the relative magnitude of the program energy savings across programs does not change the Appliance Turn in and the Custom Program produce the largest savings. The tables below show the energy savings by Company.

Table 8-46 High Case Summary of Energy Lifetime Savings by Program – OE

High Case Summary of Measure Energy Lifetime Savings by Program						
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh	
Direct Load Control	Res	1,100	5,495	8,678	11,862	
Behavioral	Res	48,597	242,794	242,794	242,794	
Lighting	Res	39,961	199,648	204,677	209,707	
Consumer Electronics	Res	6,139	30,669	30,669	30,669	
Audits & Education	Res	5,366	26,810	26,810	26,810	
EE Kits	Res	43,154	215,601	272,468	329,334	
School Education	Res	5,709	28,521	28,521	28,521	
Appliance Turn In	Res	39,062	195,157	202,683	390,210	
HVAC	Res	6,516	32,553	67,931	103,309	
Smart Thermostat	Res	1,632	8,152	13,117	18,083	
Appliances	Res	5,985	29,903	43,523	57,142	
New Homes	Res	5,662	28,287	42,386	56,485	
LI - New Homes	LI RES	54	269	269	269	
Community Connections	LI RES	2,929	14,635	14,635	14,635	
Audits & Education - SCI	COM	11,656	58,232	58,232	58,232	
Audits & Education - LCI	IND	5,528	27,617	27,617	27,617	
Custom Buildings - SCI	COM	14,761	73,748	110,505	147,263	
Appliance Turn In - SCI	COM	814	4,068	6,096	8,123	
Lighting - SCI	COM	43,926	219,459	255,920	292,381	
Lighting - LCI	IND	11,682	58,364	68,060	77,757	
Government Tariff Lighting	GOV	657	3,281	4,949	6,617	
HVAC - SCI	COM	3,047	15,224	25,219	35,215	
Appliances - SCI	COM	1,141	5,699	8,287	10,876	
Food Service	COM	5,326	26,607	31,421	36,235	
Agricultural	COM	368	1,837	3,301	4,764	
Custom - SCI	COM	30,421	151,987	298,232	444,477	
Custom - LCI	IND	55,199	275,777	524,760	773,743	
HVAC - LCI	IND	3,929	19,631	29,477	39,324	
Appliances - LCI	IND	11	53	79	106	



Table 8-47 High Case Summary of Energy Lifetime Savings by Program – CEI

High Case Summary of Measure Energy Lifetime Savings by Program					
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh
Direct Load Control	Res	806	4,025	6,375	8,725
Behavioral	Res	33,425	166,995	166,995	166,995
Lighting	Res	33,188	165,810	169,353	172,896
Consumer Electronics	Res	3,381	16,892	16,892	16,892
Audits & Education	Res	3,986	19,914	19,914	19,914
EE Kits	Res	31,041	155,085	196,532	237,979
School Education	Res	4,161	20,788	20,788	20,788
Appliance Turn In	Res	29,596	147,863	221,803	295,744
HVAC	Res	3,988	19,926	41,332	62,738
Smart Thermostat	Res	1,097	5,481	8,821	12,160
Appliances	Res	3,182	15,899	22,630	29,362
New Homes	Res	4,625	23,108	34,626	46,144
LI - New Homes	LI RES	52	262	262	262
Community Connections	LI RES	3,038	15,180	15,180	15,180
Audits & Education - SCI	COM	7,748	38,710	38,710	38,710
Audits & Education - LCI	IND	2,282	11,399	11,399	11,399
Custom Buildings - SCI	COM	9,900	49,459	74,110	98,762
Appliance Turn In - SCI	COM	556	2,778	4,163	5,547
Lighting - SCI	COM	60,516	302,340	352,571	402,802
Lighting - LCI	IND	12,840	64,148	74,805	85,463
Government Tariff Lighting	GOV	513	2,565	3,869	5,173
HVAC - SCI	COM	3,208	16,030	26,551	37,072
Appliances - SCI	COM	1,049	5,239	7,697	10,155
Food Service	COM	3,598	17,974	20,418	22,862
Agricultural	COM	285	1,423	2,657	3,892
Custom - SCI	COM	19,689	98,365	192,456	286,547
Custom - LCI	IND	27,689	138,386	263,327	388,268
HVAC - LCI	IND	2,542	12,702	19,092	25,481
Appliances - LCI	IND	5	27	41	54

Table 8-48 High Case Summary of Energy Lifetime Savings by Program – TE

High Case Summary of Measure Energy Lifetime Savings by Program					
Program Name	Class	2017 MWh	2021 MWh	2026 MWh	2031 MWh
Direct Load Control	Res	310	1,548	2,426	3,304
Behavioral	Res	12,379	61,845	61,845	61,845
Lighting	Res	11,517	57,541	58,800	60,058
Consumer Electronics	Res	1,292	6,457	6,457	6,457
Audits & Education	Res	1,525	7,619	7,619	7,619
EE Kits	Res	12,020	60,055	75,993	91,931
School Education	Res	1,600	7,994	7,994	7,994
Appliance Turn In	Res	11,448	57,195	85,797	114,398
HVAC	Res	1,928	9,630	19,969	30,309
Smart Thermostat	Res	486	2,430	3,911	5,392
Appliances	Res	1,643	8,208	11,873	15,538
New Homes	Res	1,510	7,545	11,305	15,066
LI - New Homes	LI RES	53	263	263	263
Community Connections	LI RES	2,837	14,175	14,175	14,175
Audits & Education - SCI	COM	2,849	14,232	14,232	14,232
Audits & Education - LCI	IND	2,363	11,805	11,805	11,805
Custom Buildings - SCI	COM	4,312	21,545	32,284	43,022
Appliance Turn In - SCI	COM	233	1,164	1,744	2,325
Lighting - SCI	COM	23,818	118,997	138,767	158,537
Lighting - LCI	IND	11,514	57,523	67,080	76,637
Government, Tariff Lighting	GOV	300	1,497	2,258	3,020
HVAC - SCI	COM	1,075	5,371	8,918	12,466
Appliances - SCI	COM	495	2,475	3,651	4,828
Food Service	COM	1,706	8,525	10,101	11,676
Agricultural	COM	120	598	1,088	1,577
Custom - SCI	COM	11,699	58,449	114,139	169,828
Custom - LCI	IND	21,676	108,292	206,062	303,833
HVAC - LCI	IND	2,129	10,639	15,994	21,350
Appliances - LCI	IND	4	21	31	42

As with energy savings, the High Case Scenario yields significantly higher demand savings while the relative rank among programs with respect to demand savings levels does not change from the Base Case.

Table 8-49 High Case Summary of Demand Lifetime Savings by Program – OE

High Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	9,058	45,255	45,255	45,255
Behavioral	Res	5,548	27,716	27,716	27,716
Lighting	Res	4,225	21,107	21,634	22,161
Consumer Electronics	Res	865	4,320	4,320	4,320
Audits & Education	Res	879	4,390	4,390	4,390
EE Kits	Res	5,766	28,806	36,424	44,043
School Education	Res	713	3,561	3,561	3,561
Appliance Turn In	Res	8,330	41,616	64,600	87,585
HVAC	Res	1,885	9,416	18,418	27,420
Smart Thermostat	Res	106	528	849	1,170
Appliances	Res	2,415	12,064	18,103	24,142
New Homes	Res	1,333	6,660	9,980	13,300
LI - New Homes	LI RES	26	129	129	129
Community Connections	LI RES	334	1,671	1,671	1,671
Audits & Education - SCI	COM	1,314	6,563	6,563	6,563
Audits & Education - LCI	IND	631	3,153	3,153	3,153
Custom Buildings - SCI	COM	1,685	8,419	12,615	16,811
Appliance Turn In - SCI	COM	142	711	1,065	1,419
Lighting - SCI	COM	6,802	33,985	39,631	45,277
Lighting - LCI	IND	2,171	10,845	12,646	14,448
Government Tariff Lighting	GOV	64	322	485	649
HVAC - SCI	COM	1,753	8,760	15,470	22,180
Appliances - SCI	COM	137	685	1,042	1,399
Food Service	COM	227	1,134	1,888	2,643
Agricultural	COM	22	108	162	216
Custom - SCI	COM	4,914	24,548	48,714	72,880
Custom - LCI	IND	9,739	48,657	95,830	143,002
HVAC - LCI	IND	2,072	10,353	15,516	20,679
Appliances - LCI	IND	1	6	8	11

Table 8-50 High Case Summary of Demand Lifetime Savings by Program – CEI

High Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	6,687	33,409	33,409	33,409
Behavioral	Res	3,816	19,063	19,063	19,063
Lighting	Res	3,509	17,531	17,902	18,274
Consumer Electronics	Res	464	2,318	2,318	2,318
Audits & Education	Res	653	3,261	3,261	3,261
EE Kits	Res	4,151	20,738	26,291	31,844
School Education	Res	519	2,595	2,595	2,595
Appliance Turn In	Res	6,702	33,482	52,290	71,097
HVAC	Res	1,344	6,717	13,047	19,377
Smart Thermostat	Res	73	363	584	806
Appliances	Res	1,205	6,021	8,976	11,932
New Homes	Res	1,404	7,012	10,507	14,002
LI - New Homes	LI RES	26	129	129	129
Community Connections	LI RES	347	1,733	1,733	1,733
Audits & Education - SCI	COM	899	4,493	4,493	4,493
Audits & Education - LCI	IND	260	1,301	1,301	1,301
Custom Buildings - SCI	COM	1,130	5,646	8,460	11,274
Appliance Turn In - SCI	COM	97	486	728	970
Lighting - SCI	COM	9,438	47,154	54,988	62,822
Lighting - LCI	IND	2,388	11,929	13,911	15,893
Government Tariff Lighting	GOV	46	230	347	464
HVAC - SCI	COM	1,778	8,882	15,618	22,354
Appliances - SCI	COM	129	646	986	1,325
Food Service	COM	115	573	949	1,325
Agricultural	COM	11	56	84	112
Custom - SCI	COM	3,161	15,793	31,292	46,791
Custom - LCI	IND	4,887	24,416	48,088	71,759
HVAC - LCI	IND	1,061	5,301	7,946	10,590
Appliances - LCI	IND	1	3	4	6

Table 8-51 High Case Summary of Demand Lifetime Savings by Program – TE

High Case Summary of Measure Demand Lifetime Savings by Program					
Program Name	Class	2017 kW	2021 kW	2026 kW	2031 kW
Direct Load Control	Res	2,498	12,479	12,479	12,479
Behavioral	Res	1,413	7,060	7,060	7,060
Lighting	Res	1,218	6,084	6,216	6,348
Consumer Electronics	Res	176	880	880	880
Audits & Education	Res	250	1,248	1,248	1,248
EE Kits	Res	1,607	8,027	10,162	12,297
School Education	Res	200	998	998	998
Appliance Turn In	Res	2,592	12,951	20,226	27,501
HVAC	Res	586	2,928	5,631	8,333
Smart Thermostat	Res	32	159	256	353
Appliances	Res	712	3,556	5,328	7,099
New Homes	Res	407	2,031	3,043	4,055
LI - New Homes	LI RES	26	129	129	129
Community Connections	LI RES	324	1,618	1,618	1,618
Audits & Education - SCI	COM	324	1,620	1,620	1,620
Audits & Education - LCI	IND	270	1,348	1,348	1,348
Custom Buildings - SCI	COM	492	2,459	3,685	4,911
Appliance Turn In - SCI	COM	41	202	303	404
Lighting - SCI	COM	3,502	17,494	20,400	23,307
Lighting - LCI	IND	2,148	10,731	12,514	14,297
Government Tariff Lighting	GOV	19	94	142	190
HVAC - SCI	COM	614	3,068	5,425	7,782
Appliances - SCI	COM	62	308	471	634
Food Service	COM	76	378	630	882
Agricultural	COM	6	31	47	63
Custom - SCI	COM	1,871	9,349	18,503	27,658
Custom - LCI	IND	3,824	19,107	37,630	56,154
HVAC - LCI	IND	836	4,178	6,262	8,346
Appliances - LCI	IND	0	2	3	4

For both CEI and TE, participant and utility costs increased between 30% and 31% over the Base Case, while for OE the same costs increased by 34%. This finding indicates that more customers in the CEI and TE service territories fall into the “likely to participate” category than OE customers.

Table 8-52 High Case Achievable Results and Costs – OE

High Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$11,925,055	\$11,925,055	\$1,813,958	\$1,813,958	NA
Participant Costs	\$45,244,447	\$45,244,447	\$25,321,102	\$25,321,102	\$479,433,256
Utility Costs	\$107,247,859	\$104,791,992	\$38,941,834	\$38,941,834	\$925,657,631
Total Costs (\$)	\$152,492,306	\$150,036,440	\$64,262,936	\$64,262,936	\$1,405,090,887

Table 8-53 High Case Achievable Results and Costs – CEI

High Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$14,710,128	\$14,710,128	\$2,304,712	\$2,304,712	NA
Participant Costs	\$41,134,110	\$41,134,110	\$18,258,477	\$18,258,477	\$388,255,314
Utility Costs	\$80,372,279	\$79,394,694	\$25,659,693	\$25,659,693	\$658,458,330
Total Costs (\$)	\$121,506,389	\$120,528,804	\$43,918,170	\$43,918,170	\$1,046,713,644

Table 8-54 High Case Achievable Results and Costs – TE

High Case Achievable Results and Costs					
YEAR	2017	2021	2026	2031	Total of All Years
New Participants	\$6,930,251	\$6,930,251	\$1,106,856	\$1,106,856	NA
Participant Costs	\$20,430,085	\$20,430,085	\$9,106,827	\$9,106,827	\$193,218,697
Utility Costs	\$41,523,509	\$40,545,925	\$14,442,888	\$14,442,888	\$352,046,428
Total Costs (\$)	\$61,953,594	\$60,976,009	\$23,549,715	\$23,549,715	\$545,265,125

The breakout of the utility costs for the High Case Scenario is shown in the tables below. The increase in program costs reflects the need for higher spending in order to capture the likely participants. The extended marketing campaigns and collateral necessary to reach this customer segment increases program costs.

Table 8-55 High Case Utility Program Costs – OE

High Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$56,572,033	\$54,116,166	\$19,801,270	\$19,801,270
Incentives	\$50,675,826	\$50,675,826	\$19,140,564	\$19,140,564
Total	\$107,247,859	\$104,791,992	\$38,941,834	\$38,941,834

Table 8-56 High Case Utility Program Costs – CEI

High Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$37,485,018	\$36,507,433	\$12,102,699	\$12,102,699
Incentives	\$42,887,262	\$42,887,262	\$13,556,994	\$13,556,994
Total	\$80,372,279	\$79,394,694	\$25,659,693	\$25,659,693

Table 8-57 High Case Utility Program Costs – TE

High Case Utility Program Costs (\$)				
Utility Program Costs (\$)	2017	2021	2026	2031
Implementation	\$19,594,399	\$18,616,814	\$7,089,869	\$7,089,869
Incentives	\$21,929,111	\$21,929,111	\$7,353,020	\$7,353,020
Total	\$41,523,509	\$40,545,925	\$14,442,888	\$14,442,888

Higher program costs serve to reduce the cost-effectiveness of all programs across the Companies. This is a consistent finding for each of the three Companies. The Commercial Lighting Program, which also produces significant energy and demand savings, however, remains cost-effective based on the TRC.

Table 8-58 High Case Summary of Measure Test by Program – OE

Summary of Measure Tests by Program for High Case Year 2026				
Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.80	1.20
Behavioral	Res	0.00	0.86	0.00
Lighting	Res	1.83	1.42	3.00
Consumer Electronics	Res	0.00	1.66	0.00
Audits & Education	Res	0.00	0.64	0.00
EE Kits	Res	2.04	3.73	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	2.40	3.11	42.47
HVAC	Res	2.18	0.70	0.92
Smart Thermostat	Res	1.30	0.88	1.79
Appliances	Res	2.80	3.59	9.45
New Homes	Res	1.82	1.67	4.57
LI - New Homes	LI RES	0.00	0.31	0.00
Community Connections	LI RES	0.00	1.03	0.00
Audits & Education - SCI	COM	0.00	0.75	0.00
Audits & Education - LCI	IND	0.00	2.71	0.00
Custom Buildings - SCI	COM	1.29	1.23	5.89
Appliance Turn In - SCI	COM	2.38	3.07	43.97
Lighting - SCI	COM	2.26	1.90	3.96
Lighting - LCI	IND	2.40	2.68	7.20
Government Tariff Lighting	GOV	3.53	2.70	2.98
HVAC - SCI	COM	3.61	2.23	2.48
Appliances - SCI	COM	2.52	3.09	9.60
Food Service	COM	4.39	4.34	10.34
Agricultural	COM	0.75	0.53	1.60
Custom - SCI	COM	6.77	8.29	35.97
Custom - LCI	IND	2.52	2.92	22.60
HVAC - LCI	IND	3.93	4.02	7.95
Appliances - LCI	IND	4.13	6.95	60.00



Table 8-59 High Case Summary of Measure Test by Program – CEI

Summary of Measure Tests by Program for High Case Year 2026				
Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.80	1.20
Behavioral	Res	0.00	0.79	0.00
Lighting	Res	1.83	1.42	3.00
Consumer Electronics	Res	0.00	1.74	0.00
Audits & Education	Res	0.00	0.64	0.00
EE Kits	Res	2.04	3.73	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	2.42	3.14	42.10
HVAC	Res	2.16	0.70	0.89
Smart Thermostat	Res	1.28	0.86	1.77
Appliances	Res	2.83	3.65	9.92
New Homes	Res	2.21	2.03	5.16
LI - New Homes	LI RES	0.00	0.31	0.00
Community Connections	LI RES	0.00	1.07	0.00
Audits & Education - SCI	COM	0.00	0.73	0.00
Audits & Education - LCI	IND	0.00	2.41	0.00
Custom Buildings - SCI	COM	1.17	1.12	5.35
Appliance Turn In - SCI	COM	2.16	2.78	39.86
Lighting - SCI	COM	2.28	1.94	4.08
Lighting - LCI	IND	2.40	2.68	7.22
Government Tariff Lighting	GOV	3.59	2.35	2.60
HVAC - SCI	COM	3.53	2.27	2.61
Appliances - SCI	COM	2.51	3.21	10.73
Food Service	COM	4.16	4.05	9.50
Agricultural	COM	0.67	0.47	1.42
Custom - SCI	COM	6.66	8.03	33.37
Custom - LCI	IND	2.52	2.92	22.60
HVAC - LCI	IND	3.59	3.69	7.63
Appliances - LCI	IND	4.13	6.94	60.00

Table 8-60 High Case Summary of Measure Test by Program – TE  
 Summary of Measure Tests by Program for High Case  
 Year 2026

Sub Program Name	Class	Utility Test	TRC Test	Participant Test
Direct Load Control	Res	0.00	0.80	1.20
Behavioral	Res	0.00	0.76	0.00
Lighting	Res	1.83	1.42	3.00
Consumer Electronics	Res	0.00	1.74	0.00
Audits & Education	Res	0.00	0.64	0.00
EE Kits	Res	2.04	3.73	0.00
School Education	Res	0.00	1.05	0.00
Appliance Turn In	Res	2.29	2.93	42.10
HVAC	Res	2.17	0.71	0.92
Smart Thermostat	Res	1.29	0.87	1.78
Appliances	Res	2.86	3.67	9.37
New Homes	Res	1.62	1.49	3.92
LI - New Homes	LI RES	0.00	0.31	0.00
Community Connections	LI RES	0.00	1.00	0.00
Audits & Education - SCI	COM	0.00	0.47	0.00
Audits & Education - LCI	IND	0.00	2.38	0.00
Custom Buildings - SCI	COM	1.18	1.13	5.40
Appliance Turn In - SCI	COM	2.04	2.60	39.86
Lighting - SCI	COM	2.21	1.74	3.51
Lighting - LCI	IND	2.39	2.66	7.20
Government Tariff Lighting	GOV	3.84	1.64	1.85
HVAC - SCI	COM	3.64	2.25	2.52
Appliances - SCI	COM	2.51	3.21	10.69
Food Service	COM	4.33	4.16	9.57
Agricultural	COM	0.72	0.51	1.53
Custom - SCI	COM	6.60	7.89	32.07
Custom - LCI	IND	2.52	2.92	22.60
HVAC - LCI	IND	3.47	3.57	7.46
Appliances - LCI	IND	4.11	6.89	60.00

The cost-effectiveness analysis was based upon program level costs and benefits. The data used for the analysis are shown by program in the following tables.

Table 8-61 High Case Summary of Measure Costs & Benefits – OE

High Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	2,354,437	6,905,225	463,416	6,441,809	7,221,712	1,193,799
	2021		8,210,099	549,828	7,660,271	7,221,712	1,193,799
	2026		363,919	363,919	0	0	0
	2031	547,158	439,541	439,541	0	0	0
Behavioral	2017	0	2,595,555	2,096,536	499,019	3,887,132	0
	2021		3,328,364	2,773,753	554,611	3,887,132	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	1,215,112	16,911,328	14,344,492	2,566,836	4,176,820	1,562,629
	2021		20,125,767	17,032,523	3,093,244	4,176,820	1,562,629
	2026		668,890	574,947	93,943	249,118	189,296
	2031	315,493	803,632	696,923	106,709	249,118	189,296
Consumer Electronics	2017	362,194	2,158,870	1,757,838	401,032	1,199,468	1,086,583
	2021		2,584,779	2,087,216	497,563	1,199,468	1,086,583
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	866,314	685,918	180,396	1,732,981	0
	2021		1,112,996	860,859	252,137	1,732,981	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	11,243,122	9,226,541	2,016,581	5,382,202	4,440,294
	2021		13,611,121	11,006,058	2,605,063	5,382,202	4,440,294
	2026		4,335,089	3,559,987	775,102	1,419,025	1,171,291
	2031	0	5,292,544	4,417,560	874,984	1,419,025	1,171,291
School Education	2017	0	1,469,816	1,220,552	249,264	1,688,087	814,800
	2021		1,777,964	1,455,960	322,005	1,688,087	814,800
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	679,666	16,422,357	12,592,290	3,830,067	9,927,315	2,038,999
	2021		19,696,944	14,956,052	4,740,892	9,927,315	2,038,999
	2026		12,007,296	9,200,767	2,806,530	4,981,474	1,031,377
	2031	343,792	14,440,738	11,263,655	3,177,082	4,981,474	1,031,377
HVAC	2017	10,275,170	5,065,719	3,491,173	1,574,546	2,516,273	2,182,406
	2021		5,978,292	4,124,825	1,853,467	2,516,273	2,182,406
	2026		8,141,203	5,848,278	2,292,924	2,546,701	2,329,244
	2031	12,578,986	10,626,860	8,010,097	2,616,762	2,546,701	2,329,244
Smart Thermostat	2017	937,808	826,388	751,296	75,092	702,867	401,918
	2021		980,585	891,290	89,296	702,867	401,918
	2026		730,976	669,562	61,415	429,530	245,616
	2031	573,105	878,659	808,824	69,834	429,530	245,616
Appliances	2017	676,672	3,718,805	2,151,101	1,567,704	1,563,739	1,294,337
	2021		4,435,529	2,557,131	1,878,398	1,563,739	1,294,337
	2026		2,750,977	1,648,620	1,102,357	607,739	549,322
	2031	296,632	3,244,717	1,992,089	1,252,628	607,739	549,322
New Homes	2017	1,741,942	4,213,725	3,026,743	1,186,982	2,447,504	1,402,051
	2021		4,979,519	3,589,669	1,389,850	2,447,504	1,402,051
	2026		2,968,063	2,183,059	785,005	1,223,752	701,026
	2031	870,971	3,507,893	2,612,775	895,119	1,223,752	701,026

High Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	0	7,400,523	6,230,925	1,169,597	11,633,600	4,673,828
	2021		8,759,272	7,389,778	1,369,494	11,633,600	4,673,828
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	3,525,533	9,391,424	7,891,089	1,500,335	9,363,522	2,975,660
	2021		11,115,464	9,358,706	1,756,758	9,363,522	2,975,660
	2026		6,683,741	5,691,502	932,239	4,681,761	1,487,830
	2031	1,762,766	7,943,246	6,811,824	1,131,422	4,681,761	1,487,830
Appliance Turn In - SCI	2017	-13,885	341,316	263,529	77,787	206,768	41,655
	2021		407,644	312,956	94,689	206,768	41,655
	2026		245,524	192,338	53,186	103,384	20,827
	2031	-6,942	295,709	235,450	60,259	103,384	20,827
Lighting - SCI	2017	14,744,792	28,519,053	22,455,520	6,063,533	10,592,324	10,697,261
	2021		33,732,126	26,632,726	7,099,399	10,592,324	10,697,261
	2026		6,743,266	5,406,625	1,336,641	1,765,387	1,782,877
	2031	2,457,465	8,005,345	6,481,191	1,524,154	1,765,387	1,782,877
HVAC - SCI	2017	1,180,478	2,567,244	1,212,903	1,354,341	746,262	667,859
	2021		3,040,124	1,438,893	1,601,231	746,262	667,859
	2026		2,780,225	1,284,997	1,495,228	469,639	429,755
	2031	986,098	3,248,050	1,544,308	1,703,741	469,639	429,755
Appliances - SCI	2017	103,810	512,475	421,636	90,839	179,538	168,374
	2021		609,238	500,584	108,654	179,538	168,374
	2026		370,965	304,793	66,173	90,831	85,455
	2031	52,757	444,138	368,928	75,210	90,831	85,455
Food Service	2017	213,868	1,621,972	1,454,996	166,977	547,697	501,690
	2021		1,929,737	1,731,673	198,064	547,697	501,690
	2026		772,783	620,895	151,888	109,555	100,092
	2031	102,571	921,182	748,341	172,841	109,555	100,092
Agricultural	2017	214,311	184,931	165,694	19,238	286,148	76,632
	2021		219,096	196,571	22,526	286,148	76,632
	2026		195,571	182,849	12,723	250,979	64,184
	2031	194,877	235,236	220,729	14,507	250,979	64,184
Custom - SCI	2017	1,623,062	19,684,778	15,315,727	4,369,051	3,002,808	2,305,672
	2021		23,277,581	18,161,331	5,116,250	3,002,808	2,305,672
	2026		26,992,131	21,281,364	5,710,768	2,709,829	2,015,735
	2031	1,146,927	31,981,919	25,470,141	6,511,778	2,709,829	2,015,735
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	65,569	3,516,933	2,955,083	561,851	1,468,693	480,837
	2021		4,162,558	3,504,681	657,877	1,468,693	480,837
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	2,278,276	8,172,909	6,238,991	1,933,918	2,832,561	2,865,701
	2021		9,663,509	7,399,145	2,264,363	2,832,561	2,865,701
	2026		1,926,266	1,499,947	426,319	472,094	477,617
	2031	379,713	2,281,385	1,795,262	486,123	472,094	477,617
Custom - LCI	2017	3,422,647	36,084,682	27,586,715	8,497,967	18,934,094	6,760,443
	2021		42,686,101	32,723,450	9,962,651	18,934,094	6,760,443
	2026		47,296,808	36,320,601	10,976,208	16,287,611	5,962,607
	2031	2,908,667	56,061,227	43,547,756	12,513,471	16,287,611	5,962,607

Table 8-62 High Case Summary of Measure Costs &amp; Benefits – CEI

High Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	1,738,174	5,091,219	335,523	4,755,696	5,332,174	881,328
	2021		6,053,318	398,086	5,655,232	5,332,174	881,328
	2026		268,665	268,665	0	0	0
	2031	403,942	324,493	324,493	0	0	0
Behavioral	2017	0	1,785,243	1,442,014	343,229	2,911,537	0
	2021		2,289,274	1,907,809	381,466	2,911,537	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	933,550	14,035,465	11,904,993	2,130,472	3,430,779	1,258,006
	2021		16,703,506	14,135,955	2,567,551	3,430,779	1,258,006
	2026		471,210	405,031	66,179	175,495	133,353
	2031	222,254	566,131	490,958	75,173	175,495	133,353
Consumer Electronics	2017	195,365	1,225,688	1,003,406	222,182	646,755	586,096
	2021		1,465,955	1,191,333	274,622	646,755	586,096
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	643,507	509,507	134,000	1,287,275	0
	2021		826,744	639,454	187,290	1,287,275	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	8,088,854	6,636,771	1,451,792	3,867,196	3,190,929
	2021		9,792,258	7,916,801	1,875,456	3,867,196	3,190,929
	2026		3,159,638	2,594,704	564,935	1,034,259	853,698
	2031	0	3,857,482	3,219,748	637,734	1,034,259	853,698
School Education	2017	0	1,071,279	889,602	181,677	1,230,366	593,869
	2021		1,295,873	1,061,179	234,694	1,230,366	593,869
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	517,681	12,510,970	9,531,370	2,979,600	7,528,606	1,553,043
	2021		15,022,238	11,320,923	3,701,315	7,528,606	1,553,043
	2026		9,180,887	6,966,175	2,214,713	3,781,141	787,746
	2031	262,582	11,034,872	8,528,156	2,506,715	3,781,141	787,746
HVAC	2017	6,499,579	3,230,694	2,115,598	1,115,096	1,653,225	1,410,872
	2021		3,812,931	2,499,670	1,313,261	1,653,225	1,410,872
	2026		5,134,292	3,525,448	1,607,844	1,620,793	1,467,496
	2031	7,883,431	6,655,810	4,830,941	1,824,869	1,620,793	1,467,496
Smart Thermostat	2017	638,270	554,487	502,792	51,696	478,369	273,544
	2021		657,955	596,481	61,474	478,369	273,544
	2026		490,380	448,100	42,280	292,337	167,166
	2031	390,054	589,374	541,298	48,076	292,337	167,166
Appliances	2017	344,010	1,871,937	1,099,106	772,832	871,123	693,336
	2021		2,234,535	1,307,513	927,022	871,123	693,336
	2026		1,361,643	820,561	541,082	299,480	268,611
	2031	141,003	1,606,062	991,194	614,868	299,480	268,611
New Homes	2017	1,260,646	3,722,297	2,472,627	1,249,669	1,771,262	1,014,666
	2021		4,385,747	2,932,496	1,453,251	1,771,262	1,014,666
	2026		2,609,852	1,783,399	826,462	885,631	507,333
	2031	630,323	3,076,838	2,134,446	942,392	885,631	507,333

High Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	0	4,942,760	4,141,959	800,800	7,961,520	3,198,561
	2021		5,849,963	4,912,298	937,666	7,961,520	3,198,561
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	2,600,722	6,298,350	5,292,152	1,006,198	6,907,302	2,195,091
	2021		7,454,576	6,276,408	1,178,168	6,907,302	2,195,091
	2026		4,482,445	3,817,001	665,444	3,453,651	1,097,546
	2031	1,300,361	5,327,131	4,568,344	758,787	3,453,651	1,097,546
Appliance Turn In - SCI	2017	-10,458	233,108	179,955	53,153	155,788	31,373
	2021		278,409	213,707	64,702	155,788	31,373
	2026		167,684	131,341	36,343	77,894	15,686
	2031	-5,229	201,956	160,781	41,176	77,894	15,686
Lighting - SCI	2017	19,794,560	39,440,201	31,024,932	8,415,268	14,423,277	14,747,692
	2021		46,648,430	36,795,678	9,852,752	14,423,277	14,747,692
	2026		9,324,045	7,469,007	1,855,038	2,403,880	2,457,949
	2031	3,299,092	11,067,828	8,952,547	2,115,282	2,403,880	2,457,949
HVAC - SCI	2017	1,140,205	2,649,220	1,279,468	1,369,752	759,548	691,512
	2021		3,137,424	1,517,784	1,619,640	759,548	691,512
	2026		2,819,995	1,334,456	1,485,539	486,279	447,295
	2031	968,791	3,297,099	1,604,618	1,692,481	486,279	447,295
Appliances - SCI	2017	87,828	479,213	393,162	86,051	170,086	160,031
	2021		569,623	466,732	102,891	170,086	160,031
	2026		351,647	288,921	62,726	86,412	81,507
	2031	44,713	421,037	349,748	71,290	86,412	81,507
Food Service	2017	132,952	1,012,348	928,484	83,864	371,483	340,225
	2021		1,205,099	1,105,574	99,525	371,483	340,225
	2026		387,396	312,149	75,247	58,037	52,944
	2031	56,022	461,975	376,355	85,621	58,037	52,944
Agricultural	2017	186,164	132,615	122,625	9,991	240,696	61,874
	2021		157,187	145,489	11,698	240,696	61,874
	2026		155,794	149,187	6,607	223,828	55,744
	2031	177,205	187,898	180,364	7,534	223,828	55,744
Custom - SCI	2017	1,163,866	12,751,687	9,938,098	2,813,590	1,988,266	1,541,448
	2021		15,078,887	11,784,305	3,294,582	1,988,266	1,541,448
	2026		17,374,511	13,710,163	3,664,348	1,766,621	1,322,320
	2031	796,351	20,586,510	16,408,166	4,178,345	1,766,621	1,322,320
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	30,524	1,451,637	1,219,729	231,907	683,720	223,844
	2021		1,718,122	1,446,579	271,543	683,720	223,844
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	2,496,461	8,965,825	6,858,515	2,127,310	3,114,428	3,149,778
	2021		10,624,673	8,133,872	2,490,802	3,114,428	3,149,778
	2026		2,117,833	1,648,881	468,951	519,071	524,963
	2031	416,077	2,508,242	1,973,506	534,736	519,071	524,963
Custom - LCI	2017	1,717,500	18,107,459	13,843,140	4,264,319	9,501,215	3,392,421
	2021		21,420,081	16,420,778	4,999,304	9,501,215	3,392,421
	2026		23,733,756	18,225,844	5,507,911	8,173,198	2,992,064
	2031	1,459,582	28,131,781	21,852,464	6,279,317	8,173,198	2,992,064

Table 8-63 High Case Summary of Measure Costs &amp; Benefits – TE

High Case Summary of Measure Costs and Benefits by Class and Program							
RESIDENTIAL PROGRAMS	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
Direct Load Control	2017	649,262	1,911,003	134,601	1,776,401	2,036,799	329,204
	2021		2,272,106	169,700	2,112,406	2,036,799	329,204
	2026		100,355	100,355	0	0	0
	2031	150,885	121,208	121,208	0	0	0
Behavioral	2017	0	661,145	534,034	127,111	1,122,086	0
	2021		847,808	706,536	141,272	1,122,086	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting	2017	327,411	4,871,206	4,131,802	739,404	1,192,327	438,378
	2021		5,797,176	4,906,086	891,090	1,192,327	438,378
	2026		167,359	143,854	23,505	62,330	47,363
	2031	78,938	201,072	174,373	26,699	62,330	47,363
Consumer Electronics	2017	74,284	471,934	386,884	85,050	249,730	222,852
	2021		564,360	469,335	105,025	249,730	222,852
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Audits & Education	2017	0	246,200	194,933	51,267	492,501	0
	2021		316,305	244,660	71,646	492,501	0
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
EE Kits	2017	0	3,131,942	2,570,009	561,933	1,498,409	1,236,274
	2021		3,791,602	3,065,684	725,917	1,498,409	1,236,274
	2026		1,215,005	997,765	217,240	397,713	328,280
	2031	0	1,483,353	1,238,119	245,234	397,713	328,280
School Education	2017	0	411,949	342,087	69,862	473,124	228,366
	2021		498,314	408,065	90,249	473,124	228,366
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Appliance Turn In	2017	-200,246	4,839,411	3,686,861	1,152,551	3,098,906	600,738
	2021		5,810,804	4,379,083	1,431,720	3,098,906	600,738
	2026		3,551,291	2,694,609	856,682	1,555,966	304,711
	2031	-101,570	4,268,437	3,298,804	969,633	1,555,966	304,711
HVAC	2017	3,018,359	1,510,764	1,030,001	480,764	766,988	658,200
	2021		1,783,706	1,217,078	566,629	766,988	658,200
	2026		2,395,276	1,710,675	684,601	751,085	683,659
	2031	3,655,509	3,119,177	2,337,934	781,243	751,085	683,659
Smart Thermostat	2017	281,331	246,123	223,464	22,659	210,851	120,570
	2021		292,049	265,104	26,944	210,851	120,570
	2026		217,687	199,155	18,532	128,854	73,682
	2031	171,924	261,649	240,577	21,072	128,854	73,682
Appliances	2017	184,984	1,045,043	583,750	461,293	435,029	358,709
	2021		1,246,809	694,019	552,790	435,029	358,709
	2026		763,856	441,418	322,439	164,790	149,483
	2031	80,209	899,831	533,456	366,375	164,790	149,483
New Homes	2017	542,105	1,189,224	807,286	361,938	761,682	436,329
	2021		1,381,226	957,429	423,797	761,682	436,329
	2026		821,627	582,261	239,366	380,841	218,164
	2031	271,053	969,816	696,874	272,942	380,841	218,164

High Case Summary of Measure Costs and Benefits by Class and Program							
	Year	Participant Costs	Program Benefits	Avoided Energy Costs	Avoided Capacity Costs	Total Utility Budget Costs	Incentive Costs
<b>COMMERCIAL PROGRAMS</b>							
Audits & Education - SCI	2017	0	1,811,540	1,522,861	288,679	4,596,768	1,846,763
	2021		2,144,106	1,806,089	338,018	4,596,768	1,846,763
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Custom Buildings - SCI	2017	1,122,546	2,743,659	2,305,344	438,316	2,981,388	947,464
	2021		3,247,329	2,734,101	513,228	2,981,388	947,464
	2026		1,952,823	1,882,745	289,878	1,490,694	473,732
	2031	561,273	2,320,581	1,990,042	330,539	1,490,694	473,732
Appliance Turn In - SCI	2017	-4,383	97,571	75,417	22,154	69,533	13,150
	2021		116,530	89,563	26,967	69,533	13,150
	2026		70,191	55,044	15,147	34,767	6,575
	2031	-2,192	84,543	67,382	17,162	34,767	6,575
Lighting - SCI	2017	8,898,383	15,149,202	12,028,069	3,121,133	5,778,750	5,787,933
	2021		17,920,228	14,265,889	3,654,339	5,778,750	5,787,933
	2026		3,595,288	2,897,268	688,021	963,125	964,655
	2031	1,483,064	4,259,189	3,474,648	784,541	963,125	964,655
HVAC - SCI	2017	405,953	904,053	429,044	475,009	280,533	233,239
	2021		1,070,531	508,982	561,549	280,533	233,239
	2026		982,397	457,028	525,370	164,538	150,552
	2031	345,480	1,147,846	549,208	598,638	164,538	150,552
Appliances - SCI	2017	42,172	227,939	186,774	41,166	81,350	76,488
	2021		270,926	221,716	49,211	31,350	76,488
	2026		168,500	138,385	30,115	41,414	39,027
	2031	21,493	201,742	167,515	34,227	41,414	39,027
Food Service	2017	75,136	524,213	468,460	55,753	177,340	162,500
	2021		623,649	557,523	66,126	177,340	162,500
	2026		253,612	202,965	50,647	36,481	33,381
	2031	36,191	302,274	244,642	57,632	36,481	33,381
Agricultural	2017	72,458	58,755	53,155	5,600	95,687	25,278
	2021		69,619	63,062	6,558	95,687	25,278
	2026		64,227	60,523	3,704	85,637	21,699
	2031	66,953	77,321	73,098	4,223	85,637	21,699
Custom - SCI	2017	728,590	7,578,122	5,912,111	1,666,010	1,196,669	932,723
	2021		8,961,111	7,010,330	1,950,782	1,196,669	932,723
	2026		10,284,228	8,119,514	2,164,713	1,053,581	791,429
	2031	490,639	12,185,588	9,717,227	2,468,361	1,053,581	791,429
<b>INDUSTRIAL PROGRAMS</b>							
Audits & Education - LCI	2017	31,952	1,503,337	1,263,171	240,167	715,695	234,312
	2021		1,779,314	1,498,100	281,214	715,695	234,312
	2026		0	0	0	0	0
	2031	0	0	0	0	0	0
Lighting - LCI	2017	2,246,256	8,061,360	6,148,167	1,913,192	2,823,746	2,823,694
	2021		9,531,636	7,291,510	2,240,126	2,823,746	2,823,694
	2026		1,899,899	1,478,146	421,754	470,624	470,616
	2031	374,376	2,250,092	1,769,176	480,916	470,624	470,616
Custom - LCI	2017	1,344,003	14,169,710	10,832,734	3,336,976	7,435,028	2,654,687
	2021		16,761,951	12,849,824	3,912,127	7,435,028	2,654,687
	2026		18,572,481	14,262,351	4,310,130	6,395,809	2,341,393
	2031	1,142,173	22,014,087	17,100,305	4,913,782	6,395,809	2,341,393



## 9.0 CONCLUSIONS

Based on the analyses as set forth in this Market Study, and assuming there are no significant changes to the facts underlying the assumptions and parameters as described herein, Harbourfront concludes:

1. The *Base Case Energy Efficiency* estimate of achievable potential for energy efficiency-related reductions are 26.4% for Ohio Edison; 23.7% for CEI; and 21.9% for Toledo Edison by 2031.
2. The *Base Case Peak Demand Reduction* estimate of achievable potential peak related reductions are 14.4% for Ohio Edison; 13.7% for CEI; and 13.1% for Toledo Edison by 2031.
3. The *High Case Energy Efficiency* estimate of achievable potential for energy efficiency-related reductions are 33.0% for Ohio Edison; 28.8% for CEI; and 26.6% for Toledo Edison by 2031.
4. The *High Case Peak Demand Reduction* estimate of achievable potential peak related reductions are 17.2% for Ohio Edison; 16.2% for CEI; and 15.3% for Toledo Edison by 2031.
5. There is sufficient achievable and economic energy efficiency and peak demand reduction market potential to provide the Companies with the opportunity to achieve their energy efficiency and peak demand reduction goals during the period the Proposed Plans are in effect.

## 10.0 APPENDICES

## APPENDIX A: COMMERCIAL ENERGY USE DATA TABLES

### 2015 Estimates of Commercial Sales (MWh)

2015 Estimates of Commercial Sales (MWh)											
Commercial Building Types (CBT)	Space Heating	Cooling	Ventilation	Water Heat	Uplift	Cooling	Refrigeration	Other	Computers	Other	Total
Education	48,920	268,690	278,520	37,428	861,022	6,246	54,692	34,054	307,748	70,220	1,259,813
Food Sales	18,695	37,545	21,888	6,731	143,791	6,231	371,939	6,231	6,231	31,314	650,095
Food Service	32,729	31,686	28,467	32,729	140,699	4,478	228,106	8,499	8,499	39,710	729,063
Health Care	26,692	369,140	208,467	30,074	522,797	4,772	30,768	20,148	48,841	179,214	1,234,862
Inpatient	34,736	117,846	179,041	9,391	358,396	4,847	18,783	9,391	33,021	54,216	639,161
Outpatient	17,273	51,591	22,655	3,684	160,455	2,045	22,955	11,364	17,273	85,009	306,693
Lodging	70,628	120,440	70,628	80,720	673,760	10,406	60,720	11,869	20,482	120,440	1,182,085
Retail	296,632	870,130	291,832	128,678	1,045,428	7,229	185,220	27,871	37,591	277,586	2,488,200
Retail (Other Than Mail)	21,536	50,729	57,606	6,941	401,867	-	75,818	11,105	14,575	78,618	763,478
Freight and Ship Mails	155,546	251,042	152,580	107,481	588,531	6,013	20,434	85,002	24,052	182,644	1,563,277
Office	170,993	521,123	323,656	35,641	1,453,444	6,107	181,172	184,887	360,664	408,296	3,706,493
Public Assembly	20,177	141,240	254,731	6,470	108,956	-	76,319	1,617	12,106	97,815	673,901
Public order and safety	15,436	47,042	29,218	3,308	131,204	551	34,955	34,894	34,398	42,264	334,604
Religious Worship	9,895	36,054	16,281	7,735	75,226	-	16,772	1,163	3,499	59,315	204,113
Service	22,440	55,812	63,285	-	283,630	-	33,973	3,452	10,952	108,571	552,578
Warehouse and Storage	32,000	81,599	126,188	11,200	430,387	-	227,195	17,400	32,000	183,697	1,597,576
Other	9,331	74,488	51,084	-	305,500	-	46,555	6,231	23,152	102,620	518,500
Vacant	4,336	11,057	17,126	1,518	112,534	-	30,787	1,794	4,336	24,989	208,564
Total	655,213	1,978,649	1,789,872	325,798	6,075,919	34,928	1,509,426	295,976	740,923	1,791,326	15,181,438

### EIA Estimates of Energy Use Intensities (EUIs)

EIA Estimates of Energy Use Intensities (EUIs)											
Commercial Building Types (CBT)	Space Heating	Cooling	Ventilation	Water Heat	Uplift	Cooling	Refrigeration	Other	Computers	Other	Total
Education	0.32	1.80	1.79	0.24	2.44	0.04	0.35	0.09	0.89	0.46	8.00
Food Sales	1.17	2.35	1.37	0.26	9.00	0.99	23.78	0.39	0.39	1.95	40.68
Food Service	1.41	3.96	3.38	1.41	6.06	1.83	8.87	0.28	0.28	2.12	30.60
Health Care	0.86	3.39	3.55	0.19	9.86	0.09	0.75	0.36	0.98	1.36	23.30
Inpatient	0.47	3.88	5.91	0.31	11.83	0.16	0.62	0.31	1.08	3.11	27.31
Outpatient	0.28	2.22	1.01	0.17	7.05	0.09	1.01	0.50	0.75	1.78	17.40
Lodging	0.65	1.62	0.95	0.81	8.39	0.14	0.81	0.30	0.41	1.62	15.90
Retail	1.36	2.96	1.80	0.89	7.23	0.05	1.15	0.19	0.26	1.92	17.20
Retail (Other Than Mail)	0.31	1.30	0.69	0.10	5.79	-	1.15	0.16	0.21	1.15	11.00
Freight and Ship Mails	2.07	3.34	2.08	1.43	7.83	0.08	1.07	0.30	0.32	2.43	20.89
Office	0.84	2.36	1.59	0.18	7.14	0.08	0.89	0.81	1.87	2.20	18.70
Public Assembly	0.28	1.97	3.02	0.02	1.54	-	0.51	0.02	0.17	1.51	8.50
Public order and safety	0.84	2.56	1.59	0.10	7.14	0.08	0.89	0.81	1.87	2.20	18.70
Religious Worship	0.17	0.63	0.28	0.04	0.96	-	0.34	0.02	0.05	1.00	3.50
Service	0.38	0.97	1.55	-	4.00	-	0.52	0.06	0.19	1.60	3.60
Warehouse and Storage	0.20	0.51	0.79	0.07	5.19	-	1.42	0.08	0.20	1.15	3.60
Other	0.37	2.36	2.08	-	7.14	-	1.85	0.25	0.92	4.07	24.80
Vacant	0.20	0.51	0.79	0.07	5.19	-	1.42	0.08	0.20	1.15	3.60

## APPENDIX B: LARGE MANAGED ACCOUNTS CUSTOMERS

### Large Managed Accounts Customer Characteristics

	Large Commercial & Industrial Customer Characteristics (>700kW)	Chemical & Allied Prod	Education	Electronic Mfg.	Entertainment	Food and Kindred Products	Health	Mining & Oil Gas Extract	Paper Mills & Products	Primary Metals & Hvy Mfg.	Professional	Refining & Plastics	Retail - Large	Transport Mfg.
1	These customers may have a dedicated energy manager.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	These customers may not have the luxury of having a dedicated energy manager and such duties are the responsibility of the facilities or plant manager. In these cases opportunities for energy efficiency improvements are not the primary focus of these individuals.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	The customers need to have easy and timely access to their energy demand and consumption data in order to better understand the costs associated with various production runs and the timing and use of electrical equipment.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	Large C&I account representatives have frequent contact with all managed accounts and some customers have sought out and implemented some energy efficiency measures in the past.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	These customers may have operation 24 hours per day, 5 to 7 days a week.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	These customers are in operation more than 10 hours per day, 5-6 days a week.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	While these customers have implemented some energy efficiency measures in the past, they would benefit from having an energy audit or survey of their facilities.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Typically a financial payback of < 1 year is necessary in order to get the interest of the customer.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	Typically a financial payback of 2 to 4 years is necessary in order to get the interest of the customer.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Large Commercial & Industrial Customer Characteristics (>700kW)	Chemical & Allied Prod	Education	Electronic Mfg.	Entertainment	Food and Kindred Products	Health	Mining & Oil Gas Extract	Paper Mills & Products	Primary Metals & Hvy Mfg.	Professional	Refining & Plastics	Retail - Large	Transport Mfg.
10	Typically customers receptive to further education in potential energy saving opportunities and measures.													
11	Typical barriers to investing in energy efficiency improvements are the costs, adequate payback, lack of capital and owner's uncertainty regarding general economic conditions.													
12	Potential leverage points to help encourage the customer's decision to investigate and implement energy efficient measures include education, energy audits, cost savings, rebates, cash incentives, low interest loans and environmental benefits.													
13	Major energy efficiency improvement opportunities include interior and exterior lighting improvements.													
14	Major energy efficiency improvement opportunities include motor improvements.													
15	Major energy efficiency improvement opportunities include HVAC improvements.													
16	Major energy efficiency improvement opportunities include a demand / energy management system.													

**This foregoing document was electronically filed with the Public Utilities**

**Commission of Ohio Docketing Information System on**

**4/15/2016 2:57:12 PM**

**in**

**Case No(s). 16-0743-EL-POR**

**Summary: Application electronically filed by Ms. Carrie M Dunn on behalf of The Toledo Edison Company and The Cleveland Electric Illuminating Company and Ohio Edison Company**

Jump to [Custom Buildings](#)

## Custom Equipment

The Custom Equipment Incentive Program is offered to commercial, industrial, governmental and institutional customers of Ohio Edison, The Illuminating Company and Toledo Edison (FirstEnergy's Ohio utilities).

### Eligible Measures

Custom projects include technologies or customer-specific energy efficiency projects that do not meet the eligibility criteria for other business programs.

Eligible projects and technologies may include:

- Industrial process upgrades
- Building operation training
- Energy management system installation
- New construction or renovation projects that involve multiple building systems and exceed state energy codes (e.g., lighting, HVAC and building envelope codes)
- Air Cooled Chillers
- Upgrading existing motors to energy-efficient motors
- Replacing motor speed controls with variable frequency drives (VFDs) (excluding VFDs included in the Prescriptive service offering)
- Water/wastewater system improvements
- Economizers
- Building control systems that are not required by code (e.g., demand control ventilation or exhaust air heat recovery)

Ineligible projects and technologies include:

- Power factor correction devices
- Motor soft starts
- Renewable energy technologies that generate electricity (e.g., solar photovoltaic, wind generation, micro-hydro turbines, etc.)
- Fuel Switching (e.g., replacement of an electric chiller with an absorption chiller)

### Effective Dates

To qualify for incentives through the program, equipment must be new and installed after January 1, 2017.

### Pre-Approval Requirements

All lighting incentive applications received by the program will require pre-approval before the purchase and installation of materials.

### Program Incentives

Custom Equipment Incentives	
Custom Equipment Performance Incentive	An incentive of \$0.05/kWh saved is offered for projects under the Custom Equipment Incentive program. All Custom Equipment Incentives are limited to 50 percent of the total project cost.

**EXHIBIT**

OCC 4



Prescriptive Incentives	Equipment & Eligibility Requirements	Incentive
Variable Speed Drives (VFDs)	Eligible measures include VFDs installed on existing motors that drive fans, pumps, and other suitable applications.	\$50 per hp controlled
Three Phase Motors	Eligible measures include the installation of new premium efficiency motors.	\$20 per hp

The Program Administrator must receive a copy of all required documentation before incentives are paid. Annual kWh savings are determined by one of three methods:

1. Performance-based – demonstrated by an hourly energy simulation model. For LEED-certified projects, and other projects which have a detailed energy model, input and output reports from the software program.
2. Deemed – demonstrated by submitting program-approved calculators
3. Measured – demonstrated by site data collection. Direct measurement may take place before or after retrofit, or at both times. In some cases, direct measurement may be combined with engineering calculations to determine electrical energy savings.

### How Do I Apply For Incentives?

**Step 1** – The participant should complete and submit a Custom Equipment Incentive application online and upload required documents through the application portal. The following documents are required for a pre-approval:

1. Completed and signed W-9 tax form for the incentive payee. The W-9 form must be current and dated within the last 24 months.
2. Scope of work with a summary of the existing and proposed systems
3. Manufacturers' specification (cut) sheets for each proposed item to verify that the equipment is eligible. Please circle or highlight the relevant information on the specification (cut) sheets.
4. Detailed energy savings analysis/calculations with supporting pre data/measurements (if applicable).
5. Copy of utility bill to confirm account number and service address. If desired, the participant may obscure all cost and rate related information.

**Step 2** – The Program Administrator will notify the applicant via email when the review is complete and funds have been reserved. The applicant will have 90 days from the date of the pre-approval letter to complete the project.

**Step 3** – Once the project is complete, participants should review their application for any changes and submit the following documents to the Program Administrator for review:

6. Revised energy savings analysis/calculations (if changes were made during construction).
7. Detailed, itemized invoices or proofs of purchase for the equipment installed.
8. Completed letter of attestation.
9. Post energy data/measurements (if applicable).

Supporting technical documentation will be reviewed by Program Administrator and an onsite inspection to verify the installation may be conducted. Upon receipt and verification of all required documentation, the incentive check will be processed and mailed to the applicant or to an authorized representative, if requested on the application.

[Apply Online](#) for custom equipment incentives or contact us at 1-866-578-5220.

## Custom Buildings

The Custom Buildings Incentive Program is offered to commercial, industrial, governmental and institutional customers of Ohio Edison, The Illuminating Company and Toledo Edison (FirstEnergy's Ohio utilities) for retrofits and new construction projects that include technologies or customer-specific energy efficiency projects that do not meet the eligibility criteria for other business programs.

### Eligible Measures

Custom projects include building shell and systems improvements that reduce energy consumption and demand by improving building energy performance. To qualify for incentives, projects must show minimum savings estimates.

Possible custom building projects include:

- Replacement of existing windows with high performance glazing
- Addition of insulation in exterior walls and/or roof that exceeds building code requirements
- Replacement of existing roof with reflective coating
- LEED-certified buildings, renovation or addition
- A new building automation control system
- Smart thermostats

### Effective Dates

To qualify for incentives through the Custom Buildings program, equipment must be new and installed after January 1, 2017.

### Pre-Approval Requirements

All lighting incentive applications received by the program will require pre-approval before the purchase and installation of materials.

### Limitations

Incentives available from the Custom Buildings Incentive Program are shown below, and are limited to the total project cost. Incentives for smart thermostats are limited to 75 percent of the equipment cost.

### New Construction Eligibility Requirements

Eligible new construction and major renovation projects must achieve electrical energy savings exceeding IECC 2009 or ASHRAE 90.1-2007.

### Program Incentives

Custom Building Incentives		
Custom Building Performance Incentive		An incentive of \$0.05/kWh saved is offered for projects under the Custom Buildings Incentive program. All Custom Building Incentives are limited to 50 percent of the total project cost.
Measure	Equipment & Eligibility Requirements	Incentive
Building Automation Controls	Eligible projects must include the installation of new energy management system that controls lighting, HVAC and other systems.	\$0.05/kWh
Smart Thermostats	Eligible thermostats must be able to control at least three (3) of the following parameters: Fan delays, free cooling, occupancy sensing, heat pump resistance element lockout, humidity control, compressor optimization, or behavioral "coaching". Thermostats must control electric heating and/or cooling systems.	\$0.05/kWh, limited to 75 percent of the thermostat cost.

Annual kWh savings are determined by one of three methods:

1. Performance-based – demonstrated by an hourly energy simulation model. For LEED-certified projects, and other projects which have a detailed energy model, input and output reports from the software program.
2. Deemed – demonstrated by submitting program-approved calculators
3. Measured – demonstrated by site data collection. Direct measurement may take place before or after retrofit, or at both times. In some cases, direct measurement may be combined with engineering calculations to determine electrical energy

savings.

## How Do I Apply For Incentives?

**Step 1** – The participant should complete and submit a Custom Buildings Incentive application online and upload required documents through the application portal. The following documents are required for a pre-approval (if the project is already complete, applicants should also submit the required documentation listed in Step 3):

1. Completed and signed W-9 tax form for the incentive payee. The W-9 form must be current and dated within the last 24 months.
2. Scope of work with a summary of the existing and proposed systems
3. Manufacturers' specification (cut) sheets for each proposed item to verify that the equipment is eligible. Please circle or highlight the relevant information on the specification (cut) sheets.
4. Detailed energy savings analysis/calculations.
5. Copy of utility bill to confirm account number and service address. If desired, the participant may obscure all cost and rate related information.

**Step 2** – The Program Administrator will notify the applicant via email when the review is complete and funds have been reserved. The applicant will have 90 days from the date of the pre-approval letter to complete the project.

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7. Detailed, itemized invoices or proofs of purchase for the equipment installed.
8. Completed letter of attestation.

Supporting technical documentation will be reviewed by Program Administrator and an onsite inspection to verify the installation may be conducted. Upon receipt and verification of all required documentation, the incentive check will be processed and mailed to the applicant or to an authorized representative, if requested on the application.

[Apply online](#) for Custom Building incentives today or contact us at 1-866-578-5220.

## >Apply for Equipment Incentives

## Apply for Building Incentives

### Program Resources

- [Frequently Asked Questions](#)
- [Service Map](#)
- [Attestation Letter](#)
- [W-9 Form Download](#)
- [Terms and Conditions](#)
- [Contact Us](#)

### Contact Us

866-578-5220

Fax: +1 330-319-8355

Email: [EnergySaveOH@sodexo.com](mailto:EnergySaveOH@sodexo.com)

## Service Providers

[Program Ally Registration](#)

[Program Ally Directory](#)

**Sodexo** is the designated program implementer for commercial and industrial energy efficiency programs for FirstEnergy's Ohio utilities. This website is maintained by Sodexo.

Costs of this program may be recovered through customer rates in accordance with Ohio law. For a complete list of commercial, industrial, residential and low-income energy efficiency programs, please visit [energysaveOH.com](http://energysaveOH.com)

Case No. 16-0743-EL-POR

In the Matter of the Application of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company For Approval of Their Energy Efficiency and Peak Demand Reduction Program Portfolio Plans for 2017 through 2019

RESPONSES TO DATA REQUESTS

**NRDC Set 1** Regarding FirstEnergy's \$25 million "after-tax" shared savings cap referenced on p. 100 of  
**- INT-032** Attachment A to the Application, please answer the following:

- a) Approximately what would that amount be "pre-tax"? Please use the Companies' best current estimate of its likely future tax rates in answering this question. If it cannot estimate what such future tax rates will be, please answer assuming its most recently determined tax rate.
- b) Does the proposed cap apply to the sum of shared savings from all three FirstEnergy subsidiary companies?

**Response:** a) Approximately \$39M based on the Companies' current composite income tax rate.  
b) Yes, as stated in Section 7.1 of the Companies' Plan, the \$25 million after-tax cap is per year in total across the Companies.

**EXHIBIT**

OCC 6

Case No. 16-0743-EL-POR

In the Matter of the Application of Ohio Edison Company, The Cleveland Electric  
Illuminating Company, and The Toledo Edison Company For Approval  
of Their Energy Efficiency and Peak Demand Reduction Program Portfolio  
Plans for 2017 through 2019

**RESPONSES TO DATA REQUESTS**

**OCC Set 6 –** Do the Companies propose to count savings from the Energy Special Improvement  
**INT-144** District program toward shared savings?

**Response:** Objection. This request is vague and ambiguous as to the phrase "count savings from the Energy Special Improvement District program toward shared savings". Subject to and without waving the foregoing objection, the Companies will not include Energy Special Improvement District program results in their calculation of the Portfolios' Adjusted Net Benefits used in the Shared Savings Mechanism.

Case No. 16-0743-EL-POR

In the Matter of the Application of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company For Approval of Their Energy Efficiency and Peak Demand Reduction Program Portfolio Plans for 2017 through 2019

**RESPONSES TO DATA REQUESTS**

**OCC Set 1 –** Section 7.1 of the Application states that shared savings will include a "cap of \$25 million  
**INT-012** after-tax per year in total across the Companies." If the \$25 million cap is reached, please describe how the \$25 million amount will be divided between and paid by the customers of OE, TE, and CEI, respectively.

**Response:** If the \$25 million cap is reached, the amount of shared savings that will be recovered by each Company will be based on the proportion that each Company earned an incentive in the prior reporting year.

**EXHIBIT**

OCC 8

December 1, 2016

**VIA OVERNIGHT EXPRESS  
MAIL AND E-MAIL**

Ohio Hospital Association  
Attn: Rick Sites  
155 East Broad Street, 15th Floor  
Columbus, Ohio 43215  
ricks@ohanet.org

Re: Notice of Intent to Terminate Program Administrator Agreement

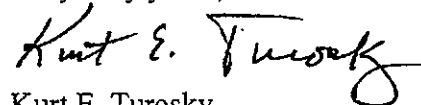
Dear Mr. Sites:

I am contacting you regarding the Program Administrator Agreement by and between Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company (collectively, "Companies"), and OHA Solutions, Inc. ("OHA") dated as of June 24, 2009 ("Agreement"). Capitalized terms used but not defined in this letter have the meanings given to them in the Agreement.

By this letter, OHA is hereby notified of the Companies' intent to terminate the Agreement effective December 31, 2016. This letter constitutes advance written notice of at least thirty (30) days pursuant to Section 11 of the Agreement. Accordingly, the Agreement will terminate on December 31, 2016, except for those provisions of the Agreement which, by their express terms, survive termination of the Agreement. Under the terms of the Agreement, OHA bears full responsibility of timely notifying its members that it will no longer represent them in the Companies' Programs.

Please do not hesitate to contact our counsel, Erika Ostrowski, Esq. (eostrowski@firstenergycorp.com), should you have any questions regarding this notice.

Very truly yours,



Kurt E. Turosky

cc: Erika Ostrowski, Esq., Dylan Borchers, Esq.

**EXHIBIT**

OHA

1



Case No. 16-0743-EL-POR

In the Matter of the Application of Ohio Edison Company, The Cleveland Electric  
Illuminating Company, and The Toledo Edison Company For Approval  
of Their Energy Efficiency and Peak Demand Reduction Program Portfolio  
Plans for 2017 through 2019

RESPONSES TO DATA REQUESTS

**OCC Set 6 –** Exhibit A to the Stipulation shows a reduction from 150,490 to 13,691 MWh in energy  
**INT-130** savings under the residential Customer Action Program. Please describe how the  
Companies arrived at the 13,691 MWh savings number. Include all assumptions,  
methodologies, formulas, and calculations.

**Response:** The Companies' updated projections of the Residential Customer Action Program ("CAP")  
are based on current expectations that the utility-administered programs will capture the  
vast majority of customer projects. Further, given the scaled back level of the plan and the  
uncertainty of the results CAP may produce, the Companies must ensure that the utility  
administered programs are of sufficient size to ensure compliance with the statutory  
targets.

**EXHIBIT**

OCC 2