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Harry M. Barton
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August 31, 2018

By Hand Delivery
Ms. Lora W. Johnson, CMC, LMMC
Clerk of Council
Council of the City of New Orleans
Room 1E09, City Hall
1300 Perdido Street
New Orleans, LA 70112

Re: **In Re: 2018 Triennial Integrated Resource Plan of Entergy New Orleans, Inc.**
Docket No. UD-17-03

Dear Ms. Johnson:

Entergy New Orleans, Inc. ("ENO" or the "Company") respectfully submits the its 2018 Integrated Resource Plan Demand Side Management ("DSM") Potential Study prepared on Navigant Consulting, Inc. on the Company's behalf in the above referenced Docket. Please file an original and two copies into the record in the above referenced matter, and return a date-stamped copy to our courier.

Should you have any questions regarding the above, I may be reached at (504) 576-2984. Thank you for your assistance with this matter.

Sincerely,

Harry M. Barton

HMB/bkd
Enclosures
cc: Official Service List (*via email)*

RECEIVED
AUG 3 1 2018
BY:

Entergy New Orleans, LLC
2018 Integrated Resource Plan
DSM Potential Study

FINAL REPORT

Prepared for:

Submitted by:

Navigant Consulting, Inc.
101 California Street | Suite 4100
San Francisco, CA 94111

navigant.com

Reference No.: 198692
August 31, 2018

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List of Figures and Tables

Disclaimer

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List of Acronyms

BP18U	Business plan 2018 Update	kWh	Kilowatt-hour
BTMS	Behind-the-meter storage	LED	Light emitting diode
BYOT	Bring your own thermostat	LMP	Locational marginal price
C&I	Commercial and industrial	MISO	Midcontinent Independent System Operator
CAC	Central air conditioner	MW	Megawatt
CBECS	Commercial Buildings Energy Consumption Survey	NEEP	Northeast Energy Efficiency Partnership
CBSA	Commercial Building Stock Assessment	NEW	New construction
CFL	Compact fluorescent lamp	NPV	Net present value
CFR	Code of Federal Regulations	NREL	National Renewable Energy Laboratory
CNO	Council of the City of New Orleans	NTG	Net-to-gross
CPP	Critical peak pricing	O&M	Operations and maintenance
DEER	Database for Energy Efficient Resources	PAC	Program administrator cost
DI	Direct install	PCT	Programmable communicating thermostat
DLC	Direct load control	POU	Publicly-owned utility
DOE	Department of Energy (US)	PV	Present value
DR	Demand response	PY	Program year
DRAS	DR automation server	RBSA	Residential Building Stock Assessment
DRSim™	Demand Response Simulator	RET	Retrofit
DSM	Demand-side management	RIM	Ratepayer impact measure
DSMSim™	Demand-Side Management Simulator	ROB	Replace-on-burnout
EE EIA	Energy Efficiency Energy Information Administration (US)	RTF	Regional Technical Forum
EISA	Energy Independence and Security Act	RUL	Remaining useful life
EMS	Energy Management Systems	SEER	Seasonal energy efficiency ratio
ENO	Entergy New Orleans, LLC	SIC	Standard industrial classification
EUI	End-use intensities	T&D	Transmission and distribution
EUL	Effective useful life	TCO	Total cost of ownership
FERC	Federal Energy Regulatory Commission	TMY	Typical meteorological year
GHG	Greenhouse gas	TOU	Time-of-use
GWh	Gigawatt-hour	TRC	Total resource cost
HVAC	Heating, ventilation, and air conditioning	TRM	Technical resource manual
IOU	Investor-Owned Utility	TSD	Technical support documents
IRP	Integrated Resource Plan	UCT	Utility cost test

Executive Summary

Introduction

In support of the process to develop the 2018 IRP, Entergy New Orleans, LLC (ENO) engaged Navigant Consulting, Inc. (Navigant or the team) to prepare a DSM potential study.[1] The study's objective was to assess the long-term potential for reducing energy consumption in the residential and C&I sectors by analyzing energy efficiency and peak load reduction measures and improving end-user behaviors.

The EE component of the potential study began with a rigorous analysis of input data necessary for Navigant to run the DSMSim™ model, which calculates various levels of EE savings potential across the ENO service area. Achievable potential was further delineated using a range of reasonable assumptions for alternative cases to estimate the effect on customer participation of funding for customer incentives, awareness, as well as other factors.

The DR potential component of this study also began with a rigorous analysis of input data necessary for Navigant's DRSim™ model. Using a range of reasonable assumptions, the DRSim™ model was used to estimate the DR potential for a low, base, and high case.

While ENO explicitly plans to use the results from the potential study to inform the IRP, these results may also be used to further ENO's DSM planning and long-term conservation goals, energy efficiency program design efforts, and long-term load forecasts. However, it should be noted that long-term potential studies do not replace the need for detailed near-term implementation planning and program design. As such, this study, as with any long-term potential study, should only be used to inform those planning and design efforts in combination with ENO's EE and DR Energy Smart program experience and the market intelligence and insights of the Council of the City of New Orleans (Council), its Advisors, and stakeholders.

Study Objectives

ENO intends to use the results of the potential study as an input to its 2018 IRP. More specifically, ENO plans to use the results of this potential study to provide a long-range outlook on the cost-effective potential for delivering demand-side resources such as EE and DR and the associated levels of investment required to implement such programs.

Given ENO's objectives and Council's rules, Navigant designed its project approach to ensure the study results adequately address those needs. Table ES-1 below provides a

[1] The study period for the potential study is 2018-2037.

high-level overview of the study's objectives and how Navigant met those objectives.

Table ES- 1. Study Objectives Overview

Objective			Navigant's Approach
1	Use consistent methodology and planning assumptions	✓	Navigant has developed a variety of analytical tools and approaches to inform DSM planning and the establishment of long-term conservation targets and goals (details provided in the following sections). The team also worked closely with ENO to vet methodology, assumptions, and inputs at each stage of this project.
2	Reflect current information	✓	Navigant leveraged learnings from its prior work with ENO to create a bottom up analysis that includes inputs, such as the New Orleans TRM, and other up-to-date information (new codes and standards, saturation data from surveys and Energy Smart programs, avoided costs, etc.) are included in this study.
3	Quantify achievable potential	✓	Navigant quantifies achievable potential for both EE and DR by first calculating the technical and economic potential. The achievable potential base case is then calibrated to the historical Energy Smart program data and the current programs approved by the Council for Energy Smart PYs 7-9.
4	Provide input to the IRP	✓	Navigant's approach provides the following for all modeled cases: • Supply curve of conservation potential for input to ENO's IRP • Outputs available with 8,760 hourly impact load shapes
5	Present the scope and methodology of the study	✓	Navigant's approach to stakeholder engagement offers relevant information to key stakeholders

Source: Navigant

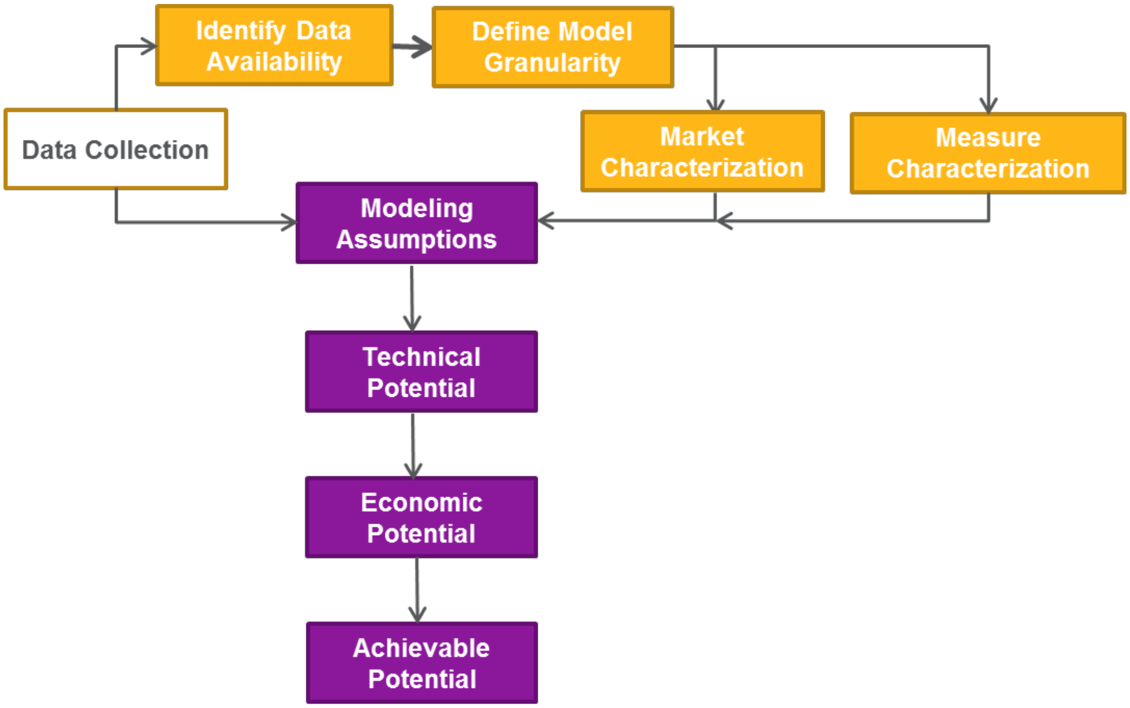
The team incorporated this high-level approach into both the EE and DR analyses.

Energy Efficiency

Detailed Approach

For the EE analysis, Navigant analyzed potential in the ENO service area from 2018 through 2037. After gathering existing data sources, the team followed three steps: (1) characterize the market, (2) characterize measures, and (3) estimate potential, using the DSMSim™ tool, a bottom-up stock forecasting model. The third step involved three sub-steps, which included calculating technical, economic, and achievable potential. The figure below illustrates the EE analysis approach.

Figure ES-1. EE Analysis Approach Overview



Source: Navigant

Market Characterization

This part of the analysis involved understanding and defining key service area, or market, characteristics. Specifically, the market characterization required defining the sales and stock for 2016, the study's base year, and then projecting the numbers from 2018 – 2037, the reference case, to provide a baseline for the study. To complete this effort, Navigant collected multiple datasets, which include, but are not limited to:

- 2016 ENO billing and customer account data
- ENO forecast sales and customer counts
- US EIA CBECS
- US Department of Labor SIC
- Navigant research

After defining the sales and stock, the team determined energy use at the customer segment and end-use levels. Navigant based the level of disaggregation for the segments and end-uses on existing program definitions, data availability, and requirements to sufficiently characterize the data at a granular level. The report contains further details on the selected customer segments as well as assumptions about the stock, electricity sales, end-use breakdown, and EUI for each segment and end-use.

In addition to identifying sales, energy use, and stock data, the team aggregated additional inputs from ENO for input into the model. These inputs include various economic and financial parameters, such as carbon pricing estimates, avoided costs, inflation assumptions, and historic program costs.

Measure Characterization

The measure characterization portion of the analysis sought to define key data points for the measures included in the study. These characteristics include assumptions about codes and standards, measure life, and measure costs. This analysis relied on data from ENO, other regional efficiency programs and utilities, and TRMs from New Orleans,[2] Arkansas, Pennsylvania, Illinois, Minnesota, Vermont, New York, and Massachusetts.

The team used the measure list in this study to appropriately focus on those technologies likely to have the highest effect on savings potential over the study horizon. The study however, does not account for unknown emerging technologies that may arise that could increase savings opportunities over the forecast horizon. It also does not account for broader societal changes that may affect levels of energy use in ways not anticipated by this study.

Estimation of Potential

After defining the market and measure characteristics, Navigant employed its proprietary DSMSim potential model to estimate the technical, economic, and achievable savings potential for electric energy and demand across ENO's service area.

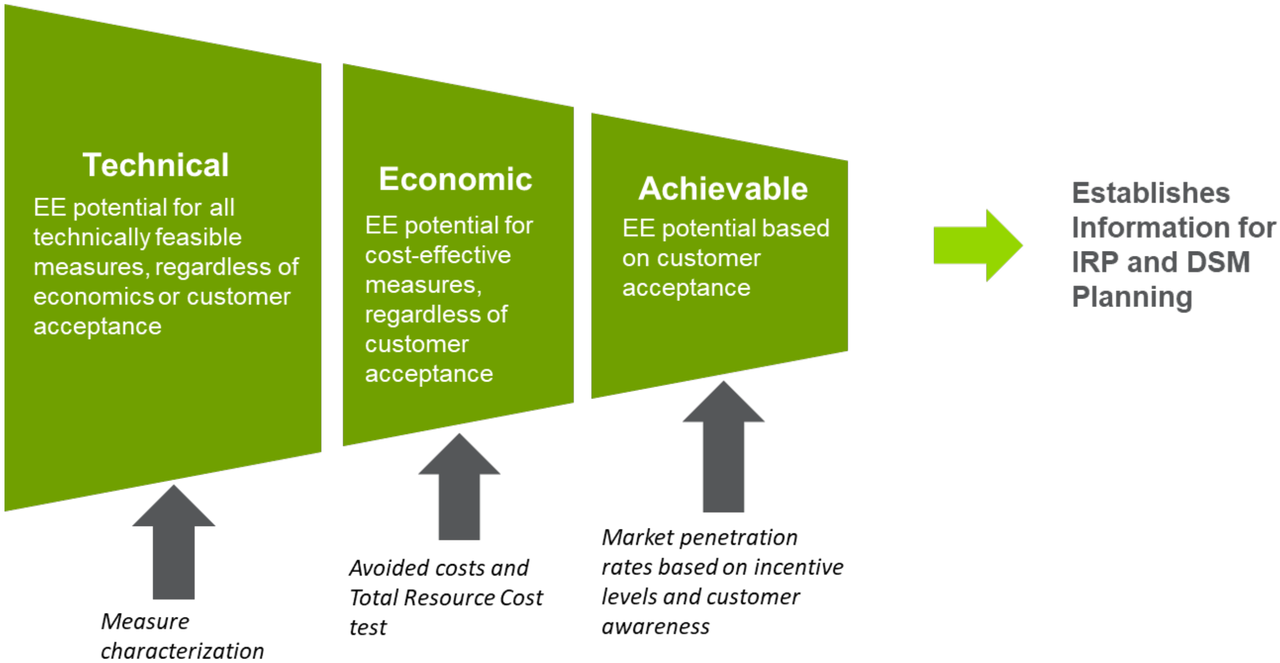
The list below defines each of these types of potential, as used in the study:

- **Technical potential** is the total energy savings available assuming all installed measures can immediately be replaced with the efficient measure/technology—wherever technically feasible—regardless of cost, market acceptance, or whether a measure has failed and must be replaced.
- **Economic potential** is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential, but including only those measures that have passed the benefit-cost test chosen for measure screening; in this study, that is the TRC test.
- **Achievable potential** is a subset of economic potential. The team determined achievable potential by incorporating measure adoption ramp rates and the diffusion of technology through the market.

Figure ES-2 provides an overview of each of these potential types and the data inputs for each.

[2] *New Orleans Energy Smart Technical Reference Manual: Version 1.0*, September 2017, prepared by ADM Associates, Inc.

Figure ES-2. EE Potential Types



Source: Navigant

Using these definitions and data inputs, the DSMSim uses a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics framework to estimate the different potential types.[3] The model reports these potential savings for the service area, sector, customer segment, end-use category, and highest impact measures.

Results

Given that ENO's objective for this study was to quantify the achievable potential for use in the 2018 IRP and gain a better understanding as to the best path for planning ENO's Energy Smart programs, the project team modeled various future cases to further inform Energy Smart program preparation. These cases include:

- **Base case:** Reflects current program spend targets with incentives on average at 50% of incremental measure cost
- **Low case:** Uses the same inputs as the base case except incentives are at 25% of incremental measure cost

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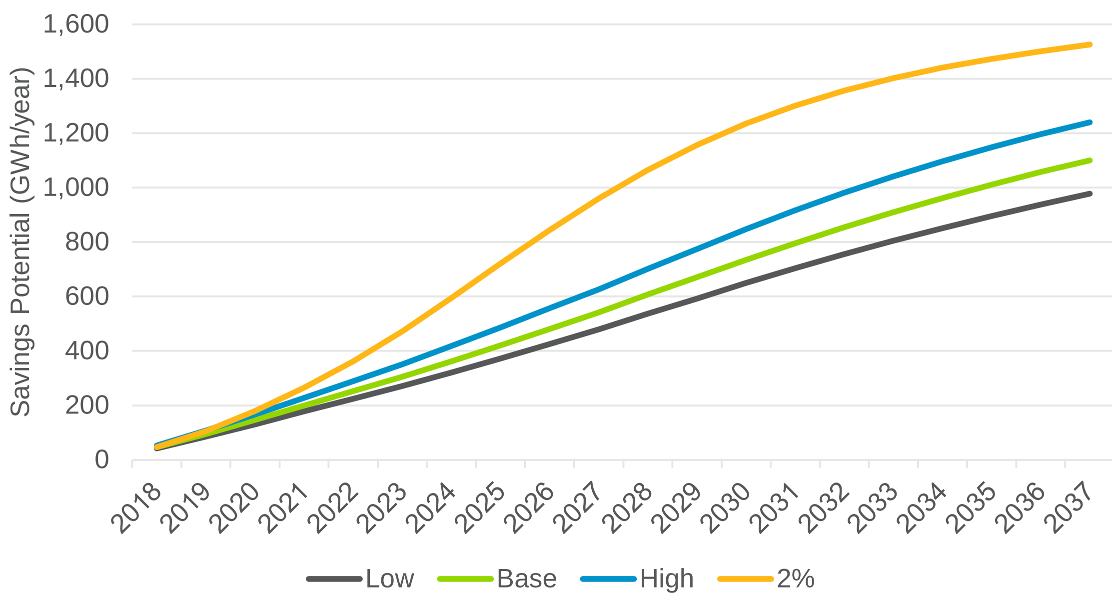
[3] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modeling.

- **High case:** Uses the same inputs as the base case except incentives are at 75% of incremental measure cost
- **2% case:** Achieve a 2% reduction during the forecast period with a 0.2% ramp year over year starting in the first modeled year (2018). To achieve 2%, Navigant modified model parameters:
    - o Increased marketing factor through 2021
    - o Increased incentive percent of incremental measure cost from 50% in 2018 then ramping up to 100% in 2024 (and maintaining 100% in remaining years)
    - o Ramped down TRC Ratio threshold from 1 in 2018 to 0.87 in 2022 and remaining years.

The study reports savings as gross rather than net, meaning they do not include the effects of natural change. Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about NTG ratios or changing EUIs become available. These results can then be used to define the portfolio energy savings goals, projected costs, and forecasts.

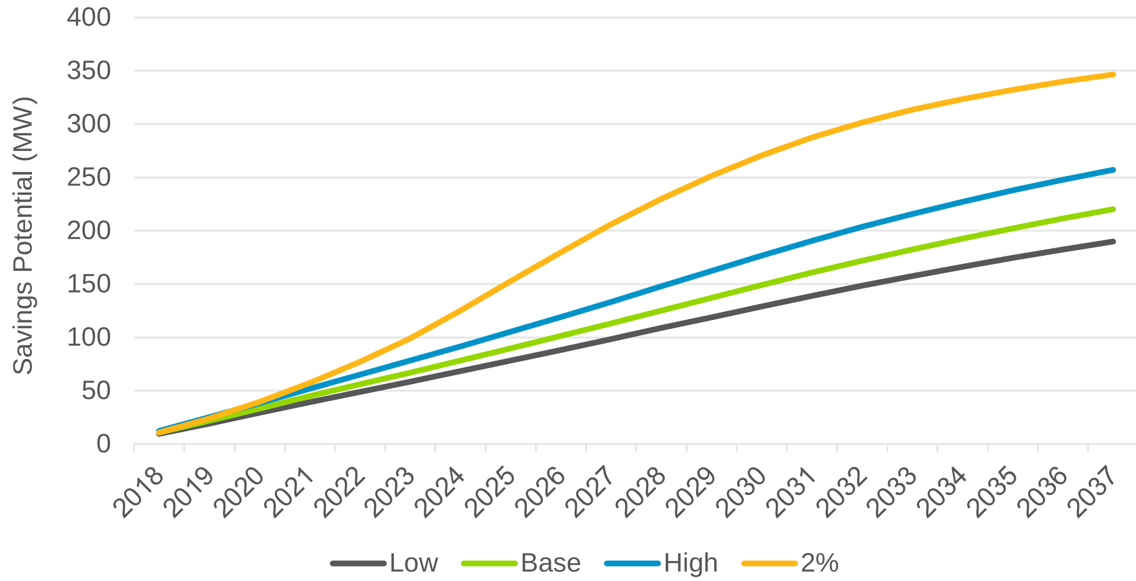
Figure ES-3 and Figure ES-4 show the cumulative annual energy and demand savings for each case.

Figure ES-3. Cumulative Energy Achievable Savings EE Potential by Case (GWh/year)



Source: Navigant analysis

Figure ES-4. Cumulative Peak Demand Achievable Savings EE Potential by Case (MW)



Source: Navigant analysis

Table ES-2 lists the energy efficiency potential study results, showing the achievable annual incremental energy and peak demand savings in 5-year increments by case. The calculated total energy efficiency potential savings for the base case is 1,100 GWh and 220 MW in 2037.

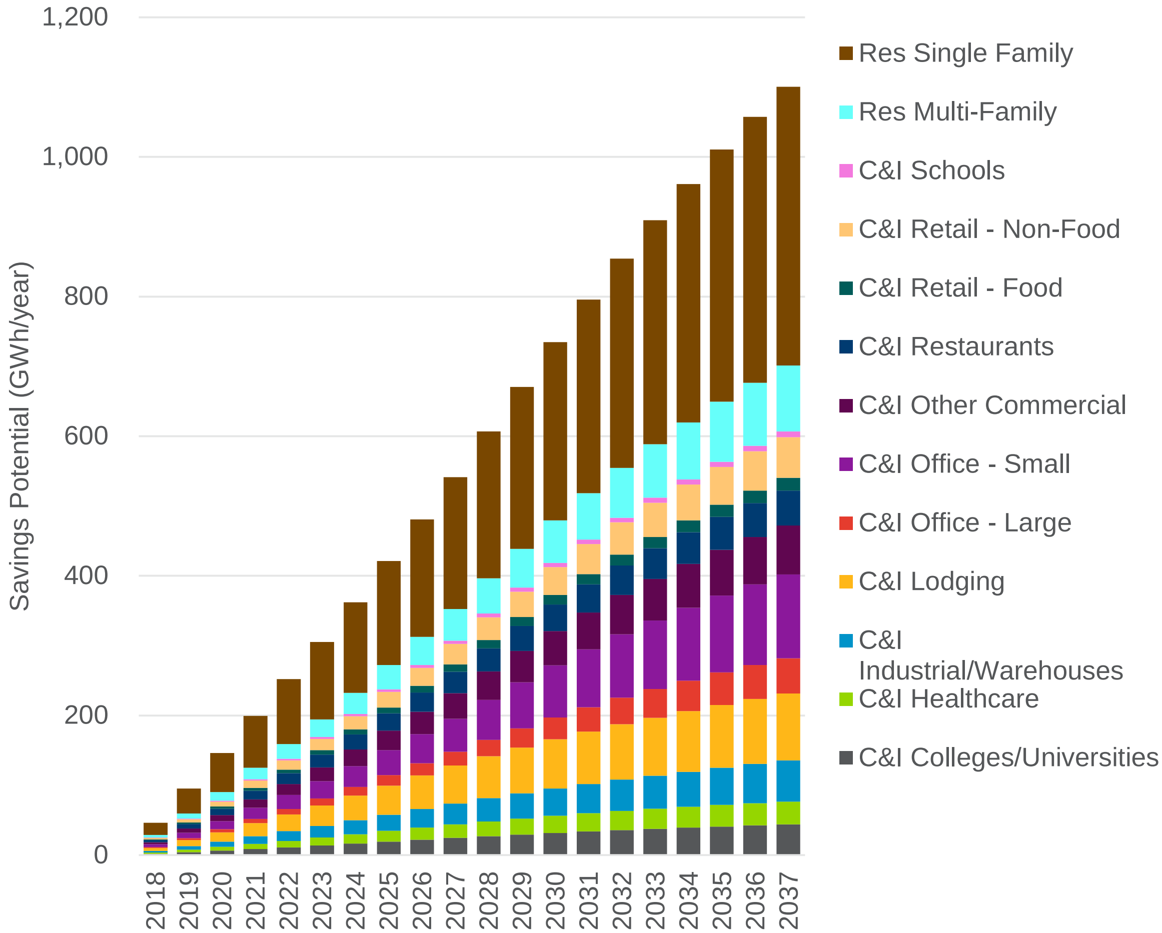
Table ES- 2. Annual Incremental Achievable Energy Efficiency Savings by Case

Year	Electric Energy (GWh/Year)				Peak Demand (MW)			
	Base	Low	High	2%	Base	Low	High	2%
2018	46	41	52	46	11	10	12	11
2022	53	46	61	97	11	10	13	20
2027	61	54	70	116	12	10	14	26
2032	58	52	65	55	11	9	13	14
2037	43	39	43	25	9	8	9	7
Total	**1,100**	**977**	**1,240**	**1,526**	**220**	**190**	**257**	**346**

Source: Navigant analysis

Figure ES-5 shows the cumulative electric energy achievable potential by customer segment. Residential single family is the largest segment. Small office and lodging contribute the most savings for the C&I sector.

Figure ES-5. Base Case Cumulative Achievable Potential Savings Customer Segment Breakdown



Source: Navigant analysis

Table ES-3 shows the incremental electric energy achievable savings as a percentage of ENO's total sales for each case in 5-year increments. For the 2% case, 2% of sales savings is achieved in 2024 through 2026. In later years, the 2% case falls below the base case because most of the measures have been adopted, depleting the available potential in the future years. As mentioned above, this study only includes known, market-ready, quantifiable measures. However, over the lifetime of energy efficiency programs, new technologies and innovative program interventions could result in additional cost-effective energy savings. Therefore, ENO should periodically revisit and reanalyze the potential forecast to account for these technologies and programs.

Table ES- 3.

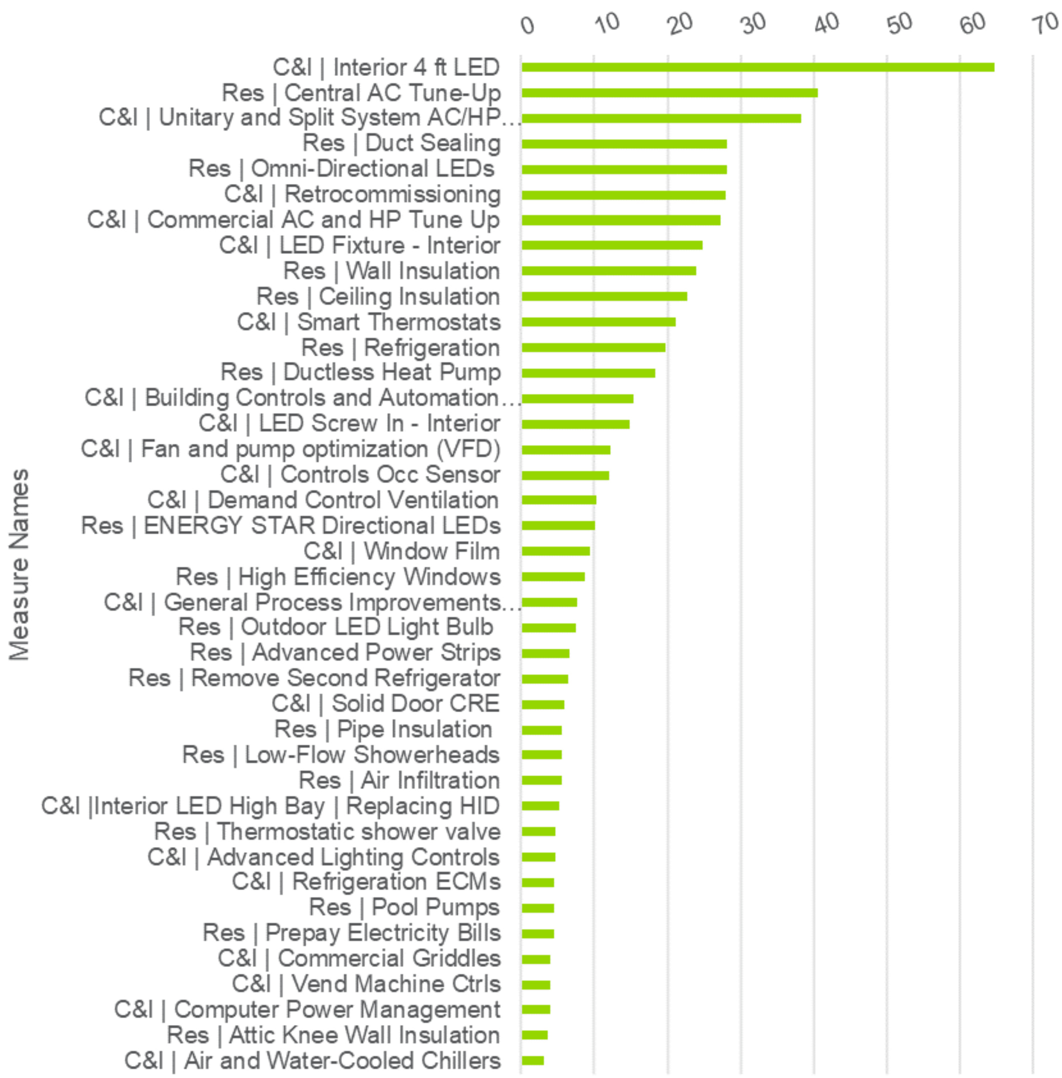
Incremental Energy Achievable Savings Potential as a Percentage of Sales by Case (%, GWh)

Year	Base	Low	High	2%
2018	0.8%	0.7%	0.9%	0.8%
2022	0.9%	0.8%	1.0%	1.6%
2027	1.0%	0.9%	1.1%	1.9%
2032	0.9%	0.8%	1.0%	0.8%
2037	0.6%	0.6%	0.6%	0.3%
Total	**17.3%**	**15.3%**	**19.5%**	**24.0%**

Source: Navigant analysis

Figure ES-6 shows the top 40 measures contributing to the electric energy achievable potential in 2028 (the middle of the study period and representative of the 20-year results). Interior 4 ft. LEDs in the C&I sector provide the most potential, followed by residential central air conditioning tune-up and commercial unitary and split system air conditioning/heat pump equipment.

Figure ES-6. Top 40 Measures for Electric Energy Base Case Achievable Savings Potential: 2028 (GWh/year)



Source: Navigant analysis

The total, administrative, and incentive costs for each case are provided in Table ES-4 in 5-year increments for the study period. It is important to note the differences in these cases as compared to the savings achieved. The administrative spending is relatively consistent between the cases, while the incentive spending varies significantly between the cases, with higher spending correlated to higher savings.

Table ES- 4. Spending Breakdown for Achievable Potential ($ millions/year)[4]

	Total				Incentives				Admin			
	Base	Low	High	2%	Base	Low	High	2%	Base	Low	High	2%
2018	$13	$8	$20	$13	$6	$2	$13	$6	$7	$6	$8	$7
2022	$15	$10	$25	$43	$7	$3	$16	$28	$8	$7	$10	$15
2027	$20	$12	$32	$79	$10	$4	$20	$59	$10	$9	$12	$20
2032	$24	$14	$37	$47	$13	$5	$25	$36	$11	$9	$12	$11
2037	$21	$13	$30	$25	$12	$5	$20	$20	$9	$8	$9	$5
Total	**$390**	**$238**	**$617**	**$960**	**$202**	**$75**	**$400**	**$698**	**$188**	**$162**	**$217**	**$262**

Source: Navigant analysis

Table ES-5. shows the portfolio TRC to be cost-effective for all cases.

Table ES- 5. Portfolio TRC Benefit-Cost Ratios for Achievable Potential (Ratio)

Year	Base	Low	High	2%
2018-2037	1.7	1.9	1.6	1.4

Source: Navigant analysis

Demand Response

Detailed Approach

Navigant developed ENO's DR potential and cost estimates using a bottom-up analysis. The analysis involved 5 steps: (1) characterize the market, (2) develop baseline projections, (3) define and characterize DR options, (4) develop key assumptions for potential and costs, and (5) estimate potential and costs. Navigant used both primary data from ENO and relevant secondary sources for this analysis as documented in this report. Figure ES-7 summarizes the DR potential estimation approach.

[4] The values in this table are shown in nominal dollars and are rounded to the nearest million which may result in rounding errors.

Figure ES-7. DR Potential Assessment Steps

Step 1: Market Characterization	Characterize market for DR potential estimation (no. of customers and coincident peak load estimates by customer class- residential, small/med/large C&I).
Step 2: Develop Baseline Projections	Develop baseline projections for customer count and load over the study period
Step 3: Define DR Options and Characterize	Define and characterize DR options and map applicable options to relevant customer classes.
Step 4: Develop Key Assumptions for Potential & Costs	Develop participation and unit load reduction assumptions under each DR option; also develop itemized cost assumptions.
Step 5: Estimate Potential Costs and Benefits	Present potential estimates by DR option and customer class, along with annual and levelized costs; also estimate program benefits and calculate cost-effectiveness of programs.

Source: Navigant

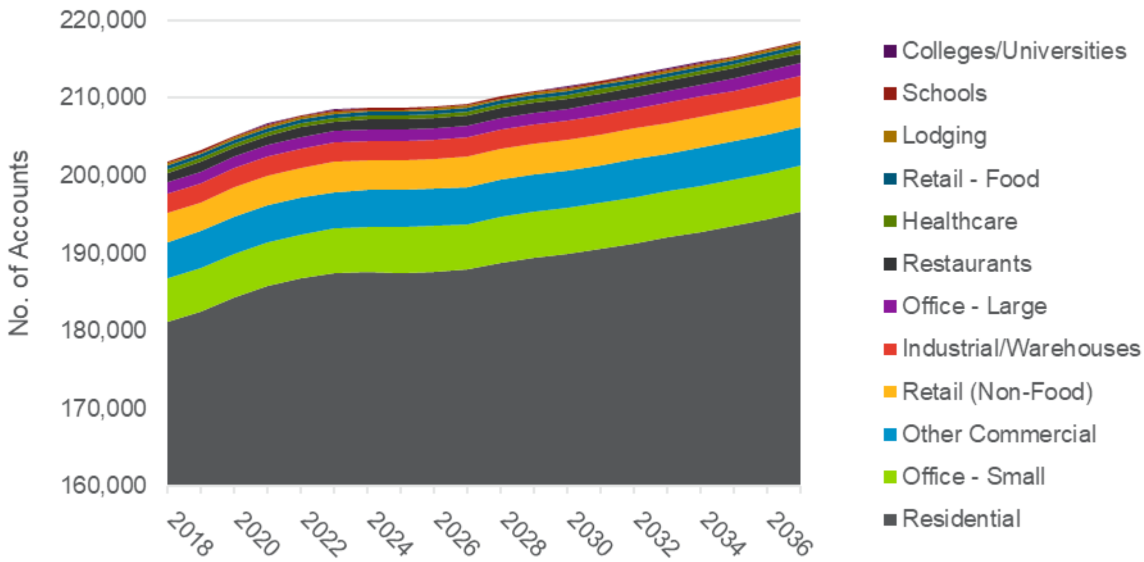
Market Characterization

The market characterization process for the DR assessment aimed to segment the market appropriately for the analysis. Specifically, Navigant aggregated data on key pieces of information, such as customer count and peak load, by customer segment and end-use to use as inputs into the model. The team based the segmentation on the examination of ENO's rate schedules and the customer segments established in the energy efficiency potential study.

Baseline Projections

The baseline projections aimed to define and forecast customer data for the study period, similar to the market characterization in the EE assessment. The project team used these projections as a basis for modeling savings. More specifically, Navigant applied the year-over-year change in the stock forecast to the 2016 customer count data segmented by customer class and customer segment to produce a customer count forecast for the study. The team then trued up this forecast to the sector-level customer count forecast provided by ENO. Figure ES-8 shows the aggregate customer count forecast by segment only, summed across all customer classes.

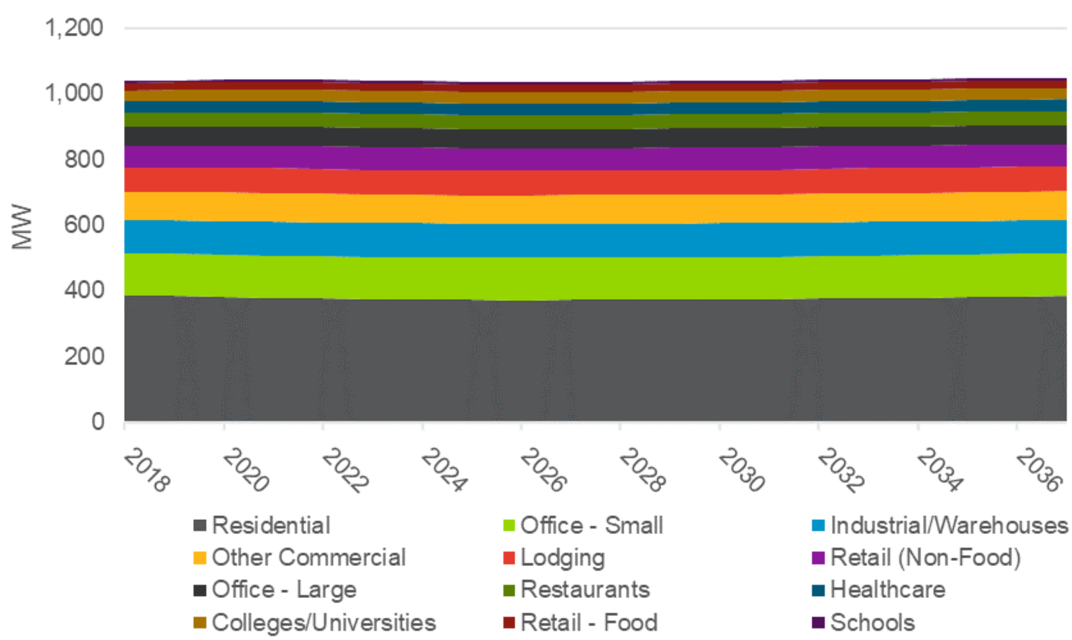
Figure ES-8. Customer Count Projections for DR Potential Assessment



Source: Navigant analysis

Figure ES-9 shows the peak load forecast that Navigant developed based on the BP18U forecast data provided by ENO for ENO's service area by customer segment.

Figure ES-9. Peak Load Forecast by Customer Segment (MW)



Source: Navigant analysis

DR Options

Once the baseline peak demand projections had been developed, the team characterized the different types of DR options that could be used to curtail peak demand. Table ES-6 summarizes the DR options included in the analysis. Most of these DR options are representative of DR programs commonly deployed in the industry.

Table ES- 6. Summary of DR Options

DR Option	Characteristics	Eligible Customer Classes	Targeted/ Controllable End Uses and/or Technologies
DLC ✓ Load control switch ✓ Thermostat	Control of water heating/cooling load using either a load control switch or PCT	Residential Small C&I	Cooling, water heating
C&I curtailment ✓ Manual ✓ Auto-DR enabled	Firm capacity reduction commitment $/kW payment based on contracted capacity plus $/kWh payment based on energy reduction during an event	Large C&I	Various load types including HVAC, lighting, refrigeration, and industrial process loads
Dynamic pricing[5] ✓ Without enabling technology ✓ With enabling technology	Voluntary opt-in dynamic pricing offer, such as CPP	All customer classes	All

Source: Navigant

Estimation of Potential

With the market, baseline projections, and options characterized, Navigant estimated technical and achievable potential by inputting the parameters into its model. To do this, Navigant used two key variables in addition to participation opt-out rates, technology market penetration, and enrollment attrition rates:

1. Customer participation rates; and
2. Amount of load reduction that could be realized from different types of control

[5] Navigant did not include TOU rates in the DR options mix because this study only includes event-based dispatchable DR options. TOU rates lead to a permanent reduction in the baseline load and are not considered a DR option.

mechanisms, referred to as unit impacts

For purposes of the DR analysis, Navigant used the following definitions for calculating technical and achievable potential:

- **Technical potential** refers to load reduction that results from 100% customer participation. This is a theoretical maximum.
- **Achievable potential** accounts for customers opting out during DR events. The team calculated this by multiplying achievable participation assumptions (subject to program participation hierarchy) by the technical potential estimates.

Results

Achievable potential is estimated to grow from 0.7 MW in 2018 to 34.6 MW in 2037. Cost-effective achievable potential makes up approximately 3.3% of ENO's peak demand in 2037. Navigant observed the following:

- DLC has the largest achievable potential: 49% share of total potential in 2037. DLC potential grows from 0.5 MW in 2018 to 17.0 MW in 2037.
- This is followed by dynamic pricing with a 47% share of the total potential in 2037. The dynamic pricing offer begins in 2020 because it is tied to ENO's AMI implementation plan. The program ramps up over a 5-year period (2020-2024) until it reaches a value of 14 MW. From then on, potential slowly increases until it reaches a value of 16 MW in 2037.
- C&I curtailment makes up the remainder of the cost-effective achievable potential with a 4% share of the total potential in 2037. C&I curtailment potential grows rapidly from 0.2 MW in 2018 to 1.9 MW in 2022. This growth follows the S-shaped ramp assumed for the program over a 5-year period. Beyond 2022, the program attains a steady participation level, and its potential slightly decreases over the remainder of the forecast period, ending at 1.2 MW in 2037.

Table ES- 7 lists the DR results by option in 5-year increments. The calculated achievable potential for peak load reduction is 34.6 MW in 2037. This report provides the methodology, data inputs, and assumptions used to calculate these potentials.

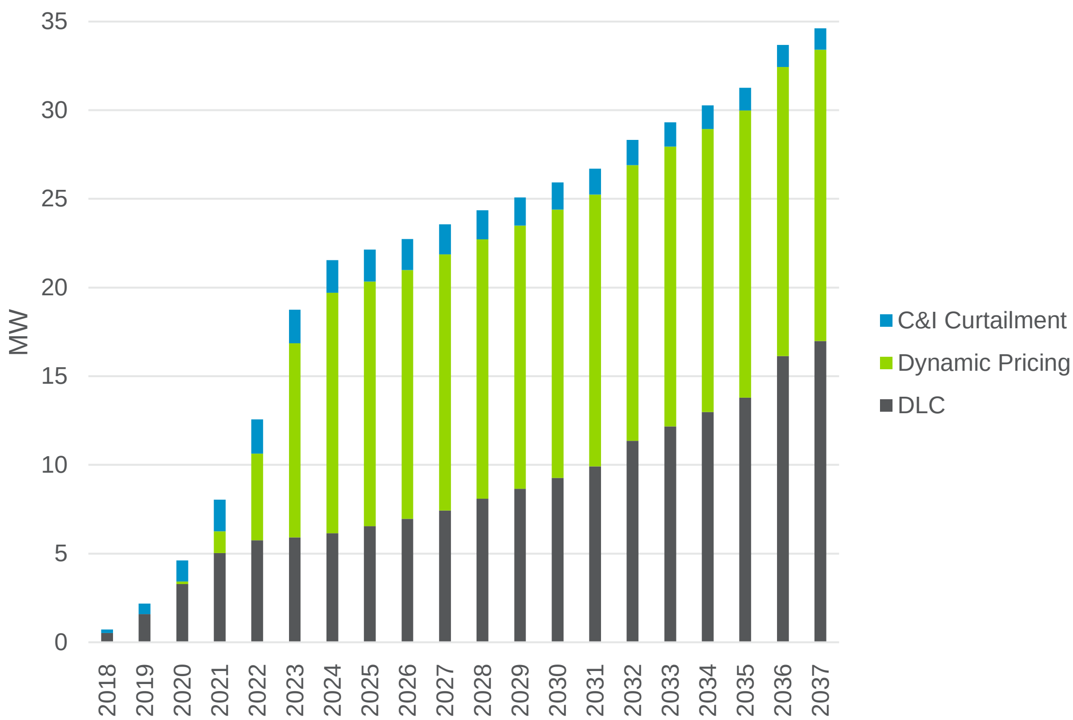
Table ES- 7. Annual Incremental Achievable Summer DR Potential by Option

Year	DLC	Dynamic Pricing	C&I Curtailment	Total
2018	0.5	0.0	0.2	0.7
2022	5.7	4.9	1.9	12.6
2027	7.4	14.4	1.7	23.6
2032	11.3	15.6	1.4	28.3
2037	17.0	16.4	1.2	34.6

Source: Navigant analysis

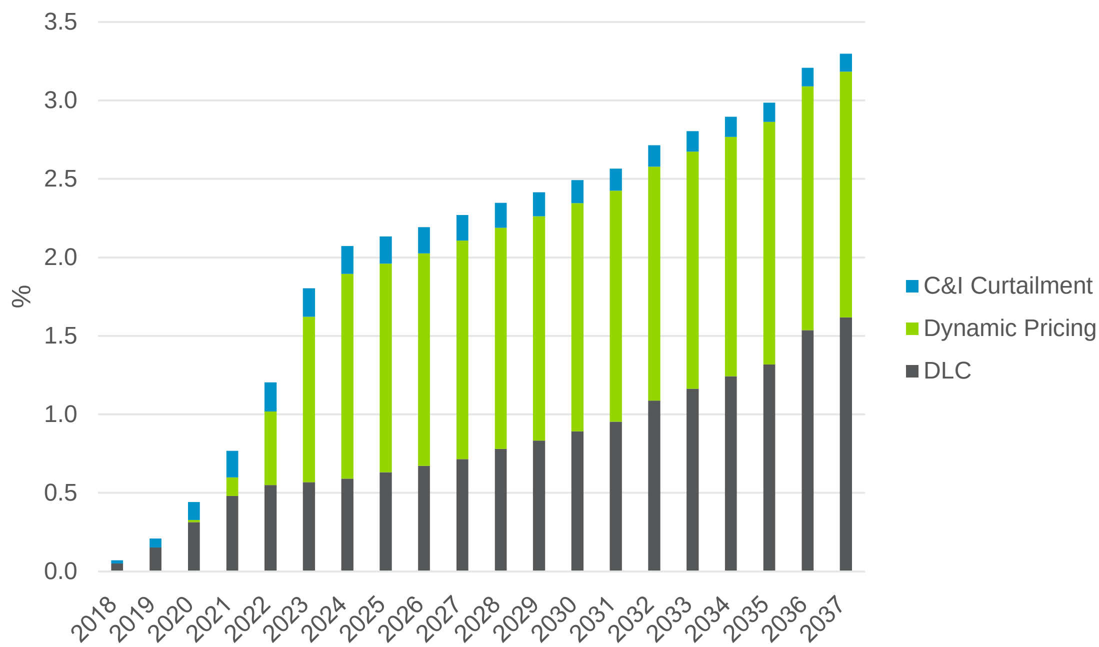
Figure ES-10 summarizes the cost-effective achievable potential by DR option for the base case. Figure ES-11 shows the cost-effective achievable potential as a percentage of ENO's peak demand.

Figure ES-10. Summer DR Achievable Potential by DR Option (MW)



Source: Navigant analysis

Figure ES-11. Summer DR Achievable Potential by DR Option (% of Peak Demand)

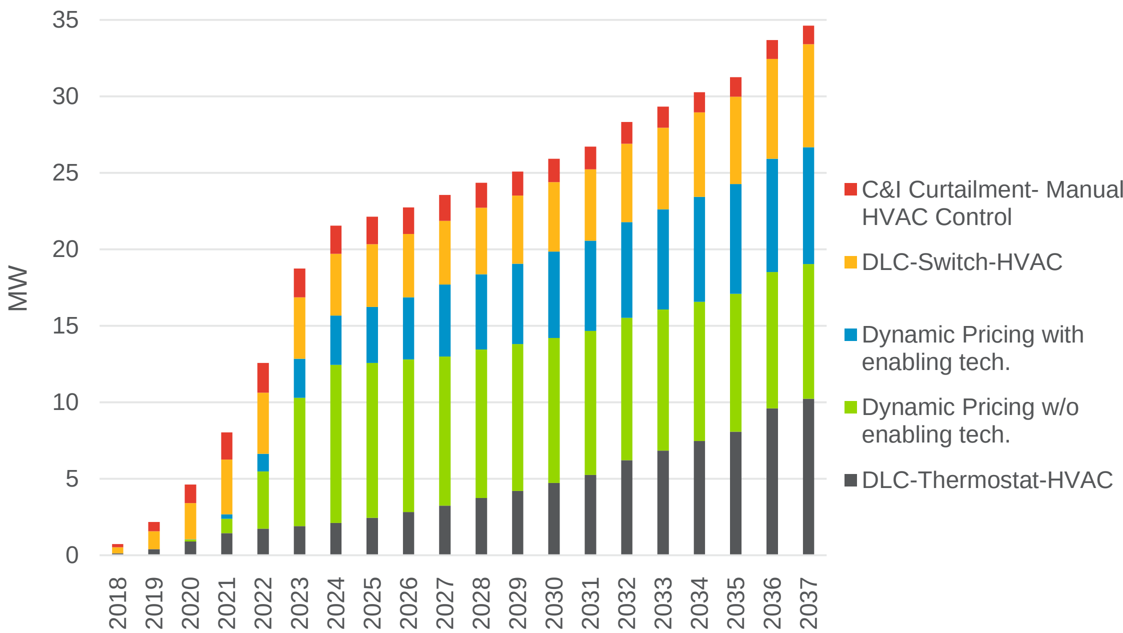


Source: Navigant analysis

Figure ES-12 summarizes the cost-effective achievable potential by DR option for the base case. The team had the following key observations:

- Only direct control of HVAC loads by small C&I customers (DLC-Switch-HVAC and DLC-Thermostat-HVAC in Figure ES-12) is cost-effective. This sub-option makes up nearly 50% of the total cost-effective achievable potential in 2037 at 17.0 MW. Of this 17.0 MW, 10.2 MW is from thermostat-based control, while the remaining 6.7 MW is from switch-based control.
- Dynamic pricing makes up 47% of the total cost-effective achievable potential in 2037. Potential from customers with enabling technology in the form of thermostats/ EMS is slightly higher than that from customers without enabling technology—8.8 MW versus 7.6 MW in 2037.
- Under the C&I curtailment program, reductions associated with manual HVAC control make up 4% of the total cost-effective potential in 2037.

Figure ES-12. Summer DR Achievable Potential by DR Sub-Option

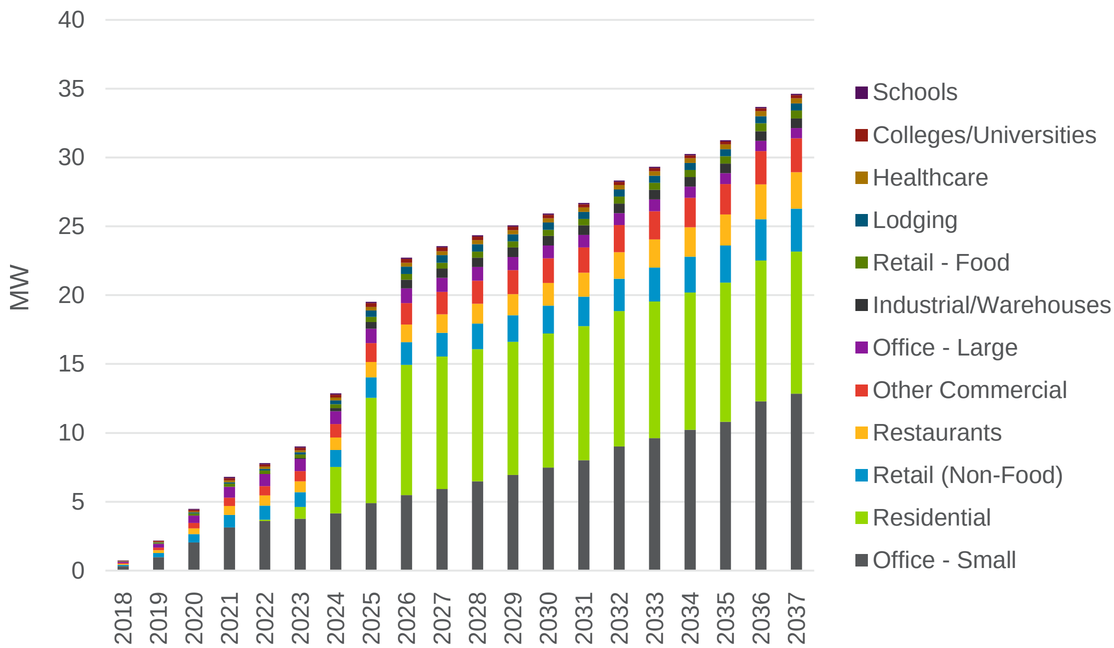


Source: Navigant

Figure ES-13 summarizes the cost-effective achievable potential by customer segment for the base case. The team observed the following:

- Potential from C&I customers primarily comes from small offices, which make up 37% (12.9 MW) of the total cost-effective achievable potential in 2037. This is followed by retail buildings, restaurants, and the other C&I building category, which each make up between 7% and 9% of the total cost-effective achievable DR potential in 2037—3.1 MW, 2.7 MW, and 2.5 MW, respectively.
- All other C&I segments make up less than 2.2% of the cost-effective achievable potential in 2037, which is less than 0.75 MW.

Figure ES-13. Summer DR Achievable Potential by Customer Segment



Source: Navigant analysis

Conclusions and Next Steps

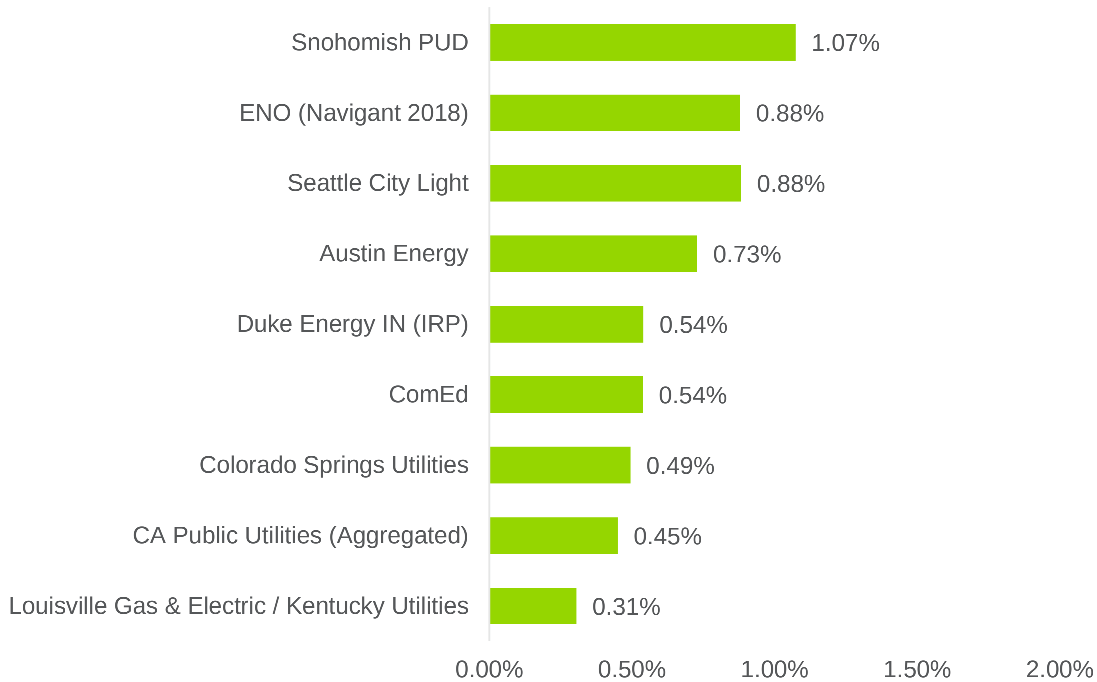
After reviewing the study results, the team benchmarked them against similar utilities, identified how the results could be used in ENO's 2018 IRP.

Benchmarking

Navigant benchmarked the energy efficiency achievable potential results against similar studies by other utilities. The goal of this exercise was to provide context for Navigant's results and to understand how various factors such as region or program spend may affect the results.

Based on the sources (provided in Section 5.1), Navigant aggregated the results into the figures below.

Figure ES-14. Benchmarking Pool Average EE Achievable Potential Savings (% of Sales)[6]



Source: Navigant analysis

When comparing potential estimates, it is important to note that although the utilities included in the benchmarking pool may have some similar characteristics, no two utilities are the same; therefore, the results may vary based on the inputs each utility provided to its respective potential study evaluator. Study methodologies may also differ based on the potential study evaluator, providing additional room for variances across studies.

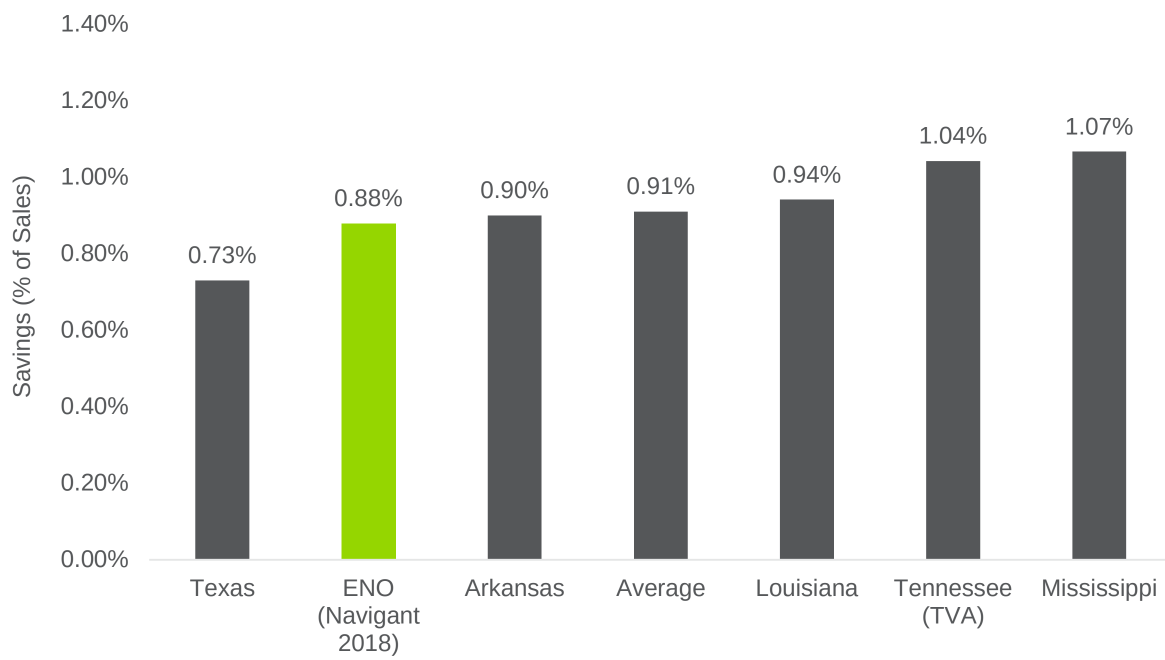
ENO's achievable potential falls within the range of the benchmarking pool at an average of 0.88% savings per year over the study period (2018-2037). This is similar to Seattle City Light and slightly above Austin Energy (0.73%). Interestingly, the three all operate in large metropolitan areas and have similar governance structures in that they are regulated by a city council.[7]

[6] These savings are shown as an annual average, which Navigant derived by dividing the cumulative study averages by the number of years in the study. Navigant used this approach since study years tend to differ greatly.

[7] It should be noted that, unlike ENO, which is an IOU, Austin Energy and Seattle City Light are both POUs that function as departments within their respective municipalities. However, all three must comply with the mandates of the local regulatory body.

In addition to benchmarking the results at the utility level, Navigant created a peer pool at the state level. The goal of this analysis was to understand ENO's potential savings within the broader context of the state of Louisiana and its neighbors. Given that the states are mostly clustered within the Southeast region of the US, they have the same general climate (hot-humid) and, therefore, may experience similar levels of achievable potential savings. Figure ES-15 shows how ENO's achievable potential fits into the broader state-level context.

Figure ES-15. Benchmarking Pool State Level EE Achievable Potential (% of Savings)

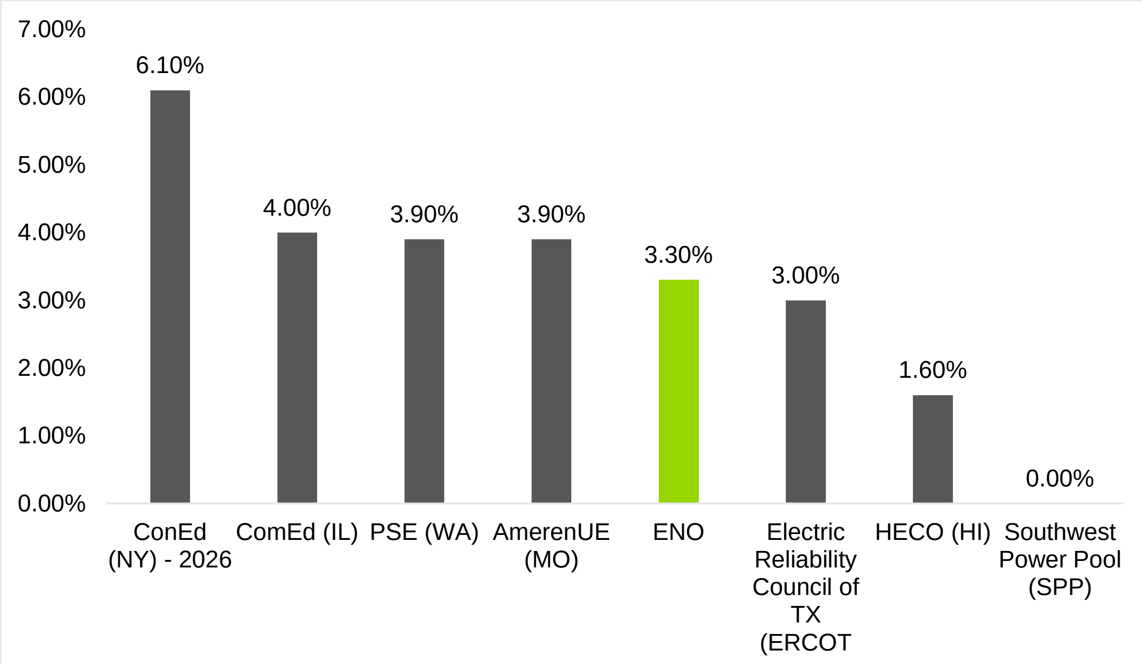


As shown in the figure above, ENO's achievable potential savings are within the range of the benchmarking pool (0.73%-1.07%), which makes sense given the similarities across the region. Its potential savings are only slightly less than the overall pool average and the state of Louisiana. The slight difference in savings between this ENO potential study and the overall state may be caused by several factors:

- Updated inputs
- Utilities outside New Orleans had not begun implementing energy efficiency programs at the time ACEEE conducted the Louisiana study in 2013
- Broader region covered (some areas may have potential savings based on stock type and other utilities' energy efficiency spending)

Navigant also benchmarked DR. The results are shown below in Figure ES-16.

Figure ES-16. Benchmarking Pool DR Potential (% of Savings)



As shown above, ENO falls in the middle of the benchmarking pool, only slightly higher than ERCOT and slightly below Ameren in Missouri. Given that DR, like EE, varies based on program administration and geographic location, amongst other factors, ENO's DR potential aligns closely to its peers.

IRP

The potential study provides forecasted savings inputs for use in the IRP modeling. These inputs are provided by sector, segment, and end use because each combination of these items is mapped to a load shape (see Appendix C). Each measure is mapped to one or more DSM programs. Navigant then developed a load shape representative of each DSM program. The DSM program load shapes represent the aggregate hourly energy savings for the group of measures included in the program over the 20-year planning period. These load shapes are what define the hourly usage profiles for the DSM program portfolio.

Program Planning

This potential study provides ENO with a wealth of data to support and inform the DSM program planning efforts. However, it is important to note that programmatic design (such as delivery methods and marketing strategies) will have implications for the overall savings goals and projected cost. As mentioned above, **near-term savings**

potential, actual achievable goals, and program costs for a measure-level implementation will vary from the savings potential and costs estimated in this long-term study. This potential study is one element to be considered in program design, along with historical program participation and current market conditions with the program implementation team.

Some observations on the potential study results that can provide input to program planning are:

- There is strong potential with promoting advanced lighting, which includes networked lighting technology and controls in all sectors.
- There is high potential in O&M and behavior-type programs such as retrocommissioning if they are cost-effective.
- HVAC unitary equipment has high potential in both sectors.

1. Introduction

1.1 Context and Study Goals

Entergy New Orleans, LLC (ENO) engaged Navigant Consulting, Inc. (Navigant or the team) to prepare a DSM potential study for electricity as an input to ENO's 2018 IRP for the 2018-2037 period. The study's objective was to assess the long-term potential for reducing energy consumption in the residential and C&I sectors by analyzing energy efficiency and peak load reduction measures and improving end-user behaviors. The energy efficiency potential analysis efforts provide input data to Navigant's DSMSim™ model, which calculates achievable savings potential across the service area. This study also includes DR program potential analyzed within Navigant's DRSim™. While ENO explicitly plans to use the results from the potential study to inform the IRP, these results may also be used as inputs to DSM planning and long-term conservation goals and energy efficiency program design.

1.1.1 Study Objectives

Potential studies provide a long-range outlook on the cost-effective potential for delivering demand-side resources such as EE and DR. Having a comprehensive review of achievable potential across ENO's service area helps forecast the effects customer actions can have over the forecast period. The level of detail and accuracy provided by the current study will allow ENO to incorporate DSM in its IRP modeling and analysis, inform the design of future customer efficiency programs, and have a clear understanding of the level of investment needed to pursue the demand-side resource options.

Given ENO's objectives and Council's rules, Navigant designed its project approach to ensure the study results adequately address those needs. Table 1-1 details these objectives and offers Navigant's approach to meeting each objective.

Table 1-1.Navigant's Approach to Addressing ENO's Objectives

Objective		Navigant's Approach	
1	Use consistent methodology and planning assumptions	✓	Navigant has developed a variety of analytical tools and approaches to inform DSM planning and the establishment of long-term conservation targets and goals (details provided in the following sections). Navigant's model is transparent. The team also worked closely with ENO to vet methodology, assumptions, and inputs at each stage of this project.

Objective			Navigant's Approach
2	Reflect current information	✓	Navigant leveraged learnings from its prior work with ENO to create a bottom up analysis that includes inputs, such as the New Orleans TRM, and other up-to-date information (new codes and standards, saturation data from surveys and Energy Smart programs, avoided costs, etc.) are included in this study.
3	Quantify achievable potential	✓	Navigant quantifies achievable potential by first calculating the technical and economic potential. The achievable potential base case is calibrated to the historical Energy Smart program data and the current programs approved by the Council for Energy Smart PYs 7-9.
4	Provide input to the IRP	✓	Navigant's approach will provide the following for all modeled cases: • Supply curve of conservation potential for input to ENO's IRP • Output available with 8,760 hourly impact load shapes
5	Present the scope and methodology of the study	✓	Navigant's approach to stakeholder engagement will provide relevant information to key stakeholders.

Source: Navigant

1.2 Organization of the Report

Navigant organized this report into five sections that detail the study's approach, results, and conclusions. The list below provides a description of each section.

- **Section 1** provides an overview of the study, including its background and purpose.
- **Section 2** describes the methodologies and approaches Navigant used to estimate energy efficiency and demand reduction potential, including discussions of base year calibration, reference case forecast, and measure characterization.
- **Section 3** details the energy efficiency achievable potential forecast, including the approach and results by case, segment, end use, and measure.
- **Section 4** details the process for estimating DR potential and offers the achievable potential savings forecast for ENO, including the modeling results by customer segment.
- **Section 5** summarizes the next steps that result from developing this potential study. Additionally, the section benchmarks the study's results against similar studies and actual achieved savings from other utilities.

The accompanying appendices provide detailed model results and additional context around modeling assumptions.

1.3 Caveats and Limitations

There are several caveats and limitations associated with the results of this study, which are detailed below. Potential studies are typically a bottom-up effort and calibrated to system and sector base load and forecasted reference case. They are an exercise in data management and analysis and in balancing data abundance and data scarcity for different inputs. A study's team must understand the data gaps and how to fill these to provide reasonable and realistic potential estimates. This report documents what approach the Navigant team took and the decisions made when appropriate data was not available.

1.3.1 Forecasting Limitations

Navigant obtained historic and forecasted energy sales and customer counts from ENO by sector. Each rate class (residential and C&I) forecast contains its own set of assumptions based on ENO's expertise and models. The team leveraged these assumptions as much as possible as inputs to develop the reference case stock and energy demand projections. Where sufficient and detailed information could not be extracted due to the granularity of the information available, Navigant developed independent projections based on best practices. These independent projections were based on secondary data resources and produced in collaboration with ENO. The secondary resources and any underlying assumptions used are referenced throughout this report.

1.3.2 Segmentation

Navigant obtained several pieces of data from ENO to segment the two sectors (residential and C&I), including customer counts by premise type for residential and industry type for C&I. The team supplemented this data using its expertise and ENO's input to ensure the allocation of sales and stock data aligned to the appropriate segments. Government customers are included as part of the C&I sector. Savings potential analysis from city-owned street lighting is not included in this study since the majority has been converted to LED.

1.3.3 Measure Characterization

Efficiency potential studies may employ a variety of primary data collection techniques (e.g., customer surveys, onsite equipment saturation studies, and telephone interviews) that can enhance the accuracy of the results, though not without associated cost and time requirements.

Energy efficiency measures: The scope of this study did not include primary data collection. Rather, the energy efficiency analysis relied on data from ENO, other regional efficiency programs and utilities, and TRMs from New Orleans,[8] Arkansas Pennsylvania, Illinois, Minnesota, Vermont, New York, and Massachusetts to inform inputs to DSMSim.

Navigant used the measure list in this study to appropriately focus on those technologies likely to have the highest impact on savings potential over the study horizon. However, there is always the possibility that emerging technologies may arise that could increase savings opportunities over the forecast horizon and broader societal changes may affect levels of energy use in ways not anticipated by this study.

DR programs: The scope of this study leveraged available ENO data from the direct load control pilot over the last two PYs to characterize DR program participation and costs. Additional DR characterization is based on Navigant's research on programs nationwide and other potential studies. This study leveraged ENO load and account data to size the market eligible for DR program participation.

1.3.4 Measure Interactive Effects

This study models energy efficiency measures independently. Thus, the total aggregated energy efficiency potential estimates may be higher or lower than the actual potential available if a customer installs multiple measures in their home or business. Multiple measure installations at a single site generate two types of interactive effects: within end-use interactive effects and cross end-use interactive effects. An example of a within end-use interactive effect is when a customer implements temperature control strategies but also installs a more efficient cooling unit. To the extent that the controls reduce cooling requirements at the cooling unit, the savings from the efficient cooling unit would be reduced. An example of a cross end-use interactive effect is when a homeowner replaces heat-producing incandescent light bulbs with efficient LEDs. This influences the cooling and heating load of the space—however slightly—by increasing the amount of heat and decreasing the amount of cooling generated by the heating, ventilation, and air conditioning (HVAC) system.

Navigant employed the following methods to account for measure interactive effects:

- Where measures clearly compete for the same application (e.g., an air source heat pump being replaced by either a more efficient air source heat pump or a ground source heat pump), the team created competition groups to eliminate the potential for double counting savings.
- For measures with significant interactive effects (e.g., HVAC control upgrades and building automation systems), the team adjusted applicability percentages to reflect varying degrees of interaction.
- Wherever cross end-use interactive effects were appreciable (e.g., lighting and

[8] New Orleans Energy Smart Technical Reference Manual: Version 1.0, September 2017, prepared by ADM Associates, Inc.

HVAC), the team typically characterized those interactive effects for same fuel (e.g., lighting and electric heating) applications but not for cross fuel because no natural gas savings or consumptions were considered in this study.

There may be instances where the stacking of savings was not considered. These included mostly measures from the TRM, the primary source for the measure characterization. For example, if an efficient cooling unit is installed at the same time as improved insulation, the overall effects will be lower than the sum of individual effects. Appendix E provides further discussion of the challenges involved with accurately determining interactive effects.

1.3.5 Measure-Level Results

This report includes a high level account of potential results across the ENO service area and focuses largely on aggregated forms of potential. Navigant mapped the measure-level data to the customer segments and end-use categories so a reviewer can easily create custom aggregations.

1.3.6 Gross Savings Study

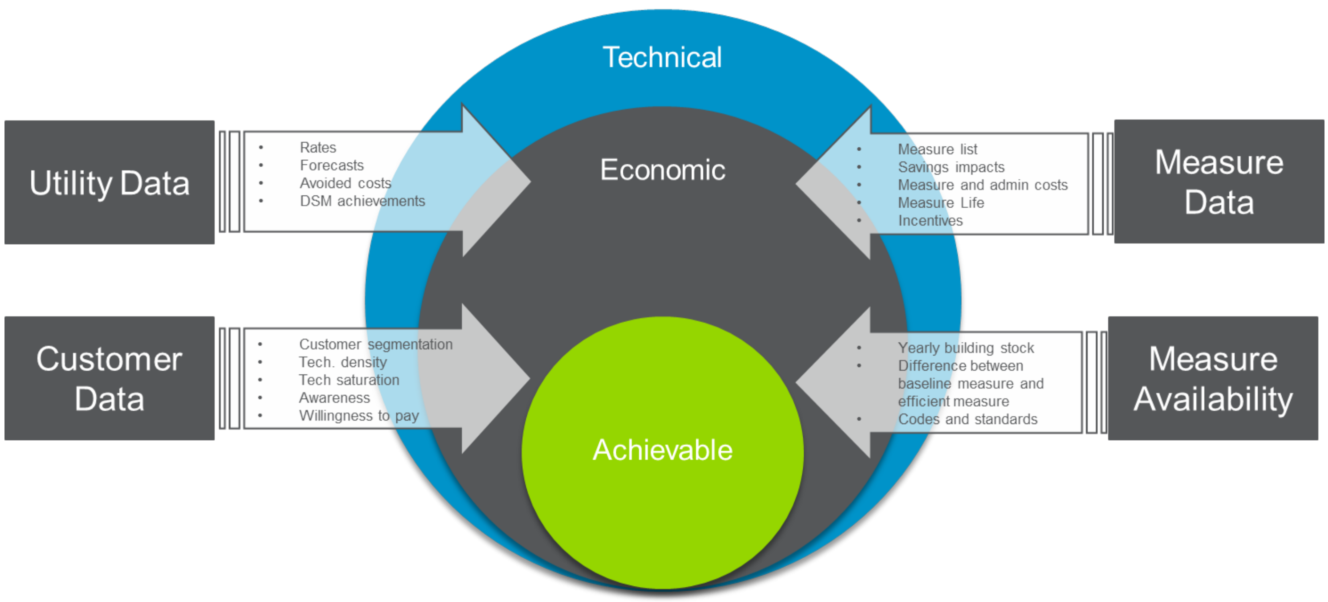
Savings in this study are shown at the gross level, meaning natural change (either natural conservation or natural growth in consumption) or, in other words, free-ridership, is not included in the savings estimates. Providing gross potential is advantageous because it permits a reviewer to easily calculate net potential when new information about changing EUIs, considerations of program design, or NTG ratios becomes available.

2. Study Approach and Data

2.1 Energy Efficiency

Navigant developed forecasts of technical, economic, and program achievable electric savings potential in the ENO service area from 2018 through 2037 using a bottom-up potential model. These efficiency forecasts relied on disaggregated estimates of building stock and electric energy sales before conservation and a set of detailed measure characteristics for a comprehensive list of energy efficiency measures relevant to ENO's service region. This section details the team's approach and methodology to develop the key inputs to the potential model, as illustrated in Figure 2-1.

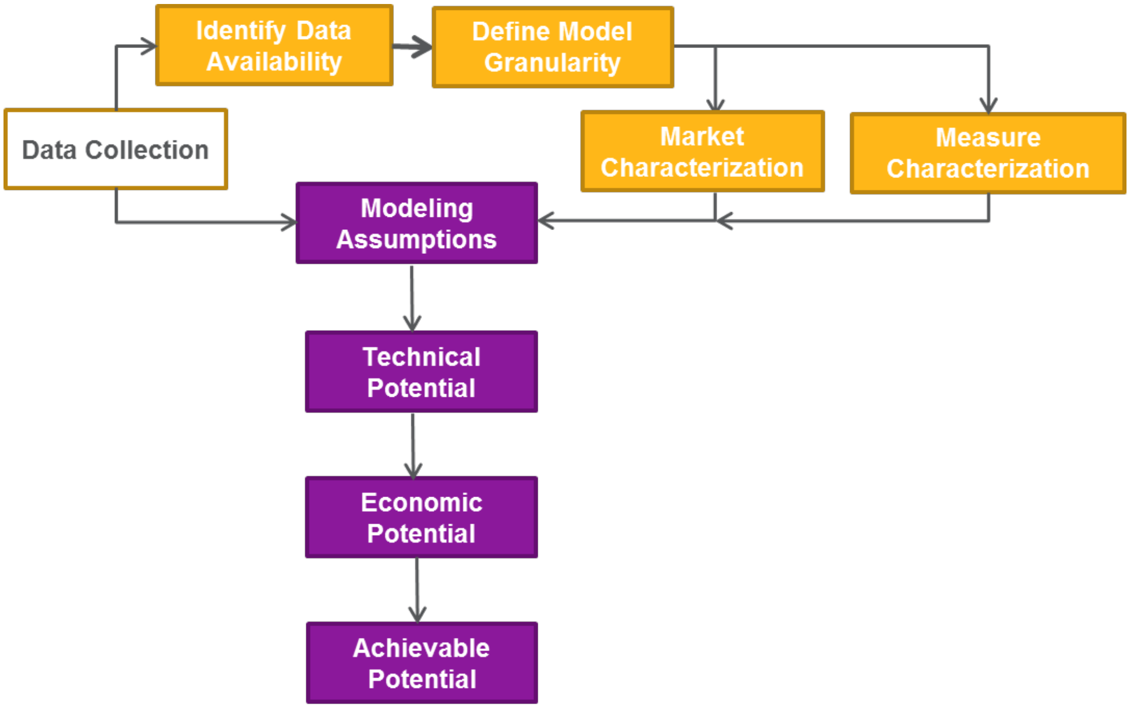
Figure 2-1. Potential Study Inputs



Source: Navigant

The methodology to calculate achievable potential includes several elements such as a base year calibration, a reference case forecast, and full measure characterization. Figure 2-2 shows how these elements interact to result in the achievable savings potential.

Figure 2-2. High Level Overview of Potential Study Methodology



Source: Navigant

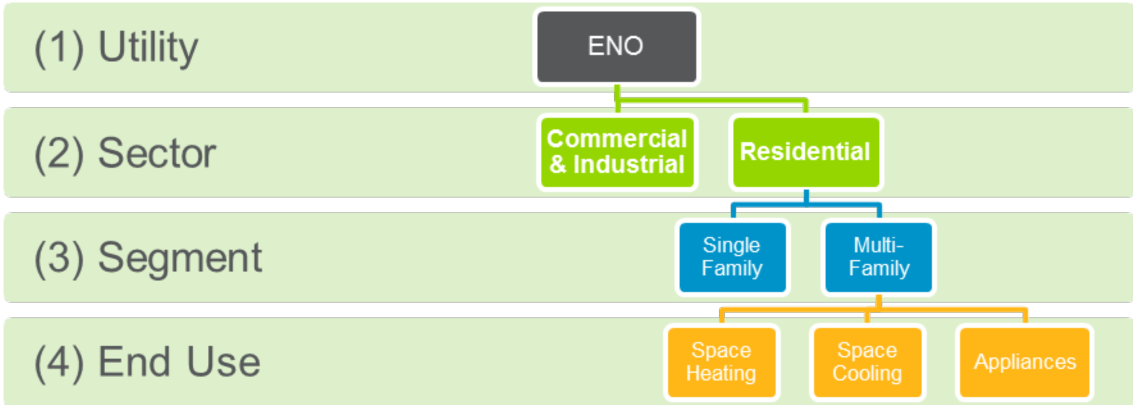
2.1.1 Market Characterization

Navigant's model uses inputs from two workflows: Market Characterization and Measure Characterization. This section describes the steps involved in the first workflow, Market Characterization. The Market Characterization workflow aims to define both the base year profile and reference case used to calculate potential.

2.1.1.1 Base Year Profile

This section describes the approach used to develop the base year (2016) profile of electricity use in ENO's service area, a key input to the potential model. The objective of the base year is to define a detailed profile of electricity sales by customer sector, segment, and end use (Figure 2-3). The model uses the base year as the foundation to develop the reference case forecast of electricity demand from 2018 through 2037.

Figure 2-3. Base Year Electricity Profile – Residential Example



Source: Navigant

Navigant developed the base year profile based on 2016 billing and customer account data provided by ENO because it was the most recent year with a fully complete and verified dataset. Where ENO-specific information was unavailable, Navigant used data from publicly available sources such as the US EIA CBECS and the US Department of Labor SIC System, in addition to internal Navigant data sources. The team used these resources to support the data sources provided by ENO and to ensure consistency with ENO data.

2.1.1.2 Defining Customer Sectors and Segments

The first major task to develop the base year electricity calibration involved disaggregating the main sectors—residential and C&I—into specific customer segments. The team selected customer segments based on several factors, including data availability and level of detail. Table 2-1 shows the segmentation used for the residential and C&I sectors. The following subsections detail the segmentation used for these sectors.

Table 2-1. Customer Segments by Sector

Residential	Commercial & Industrial
Single Family	Colleges/Universities
Multifamily	Healthcare
	Industrial/Warehouse
	Lodging
	Large Office
	Small Office
	Other
	Restaurants
	Retail – Food
	Retail – Non-Food
	Schools

Source: Navigant analysis

2.1.1.3 Residential Segments

After establishing the study sectors and segments, Navigant aligned ENO's data to the definitions established above, working closely with ENO. For residential, the team divided the sector into two segments based on consumption: single family and multifamily. The data ENO provided did not align perfectly with these segments due to differences in disaggregation methods. Navigant took two steps to reconcile the data:

1. **Sorted out unnecessary premises.** Navigant analyzed the proportion of total consumption for the different premise types provided in ENO's data. More specifically, the team calculated the total kilowatt-hour (kWh) consumption of each premise type (by multiplying the number of accounts by the average monthly kWh sales for each account) and compared those to the total monthly residential kWh consumption (by adding up all the total consumptions of each premise type). Based on this analysis, the team decided to exclude certain premise types depending on their proportion of the total consumption. For instance, if the premise type made up less than 1% of the residential sector's kWh sales and did not align with the study's residential segments (e.g., Boat Slip, Not Assigned), it was excluded.
2. **Mapped the remaining premise types to the study segments.** Navigant sorted the remaining premise types—house, apartment, duplex, condo, and mobile home—to the study segments. This process involved looking at each premise type's average monthly kWh consumption. Based on this comparison, the team determined that houses, condos, and homes would be classified as Single Family and duplexes and apartments would be classified as Multifamily.

Table 2-2 provides the finalized descriptions for each of these residential segments.

Table 2-2. Residential Segment Descriptions

Segment	Description
Single Family	Detached, attached row and/or townhouses (condominium), and mobile homes residential dwellings
Multifamily	Apartment units located in low rise or high rise apartment buildings and duplexes

Source: Navigant

2.1.1.4 C&I Segments

Navigant combined the C&I sectors into one, noted as C&I, because ENO's industrial sector made up roughly 13% of the total load based on ENO's load forecast analysis. Working closely with ENO, the team divided the C&I sector into 11 customer segments. Table 2-3 provides descriptions for each segment.

The team selected these C&I segments to be representative of the population of C&I customers in ENO's service area by comparing similar building characteristics such as patterns of electricity use, operating and mechanical systems, and annual operating hours. Generally, the selection of these segments aligned with the New Orleans TRM v1 and the SIC code for the account and kWh sales data provided by ENO. This study differs from those sources in that it includes industrial/warehouses and other as standalone segments and aggregates fast food and full menu restaurant into a single segment.

Appendix A.3 details on the allocation of the sales and stock data into the C&I sector.

Table 2-3. C&I Segment Descriptions

Segment	Description
Large Office	Larger offices engaged in administration, clerical services, consulting, professional, or bureaucratic work; excludes retail sales.
Small Office	Smaller offices engaged in personal services (e.g., dry cleaning), insurance, real estate, auto repair, and miscellaneous work; excludes retail sales.
Retail – Food	Retail and distribution of food; excludes restaurants.
Retail – Non-Food	Retailing services and distribution of merchandise; excludes retailers involved in food and beverage products services.
Healthcare	Health services, including diagnostic and medical treatment facilities, such as hospitals and clinics.
Lodging	Short-term lodging and related services, such as restaurants and recreational facilities; includes residential care, nursing, or other types of long-term care.
Restaurant	Establishments engaged in preparation of meals, snacks, and beverages for immediate consumption including restaurants, taverns, and bars.

Segment	Description
School	Primary schools, secondary schools (K-12), and miscellaneous educational centers, like libraries and information centers.
College/University	Post-secondary education facilities such as colleges, universities, and related training centers.
Industrial/Warehouse	Establishments that engage in the production, manufacturing, or storing of goods, including warehouses, manufacturing facilities, and storage facilities for general merchandise, refrigerated goods, and other wholesale distribution.
Other	Establishments not categorized under any other sector including but not limited to recreational, entertainment, and other miscellaneous activities.

Source: Navigant

2.1.1.5 Defining End Uses

The next step in the base year analysis was to establish end uses for each customer sector. Navigant defined these uses based on best practices, past ENO potential studies, and internal expertise.

The end uses selected in Table 2-4 are important for several reasons, including reporting and defining savings. For instance, the team uses the categories to report achievable savings with more granularity than at the sector and segment levels. Navigant derives these reported end-use savings by rolling up individual energy efficiency measures that map to the broader end-use categories. For example, savings from ENERGY STAR refrigerators and freezers are reported under the plug load end use.

Table 2-4. End Uses by Sector

Residential	C&I
Lighting Interior	Lighting Interior
Lighting Exterior	Lighting Exterior
Plug Loads	Plug Loads
Cooling	Cooling
Heating	Heating
Hot Water	Fans/Ventilation
Fans/Ventilation	Refrigeration
	Hot Water

Source: Navigant

Navigant used two additional end uses in Table 2-4 to report measure savings: total facility and heating and cooling*.* The team used these end uses to report savings from measures that affect electricity consumption across an entire home or facility or from measures that affect both heating and cooling consumption. For example, because smart thermostats result in electricity savings associated with both heating and cooling, savings from smart thermostats are assigned to the heating and cooling end use rather than individually to either heating or cooling.

2.1.1.6 Base Year Inputs

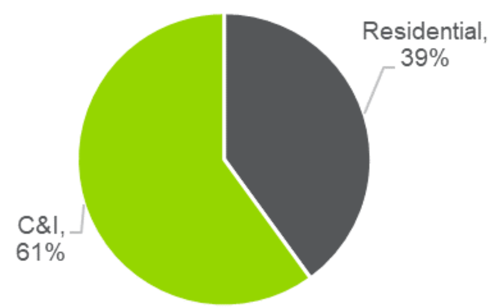
This section summarizes the breakdown of stock (households), electricity sales, and EUIs at the sector level, segment level, and end-use level. The team used these base year sales as direct inputs to the potential model. Appendix A provides a detailed description of the methodology used to develop these estimates. The DR portion of this study reconciles and derives the breakdown of demand across the sectors, segments, and end uses.[9]

Table 2-5 and Figure 2-4 show the high level breakdown of electricity sales by sector. Of total electricity sales, 61% comes from the C&I sector and 39% from the residential sector.

Table 2-5. 2016 Base Year Electricity Sector Sales (GWh)

Sector	GWh
Residential	2,230
C&I	3,503
Total	**5,733**

Figure 2-4. 2016 Base Year Electricity Sector Breakdown (%, GWh)



Source: Navigant analysis

All other base year inputs are shown and detailed below.

Residential Sector

To define the base year residential sector inputs, Navigant began by determining the base year stock and sales using ENO's account and billing data as the starting point. Although the account and billing data provided an approximation of ENO's stock by premise type (e.g., homes, condos, duplexes, etc.), the team further calibrated the

[9] Navigant developed the peak demand base case using the average peak demand factors from the 2016 sales data for the top 50 hours in each season.

numbers to ENO's account and load forecasts to ensure all datasets aligned. See Appendix A.2 for more detail about the calibration.

The next step in the base year definition process involved developing residential EUI values in kWh per household. Navigant used ENO's 2016 base year and the residential sales and count forecast to develop these values at the sector and segment levels by dividing the sales by the stock. Once the team determined the base year sector- and segment-level EUIs, it then determined the end-use-level EUIs, a more granular view of the EUIs. In the absence of local, ENO-specific data sources, Navigant used the US DOE's EnergyPLUS prototypical models in conjunction with its proprietary updates based on several different studies to determine the proportion of energy allocated to each of the study's end uses. The team used these proportions to further disaggregate the segment-level EUIs to the end-use level.

Table 2-6 shows the base year residential stock, electricity sales, and average electricity usage per home by segment. The base year residential stock is approximately 180,000 homes and accounts for just over 2,200 GWh of sales.

Table 2-6. Base Year Residential Results

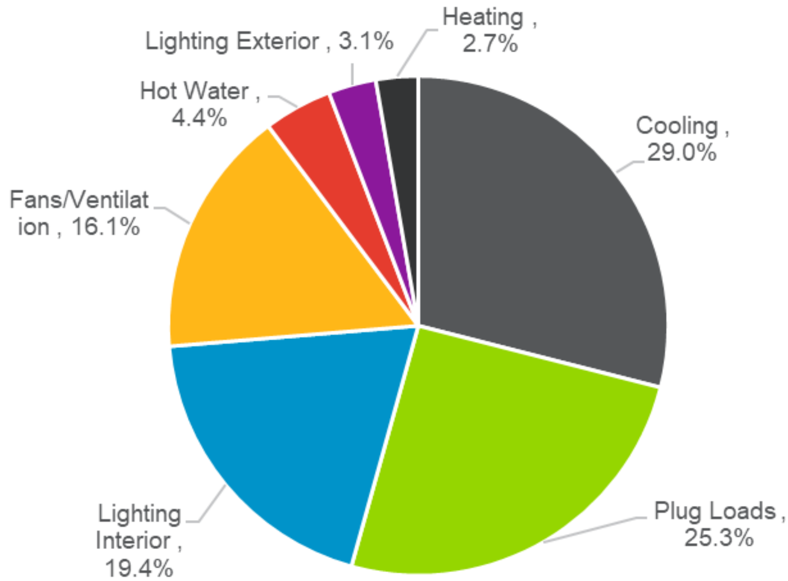
Segment	Stock (Accounts)	Electricity Use (GWh)	kWh per Account
Single Family	132,901	1,481	11,144
Multifamily	45,048	749	16,632
Total	**177,949**	**2,230**	**12,533**[10]

Source: Navigant analysis of ENO data

Figure 2-5 shows the breakdown of base year residential electricity sales by end use and segment, respectively. In terms of end uses, lighting, cooling, fans/ventilation, and plug loads represent the largest residential end uses and account for 90% of residential electricity sales.

[10] Note that this number represents the average annual kWh consumption for all households (total electricity use/ total accounts) and not the sum of the kWh per account for the two segments.

Figure 2-5. Base Year Residential Electricity End-Use Breakdown (%, GWh)



Source: Navigant analysis

C&I Sector

Similar to the residential sector, Navigant needed to determine the base year stock (thousands square feet [SF]) by segment, sales (kWh) by segment, and EUIs (kWh/thousands SF) by end use. Navigant followed three steps to determine these values for the base year:

1. Identify EUI by sector and segment for ENO
2. Define sales usage based on ENO's account and billing data
3. Determine the base year stock

This section will outline the general processes for each of these steps. Appendix A.3 provides specific details on the calibrations, data, and calculations used to define the base year values.

For step 1, Navigant used data from the EIA to determine 2016 EUIs at the sector and segment levels for ENO's climate region, hot-humid. The team then further calibrated this data to align with ENO's specific forecasts to finalize the EUIs. To disaggregate the EUIs by end use, Navigant created end-use allocations using the DOE's EnergyPLUS model in conjunction with proprietary Navigant models.

Once the EUIs were finalized, Navigant determined electricity usage, or sales, by segment by mapping ENO's account and billing data, which was classified by SIC, to the study's segments. The mapping process ultimately helped the team divide the total sales into segments, yielding the segment-level base year sales. This analysis included government accounts within the C&I sector.

Finally, Navigant determined the stock using the EUI and sales determined in the previous two steps. More specifically, the team divided the segment-level EUI, which was in kWh/thousands SF, by the segment-level sales, which was in kWh. This calculation yielded the stock by segment in thousands SF.

Table 2-7 shows the base year C&I stock (SF of floor space), electricity sales, and average electricity usage per SF by segment. C&I floor space stock is estimated at 188 million SF and contributes approximately 3,503 GWh of sales.

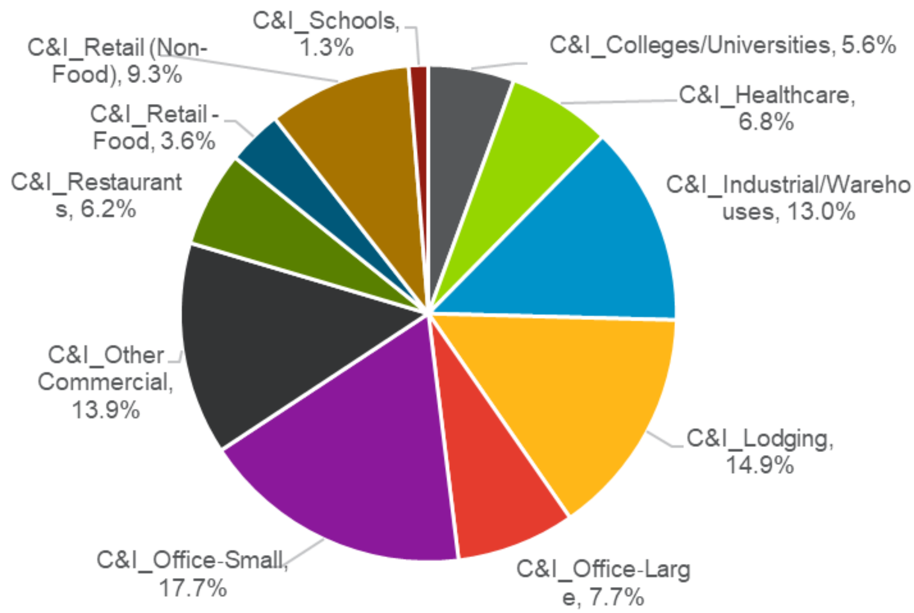
Table 2-7. Base Year C&I Results

Segment	Stock (thousands SF)	Electricity Use (GWh)	kWh per SF
College/University	15,388	196	12.7
Healthcare	8,318	237	28.5
Industrial/Warehouse	27,863	457	16.4
Lodging	34,693	523	15.1
Office – Large	15,875	270	17.0
Office – Small	36,365	619	17.0
Other Commercial	22,504	485	21.6
Restaurant	4,720	218	46.2
Retail – Food	2,574	125	48.7
Retail – Non-Food	16,548	327	19.8
School	3,494	45	12.7
Total	**188,340**	**3,503**	**--**

Source: Navigant analysis

Figure 2-6 shows the breakdown of base year C&I electricity sales by segment, respectively. Offices and lodging consume the most electricity, accounting for almost half (40%) of C&I electricity sales.

Figure 2-6. Base Year C&I Electricity Segment Breakdown (%, GWh)

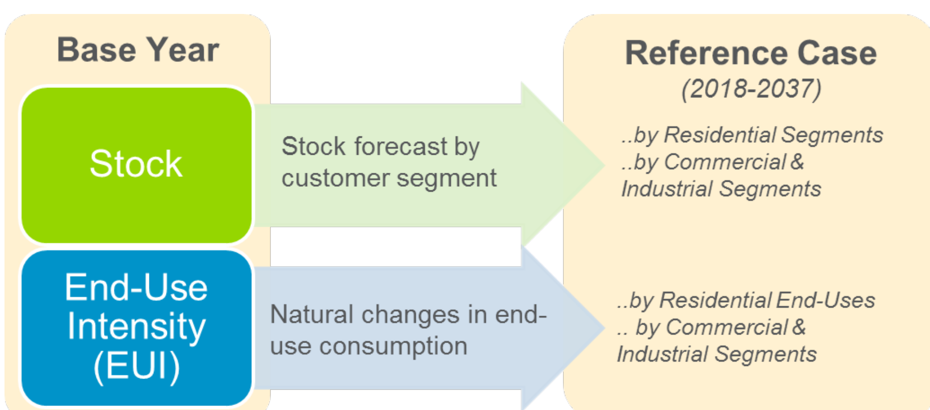


Source: Navigant analysis

2.1.2 Reference Case Forecast

This section presents the reference case forecast from 2018 to 2037. The reference case represents the expected level of electricity sales over the study period, absent incremental DSM activities or load impacts from rates. Electricity sales in the reference case are consistent with ENO's load forecast. The reference case is significant because it acts as the point of comparison (i.e., the reference) for the calculation of achievable potential cases. Figure 2-7 illustrates the process Navigant used to develop the reference case forecast. The reference case uses the base year profile as its foundation and applies changes in stock growth and EUI over time to develop the residential and C&I forecasts.

Figure 2-7. Schematic of Reference Case



Source: Navigant

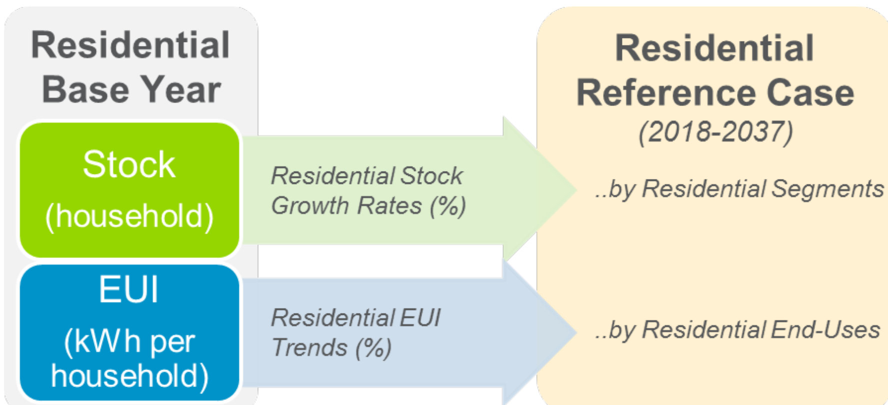
Navigant constructed the reference case forecast by applying growth rates from ENO's account and load forecasts directly to the base year stock, sales, and EUI values.

The following sections describe the approach and assumptions employed and present the results of the residential and C&I reference case forecasts.

2.1.2.1 Residential Reference Case

Figure 2-8 illustrates this process. Appendix A.2 provides a description of the process used to develop the residential stock forecast.

Figure 2-8. Residential Reference Case Schematic



Source: Navigant

For the residential reference case, the first step involved developing stock growth rates for each residential segment over the 2018-2037 period. Navigant derived residential stock growth rates based on ENO's residential account forecast and applied them to the base year residential stock. Table 2-8 shows the growth in residential stock forecast from 2018 to 2037. Residential stock increases at an average annual growth rate of 0.4% from approximately 178,000 accounts in 2016 to 194,000 accounts in 2037.

Table 2-8. Residential Reference Case Stock Forecast (Accounts)

Segment	2016	2037
Single Family	132,901	144,972
Multifamily	45,048	49,139
Total	**177,949**	**194,111**

Source: Navigant analysis of ENOs residential load forecast

Navigant followed a similar methodology for sales, leveraging ENO's forecasting. To forecast the sales, the team determined the growth rates for each year of ENO's load forecast and then applied these rates directly to the load.

Finally, Navigant needed to forecast the EUIs. Due to data availability, Navigant did not apply individual EUI trends by end use. Instead, the team applied ENO's residential account forecast growth rates at each level to determine the changes in EUI over time. Although it is unlikely that end-use EUI trends will follow the account-level trends exactly, Navigant did not have any other reliable estimates to leverage.[11] ENO currently does not estimate these values, and the team could not find any reliable secondary sources specifically for the New Orleans area.[12] Table 2-9 shows the resulting EUI trends by residential end use, which is an overall reduction per household.

Table 2-9. Residential Reference Case EUI Forecast (kWh/Account)

Segment	End Use	2016	2037
Single Family	Cooling	3,229	3,138
	Fans/Ventilation	1,790	1,740
	Heating	304	296
	Hot Water	493	479
	Lighting Exterior	345	335
	Lighting Interior	2,158	2,097
	Plug Loads	2,824	2,744
	Total	**11,144**	**10,829**
Multifamily	Cooling	4,819	4,683
	Fans/Ventilation	2,672	2,596
	Heating	454	441
	Hot Water	736	715
	Lighting Exterior	515	500
	Lighting Interior	3,221	3,130
	Plug Loads	4,215	4,095
	Total	**16,632**	**16,161**

Source: Navigant analysis

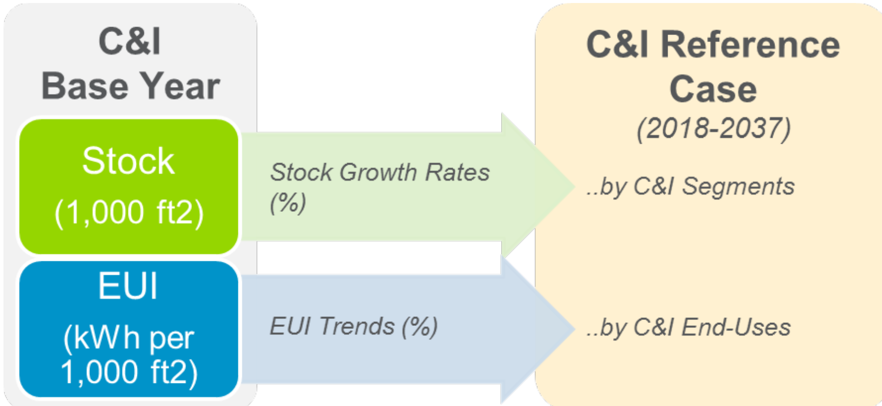
2.1.2.2 C&I Reference Case

Like the residential reference case, Navigant built the C&I reference case by applying growth rates from ENO's load forecast to the base year values. Figure 2-9 provides an overview of the inputs and the EUI and stock analyses for the C&I sector. Appendix A.3 provides a detailed description of the process used to develop the C&I stock forecast.

[11] In other studies, Navigant usually sees a decrease in lighting EUIs and an increase in plug load EUIs over time, which is consistent with the assumption made here. Other end-use EUI projection rates may also vary.

[12] Navigant reviewed national-level data from the US EIA and methodologies from other Navigant potential studies; however, the trends did not align well with ENO-specific trends.

Figure 2-9. C&I Reference Case Schematic



Source: Navigant

To forecast out the stock, Navigant applied the growth rate of 0.4% from ENO's account forecast for each study year.[13] Similarly, the team used the growth rate of 0.4% from ENO's load forecast to estimate sales by year. Because ENO only had sector-level forecasts, Navigant applied the growth rates evenly across all segments except for the industrial/warehouse segment. For that segment, the team applied the growth rate of 0.0% from the Industrial sector portion of ENO's forecasts to ensure alignment. Appendix A.3 provides more details about the source data for the growth rates. Given data availability, Navigant leveraged these growth rates to determine the EUI trends as well. Although it is unlikely that end-use EUI trends will follow the account-level trends exactly, the team did not have any other reliable estimates to leverage. ENO currently does not estimate these values, and Navigant could not find any reliable secondary sources specifically for the New Orleans area.

Table 2-10 and Table 2-11 show the results of the reference case analysis.

[13] Note that the growth rates presented in the paragraph represent the compound annual growth rate (CAGR) over the entire study period. The annual rates vary based on specific inputs, such as job, stock, and industry growth rates, according to ENO's load forecasting team.

Table 2-10. C&I Reference Case Stock Forecast (Thousands SF)

Segment	2016	2037
Colleges/Universities	15,388	16,580
Healthcare	8,318	8,962
Industrial/Warehouses	27,863	27,734
Lodging	34,693	37,381
Office – Large	15,875	17,105
Office – Small	36,365	39,183
Other Commercial	22,504	24,248
Restaurants	4,720	5,085
Retail – Food	2,574	2,773
Retail – Non-Food	16,548	17,830
Schools	3,494	3,765
Total	**188,340**	**200,648**

Source: Navigant analysis

Table 2-11. C&I Reference Case EUI Forecast (kWh/Thousands SF)

Segment	End Use	2016	2037
Colleges/Universities	Cooling	2,662	2,820
	Fans/Ventilation	2,468	2,615
	Heating	1,885	1,998
	Hot Water	196	207
	Lighting Exterior	347	367
	Lighting Interior	3,238	3,430
	Plug Loads	1,804	1,911
	Refrigeration	148	156
	Heating/Cooling	4,547	4,818
	Total Facility	**12,747**	**13,506**
Healthcare	Cooling	7,803	8,268
	Fans/Ventilation	2,806	2,974
	Heating	4,217	4,468
	Hot Water	356	377
	Lighting Exterior	224	238
	Lighting Interior	5,999	6,357
	Plug Loads	6,978	7,394
	Refrigeration	141	149
	Heating/Cooling	12,021	12,737
	Total Facility	**28,525**	**30,224**
Industrial/Warehouses	Cooling	64	74

Segment	End Use	2016	2037
	Fans/Ventilation	4,006	4,595
	Heating	3,171	3,637
	Lighting Exterior	266	305
	Lighting Interior	5,439	6,239
	Plug Loads	883	1,012
	Refrigeration	502	576
	Hot Water	2,071	2,375
	Heating/Cooling	3,235	3,711
	Total Facility	**16,402**	**18,813**
Lodging	Cooling	2,683	2,843
	Fans/Ventilation	2,006	2,125
	Heating	176	186
	Hot Water	3,812	4,040
	Lighting Exterior	176	187
	Lighting Interior	2,402	2,546
	Plug Loads	3,687	3,906
	Refrigeration	123	130
	Heating/Cooling	2,859	3,029
	Total Facility	**15,065**	**15,962**
Office – Large	Cooling	6,432	6,815
	Fans/Ventilation	495	524
	Heating	1,468	1,556
	Hot Water	61	64
	Lighting Exterior	34	36
	Lighting Interior	5,291	5,606
	Plug Loads	3,245	3,438
	Heating/Cooling	7,900	8,371
	Total Facility	**17,026**	**18,040**
Office – Small	Cooling	6,269	6,642
	Fans/Ventilation	482	511
	Heating	1,846	1,956
	Hot Water	76	81
	Lighting Exterior	33	35
	Lighting Interior	5,157	5,464
	Plug Loads	3,162	3,351
	Heating/Cooling	8,115	8,598
	Total Facility	**17,026**	**18,040**
Other Commercial	Cooling	687	727

Segment	End Use	2016	2037
	Fans/Ventilation	4,096	4,340
	Heating	1,805	1,912
	Hot Water	1,457	1,543
	Lighting Exterior	190	201
	Lighting Interior	2,953	3,129
	Plug Loads	9,608	10,181
	Refrigeration	777	823
	Heating/Cooling	2,491	2,640
	Total Facility	**21,572**	**22,857**
Restaurants	Cooling	8,553	9,062
	Fans/Ventilation	6,578	6,970
	Heating	1,970	2,088
	Hot Water	2,389	2,531
	Lighting Exterior	2,073	2,196
	Lighting Interior	3,422	3,626
	Plug Loads	19,710	20,884
	Refrigeration	1,481	1,569
	Heating/Cooling	10,523	11,150
	Total Facility	**46,175**	**48,925**
Retail – Food	Cooling	3,980	4,217
	Fans/Ventilation	5,927	6,280
	Heating	2,151	2,279
	Hot Water	45	48
	Lighting Exterior	595	631
	Lighting Interior	10,889	11,538
	Plug Loads	5,586	5,918
	Refrigeration	19,498	20,659
	Heating/Cooling	6,131	6,496
	Total Facility	**48,671**	**51,570**
Retail – Non-Food	Cooling	1,915	2,030
	Fans/Ventilation	2,916	3,089
	Heating	1,795	1,902
	Lighting Exterior	599	634
	Lighting Interior	8,770	9,293
	Plug Loads	980	1,039
	Refrigeration	642	680
	Hot Water	2,172	2,301
	Heating/Cooling	3,711	3,932

Segment	End Use	2016	2037
	Total Facility	**19,789**	**20,968**
Schools	Cooling	2,504	2,653
	Fans/Ventilation	2,322	2,460
	Heating	2,459	2,605
	Hot Water	255	271
	Lighting Exterior	326	346
	Lighting Interior	3,046	3,227
	Plug Loads	1,697	1,798
	Refrigeration	139	147
	Heating/Cooling	4,962	5,258
	Total Facilities	**12,747**	**13,506**

Source: Navigant analysis

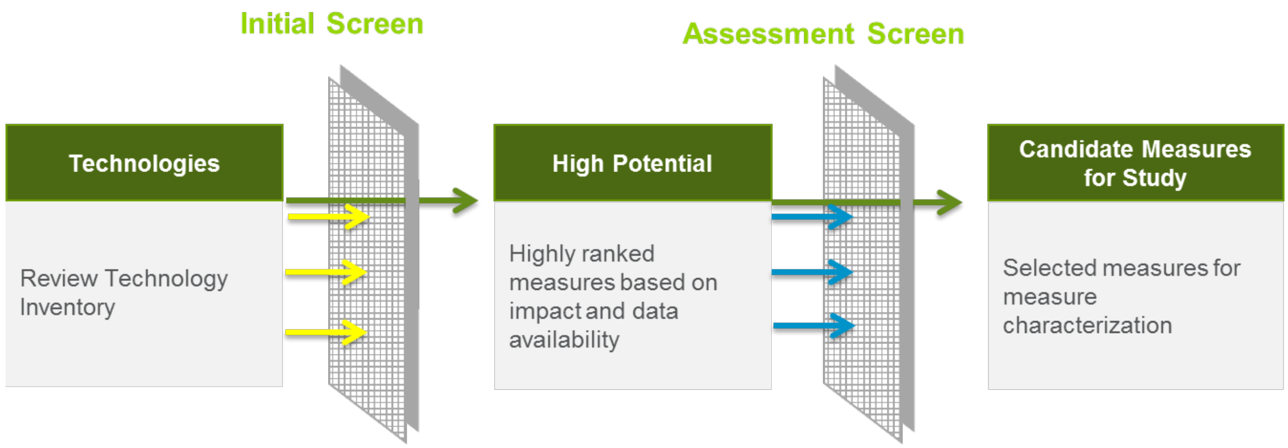
2.1.3 Energy Efficiency Measure Characterization

Navigant fully characterized over 100 measures or measure groupings across ENO's residential and C&I sectors. The team prioritized high-impact measures with good data availability that are most likely to be cost-effective for inclusion into DSMSim.

2.1.3.1 Measure List

Navigant developed a comprehensive list of energy efficiency measures likely to contribute to achievable potential. The team reviewed current ENO Energy Smart program offerings, other regional programs, and potential model measure lists from other states to identify energy efficiency measures with the highest expected economic impact. The team supplemented the measure list using secondary data from publicly available sources such as TRMs from various US regions including Arkansas, Illinois, and the mid-Atlantic. Navigant prioritized measures in existing ENO Energy Smart programs based on data availability for appropriate characterization and measures most likely to be cost-effective. The team also ensured that high impact measures were captured in the list. The team worked with ENO and ENO contractors, including program implementers, to finalize the measure list and ensure it contained technologies viable for future ENO program planning activities. Figure 2-10 shows the process Navigant implemented to narrow down the measure list.

Figure 2-10. Measure Screening Process



Source: Navigant

There were many measures included in the initial and assessment screens that did not make it into the study. The high potential measures that did not become candidate measures for the study are documented. Working sessions with ENO staff revealed topics of note regarding the following measures:

- **Residential lighting:** Low efficiency residential lighting types such as incandescent and halogen lamps can be replaced with higher efficiency CFL and LED bulbs. As LED bulbs have become more common in the market and less expensive over time, they offer cost-effectiveness advantages over CFL bulbs. Navigant anticipates that future programs will no longer incentivize CFLs. Therefore, this study included LEDs but not CFLs.
- **Residential thermostats:** Programmable thermostats control space temperatures according to a preset schedule, while smart thermostats are Wi-Fi controlled and implement a learning algorithm to control temperature to a desired level while managing HVAC energy use. ENO recently conducted a pilot study in low income housing in anticipation of developing a future program offering. Navigant included both programmable and smart thermostats in this study.
- **Industrial measures:** ENO reported that its industrial energy use is relatively low compared to the commercial and residential sectors. Navigant used industrial measure expertise from previous potential studies and industrial subject matter experts to develop a limited list of industrial sector measures; the team then aggregated the industrial sector potential together with the commercial sector potential.

2.1.3.2 Measure Characterization Key Parameters

The measure characterization effort consisted of defining nearly 50 individual parameters for each of the measures included in this study. This section defines the top nine key parameters and how each influences technical and economic, and therefore achievable, potential savings estimates.

1. **Measure Definition:** Navigant used the following variables to qualitatively define each characterized measure:
    - ***Replacement Type:*** Replacing the baseline technology with the efficient technology can occur in three variations:
        i. <u>Retrofit (RET)</u>: In this variation, equipment is replaced before the end of its life. The model considers the baseline to be the existing equipment and uses the energy and demand savings between the existing equipment and the efficient technology during technical potential calculations. RET also applies the full installed cost of the efficient equipment during the economic screening.
        ii. <u>Replace-on-Burnout (ROB):</u> In this variation, equipment is replaced when it fails. The model considers the baseline to be the code-compliant technology option and uses the energy and demand savings between the current code option and the efficient technology during technical potential calculations. ROB also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
        iii. <u>New Construction (NEW)</u>: In this variation, new equipment is installed in a new home or building. The model considers the baseline to be the least-cost, code-compliant option and uses the energy and demand savings between this specific current code option and the efficient technology during technical potential calculations. NEW also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
    - ***Baseline Definition:*** Describes the baseline technology.
    - ***Energy Efficiency Definition:*** Describes the efficient technology set to replace the baseline technology.
    - ***Unit Basis:*** The normalizing unit for energy, demand, cost, and density estimates.
2. **Sector and End-Use Mapping:** The team mapped each measure to the appropriate end uses, customer segments, and sectors across ENO's service area. Section 2.1.1 describes the breakdown of customer segments within each sector.
3. **Annual Energy Consumption:** The annual energy consumption in kWh for each base and energy efficient technology.
4. **Fuel Type Applicability Multipliers:** Applies an adjustment to the total equipment stock to account for the proportion applicable to a given measure's fuel type. For example, a measure that replaces a baseline efficiency resistance water heater with a more efficient unit is only applicable to existing electric resistance water heaters. The team used this multiplier to restrict the existing

water heater equipment stock to only those that use electricity. Table 2-12 provides the fuel share splits.

Table 2-12. Fuel Share Splits for Domestic Hot Water and Heating

Customer Segment	DHW – Elec Only	DHW – Gas Only	Heating – Elec Only	Heating – Gas
Residential	50%	50%	50%	50%
C&I	60%	40%	60%	40%

Source: Navigant analysis

5. **Measure Lifetime:** The lifetime in years for the base and energy efficient technologies. The base and energy efficient lifetimes only differ in instances where the two cases represent inherently different technologies, such as LEDs compared to a baseline incandescent bulb.
6. **Incremental Costs:** The incremental cost between the assumed baseline and efficient technology using the following variables:
    - ***Base Costs***: The cost of the base equipment, including both material and labor costs.
    - ***Energy Efficient Costs:*** The cost of the energy efficient equipment, including both material and labor costs.
7. **Technology Densities:** This study defines density as the penetration or saturation of the baseline and efficient technologies across the service area. For residential, these saturations are on a per-home basis and for C&I, they are per 1,000 SF of building space.[14]
    - ***Base Initial Saturation***: The initial saturation of the baseline equipment for a given customer segment as defined by the fraction of the end-use stock that has the baseline equipment installed.
    - ***Energy Efficiency Initial Saturation:*** The initial saturation of the efficient equipment for a given customer segment as defined by the fraction of the end-use stock that has the efficient measure installed.
    - ***Total Maximum Density:*** The total number of both the baseline and efficient units for a given technology.
8. **Technical Suitability:** The percentage of the base technology that can be reasonably and practically replaced with the specified efficient technology. For instance, occupancy sensors are only practical for certain interior lighting fixtures

[14] Navigant sourced density estimates from Energy Smart program data and other related secondary sources.

(suitability less than 1.0), while all existing incandescent exit signs can be replaced with efficient LED signs (suitability of 1.0).

9. **Competition Group:** Navigant combined efficient measures competing for the same baseline technology density into a single competition group to avoid the double counting of savings.

2.1.3.3 Measure Characterization Approaches and Sources

This section provides approaches and sources for the main measure characterization variables.

Table 2-13. Measure Characterization Input Data Sources

Measure Input	Data Sources
Measure Costs, Measure Life, Energy Savings	• Energy Smart program data • 2017 New Orleans TRM • 2017 ENO potential study data • US DOE Appliance Standards and Rulemakings supporting documents • Engineering analyses • TRMs and RTF measure workbooks • Navigant measure database and previous potential studies
Fuel Type Applicability Splits, Density, Baseline Initial Saturation, Technical Suitability, End-Use Consumption Breakdown	• Energy Smart program data • Navigant's previous potential studies
Codes and Standards	• US DOE CFR engineering analyses • Local building code

Source: Navigant

2.1.3.4 Energy Savings

Navigant used three general bottom-up approaches to analyze residential and C&I measure energy savings:

1. **New Orleans Technical Reference Manual Calculations:** Navigant used the New Orleans 2017 TRM as much as possible for unit energy savings calculations. The TRM provided deemed (default) savings values for most measures in this study.

2. **Standard algorithms:** Navigant used standard algorithms for unit energy savings calculations for most measures not contained in the New Orleans TRM. To supplement this, the team leveraged ENO data, DOE Appliance Standards and Rulemaking supporting documents, RTF measure workbooks, and other TRMs.

3. **Engineering analysis:** Navigant used appropriate engineering algorithms to calculate energy savings for any measures not included in the New Orleans TRM or available TRMs. The team leveraged its internal expertise and experience with potential studies to calculate the energy savings.

2.1.3.5 Peak Demand Savings

Peak demand savings were either from the New Orleans TRM or generally calculated by dividing the annual energy use by the annual hours of use and then multiplying by a coincidence factor. The coincidence factor is an expression of how much of the equipment's demand occurs during the system's peak period. The defined peak period according to the TRM is the average peak demand savings, Monday-Friday, non-holidays from 4-6pm in the months of June, July, and August.

2.1.3.6 Incremental Costs

Navigant relied on the cost information in the New Orleans TRM as much as possible. The team conducted secondary research and used other publicly available cost data sources such as regional TRMs, RTF measure workbooks, the California DEER, ENERGY STAR, US DOE Appliance Standards and Rulemaking, and other state databases for all other cost data.

2.1.3.7 Building Stock and Densities

Navigant developed building stock estimates for the residential sector in terms of residential accounts and the C&I sector in terms of floor space. The approaches used to develop the base year and reference case building stock assumptions are described in Section 2.1.1.

Measure densities—used to characterize the penetration or saturation of measures—were developed based on a variety of data sources including ENERGY STAR, the Northwest Energy Efficiency Alliance's Residential Building Stock Assessment (RBSA) and Commercial Building Stock Assessment (CBSA), and previous potential studies from other jurisdictions.

2.1.3.8 8,760 Load Profile

Appendix C provides detail on the development of the end-use profiles. These profiles are 8,760 (i.e., hourly annual) end-use load shapes. These profiles are by end use (e.g., heating, lighting, etc.), by sector (e.g., residential, commercial, etc.), and, where relevant and appropriate, by commercial and industrial segments (e.g., retail, office, etc.).

2.1.3.9 Codes and Standards Adjustments

The US DOE publishes federal energy efficiency regulations for many types of residential appliances and commercial equipment. The US DOE Technical Support Documents (TSD)[15] contain information on energy and cost impacts of each appliance standard. In the TSD, engineering analysis is available in Chapter 5, energy use analysis in Chapter 7, and cost impact in Chapter 8.

As these codes and standards take effect, the energy savings from existing measures impacted by these codes and standards decline and the reduction is transferred to the codes and standards savings potential. Navigant accounts for the effect of codes (including building code[16]) and standards through baseline energy and cost multipliers (sourced from the DOE's analysis), which reduce the baseline equipment consumption starting from the year a code or standard takes effect. The baseline cost of an efficient measure affected by codes and standards will often increase upon the code's implementation. For example, Navigant incorporated the 2023 residential central air conditioners standard in this study, which results in the baseline for residential air conditioners changing from 14 Seasonal Energy Efficiency Ratio (SEER) to 14.3 SEER in 2023. Accordingly, the model accounts for a reduction in energy consumption and an increase in cost in 2023 for the baseline technology through the codes and standards multipliers. As such, computed measure-level potential is net of these adjustments from codes and standards implemented after the first year of the study.[17]

2.1.3.10 *Measure Quality Control*

Navigant fully vetted and characterized each measure in terms of its energy savings, costs, and applicability. The characterization includes the following:

- Measure descriptions and baseline assumptions
- Energy savings and cost associated with the measure
- Cost of conserved energy, including O&M costs
- Lifetime of the measure (Effective useful life and remaining useful life)
- Applicability factors including initial energy efficient market penetration and technical suitability
- Load shape of measure
- Replacement type of measure

[15] Appliance standards rulemaking notices and TSD can be found at: https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program

[16] Section 26-15 of the New Orleans Code of Ordinances

[17] It is important to note that the second tier of Energy Independence and Security Act of (EISA) 2007 regulations go into effect beginning January 2020 where the general service lamps must comply with a higher standard. Because the EUL of some lamps extend beyond this date, the baseline per guidance from the New Orleans TRM is adjusted to the second tier in years after 2022. For commercial lighting, these retrofits are considered as RET and baseline changes start in 2020.

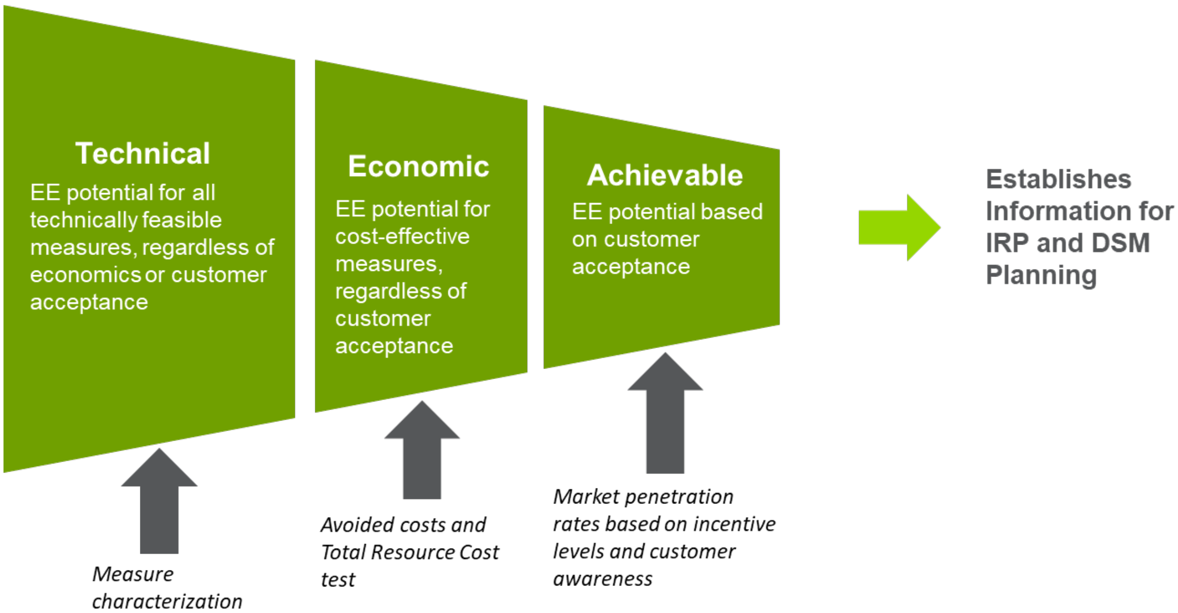
2.1.4 Potential Estimation Approach

Navigant employed its proprietary DSMSim potential model to estimate the technical, economic, and achievable savings potential for electric energy and demand across ENO's service area. DSMSim is a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics[18] framework. The DSMSim model explicitly accounts for different types of efficient measures such as RET, ROB, and NEW and the effects these measures have on savings potential. The model then reports the technical, economic, and achievable potential savings in aggregate for the service area, sector, customer segment, end-use category, and highest impact measures.

This study defines technical potential as the total energy savings available assuming all installed measures can immediately be replaced with the efficient measure/technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced. Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential but including only those measures that have passed the benefit-cost test chosen for measure screening; in this case, that is the total resource cost (TRC) test. Finally, the achievable potential is analyzed based on the measure adoption ramp rates and the diffusion of technology through the market. Figure 2-11 provides an overview of the methodology.

[18] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modeling.

Figure 2-11. Potential Calculation Methodology



Source: Navigant

Savings reported in this study are gross rather than net, meaning they do not include the effects of natural change. Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about NTG ratios or changing EUIs become available.

Once the potential results and cases are analyzed, the output can be used to define the portfolio energy savings goals, costs, and forecast for alignment into other utility planning landscapes like the IRP.

2.1.4.1 Technical Potential

Approach to Estimating Technical Potential

This study defines technical potential as the total energy savings available assuming all installed measures can immediately be replaced with the efficient measure/technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced.

Navigant's modeling approach considers an energy efficient measure to be any change made to a building, piece of equipment, process, or behavior that can save energy.[19] The savings can be defined in numerous ways depending on which method is most appropriate for a given measure. Measures that consist of a change to a single, discrete

[19] This study does not examine the impact of end-user electricity rates on sales or energy efficiency's impact on electricity rates.

product or piece of equipment (e.g., lighting fixture replacements) are best characterized as some fixed amount of savings per fixture. Measures related to products or equipment that vary by size (e.g., air conditioning equipment) are best characterized on a basis that is normalized to a certain aspect of the equipment, such as per ton of air conditioning capacity. Other measures that could affect multiple pieces of equipment (e.g., behavior-based measures) are characterized as a percentage of customer segment sales saved.

The calculation of technical potential in this study differs depending on the assumed measure replacement type. Technical potential is calculated on a per-measure basis and includes estimates of savings per unit, measure density (e.g., quantity of measures per home for residential or per 1,000 SF of floor space for C&I), and total building stock in each service area. The study accounts for three replacement types, where potential from RET and ROB measures are calculated differently from potential for NEW measures. The formulae used to calculate technical potential by replacement type are shown below.

Retrofit and ROB Measures

RET measures, commonly referred to as advancement or early retirement measures, are replacements of existing equipment before the equipment fails. RET measures can also be efficient processes that are not currently in place and that are not required for operational purposes. RET measures incur the full cost of implementation rather than incremental costs to some other baseline technology or process because the customer could choose not to replace the measure and would, therefore, incur no costs. In contrast, ROB measures—sometimes referred to as lost opportunity measures—are replacements of existing equipment that have failed and must be replaced or are existing processes that must be renewed. Because the failure of the existing measure requires a capital investment by the customer, the cost of implementing ROB measures is always incremental to the cost of a baseline (and less efficient) measure.

RET and ROB measures have a different meaning for technical potential compared with NEW measures. In any given year, the model uses the existing building stock to calculate technical potential.[20] This method does not limit the calculated technical potential to any pre-assumed adoption rate of RET measures. Existing building stock is reduced each year by the quantity of demolished building stock in that year and does not include new building stock that is added throughout the simulation. For RET and ROB measures, annual potential is equal to total potential, thus offering an instantaneous view of technical potential. Navigant used Equation 2-1 to calculate technical potential for RET and ROB measures.

[20] In some cases, customer segment-level and end-use-level sales are used as proxies for building stock. These sales figures are treated like building stock in that they are subject to demolition rates and stock tracking dynamics.

Equation 2-1. Annual/Total RET/ROB Technical Savings Potential

$$\begin{aligned}&Total\ Potential\\&= Existing\ Stock\ x\ Measure\ Density\ x\ Savings\ x\ Technical\ Suitability\ \ x\ Baseline\ Initial\ Saturation\end{aligned}$$

Where:

- *Total Potential:* kWh
- *Existing Stock:*[21] C&I floor space per year or residential households per year
- *Measure Density:* Widgets per unit of stock
- *Savings:* kWh per widget per year
- *Technical Suitability:* Percentage of applicable stock
- *Baseline Initial Saturation:* Percentage of energy efficient stock

New Construction Measures

The cost of implementing NEW measures is incremental to the cost of a baseline (and less efficient) measure. However, NEW technical potential is driven by equipment installations in new building stock rather than by equipment in existing building stock.[22] New building stock is added to keep up with forecast growth in total building stock and to replace existing stock that is demolished each year. Demolished (sometimes called replacement) stock is calculated as a percentage of existing stock in each year, and this study uses a demolition rate of 0.5% per year for residential and C&I stock. New building stock determines the incremental annual addition to technical potential, which is then added to totals from previous years to calculate the total potential in any given year. The equations used to calculate technical potential for new construction measures are provided in Equation 2-2 and Equation 2-3.

Equation 2-2. Annual Incremental NEW Technical Potential (AITP)

$$AITP = New\ Stock\ x\ Measure\ Density\ x\ Savings\ x\ Technical\ Suitability$$

Where:

- *Annual Incremental NEW Technical Potential:* kWh

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[21] Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 SF of building space, number of residential homes, customer segment sales, etc.).

[22] In some cases, customer segment-level and end-use-level sales are used as proxies for building stock. These sales figures are treated like building stock in that they are subject to demolition rates and stock tracking dynamics.

- *New Stock:*[23] C&I floor space per year or residential households per year
- *Measure Density:* Widgets per unit of stock
- *Savings:* kWh per widget per year
- *Technical Suitability:* Percentage of the total baseline measures that could be replaced with the efficient measure. For example, CFLs cannot replace all incandescent bulbs because of their size, inability to be dimmed, and sensitivity to temperature.

Equation 2-3. Total NEW Technical Potential (TTP)

$$\text{TTP} = \sum_{YEAR=2018}^{YEAR=2037} AITP_{YEAR}$$

Competition Groups

Navigant's modeling approach recognizes that some efficient technologies will compete against each other in the calculation of potential. The study defines competition as an efficient measure competing for the same installation as another efficient measure. For instance, a consumer has the choice to replace an air source heat pump with a more efficient air source heat pump or a ground source heat pump, but not both. These efficient technologies compete for the same installation.

There are several general characteristics of competing technologies that Navigant used to define competition groups in this study:

- Competing efficient technologies share the same baseline technology characteristics, including baseline technology densities, costs, and consumption.
- The total (baseline plus efficient) measure densities of competing efficient technologies are the same.
- Installation of competing technologies is mutually exclusive (i.e., installing one precludes installation of the others for that application).
- Competing technologies share the same replacement type (RET, ROB, or NEW).

To address the overlapping nature of measures within a competition group, Navigant's analysis only selected one measure per competition group to include in the summation of technical potential across measures (e.g., at the end use, customer segment, sector, service area, or total level). The measure with the largest energy savings potential in each competition group was used to calculate total technical potential of that

[23] Units for new building stock and measure densities may vary by measure and customer segment (e.g., 1,000 SF of building space, number of residential homes, customer segment consumption, etc.)

competition group. This approach ensures that the aggregated technical potential does not double count savings. The model does still, however, calculate the technical potential for each individual measure outside of the summations.

2.1.4.2 Economic Potential

This section describes the economic savings potential—potential that meets a prescribed level of cost-effectiveness—available in ENO's service area. The section explains Navigant's approach to calculating economic potential.

Approach to Estimating Economic Potential

Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential but including only those measures that have passed the benefit-cost test chosen for measure screening (in this study the TRC test, as per the Council's IRP rules). The TRC ratio for each measure is calculated each year and compared against the measure-level TRC ratio screening threshold of 1.0. A measure with a TRC ratio greater than or equal to 1.0 is a measure that provides monetary benefits greater than or equal to its costs. If a measure's TRC meets or exceeds the threshold, it is included in the economic potential.

The TRC test is a benefit-cost metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the utility (or program administrator) and the customers. The TRC benefit-cost ratio is calculated in the model using Equation 2-4.

Equation 2-4. Benefit-Cost Ratio for the TRC Test

$$TRC = \frac{PV(Avoided\ Costs)}{PV(Incremental\ Cost + Admin\ Costs)}$$

Where:

- *PV* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits that result from electric energy and capacity savings—e.g., avoided or deferred costs of infrastructure investments and avoided long-run marginal cost (commodity costs) due to electric energy conserved by efficient measures.
- *Incremental Cost* is the measure cost as defined (see definition in Section 2.1.3.6).
- *Admin Costs* are the administrative costs incurred by the utility or program administrator (not including incentives).

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined in the numerator and denominator, respectively) over each measure's life. Avoided costs, discount rates, and other key data inputs used in the TRC calculation are presented in Appendix B. Effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow ENO to easily apply updated NTG assumptions in the future and allows for variations in NTG assumptions by reviewers. Although the TRC equation includes administrative costs, the study did not consider these costs during the economic screening process because the study is concerned with an individual measure's cost-effectiveness on the margin.

Like technical potential, only one economic measure from each competition group was included in the summation of economic potential across measures (e.g., at the end-use category, customer segment, sector, service area, or total level). If a competition group was composed of more than one measure that passes the TRC test, then the economic measure that provides the greatest electric savings potential was included in the summation of economic potential. This approach ensures that double counting is not present in the reported economic potential, though economic potential for each individual measure is still calculated and reported outside of the summation.

2.1.4.3 Achievable Potential

Achievable potential is defined as the subset of economic potential considered achievable given assumptions about the realistic market adoption of a given measure. It is the product of the economic potential with two measure-specific factors: 1) the assumed maximum long-run achievability of each measure, and 2) a time-dependent factor called ramp rate reflects barriers to market adoption. The adoption of measures can be broken down into calculation of the "equilibrium" market share and calculation of the dynamic approach to equilibrium market share.

The effects or program intervention result in applying ramp rates to the maximum achievable potential to model the changes in time-dependent barriers to market adoption. These ramp rates spread each measure's maximum achievable potential over the study horizon, accounting for assumptions about the timing of when this potential will be realized.

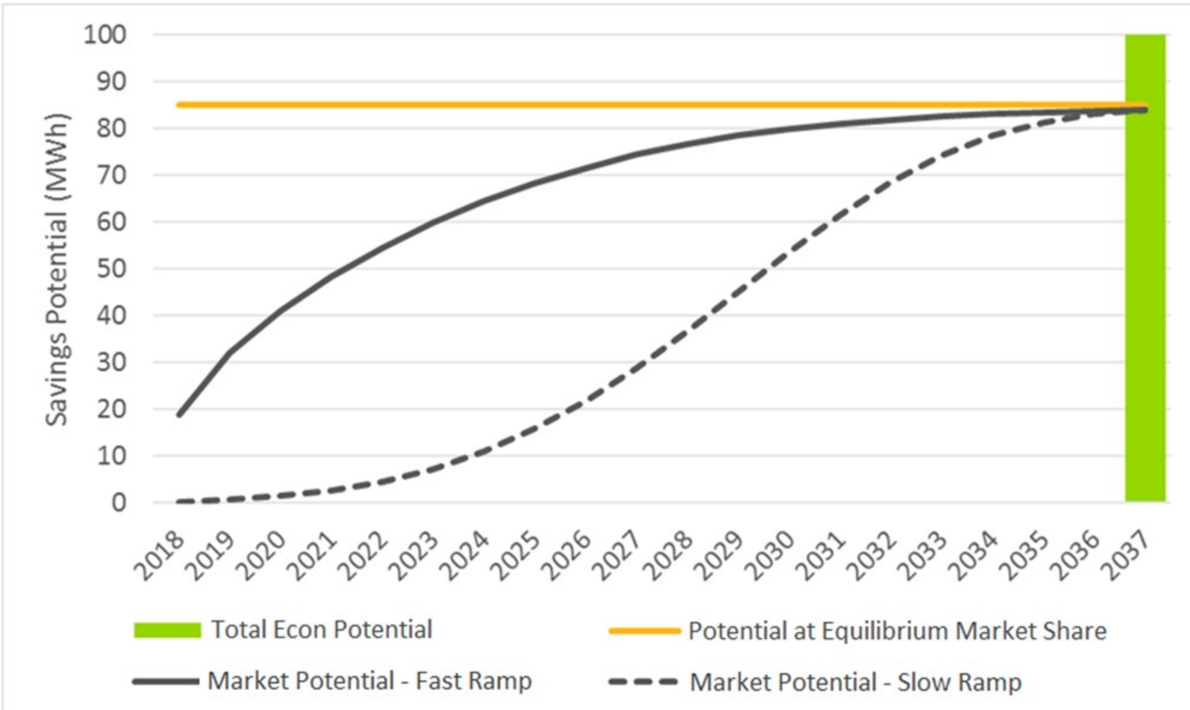
Using the definitions of cumulative total technical potential provided in Section 2.1.4.1, Equation 2-5 provides the formula to calculate achievable potential. As shown, Navigant calculated achievable potential by multiplying each measure's total economic potential by its maximum achievability factor and then applying a ramp rate for the adoption to the resulting maximum achievable potential.

Equation 2-5. Achievable Potential

$$Achievable\ Potential_{Year} = Total\ Economic\ Potential \times Max\ Achievability\ Factor \times Ramp\ Rate_{Year}$$

Figure 2-12 illustrates the relationship between total economic potential, maximum achievable potential, and final computed achievable potential in each year of the study as a function of ramp rate choice. The timing of achievable potential across the study horizon is driven by the choice of ramp rate. All values in the figure are for illustration purposes only.

Figure 2-12. Illustration of Achievable Potential Calculation



Source: Navigant

For measures involved in competition groups, an additional computational step is required to compute achievable potential to ensure no double counting of savings. While the technical and economic potential for a competition group reflects only the measure in that group with the greatest savings potential, all measures in a competition group may be allocated achievable potential based on their attractiveness (relative to one another).

Navigant allocated the economic potential proportionally across the various competing measures within the group based on their relative customer economics (payback). The team computed the relative customer economics ratio to reflect all costs and savings a customer would experience as a result of implementing the measure. The team multiplied the resulting market share splits by the maximum achievable potential for the group to get the achievable potential for each individual measure. This methodology ensured that final estimates of achievable potential reflected the relative economic attractiveness of measures in a competition group and that the sum of achievable potential from all measures in a competition group reflected the maximum achievable potential of the whole group.

2.2 Demand Response

Navigant prepared a DR potential assessment for ENO's electric service area from 2018 to 2037 as part of the DSM potential study. The objective of this assessment was to estimate the potential for using DR to reduce customer loads during peak summer periods.

Navigant identified and analyzed a suite of DR options for potential implementation in ENO's service area based on similar studies performed in other jurisdictions. These are:

1. **Direct load control (DLC):** This program controls water heating and cooling loads for residential and small business customers using either a DLC device (switch) or a PCT.
2. **C&I curtailment:** This program curtails a fixed amount of load reduction among C&I customers over a fixed contract period.
3. **Dynamic pricing:** This program encourages load reduction through CPP, with a 6:1 critical peak to off-peak price ratio. All customer types are eligible to participate.
4. **Behind-the-meter storage (BTMS):** This program triggers power dispatch from battery storage systems that are grid-connected during peak load conditions.

Navigant developed achievable potential estimates for each of these DR options at various levels of disaggregation, along with the costs associated with rolling out and implementing a DR program portfolio. The assessment considered both conventional and advanced control methods to curtail load at customer premises. Navigant also assessed the cost-effectiveness of the DR program options and measure types.

2.2.1 General Approach and Methodology

Navigant developed ENO's DR potential and cost estimates using a bottom-up analysis. The analysis used primary data from ENO and relevant secondary sources. The team configured its DRSim model, which uses this data as inputs, for this study. The following subsections detail Navigant's DR potential and cost estimation methodology:

- **Market Characterization:** Segment ENO's customer base into customer classes eligible to participate in DR programs.
- **Develop Baseline Projections:** Develop baseline projections for customer count and peak demand over the 20-year forecast period.
- **Characterize DR Options:** Define DR program options and map them to applicable customer classes.
- **Develop Model Inputs for Potential and Cost Estimates:** Develop participation, load reduction, and cost assumptions that feed the DRSim model.
- **Case Analysis:** Estimate DR potential and associated implementation costs for low and high cases relative to the base (medium) case.

2.2.2 Market Characterization for DR Potential Assessment

Market characterization was the first step in the DR potential assessment process. Table 2-14 presents the different levels of market segmentation for the DR potential assessment. It is based on Navigant's examination of ENO's rate schedules and the customer segments established in the energy efficiency potential study. The team finalized the market segmentation for the DR potential assessment in consultation with ENO.

The methodology Navigant used to segment the market at these levels is briefly described below. Government customers are included as part of the C&I sector. Savings potential analysis from street lighting is not included in this study.

Table 2-14. Market Segmentation for DR Potential Assessment

Level	Description
Level 1: Sector	• Residential • C&I
Level 2: Customer Class	• Residential • C&I customers by size based on maximum demand values: o Small C&I: <= 100 kW maximum demand o Large C&I: >100 kW maximum demand
Level 3: Customer Segment	• Residential • C&I customer segments[24] o Colleges/Universities o Healthcare o Industrial/Warehouse o Lodging o Office – Large o Office – Small o Other o Restaurants o Retail – Food o Retail – Non-Food o Schools

Source: Navigant

Navigant first segmented customers into residential and C&I. The team combined single family and multifamily customers into a single residential category because DR program and pricing offers are typically not distinguished by dwelling type. Next, Navigant

[24] Descriptions of these customer segments can be found in Table 2-3.

segmented C&I customers into two size categories (small and large) and further segmented them into customer segments. To do this, the team requested 2016 account-level maximum billed demand data from ENO. As mentioned in Section 2.1.1, 2016 was chosen as the base year for this analysis because it was the most recent year with a fully complete and verified dataset. Navigant mapped the SIC codes associated with these accounts to customer segments in the analysis, similar to the approach used by the energy efficiency potential study team in its market characterization effort. Then, the team calculated the split of customers between the small and large size categories by customer segment using a cutoff value of 100 kW.[25] This cutoff value was determined in consultation with ENO and is aligned to ENO's energy efficiency programs when there is a specific offer to the small C&I market segment. These splits were then used to develop a customer count and sales forecast by customer class and segment for the DR study. This segmentation is necessary because DR program offerings typically vary by customer size.

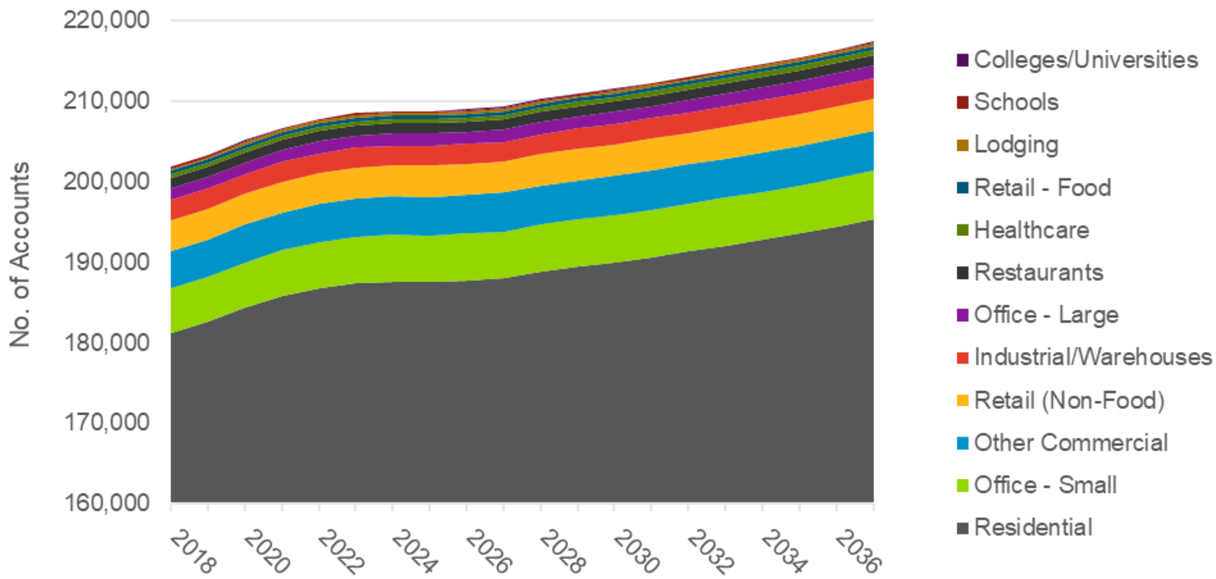
2.2.3 Baseline Projections

2.2.3.1 Customer Count Projections

Navigant applied year-over-year change in the stock forecast (described in Appendix A.2 and B.3) to the 2016 customer count data segmented by customer class and customer segment to produce a customer count forecast for the DR potential study. The team then trued up this forecast to the sector-level customer count forecast provided by ENO. Figure 2-13 shows the aggregate customer count forecast by segment only, summed across all customer classes.

[25] Since specific NAICS codes map to small and large offices, Navigant did not use the 100 kW cutoff to segment office customers into the small and large categories. The small versus large distinction for offices is solely based on the NAICS code mapping.

Figure 2-13. Customer Count Projections for DR Potential Assessment



Source: Navigant

2.2.3.2 Peak Demand Projections

Navigant worked with ENO to define the peak period for the DR potential assessment. The baseline peak demand forecast used the defined peak period; reduction estimates are applied to the peak period to estimate DR potential. ENO expressed a desire to align the peak period definition with times MISO is expected to see peak demand. This is so ENO can leverage the findings of the DR potential assessment should it seek to register any DR resources as load modifying resources with MISO. Per MISO's business practice manual, *"…the expected peak occurs during the summer (June through September) during the hours from 2:00 pm through 6:00 pm*." [26] Navigant added two additional constraints to this definition. First, the team only included weekdays in the peak period definition because it is not typical for utilities to call DR events on weekends. Second, Navigant only included the top 40 weekday hours within this window to better capture demand levels during a DR event. The team chose this threshold by studying ENO's historic 8,760 system load data and found that the top 25 and 35 hours in this window were within 5% of their maximum peak demand in 2014 and 2015, respectively, which is a typical margin for when DR events typically occur. Navigant selected the top 40 hours to stay conservative and refined the peak definition to include just those hours.

Once the peak period was defined, Navigant developed a disaggregated bottom-up peak demand forecast by customer class and segment. The team also estimated the

[26] MISO. *Business Practice Manual*. Demand Response. Effective date: June 1, 2016. pg 15.

end-use breakdown of the peak demand for C&I customers, as reduction estimates are typically expressed as a percentage of baseline load for these customers. The step-by-step methodology Navigant used to develop the baseline peak load projections is summarized as follows:

1. **Disaggregate sales forecast by customer class and customer segment:** Navigant first projected the base year (2016) sales data, segmented by customer class and customer segment, over the study horizon using the year-over-year change in building stock. The team then trued up the customer segment-level totals in this forecast to the sector-level totals in the forecast sent by ENO.[27]
2. **Develop 8,760 load shapes by customer segment:** The team used ENERGYPlus to develop hourly load shapes for ENO's service area to transform annual potential estimates into an 8,760 format (see Appendix C for description of load shape development).
3. **Calculate peak load factors:** Navigant calculated the average peak load factor over the hours that fell under the peak period definition for each customer class and customer segment combination. Per the industry-standard definition, peak load factor is defined as follows:

$$Peak\ Load\ Factor = \frac{Annual\ Sales}{Annual\ Peak\ Demand * 8{,}760}$$

Table 2-15 provides the calculated peak load factors by segment.

Table 2-15. Peak Load Factors by Customer Segment Type

Customer Segment	Peak Load Factor
Lodging	0.86
Healthcare	0.83
Schools	0.74
Colleges/Universities	0.70
Other	0.69
Retail – Food	0.66
Restaurants	0.62
Office – Small	0.59

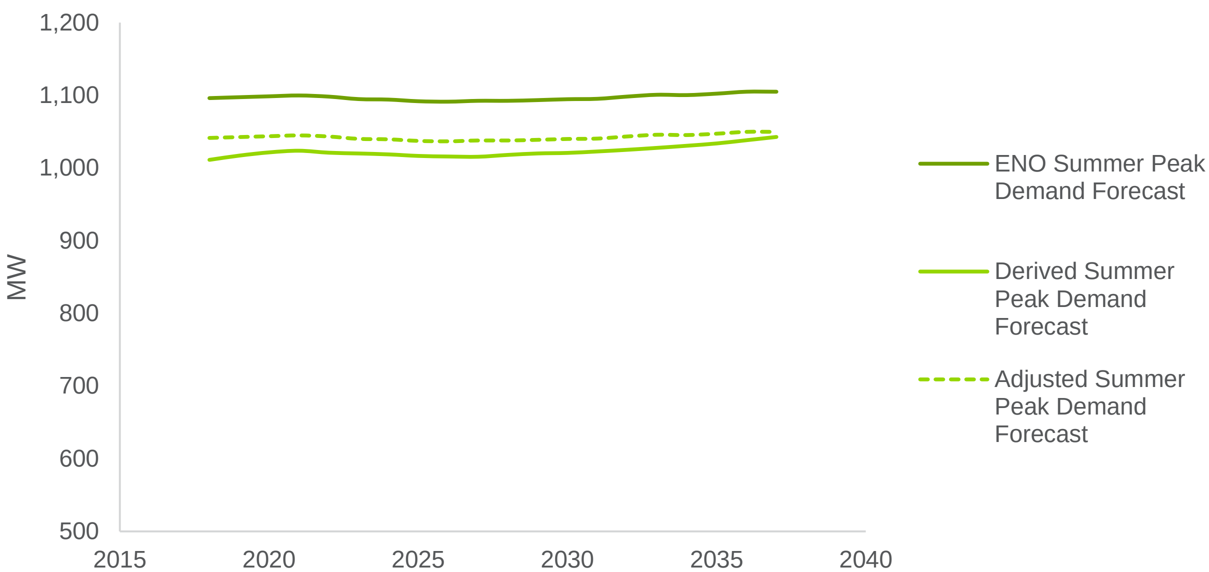
[27] Navigant did not directly use the account-level data provided by ENO to segment and roll up customer count and sales by customer class and customer segment. This is because the totals from this dataset did not match the totals from the SIC code-level data the energy efficiency potential study team received from ENO.

Customer Segment	Peak Load Factor
Retail – Non-Food	0.59
Office – Large	0.58
Industrial/Warehouses	0.55
Residential	0.68

Source: Navigant

4. **Disaggregate peak load forecast by customer class, customer segment, and end use (for C&I customers only):** Navigant applied the peak load factors derived in the previous step to the sales forecast developed in the first step. The team also used the 8,760 normalized load shapes to estimate the breakdown of peak load by end use for C&I customers (load reduction estimates associated with DR programs for these customers are typically available as a percentage of end-use load).
5. **Calibrate peak load forecast:** Navigant trued up the annual totals in the disaggregated derived peak demand forecast to 95% of ENO's BP18U peak forecast.[28]

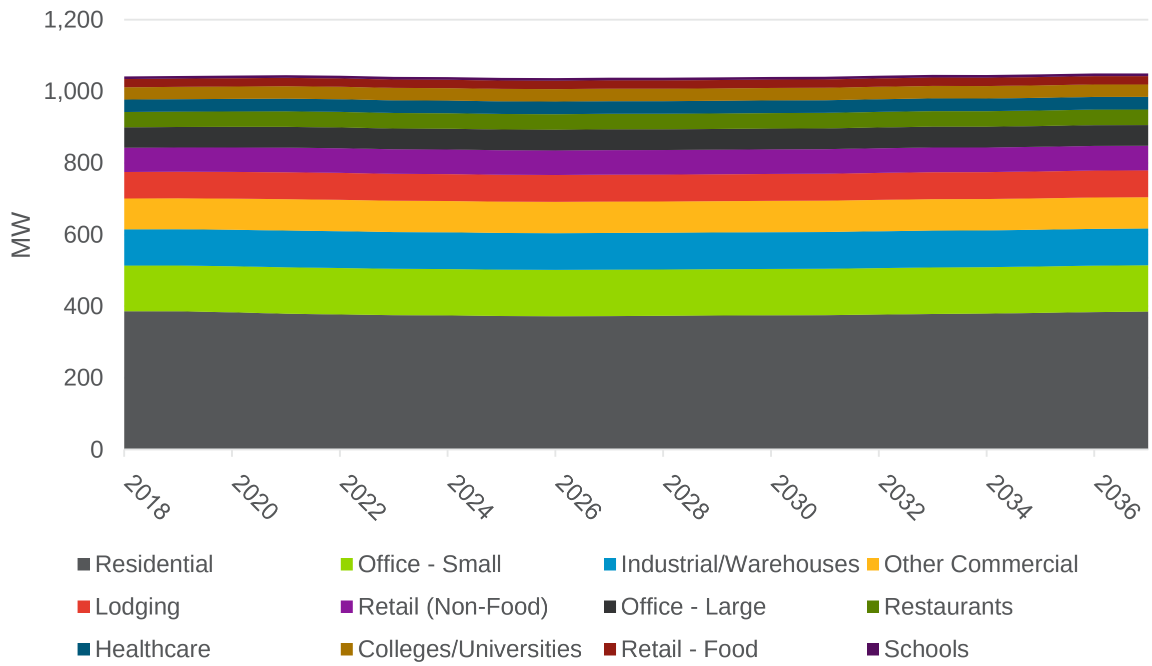
Figure 2-14. Peak Demand Forecast Comparisons



Source: Navigant

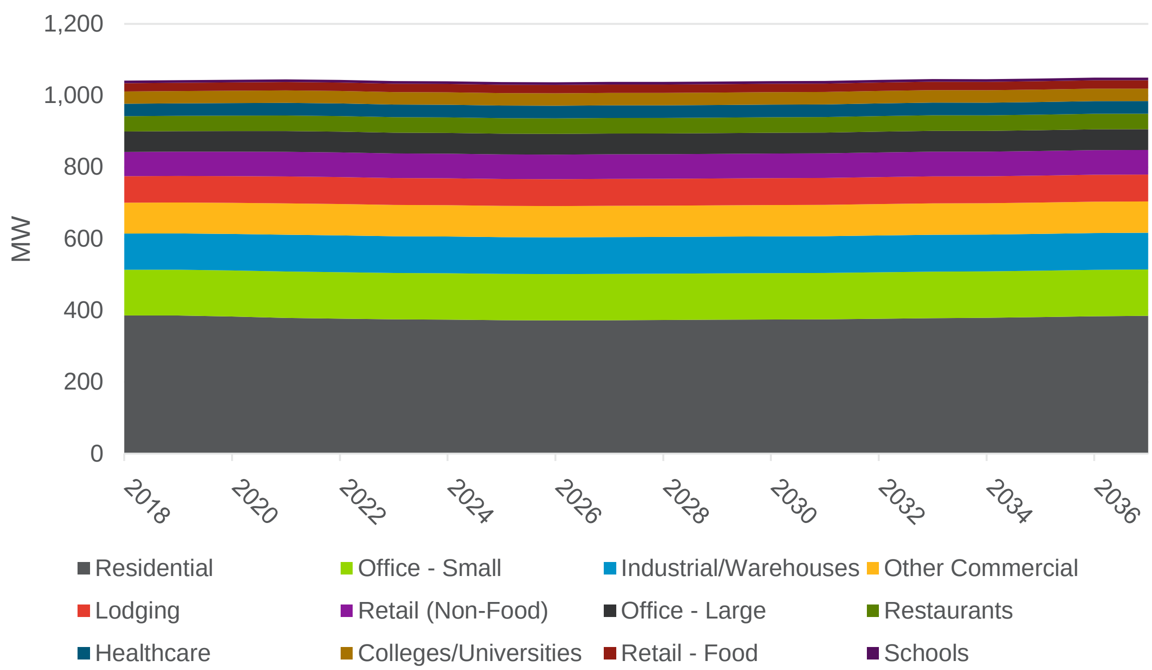
[28] This calibration target was chosen because utilities typically aim to reduce load within 5% of their annual system peak through DR events.

Figure 2-15. Peak Load Forecast by Customer Segment (MW)



Source: Navigant

Figure 2-16. Peak Load Forecast by End Use for C&I customers (MW)



Source: Navigant

2.2.4 Descriptions of DR Options

Once the baseline peak demand projections have been developed, the next step was to characterize the different types of DR options that could be used to curtail peak demand. Table 2-16 summarizes the DR options included in the analysis. Most of these DR options are representative of programs commonly deployed in the industry. These programs also align with Council's IRP rules, which state that DR programs should include those *"…enabled by the deployment of Advanced Meter Infrastructure, including both direct load control and DR pricing programs for both Residential and Commercial customer class".* The different types of DR options are described in detail below.

Table 2-16. Summary of DR Options

DR Option	Characteristics	Eligible Customer Classes	Targeted/ Controllable End Uses and/or Technologies
DLC ✓ Load control switch ✓ Thermostat	Control of water heating/cooling load using either a load control switch or PCT	Residential Small C&I	Cooling, water heating
C&I Curtailment ✓ Manual ✓ Auto-DR enabled	Firm capacity reduction commitment $/kW payment based on contracted capacity plus $/kWh payment based on energy reduction during an event	Large C&I	Various load types including HVAC, lighting, refrigeration, and industrial process loads
Dynamic Pricing[29] ✓ Without enabling technology ✓ With enabling technology	Voluntary opt-in dynamic pricing offer, such as CPP	All customer classes	All
BTMS ✓ Standalone battery storage	Power dispatch from battery storage systems installed by customers during peak load conditions	Small C&I Large C&I [30]	Batteries

[29] Navigant did not include time-of-use (TOU) rates in the DR options mix because this study only includes event-based dispatchable DR options. TOU rates lead to a permanent reduction in the baseline load and are not considered a DR option.

[30] Residential customers are not expected to significantly adopt standalone battery storage systems because ENO does not have any residential demand charge.

Source: Navigant

Each DR option was segmented into several DR sub-options, each of which was tied to a specific end use and/or control strategy. Table 2-17 summarizes this segmentation. The different types of DR options are described in detail below.

Table 2-17. Segmentation of DR Options into DR Sub-Options

DR Option	DR Sub-Option	Eligible Customer Classes
DLC	Switch-Water Heating	Residential Small C&I
	Thermostat-Heat Pump	Residential
	Thermostat-Central Air Conditioning	Residential
	Switch-Heat Pump	Residential
	Switch-Central Air Conditioning	Residential
	Thermostat-HVAC	Small C&I
	Switch-HVAC	Small C&I
C&I Curtailment	Curtailment-Manual HVAC Control	Large C&I
	Curtailment-Auto-DR HVAC Control	
	Curtailment-Standard Lighting Control	
	Curtailment-Advanced Lighting Control	
	Curtailment-Water Heating Control	
	Curtailment-Refrigeration Control	
	Curtailment-Compressed Air	
	Curtailment-Fans/Ventilation	
	Curtailment-Industrial Process	
	Curtailment-Pumps	
	Curtailment-Other	
Dynamic Pricing	Dynamic pricing with enabling tech	Residential Small C&I Large C&I
	Dynamic pricing without enabling tech	
BTMS	BTMS-Battery Storage	Small C&I Large C&I

2.2.4.1 Direct Load Control

DLC involves ENO directly controlling electric water heating and cooling load using a load control switch and cooling load using a PCT. There are two types of delivery models for DLC: DI and BYOT. In the DI approach, ENO would be responsible for installing the thermostat at the customer premises and bear part or all of the costs of thermostat purchase and installation and DR enablement. In the BYOT approach, the customer purchases and installs their own thermostat and is subsequently enrolled in the DR program. Therefore, the purchase and installation costs of the thermostat are borne by the customer, which would consequently lower ENO's costs. This study considers only a DI approach for switch-based control and a BYOT approach for thermostat-based control. Table 2-18 summarizes the DLC program characteristics considered in this study.

Table 2-18. DLC Program Characteristics

Item	Description
Program Name	Direct Load Control (DLC)
Program Description	This program controls electric water heating and cooling (including central air conditioning and heat pumps) loads for residential and small/medium business customers using either a DLC device (switch) or a PCT, where and when applicable. Water heating and cooling loads are cycled/turned off during the event period using a load control switch. For thermostat-based cooling load control, unit impact estimates are based on a 2°F-3°F temperature setback strategy using a smart thermostat.
Purpose/Trigger	DLC events will be called primarily to meet capacity shortfalls during summer, triggered primarily by a high day-ahead temperature forecast.
Key Program Design Parameters	• Events will be called during peak demand periods in summer. • Participants will not have any advance notification for DR events. However, they can choose to opt out of an event at any time during the event. • Average event duration is 4 hours. No more than one event is called in a day. Calling events for more than 2 consecutive days may lead to customer dissatisfaction and disenrollment.
Participation Eligibility	Residential and small C&I customers with HVAC and electric water heaters.

Item	Description
Dependent Technology and Metering	**Technology:** Switches control water heating, central air conditioning, or heat pumps. PCT temperature adjustment controls central air conditioning or heat pumps. **Metering:** Standard meter (no interval meter required). The program can use data loggers on a sample of participants to record interval usage for measurement and verification.

Source: Navigant

2.2.4.2 C&I Curtailment

The C&I curtailment program as represented in this study is the most commonly deployed program for large C&I customers in the industry. It involves a contract for a firm capacity reduction commitment from large C&I customers. Under this option, utilities typically enter into a turnkey implementation contract with a third-party DR service provider (commonly referred to as an aggregator) to deliver a certain fixed amount of megawatt (MW) load reduction.[31] Enrolled participants agree to curtail their demand to a pre-specified level. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (expressed as $/kW-year). Customers are paid to be on-call even though actual load curtailments may not occur. The capacity payment level could vary with the load commitment level. In addition to the fixed capacity payment, participants typically receive a payment for energy reduction ($/kWh amount). Because it is a contractual arrangement for a specific level of load reduction, enrolled loads represent a firm resource. Once enrolled, participation during events is mandatory and there are penalty clauses. A specific site could curtail a variety of end-use loads depending on the types of business processes, either manually or automatically (Auto-DR-enabled). Auto-DR enablement can help provide greater reliability and higher predictability in load reductions. Table 2-19 describes the C&I curtailment program characteristics considered in this study.

[31] With the aggregator model, the service provider can aggregate multiple small customers to deliver capacity reduction.

Table 2-19. C&I Curtailment Program Characteristics

Item	Description
Program Name	C&I Curtailment
Program Description	Typically, this type of program is administered by a third-party DR service provider. This is usually a turnkey contract, in which the vendor is responsible for a fixed amount of load reduction over the contract period. The common approach is for the utility to pay a predetermined capacity payment ($/kW-yr.) based either on the nominated load reduction (if no event is called) or actual load reduction (if an event is called) to the third party administering the program. In addition, the utility would pay the vendor for actual energy reduced during an event based on a specified $/kWh level in the contract. Participating sites enrolled in the program curtail a variety of end uses (e.g., HVAC, water heating, lighting, refrigeration, process loads), depending on the business type. Load curtailment can be manual and/or Auto-DR[32]-enabled. Participants may also shift load to backup generators during the DR event period.
Purpose/Trigger	DR events are likely to be called to help meet summer capacity shortfalls.
Key Program Design Parameters	• Events will be called during summer peak demand periods. • Event notification is typically day-ahead and/or 1-2 hours ahead. • Average event duration is 4 hours. No more than one event is called in a day. Calling events for more than 2 consecutive days may lead to customer dissatisfaction and disenrollment. • Annual maximum event hours set at 80-100 hours.
Participation Eligibility	All Large C&I customers.

[32] Under Auto-DR, customer loads will be curtailed automatically via a building EMS in response to a signal from ENO. Auto-DR is a platform to automatically activate a preprogrammed load reduction strategy in response to a signal from a DR automation server (DRAS). Load is curtailed by the customer's building management after being triggered by a signal sent from ENO's control room to the vendor's operations center and on to the customer's facility. The customer always retains the ability to override the curtailment sequence in the event a site cannot participate in a specific DR dispatch. Auto-DR ensures higher reliability of response than manual curtailment.

Item	Description
Dependent Technology and Metering	**Dependent technology:** Manual DR requires a communication channel between the vendor and the customers, which might include text, email, or telephone. Auto-DR requires a building automation system, a load control device, or breakers on specific circuits. All control mechanisms must be able to receive an electronic signal from the program administrator and initiate the curtailment procedure without manual intervention. Auto-DR dispatches are called using an open communication protocol known as Open-ADR. For Auto-DR customers, the vendor installs an Open-ADR-compliant gateway at the participating site, which is then able to notify the EMS or other control systems at the facility to run their preprogramed curtailment scripts. The vendor monitors energy reduction in real time and provides visual access to this demand data to the participant through a web-based software platform. This platform may be integrated for overall energy optimization, which may help realize energy efficiency benefits along with DR benefits. **Metering:** Interval meters.

Source: Navigant

2.2.4.3 Dynamic Pricing

Dynamic pricing refers to a CPP rate offer across all customer classes. This is the most commonly deployed dynamic rate in the industry. Customers who opt to participate in the program are placed on a CPP rate with a significantly higher rate during certain critical peak periods in the year and a lower off-peak rate than the standard offer rate. Customers enrolled in the CPP rate pay the higher critical peak rate for electricity consumption during the critical peak periods, which incentivizes them to reduce consumption during those periods. Customers enrolled in the CPP rate receive either day-of or day-ahead notification of the critical peak period.

The unit impacts or per-customer load reductions depend on the critical peak to off-peak price ratio. This study assumes a 6:1 critical peak to off-peak price ratio. Industry experience suggests that enabling technology such as smart thermostats and Auto-DR can substantially enhance load reductions when customers on CPP rates are equipped with these technologies. CPP can be offered either as an opt-in rate or as a default rate with opt out. This study assumes an opt-in offer type for CPP.

The CPP offer requires AMI meters for settlement purposes. Hence, the rate offer is tied to AMI deployment. Per discussions with ENO, the utility's current plan is to fully deploy AMI by 2020. Table 2-20 describes the dynamic pricing program characteristics considered in this study.

Table 2-20. Dynamic Pricing Program Characteristics

Item	Description
Program Name	Dynamic Pricing

Program Description	Opt-in CPP offer to all customers with a 6:1 critical peak to off-peak price ratio.
Purpose/Trigger	Events are called to help meet summer capacity shortfalls.
Key Program Design Parameters	• Events will be called during summer peak demand periods. • Event notification is typically day-ahead and/or 1-2 hours ahead. • Average event duration assumed to be 4 hours. No more than one event is called in a day. Calling events for more than 2 consecutive days may lead to customer dissatisfaction and disenrollment. • Annual maximum event hours set at 80-100 hours.
Participation Eligibility	All customers.
Dependent Technology and Metering	All customers need smart meters for settlement purposes.

Source: Navigant

2.2.4.4 Behind-the-Meter Storage

BTMS refers to customers using their battery systems to discharge power to the grid during peak load conditions. Backup generators were not considered for this program in this study because ENO does not have data on the number or capacity of non-grid interconnected backup generators at customer sites in its service area. Navigant assumed the market adoption and size for battery storage systems using internal analysis. Therefore, BTMS only considers power dispatch from battery storage systems in this study. It is expected that customers would either charge their batteries during off-peak hours with grid power or by using solar PV. Table 2-21 describes the BTMS program characteristics considered in this study.

Table 2-21. BTMS Program Characteristics

Item	Description
Program Name	Behind-the-Meter Storage (BTMS)
Program Description	Customers install battery storage systems that are interconnected with the grid. When there are peak load conditions, the utility sends signals to the battery system, which would trigger power dispatch to the grid.
Purpose/Trigger	Events are called to help meet summer capacity shortfalls.
Key Program Design Parameters	• Events will be called during summer peak demand periods. • Average event duration assumed to be 4 hours. • Event notification is typically day-ahead and/or 1-2 hours ahead. • Annual maximum event hours set at 80-100 hours.
Participation Eligibility	Large C&I customers such as manufacturing or big box retail with battery storage systems. Grid dispatch from batteries could also include new technologies targeted at smaller commercial customers or even residential.

Dependent Technology and Metering	All customers need PV-tied or standalone batteries with grid interconnection.

Source: Navigant

2.2.5 Key Assumptions for DR Potential and Cost Estimation

There are two key variables that feed the DR potential calculation in this study:

- Customer participation rates
- Amount of load reduction that could be realized from different types of control mechanisms, referred to as unit impacts

Secondary variables that feed the DR potential calculation include participation opt-out rates, technology market penetration, and enrollment attrition rates.

Navigant calculated both the technical and achievable potential associated with implementing DR programs for this study. Technical potential refers to load reduction that results from 100% customer participation. This is a theoretical maximum. The team calculated technical potential by multiplying the eligible load/customers by the unit impact for each DR sub-option. The technical potential calculation does not account for participation overlaps between the DR sub-options. Therefore, technical potential across the various sub-options is not additive and should not be added together to obtain a total technical potential. In other words, the technical potential estimates for each DR sub-option should be considered independently. The technical potential calculation is summarized through Equation 2-6.

Equation 2-6. DR Technical Potential

$$
\begin{aligned}
&\mathit{Technical\ Potential}_{DR\ Sub\ Option, End\ Use, Year} \\
&\quad = \mathit{Eligible\ Load}_{DR\ Sub\ Option, Segment, End\ Use, Year} \\
&\quad * \mathit{Unit\ Impact}_{DR\ Sub\ Option, Segment, Year}
\end{aligned}
$$

Navigant then calculated the achievable potential by multiplying achievable participation assumptions (subject to the program participation hierarchy discussed below) by the technical potential estimates. Market potential also accounts for customers opting out during DR events. The achievable potential calculation is summarized through Equation 2-7.

Equation 2-7. DR Achievable Potential

$$
\begin{aligned}
&\mathit{Achievable\ Potential} \\
&\quad = \mathit{Technical\ Potential}_{DR\ Sub\ Option, Segment, End\ Use, Year} \\
&\quad * \mathit{Achievable\ Participation\ Rate}_{DR\ Sub\ Option, Segment, Year} \\
&\quad * (1 - \mathit{Event\ Opt\ Out\ Rate})_{DR\ Sub\ Option, Year}
\end{aligned}
$$

In addition to the potential estimates, the team developed annual and levelized costs by DR option and sub-option. Navigant subsequently assessed the cost-effectiveness of each sub-option and DR option in aggregate. Developing annual and levelized costs involves itemizing various cost components such as program development costs, equipment costs, participant marketing and recruitment costs, annual program administration costs, product lifetimes, and a discount rate. Table 2-22 summarizes the key variables Navigant used to calculate DR potential and its associated costs in this analysis. These key variables are discussed further in the following subsections.

Table 2-22. Key Variables for DR Potential and Cost Estimates

Key Variables	Description
Participation Rates	Percentage of eligible customers by program type and customer class.
Unit Impacts	• kW reduction per device for DLC • Percentage of enrolled load by end use for C&I curtailment • Percentage of total facility load for dynamic pricing • Percentage of battery load for BTMS
Costs	• One-time fixed costs related to program development • One-time variable costs for customer recruitment, program marketing, and equipment installation and enablement • Recurring fixed and variable costs such as annual program admin. costs, customer incentives, O&M, etc.
Global Parameters	Program lifetime, discount rate, inflation rate, line losses, avoided costs

Source: Navigant

2.2.5.1 Participation Assumptions and Hierarchy

The participation assumptions differ by customer class and segment. Based on standard industry practice, Navigant assumed a 5-year S-shaped ramp for the DR options. For all DR options other than dynamic pricing, program participation is assumed to begin in 2018. As previously mentioned, dynamic pricing is tied to AMI deployment and starts in 2020.

The participation assumptions are also tied to the market penetration of DR-enabling technologies such as EMSs. For example, only C&I customers with EMS are eligible for Auto-DR HVAC control. All other customers are eligible for manual HVAC control.

Navigant also accounted for participation overlaps among the different DR programs in estimating potential. Table 2-23 presents the participation hierarchy considered in this study, whereby achievable participation estimates are applied to eligible customers only. The participation hierarchy presented here is a well-tested approach, initially established in the *National Assessment of DR Potential Study* conducted by the Federal Energy Regulatory Commission (FERC)[33] and adopted in other DR potential studies. The participation hierarchy helps avoid double counting of potential through common load participation across multiple programs and is necessary to arrive at an aggregate potential estimate for the entire portfolio of DR programs.

Table 2-23. Program Hierarchy to Account for Participation Overlaps

Customer Class	DR Options	Eligible Customers
Residential	DLC - Thermostat	Customers with central air conditioning or heat pumps controlled by thermostats
	DLC - Switch	Customers with central air conditioning or heat pumps that are not enrolled in DLC – Thermostat; customers with water heating load
	Dynamic Pricing	Customers not enrolled in DLC
Small C&I	BTMS	Customers with batteries
	DLC - Thermostat	Customers with HVAC controlled by thermostats
	DLC - Switch	Customers with HVAC that are not enrolled in DLC – Thermostat; customers with water heating load
	Dynamic Pricing	Customers not enrolled in DLC
Large C&I	BTMS	Customers with batteries
	C&I Curtailment	Customers with batteries not enrolled in BTMS; customers without batteries
	Dynamic Pricing	Customers with batteries not enrolled in BTMS or C&I curtailment; customers without batteries not enrolled in C&I curtailment

Source: Navigant

2.2.5.2 Unit Impact Assumptions

The unit impacts specify the amount of load that could be reduced during a DR event by customers enrolled in a DR program. Unit impacts differ by sub-option because they are tied to specific end uses and control strategies. For example, the load reductions associated with manual HVAC control and Auto-DR HVAC control are different and are specified accordingly. Unit impacts can be specified either directly as kW reduction per

[33] https://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdfelow

participant or as percentage of enrolled load: [34]

- DLC sub-options use kW reduction per participant for residential and percentage of the end-use load for small C&I
- C&I curtailment sub-options use percentage of the end-use load
- Dynamic pricing uses a percentage of the total facility load
- BTMS uses a percentage of the battery load

This study leveraged ENO's DLC pilot program accomplishments and the latest available secondary sources of information for other programs for the unit impact assumptions.

2.2.5.3 Cost Assumptions

Navigant developed itemized cost assumptions for each DR option to calculate annual program costs and levelized costs for each option. These assumptions also feed the cost-effectiveness calculations in this study.

The cost assumptions fall into the following broad categories:

- **One-time fixed costs**, specified in terms of $/DR option, including the program startup costs—for example, the software and IT infrastructure-related costs and associated labor time/costs (in terms of full time equivalents (FTEs)) incurred to set up the program.
- **One-time variable costs**, which include marketing/recruitment costs for new participants, metering costs, and all other costs associated with control and communications technologies that enable load reduction at participating sites. The enabling technology cost is specified either in terms of $/new participant on a per-site basis or as $/kW of enabled load reduction on a participating load basis.
- **Annual fixed costs,** specified in terms of $/yr, which primarily includes FTE costs for annual program administration.
- **Annual variable costs,** which primarily includes customer incentives, specified either as a fixed monthly/annual incentive amount per participant ($/participant) or in terms of load and/or energy reduction ($/kW and $/kWh reduction) depending on the program type. It also includes additional O&M costs that may be associated with servicing technology installed at customer premises.
- **Program delivery costs,** which is a fixed contracted payment for third-party delivery of DR programs and is specified as $/kW-yr.

[34] The unit impact values assume a 4-hour event duration, and the values represent the average load reduction over the 4-hour event duration.

In addition to these itemized program costs, the following variables feed the cost-effectiveness calculations in this study.

- **Nominal discount rate** of 7.72% used for net present value (NPV) calculations.
- **Inflation rate** of 2% used to inflate the costs over the forecast period (2018-2037).
- **Transmission and distribution (T&D) line loss** of about 2% for industrial/warehouse customers and 5% for all other customers; line loss is used to bring the potential at the customer meter up to the generator for the cost-effectiveness assessment.
- **Program life**, assumed to be 10 years for DLC, C&I curtailment, and BTMS and 20 years for dynamic pricing.
- **Derating factor,** used to derate the benefits from DR to bring it to par with generation. The derating factor is used to derate the benefits from DR to account for program design constraints, such as limitations on how often events can be called, annual maximum hours for which events can be called, window of hours during the day during which events can be called, and sometimes even the number of days in a row that events may be called. The derating factor lowers the benefits from DR so that a megawatt from DR is not considered the same as a megawatt from a generator, which does not have similar availability constraints and could be available round the clock.[35]

To assess the benefits associated with DR programs, Navigant used the avoided generation capacity projections provided by ENO. Navigant calculated benefit-cost ratios for the TRC, program administrator cost (PAC), ratepayer impact measure (RIM), and participant cost tests (PCT) for this study, consistent with the Council's IRP rules.

[35] "Valuing Demand Response: International Best Practices, Case Studies, and Applications." Prepared by the Brattle Group. January 2015. Page 10 of this report explains why the derating factor is important, though its inclusion varies across utilities and jurisdictions: http://files.brattle.com/files/5766_valuing_demand_response_-_international_best_practices__case_studies__and_applications.pdf

3. Energy Efficiency Achievable Potential Forecast

This section provides the results of the energy efficiency achievable potential analysis.

3.1 Model Calibration

Calibrating a predictive model imposes unique challenges, as future data is not available to compare against model predictions. While engineering models, for example, can often be calibrated to a high degree of accuracy because simulated performance can be compared directly with performance of actual hardware, predictive models do not have this luxury. Therefore, DSM models must rely on other techniques to provide both the developer and the recipient with a level of comfort that simulated results are reasonable. For this project, Navigant took several steps to ensure that the forecast model results are reasonable and consider historic adoption:

- Comparing forecast values by sector and end use, typically against historic achieved savings (e.g., program savings from 2016) and planned savings for Energy Smart PY8. Although some studies indicate that DSM potential models are calibrated to ensure first-year simulated savings precisely equal prior-year reported savings, Navigant notes that forcing such precise agreement has the potential to introduce errors into the modeling process by effectively masking the explanation for differences—particularly when the measures included may vary significantly. Additionally, there may be sound reasons for first-year simulated savings to differ from prior-year reported savings (e.g., a program is rapidly ramping up or savings estimates have changed). Thus, while the team endeavored to achieve agreement to a degree believed to be reasonable between past results and forecast first-year results, the team’s approach did not force the model to do so, providing what the team believes is a degree of confidence that the model is internally consistent.
- Identifying and ensuring an explanation existed for significant discrepancies between forecast savings and prior-year savings, recognizing that some ramp up is expected, especially for new measures or archetype programs.
- Calculating $/first-year kWh costs and comparing them with past results.
- Calculating the split (percentage) in spending between incentives and variable administrative costs predicted by the model to historic values.
- Calculating total spending and comparing the resulting values to historical spending.

3.1.1 Achievable Potential Case Studies and Incentive Levels

A key component of any potential study is determining the appropriate level at which to set measure incentives for each case.

For ENO, the incentive-level strategy characterized is the ***percent of incremental cost approach.*** This approach calculates measure-level incentives based on a specified percentage of incremental measure costs. For example, if the specified incentive percentage was 50% and a measure's incremental cost was $100, then the calculated incentive for that measure would be $50.

3.1.2 Achievable Cases Analysis

Navigant ran multiple cases for achievable potential. These approaches are described briefly below.

3.1.2.1 2018 Savings Target Cases

Navigant reviewed historic ENO data from PY4 through PY6 and found an average annual savings of approximately 20 GWh. However, ENO's target in Energy Smart Program Year 8 (2018), which coincides with the first year of the potential analysis, is 46 GWh. The 2018 target is significantly higher than the historic average given the CNO's direction to implement programs that would seek to achieve the Council's goal of 0.2% annual and 2% overall energy savings. Therefore, Navigant targeted a savings value of 46 GWh for the base case and a $/kWh value of 0.27, which represents both the planned and historic average of portfolio cost. The base case used an incentive level of 50% of incremental cost to align with ENO's assessed value as currently implemented.

Navigant analyzed two additional cases that used the same inputs as the base case except for incentive values at 25% and 75% of incremental cost, respectively.

3.1.2.2 Council's 2% DSM Goal Case

In this case, Navigant started with incentives at 50% of the incremental cost in 2018 and then ramped up to 100% in 2024. When using the TRC test as the measure screen, incentive levels do not affect cost-effectiveness because incentives are treated as a pass through in the TRC test. Thus, setting incentives at 100% of incremental cost results in the highest forecast savings levels (effectively a zero-payback time) but also comes with a high level of investment forecasts.

Navigant also changed the adoption parameters for the 2% case, including a ramp up of the marketing factor through 2021. Additionally, Navigant ramped down the TRC ratio threshold from a value of 1.0 in 2018 to 0.87 in 2022 and remaining years. This change in TRC ratio allowed more measures to pass through to achievable potential modeling.

3.2 Energy Efficiency Achievable Potential Results

Values shown for achievable potential are termed *annual incremental potential*— they represent the incremental new potential available in each year. The total cumulative potential over the time period is the sum of each year's annual incremental achievable potential. Economic potential can be thought of as a reservoir of cost-effective potential[36] from which programs can draw over time. Achievable potential represents the draining of that reservoir, the rate of which is governed by several factors including the lifetime of measures (for ROB technologies), market effectiveness, incentive levels, and customer willingness to adopt, among others. If the cumulative achievable potential ultimately reaches the economic potential, it would signify that all economic potential in the reservoir had been drawn down or harvested. However, achievable potential levels rarely reach the full economic potential level due to a variety of market and customer constraints that inhibit full economic adoption.[37]

All tables and figures (except for Section 3.2.1) have the potential savings for the base case only.

3.2.1 Case-Level Results

As explained in Section 2.1.4.3, the achievable potential analysis was modeled with four different case studies. The case studies are based on the incremental measure cost:

- **Base case:** Reflects current program spend targets with incentives at 50% of incremental measure cost
- **Low case:** Uses the same inputs as the base case except incentives are at 25% of incremental measure cost
- **High case:** Uses the same inputs as the base case except incentives are at 75% of incremental measure cost
- **2% case:** Achieve 2% for at least 1 year during the forecast period with a 0.2% ramp year over year starting in the first modeled year (2018)

Table 3-1 shows the incremental energy and demand savings per year for each case. Figure 3-1 and Figure 3-2 show the cumulative annual energy and demand savings for each case.

[36] Cost-effectiveness threshold is a TRC = 1.0. Because the New Orleans TRM does not include gas or water savings in the benefit calculations, they were not calculated in this study. However, there were measures that were passed through with a TRC ratio <1.0 where it was reasonable to assume that the inclusion of gas or water savings would have enabled the measure to reach the 1.0 TRC threshold. These measures include: commercial clothes washer, commercial low flow showerheads, high efficiency windows, home energy report, and residential thermostatic shower valve.

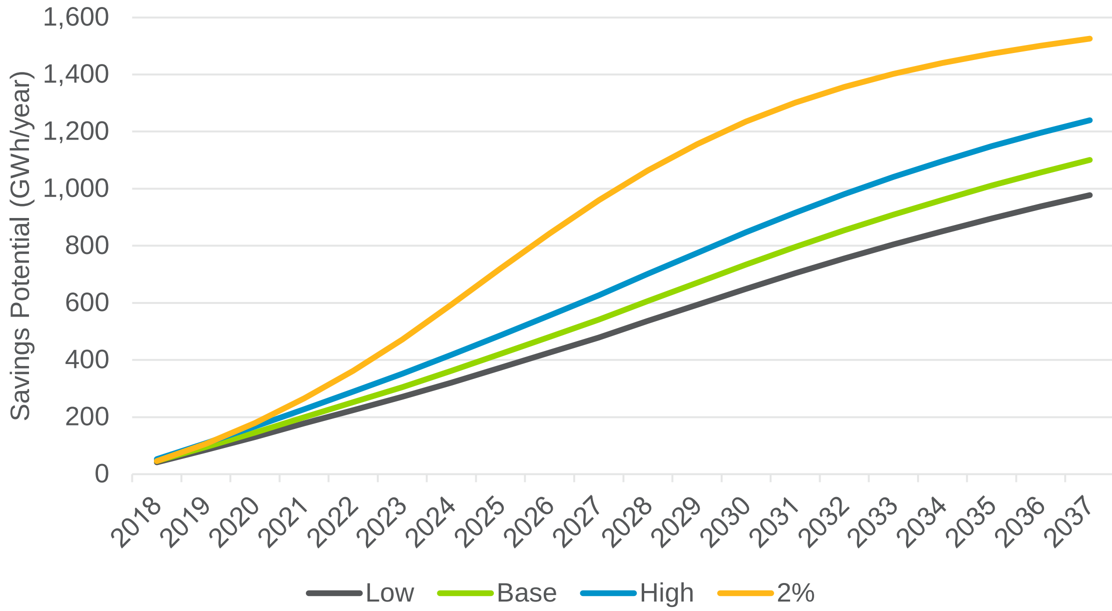
[37] Constraints on achievable potential that inhibit realization of the full economic potential include the rate at which homes and businesses will adopt efficient technologies, as well as the word of mouth and marketing effectiveness for the technology. If a technology already has high saturation at the beginning of the study, it may theoretically be possible to fully saturate the market and achieve 100% of the economic potential for that technology.

Table 3-1. Annual Incremental Achievable Energy Efficiency Savings by Case

Year	Electric Energy (GWh/Year)				Peak Demand (MW)			
	Base	Low	High	2%	Base	Low	High	2%
2018	46	41	52	46	11	10	12	11
2019	49	44	56	60	11	10	13	13
2020	51	45	58	74	11	10	13	16
2021	53	47	61	86	12	10	13	18
2022	53	46	61	97	11	10	13	20
2023	53	47	62	110	11	9	13	22
2024	57	50	66	123	11	10	13	26
2025	59	52	69	127	12	10	14	28
2026	60	53	70	122	12	10	14	27
2027	61	54	70	116	12	10	14	26
2028	65	58	75	104	12	10	15	24
2029	64	56	73	92	12	10	14	22
2030	64	57	73	79	12	10	15	19
2031	61	54	69	67	12	10	14	17
2032	58	52	65	55	11	9	13	14
2033	55	49	60	46	11	9	12	12
2034	52	46	56	38	10	9	11	10
2035	50	45	52	32	10	8	11	9
2036	47	42	48	29	9	8	10	8
2037	43	39	43	25	9	8	9	7
Total	**1,100**	**977**	**1,240**	**1,526**	**220**	**190**	**257**	**346**

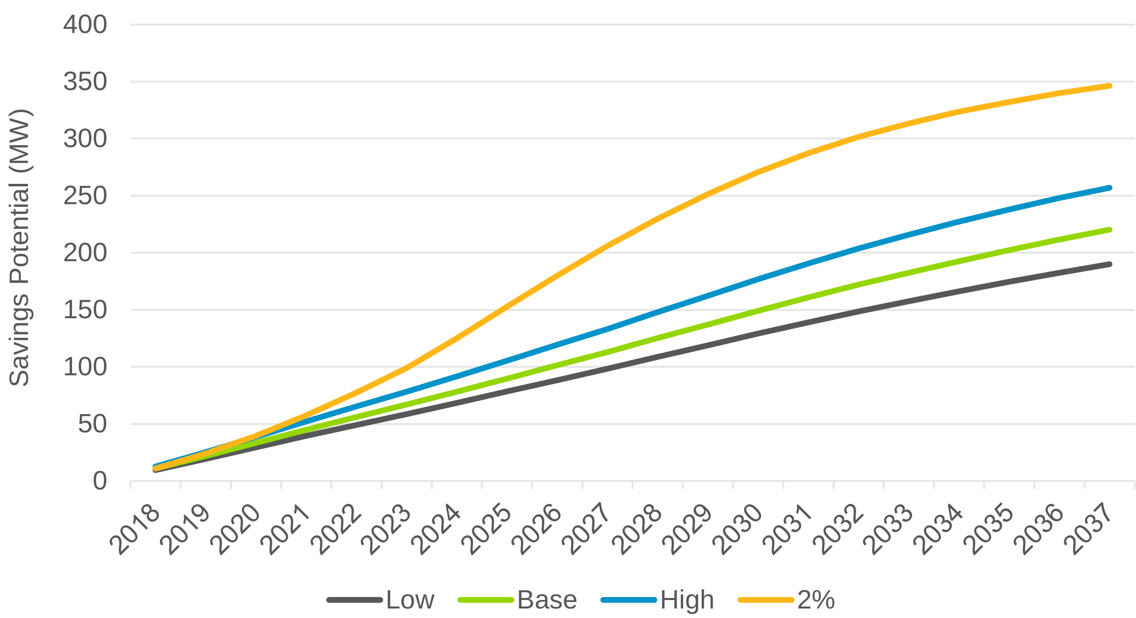
Source: Navigant analysis

Figure 3-1. Electric Energy Cumulative Achievable Savings Potential by Case (GWh/year)



Source: Navigant analysis

Figure 3-2. Peak Demand Cumulative Achievable Savings Potential by Case (MW)



Source: Navigant analysis

Table 3-2 shows the incremental electric energy achievable savings as a percentage of ENO's total sales for each case. For the 2% case, 2% of sales savings is achieved in 2024-2026. In later years, the 2% case falls below the base case since most of the measures have been adopted, depleting the available potential in the future years. This study only includes known, market-ready, quantifiable measures without introducing new measures in later years. However, over the lifetime of energy efficiency programs, new technologies and innovative program interventions could result in additional cost-effective energy savings. Therefore, the need to periodically revisit and reanalyze the potential forecast is necessary.

Table 3-2. Incremental Electric Energy Achievable Savings Potential as a Percentage of Sales, by Case (%, GWh)

Year	Base	Low	High	2%
2018	0.8%	0.7%	0.9%	0.8%
2019	0.8%	0.7%	0.9%	1.0%
2020	0.8%	0.7%	0.9%	1.2%
2021	0.9%	0.8%	1.0%	1.4%
2022	0.9%	0.8%	1.0%	1.6%
2023	0.9%	0.8%	1.0%	1.8%
2024	0.9%	0.8%	1.1%	2.0%
2025	1.0%	0.8%	1.1%	2.0%
2026	1.0%	0.8%	1.1%	2.0%
2027	1.0%	0.9%	1.1%	1.9%
2028	1.0%	0.9%	1.2%	1.6%
2029	1.0%	0.9%	1.1%	1.4%
2030	1.0%	0.9%	1.2%	1.2%
2031	1.0%	0.8%	1.1%	1.0%
2032	0.9%	0.8%	1.0%	0.8%
2033	0.8%	0.8%	0.9%	0.7%
2034	0.8%	0.7%	0.8%	0.5%
2035	0.7%	0.7%	0.8%	0.4%
2036	0.7%	0.6%	0.7%	0.4%
2037	0.6%	0.6%	0.6%	0.3%
Total	**17.3%**	**15.3%**	**19.5%**	**24.0%**

Source: Navigant analysis

The total, administrative and incentive costs for each case are provided in Table 3-3 for each year of the study period. It is important to note the differences in these cases as compared to the savings achieved. Administrative spending is relatively consistent between the cases, while incentive spending varies significantly between the cases, with higher spending correlated to higher savings.

Table 3-3. Spending Breakdown for Achievable Potential ($ millions/year)[38]

	Total				Incentives				Admin			
	Base	Low	High	2%	Base	Low	High	2%	Base	Low	High	2%
2018	$13	$8	$20	$13	$6	$2	$13	$6	$7	$6	$8	$7
2019	$14	$9	$22	$17	$7	$3	$13	$8	$7	$6	$8	$9
2020	$14	$9	$23	$24	$7	$3	$14	$13	$8	$7	$9	$11
2021	$15	$9	$24	$31	$7	$3	$15	$18	$8	$7	$9	$13
2022	$15	$10	$25	$43	$7	$3	$16	$28	$8	$7	$10	$15
2023	$16	$10	$26	$52	$8	$3	$16	$34	$8	$7	$10	$17
2024	$17	$11	$28	$75	$8	$3	$18	$55	$9	$7	$11	$20
2025	$18	$11	$30	$81	$9	$3	$19	$60	$9	$8	$11	$21
2026	$19	$12	$31	$81	$9	$3	$19	$60	$10	$8	$12	$21
2027	$20	$12	$32	$79	$10	$4	$20	$59	$10	$9	$12	$20
2028	$22	$13	$37	$74	$11	$4	$24	$56	$11	$9	$13	$19
2029	$23	$14	$37	$69	$12	$4	$25	$52	$11	$9	$13	$17
2030	$24	$14	$39	$62	$12	$5	$26	$47	$11	$10	$13	$15
2031	$24	$14	$38	$54	$13	$5	$25	$42	$11	$10	$13	$13
2032	$24	$14	$37	$47	$13	$5	$25	$36	$11	$9	$12	$11
2033	$23	$14	$36	$40	$13	$5	$24	$31	$11	$9	$12	$9
2034	$23	$14	$35	$35	$13	$5	$23	$27	$10	$9	$11	$8
2035	$23	$14	$34	$30	$13	$5	$23	$24	$10	$9	$11	$7
2036	$22	$13	$32	$28	$13	$5	$22	$22	$10	$9	$10	$6
2037	$21	$13	$30	$25	$12	$5	$20	$20	$9	$8	$9	$5
Total	**$390**	**$238**	**$617**	**$960**	**$202**	**$75**	**$400**	**$698**	**$188**	**$162**	**$217**	**$262**

Source: Navigant analysis

The TRC test is a benefit-cost metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the program administrator (utility) and program participants. The TRC benefit-cost ratio is calculated in the model using Equation 3-1.

Equation 3-1. Benefit-Cost Ratio for the TRC Test

$$TRC = \frac{PV(Avoided\ Costs + Externalties)}{PV(Technology\ Cost + Admin\ Costs)}$$

[38] The values in this table are rounded to the nearest million and may result in rounding errors.

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits that result from electric energy and capacity savings—e.g., avoided costs of infrastructure investments and avoided fuel (commodity costs) due to electric energy conserved by efficient measures.
- *Externalities* are the monetary or quantifiable benefits associated to greenhouse gas (GHG) gas reductions (i.e., the market cost of carbon).
- *Technology Cost* is the incremental equipment cost to the customer to purchase and install a measure.
- *Admin* are the costs incurred by the program administrator to deliver services (excluding incentive costs paid to participants).

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined by the numerator and denominator, respectively) over each measure's life. Avoided costs, discount rates, and other key data inputs used in the TRC calculation are presented in Appendix B. Effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow the utility to easily apply updated NTG assumptions in the future and allow for variations in NTG assumptions by reviewers.

The TRC ratios for these cases are provided by year in Table 3-4. Even with the large increases in incentives for the high and 2% cases, all cases are cost-effective. Increasing incentives does not necessarily translate to a lower TRC because incentives are considered a transfer cost. However, higher incentives may make higher cost measures more attractive to end users and spur their adoption. Thus, where incentives increase as a percentage of measure cost, TRC scores can be lower even though incentives are not part of the TRC calculation.

Table 3-4. Portfolio TRC Benefit-Cost Ratios for Achievable Potential (Ratio)

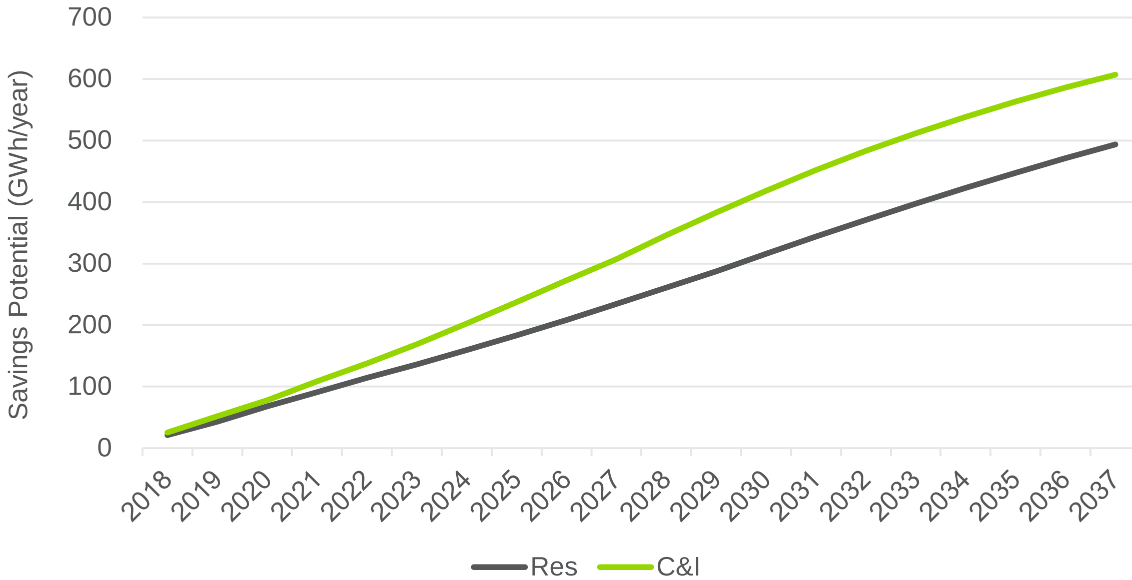
Year	Base	Low	High	2%
2018	1.5	1.6	1.4	1.5
2019	1.5	1.7	1.4	1.5
2020	1.6	1.7	1.5	1.4
2021	1.7	1.8	1.5	1.4
2022	1.8	1.9	1.6	1.4
2023	1.9	2.1	1.7	1.3
2024	1.8	2.0	1.7	1.3
2025	1.8	2.0	1.7	1.3
2026	1.9	2.1	1.7	1.3
2027	1.9	2.1	1.7	1.4
2028	1.7	1.9	1.6	1.4
2029	1.8	1.9	1.6	1.4
2030	1.7	1.9	1.6	1.4
2031	1.7	1.9	1.6	1.4
2032	1.7	1.9	1.6	1.5
2033	1.8	1.9	1.6	1.5
2034	1.8	1.9	1.6	1.5
2035	1.8	1.9	1.6	1.6
2036	1.8	1.9	1.7	1.6
2037	1.8	2.0	1.7	1.7
2018-2037	**1.7**	**1.9**	**1.6**	**1.4**

Source: Navigant analysis

3.2.2 Achievable Potential Results by Sector

Figure 3-3 shows the cumulative electric achievable savings potential for all analysis years by sector for the base case.

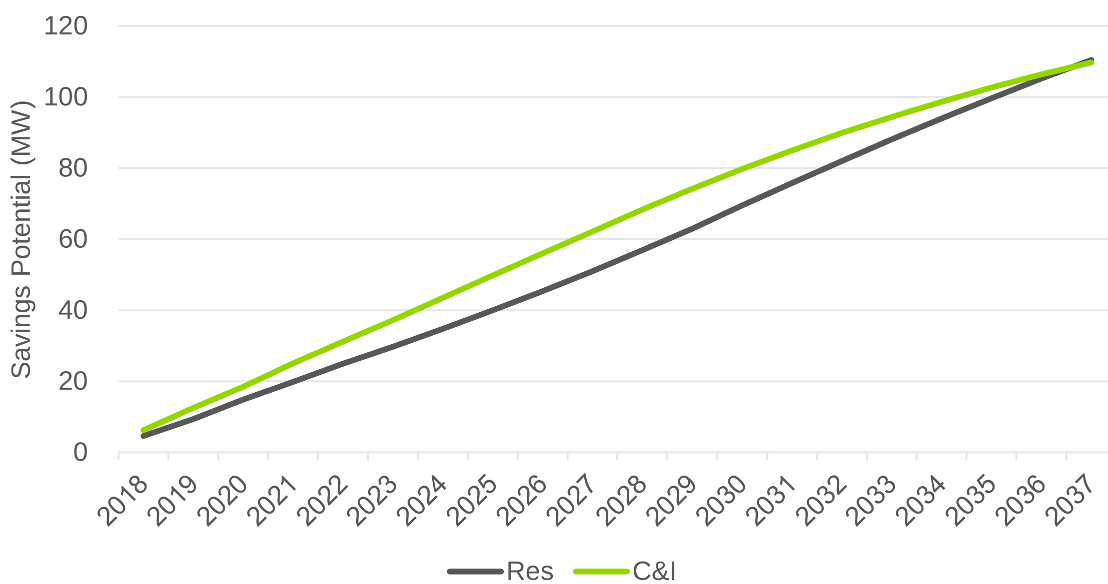
Figure 3-3. Electric Energy Cumulative Base Case Achievable Savings Potential by Sector (GWh/year)



Source: Navigant analysis

Figure 3-4 shows the cumulative demand achievable savings potential for all analysis years by sector for the base case.

Figure 3-4. Electric Demand Cumulative Base Case Achievable Savings by Sector (MW)



Source: Navigant analysis

Table 3-5 shows the cumulative electric energy achievable savings as a percentage of ENO's total sales for each sector. The residential sector accounts for a larger percentage than the C&I sector.

Table 3-5. Cumulative Electric Energy Base Case Achievable Savings Potential by Sector as a Percentage of Sales (%, GWh)

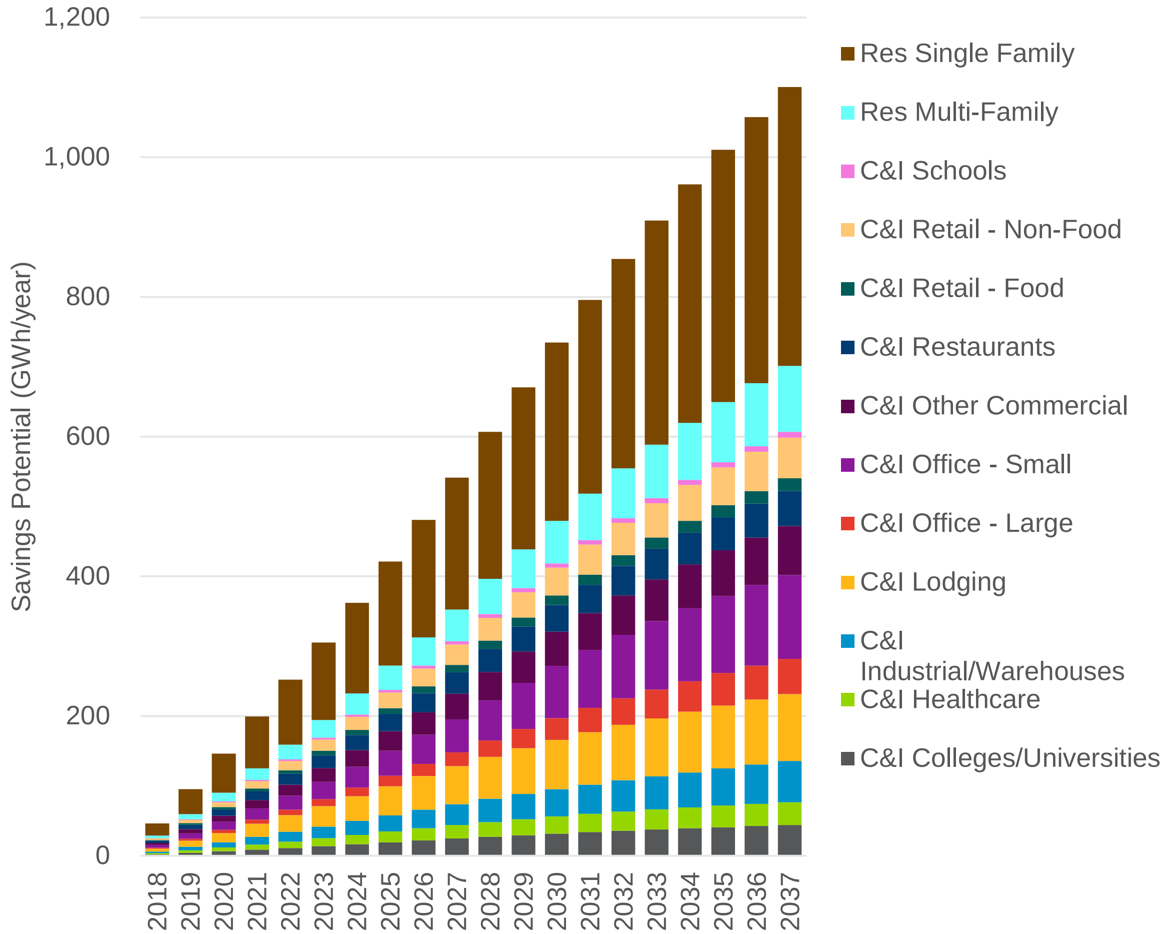
Year	All	C&I	Residential
2018	0.8%	0.7%	0.9%
2019	1.6%	1.4%	1.9%
2020	2.4%	2.1%	3.0%
2021	3.3%	2.8%	4.0%
2022	4.1%	3.6%	5.1%
2023	5.0%	4.4%	6.1%
2024	5.9%	5.2%	7.1%
2025	6.8%	6.1%	8.2%
2026	7.8%	6.9%	9.3%
2027	8.8%	7.8%	10.4%
2028	9.8%	8.8%	11.5%
2029	10.8%	9.7%	12.6%
2030	11.8%	10.6%	13.9%
2031	12.7%	11.4%	15.0%
2032	13.6%	12.2%	16.2%
2033	14.5%	12.9%	17.3%
2034	15.3%	13.5%	18.3%
2035	16.0%	14.1%	19.2%
2036	16.7%	14.7%	20.1%
2037	17.3%	15.2%	20.9%

Source: Navigant analysis

3.2.3 Results by Customer Segment

Figure 3-5 shows the cumulative electric energy achievable potential by customer segment. Residential single family is the largest segment. Small office and lodging contribute the most savings for the C&I sector.

Figure 3-5. Segment Electric Energy Base Case Achievable Potential Customer Segment Breakdown

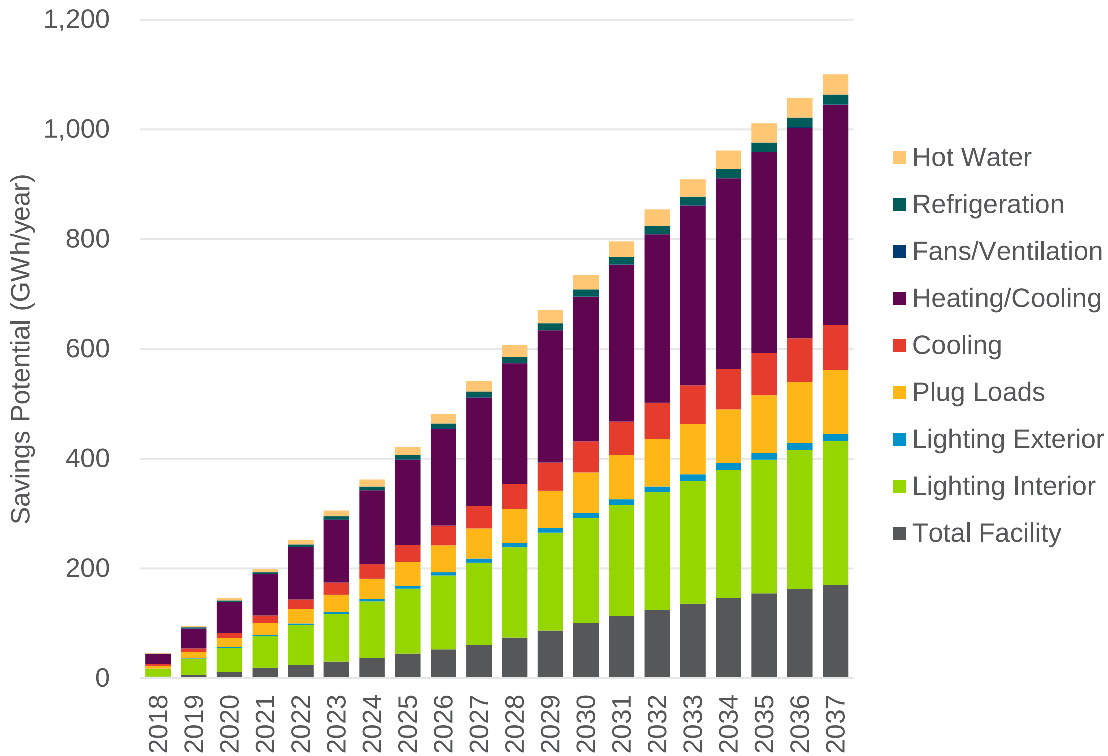


Source: Navigant analysis

3.2.4 Results by End Use

Figure 3-6 shows the electric energy cumulative achievable potential by end use. Figure 3-7 and Figure 3-8 show the percentage of each end use for each sector. The heating/cooling end use has the largest potential, with lighting interior also making a significant contribution. The heating and cooling end uses are high relative to cooling because this end use includes the sales associated with envelope and systems that affect both end uses. ENO has a relatively high penetration of electric heating, which contributes to this factor even though New Orleans experiences rather low heating degree days and high cooling degree days.

Figure 3-6. Electric Energy Base Case Achievable Potential End Use Breakdown



Source: Navigant analysis

Figure 3-7. Residential Electric Energy Achievable Potential End-Use Breakdown (%, GWh)

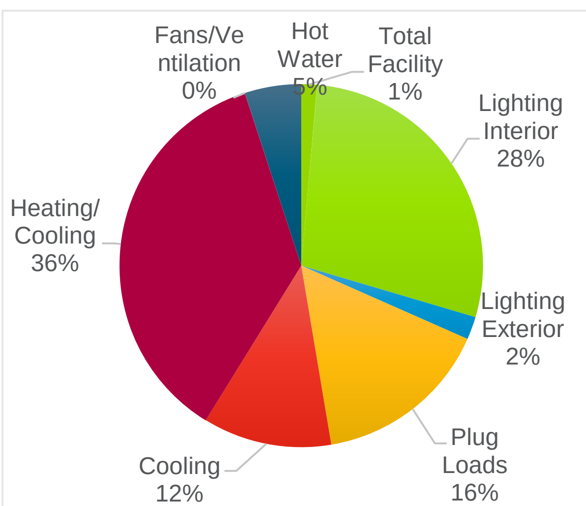
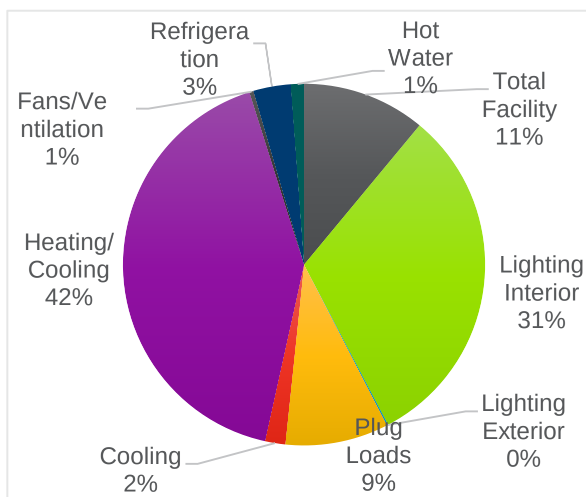


Figure 3-8. C&I Electric Energy Achievable Potential End-Use Breakdown (%, GWh)

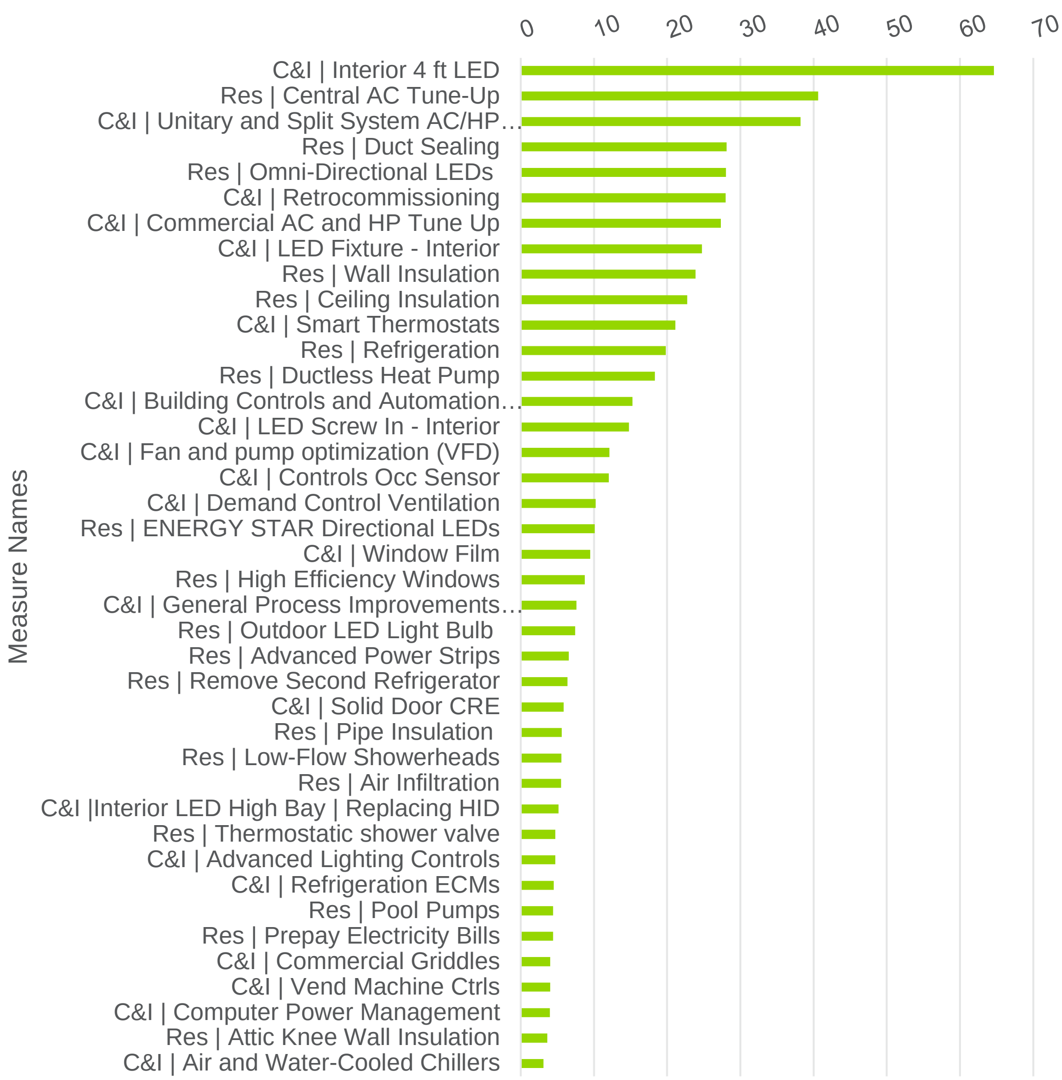


Source: Navigant analysis

3.2.5 Achievable Potential Results by Measure

Figure 3-9 shows the top 40 measures contributing to the electric energy achievable potential in 2028 (the middle of the study period and representative of the 20-year results). Interior 4 ft. LEDs in the C&I sector provide the most potential, followed by residential central air conditioning tune-up and commercial unitary and split system air conditioning/heat pump equipment.

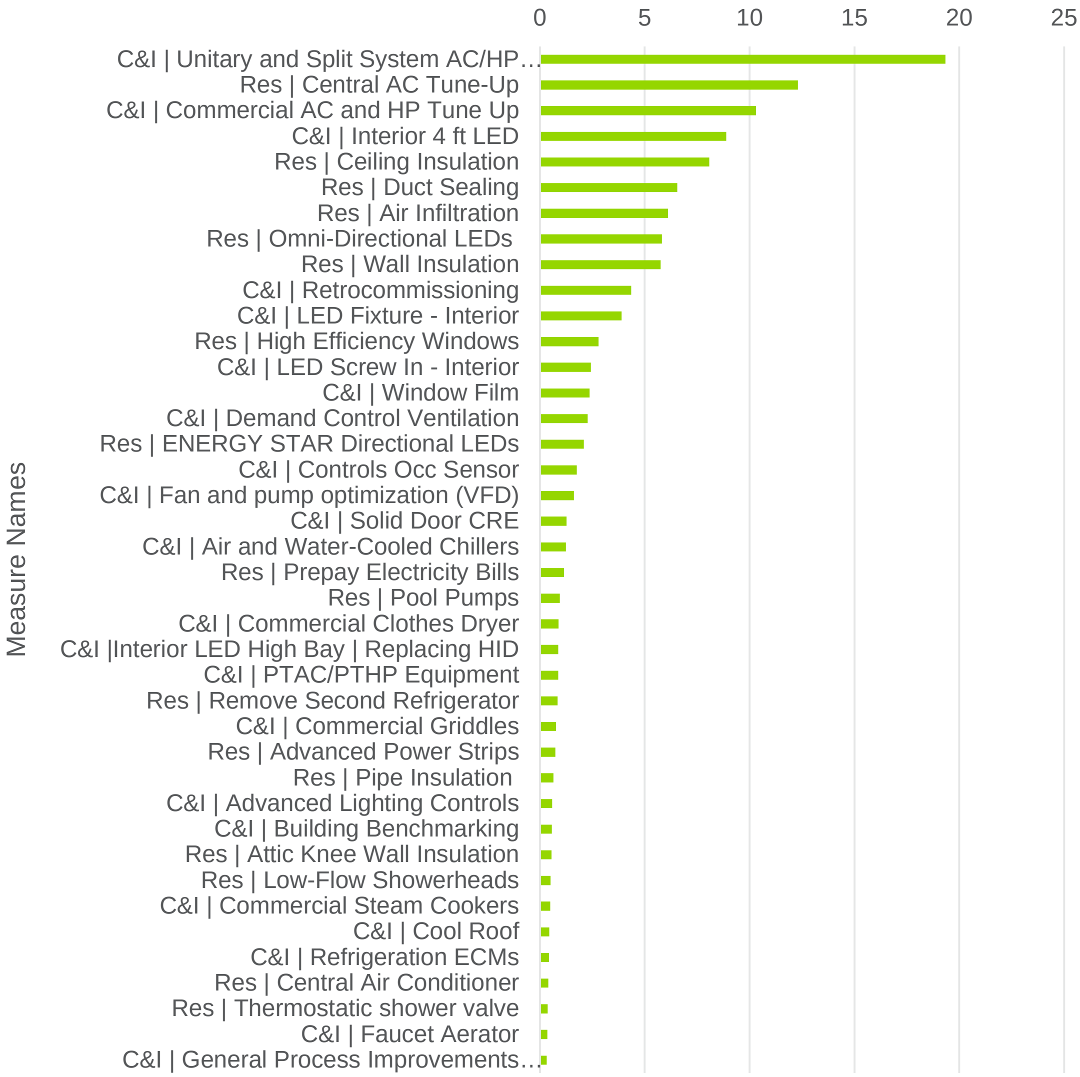
Figure 3-9. Top 40 Measures for Electric Energy Base Case Achievable Savings Potential: 2028 (GWh/year)



Source: Navigant analysis

Figure 3-10 shows the top 40 measures contributing to the demand achievable potential in 2028. The top measures are similar to those listed for electric energy.

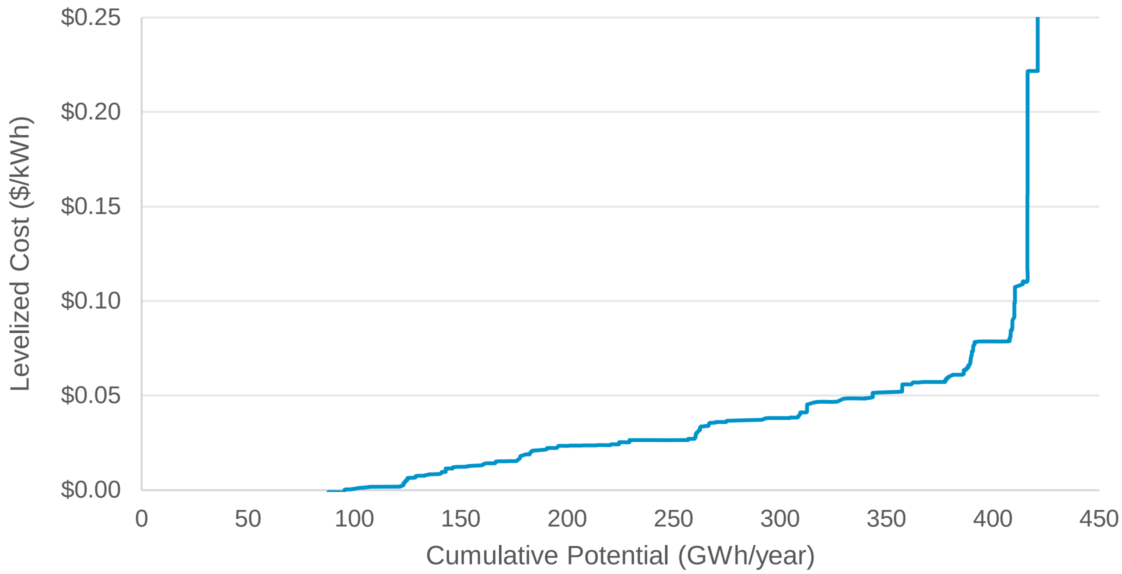
Figure 3-10. Top 40 Measures for Electric Demand Base Case Savings Potential: 2028 (MW)



Source: Navigant analysis

Figure 3-11 provides a supply curve of savings potential versus the levelized cost of savings in $/kWh for all measures considered in the study. The achievable potential levels out at about $0.08/kWh; incremental savings above this level become costlier.

Figure 3-11. Supply Curve of Electric Energy Achievable Potential (GWh/year) vs. Levelized Cost ($/kWh): 2028

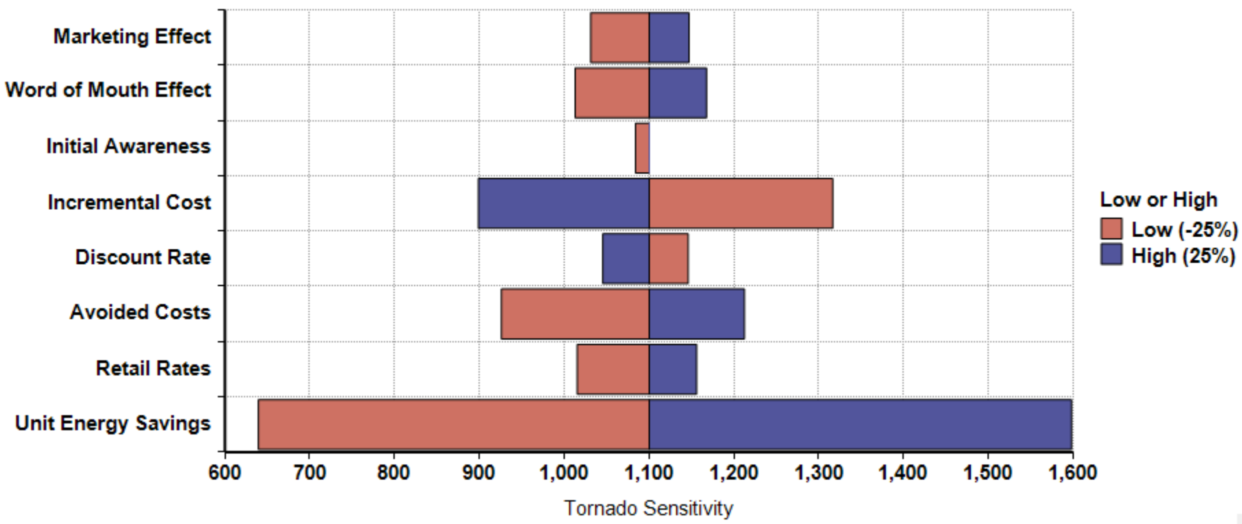


Source: Navigant analysis

3.2.6 Sensitivity Analysis

Figure 3-12 shows a sensitivity analysis of the effect on energy savings potential that results from varying the most influential factors by +/- 25%. Table 3-6 shows the percent change to the cumulative energy savings potential for each sensitivity parameter in 2037. Unit energy savings have the largest impact, followed by incremental costs, avoided costs, and retail rates. Such understandings are critical to evaluating related policy decisions and informing effective program design.

Figure 3-12. Cumulative Achievable GWh Savings in 2037 Sensitivity to Key Variables



Source: Navigant analysis

Table 3-6. Percent Change to Cumulative Potential in 2037 with 25% Parameter Change

Parameter	Low (-25%)	High (25%)
Marketing Effect	-6%	4%
Word-of-Mouth Effect	-8%	6%
Initial Awareness	-1%	0%
Incremental Cost	20%	-18%
Discount Rate	4%	-5%
Avoided Costs	-16%	10%
Retail Rates	-8%	5%
Unit Energy Savings[39]	-42%	45%

Source: Navigant analysis

[39] Unit energy savings are the same as deemed savings and sourced from the New Orleans TRM to the extent possible.

4. Demand Response Achievable Potential and Cost Results

This chapter presents the DR achievable potential and cost results based on the approach described in Section 2.2.

4.1 Cost-Effectiveness Results

This section presents cost-effectiveness results by DR option and sub-option based on the TRC test. Navigant also calculated the cost-effectiveness results based on three additional tests: the utility cost test (UCT), RIM test, and the Participant Cost Test (PCT).

4.1.1 Cost-Effectiveness Assessment Results

Table 4-1 shows benefit-cost ratios calculated for each DR sub-option based on the TRC test over the forecast period. Only the following programs are cost-effective:

- **Residential:** Dynamic pricing sub-options.
- **Small C&I customers:** HVAC DLC and dynamic pricing with enabling technology sub-options
- **Large C&I customers:** Manual curtailment of HVAC loads and dynamic pricing with enabling technology

Based on data made available by ENO, the only benefit stream captured by the TRC test is the avoided cost of generation capacity. ENO does not currently have a way to value avoided T&D capacity. These cost-effectiveness results would improve if avoided T&D capacity benefits were also included in the cost-effectiveness assessment. Only cost-effective sub-options are shown in the achievable potential results in subsequent sections.

Table 4-1. Base Case Benefit-Cost Ratios by DR Options and Sub-Options

Customer Class	DR Option	DR Sub-Option	TRC Ratio
Residential	DLC	DLC-Switch-Water Heating	0.21
		DLC-Thermostat-Heat Pump	0.95
		DLC-Thermostat-Central Air Conditioning	0.95
		DLC-Switch-Heat Pump	0.56
		DLC-Switch-Central Air Conditioning	0.56
	Dynamic Pricing	Dynamic pricing without enabling tech	1.38
		Dynamic pricing with enabling tech	1.89
Small C&I	BTMS	BTMS-Battery Storage	0.18

Customer Class	DR Option	DR Sub-Option	TRC Ratio
	DLC	DLC-Switch-Water Heating	0.17
		DLC-Thermostat-HVAC	6.53
		DLC-Switch-HVAC	2.96
	Dynamic Pricing	Dynamic pricing without enabling tech	0.24
		Dynamic pricing with enabling tech	2.90
Large C&I	BTMS	BTMS-Battery Storage	0.16
	C&I Curtailment	C&I Curtailment-Advanced Lighting Control	0.53
		C&I Curtailment-Auto-DR HVAC Control	0.57
		C&I Curtailment-Industrial	0.66
		C&I Curtailment-Manual HVAC Control	1.02
		C&I Curtailment-Other	0.61
		C&I Curtailment-Refrigeration Control	0.68
		C&I Curtailment-Standard Lighting Control	0.36
		C&I Curtailment-Water Heating Control	0.72
	Dynamic Pricing	Dynamic pricing without enabling tech	3.18
		Dynamic pricing with enabling tech	0.90

Source: Navigant

4.1.2 Comparison of Cost-Effectiveness Results by Cases

As described in Section 2.2.5, in addition to the base case, Navigant modeled potential results for low and high cases. For these cases, the team adjusted assumed participation levels and incentive amounts to determine the impacts on the DR achievable potential. Table 4-2 shows cost-effective results across the three cases for the DR sub-options that pass the cost-effectiveness screen for the base case. The C&I curtailment-manual HVAC control sub-option for large C&I participants under the low case is not cost-effective. All other base case cost-effective measures remain cost-effective under the low and high cases.

Table 4-2. Benefit-Cost Ratio Comparisons by Cases by DR Options and Sub-Options

Customer Class	DR Option	DR Sub-Option	Base TRC Ratio	Low TRC Ratio	High TRC Ratio
Residential	Dynamic	Dynamic pricing without enabling tech	1.38	1.39	1.38

Customer Class	DR Option	DR Sub-Option	Base TRC Ratio	Low TRC Ratio	High TRC Ratio
	Pricing[40]	Dynamic pricing with enabling tech	1.89	1.90	1.89
Small C&I	DLC	DLC-Thermostat-HVAC	6.53	6.09	6.76
		DLC-Switch-HVAC	2.96	2.84	3.02
	Dynamic Pricing	Dynamic pricing with enabling tech	2.90	2.91	2.89
Large C&I	C&I Curtailment	C&I Curtailment-Manual HVAC Control	1.02	0.96	1.05
	Dynamic Pricing	Dynamic pricing without enabling tech	3.18	3.21	3.17

Source: Navigant

4.2 Achievable Potential Results

This section presents cost-effective achievable potential results by DR option, sub-option, customer class and segment.

4.2.1 Achievable Potential by DR Option

Figure 4-1 summarizes the cost-effective achievable potential by DR option for the base case. Figure 4-2 shows the cost-effective achievable potential as a percentage of ENO's peak demand. Achievable potential is estimated to grow from 0.7 MW in 2018 to 34.6 MW in 2037. Cost-effective achievable potential makes up approximately 3.3% of ENO's peak demand in 2037. The team made several key observations:

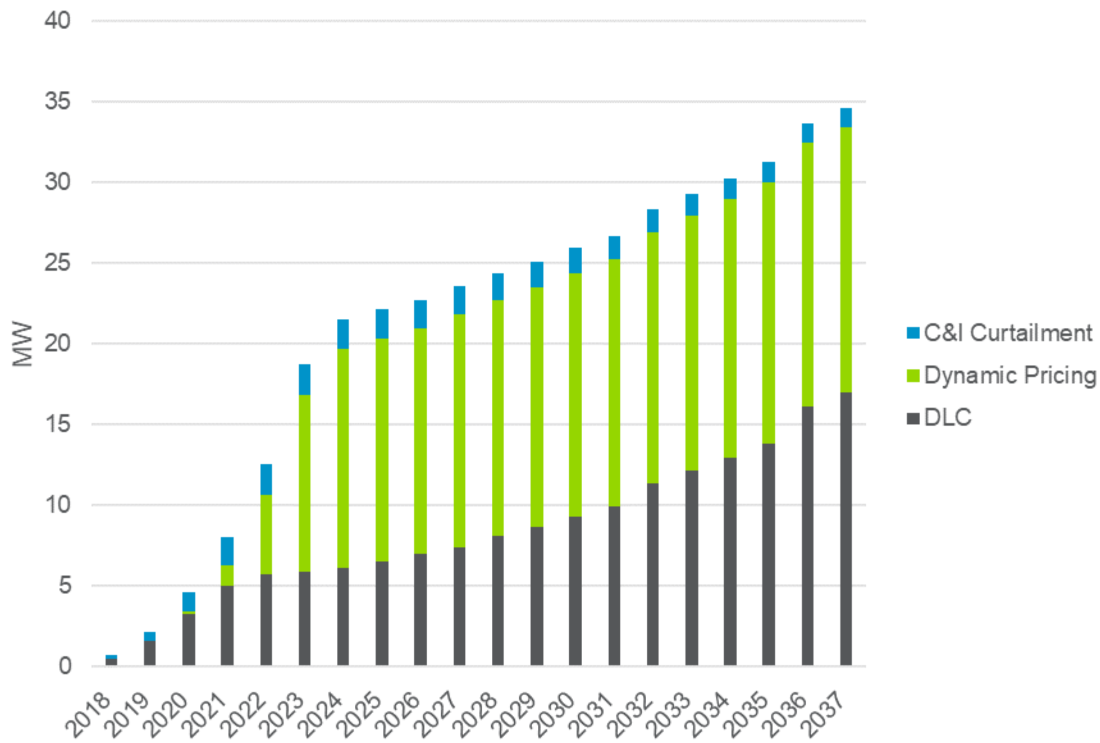
- DLC has the largest achievable potential: a 49% share of total potential in 2037. DLC potential grows from 0.5 MW in 2018 to 17.0 MW in 2037.
- This is followed by dynamic pricing with a 47% share of the total potential in 2037. As previously mentioned, the dynamic pricing offer begins in 2020 because it is tied to ENO's smart meter rollout plan. The program ramps up over a 5-year period (2020-2024) until it reaches a value of 14 MW. From then on, potential slowly increases until it reaches a value of 16 MW in 2037.
- C&I curtailment makes up the remainder of the cost-effective achievable potential with a 4% share of the total potential in 2037. C&I curtailment potential grows

[40] There are no incentives provided to customers for participating in dynamic pricing. Hence, participation, corresponding potential, costs and cost-effectiveness stay the same across scenarios. The low case ratio is slightly higher than the base and high case ratios due to lower interactive/competing effects with other programs.

rapidly from 0.2 MW in 2018 to 1.9 MW in 2022. This growth follows the S-shaped ramp assumed for the program over a 5-year period. Beyond 2022, the program attains a steady participation level and its potential slightly decreases over the remainder of the forecast period, ending at 1.2 MW in 2037.

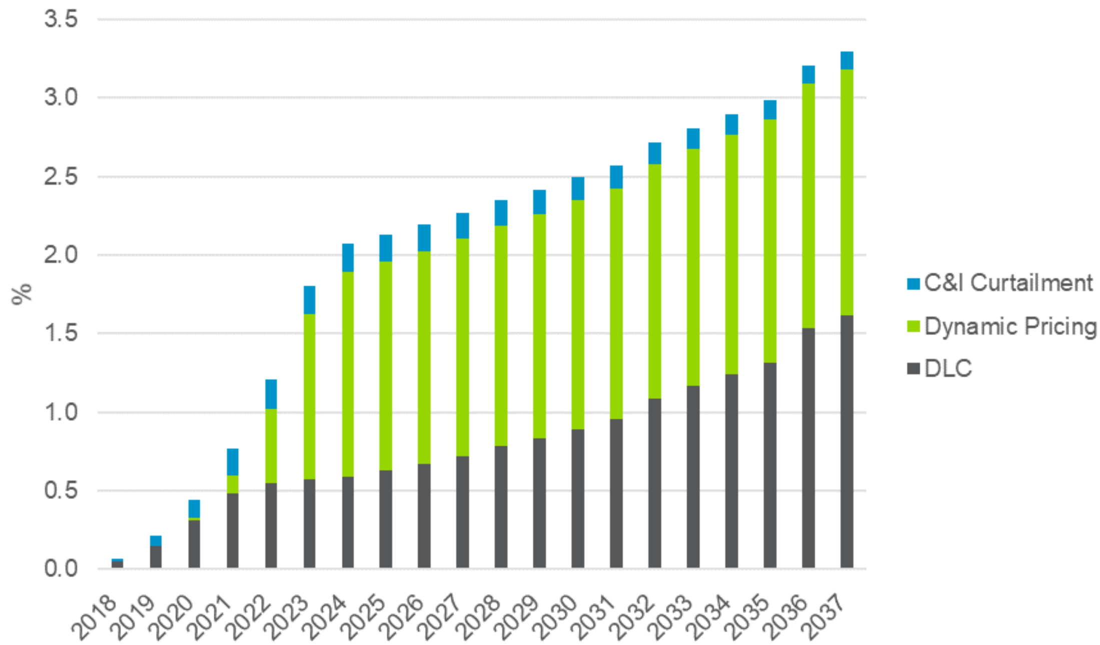
- BTMS, as described in this report, is not cost-effective; thus, it contributes 0 MW to the DR achievable potential.

Figure 4-1. Summer DR Achievable Potential by DR Option (MW)



Source: Navigant analysis

Figure 4-2. Summer DR Achievable Potential by DR Option (% of Peak Demand)



Source: Navigant analysis

4.2.2 Case Analysis Results

Navigant developed DR potential estimates for three different cases. These cases are based on the DR program incentive levels:

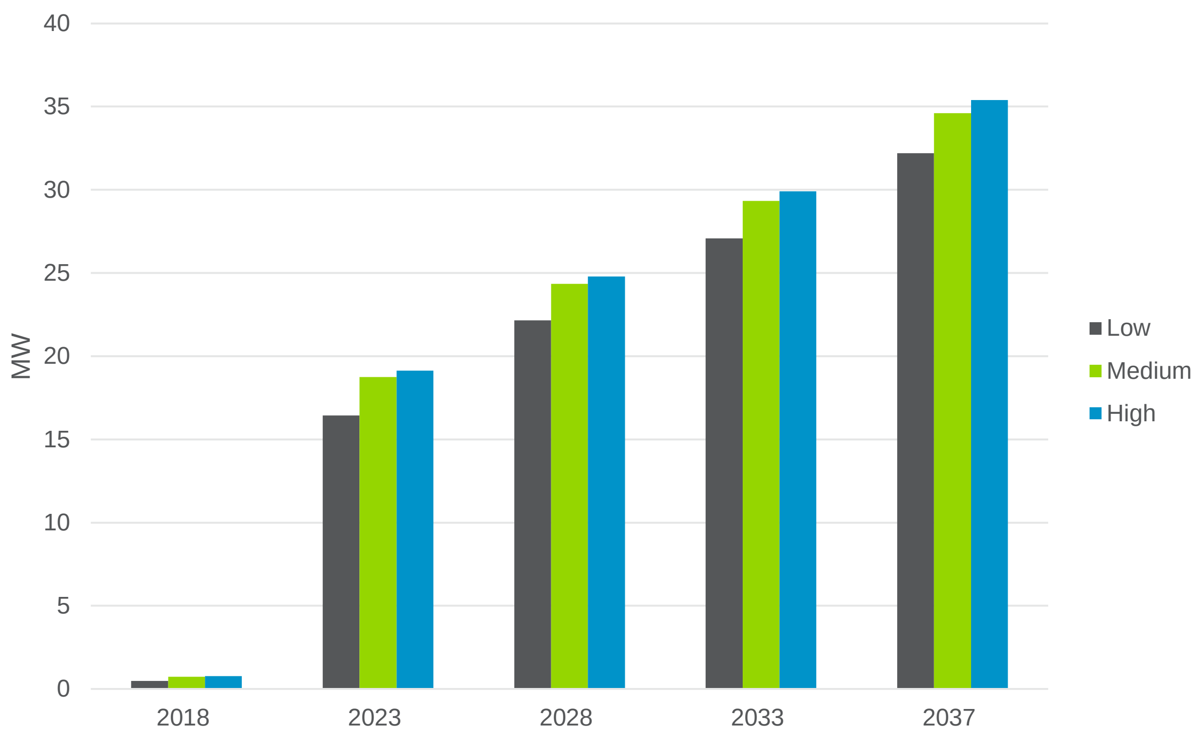
- **Base case:** Reflects DR program participation based on incentives at levels that match current programs (e.g., ENO's Smart Easy Cool program) and industry best practice.
- **Low case:** Assumes incentives are 50% lower than in the base case. This drives program participation down and results in lower implementation costs.
- **High case:** Assumes incentives are 50% higher than in the base case. This drives program participation up and results in higher implementation costs.

The low and high cases do not apply to the dynamic pricing program, as participation is strictly based on customer response to real-time price signals. The change in participation levels due to changes in incentives is based on price response curves developed by the Lawrence Berkeley National Laboratory (Berkeley Lab) for the *2025*

California Demand Response Potential Study.[41, 42]

Figure 4-3 and Figure 4-4 show the achievable potential results in terms of MW and percentage of peak demand, respectively. Under the base case, the achievable potential makes up approximately 3.3% of ENO's peak load in 2037. Under the low and high cases, the achievable potential represents approximately 3.1% and 3.4% of ENO's peak demand in 2037, respectively.

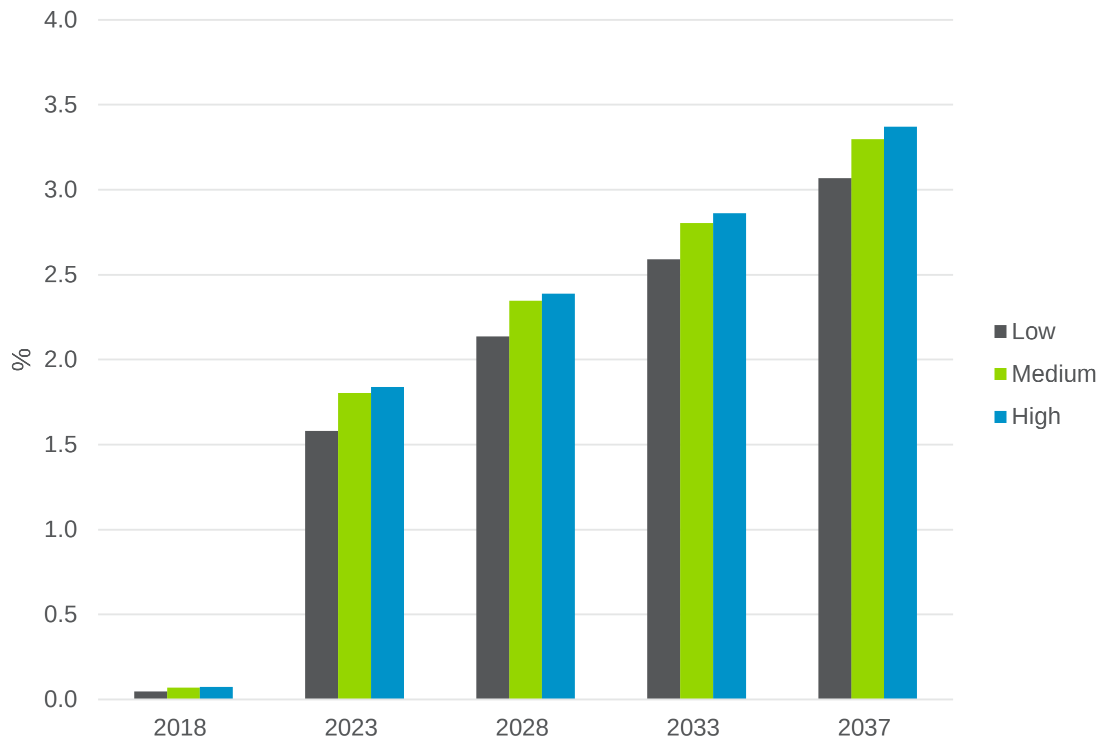
Figure 4-3. Summer DR Achievable Potential by Case (MW)



Source: Navigant

[41] Lawrence Berkeley National Laboratory. *2025 California Demand Response Potential Study: Charting California's Demand Response Future.* Appendix F. March 1, 2017.
[42] Navigant assumed medium marketing spending levels for DR programs across cases.

Figure 4-4. Summer DR Achievable Potential by Case (% of Peak Demand)



Source: Navigant analysis

4.2.3 Achievable Potential by DR Sub-Option

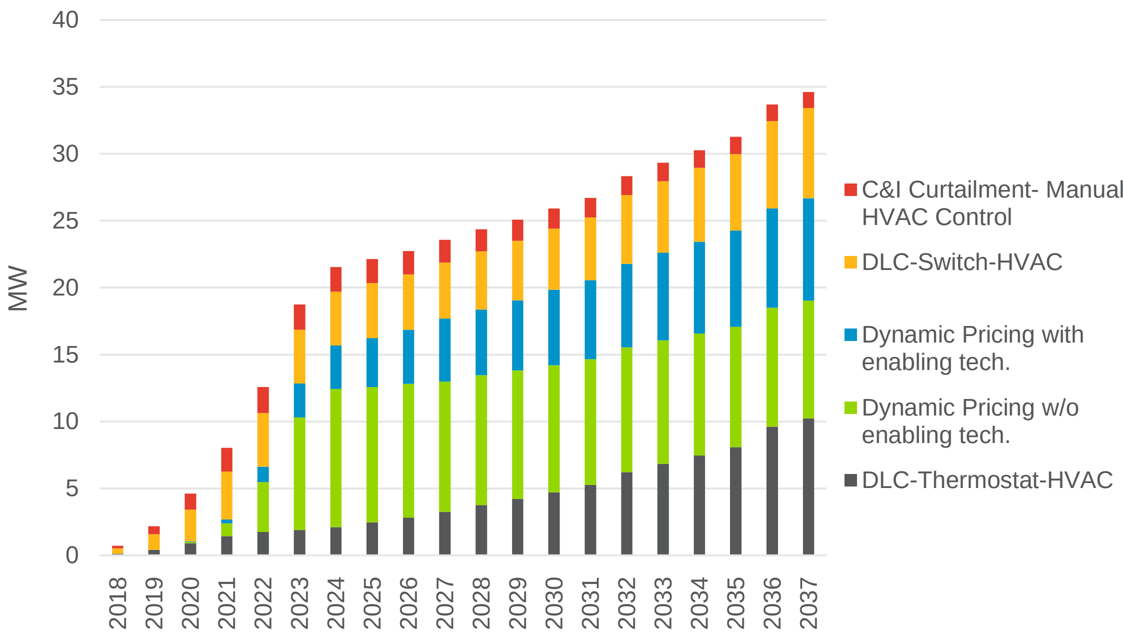
This section presents the breakdown of cost-effective potential by DR sub-option. Each sub-option is tied to a specific control technology and/or end use. Any sub-option that is tied to a control technology is tied to the penetration of that technology in the market. This penetration trajectory is informed by saturation values from the energy efficiency potential study.

Figure 4-5 summarizes the cost-effective achievable potential by DR option for the base case. Navigant had the following key observations:

- Only direct control of HVAC loads by small C&I customers is cost-effective (DLC-Switch-HVAC and DLC-Thermostat HVAC in Figure 4-5). This sub-option makes up 50% of the total cost-effective achievable potential in 2037 at 17.0 MW. Of this 17.0 MW, 10.2 MW is from thermostat-based control, while the remaining 6.7 MW is from switch-based control.
- Dynamic pricing makes up 47% of the total cost-effective achievable potential in 2037. Potential from customers with enabling technology in the form of thermostats/EMS (8.8 MW in 2037) is slightly higher than from customers without enabling technology—8.8 MW versus 7.6 MW in 2037.
- Under the C&I curtailment program, reductions associated with manual HVAC

control make up 4% of the total cost-effective potential in 2037.

Figure 4-5. Summer DR Achievable Potential by DR Sub-Option



Source: Navigant analysis

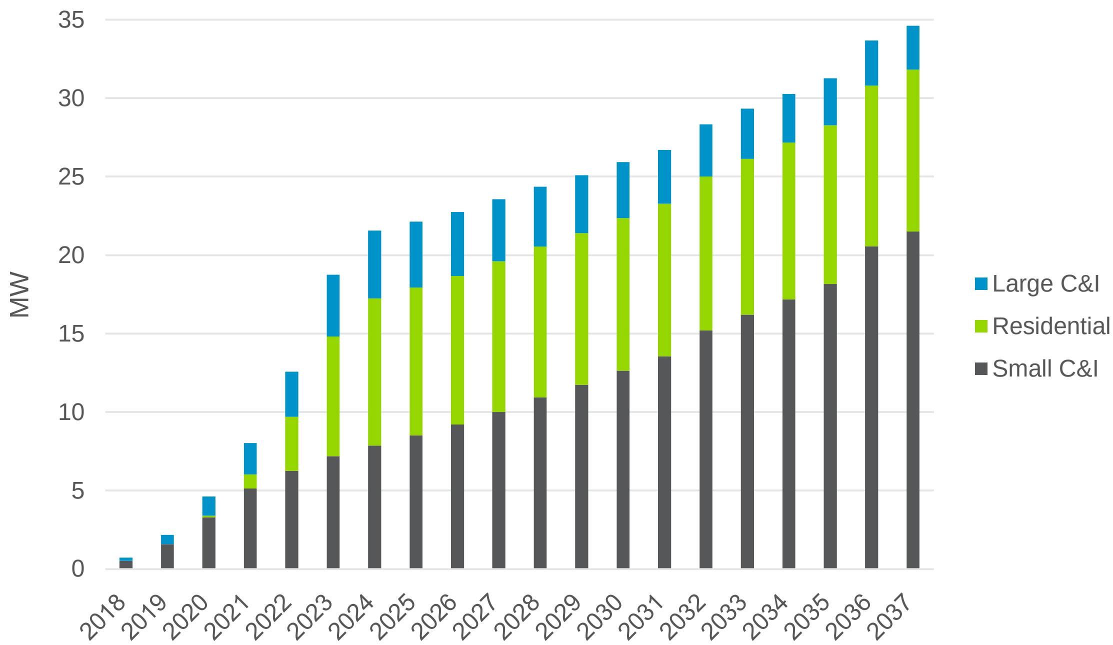
4.2.4 Achievable Potential by Customer Class

This section presents the breakdown of cost-effective potential by customer class. The three customer classes included in the study are residential, small C&I, and large C&I.

Figure 4-6 summarizes the cost-effective achievable potential by customer class for the base case. The team had the following key observations:

- Potential from residential customers makes up 30% (10.3 MW) of the total cost-effective achievable potential in 2037. C&I customers make up the remaining 70%.
- Potential from small C&I customers makes up 61% (21.5 MW) of the total cost-effective achievable potential in 2037. DLC of HVAC loads makes up 79% (48% from thermostat-based control and 31% from switch-based control) of this 21.5 MW, while dynamic pricing with enabling technology in the form of thermostats makes up the remaining 21%.
- Potential from large C&I customers makes up 8% (2.8 MW) of the total cost-effective achievable potential in 2037. Dynamic pricing with enabling technology in the form of an EMS makes up 57% of this 2.8 MW, while manual curtailment of HVAC loads makes up the remaining 43%.

Figure 4-6. Summer DR Achievable Potential by Customer Class (MW)



Source: Navigant analysis

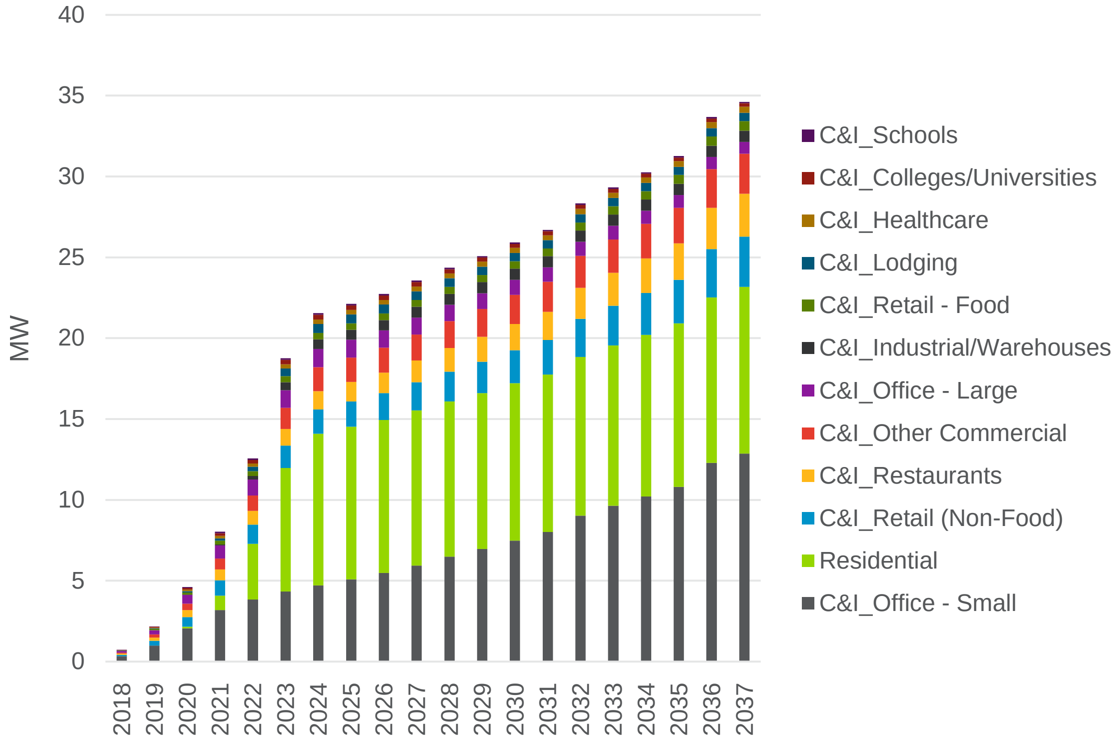
4.2.5 Achievable Potential by Customer Segment

This section presents the breakdown of cost-effective potential by customer segment. As previously discussed in the DR methodology section, these segments align with those included in the energy efficiency potential study. Navigant combined single family and multifamily customers into a single residential category because DR program and pricing offers are typically not distinguished by dwelling type. Government customers are included as part of the C&I sector. Savings potential analysis from street lighting is not included in this study.

Figure 4-6 summarizes the cost-effective achievable potential by customer segment for the base case. Navigant had the following key observations:

- Potential from C&I customers primarily comes from small offices, which make up 37% (12.9 MW) of the total cost-effective achievable potential in 2037. This is followed by retail buildings, restaurants and the other commercial building category, which each make up between 7% and 9% of the total cost-effective achievable DR potential in 2037—3.1 MW, 2.7 MW, and 2.5 MW, respectively.
- All other C&I segments make up less than 2.2% of the cost-effective achievable potential in 2037, which is less than 0.75 MW.

Figure 4-7. Summer DR Achievable Potential by Customer Segment



Source: Navigant analysis

4.3 Program Costs Results

This section presents annual program costs by case and DR option and sub-option. It also presents levelized cost estimates by DR sub-option. Annual costs and levelized costs are only shown only for cost-effective DR sub-options.

4.3.1 Annual Program Costs

4.3.1.1 Annual Costs by Case

Table 4-3 shows annual implementation costs for the entire cost-effective DR portfolio by case. These costs represent the estimated total annual costs that ENO is likely to incur to realize the potential values discussed in Section 4.2.

Relative to the base case, costs are lower and higher in the low and high cases, respectively, due to varied incentive levels paid to customers. This affects the level of participation from customers, which varies technology enablement costs, marketing costs, and O&M costs.

Table 4-3. Annual DR Portfolio Costs by Case

Year	Low	Base	High
2018	$148,508	$243,263	$250,759
2019	$112,142	$207,712	$232,074
2020	$579,445	$730,905	$778,924
2021	$655,853	$860,253	$930,087
2022	$806,604	$1,022,063	$1,095,810
2023	$813,775	$1,027,173	$1,100,283
2024	$459,268	$675,505	$751,149
2025	$295,230	$513,121	$590,823
2026	$313,916	$531,256	$609,786
2027	$331,867	$548,701	$628,218
2028	$510,256	$765,016	$847,832
2029	$431,276	$654,068	$741,000
2030	$486,591	$712,843	$803,392
2031	$511,942	$738,094	$830,734
2032	$500,861	$725,569	$820,344
2033	$455,034	$675,430	$769,963
2034	$473,555	$694,172	$791,230
2035	$497,330	$720,181	$820,580
2036	$599,336	$834,295	$945,949
2037	$557,774	$790,710	$903,719

Source: Navigant analysis

4.3.1.2 Annual Costs by DR Option and Sub-Option

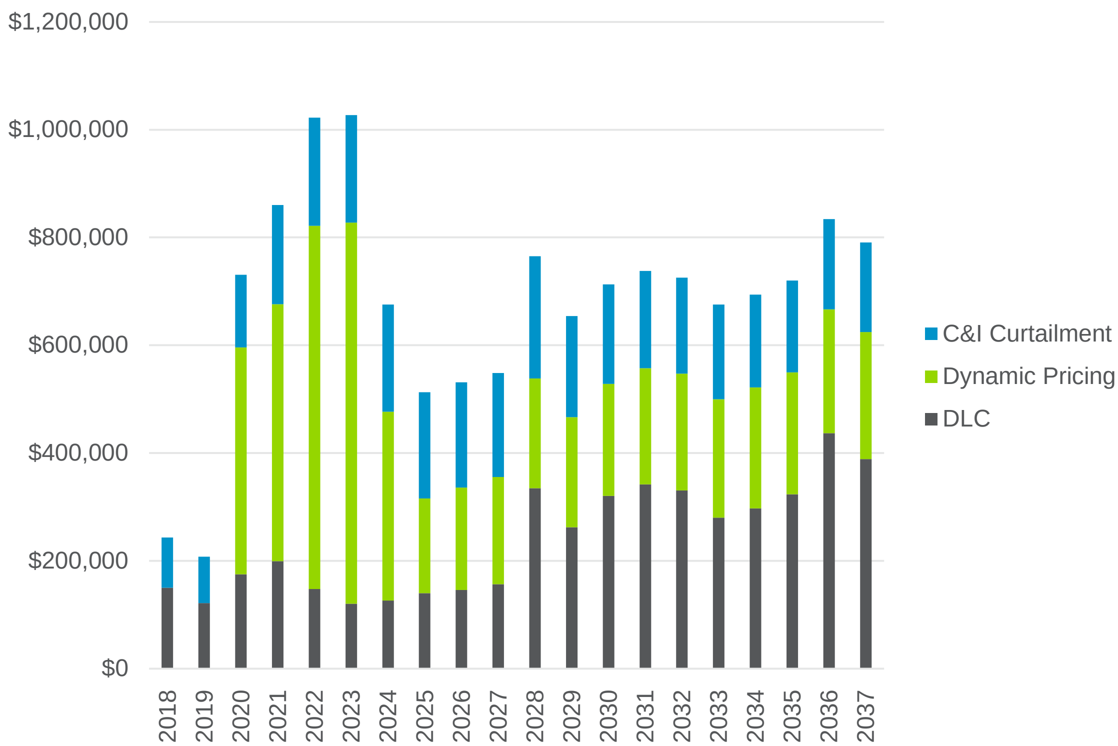
Figure 4-8 summarizes the annual program costs by DR option. Figure 4-10 summarizes the annual program costs by DR sub-option. The team observed the following:

- The program costs for DLC increase steadily from 2018 to 2021 and then drop in 2022, once the program is fully ramped up. By 2021, 90% of the program is ramped up, so the incremental cost to recruit new customers is lower in 2022. The costs remain steady and then spike back up in 2028 because the DLC program has a program life of 10 years, so technology enablement and program development costs are re-incurred at this time. From then on, costs fluctuate in accordance with program participation, which is tied in part to thermostat market penetration, until it reaches its final value of $389,000 in 2037.
- The program costs for C&I curtailment increase steadily from 2018 to 2022 until the program is fully ramped up. Because manual HVAC control is the only C&I

curtailment sub-option that is cost-effective, these costs do not include any technology enablement costs. There is a spike in costs in 2028 because, like DLC, the C&I curtailment program has a program life of 10 years, so program development costs are re-incurred at this time. From then on, costs fluctuate with program participation until it reaches its final value of $166,000 in 2037.

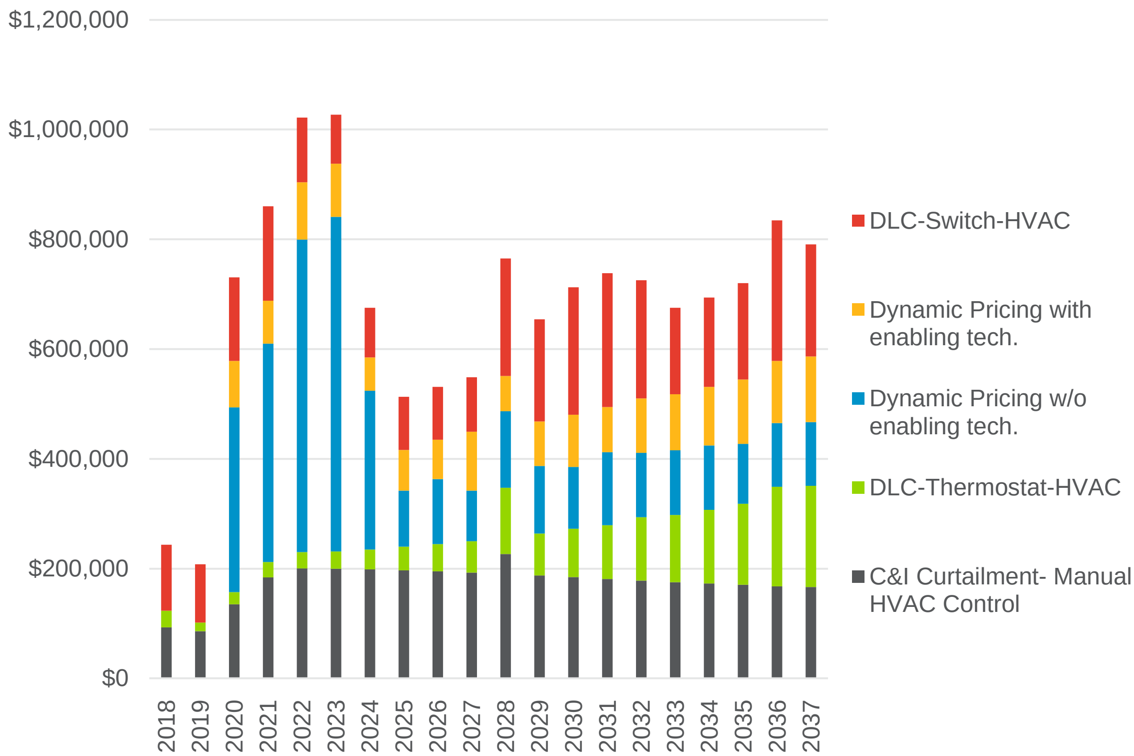
- Dynamic pricing program costs are relatively high during its initial ramp up between 2020 and 2023, and then drop in 2024 when the program is fully ramped up. By 2023, 90% of the program is ramped up, so the incremental cost to recruit new customers is lower in 2024. Beyond 2024, costs remain low and relatively steady.
- Annual BTMS program costs are zero as the program is not cost-effective.

Figure 4-8. Annual Program Costs by DR Option



Source: Navigant analysis

Figure 4-9. Annual Program Costs by DR Sub-Option

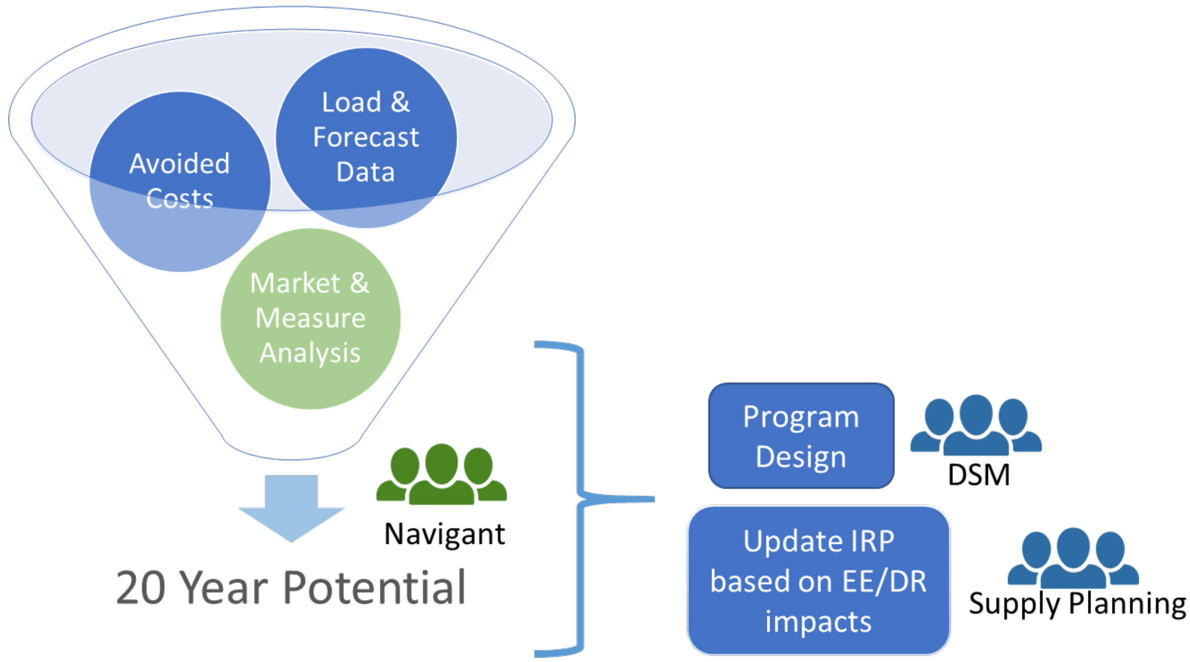


Source: Navigant analysis

5. Conclusions and Next Steps

Figure 5-1 provides an illustrative view of the data inputs and outputs of the potential study, most notably for IRP and program planning.

Figure 5-1. Integrating Potential Study Outputs to IRP and DSM Planning



Source: Navigant

5.1 Benchmarking the Results

Energy Efficiency

After completing the potential study analysis, Navigant benchmarked the energy efficiency achievable potential results against similar studies by other utilities. The goal of this exercise was to provide context for Navigant's results and to understand how various factors such as region or program spend may affect the results.

For this exercise, Navigant conducted a literature review on recent potential studies and aggregated the results. In conducting this review, the team aimed to include a mixture of utilities that had comparable electric customer counts, climate regions, regulatory requirements (e.g., publicly owned utilities), and/or locales (e.g., metropolitan centers). Based on this literature review, Navigant conducted three comparisons:

- Average annual achievable potential savings at the utility level
- Average annual potential savings at the state level
- Energy savings per dollar of program spend

Note that the sources and points of comparison differ due to data availability. The tables below list the final benchmarking pool for these comparisons and their respective data sources.

Table 5-1. EE Achievable Potential Benchmarking Pool and Sources

Utility	Data Source
Austin Energy	Austin Energy DSM Market Potential Assessment, 2012
Louisville Gas & Electric / Kentucky Utilities	Louisville Gas & Electric Company and Kentucky Utilities Company, Demand-Side Management Potential Study, 2017[43]
Commonwealth Edison (ComEd)	ComEd Energy Efficiency Potential Study, 2016[44]
Duke Energy (Indiana)	The Duke Energy Indiana 2015 Integrated Resource Plan, 2015[45]
California Public Utilities[46]	California Public Utilities Commission, 2018 Potentials & Goals Study Results Viewer[47]
Colorado Springs Utilities	Colorado Springs Utilities 2015 Demand Side Management Potential Study, 2016[48]
Seattle City Light	Seattle City Light Conservation Potential Assessment, 2016[49]

[43] CADMUS, Louisville Gas & Electric Company and Kentucky Utilities Company, *Demand-Side Management Potential Study 2019-2038*, 2017, https://lge-ku.com/sites/default/files/2017-10/LGE-KU-DSM-Potential-Study.pdf

[44] ICF, *ComEd Energy Efficiency Potential Study*, 2017-2030, May 2016, http://ilsagfiles.org/SAG_files/Potential_Studies/ComEd/ComEd_2017-2030_EE_Potential_Final_Report_5-2016.pdf

[45] Duke Energy Indiana, *The Duke Energy Indiana 2015 Integrated Resource Plan*, 2015, https://www.in.gov/iurc/files/2015_Duke_IRP_Report_Volumn_1_Public_Version.pdf

[46] CA Public Utilities are grouped together due to data availability and the study results referenced.

[47] Navigant, *California Public Utilities Commission 2018 Potentials & Goals (PG) Study Results Viewer*, 2018, http://www.cpuc.ca.gov/General.aspx?id=6442452619

[48] CADMUS, *Colorado Springs Utilities 2015 Demand Side Management Potential Study*, 2016, https://www.csu.org/CSUDocuments/dsmpotentialstudyvolume1.pdf

[49] Seattle City Light 2016 IRP “Appendix 6, Conservation Potential Assessment,” https://www.seattle.gov/light/IRP/docs/2016App-6-Conservation%20Potential%20Assessment.pdf

Table 5-2. EE Achievable Potential Savings by State Benchmarking Pool and Sources

State	Data Source
Arkansas	Arkansas Energy Efficiency Potential Study[50]
Mississippi	A Guide to Growing an Energy-Efficient Economy in Mississippi[51]
Louisiana	Louisiana's 2030 Energy Efficiency Roadmap[52]
Tennessee	Tennessee Valley Authority Potential Study[53]
Texas	Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas's Growing Electricity Needs[54]

[50] Navigant, *Arkansas Energy Efficiency Potential Study*, 2015, www.apscservices.info/pdf/13/13-002-U_212_2.pdf

[51] ACEEE, *A Guide to Growing an Energy-Efficient Economy in Mississippi*, 2013, http://aceee.org/research-report/e13m

[52] ACEEE, *Louisiana's 2030 Energy Efficiency Roadmap*, 2013, http://aceee.org/research-report/e13b

[53] Global Energy Partners, *Tennessee Valley Authority Potential Study*, 2011, http://152.87.4.98/news/releases/energy_efficiency/GEP_Potential.pdf

[54] ACEEE, *Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas's Growing Electricity Needs*, 2007, https://aceee.org/research-report/e073

Table 5-3. EE Actual Spending and Saving Benchmarking Pool and Sources

Utility	Data Source
Anaheim Public Utilities	Energy Efficiency in California's Public Power Sector 11th Edition[55]
Pasadena Water & Power	
Los Angeles Department of Water & Power	
Sacramento Municipal Utility District	
SWEPCO	Texas Efficiency, Energy Efficiency Accomplishments of Texas Investor-Owned Utilities 2016[56]
Entergy Texas, Inc.	
El Paso Electric	
CPS Energy (City of San Antonio)	Evaluation, Measurement & Verification of CPS Energy's DSM Programs FY 2016[57]
Louisville Gas & Electric/Kentucky Utilities	LG&E/KU DSM Advisory Group Meeting, 2017[58]

Based on the sources above, Navigant aggregated the results into the figures below.

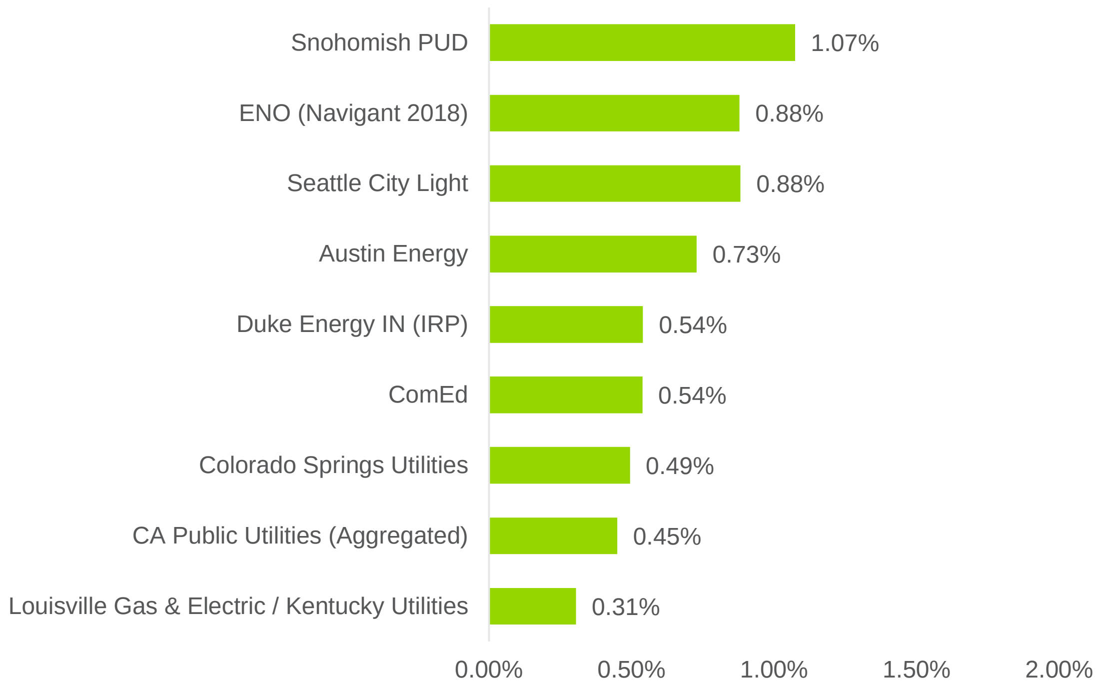
[55] California Municipal Utilities Association, Northern California Power Agency, Southern California Agency, *Energy Efficiency in California's Public Power Sector,* 11th Edition, 2017, http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN217680_20170522T124015_Energy_Efficiency_in_California's_Public_Power_Sector_11th_Edit.pdf

[56] Frontier Associates, *Energy Efficiency Accomplishments of Texas Investor-Owned Utilities 2016*, 2017, http://www.texasefficiency.com/images/documents/Publications/Reports/EnergyEfficiencyAccomplishments/EEPR2016.pdf

[57] Frontier Associates, *Evaluation Measurement & Verification of CPS Energy's FY 2016 DSM Programs*, https://www.sanantonio.gov/portals/0/files/sustainability/Environment/CPSFY2016.pdf

[58] LG&E and KU, "DSM Advisory Group Meeting," 2017, https://lge-ku.com/sites/default/files/2017-10/9-26-2017-EE-Advisory-Group-Presentation.pdf

Figure 5-2. Benchmarking Pool Average Achievable Potential Savings (% of Sales)[59]



Source: Navigant analysis

When comparing potential estimates, it is important to note that although the utilities included in the benchmarking pool may have some similar characteristics, no two utilities are the same; therefore, the results may vary based on the inputs each utility provided to its respective potential study evaluator. Study methodologies may also differ based on the potential study evaluator, providing additional room for variances across studies.

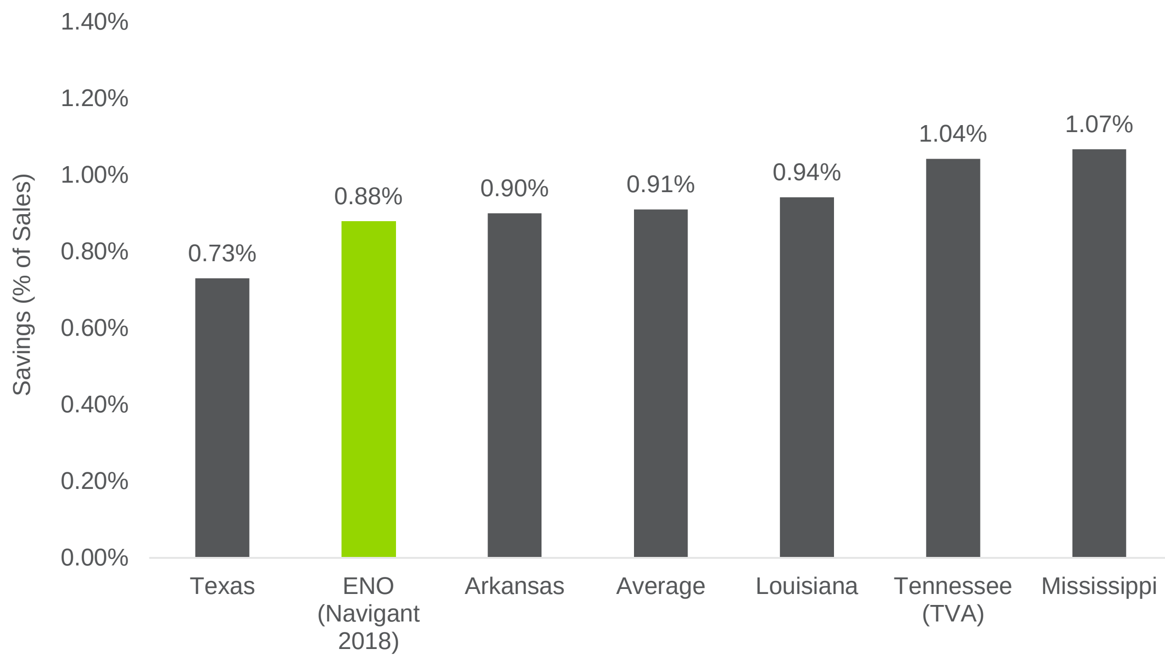
With that in mind, achievable potential savings range from 0.31% to 1.07% of sales. Snohomish Public Utility District in Washington has the highest potential and Louisville Gas & Electric/Kentucky Utilities, the lowest. As mentioned above, these differences may be driven by many factors, including measures studied, cost inputs, study years, and study methodology. ENO's achievable potential falls within the range of the benchmarking pool at an average of 0.88% savings per year over the study period (2017-2038). This is similar to Seattle City Light and slightly above Austin Energy (0.73%). Interestingly, the three all operate in large metropolitan areas and have similar

[59] These savings are shown as an annual average, which Navigant derived by dividing the cumulative study averages by the number of years in the study. The team used this approach because study years tend to differ greatly.

governance structures in that they are regulated by a city council.[60]

In addition to benchmarking the results at the utility level, Navigant created a peer pool at the state level. The goal of this analysis was to understand ENO's potential savings within the broader context of the state of Louisiana and its neighbors. Given that the states are mostly clustered within the Southeast region of the US, they have the same climate (hot-humid) and, therefore, may experience similar levels of achievable potential savings. Figure 5-3 shows how ENO's achievable potential fits into the broader state-level context.

Figure 5-3. Benchmarking Pool State Level Achievable Potential (% of Savings)



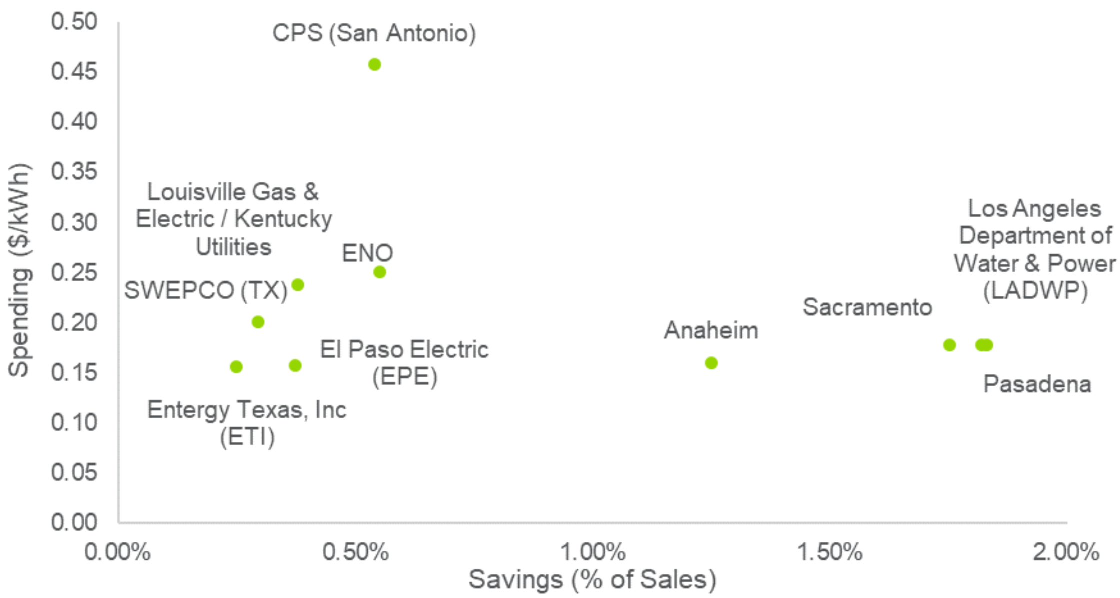
As shown in the figure above, ENO's achievable potential savings are within the range of the benchmarking pool (0.73%-1.07%), which makes sense given the similarities across the region. Its potential savings are only slightly less than the overall pool average and the state of Louisiana. The slight difference in savings of this potential study and the state may be caused by several factors, including:

- Updated inputs

[60] It should be noted that, unlike ENO, which is an IOU, Austin Energy and Seattle City Light are both POUs that function as departments within their respective municipalities. However, all three must comply with the mandates of the local regulatory body.

- Utilities outside New Orleans had not begun implementing energy efficiency programs at the time ACEEE conducted the Louisiana study in 2013
- Broader region covered (some areas may have more or less potential savings based on stock type and other utilities' energy efficiency spending)

Figure 5-4. Benchmarking Pool Actual Savings (% of Sales) vs. Spending ($/kWh)



Source: Navigant analysis

Like achievable potential estimations, actual savings and spending may vary greatly among utilities based on inputs. In this case, inputs may include how the study is administered, what measures are offered, how the program is designed, and the number of years the program has been in place. The figure above shows that CPS Energy in San Antonio spends the most ($0.46/kWh) for less savings (0.54%), while the larger California public utilities (Sacramento Municipal Utilities District, Los Angeles Department of Water & Power, and Pasadena Water & Power) spend the least ($0.16/kWh-$0.18/kWh) but achieve the most (1.25%+). ENO falls in between these two, spending $0.24/kWh and saving 0.55% in 2016. Looking at its Southern peers, ENO's most recent spending and savings align closely, suggesting regional program administration and design variances. Additionally, California programs have been around for significantly longer, which may account for additional cost/savings differentials.

Demand Response

In addition to EE potential, the team also benchmarked DR potential, following a similar process. The process included creating a peer pool based on ENO's characteristics and data availability. This particular effort included both individual utilities and two nearby Independent System Operators (ISOs) or Regional Transmission Authorities (RTOs). The table below includes the sources used for this analysis.

Utility or ISO/RTO	Data Source
Ameren Union Electric (AmerenUE)	AmerenUE DSM Market Potential Study[61]
Con Edison (Con Ed)	DER Potential Study[62]
Commonwealth Edison (ComEd)	Comprehensive Assessment of Demand-Side Resource Potentials[63]
Electric Reliability Council of TX (ERCOT)	Assessment of Demand Response and Advanced Metering[64]
Hawaii Electric Company (HECO)	Fast DR Pilot Program Evaluation[65]
Puget Sound Energy (PSE)	2017 IRP Demand-Side Resource Conservation Potential Assessment Report[66]
Southwest Power Pool (SPP)	Assessment of Demand Response and Advanced Metering[67]

The results of this analysis are shown in the graphic below.

[61] Global Energy Partners, AmerenUE Demand Side Management (DSM) Market Potential Study Volume 1: Executive Summary, January 2010, https://www.ameren.com/-/media/missouri-site/Files/Environment/Renewables/AmerenUEVolume1ExecutiveSummary.pdf.

[62] Navigant, DER Potential Study, 2016.

[63] Cadmus Group, Comprehensive Assessment of Demand-Side Resource Potentials, February 2009, https://www.illinois.gov/sites/ipa/Documents/Appendix%20C-1%20-%20ComEd%20Potential%20Study.pdf

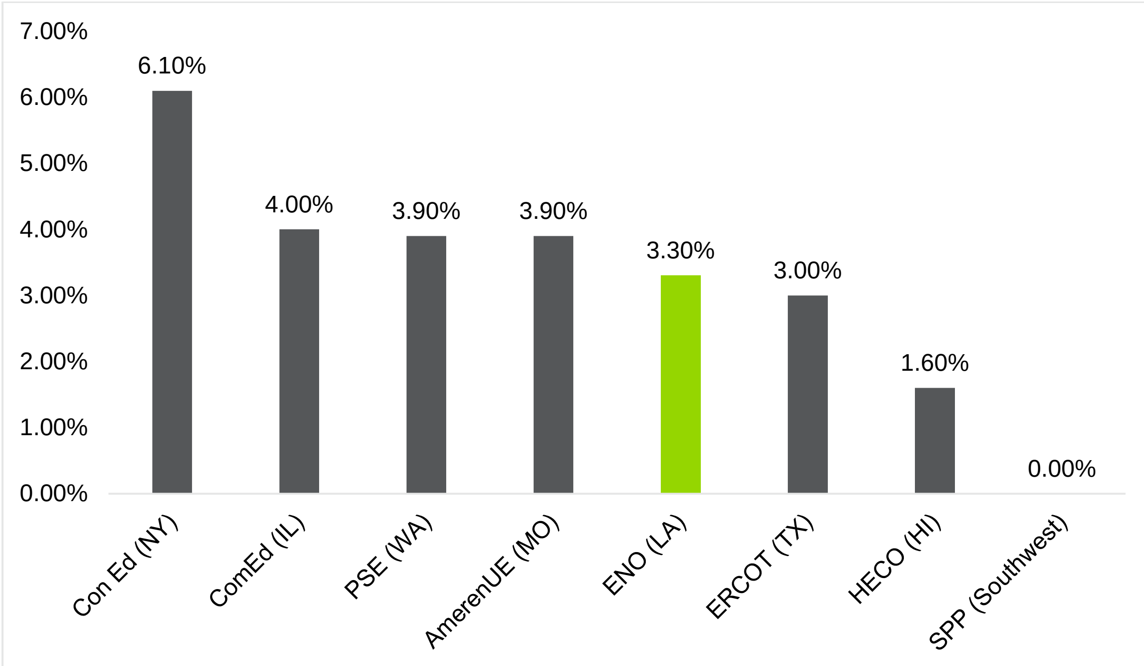
[64] Federal Energy Regulatory Commission (FERC) Assessment of Demand Response and Advanced Metering, 2016, https://www.ferc.gov/legal/staff-reports/2016/DR-AM-Report2016.pdf

[65] Navigant, Fast DR Pilot Program Evaluation, May 2015, http://media.navigantconsulting.com/emarketing/Documents/Energy/HawaiianElectricFastDREvaluationReport_Sept302014NavigantRevisedMay192015v2.pdf

[66] Navigant, 2017 IRP Demand-Side Resource Conservation Potential Assessment Report, June 2017, https://pse.com/aboutpse/EnergySupply/Documents/DSR-Conservation-Potential-Assessment.pdf

[67] FERC, Assessment of Demand Response and Metering.

Figure 5-5. Benchmarking Pool DR Potential (% of Savings)



As shown above, ENO falls in the middle of the benchmarking pool, only slightly higher than ERCOT and slightly below Ameren in Missouri. Given that DR, like EE, varies based on program administration and geographic location, amongst other factors, ENO's DR potential aligns closely to its peers.

5.2 IRP

The IRP is typically an iterative process to optimize the mix of supply- and demand-side resources to meet the utility's demand. The mix of supply-side resources dictates the costs to be used as avoided costs, but if energy efficiency programs can vary the supply-side mix (i.e., reduce the need of costlier resources), the avoided costs will vary. The IRP outputs feed into the projected cost and goals used to formulate the near-term DSM program implementation portfolio.

The potential study provides forecasted savings inputs for use in the IRP modeling. These inputs are provided by sector, segment, and end use because each combination of these items is mapped to a load shape (see Appendix C). Each measure is mapped to one or more DSM programs. Navigant then developed a load shape representative of each DSM program. The DSM program load shape represents the aggregate hourly energy savings for the group of measures included in the program over the 20-year planning period. These load shapes are what define the hourly usage profiles for the DSM program portfolio. The data provided is aligned with the Council's IRP rulemaking, R-17-429 which requests that the data supplied should include: a description of each demand-side resource considered, including a description of resource expected penetration levels by year; hourly load reduction profiles for each DSM program; and results of all 4 standard cost-effectiveness tests.

5.3 Program Planning

It is important to recognize that DSM potential studies like this one are inherently different from DSM program portfolio designs. The long-term achievable potential identified for a 20-year period through this study is different from the short-term savings potential that would be identified though a DSM program portfolio design effort targeting a 3-year period. However, it is important to note that programmatic design (such as delivery methods and marketing strategies) will have implications for the overall savings goals and projected cost. As mentioned above, **near-term savings potential, actual achievable goals, and program costs for a measure-level implementation will vary from the savings potential and costs estimated in this long-term study**. This potential study is one element to be considered in program design, along with historical program participation and current market conditions (with the team members on the ground).

Some observations on the potential study results that can provide input to program planning are:

- There is strong potential with promoting advanced lighting, which includes networked lighting technology and controls in all sectors.
- There is high potential in O&M and behavior-type programs such as retrocommissioning if they are cost-effective.
- HVAC unitary equipment has high potential in both sectors.

5.4 Further Research

Finally, the potential study identified data gaps in characterizing ENO's market and measures. This is common for most utilities; however, for ENO to have more accurate potential estimates and information to support DSM planning, there is ENO-specific data that could support this end goal:

- Baseline and saturation studies for each sector
- Updated residential end-use survey
- C&I end-use survey
- Customer payback acceptance analysis specific to the ENO service area (in particular due to the high penetration of renters)

Appendix A. Energy Efficiency Detailed Methodology

A.1 End-Use Definitions

Table A-1. Description of End Uses

Segment	End Use	Definition
Residential	Total Facility	Consumption of all electric end uses in aggregate
	Lighting Interior	Overhead lights, lamps, etc.
	Lighting Exterior	Spotlighting, security lights, holiday/seasonal lighting, etc.
	Plug Loads	Large/small appliances including ovens, refrigerators, freezers, clothes washers, etc. Televisions, computers and related peripherals, and other electronic systems
	Cooling	All cooling, including both central air conditioning and room or portable air conditioning
	Heating	All heating, including both primary heating and supplementary heating
	Fans/Ventilation	Motor drives associated with heating and cooling
	Water Heating	Heating of water for domestic hot water use
	Other	Miscellaneous loads
C&I	Total Facility	Consumption of all electric end uses in aggregate
	Lighting Interior	Overhead lights, lamps, etc. (main building and secondary buildings)
	Lighting Exterior	Spotlighting, security lights, holiday/seasonal lighting, etc. (main building and secondary buildings)
	Plug Loads	Computers, monitors, servers, printers, copiers, and related peripherals
	Cooling	All cooling equipment, including chillers and direct expansion cooling
	Heating	All heating equipment, including boilers, furnaces, unit heaters, and baseboard units
	Fans/Ventilation	Motor drives associated with heating and cooling
	Refrigeration	Refrigeration equipment including fridges, coolers, and display cases
	Water Heating	Hot water boilers, tank heaters, and others
	Other	Miscellaneous loads including elevators, gym equipment, and other plug loads

Source: Navigant

A.2 Residential Sector

The following sections describe the detailed approach used to determine electricity consumption by segment, the approach used to estimate end-use intensities (EUIs), and the resulting residential household stock. To do this, Navigant needed to determine four pieces of information:

1. Base year stock
2. Base year consumption
3. Base year EUIs
4. Reference case forecast for all values

1. Base Year Residential Stock and 2. Base Year Electricity

To estimate the residential stock, Navigant proposed an approach that leveraged ENO's billing data. The challenge with this approach was that ENO's billing data identifies residential accounts using a customer name rather than a billing address. This can overstate the residential stock, as multiple tenants may occupy a single billing address over time. For example, a home with two different tenants (e.g., tenant A from January to June, and tenant B from July to December) are reported as two separate accounts and thus imply two separate residential households. This approach can also underestimate the average electricity usage by account. In fact, the team compared the billing and consumption data against historical sales and found that the data did not align. Navigant overcame these challenges by:

- Determining residential electricity sales (GWh) with a full year of data (e.g., an account with 12 consecutive months of sales) by segment and calibrating these values to ENO's sales forecast to ensure alignment with ENO's sales planning assumptions moving forward.
- Determining stock (#) from accounts with a full year of data (e.g., an account with 12 consecutive months of sales) by segment and calibrating these to ENO's account forecast to ensure alignment with ENO's account planning assumptions moving forward.

The team applied this approach to the two residential segments to ensure that all datasets provided by ENO aligned to their internal planning assumptions. Table A-2 provides an example of the base year residential stock and sales calculations.[68]

[68] Note these do not represent actual values provided by ENO. All values are meant to illustrate the methodology.

Table A-2. Example Base Year Residential Stock and Sales Equations

Step	Value	Calculation
(1) Aggregate sales from residential sector billing data to get a sector-level sales value (1,000 GWh for single family and 900 GWh for multifamily)	1,900 GWh	
(2) Determine sales for residential sector from billing data	1,700 GWh	Provided by ENO
(3) Compare (1) to (2) to get a calibration factor	0.89	(2) / (1)
(4) Calibrate segment-level sales by calibration factor from (3)	895 GWh for single family; 805 GWh for multifamily	Segment-level sales from (1)*(3)

Note: Navigant used this process for both the residential stock (accounts) and sales (load). As mentioned above, the team used ENO's billing data as a starting point and the account forecast as the basis for calibration.
Source: Navigant analysis

Table A-3 shows the segment-level stock and base year sales derived from the calibration analysis outlined above.

Table A-3. ENO Residential Base Year Results

Segment	Sales (GWh)	Stock (Households)	kWh/ Household
Single Family	749	132,901	11,144
Multifamily	1,481	45,048	16,632
Total	**2,230**	**177,949**	**12,533**[69]

Source: Navigant analysis

3. Base Year EUIs

To determine residential EUIs at the segment level, Navigant leveraged the calibrated sales and stock derived above. The team then divided the load per segment by the stock per segment to get the EUIs. After calculating the segment-level EUIs, Navigant further disaggregated the values to get EUIs, a key model input. This process consisted of multiplying the segment-level EUIs by end-use allocations, or the proportion of energy used by a certain end use (e.g., this proportion of the EUI is X% of the total EUI). Navigant derived these proportions using the DOE's EnergyPLUS model in

[69] This figure represents the total consumption divided by the total number of households and not the addition of the single family and multifamily kWh/household EUI values.

conjunction with an internal model.

Table A-4 provides the derived end-use allocations by residential segment.

Table A-4. Base Year Residential EUIs (kWh per Acct.)

Building Segment	Cooling	Fans/ Ventilation	Heating	Hot Water	Lighting Exterior	Lighting Interior	Plug Loads	Heating/ Cooling	Total Facility
Single Family	3,229	1,790	304	493	345	2,158	2,824	3,533	11,144
Multifamily	4,819	2,672	454	736	515	3,221	4,215	5,273	16,632

Source: Navigant analysis

4. Reference Case Stock and EUIs

To develop the residential stock forecast through 2037, ENO provided Navigant with its residential account and sales forecasts. Based on these forecasts, the team derived the annual growth rates by dividing the difference of the new and old stock by the old stock (e.g., (2017 stock – 2016 stock) / 2016 stock). Navigant used the same approach to determine the annual sales forecast growth. After deriving the growth rates, the team applied them directly from the account forecast to determine the growth in stock across all segments over the forecast period. Likewise, the team applied the annual growth rates directly from the sales forecast to determine the growth in sales across all segments over time.

Table A-5 shows the growth in stock from 2016 to 2037 used in the reference case by segment.

Table A-5. Reference Case Residential Stock Forecast (Accounts)

Segment	2016	2037
Single Family	132,901	144,972
Multifamily	45,048	49,139
Total	**177,949**	**194,111**

Source: Navigant analysis

Because the EUI formula leverages the stock and load directly, the EUI growth trends follow both the stock and load trends. More specifically, the team divided the load by the stock to get the base year's EUIs. Therefore, the overall growth rate is 0.4% from 2016 to 2037 for both segments and all end uses. Table A-6 shows the change in EUI from 2016 to 2037.

Table A-6. Reference Case EUI Forecast (Accounts)

Segment	2016	2037
Single Family	11,144	10,829
Multifamily	16,632	16,161

A.3 C&I Sector

To determine the total C&I floor space stock in ENO's service area, Navigant needed to determine four key pieces of information:

1. Base EUI for ENO's climate region in kWh/thousands SF
2. ENO's base year sales by segment in kWh
3. Base year C&I stock in thousands SF
4. Reference case forecast based on the base year numbers

The approach used to determine each of these pieces of information and the methodology for deriving the floor space stock is described below.

1. Base EUIs for ENO's Climate Region

As a starting point for the analysis, Navigant needed to determine a base EUI value by segment that the team could calibrate to ENO's stock and climate. Navigant first began with the US Energy Information Administration's (EIA's) electricity energy (use) intensity in kWh/SF by EIA principal building activity for ENO's climate category, the hot-humid region.[70] The team then mapped the principal building activities to the study's segments as a basis for the EUI. Table A-7 shows the mappings.

Table A-7. C&I EIA EUI Segments to Study Segment Mappings

EIA Principal Building Activity	Study Segment
Education	Colleges/Universities
Health care	Healthcare
All Buildings	Industrial/Warehouses
Lodging	Lodging

[70] Source: CBECS, Table C20. Electricity consumption and conditional energy intensity by climate region, 2012, May 2016, https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c20.php

EIA Principal Building Activity	Study Segment
Office	Office – Large
Office	Office – Small
Public Assembly	Other Commercial
Food Service	Restaurants
Food Sales	Retail – Food
Mercantile	Retail – Non-Food
Education	Schools

Source: Navigant analysis

After deriving the calibrated segment-level EUIs, Navigant further disaggregated by end use to obtain EUIs. The team disaggregated the values by first determining the end-use allocations for each segment, leveraging the US Department of Energy's (DOE's) EnergyPLUS model in conjunction with proprietary internal models. Like residential, these values represented a proportion of each segment and were applied by multiplying the proportion by the segment-level EUIs.

As noted above, Navigant used a top-down approach rather than bottom-up for this particular analysis due to data availability. The team wanted to leverage as many ENO-specific sources as possible to ensure consistency with ENO's planning. In this case, ENO had not conducted any recent commercial end-use saturation studies, and Navigant could not find any reliable secondary studies specifically for the New Orleans area. For this reason, the team used the best data available at the time of modeling, which was ENO's internal forecasts and Navigant's end-use allocation estimates.

2. Base Year Electricity Sales

To determine the base year electricity sales of each C&I segment, ENO provided SIC account data, which the team used to create a breakdown of electricity sales by SIC. Navigant and ENO then worked together to develop a mapping of SIC data to C&I segments. It is generally recognized that SIC assignment to account data may have errors. The team developed this mapping through various reviews of the data to minimize electricity sales allocated to the other commercial segment. The mapping yielded a breakdown of accounts by segments (e.g., 5.6% of accounts are colleges/universities). Navigant used this breakdown to disaggregate the 2016 sales into segments (e.g., 5.6% of accounts are colleges/universities; therefore, 5.6% of the load belongs to that segment).

One exception to the account and sales mapping process was the industrial/warehouses segment. For this specific segment, Navigant noticed that the proportion of accounts mapped to this segment was greater than ENO's industrial load forecast by roughly 3%. To ensure complete alignment with ENO's internal planning assumptions, the team moved the excess 3% sales into the other commercial segment after discussions with the utility. Navigant then added in the industrial proportion, which was negligible (0%). This resulted in industrial/warehouses having 13.0% of the sales and other commercial having 13.9% of the sales.

Table A-8 shows the breakdown of C&I sales resulting from this analysis.

Table A-8. ENO C&I Base Year Results (GWh)

Segment	Stock (thousands SF)	Total Sales (GWh)	Percentage of Total
Colleges/Universities	15,388	196	5.6%
Healthcare	8,318	237	6.8%
Industrial/Warehouses	27,863	457	13.0%
Lodging	34,693	523	14.9%
Office – Large	15,875	270	7.7%
Office – Small	36,365	619	17.7%
Other Commercial	22,504	485	13.9%
Restaurants	4,720	218	6.2%
Retail – Food	2,574	125	3.6%
Retail – Non-Food	16,548	327	9.3%
Schools	3,494	45	1.3%
Total	**188,340**	**3,503**	**100%**

Source: Navigant analysis

3. Base Year Stock Calibration Approach

After determining the base EUIs from EIA data and disaggregating ENO's sales data, Navigant calculated the base year C&I stock using the formula in Figure A-1.

Figure A-1. C&I Base Year Stock Formula

$$\underline{\text{ENO Stock by Segment}}\ [ft^2] = \underbrace{\underline{\text{ENO Sales by Segment}}\ [kWh]}_{\text{Derived from Step 2}} \ / \ \underbrace{\underline{\text{EUI by Segment}}\ [kWh/ft^2]}_{\text{Derived from Step 1}}$$

Source: Navigant analysis

The calculation yielded the base year stock by segment, which the team then used to determine the reference case stock and EUI.

4. Reference Case Stock and EUI Approach

The team used the base year values to create the reference case stock and EUI forecasts. To do this, Navigant used the growth rates directly from ENO's sales and account forecast, applying the C&I sector forecasts to all segments except for industrial/warehouses.[71] For that specific segment, Navigant applied the industrial sector forecast to ensure consistency with ENO's data. The team then applied these growth rates to each of the base year values to obtain the reference case.

Table A-9 shows the results of these analyses.

Table A-9. Reference Case C&I EUI, Sales, and Stock

Data Point	2016	2037
Sales (GWh)	3,503	3,999
EUI (kWh/thousands SF)	255,744	272,412
Stock (thousands SF)	188,340	200,648

Source: Navigant analysis

[71] Note that the growth rates for the forecasts aligned at 0.4% for commercial and 0.0% for industrial/warehouses over the study period. These rates represent the compound annual growth rate (CAGR) across the entire study period. Actual growth rates fluctuate from year to year following the load forecast provided by ENO. The load forecasts are largely driven by industry indices.

Appendix B. Energy Efficiency Input Assumptions

B.1 Measure List and Characterization Assumptions

Navigant developed the measure list and characterizations based on internal expertise, ENO-specific data, the New Orleans TRM, and secondary sources where necessary.

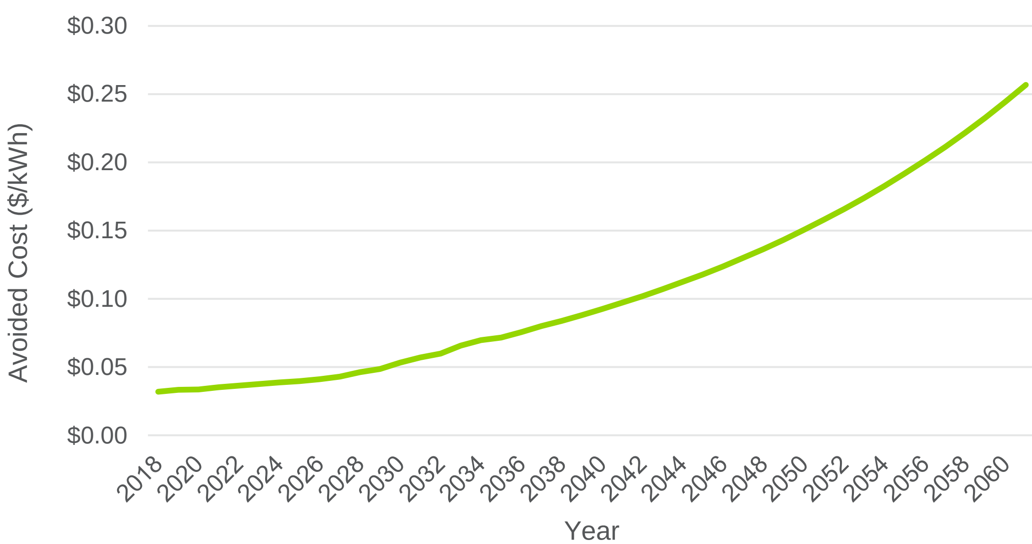
B.2 Avoided Costs and Cost-Effectiveness

In addition to the reference case and measure characterization assumptions, Navigant input several cost-related inputs to determine the cost-effectiveness of measures over the study period. This section details those inputs.

Avoided Energy Costs

ENO provided the BP18U[72] avoided costs over the study period plus the longest measure life (2037 + 25 years) to Navigant to input into the model. Figure B-1 shows the avoided energy cost projections, or forecasted locational marginal prices (LMPs).

Figure B-1. ENO BP18U Avoided Cost Projections

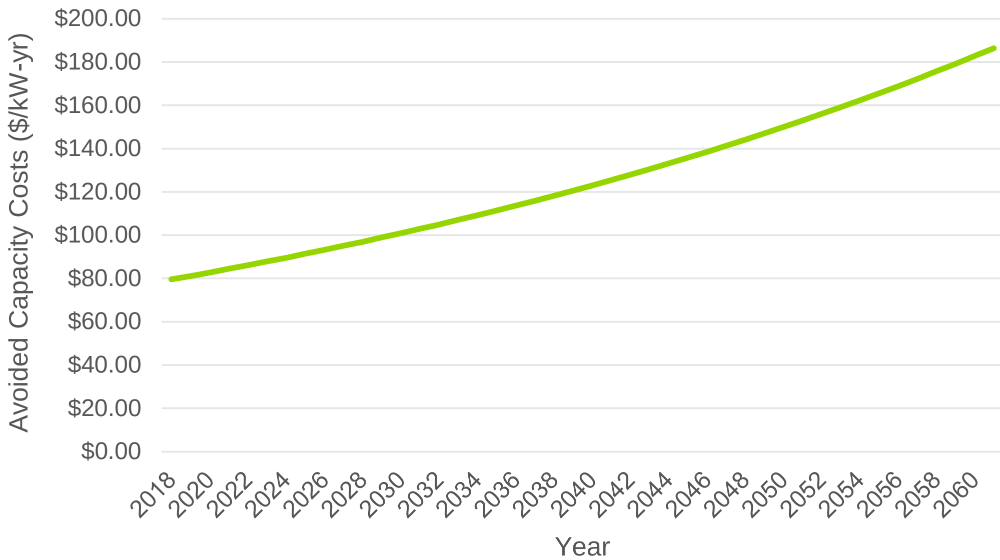


[72] BP18U refers to the vintage of a set of planning and modeling assumptions. At the time of this study, BP18U was the latest assumption set available.

Avoided Capacity Cost

ENO also gave Navigant avoided capacity costs to input into the model for costs over the study period plus the longest measure life (2037 + 25 years). Like the avoided energy costs, the capacity costs align with ENO's BP18U and its internal planning. Figure B-2 shows these costs over the study period.

Figure B-2. ENO BP18U Avoided Capacity Projections

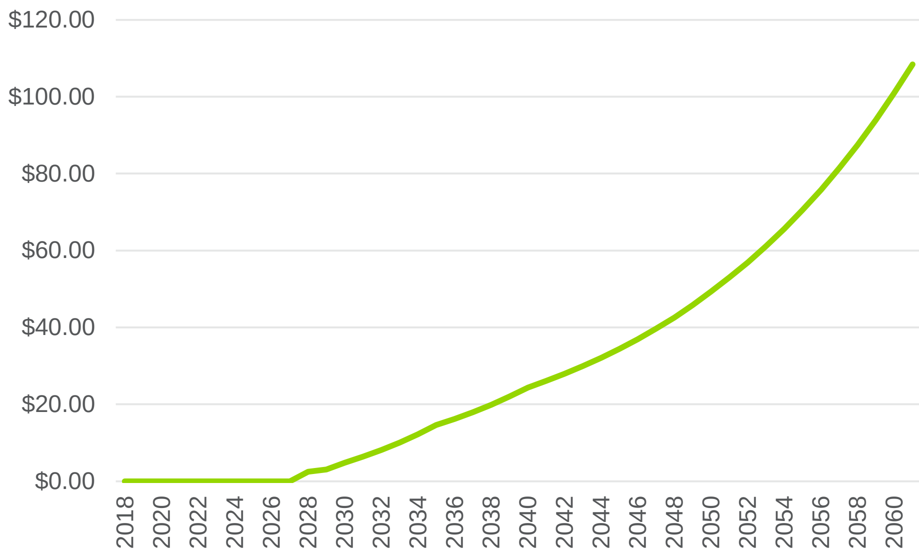


Carbon Pricing

In addition to avoided costs, ENO provided carbon pricing estimates through 2050 for the potential model. However, the carbon pricing inputs needed to extend further out than the study period to accurately model measure costs over their lifetime. More specifically, Navigant needed to model carbon prices up until the end of the study period plus the longest measure life (25 years). The team extrapolated these last years by taking the average growth (8%) for the last 5 years of the forecast (2045-2050) and applying it to the remaining 11 years.[73] Figure B-3 shows the carbon pricing estimates provided and extrapolated.

[73] Note that the growth rate was flat for the remaining 5 years provided.

Figure B-3. ENO Carbon Pricing Projections[74]



B.3 Cost-Effectiveness Calculations

The potential analysis uses two forms of cost-effectiveness calculations. The total resource cost (TRC) test is for utility cost-effectiveness. There is also the participant cost test (PCT), which is mostly addressed by calculating the participant payback period instead of the benefit-cost ratio for the PCT. This section describes these tests, the inputs, and how they are used for the potential study.

TRC Test

The TRC test is a benefit-cost metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the utility (or program administrator) and the customers. The TRC benefit-cost ratio is calculated in the model using Equation B-1.

Equation B-1. Benefit-Cost Ratio for TRC Test

$$TRC = \frac{PV(Avoided\ Costs)}{PV(Technology\ Cost + Admin\ Costs)}$$

[74] Note that the forecast extends until 2061, although the label for year 2061 is not visible. This is because the chart shows years in increments of two for aesthetic purposes.

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric energy and capacity savings—e.g., avoided costs of infrastructure investments and avoided fuel (commodity costs) due to electric energy conserved by efficient measures.
- *Technology Cost* is the incremental equipment cost to the customer.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. Effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow ENO to easily apply updated NTG assumptions in the future and allow for variations in NTG assumptions.

The administrative costs are included when reporting sector-specific or portfolio-wide cost-effectiveness. However, they are not included at the measure level for economic potential screening. For this screening, it is important to identify measures that are cost-effective on the margin prior to assessing effects for the achievable potential where administrative costs are considered depending on the amount and level of programmatic spend.

Participant Payback Period

Navigant calculates the customer payback period to assess customer potential to implement the energy-saving action. The payback period is used to assess customer acceptance and adoption of the measure. Additional details are described in the achievable potential methodology section 2.1.4.3. The payback period is calculated after the incentive is applied to the measure cost. Equation B-2 demonstrates the calculation.

Equation B-2. Participant Payback Period

$$Payback = \frac{Annual\ kWh\ Saved\ \times Annualized\ Retail\ Rate\ \left(\$/_{kWh}\right)}{Incremental\ Measure\ Cost - Incentive}$$

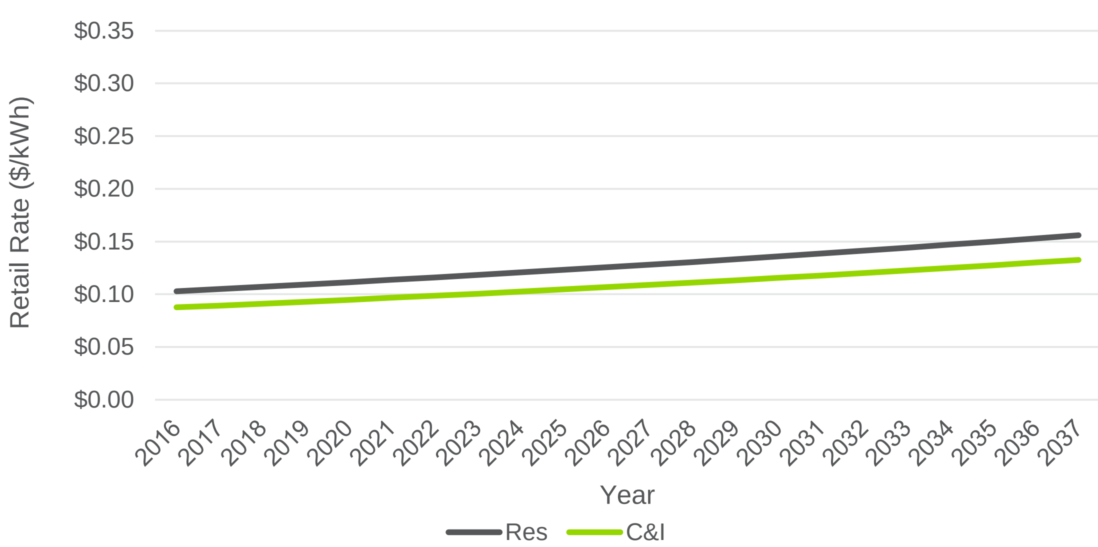
Where:

- *Annual kWh Saved* is calculated for each measure and segment (as appropriate).
- *Annualized Retail Rate* is the overall cost a customer pays per kWh consumed (see Appendix B.4).
- *Incremental Measure Costs* are the costs the participant would pay (without an incentive) to implement the measure. In replace-on-burnout (ROB) and new construction (NEW), depending on the measure, the difference in the cost of the efficiency and standard equipment is used instead of the full cost of installation (material and labor costs).
- *Incentives* are the incentive costs paid for a customer's out of pocket costs to be reduced.

B.4 Retail Rates

Because customer economics is a primary driver of energy efficiency measure adoption, Navigant used a forecast of electric retail rates for each sector to estimate achievable energy and demand potential. Because ENO did not have a forecast of retail rates readily available, the team calculated the retail rates by dividing the historic revenue ($) by the historic sales (kWh) to yield an approximation of retail rates ($/kWh) by sector for the base year (2016). Navigant then assumed that the rates would increase with inflation, or 2% per year.

Figure B-4. Electricity Retail Rate Forecast: 2016-2037



Source: Navigant analysis

B.5 Other Key Input Assumptions

As shown in Table B-1 below, Navigant used ENO's financial WACC as the discount rate[75] and an inflation rate consistent with the utility's planning.

Table B-1. Potential Study Assumptions

Variable Name	Percentage
Discount Rate	7.72%
Inflation Rate	2.00%

Source: ENO

75 *See*, Docket UD-08-02, Technical Advisors' Evaluation of Energy Smart Program Years 7-9 Proposed Program Budget, dated July 6, 2017, for discussion of appropriate use of utility WACC as discount rate in evaluating cost effectiveness of DSM programs.

Appendix C. Hourly 8,760 Analysis and Measure/Program Mapping

Navigant developed an 8,760 hourly normalized end-use load shape library to support case-specific assessments of specific energy efficiency, demand response (DR), and other technologies assessed as part of this study. For this task, the team created representative end-use load shapes for each customer segment identified by ENO. Navigant also used these load shapes to calculate the peak savings for energy efficiency measures.

In the absence of end-use metered consumption, the US Department of Energy (DOE) prototype reference building models, simulated with local weather files, provide reasonable end-use load shapes to use in the potential model. The end-use load profiles are sensitive to several of the building model inputs (temperature setpoints, operation schedules, etc.); however, Navigant put considerable thought into adjusting these inputs to model typical consumption profiles for each building segment.

End-use metering provides load shapes with a higher degree of certainty, but the costs far exceed those of using prototypical building models. The resulting end-use load shape estimates may have high uncertainty. Additional rigor of the end-use load shape estimate becomes critical when the valuation of energy efficiency and understanding of each electric using equipment load profile must match each kW as tracked by supply-side resource planning. In these instances, end-use metering may be warranted.

C.1 End-Use Load Shape Development

Navigant's load profile development followed these steps:

1. **Assess measures and identify load profiles.** Following ENO approval of the final list of measures to be characterized and included in the analysis, Navigant staff identified a set of end use/sector/segment combinations of load profiles such that each conservation measure and base technology has an assigned load profile.
2. **Present load profile mapping for ENO feedback and approval.** Once Navigant staff mapped a load profile type to each measure, ENO reviewed the list of load profiles and the measures to which they map.
3. **Identify appropriate base load shapes.** To maximize value for ENO, Navigant leveraged its existing database of end-use sectoral load profiles for this analysis.
4. **Adapt load shapes to New Orleans.** Navigant include New Orleans-specific weather and residential sector consumption data to adapt load shapes to be ENO-specific. The next section describes the approach used for this step.
5. **Apply load profiles to DSMSim outputs.** Navigant applied the final load shapes to the aggregated DSMSim outputs to deliver the 8,760 profile of conservation impacts required by ENO.

Load Shape Development Approach

Navigant used the EnergyPlus building simulation software to run prototypical building energy models for residential and C&I customer segments. The team used updated versions of the US DOE commercial and residential reference building models to complete the simulations; these are representative of typical building constructions and represent typical energy and demand for buildings within the building stock. Navigant maintains this model set for extracting end-use load shapes for potential studies. The team leveraged EnergyPLUS prototype models that include several updates made during a previous study to more accurately reflect typical hourly energy consumption of buildings. These updates include smoothing HVAC operation schedules and ramping HVAC setpoint changes over many hours instead of a step-change in setpoint between two adjacent hours. Navigant also leveraged various end-use load shape metering studies to make informed model updates to more accurately reflect real-world operation of these equipment types:

- Navigant updated the lighting profiles contained in the DOE commercial reference building models with Northeast Energy Efficiency Partnerships (NEEP) lighting profiles.[76] The NEEP lighting profiles are weather-normalized lighting profiles that were developed for the Northeast and Mid-Atlantic regions of the US using data from integral lighting meters. The metered data was collected for energy efficiency project evaluations ranging from 2000 to 2011. It is important to note that non-weather dependent end uses can be transferable from one region to another, such as lighting and appliances.[77]
- Navigant updated the lighting profiles for the residential reference building with the residential lighting load shapes from a metering study in the Northeast. The metered data was collected in 2015.

Navigant used typical meteorological year (TMY) weather data for New Orleans in the EnergyPLUS modeling environment.

Residential Load Shapes

ENO provided Navigant with 2015 distribution-level data containing hourly energy consumption for residential buildings across the ENO service area. The team used the consumption data for the residential sector to visually calibrate the load shape outputs

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[76] Lighting hourly load profiles were taken from the July 19, 2011 C&I Lighting Load Shape Project for NEEP (associated spreadsheet - Profiles v2.6_4_18-KIC.xls).

[77] End-Use Load Data Update Project Final Report, www.neep.org/file/2693/download?token=aOWk8oud. Tables 3 and 4 in the report identify the load shapes that are highly transferrable across regions.

from the residential building models for the 2015 model year. To do this, Navigant processed the consumption data and the hourly building energy model output data to visually compare average daily profiles (weekday and weekend) for each month of the year. The team adjusted building model inputs to calibrate the total building load to the ENO distribution data.

For the residential building model, Navigant used the average daily load shapes from the ENO residential distribution data to adjust various inputs in the building model. The team adjusted building model input parameters to match the on-peak and off-peak energy consumption shapes and to ensure that the total facility energy peaks developed with the building model lined up temporally with the system peaks represented within the distribution data. Navigant made slight adjustments to lighting, equipment, and heating and cooling schedules to calibrate the residential model to the ENO distribution data.

Load profiles were then developed using the calibrated building models and a TMY3 New Orleans weather file. Table D-1 and Table D-2 list the residential customer segment building types and end uses modeled, respectively.

C&I Load Shapes

The Navigant team used the commercial building models from its model library and simulated typical load shapes using the TMY3 New Orleans weather files. Navigant inputted these load shapes into the ENO potential model. Table C-1 and Table C-2 list the C&I customer segment building types and end uses modeled, respectively.

Table C-1. Modeled Customer Segments by Sector

Residential	Commercial and Industrial
Multifamily	Colleges/Universities
Single Family	Healthcare
	Industrial/Warehouses
	Lodging
	Office-Large
	Office-Small
	Schools
	Restaurants
	Retail - Food
	Retail (Non-Food)
	Other Commercial

Table C-2. Modeled End Uses by Sector

Residential	Commercial & Industrial
Total Facility (Electric)	Total Facility (Electric)
Lighting Interior (Electric)	Lighting Interior (Electric)
Lighting Exterior (Electric)	Lighting Exterior (Electric)
Plug Loads (Electric)	Plug Loads (Electric)
Cooling (Electric)	Cooling (Electric)
Heating (Electric)	Heating (Electric)
Heating/Cooling (Electric)	Heating/Cooling (Electric)
Hot Water (Electric)	Fans/Ventilation (Electric)
Other	Refrigeration (Electric)
	Hot Water (Electric)
	Other

C.2 Hourly IRP Model Inputs Development

The Navigant team used the 8,760 loadshapes developed using the approach described in the previous section to convert the annual potential estimates into hourly potential estimates. In doing so, Navigant created program categories (Table C-3) to aggregate these hourly potential estimates to the program level and develop the input files necessary to support the IRP modeling. Navigant performed this aggregation using the mapping in Table C-4, below. The table shows a many-to-one mapping between measures and programs because some measures belong to more than one program. Navigant used the verified savings breakdown by program in ENO's PY6 Energy Smart EM&V report to weight the savings allocation of these measures to programs.

Table C-3. Program Categories

Sector	Program Name	Program Abbreviation
C&I	Commercial Behavior	Com Behavior
	Large Commercial & Industrial	Large C&I
	Small Commercial & Industrial	Small C&I
Res	Consumer Products	Consumer Products
	Home Performance with Energy Star	HPwES
	Heating, Ventilation, Air Conditioning	HVAC
	Low Income_ Multi-Family	LI_MF
	Residential Behavior	Res Behavior

School Kits	School Kits

Table C-4. Measure and Program Mapping for IRP Modeling Inputs

Sector	Program	Measure
C&I	Com Behavior	C&I | Building Benchmarking
C&I	Com Behavior	C&I | Retro commissioning
C&I	Large C&I	C&I | Advanced Lighting Controls
C&I	Large C&I	C&I | Advanced Roof Top Unit (RTU) Controls
C&I	Large C&I	C&I | Air and Water-Cooled Chillers
C&I	Large C&I	C&I | Air Compressor Improvements
C&I	Large C&I	C&I | Building Controls and Automation Systems (applicable to central/RTU systems)
C&I	Large C&I	C&I | Combination Ovens
C&I	Large C&I	C&I | Commercial Clothes Dryer
C&I	Large C&I	C&I | Commercial Clothes Washer
C&I	Large C&I	C&I | Commercial Fryers
C&I	Large C&I	C&I | Commercial Griddles
C&I	Large C&I	C&I | Commercial Steam Cookers
C&I	Large C&I	C&I | Computer Power Management
C&I	Large C&I	C&I | Controls Continuous Dimming
C&I	Large C&I	C&I | Controls Occupancy Sensor
C&I	Large C&I	C&I | Convection Ovens
C&I	Large C&I	C&I | Cool Roof
C&I	Large C&I	C&I | Demand Control Ventilation
C&I	Large C&I	C&I | Demand Controlled Ventilation (DCV) Exhaust Hood
C&I	Large C&I	C&I | Door LEDs
C&I	Large C&I	C&I | Ductless Mini-Split Heat Pump
C&I	Large C&I	C&I | Electric Storage Water Heater
C&I	Large C&I	C&I | Electric tankless water heater
C&I	Large C&I	C&I | ENERGY STAR Clothes Washers
C&I	Large C&I	C&I | ENERGY STAR Residential-size Refrigerator in Commercial Buildings
C&I	Large C&I	C&I | Evap Fan Controls
C&I	Large C&I	C&I | Fan and pump optimization (variable frequency drive)
C&I	Large C&I	C&I | Faucet Aerator
C&I	Large C&I	C&I | General Process Improvements (Strategic Energy management)
C&I	Large C&I	C&I | Heat Pump Water Heater
C&I	Large C&I	C&I | High Efficiency Fans and energy management

Sector	Program	Measure
C&I	Large C&I	C&I | Interior 4 ft LED
C&I	Large C&I	C&I | Interior LED High Bay | Replacing HID
C&I	Large C&I	C&I | Interior LED High Bay | Replacing T8HO HB
C&I	Large C&I	C&I | LED Fixture - Interior
C&I	Large C&I	C&I | LED Screw In - Interior
C&I	Large C&I	C&I | LED Traffic Signals
C&I	Large C&I	C&I | Low-Flow Showerheads
C&I	Large C&I	C&I | Plug Load Occupancy Sensors
C&I	Large C&I	C&I | Pre-rinse spray valve
C&I	Large C&I	C&I | PTAC/PTHP Equipment
C&I	Large C&I	C&I | Smart Thermostats
C&I	Large C&I	C&I | Unitary and Split System AC/HP Equipment
C&I	Large C&I	C&I | Variable Air Volume HVAC
C&I	Large C&I	C&I | Water Heater Pipe Insulation
C&I	Large C&I	C&I | Window Film
C&I	Large C&I	C&I | Zero Energy Doors
C&I	Small C&I	C&I | Advanced Lighting Controls
C&I	Small C&I	C&I | Advanced Power Strips
C&I	Small C&I	C&I | Advanced Roof Top Unit (RTU) Controls
C&I	Small C&I	C&I | Building Controls and Automation Systems (applicable to central/RTU systems)
C&I	Small C&I	C&I | Combination Ovens
C&I	Small C&I	C&I | Commercial AC and HP Tune Up
C&I	Small C&I	C&I | Commercial Clothes Dryer
C&I	Small C&I	C&I | Commercial Clothes Washer
C&I	Small C&I	C&I | Commercial Fryers
C&I	Small C&I	C&I | Commercial Griddles
C&I	Small C&I	C&I | Commercial Steam Cookers
C&I	Small C&I	C&I | Computer Power Management
C&I	Small C&I	C&I | Controls Continuous Dimming
C&I	Small C&I	C&I | Controls Occupancy Sensor
C&I	Small C&I	C&I | Convection Ovens
C&I	Small C&I	C&I | Cool Roof
C&I	Small C&I	C&I | Demand Control Ventilation
C&I	Small C&I	C&I | Demand Controlled Ventilation (DCV) Exhaust Hood
C&I	Small C&I	C&I | Door Heater Controls
C&I	Small C&I	C&I | Door LEDs
C&I	Small C&I	C&I | Ductless Mini-Split HP
C&I	Small C&I	C&I | Electric Storage Water Heater

Sector	Program	Measure
C&I	Small C&I	C&I | Electric tankless water heater
C&I	Small C&I	C&I | Electronically Commutated Motors (ECMs) for Refrigeration and HVAC Applications
C&I	Small C&I	C&I | ENERGY STAR Clothes Washers
C&I	Small C&I	C&I | ENERGY STAR Residential-size Refrigerator in Commercial Buildings
C&I	Small C&I	C&I | Evap Fan Controls
C&I	Small C&I	C&I | Fan and pump optimization (variable frequency drive)
C&I	Small C&I	C&I | Faucet Aerator
C&I	Small C&I	C&I | Heat Pump Water Heater
C&I	Small C&I	C&I | Interior 4 ft LED
C&I	Small C&I	C&I | Interior LED High Bay | Replacing HID
C&I	Small C&I	C&I | Interior LED High Bay | Replacing T8HO HB
C&I	Small C&I	C&I | LED Fixture - Interior
C&I	Small C&I	C&I | LED Screw In - Interior
C&I	Small C&I	C&I | Low-Flow Showerheads
C&I	Small C&I	C&I | Plug Load Occupancy Sensors
C&I	Small C&I	C&I | Package terminal air conditioner/Package terminal heat pump Equipment
C&I	Small C&I	C&I | Refrigeration electronically commutated motor
C&I	Small C&I	C&I | Smart Thermostats
C&I	Small C&I	C&I | Solid Door commercial refrigerator
C&I	Small C&I	C&I | Strip Curtain
C&I	Small C&I	C&I | Variable Air Volume HVAC
C&I	Small C&I	C&I | Vend Machine Controls
C&I	Small C&I	C&I | Water Heater Pipe Insulation
C&I	Small C&I	C&I | Window Film
C&I	Small C&I	C&I | Zero Energy Doors
Res	Consumer Products	Res | Dehumidifiers
Res	Consumer Products	Res | Dryers
Res	Consumer Products	Res | ENERGY STAR Directional LEDs
Res	Consumer Products	Res | Omni-Directional LEDs
Res	Consumer Products	Res | Outdoor LED Light Bulb
Res	Consumer Products	Res | Pool Pumps
Res	Consumer Products	Res | Refrigeration
Res	Consumer Products	Res | Remove Second Refrigerator
Res	Consumer Products	Res | Window AC
Res	HPwES	Res | Advanced Networked Lighting Controls with Directional LEDs

Sector	Program	Measure
Res	HPwES	Res | Advanced Networked Lighting Controls with Omni-Directional LEDs
Res	HPwES	Res | Advanced Power Strips
Res	HPwES	Res | Air Infiltration
Res	HPwES	Res | Attic Knee Wall Insulation
Res	HPwES	Res | Ceiling Insulation
Res	HPwES	Res | Central AC Tune-Up
Res	HPwES	Res | Duct Sealing
Res	HPwES	Res | ENERGY STAR Directional LEDs
Res	HPwES	Res | Faucet Aerators
Res	HPwES	Res | Furnace Filter Whistle
Res	HPwES	Res | High Efficiency Windows
Res	HPwES	Res | Low-Flow Showerheads
Res	HPwES	Res | Omni-Directional LEDs
Res	HPwES	Res | Outdoor Dusk-Til-Dawn LED Light Bulb
Res	HPwES	Res | Outdoor LED Light Bulb
Res	HPwES	Res | Pipe Insulation
Res	HPwES	Res | Smart Thermostats
Res	HPwES	Res | Thermostatic shower valve
Res	HPwES	Res | Wall Insulation
Res	HPwES	Res | Window Film
Res	HVAC	Res | Air Source Heat Pump
Res	HVAC	Res | Central AC Tune-Up
Res	HVAC	Res | Central Air Conditioner
Res	HVAC	Res | Duct Sealing
Res	HVAC	Res | Ductless Heat Pump
Res	LI_MF	Res | Air Infiltration
Res	LI_MF	Res | Attic Knee Wall Insulation
Res	LI_MF	Res | Ceiling Insulation
Res	LI_MF	Res | Central AC Tune-Up
Res	LI_MF	Res | Duct Sealing
Res	LI_MF	Res | ENERGY STAR Directional LEDs
Res	LI_MF	Res | Faucet Aerators
Res	LI_MF	Res | Furnace Filter Whistle
Res	LI_MF	Res | High Efficiency Windows
Res	LI_MF	Res | Low-Flow Showerheads
Res	LI_MF	Res | Omni-Directional LEDs
Res	LI_MF	Res | Outdoor Dusk-Til-Dawn LED Light Bulb
Res	LI_MF	Res | Outdoor LED Light Bulb

Sector	Program	Measure
Res	LI_MF	Res | Pipe Insulation
Res	LI_MF	Res | Smart Thermostats
Res	LI_MF	Res | Thermostatic shower valve
Res	LI_MF	Res | Wall Insulation
Res	LI_MF	Res | Window Film
Res	Res Behavior	Res | Home Energy Report
Res	Res Behavior	Res | Large Residential Competitions
Res	Res Behavior	Res | Prepay Electricity Bills
Res	Res Behavior	Res | Web-based Real-time Feedback
Res	School Kits	Res | ENERGY STAR Directional LEDs
Res	School Kits	Res | Faucet Aerators
Res	School Kits	Res | Low-Flow Showerheads
Res	School Kits	Res | Outdoor LED Light Bulb

Note that the following programs that appear in the PY6 Energy Smart EM&V report have been rolled up to broader program categories in Table C-3, as follows:

- Low Income/Multi-Family—includes the Low Income and Multi-Family programs from the EM&V report
- Consumer Products—includes the GreenLight, Residential Lighting, and Other programs from the EM&V report

Appendix D. Achievable Potential Modeling Methodology Details

D.1 Calculating Achievable Potential

This section demonstrates Navigant's approach to calculating achievable potential, which is fundamentally more complex than calculating technical or economic potential.

The critical first step in the process to accurately estimate achievable potential is to simulate market adoption of energy efficient measures. The team's approach to simulating the adoption of energy efficient technologies for purposes of calculating achievable potential can be broken down into the following two strata:

1. Calculation of the dynamic approach to equilibrium market share
2. Calculation of the equilibrium market share

D.2 Calculation of Dynamic Equilibrium Market Share

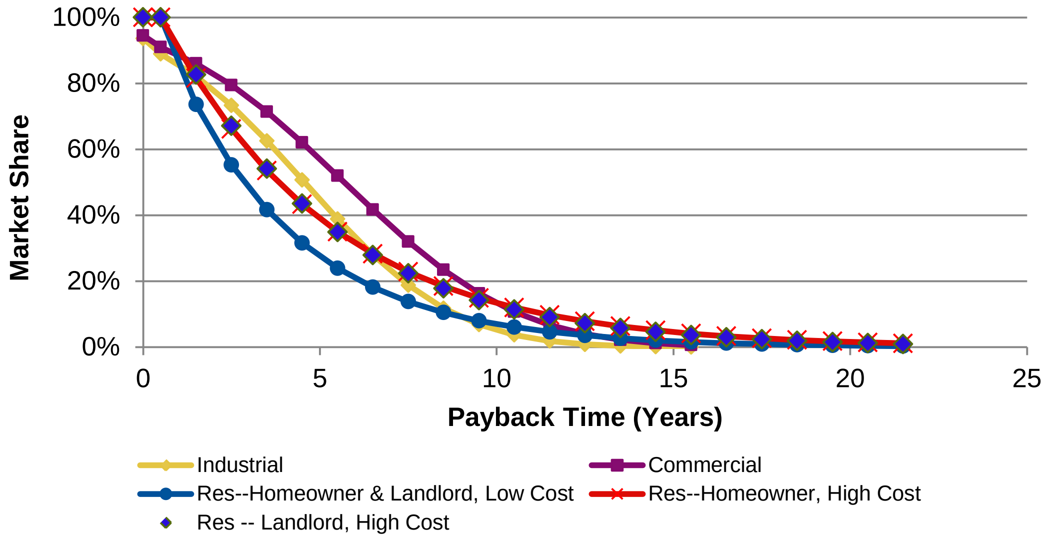
The equilibrium market share can be thought of as the percentage of individuals choosing to purchase a technology, provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). For energy efficient technologies, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. That additional efficiency often comes at a premium in initial cost. Thus, in efficiency potential studies, equilibrium market share is often calculated as a function of the payback time of the efficient technology relative to the inefficient technology. While such approaches have limitations, they are nonetheless directionally reasonable and simple enough to permit estimation of market share for the dozens or even hundreds of technologies that are often considered in potential studies.

Navigant uses equilibrium payback acceptance curves that were developed using primary research conducted by Navigant in the Midwest US in 2012.[78] To develop these curves, Navigant conducted surveys of 400 residential, 400 commercial, and 150 industrial customers. These surveys presented decision makers with numerous choices between technologies with low upfront costs but high annual energy costs and measures with higher upfront costs but lower annual energy costs. Navigant conducted statistical analysis to develop the set of curves shown in Figure D-1, which were leveraged in this study. Though ENO-specific data is not currently available to estimate these curves, Navigant considers that the nature of the decision-making process is such

[78] A detailed discussion of the methodology and findings of this research is contained in the *Demand Side Resource Potential Study*, prepared for Kansas City Power and Light, August 2013.

that the data developed using these surveyed customers represents the best data available for this study at this time.

Figure D-1. Payback Acceptance Curves



Source: Navigant, 2015

Because the payback time of a technology can change over time, as technology costs and/or energy costs change over time, the equilibrium market share can also change over time. The equilibrium market share is, thus, recalculated for every time-step within the market simulation to ensure the dynamics of technology adoption considers this effect. As such, the term equilibrium market share is a bit of an oversimplification and a misnomer, as it can itself change over time and is, therefore, never truly in equilibrium. It is used nonetheless to facilitate understanding of the approach.

D.3 Calculation of the Approach to Equilibrium Market Share

The team used two approaches to calculate the approach to equilibrium market share (i.e., how quickly a technology reaches final market saturation): one for new technologies or those being modeled as a retrofit (a.k.a. discretionary) measures, and one for technologies simulated as replace-on-burnout (ROB, a.k.a. lost opportunity) measures.[79] A high level overview of each approach is provided in the following sections.

[79] Each of these approaches can be better understood by visiting Navigant's technology diffusion simulator, available at: http://forio.com/simulate/navigantsimulations/technology-diffusion-simulation.

Retrofit/New Technology Adoption Approach

Retrofit and new technologies employ an enhanced version of the classic Bass diffusion model[80,81] to simulate the S-shaped approach to equilibrium that is commonly observed for technology adoption. Figure E-2 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this model, achievable potential flows to adopters through two primary mechanisms: adoption from external influences such as program marketing/advertising, and adoption from internal influences including word of mouth. The fraction of the population willing to adopt is estimated using the payback acceptance curves illustrated in Figure D-1.

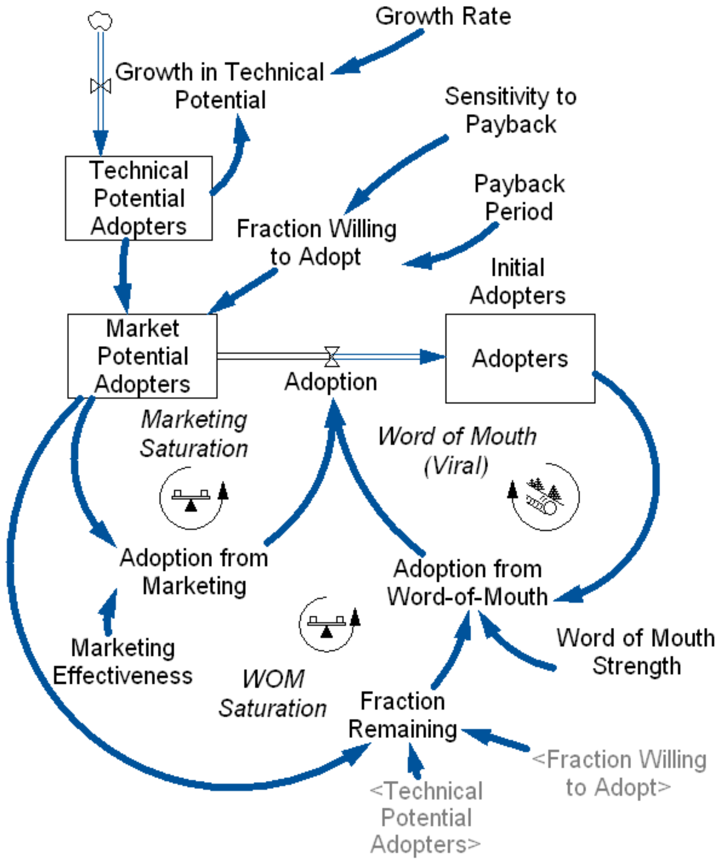
The marketing effectiveness and external influence parameters for this diffusion model are typically estimated upon the results of case studies where these parameters were estimated for dozens of technologies.[82] Additionally, the calibration process permits adjusting these parameters as warranted (e.g., to better align with historic adoption patterns within the ENO market). Recognition of the positive or self-reinforcing feedback generated by the word of mouth mechanism is evidenced by increasing discussion of concepts like social marketing and the term viral, which has been popularized and strengthened by social networking sites such as Facebook and YouTube. However, the underlying positive feedback associated with this mechanism has always been part of the Bass diffusion model of product adoption since its inception in 1969.

[80] Bass, Frank (1969). "A new product growth model for consumer durables." *Management Science* 15 (5): p215–227.

[81] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000. p. 332.

[82] See Mahajan, V., Muller, E., and Wind, Y. (2000). *New Product Diffusion Models.* Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies. This model uses the median value of 0.365 for the word of mouth strength in the base case. The Marketing Effectiveness parameter was assumed to be 0.04, representing a somewhat aggressive value that exceeds the most likely value of 0.021 (75th percentile value is 0.055) per Mahajan 2000.

Figure D-2. Stock/Flow Diagram of Diffusion Model for New Products and Retrofits

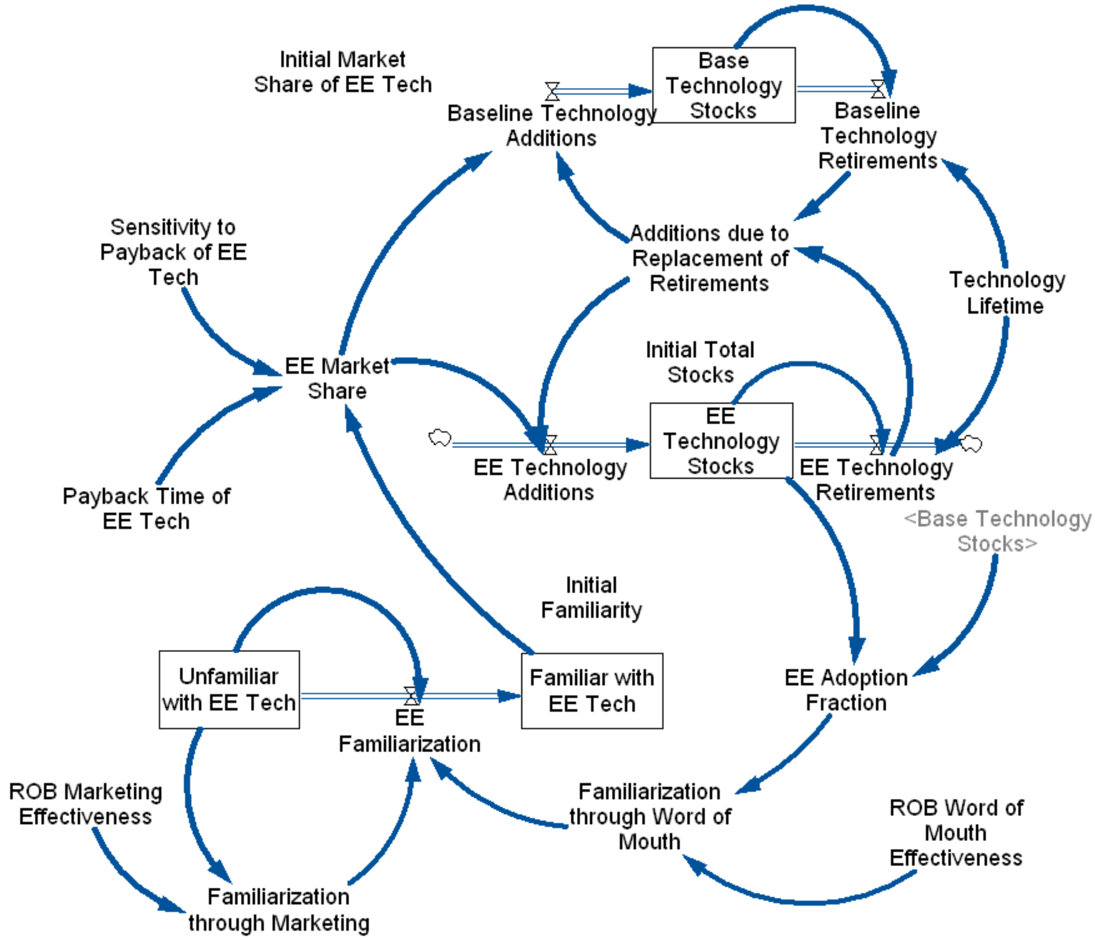


Source: Navigant, 2015

ROB Technology Adoption Approach

The dynamics of adoption for ROB technologies are somewhat more complicated than for new/retrofit technologies because it requires simulating the turnover of long-lived technology stocks. To account for this, the DSMSim model tracks the stock of all technologies, both base and efficient, and explicitly calculates technology retirements and additions consistent with the lifetime of the technologies. Such an approach ensures that technology churn is considered in the estimation of achievable potential, as only a fraction of the total stock of technologies are replaced each year, which affects how quickly technologies can be replaced. A model that endogenously generates growth in the familiarity of a technology, analogous to the Bass approach described above, is overlaid on the stock tracking model to capture the dynamics associated with the diffusion of technology familiarity. A simplified version of the model employed in DSMSim is illustrated graphically in Figure D-3.

Figure D-3. Stock/Flow Diagram of Diffusion Model for ROB Measures



Source: Navigant, 2015

Appendix E. Interactive Effects of Efficiency Stacking

The report's results assume that all measures are implemented in isolation from one another and that the measures do not include adjustments for interactive effects from efficiency stacking. Interactive effects from efficiency stacking are different from cross end-use interactive effects (e.g., efficient lighting affects heating/cooling loads), which are present regardless of stacking assumptions and are included in the reported savings estimates. This appendix describes the challenges related to accurately determining the effects of efficiency stacking, and why Navigant has modeled savings as though measures are implemented independently from one another.

E.1 Background on Efficiency Stacking

When a home or business installs two or more measures that affect the same end-use energy consumption in the same building, the total achievable savings is less than the sum of the savings from those measures independently. For example, in isolation, the installation of light-emitting diode (LED) lighting might save 40% of electric consumption relative to baseline linear fluorescent fixtures, while occupancy sensors might save 25% of electric consumption relative to fixtures without occupancy sensors. However, if both LED fixtures and occupancy sensors are installed in the same facility, the savings from the LED lighting decrease due to the reduced lighting operating hours caused by the occupancy sensors.

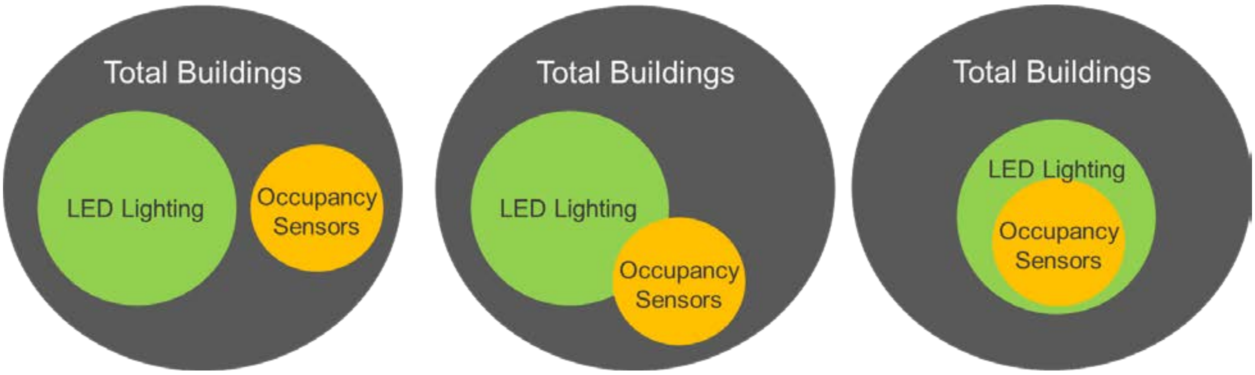
Navigant generalizes this concept by referring to measures that convert energy as engines (boilers, light bulbs, motors, etc.) and measures that affect the amount of energy an engine must convert as drivers (insulation, thermostats, lighting controls, etc.). Any time an engine and driver are implemented in the same building, the expectation is savings from the engine measure will decrease.[83]

Figure E-1 provides an illustration of three different efficiency stacking approaches. The modeled approach assumes no overlap in measure implementation and no efficiency stacking, which leads to an upper bound on savings potential. The opposite of the modeled approach is to assume all measures are stacked wherever possible, which provides a lower bound on savings. Lastly, there is the real-world approach where some measures are implemented in isolation and others are stacked. However, the data is simply not available to accurately estimate the savings from the real-world approach.

[83] In practice, it does not matter whether one assumes the engine's savings decrease or the driver's savings decrease, as the final savings result is the same. In this discussion, Navigant chose to always reduce the savings from the engine measures, while holding the savings from the driver measures fixed.

Figure E-1. Venn Diagrams for Various Efficiency Stacking Situations

Upper Bound (Modeled)	**Real World**	**Lower Bound**
Savings are independent	Uncertain mix of independent and stacked savings	Savings are stacked wherever possible



Source: Navigant

The area of the colored circle represents the number of buildings with a given savings opportunity. Overlapping circles indicate a building has implemented both measures.

E.2 Illustrative Calculation of Savings after Efficiency Stacking

For a simplistic scenario looking at only two measures it is possible to determine the stacked savings from the lower bound approach, which assumes efficiencies are stacked wherever possible. To find the LED lighting savings relative to the baseline after stacking:

1. **Find the complement of the occupancy sensor savings percentage.**

Occupancy Sensor Savings Complement = 100% - Occupancy Sensor Savings

Occupancy Sensor Savings Complement = 100% - 25% = 75%

2. **Reduce the LED lighting unstacked savings by the complement of the occupancy sensor savings.**

Stacked LED Lighting Savings = Unstacked LED Lighting Savings x Occupancy Sensor

Savings Complement Stacked LED Lighting Savings = 40% x 75% = 30%

3. **Find the greatest percentage of buildings where LED lighting and occupancy sensor stacking is possible.**

% of Buildings with Stacking = Buildings with Occupancy Sensors / Buildings with LED lighting x 100%

% of Buildings with Stacking = 145,300 / 720,200 x 100% = 20.2%

4. **Calculate the LED lighting weighted average savings across all buildings with occupancy sensors.**

Weighted LED Lighting Savings = Stacked LED Lighting Savings x % of Buildings with Stacking + Unstacked LED Lighting Savings x (100% - % of Buildings with Stacking)

Weighted LED Lighting Savings = 30% x 20.2% + 40% x (100% - 20.2%) = 38%

Table E-1 summarizes the example for the LED lighting and occupancy sensors before and after stacking. As expected, when treated independently the combined savings from the measures exceeds the combined savings after stacking.

Table E-1. Comparison of Savings Before and After Stacking

	LED Lighting	Occupancy Sensors
Applicable Buildings	720,200	145,300
Savings Treated Independently (No Stacking)		
Savings Relative to Baseline (%)	40%	25%
Savings Treated Interactively (Stacking)		
Savings Relative to Baseline (%)	38%	25%

Source: Navigant analysis

E.3 Impetus for Treating Measure Savings Independently

Although it is possible to find the lower bound on savings with just one driver and one engine measure, the process becomes intractable when multiple drivers and engines can be installed in the same facility. Table E-2 lists all the engine and driver measures included in this study that could have interactive effects within the commercial lighting end use, which is just one of many end uses across multiple sectors where stacking could occur.

Table E-2. Measures with Opportunity for Stacking in Commercial Lighting End Use

Engine Measures	Driver Measures
Exterior LED	Photocell
Interior LED Tube	Interior Daylighting Controls
Interior LED MR/PAR Lamps	Fixture or Wall-Mounted Occupancy Sensors
Interior Recessed LED Downlighting (Troffer LEDs)	-
Interior High Bay LED	-
LED Luminaire	-

Source: Navigant

Determining the appropriate stacking and correctly weighting the savings percentages from each of the engine measures requires the following:

- Case-by-case expert judgment about the combinations of driver and engine measures that might realistically be found in the same building given historic and future construction practices
- The conditional probability that a building has an inefficient driver A and an inefficient engine B for all drivers and engines relevant to a given end use
- In-depth knowledge of program design and how managers are considering pursuing participants and bundling measure offerings

Lastly, at low levels of customer participation, assuming savings are independent is the best representation of what the actual measure stacking would be. When customer participation is high, the real-world scenario is the best representation of actual measure stacking. Thus, under the plausible ranges of customer participation, the modeled (upper bound) scenario is likely to be a better representation of actual measure stacking than the lower bound scenario.

Although this report does not rigorously attempt to quantify the impact from efficiency stacking within the ENO service area, Navigant's experience indicates stacking can lead to a 5%-10% reduction in savings potential at high levels of technology adoption. This estimate is applicable to the residential and C&I sectors but is less applicable for the industrial sector because of reduced opportunity for stacking among the industrial measures considered in this study. Additionally, the 5%-10% reduction is highly uncertain and dependent upon the characteristics of any given building and grouping of measures.

CERTIFICATE OF SERVICE
Docket No. UD-17-03

I hereby certify that I have served the required number of copies of the foregoing report upon all other known parties of this proceeding, by the following: electronic mail, facsimile, overnight mail, hand delivery, and/or United States Postal Service, postage prepaid.

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