INDIANAPOLIS POWER & LIGHT COMPANY

2019 Integrated Resource Plan

Volume 3 of 3

December 16, 2019

GDS Associates, Inc. ENGINEERS & CONSULTANTS Attachment 5.1

Demand Side Analytics DATA DRIVEN RESEARCH AND INSIGHTS

Thorpe Energy Services

prepared for

INDIANAPOLIS POWER & LIGHT COMPANY

2018 Demand Side Management Market Potential Study

August 13, 2019

FINAL REPORT

prepared by

GDS ASSOCIATES INC
DEMAND SIDE ANALYTICS
THORPE ENERGY SERVICES

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EXECUTIVE SUMMARY

2018 IPL DEMAND SIDE MANAGEMENT Market Potential Study

prepared for

AUGUST 2019

1 Executive Summary

1.1 OBJECTIVES & SCOPE

This project included a demand-side management (DSM) Market Potential Study and End Use Analysis for Indianapolis Power & Light Company (IPL). The study included assessments of electric energy efficiency and demand response potential. This report provides the results of the electric energy efficiency and demand response potential analysis for the 2021-2039 (19-year) timeframe.[1]

The energy efficiency potential study assessed potential by customer segment (residential, commercial, and industrial – with and without opt-out customers[2]). The effort included several preliminary tasks to assess the IPL market and develop foundational assumptions about the customer base, sales forecasts, and savings opportunities to order to then assess the overall energy efficiency potential in the IPL services territories.

1.2 APPROACH SUMMARY

The GDS team used a bottom-up approach to estimate energy efficiency potential in the residential sector. Bottom-up approaches begin with characterizing the eligible equipment stock, estimating savings and screening for cost-effectiveness first at the measure level, then summing savings at the end-use and service area levels. In the commercial and industrial (C&I) sectors, GDS utilized the bottom-up modeling approach to first estimate measure-level savings and costs as well as cost-effectiveness, and then applied cost-effective measure savings to all applicable shares of energy load. The demand response potential assessment was conducted in a similar manner as the energy efficiency potential assessment. Below is the summary of the Maximum Achievable Potential (MAP) and Realistic Achievable Potential (RAP). More detail can be found in Section 1 of Volume I, Market Potential Study.

- ***Achievable Potential*** is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and willingness to participate (WTP) in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:
- ***MAP*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***RAP*** estimates achievable potential with IPL paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

The 2019 Market Potential Study included a detailed End Use Analysis that utilized primary market research at residential dwellings, as well as commercial and industrial facilities, to better understand the mix of customers, building characteristics, and efficiency trends for each customer segment. Historically, IPL's Market Potential Studies and load forecasts have been driven by the Energy Information Administration's regional end use saturation and intensity baselines and forecasts. The End Use Analysis served to create more IPL-specific saturation and efficiency profiles for both the 2019 Market Potential Study, but for future load forecasting efforts as well.

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[1] The study period is for 2021-2039 to align with the 2019 Integrated Resource Plan (IRP) timeline. In addition, the GDS Team assessed the electric energy efficiency potential in 2020 as part of an analysis to determine whether current planned DSM levels in 2020 addressed the identified potential. Results of this analysis are included as an appendix to this report.

[2] In Indiana, a combined energy efficiency resource standard repeal and opt-out bill became law in 2014. The opt-out placed eligibility at 1 MegaWatt (MW) – any customer that has a peak demand of at least 1MW can opt-out of paying the charge levied to support the utility-run energy efficiency program.

1.3 RESULTS

Table ES-1 summarizes the electric energy-efficiency savings for all measures at the different levels of potential relative to the baseline forecast. This provides cumulative annual technical, economic, MAP and RAP potential energy savings, in total MWh and as a percentage of the sector-level sales forecast for the first three years of the analysis, as well as in the 10th and 19th year of the analysis. The cumulative RAP increases to 4.8% cumulative annual savings over the next three years. The RAP savings estimates have a large residential sector low-income component.[3] Approximately 58% of the residential sector budget addresses the low-income market segment, with about 25% of the RAP savings are attributable to this segment. Forecasted sales are total sales including commercial and industrial opt-out customers.

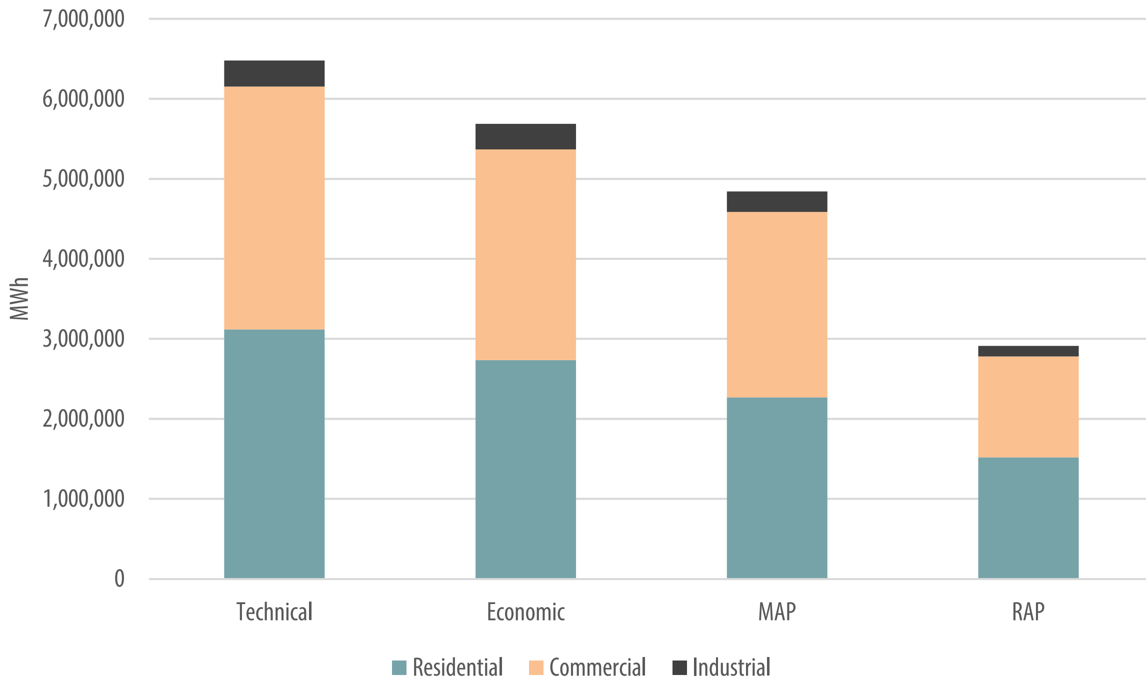
TABLE ES-1 CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY (NET OF LARGE CUSTOMER OPT-OUT LOAD)

	2021	2022	2023	2030	2039
MWh					
Technical	777,115	1,495,812	2,222,444	5,480,409	6,479,384
Economic	699,639	1,316,546	1,938,817	4,773,845	5,687,312
MAP	463,542	879,184	1,325,103	3,712,615	4,841,953
RAP	273,942	462,015	656,209	2,006,568	2,911,537
Forecasted Sales	13,543,498	13,708,234	13,809,273	14,490,281	15,411,542
Energy Savings (as % of Forecast)					
Technical	5.7%	10.9%	16.1%	37.8%	42.0%
Economic	5.2%	9.6%	14.0%	32.9%	36.9%
MAP	3.4%	6.4%	9.6%	25.6%	31.4%
RAP	2.0%	3.4%	4.8%	13.8%	18.9%

Figure ES-1 provides the electric technical, economic, and achievable potential, by sector, by the end of the 19-year timeframe for the study (2021-2039). The residential sector contributes about half of the overall RAP.

[3] Low income households were characterized as homes that have household incomes at or below 200% of federal poverty guidelines. Based on data from the American Community 5-Year Public Use Microdata Set (PUMS), GDS used household income and number of people per household to identify the percent of the population at or below 200% of federal poverty guidelines for the IPL service area. 30.6% of single-family households and 52.7% of multifamily households were identified to meet the criteria.

FIGURE ES-1 NINETEEN (19)-YEAR CUMULATIVE ANNUAL ELECTRIC ENERGY EFFICIENCY POTENTIAL – ALL SECTORS COMBINED (NET OF LARGE CUSTOMER OPT-OUT LOAD)



1.3.1 Measure-Level Realistic Achievable Potential (Net of Opt-Outs)

Table ES-2 provides the incremental RAP for each year by sector. The incremental annual savings potential ranges from 274 GWh to nearly 350 GWh. These results exclude savings attributed to large customers that have opted out of energy efficiency programs.

TABLE ES-2 INCREMENTAL ELECTRIC MEASURE LEVEL RAP – BY SECTOR (2021-2023, 2030, AND 2039)

Incremental Annual MWh	2021	2022	2023	2030	2039
Sector					
Residential	175,436	164,092	164,881	171,594	164,489
Commercial	87,433	87,790	88,538	128,764	163,720
Industrial	11,073	12,149	13,001	15,566	21,577
Total	273,942	264,031	266,420	315,924	349,786
Forecasted Sales	13,543,498	13,708,234	13,809,273	14,490,281	15,411,542
Incremental Annual Savings %					
Sector					
Residential	1.3%	1.2%	1.2%	1.2%	1.1%
Commercial	0.6%	0.6%	0.6%	0.9%	1.1%
Industrial	0.1%	0.1%	0.1%	0.1%	0.1%
% of Forecasted Sales	2.0%	1.9%	1.9%	2.2%	2.3%

Table ES-3 provides the cumulative RAP for each year across the 2021-2023 timeframe, as well as for 2030 and 2039.[4] The cumulative annual savings potential ranges from 274 GWh to nearly 2,912 GWh. These results assume that opt-out C&I customers do not provide any savings potential.

TABLE ES-3 CUMULATIVE ELECTRIC MEASURE LEVEL RAP – BY SECTOR (2021-2023, 2030, AND 2039)

Cumulative Annual MWh	2021	2022	2023	2030	2039
Sector					
Residential	175,436	266,884	365,671	1,079,971	1,518,517
Commercial	87,433	172,729	256,487	824,507	1,259,861
Industrial	11,073	22,402	34,051	102,090	133,159
Total	273,942	462,015	656,209	2,006,568	2,911,537
Forecasted Sales	13,543,498	13,708,234	13,809,273	14,490,281	15,411,542
Cumulative Annual Savings %					
Sector					
Residential	1.3%	1.9%	2.6%	7.5%	9.9%
Commercial	0.6%	1.3%	1.9%	5.7%	8.2%
Industrial	0.1%	0.2%	0.2%	0.7%	0.9%
% of Forecasted Sales	2.0%	3.4%	4.8%	13.8%	18.9%

Table ES-4 provides the annual budgets in the RAP scenario. The total RAP budgets across all sectors ranges from $91 million to $121 million during the 2020-2023 timeframe.

TABLE ES-4 ANNUAL BUDGETS (2021-2023, 2030, AND 2039) IN THE RAP SCENARIO ($ IN MILLIONS)

RAP Budgets	2021	2022	2023	2030	2039
Energy Efficiency					
Incentives	$60.5	$68.9	$75.3	$77.7	$59.6
Admin	$24.8	$27.9	$30.7	$41.6	$51.0
Energy Efficiency Sub-Total	$85.3	$96.8	$106.0	$119.4	$110.6
Demand Response					
Incentives	$2.0	$3.4	$4.9	$7.3	$8.9
Admin	$4.2	$6.9	$10.0	$3.8	$4.9
Demand Response Sub-Total	$6.1	$10.3	$14.9	$11.1	$13.8
Total					
Total Costs	$91.4	$107.1	$120.9	$130.5	$124.4

1.4 DEMAND SAVINGS

The study also included an assessment of peak demand savings potential. Table ES-5 below provides the overall peak demand savings from energy efficiency and demand response potential. The demand response potential assumes the energy efficiency peak demand reductions take precedent, and thereby reduce the baseline peak demand which can be further reduced by demand response.

[4] Cumulative annual savings refers to the overall savings occurring in a given year from both new participants and savings continuing to result from past participation with measures that are still in place. Cumulative annual does not always equal to the sum of all prior year incremental values as some measures have relatively short measure lives, and a result, their savings drop off over time.

TABLE ES-5 CUMULATIVE PEAK DEMAND SAVINGS POTENTIAL – MAP AND RAP (2021-2023, 2030, AND 2039)

MW	2021	2022	2023	2030	2039
MAP					
Energy Efficiency	79	156	239	684	896
Demand Response	91	161	228	331	397
Total	171	317	467	1,015	1,293
RAP					
Energy Efficiency	48	86	124	385	546
Demand Response	73	114	155	218	253
Total	121	200	279	603	799

VOLUME I

2018 IPL Demand Side Management Market Potential Study

prepared for

JUNE 2019

1 Introduction

1.1 BACKGROUND & STUDY SCOPE

This Market Potential Study was conducted to support the Integrated Resource Plan (IRP) and DSM planning for IPL. The study included primary market research and a comprehensive review of current programs, historical savings, and projected energy savings opportunities to develop estimates of technical, economic, and achievable potential. Separate estimates of electric energy efficiency and demand response potential were developed. The effort was highly collaborative, as the GDS Team worked closely alongside IPL, as well as the IPL Oversight Board, to produce reliable estimates of future saving potential, using the best available information and best practices for developing market potential saving estimates.

The 2019 Market Potential Study included a detailed End Use Analysis that utilized primary market research at residential dwellings, as well as commercial and industrial facilities, to better understand the mix of customers, building characteristics, and efficiency trends for each customer segment. Historically, IPL's Market Potential Studies and load forecasts have been driven by the Energy Information Administration's regional end use saturation and intensity baselines and forecasts. The End Use Analysis served to create more IPL-specific saturation and efficiency profiles for both the 2019 Market Potential Study, but for future load forecasting efforts as well.

1.2 TYPES OF POTENTIAL ESTIMATED

The scope of this study distinguishes three types of energy efficiency potential: (1) technical, (2) economic, and (3) achievable.

- ***Technical Potential*** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is constrained only by factors such as technical feasibility and applicability of measures.
- ***Economic Potential*** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Economic potential follows the same adoption rates as technical potential. Like technical potential, the economic scenario ignores market barriers to ensuring actual implementation of efficiency. Finally, economic potential only considers the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them. This study uses the Utility Cost Test (UCT) to assess cost-effectiveness.
- ***Achievable Potential*** is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and WTP in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:
- ***MAP*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***RAP*** estimates achievable potential with IPL paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

1.3 STUDY LIMITATIONS

As with any assessment of energy efficiency potential, this study necessarily builds on various assumptions and data sources, including the following:

- Energy efficiency measure lives, savings, and costs
- Projected penetration rates for energy efficiency measures

- Projections of electric avoided costs
- Future known changes to codes and standards
- IPL load forecasts and assumptions on their disaggregation by sector, segment, and end use
- End-use saturations and fuel shares

While the GDS team has sought to use the best and most current available data, there are often reasonable alternative assumptions which would yield slightly different results.

1.4 ORGANIZATION OF REPORT

The remainder of this report is organized in seven sections as follows:

Section 2 MPS End-Use Analysis details the primary market research studies completed in conjunction with the market potential analysis, and a summary of the end-use analysis results by sector.

Section 3 MPS Methodology details the methodology used to develop the estimates of technical, economic, and achievable energy efficiency and demand response potential savings.

Section 4 MPS Market Characterization provides an overview of the IPL service areas and a brief discussion of the forecasted energy sales by sector.

Section 5 Residential Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the residential sector.

Section 6 Commercial Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the commercial sector.

Section 7 Industrial Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the industrial sector.

Section 8 Demand Response Potential provides a breakdown of the technical, economic, and achievable potential demand response by program type.

Appendices for the DSM Market Potential are included in Volume II of this report. MPS appendices include a discussion of sources used for the analysis, detailed measure level assumptions by customer segment, nonresidential sector potential savings (including opt-out customers), and detailed demand response results. A discussion of the 2020 Refresh analysis is also included as an appendix.

2 Market Potential Study End Use Analysis

In 2018 and 2019, IPL and the GDS team performed multiple market research studies targeting the residential, commercial, and industrial sectors. The goal of the research was to collect primary data from IPL customers to inform the market potential study and to improve upon assumptions built into IPL's load forecasting system. This chapter will describe the methods employed by the GDS team to collect primary research data for the end-use analysis and provide summary results.

2.1 RESIDENTIAL SECTOR

There were three objectives of the end use analysis specific to the residential sector:

- Collect market share information of electric end uses specific to IPL's residential class of customers,
- Perform a demographic survey to collect key demographic information,
- Update Unit Energy Consumption assumptions, representing the amount of electricity used by typical major appliances in homes.

To meet these objectives, the GDS team performed research activities through four tasks in 2018 and 2019. A self-report study conducted via internet and the mail was conducted to collect initial market saturation and demographic data. From the pool of respondents, participants were recruited to participate in on-site visits conducted by trained technicians to collect detailed home and end-use characteristic data. Independent of that process, an online survey of a separate population frame of residences was conducted to understand WTP in energy efficiency programs. Finally, GDS developed building energy simulation models.

2.1.1 Self-Report Survey

The self-report study was conducted via a mailed questionnaire to selected representative homes in the IPL service territory. The recruitment population frame was drawn using a structured stratified sampling approach using annual energy consumption to stratify the population. Homeowners were asked to complete the questionnaire either by filling out a form mailed to them or by visiting a web-based survey instrument online. A total of 30 questions were included in the survey, seeking to collect information about ownership of electric appliances; the type, fuel, and age of heating, ventilation, and air conditioning (HVAC) and water heating equipment in the home; the types of energy improvements that may have been made to the home; demographic information; and if the homeowner had interest in participating in the onsite survey.

The research objective was to collect at least 384 survey responses, representing a design with 95% confidence and +/- 5% precision. The survey was initially mailed to 1,400 residences drawn from IPL's billing database. After the first mailing, only 94 responses were collected by mail and 32 by internet, representing only 126 responses. A reminder email was sent to those customers in the original recruitment frame for whom IPL had a valid email address and who had not yet responded to the survey, which generated an additional 27 responses. Finally, a second recruitment frame of 1,375 new residences was developed. For the new frame, an email campaign was launched asking customers to respond online. The second wave garnered an additional 72 responses. In total, the self-report study solicited 231 responses, representing 95% confidence with +/- 6.45% precision.[5]

[5] Although the goal was to achieve 5% precision, this result is acceptable, especially given the additional site-specific research conducted for the residential sector. It was concluded by GDS and IPL that the costs of additional efforts to improve precision outweighed the value achieving such additional precision would provide.

FIGURE 2-1 SELF-REPORT SURVEY RETURNS BY MEDIUM

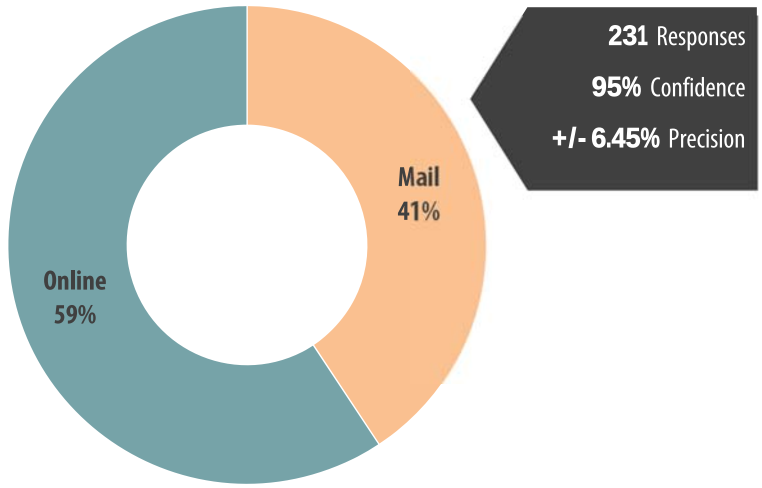
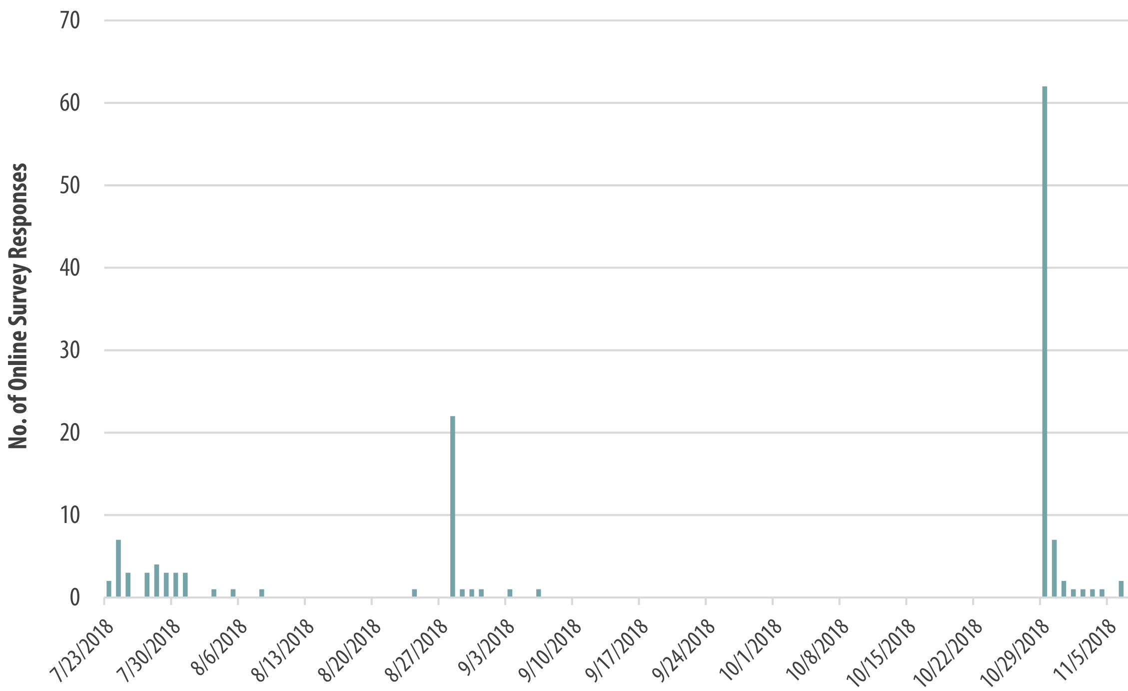


FIGURE 2-2 SELF-REPORT SURVEY, TIMING OF ONLINE RESPONSES



2.1.2 On-Site Survey

Following the self-report survey, the GDS team conducted a series of residential on-site visits. The purpose of the site-visits was to collect more detailed end-use and housing characteristics that are difficult to collect in a self-report survey. The goal was to recruit 68 homes to participate in site visits, using the self-report survey as the first recruitment tool. Interest in participating in a site visit was high from survey respondents, with 67% (156) respondents indicating interest in finding out more about the visits. To ensure a representative sample of homes in the study, GDS developed 68 recruitment bins sorted by average usage. Nearly 40 of the recruitment bins were successfully filled from the 156 homes that indicated initial interest in the study, with attrition associated with fulfilling recruitment bins from other homes and loss of interest once homeowners understood in more detail the nature of the site visits. Therefore, the GDS team supplemented the study by recruiting additional homes to agree to participate in site visits by contacting homes from the initial recruitment frames of the self-report survey group.

2.1.3 Willingness to Participate

IPL and the GDS team worked together to develop a series of questions designed to understand residential WTP in various energy efficiency programs given varying incentive levels. Such research was valuable to helping identify participation levels that can be assumed in various scenarios within the market potential study. The original goal was to collect WTP information during the residential site visits. However, the WTP questionnaire was still being developed by the GDS team while technicians were conducting site visits. The site visits therefore did not collect a statistically significant number of WTP survey responses. Therefore, GDS created a supplemental online WTP survey. Fifteen thousand (15,000) residential accounts were selected to receive an email asking for participation in the online WTP survey. These accounts had not yet been contacted by IPL and GDS for any aspect of survey work prior to this email. GDS collected 875 WTP survey responses.

2.1.4 Building Energy Simulation Modeling

The final phase of end use analysis for the residential sector consisted of constructing building energy simulation models using BEopt™ (Building Energy Optimization)[6] software. The building simulations involve developing end-use energy profiles based on assigned housing characteristics. The housing characteristics (e.g., size of home, type of end use equipment, etc.) were developed from the primary market research conducted by the GDS team.

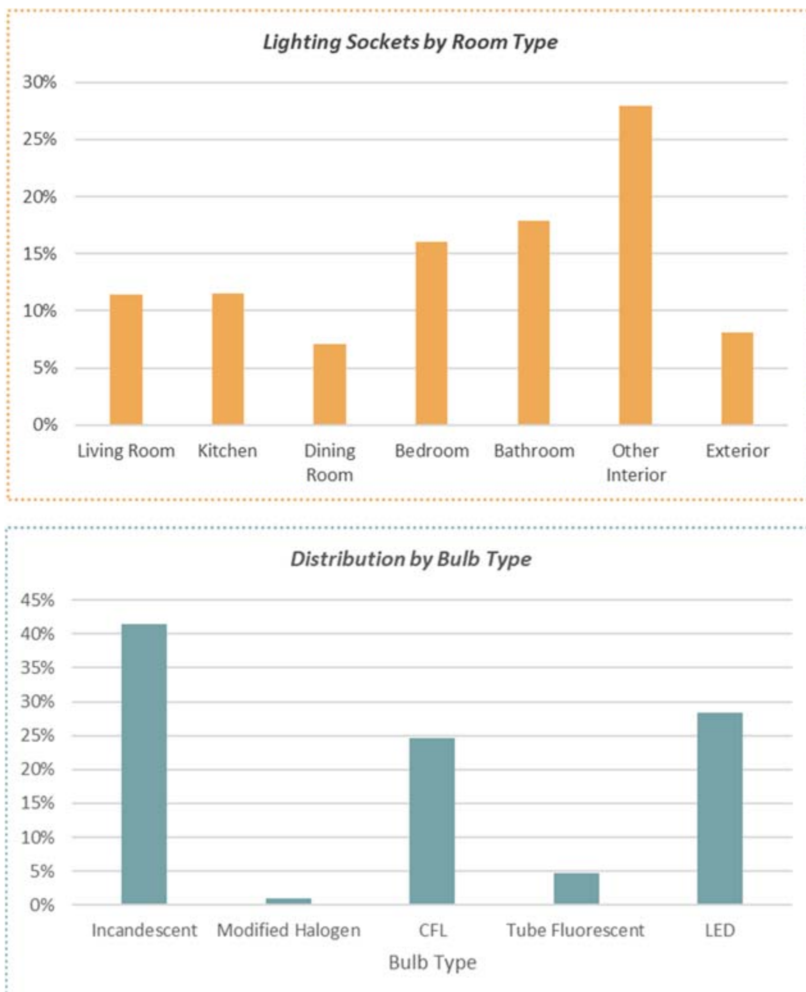
2.1.5 Summary Results of Residential End Use Analysis

Although detailed information was collected for many end-uses in the residential sector, this section provides an overview of the data collection for lighting and space heating equipment. The end use databases developed through the primary research methods were used by the GDS to inform potential study and load forecast inputs for many end uses.

Lighting. In self-response surveys, homeowners tend to underestimate the number of lighting sockets in the home, which was the case with IPL as well. The IPL self-responders indicated they had an average of 20 bulbs per home, whereas the site visits indicated the average exceeds 40 bulbs per home. This was the biggest discrepancy between self-reported information and information collected from onsite technicians. The GDS team considered the site visits data to be more accurate since onsite technicians take the time to record every lighting socket in the home and collect information on the type and wattage of the bulbs installed in those sockets.

As part of the onsite visits, technicians also collect the number of bulbs in storage to provide an indication of the potential lighting efficiency in

FIGURE 2-3 LIGHTING END USE RESULTS - RESIDENTIAL SECTOR



[6] BEopt can be used to analyze both new construction and existing home retrofits, as well as single-family detached and multi-family buildings, through evaluation of single building designs, parametric sweeps, and cost-based optimizations.

the near future when bulbs are replaced. The study indicated that the average home had 5.5 bulbs in storage, and that 48% of those bulbs were incandescent bulbs, which is higher than the share of incandescent bulbs (42%) in service in homes.

Space Heating. Other than the lighting counts, the only other major appliance that had a market penetration differential between self-reporting and the site visits was the share of electric primary space heating equipment. The self-report survey indicated that 45% of homes had electric heat while the site visits found 21% of homes with electric heat. With such a discrepancy, a third source of information was consulted. IPL's retail rate codes are designed such that homes with electric heat can be identified. In theory, the homes had electric heat when they signed up for service, although if they have since switched to non-electric heat, they could possibly still be on the electric heat service code. The IPL billing database shows approximately 35% of homes having electric heat. For purposes of the market potential study, the 35% market share was assumed.

Load Forecast Disaggregation. Figure 2-4 and Figure 2-5 summarize the end-use disaggregation for residential energy sales as a result of the end use analysis.

FIGURE 2-4 SHARE OF ANNUAL HOUSEHOLD ENERGY CONSUMPTION BY END USE - RESIDENTIAL SECTOR

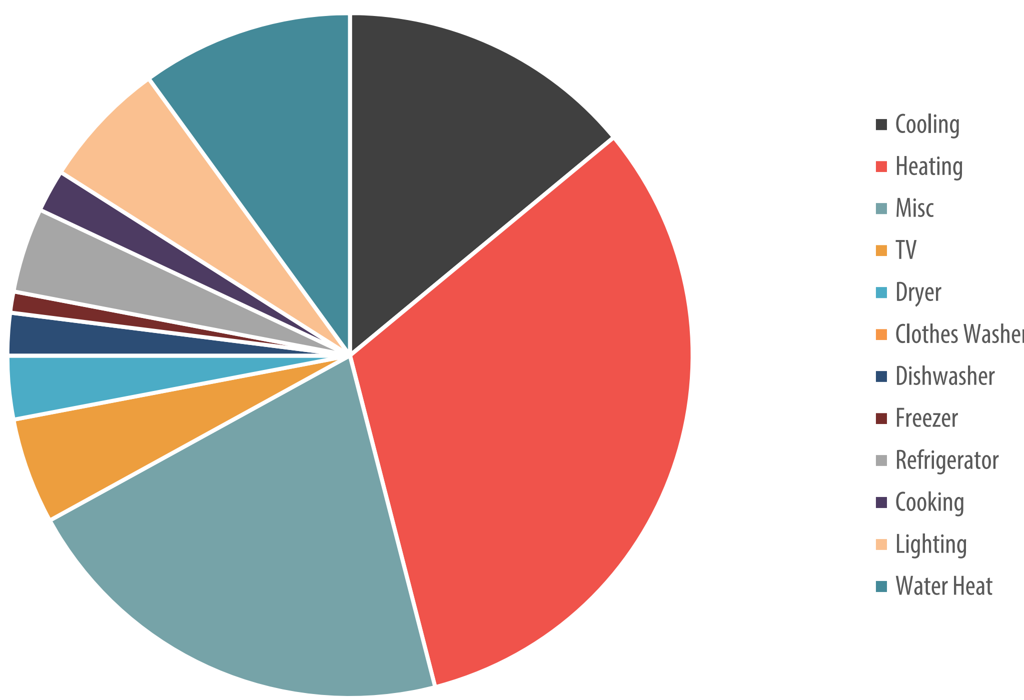
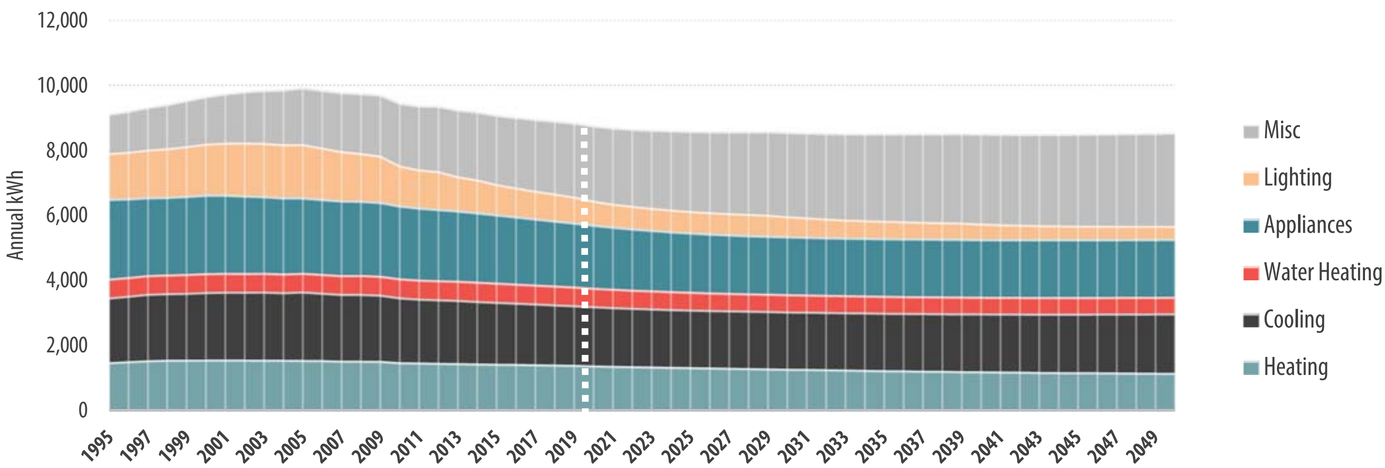


FIGURE 2-5 RESIDENTIAL LOAD FORECAST BY END USE



2.2 COMMERCIAL SECTOR

In the commercial sector, the GDS Team conducted a series of site visits to collect end use information. The first step was to segment the commercial class by building type to determine the recruitment frame for site visits. Then, sites were recruited from bins segmented by building type to recruit a total of 68 sites. A detailed end use survey was then completed by technicians to collect detailed research data and WTP information from site representatives.

2.2.1 Segmentation by Building Type

The GDS Team segmented commercial energy sales by building type using several analytical techniques. The first step was to assign an industry code (NAICS[7] and/or SIC[8]) to as many customers in IPL's commercial billing database as possible. Then, the codes were mapped to building types consistent with the types used in IPL's forecasting models and in the Commercial Building Energy Consumption Survey (CBECS) conducted by the US Department of Energy.

A multi-step process was used to assign industry codes to commercial accounts. First, codes that were available from IPL's databases were used. Then, a secondary database was used to supplement the IPL designations. The second data source was InfoUSA, which contains a business listing for Indianapolis and includes industry codes for those businesses.

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[7] North American Industry Classification System
[8] Standard Industrial Classification

FIGURE 2-6 HEURISTIC WORDS ASSIGNED TO SPECIFIC BUILDING TYPES

CHURCH	GRILL
HOSPITAL	OFFICE
AUTO	OFFICES
BANK	MOTEL
APARTMENTS	HOTEL
UNIVERSITY	WENDY'S
INVESTMENTS	MCDONALDS
REALTY	BURGER
PIZZA	RETAIL
RESTAURANT	SCHOOL
INSURANCE	COLLEGE
FITNESS	BAKERY
SALON	KOHLS
MEDICAL	SUBWAY
DENTAL	PUB
STUDIO	EATERY
BAPTIST	HOSPITALITY
DEPT OF TRANS	SPEEDWAY LLC

One challenge GDS had was matching InfoUSA information to IPL's customer billing database. A three-step process was employed to achieve the matching. First, we included the industry codes in InfoUSA if there was an exact match between the billing database and InfoUSA database for address, zip code, and phone number of the business. Next, GDS used a Levenshtein matching distance scoring algorithm[9] to compare business name, address, zip code, and phone number between the two data sources. The Levenshtein score determines how many textual changes have to be made between two strings of text to make them equivalent. Although some fuzzy logic is deployed in selecting a score that is considered a match and one that is not, GDS used observational evidence to set a score setpoint that would tend to reject more matches than accept. For example, if one database had "Arby's Restaurant #5852" as the business name and the other database simply had "Arby's", the Levenshtein score was 500 and considered a match if addresses also matched. However, "Beech Grove Community School" and "Beech Grove Aquatic" would have a score of 600 and would not be considered a match. Finally, the supplement the number of industry codes identified, GDS performed a heuristic approach by calculating a frequency of the number of times specific words appeared in business names and identified building types associated with certain key words. For instance, the word "Hotel" in a company name that was not otherwise identified with an industry code was assigned to the Lodging building type.

FIGURE 2-7 SALES SEGMENTATION BY BUILDING TYPE

2.2.2 Site Visits

A total of 68 site visits were completed, with representation from the major building types shown in Figure 2-7 above. Technicians collected data on building characteristics, heating and cooling behaviors, and detailed end-use equipment at each site, including information on HVAC, water heating, ventilation, cooking, refrigeration, air pressure, and other equipment.

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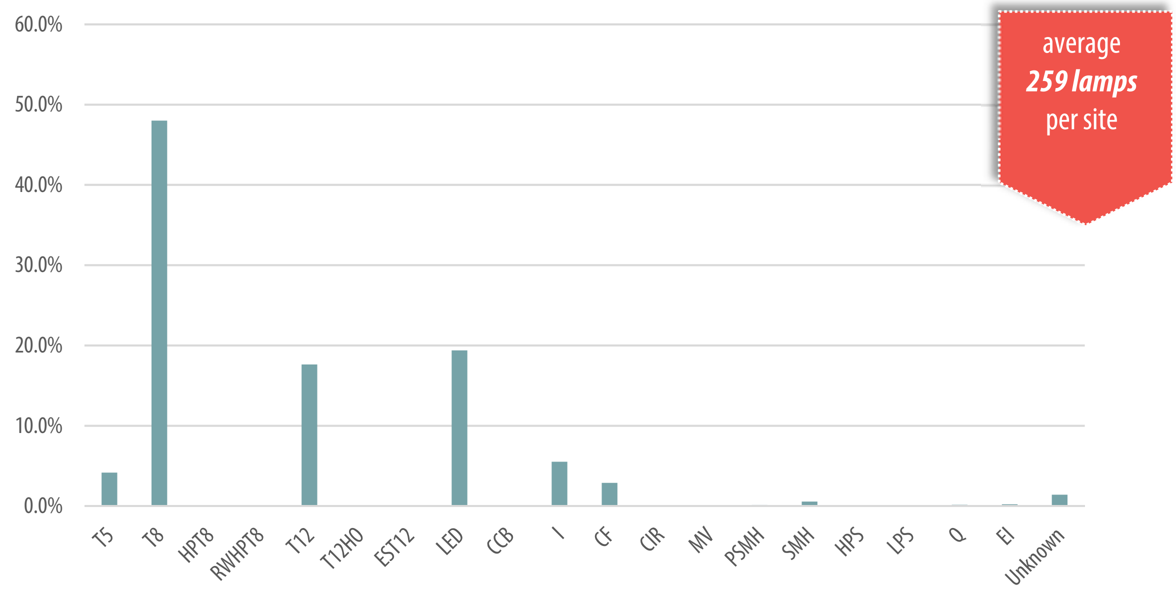
[9] In information theory, the Levenshtein distance is as string metric for measuring the distance between two sequences. Informally, it is the minimum number of single-character edits (insertions, deletions, or substitutions) required to change one string of text into the other.

As an example of the information collected, an average of 259 lamps per site were found during the site visits. Of those, 52% were T5/T8 bulbs and 20% were light emitting diode (LED).

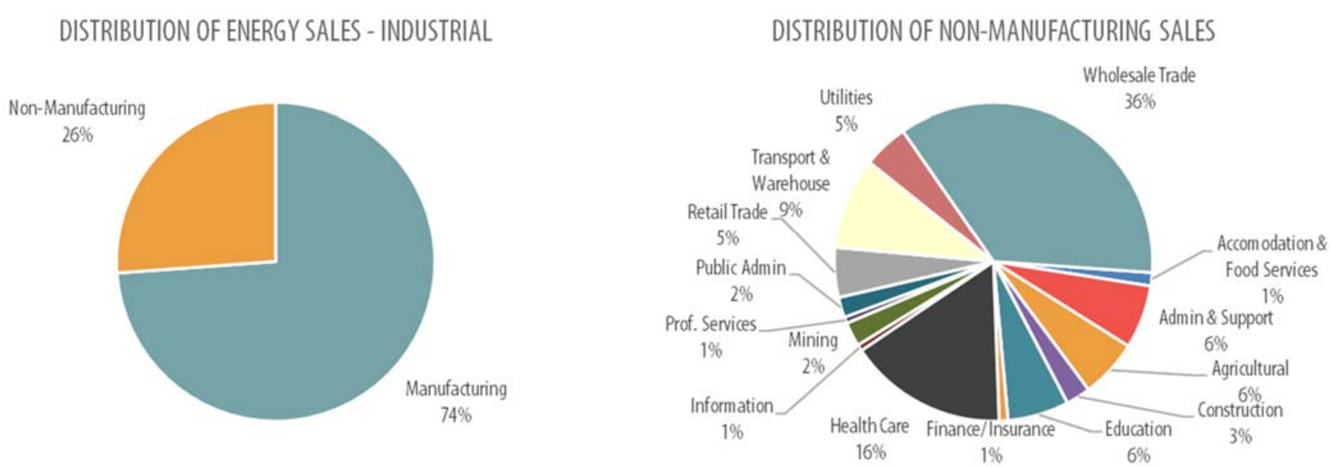
FIGURE 2-8 LIGHTING RESULTS FROM ONSITE SURVEYS - COMMERCIAL SECTOR



2.3 INDUSTRIAL SECTOR

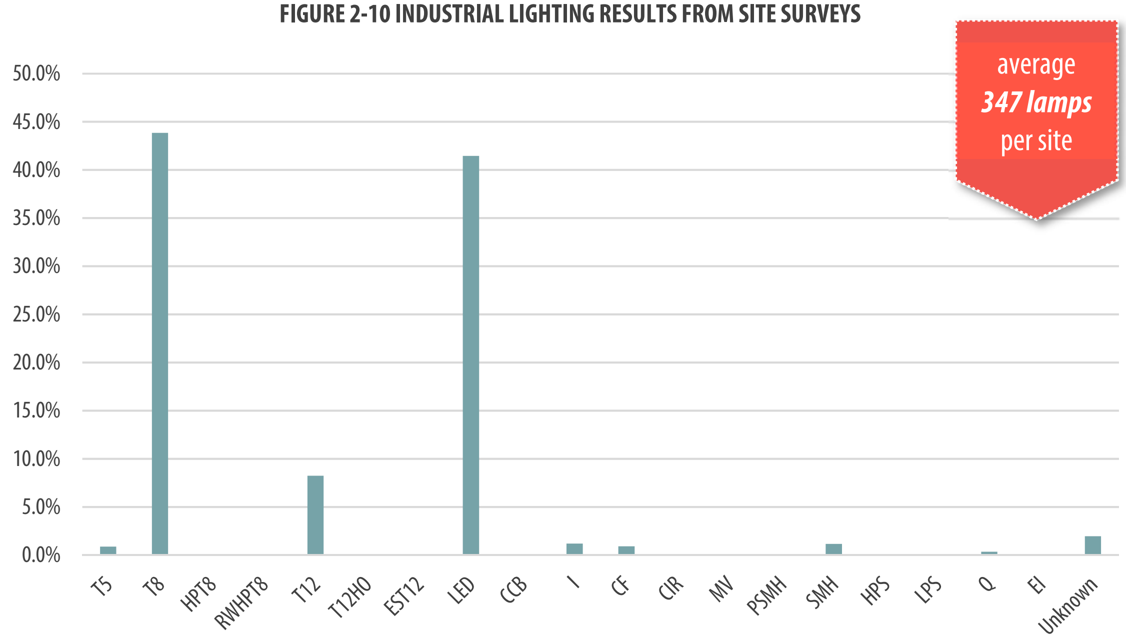
Much like in the commercial sector, end use analysis for the industrial sector involved market segmentation and onsite visits. Market segmentation was conducted using industry codes as described in the Commercial Sector section above. The segmentation analysis indicates that three quarters of industrial energy sales are to manufacturing industries. Of the quarter of non-manufacturing accounts, 50% of energy sales are in wholesale trade and health care industries with transportation and warehousing accounting for an additional nearly 10%.

FIGURE 2-9 INDUSTRIAL SEGMENTATION



A total of 40 site visits were conducted for the industrial sector, in which WTP and detailed end-use information was collected. One goal of the research was to recruit multiple opt-out accounts for onsite surveys. However, only 1 opt-out site agreed to participate in a site visit even though the GDS recruitment frame was designed with a significant number of opt-out accounts in it. Lighting information is provided in Figure 2-10 below as an example of summary information collected for the industrial sector.

FIGURE 2-10 INDUSTRIAL LIGHTING RESULTS FROM SITE SURVEYS



3 Market Potential Study Methodology

This section describes the overall methodology utilized to assess the electric energy efficiency and demand response potential in the IPL service area. The main objectives of this Market Potential Study were to estimate the technical, economic, MAP and RAP of energy efficiency and demand response in the IPL service territory; and to quantify these estimates of potential in terms of MWh and MW savings, for each level of energy efficiency and demand response potential.

3.1 OVERVIEW OF APPROACH

For the residential sector, GDS took a bottom-up approach to the modeling, whereby measure-level estimates of costs, savings, and useful lives were used as the basis for developing the technical, economic, and achievable potential estimates. The measure data was used to build-up the technical potential, by applying the data to each relevant market segment. The measure data allowed for benefit-cost screening to assess economic potential, which was in turn used as the basis for achievable potential. For the C&I sectors, GDS took a bottom-up modeling approach to first estimate measure-level savings and costs as well as cost-effectiveness, and then applied cost-effective measure savings to all applicable shares of energy load.

Further details of the market research and modeling techniques utilized in this assessment are provided in the following sections.

3.2 MARKET CHARACTERIZATION

The initial step in the analysis was to gather a clear understanding of the current market segments in the IPL service area. The GDS team coordinated with IPL to gather utility sales and customer data and existing market research to define appropriate market sectors, market segments, vintages, saturation data and end uses. This information served as the basis for completing a forecast disaggregation and market characterization of both the residential and nonresidential sectors.

3.2.1 Forecast Disaggregation

In the residential sector, GDS calibrated its building energy modeling simulations with IPL's sales forecasts.[10] This process began with the construction of building energy models, using the BEopt^{TM} (Building Energy Optimization) software, which were specified in accordance with the most currently available data describing the residential building stock in the IPL service area. Models were constructed for both single-family and multifamily homes, as well as various types of heating and cooling equipment and fuel types. Key characteristics defining these models include conditioned square footage, typical building envelope conditions such as insulation levels and representative appliance and HVAC efficiency levels. The simulations yielded estimated energy consumption for each building prototype, including estimates of each key end use. These end use estimates were then multiplied by the estimated proportion of customers that applied to each end use, to calculate an estimated service territory total consumption for each end use. For example, when completing this process for the IPL potential analysis, the simulated heat pump electric heating consumption was multiplied by the proportion of homes that rely on heat pumps for their electric heating needs, to calculate the total heat pump electric heating load in the IPL service territory.

The simulation process required several iterations. GDS collaborated with IPL to verify and modify certain assumptions about the market characteristics, such as the heating fuel and equipment types. GDS adjusted its assumptions about key market characteristics and revised its BEopt models to calibrate its building energy models to within 4% of forecasted sales in 2021.

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[10] IPL's sales forecast in all sectors excludes the impact of future DSM savings. Excluding future DSM savings prevents under-estimating energy efficiency savings potential.

In the C&I sectors, disaggregated forecast data provides the foundation for the development of energy efficiency potential estimates. GDS disaggregated the nonresidential sector for IPL into building or industry types using IPL's C&I customer database and 2017 monthly sales data. GDS supplemented the IPL customer database with a third-party dataset (purchased from InfoUSA) that provided additional SIC/NAICS code data by business.[11] This disaggregation involved two steps. First, the GDS team used rate codes to determine whether the customer was captured in either IPL's commercial or industrial load forecast. Next, GDS determined the appropriate industry for industrial customers and the building type for commercial customers. We used the following information, either from IPL's customer data or third-party dataset, to determine the appropriate building or industry type. Using these fields, GDS assigned customers IPL's non-residential data sets to one of the commercial or industrial segments listed in Table 3-1.

TABLE 3-1 NON-RESIDENTIAL SEGMENTS

COMMERCIAL	INDUSTRIAL	
Education	Chemicals	Paper
Food Sales	Fabricated Metals	Plastics & Rubber
Food Service	Food & Agriculture	Primary Metals
Health Care	Machinery	Transportation Equipment
Hospital	Mining	Wood
Lodging	Nonmetallic Mineral	
Office		
Public Assembly		
Retail		
Warehouse		

GDS further disaggregated sales for each of the segments into end uses. For commercial segments, GDS primarily used IPL's 2019 end-use forecast planning models supplemented with updated Energy Information Administration (EIA) 2012 CBECS data. This information was used to determine energy use intensities, expressed in kWh per square foot, for each end use within each segment.[12] We then used data compiled from metering studies, evaluation, measurement and verification (EM&V), and engineering algorithms to further disaggregate energy intensities into more granular end uses and technologies. For the industrial sector, the analysis relied on the EIA's Manufacturing Energy Consumption survey to disaggregate industry-specific estimates of consumption into end uses.[13]

Table 3-2 lists the electric end-uses considered in the forecast disaggregation and subsequent potential assessment.

TABLE 3-2 ELECTRIC END USES

Residential	Commercial	Industrial
Behavioral	Cooking	Agriculture
Clothes Washer/Dryer	Space Cooling	Computers & Office Equipment
Dishwasher	Lighting	CHP
Electronics	Office Equipment	Lighting
Hot Water	Refrigeration	Machine Drive
HVAC Equipment	Space Heating	Process Heating
HVAC Shell	Ventilation	Process Cooling
Lighting	Water Heating	Space Cooling
Pools		Space Heating

[11] The IPL dataset classifies businesses by Standard Industrial Classification (SIC) code, a four-digit standardized code, that has largely been replaced by the North American Industry Classification System (NAICS) code. The GDS Team converted the IPL SIC codes to NAICS codes, then mapped NAICS/SIC codes to building and industry types considered in this study.

[12] U.S. Energy Information Agency. *Commercial Buildings Energy Consumption Survey*. May 20, 2016.

[13] U.S. EIA. *Manufacturing Energy Consumption Survey 2010.* March 2013.

Residential	Commercial	Industrial
		Ventilation Water Heating

3.2.2 Eligible Opt-Out Customers

In Indiana, commercial or industrial customers with a peak load greater than 1MW are eligible to opt out of utility-funded electric energy efficiency programs. In the IPL service area, approximately 6.5% of commercial sales have opted out of utility-funded electric energy efficiency programs, while nearly 45% of industrial sales have opted out. [14]

FIGURE 3-1 OPT-OUT SALES BY C&I SECTOR

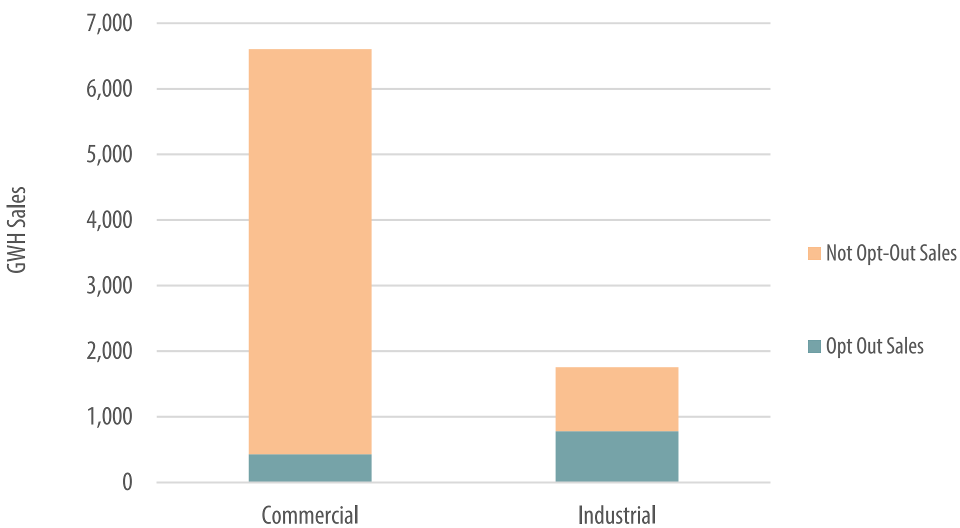

Figure 3-1 shows the total sales for the C&I sectors, as well as the sales, by sector, that have currently opted out of paying the charge levied to support utility-administered energy efficiency programs. The portion of sales that have not opted out include both ineligible load (i.e. does not meet the 1 MW monthly peak requirement) as well as eligible load that has not yet opted out.

The main body of this report focuses on the electric energy efficiency potential savings in the C&I sectors excluding sales from opt-out customers. Results of C&I sector potential in a scenario that includes savings from IPL's opt-out customers are provided in an appendix to this report.

3.2.3 Building Stock/Equipment Saturation

To assess the potential electric energy efficiency savings available, estimates of the current saturation of baseline equipment and energy efficiency measures are necessary.

3.2.3.1 Residential Sector

For the residential sector, GDS relied on several primary research efforts. The most important effort was a 2018 online survey of IPL customers conducted by the GDS Team as part of the study. More than 200 responses provided a strong basis for many of the IPL measure baseline and efficient saturation estimates. GDS also relied on an onsite survey of IPL customers conducted by the GDS Team in 2018. This study helped fill in data gaps and confirm the results of the online survey.

Other data sources included ENERGY STAR unit shipment data, IPL evaluation reports, EIA Residential Energy Consumption Survey data from 2015 and baseline studies from other states. The ENERGY STAR unit shipment data filled data gaps related to the increased saturation of energy efficient equipment across the U.S. in the last decade.

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[14] These percentages were calculated based on the 2017 IPL non-residential customer data and 2017 billing history. Note, the total C&I sales were adjusted to shift select industrial sales into the commercial sector based on the identified building type and more applicable mapping to the commercial sector models for the MPS.

3.2.3.2 Commercial Sector

For the commercial sector, data collected through on-site visits as part of this study was leveraged to develop remaining factors for many of the measures. GDS coordinated with IPL and the Oversight Board to develop a research plan, sampling plan, and a survey questionnaire used to collect data. The on-site data collection included facility operation schedules and building characteristics, HVAC equipment type and efficiency levels, lighting fixture inventories, control systems and strategies, and related electric consuming equipment characteristics.

The survey data was used to inform two main assumptions for the potential study, the Base Case factor and saturation of efficient equipment. The Base Case Factor is the fraction of the end use energy that is applicable for the efficient technology in given market segment. Survey data was used to determine fractional energy use for most measures in the study. The survey data provided counts for equipment and energy usage levels for the lighting, heating, cooling, water heating, motors and refrigeration end-uses. For example, T12 and T8 lighting used 84% of the energy for interior fluorescent lamps and fixtures for the surveyed buildings. The remaining usage was a combination of compact fluorescent lights (CFLs), T5s and LED linear tube lighting.

In total, 63% of the base case allocations came directly from the survey data and the other 37% came from regional potential study data from other Indiana Utilities or from GDS estimates based upon past study experience.

In addition to base equipment saturation data, the commercial survey data was used to determine the efficient saturations for 60% of all measures in the study. For example, the survey found that 14% of commercial building lighting has already been concerted to LEDs. The latest ENERGY STAR shipment data report was also used to determine efficient equipment saturation estimates. Emerging technologies typically assumed no significant market saturation levels.

3.2.3.3 Industrial Sector

As in the commercial sector, data collected in industrial facilities through on-site visits as part of this study was leveraged to develop remaining factors for many of the measures. The on-site data collection included facility operation schedules and building characteristics, HVAC equipment type and efficiency levels, lighting fixture inventories, control systems and strategies, and related process electric consuming equipment characteristics.

Survey data was used to determine fractional energy use for most measures in the study. The survey data provided counts for equipment and energy usage levels for the lighting, heating, cooling, water heating, motors and refrigeration end-uses. For example, 56% of lighting energy was found to be associated with high bay and low bay light fixtures, while 33% was found to be associated with other interior tube lighting (T8, T12, LED). 11% was associated with exterior lighting and other interior bulbs such as CFLs and incandescent bulbs.

Base factor assumptions for industrial lighting, process motors, and space cooling came directly from the survey data and the other base factor information came from regional potential study data from other Indiana Utilities or from GDS estimates based upon past study experience.

In addition to base case factor, the survey data was also utilized, where possible, to estimate the saturation of efficient equipment, primarily lighting. GDS relied on secondary research, including the EIA Manufacturing Energy Consumption Survey for assessing the efficiency saturation of the remaining measures for industrial lighting, process motors and variable frequency drives, space cooling equipment, and air compressors. Like the commercial sector, emerging technologies were assumed to have little to no significant market saturation.

3.2.4 Remaining Factor

The remaining factor is the proportion of a given market segment that is not yet efficient and can still be converted to an efficient alternative. It is the inverse of the saturation of an energy efficient measure, prior to any adjustments. For this study we made two key adjustments to recognize that the energy efficient saturation does not necessarily always fully represent the state of market transformation. In other words, while a percentage of installed measures may already be efficient, this does not preclude customers from backsliding, or reverting to standard technologies, or otherwise less efficient alternatives in the future, based on considerations like measure cost and availability and customer preferences (e.g. historically, some customers have disliked CFL light quality, and have reverted to incandescent and halogen bulbs after the CFLs burn out).

For measures categorized as market opportunity (i.e. replace-on-burnout), we assumed that 50% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. Essentially this adjustment implies that we are assuming that 50% of the market is transformed, and no future savings potential exists, whereas the remaining 50% of the market is not transformed and could backslide without the intervention of an IPL program and an incentive. Similarly, for retrofit measures, we assumed that only 10% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. This recognizes the more proactive nature of retrofit measures, as the implementation of these measures are more likely to be elective in nature, compared to market opportunity measures, which are more likely to be needs-based. We recognize the uncertainty in these assumptions, but we believe these are appropriate assumptions, as they recognize a key component of the nature of customer decision making.

3.3 MEASURE CHARACTERIZATION

3.3.1 Measure Lists

The study's sector-level energy efficiency measure lists were informed by a range of sources including the Indiana TRM, current IPL program offerings, and commercially viable emerging technologies, among others. Measure list development was a collaborative effort in which GDS developed draft lists that were shared with IPL and stakeholders. The final measure lists ultimately included in the study reflected the informed comments and considerations from the parties that participated in the measure list review process.

In total, GDS analyzed 554 measure types for IPL. Many measures were included in the study as multiple permutations to account for different specific market segments, such as different building types, efficiency levels, and replacement options. GDS developed a total of 4,708 measure permutations for this study. Each permutation was, screened for cost-effectiveness according to the UCT. The parameters for cost-effectiveness under the UCT are discussed in detail later in Section 3.4.3.

TABLE 3-3 NUMBER OF MEASURES EVALUATED

	# of Measures	Total # of Measure Permutations	# with UCT ≥ 1
IPL – Electric			
Residential	187	648	420
Commercial	237	2370	2160
Industrial	130	1690	1482
Total	***554***	***4708***	***4062***

3.3.2 Emerging Technologies

GDS considered several specific emerging technologies as part of analyzing future potential. In the residential sector, these technologies include several smart technologies, including smart appliances, smart water heater (WH) tank controls, smart window coverings, smart ceiling fans, heat pump dryers and home automation/home energy management systems. In the non-residential sector, specific emerging technologies that were considered as part of the analysis include strategic energy management, advance lighting controls, advanced rooftop controls, cloud-based energy information systems (EIS), high performance elevators, and escalator motor controls. While this is likely not an exhaustive list of possible emerging technologies over the next twenty years it does consider many of the known technologies that are available today but may not yet have widespread market acceptance and/or product availability.

In addition to these specific technologies, GDS acknowledges that there could be future opportunities for new technologies as equipment standards improve and market trends occur. While this analysis does not make any explicit assumption about unknown future technologies, the methodology assumes that subsequent equipment replacement that occurs over the course of the 19-year study timeframe, and at the end of the initial equipment's useful life, will continue to achieve similar levels of energy savings, relative to improved baselines, at similar incremental costs.

3.3.3 Assumptions & Sources

A significant amount of data is needed to estimate the electric savings potential for individual energy efficiency measures or programs across the residential and nonresidential customer sectors. GDS utilized data specific to IPL when it was available and current. GDS used the most recent IPL evaluation report findings (as well as IPL program planning documents), 2015 Indiana Technical Reference Manual (TRM), the Illinois TRM, and the Michigan Energy Measures Database (MEMD) to a large amount of the data requirements. Evaluation report findings and the Indiana TRM were leveraged to the extent feasible – additional data sources were only used if these first two sources either did not address a certain measure or contained outdated information. The BEopt simulation modeling results formed the basis for most heating and cooling end use measure savings. The National Renewable Energy Laboratory (NREL) Energy Measures Database also served as a key data source in developing measure cost estimates. Additional source documents included American Council for an Energy-Efficient Economy (ACEEE) research reports covering topics like emerging technologies.

Measure Savings: GDS relied on existing IPL evaluation report findings[15] and the 2015 IN TRM to inform calculations supporting estimates of annual measure savings as a percentage of base equipment usage. For custom measures and measures not included in the IN TRM, GDS estimated savings from a variety of sources, including:

- Illinois TRM, MEMD, and other regional/state TRMs
- Building energy simulation software (BEopt) and engineering analyses
- Secondary sources such as the ACEEE, Department of Energy (DOE), EIA, ENERGY STAR©, and other technical potential studies

Measure Costs: Measure costs represent either incremental or full costs. These costs typically include the incremental cost of measure installation, when appropriate based on the measure definition. For purposes of this study, nominal measure costs held constant over time.[16] One exception is an assumed decrease in costs for LED bulbs over the study horizon. LED bulb consumer costs have been declining rapidly over the last several years and future cost projections indicate a continued decrease in bulb costs.[17] GDS' treatment of LED bulb costs, LED lighting efficacy, and the impacts of the Energy Independence and Security Act (EISA) are discussed in greater detail in Section 3.3.5, "Review of LED Lighting Assumptions."

GDS obtained measure cost estimates primarily from the IPL program planning databases, and the 2015 IN TRM. GDS used the following data sources to supplement the IN TRM:

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[15] 2016 EM&V (Cause No. 44497) and 2017 EM&V (Cause No. 44792)

[16] GDS reviewed the deemed measure cost assumptions included in the Illinois TRM from 2012 (v1) through 2018 (v7). Where a direct comparison of cost was applicable, GDS found no change in measure cost across 80% of residential and nonresidential measures. In a similar search of the MEMD from 2011 to 2018, GDS again found that most of incremental measure costs in 2018 were either the same or higher than the recorded incremental measure cost in 2011.

[17] LED Incremental Cost Study Overall Final Report. The Cadmus Group. February 2016

- Illinois TRM, MEMD, and other regional/state TRMs
- Secondary sources such as the ACEEE, ENERGY STAR, and NREL
- Program evaluation and market assessment reports completed for utilities in other states

Measure Life: Measure life represents the number of years that energy using equipment is expected to operate. GDS obtained measure life estimates from the 2015 IN TRM and IPL program planning databases, and used the following data sources for measures not in the IN TRM:

- Illinois TRM, MEMD, and other regional/state TRMs
- Manufacturer data
- Savings calculators and life-cycle cost analyses

All measure savings, costs, and useful life assumption sources are documented in Appendices B-D.

3.3.4 Treatment of Codes & Standards

Although this analysis does not attempt to predict how energy codes and standards will change over time, the analysis does attempt to reflect the latest legislated improvements to federal codes and standards. Where possible, improvements to baseline equipment standards can typically be met with incremental improvements to efficient equipment standards. However, in select case, such as screw-in lighting (discussed further below), improvements to the baseline standard effectively will be expected to eliminate the efficient technology from future consideration.

3.3.5 Review of LED Lighting Assumptions

Recognizing that there remains significant uncertainty regarding the future potential of residential screw-in lighting, GDS reviewed the latest lighting-specific program designs and consulted with industry peers to develop critical assumptions regarding the future assumed baselines for LED screw base omnidirectional, specialty/decorative, and reflector/directional lamps over the study timeframe.

EISA Impacts. LED screw base omnidirectional and decorative lamps are impacted by the EISA 2007 regulation backstop provision, which requires all non-exempt lamps to be 45 lumens/watt, beginning in 2020. Based on this current legislation, the federal baseline in 2020 will be roughly equivalent to a CFL bulb. However, in January 2017, the Department of Energy expanded the scope of the standard to include directional and specialty bulb but stated that they may delay enforcement based on ongoing dialog with industry stakeholders. Although there is uncertainty surrounding EISA and the backstop provision, the Market Potential Study assumes the backstop provision for standard (A-lamp) screw-in bulbs will take effect beginning in 2022. The analysis assumes the expanded definition of general service lamps to include specialty and reflector sockets will impact those sockets beginning in 2023. Last, the analysis assumes a limited opportunity for direct install of LED bulbs replacing halogen bulbs through 2024 in both low-income and non-low-income households.

TABLE 3-4 ASSUMED LIGHTING BASELINE TECHNOLOGY BY YEAR

Delivery Approach/Bulb Type	2021	2022	2023	2024
Buydown				
Standard LED	Halogen	CFL	CFL	CFL
Specialty LED	Incandescent	Incandescent	CFL	CFL
Reflector LED	Incandescent	Incandescent	CFL	CFL
Direct Install				
Standard LED	Halogen	Halogen	Halogen	CFL
Specialty LED	Incandescent	Incandescent	Incandescent	CFL
Reflector LED	Incandescent	Incandescent	Incandescent	CFL

LED Bulb Costs. Based on EIA Technology Forecast Report, LED bulb costs were assumed to decrease over the analysis period. LED bulb costs ranged between $2.95 (standard) and $5.45 (reflector) in 2021, decreasing to

$2-$3 by 2039. Incentives were modeled as a % of incremental cost, resulting in decreasing incentives over the analysis timeframe as well.

LED Lighting Efficacy. Using the same EIA Technical Forecast Report, LED efficacy was also assumed to improve over the analysis timeframe. By 2040, the LED wattage of a bulb equivalent to a 60W incandescent will improve from 8W (today's typical LED) down to 4W.

3.3.6 Net to Gross (NTG)

All estimates of technical, economic, and achievable potential, as well as measure level cost-effectiveness screening were conducted in terms of gross savings to reflect the absence of program design considerations in these phases of the analysis. The impacts of free-riders (participants who would have installed the high efficiency option in the absence of the program) and spillover customers (participants who install efficiency measures due to program activities, but never receive a program incentive) were considered in the development of DSM Inputs into IPL's upcoming IRP.

3.4 ENERGY EFFICIENCY POTENTIAL

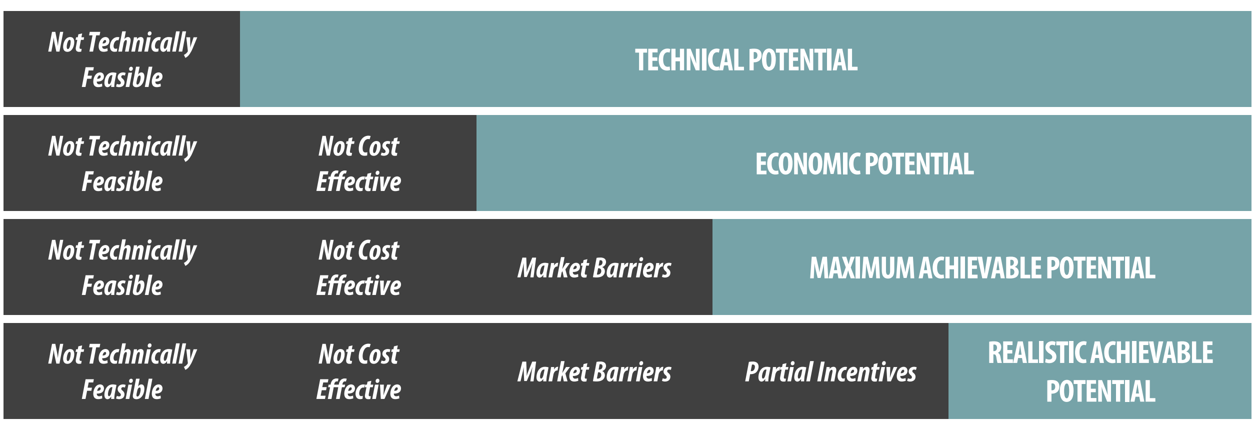
This section reviews the types of potential analyzed in this report, as well as some key methodological considerations in the development of technical, economic, and achievable potential.

3.4.1 Types of Potential

Potential studies often distinguish between several types of energy efficiency potential: technical, economic, achievable, and program. However, because there are often important definitional issues between studies, it is important to understand the definition and scope of each potential estimate as it applies to this analysis.

The first two types of potential, technical and economic, provide a theoretical upper bound for energy savings from energy efficiency measures. Still, even the best-designed portfolio of programs is unlikely to capture 100% of the technical or economic potential. Therefore, achievable potential attempts to estimate what savings may realistically be achieved through market interventions, when it can be captured, and how much it would cost to do so. Figure 3-2 illustrates the types of energy efficiency potential considered in this analysis.

FIGURE 3-2 TYPE OF ENERGY EFFICIENCY POTENTIAL



3.4.2 TECHNICAL POTENTIAL

Technical potential is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. Under technical potential, GDS assumed that 100% of new construction and market opportunity measures are adopted as those opportunities become available (e.g., as new buildings are constructed, they immediately adopt efficiency measures, or as existing measures reach the end of their useful life). For retrofit measures, implementation was assumed to be resource constrained and that it was not possible to install all retrofit measures all at once. Rather, retrofit opportunities were assumed to be replaced incrementally until 100% of stock was converted to the efficient measure over a period of no more than 15 years.

3.4.2.1 Competing Measures & Interactive Effects Adjustments

GDS prevents double-counting of savings, and accounts for competing measures and interactive savings effects, through three primary adjustment factors:

Baseline Saturation Adjustment. Competing measure shares may be factored into the baseline saturation estimates. For example, nearly all homes can receive insulation, but the analysis has created multiple measure permutations to account for varying impacts of different heating/cooling combinations and have applied baseline saturations to reflect proportions of households with each heating/cooling combination.

Applicability Factor Adjustment. Combined measures into measure groups, where total applicability factor across measures is set to 100%. For example, homes cannot receive a programmable thermostat, connected thermostat, and smart thermostat. In general, the models assign the measure with the most savings the greatest applicability factor in the measure group, with competing measures picking up any remaining share.

Interactive Savings Adjustment. As savings are introduced from select measures, the per-unit savings from other measures need to be adjusted (downward) to avoid over-counting. The analysis typically prioritizes market opportunity equipment measures (versus retrofit measures that can be installed at any time). For example, the savings from a smart thermostat are adjusted down to reflect the efficiency gains of installing an efficient air source heat pump. The analysis also prioritizes efficiency measures relative to conservation (behavioral) measures.

3.4.3 Economic Potential

Economic potential refers to the subset of the technical potential that is economically cost-effective (based on screening with the UCT) as compared to conventional supply-side energy resources.

3.4.3.1 Utility Cost Test & Incentive Levels

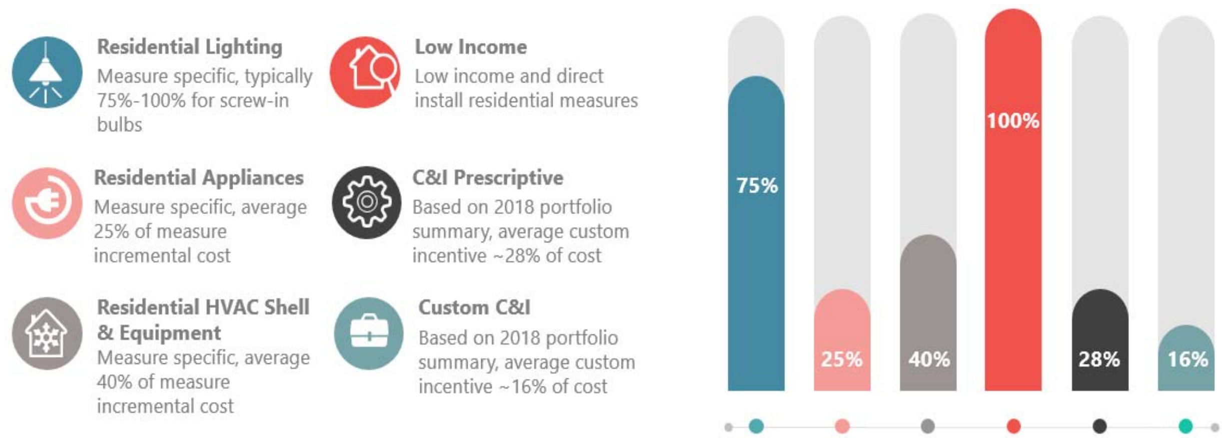
The economic potential assessment included a screen for cost-effectiveness using the UCT at the measure level. In the IPL territory, the UCT considers electric energy, capacity, and transmission & distribution (T&D) savings as benefits, and utility incentives and direct install equipment expenses as the cost. Consistent with application of economic potential according to the National Action Plan for Energy Efficiency, the measure level economic screening does not consider non-incentive/measure delivery costs (e.g. admin, marketing, evaluation etc.) in determining cost-effectiveness.[18]

Apart from the low-income segment of the residential sector, all measures were required to have a UCT benefit-cost ratio greater than 1.0 to be included in economic potential and all subsequent estimates of energy efficiency potential. Low-income measures were not required to be cost-effective; all low-income specific measures are included in the economic and achievable potential estimates.

For both the calculation of the measure-level UCT, as well as the determination of RAP, historical incentive levels (as a % of incremental measure cost) were calculated for current measure offerings. Figure 3-3 describes the incentive levels by key market segment within the residential and nonresidential sectors.

[18] National Action Plan for Energy Efficiency: Understanding Cost-Effectiveness of Energy Efficiency Programs. *Note: Non-incentive delivery costs are included in the assessment of achievable potential.*

FIGURE 3-3 INCENTIVES BY SECTOR AND MARKET SEGMENT



GDS relied on IPL's DSM Portfolio Summary to map current measure offerings to their historical incentive levels. For study measures that did not map directly to a current offering, GDS calculated the weighted average incentive level (based on 2017 participation) by sector and/or program and applied these "typical" incentive levels to the new measures.

- In the residential sector, lighting incentive levels were assumed to represent 75-100% of the measure cost. Overall, residential appliance incentive levels averaged 25% of the incremental measure cost, while HVAC Shell and Equipment incentives averaged roughly 4-% of the measure cost.
- Low income and direct install measures received incentives equal to 100% of the measure cost.
- In the non-residential sector, prescriptive incentives were approximately 28% of the measure cost, and custom measures received incentives equal to 16% of the measure cost.
- In the MAP scenario, all incentives were set to 100% of the incremental measure cost.

3.4.3.2 Avoided Costs

Avoided energy supply costs are used to assess the value of energy savings. Avoided cost values for electric energy, electric capacity, and avoided T&D were provided by IPL as part of an initial data request. Electric energy is based on an annual system marginal cost. For years outside of the avoided cost forecast timeframe, future year avoided costs are escalated by the rate of inflation.

3.4.4 Achievable Potential

Achievable potential is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and WTP in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:

- ***MAP*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***RAP*** estimates achievable potential with IPL paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

3.4.4.1 Market Adoption Rates

GDS assessed achievable potential on a measure-by-measure basis. In addition to accounting for the natural replacement cycle of equipment in the achievable potential scenario, GDS estimated measure specific maximum adoption rates that reflect the presence of possible market barriers and associated difficulties in achieving the 100% market adoption assumed in the technical and economic scenarios.

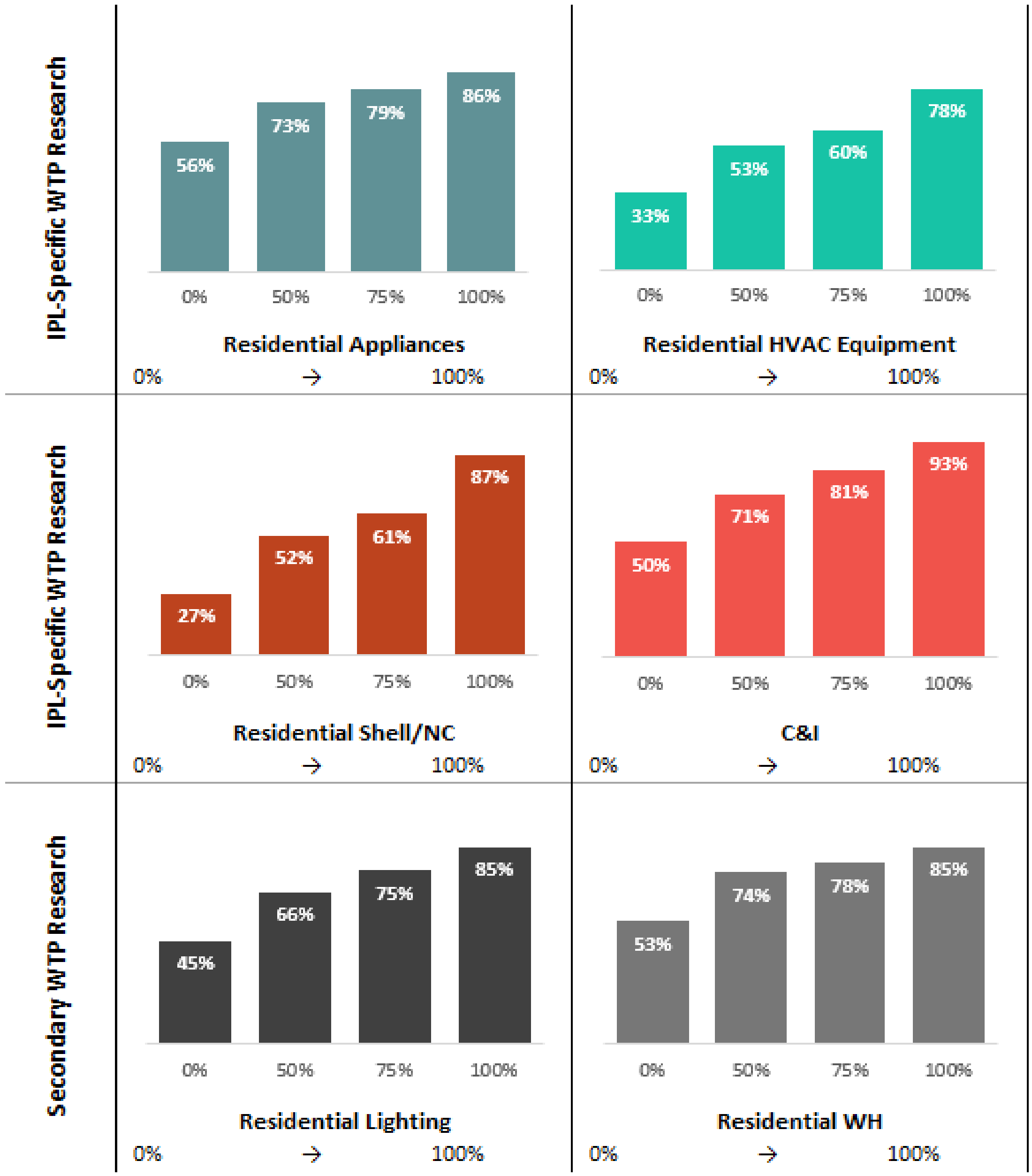
The initial step was to assess the long-term market adoption potential for energy efficiency technologies. Due to the wide variety of measures across multiple end-uses, GDS employed varied measure and end-use-specific ultimate adoption rates versus a singular universal market adoption curve. These long-term market adoption estimates were based on either IPL-specific WTP market research or publicly available DSM research including market adoption rate surveys and other utility program benchmarking. These surveys included questions to residential homeowners and nonresidential facility managers regarding their perceived willingness to purchase and install energy efficient technologies across various end uses and incentive levels.

GDS utilized likelihood and willingness-to-participate data to estimate the long-term market adoption potential for both the maximum and realistic achievable scenarios.[19] Table 3-5 presents the long-term market adoption rates at varied incentive levels used for both the residential and nonresidential sectors. When incentives are assumed to represent 100% of the measure cost (maximum achievable), the long-term market adoption typically ranged by sector and end-use from 78% to 93%. For the RAP scenario, the incentive levels also varied by measure resulting in measure-specific market adoption rates.

[19] For the MAP Scenario, the long-term adoption rate was reached by Year15 (or earlier) and annual participation remained flat in the final five years of the analysis. In the RAP scenario, the analysis assumes the maximum adoption rate is reached over a period of 20-years or less.

TABLE 3-5 LONG-TERM MARKET ADOPTION RATES AT DISCRETE INCENTIVE LEVELS

(based on Willingness-to-Participate Survey Results)



GDS then estimated initial year adoption rates by reviewing the current saturation levels of efficient technologies and (if necessary) calibrating the estimates of 2020 annual potential to recent historical levels achieved by IPL's current DSM portfolio. This calibration effort ensures that the forecasted achievable potential in 2020 is realistic and attainable. GDS then assumed a non-linear ramp rate from the initial year market adoption rate to the various long-term market adoption rates for each specific end-use.

One caveat to this approach is that the ultimate long-term adoption rate is generally a simple function of incentive levels and payback. There are other factors that may influence a customer's willingness to purchase an energy efficiency measure. For example, increased marketing and education programs can have a critical impact on the success of energy efficiency programs. Other benefits, such as increased comfort or safety and reduced maintenance costs could also factor into a customer's decision to purchase and install energy efficiency measures. To acknowledge these impacts, GDS reviewed the stated adoption levels depending on whether cost was named as the primary barrier towards adoption. For respondents who did not select cost as the primary barrier, stated adoption levels were typically higher than those where cost was the primary barrier. To reflect the opportunity for increased education, marketing, and awareness to impact future long-term adoption levels, GDS ultimately utilized the adoption rates from respondents where cost was not the primary barrier. Although we recognize this approach does not capture every possible factor in determining appropriate long-term adoption levels, it does assign some weight to non-financial considerations in the assessment of long-term energy efficiency potential.

3.4.4.2 Non-Incentive Costs

Consistent with National Action Plan for Energy Efficiency (NAPEE) guidelines[20], utility non-incentive costs were included in the overall assessment of cost-effectiveness at the RAP scenario. 2021 direct measure/program non-incentive costs were calibrated to recent projected levels (using the 2019 portfolio summary) and set at:

- $0.31 per Home Energy Report
- $1.5-$2.5 per bulb for residential LEDs
- $0.05-$.10 per first year kWh saved for most residential appliance, electronics, and water heating retrofit measures;
- $0.16 per first year kWh saved for residential appliance recycling;
- $0.28 per first year kWh saved for residential heating and cooling equipment;
- 0.20-$0.23 per first year kWh saved for the remaining residential measures,
- $0.25-.28 per first year kWh saved for prescriptive C&I measures
- $0.06 per first year kWh saved for custom C&I measures; and
- $0.08 per first year kWh saved for C&I emerging technology measures.

Non-incentive costs were then escalated annually at the rate of inflation. [21]

3.5 DEMAND RESPONSE POTENTIAL

This section provides an overview of the demand response potential methodology. Summary results of the demand response analysis are provided in Section 8. Additional results details are provided in Appendix G.

3.5.1 Demand Response Program Options

Table 3-6 provides a brief description of the demand response program options considered and identifies the eligible customer segment for each demand response program that was considered in this study. This includes direct load control (DLC) and rate design options.

TABLE 3-6 DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS

Demand Response Program Option	Program Description	Eligible Markets
DLC AC (Switch)	The compressor of the air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle). GDS looked at both the one-way communicating Cannon switches and two-way communicating L+G switches. Both switch options were assumed to be phased out as customers switch to thermostats over time.	Residential and Non-Residential Customers

[20] National Action Plan for Energy Efficiency (2007). Guide for Conducting Energy Efficiency Potential Studies. Prepared by Optimal Energy. This study notes that economic potential only considers the cost of efficiency measures themselves, ignoring programmatic costs. Conversely, achievable potential should consider the non-measures costs of delivering programs. Pg. 2-4.
[21] As noted earlier in the report, measure costs and utility incentives were not escalated over the 20-year analysis timeframe to keep those costs constant in nominal dollars.

Demand Response Program Option	Program Description	Eligible Markets
DLC AC (Thermostat)	The system operator can remotely raise the AC's thermostat set point during peak load conditions, lowering AC load. GDS looked at the three options IPL currently has: a customer is given a free thermostat to participate along with an annual incentive, a customer is given a rebate through the marketplace or a storefront along with an annual incentive, or the customer brings an existing thermostat and is only given an annual incentive.	Residential and Non-Residential Customers
DLC Space Heating	The system operator can remotely lower the HVAC's thermostat set point during winter peak load conditions, lowering the heating load. This program is an add-on to the DLC AC Thermostat program. Only participants in the AC Thermostat program would be allowed to participate in the Space Heating program.	Residential and Non-Residential Customers
DLC Water Heaters	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 8 hours.	Residential and Non-Residential Customers
Ice Storage Cooling Rate	The use of a cold storage medium such as ice, chilled water, or other liquids. Off-peak energy is used to produce chilled water or ice for use in cooling during peak hours. The cool storage process is limited to off-peak periods.	Large Non-Residential Customers
DLC Lighting	Part of the lighting load is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours.	Non-Residential Customers
Curtailable Rate (Day of)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	Non-Residential Customers
Curtailable Rate (Day Ahead)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	Non-Residential Customers

Double-counting savings from demand response programs that affect the same end uses is a common issue that must be addressed when calculating the demand response savings potential. For example, a direct load control (DLC) program of air conditioning and a rate program both assume load reduction of the customers' air conditioners. For this reason, it is typically assumed that customers cannot participate in programs that affect the same end uses. However, in this study, none of the programs interacted with each other. All residential programs considered were direct load control. Only small non-residential customers were eligible for direct load control programs, and large non-residential customers were eligible for the Ice Storage Cooling Rate and Curtailable Rate.

3.5.2 Demand Response Potential Assessment Approach Overview

The analysis of demand response, where possible, closely followed the approach outlined for energy efficiency. The framework for assessing the cost-effectiveness of demand response programs is based *on A Framework for Evaluating the Cost-Effectiveness of Demand Response, prepared for the National Forum on the National Action Plan (NAPA) on Demand Response*.[22] Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.[23] GDS utilized this guide to define avoided ancillary services and energy and/or capacity price suppression benefits.

Direct load control demand response analysis was conducted using the GDS Demand Response Model. Demand response via rate programs (specifically, curtailable rates) were analyzed by Demand Side Analytics (DSA). GDS and DSA determine the estimated savings for each demand response program by performing a review of all benefits and cost associated with each program. Both firms a modeling approach that considers numerous required inputs for each program including: expected life, coincident peak (CP) kW load reductions, proposed rebate levels, program related expenses such as vendor service fees, marketing and evaluation cost and on-going O&M expenses.

The UCT was used to determine the cost-effectiveness of each demand response program. Benefits are based on avoided demand, energy (including load shifting), wholesale cost reductions and T&D costs. Costs include incremental program equipment costs (such as control switches or smart thermostats), fixed program capital costs (such as the cost of a central controller), program administrative, marketing, and evaluation costs. Incremental equipment program costs are included for both new and replacement units (such as control switches) to account for units that are replaced at the end of their useful life.

The demand response analysis includes estimates of technical, economic, and achievable potential. Achievable potential is broken into maximum and RAP in this study:

MAP represents an estimate of the maximum cost-effective demand response potential that can be achieved over the 19-year study period. For this study, this is defined as customer participation in demand response program options that reflect a “best practices” estimate of what could eventually be achieved. MAP assumes no barriers to effective delivery of programs.

RAP represents an estimate of the amount of demand response potential that can be realistically achieved over the 19-year study period. For this study, this is defined as achieving customer participation in demand response program options that reflect a realistic estimate of what could eventually be achieved assuming typical or “average” industry experience. RAP is a discounted MAP, by considering program barriers that limit participation, therefore reducing savings that could be achieved.

3.5.3 Avoided Costs

Demand response avoided costs were consistent with those utilized in the energy efficiency potential analysis and were provided by IPL. The primary benefit of demand responses is avoided generation capacity, resulting from a reduction in the need for new peaking generation capacity. Demand response can also produce energy related benefits. If the demand response option is considered “load shifting”, such as direct load control of electric water heating, the consumption of energy is shifted from the control period to the period immediately following the period of control. For this study, GDS assumed that the energy is shifted with no loss of energy. If the program is not considered to be “load shifting” the measure is turned off during peak control hours, and the energy is saved altogether. Demand response programs can also potentially delay the construction of new transmission and distribution lines and facilities, which is reflected in avoided T&D costs.

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[22] Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.

[23] National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, May 18, 2017, Prepared by The National Efficiency Screening Project

3.5.4 Demand Response Program Assumptions

This section briefly discusses the general assumptions and sources used to complete the demand response potential analysis. Appendix G provides additional detail by program and sector related to load reduction, program costs, and projected participation.

3.5.4.1 Direct Load Control Program Assumptions

Load Reduction: Demand reductions were based on load reductions found in IPL's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies. DLC and thermostat-based demand response options were typically calculated based on a per-unit kW demand reduction whereas rate-based demand response options were typically assumed to reduce a percentage of the total facility peak load.

Useful Life: The useful life of a smart thermostat is assumed to be 12 years . Load control switches have a useful life of 12 years. This life was used for all direct load control measures in this study.

Program Costs: One-time program development costs included in the first year of the analysis for new programs. No program development costs are assumed for programs that already exist. Each new program includes an evaluation cost, with evaluation cost for existing programs already being included in the administration costs. It was assumed that there would be a cost of $50[24] per new participant for marketing for the DLC programs. Marketing costs are assumed to be 33.3% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

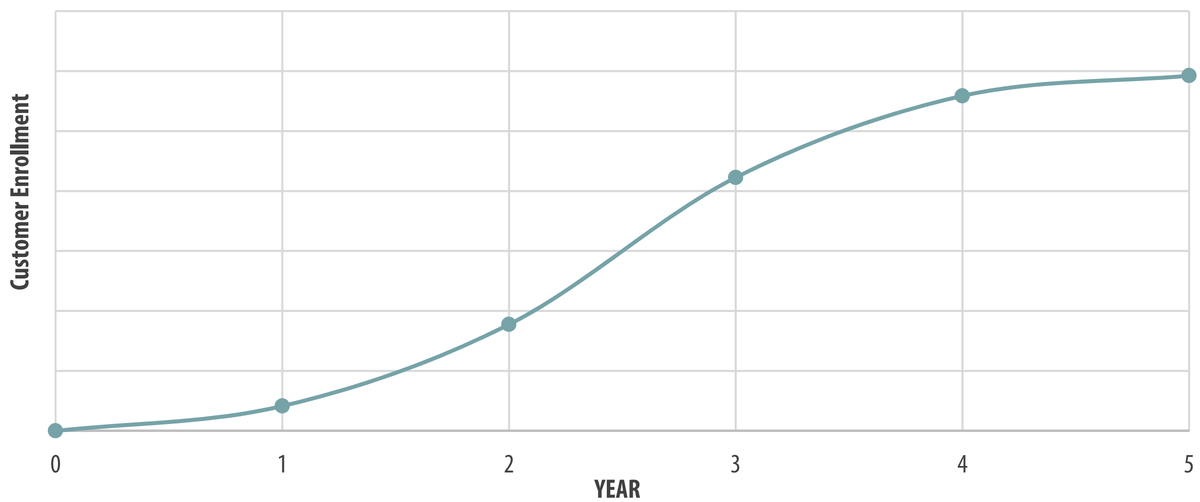
Saturation: The number of control units per participant was assumed to be 1 for all direct load control programs using switches (such as water heaters and air conditioning switches), because load control switches can control up to two units. However, for controllable thermostats, some participants have more than one thermostat. The average number of residential thermostats per single family home was assumed to be 1.055 thermostats.

Program Adoption Levels: Long-term program adoption levels (or "steady state" participation) represent the enrollment rate once the fully achievable participation has been reached. GDS reviewed industry data and program adoption levels from several utility demand response programs. The main sources of participant rates are several studies completed by the Brattle Group. Additional detail about participation rates and sources are shown in Appendix G. As noted earlier in this section, for direct load control programs, MAP participation rates rely on industry best adoption rates and RAP participation rates are based on industry average adoption levels. For the rate programs, the MAP steady-state participation rates assumed programs were opt-out based and RAP participation assumed opt-in status.

Customer participation in new demand response programs is assumed to reach the steady state take rate over a five-year period. The path to steady state customer participation follows an "S-shaped" curve, in which participation growth accelerates over the first half of the five-year period, and then slows over the second half of the period (see Figure 3-4). Existing programs have already gone through this ramp-up period, so they were escalated linearly to the final participation rate.

[24] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011

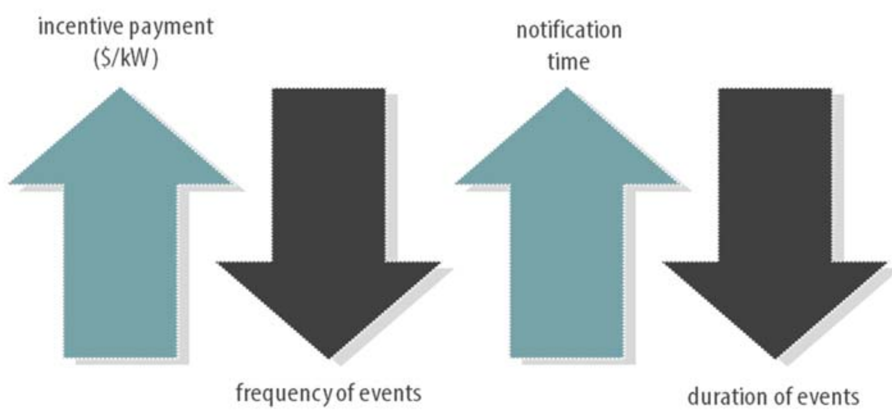
FIGURE 3-4 ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE



3.5.4.2 C&I Curtailment Load Program Assumptions

One of the most prominent forms of demand response among non-residential customers is load curtailment agreements where the utility, or an aggregator on the utility's behalf, enters financial agreements with businesses to reduce load when dispatched. Load curtailment potential is driven by a few key factors – incentive payments, the frequency of events, the duration of events, and the level of notification participants are given about pending events. The directional effect these factors have on demand response potential is shown in Figure 3-5.

FIGURE 3-5 DRIVERS OF DR POTENTIAL



Several different estimates of Curtailment Load potential can be produced by turning levers related to these four inputs. Rather than producing several different scenario-based estimates, the research team made several simplifying assumptions regarding program design. Components of program design include how many demand response events will be called, how long the demand response events will last, how far in advance participants are notified of the upcoming demand response event, and the incentive payment participants receive (the amount and how it is distributed – annually, monthly, per event, etc.).

Program Design: Previous Indiana research suggests relatively short demand response events would serve the region better than relatively long events, as summer peaks are concentrated between 2:00 PM and 6:00 PM. Thus, our estimates of potential assume a four-hour event duration. We're also assuming that there will be an average of seven summer events will be called (28 total event hours for the summer).

Results were calculated for both a "day-ahead" notification design and a "day-of" notification design. "Day-ahead" notification assumes a 24-hour notice, and "day-of" notification assumes a 3-to-6-hour notice. Potential is higher under the "day-ahead" notification design, as this provides participants greater opportunities to shift energy-intensive tasks to off-peak periods

Participant Incentive: For C&I Curtailable demand response, our team modeled the incentive as a reservation payment. This is an annual payment provided to the participant. In exchange, the participant agrees to curtail load when events are dispatched. For RAP, our approach to setting incentive levels involved optimizing net benefits. To determine the optimal incentive level, the research team performed a simulation where the critical input was the incentive level and the critical output was the net benefit of the demand response program. The simulation leveraged several of the inputs discussed herein. The results indicated that the optimal incentive level in 2020 is $21/kW-year.

For MAP, the goal of the simulation was not to optimize net benefits. Instead, we used the simulation to determine the greatest possible incentive level that would produce a cost-effective program (e.g., largest incentive value such that the UCT ratio does not fall below 1). The results indicated an incentive level of $39/kW-year should be used in estimating MAP for summer 2020.

In both cases, the incentive level is escalated annually at a rate that matches the growth rate of avoided costs. This growth rate is largely driven by the generation component (avoided cost of generation capacity was provided by IPL).

Price Elasticity of Demand Coefficients: The price elasticity of demand coefficients used in this research were derived from two years of demand response performance data for C&I demand response participants in Pennsylvania. Information about sector (small/large), incentive levels, and the peak load share of each participant was used in the development of the elasticity coefficients. Traditional elasticity formulas were used.

Leveraging the inputs discussed above, C&I Curtailable load potential estimates were developed via a "top-down" approach. At a high level, the approach entails disaggregating the peak load forecast into peak load forecasts by sector, and then combining these forecasts with the price elasticity of demand coefficients to estimate potential. Price elasticity of demand can be thought of as the percentage change in the quantity of electricity demanded divided by the percentage change in the price (including an incentive) of demand response:

$$Elasticity = \frac{\%\ change\ in\ Quantity}{\%\ change\ in\ Price}$$

Rearranging the terms in the elasticity equation yields the following:

$$\%\ change\ in\ Quantity = (Elasticity) \times (\%\ change\ in\ Price)$$

Note that "% change in Quantity" can also be expressed as:

$$\%\ change\ in\ Quantity = \frac{(Summer\ peak - \ DR\ potential) - Summer\ Peak}{Summer\ Peak} * 100\%$$

Combing these two "% change in Quantity" equations yields:

$$(Elasticity) \times (\%\ change\ in\ Price) = \frac{(Summer\ peak - \ DR\ potential) - Summer\ Peak}{Summer\ Peak} * 100\%$$

By making assumptions about price elasticity, the percentage change in price (related to electric retail rates and the incentive level), and the summer peak load, it is possible to estimate how much demand response potential exists in each market segment by solving for "demand response potential". It is important to note that the estimates of C&I Curtailable Load demand response potential discussed in this section are not incremental to existing IPL programs. That is, we are not estimating how much Curtailable Load demand response potential exists beyond the existing IPL resources. It is also important to note that this top-down methodology produces estimates of Curtailable Load demand response potential at the system-level (inclusive of line losses).

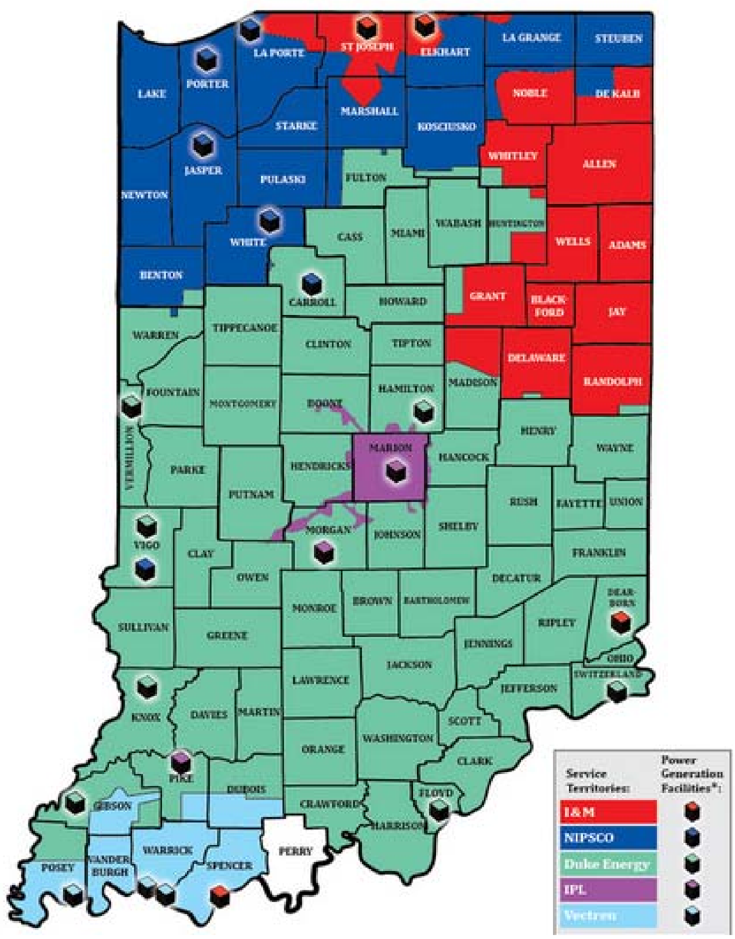
4 Market Characterization

Developing a market characterization in the context of utility electric consumption among each sector is a key foundational element to market potential studies. A market characterization describes how energy is used among the various end-uses and building types that are the subject of the potential study. This section provides a brief overview of the sales and customer forecasts for IPL's electric customers. It also includes a more detailed breakdown of the end-use and building type consumption, along with an overview of how these segmentations were developed.

4.1 INDIANAPOLIS POWER & LIGHT COMPANY SERVICE AREA

This study assessed the electric energy efficiency potential for IPL. Figure 4-1 identifies the overall IPL territory relative to the geographic area of Indiana.

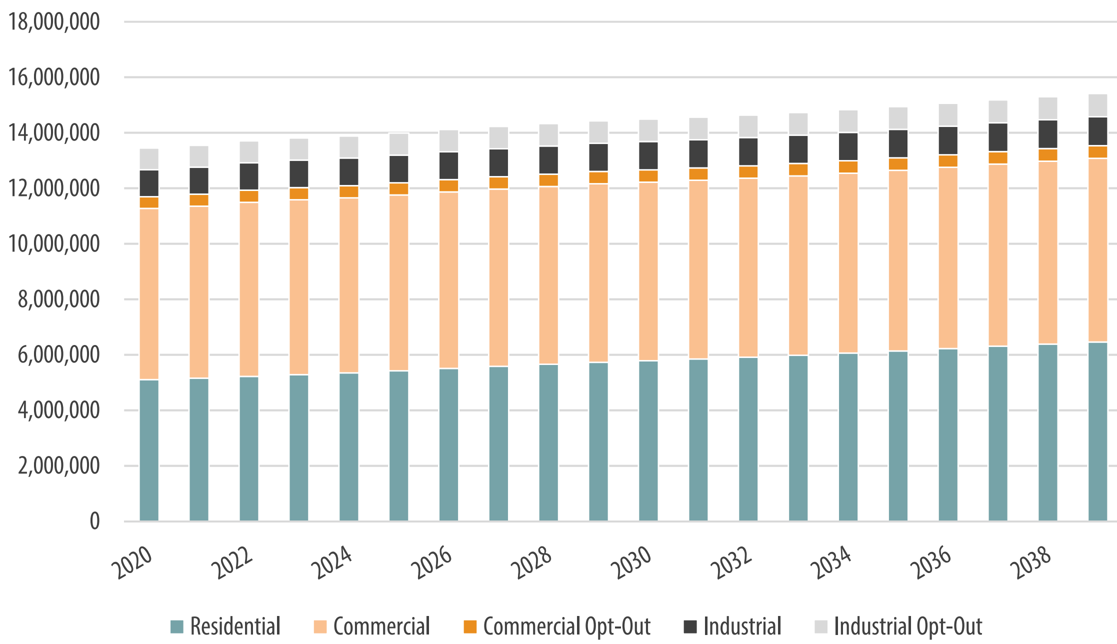
FIGURE 4-1 IPL SERVICE TERRITORY MAP



4.2 LOAD FORECASTS

Figure 4-2 provides the electric sales by sector across the 2020-2039 timeframe. Sales are forecasted to gradually increase from 13.4 million MWh to 15.4 million MWh from 2020 to 2039. The sales figure shows C&I sales break outs of the sales projections for opt-out customers.

FIGURE 4-2 20-YEAR ELECTRIC SALES (MWH) FORECAST BY SECTOR

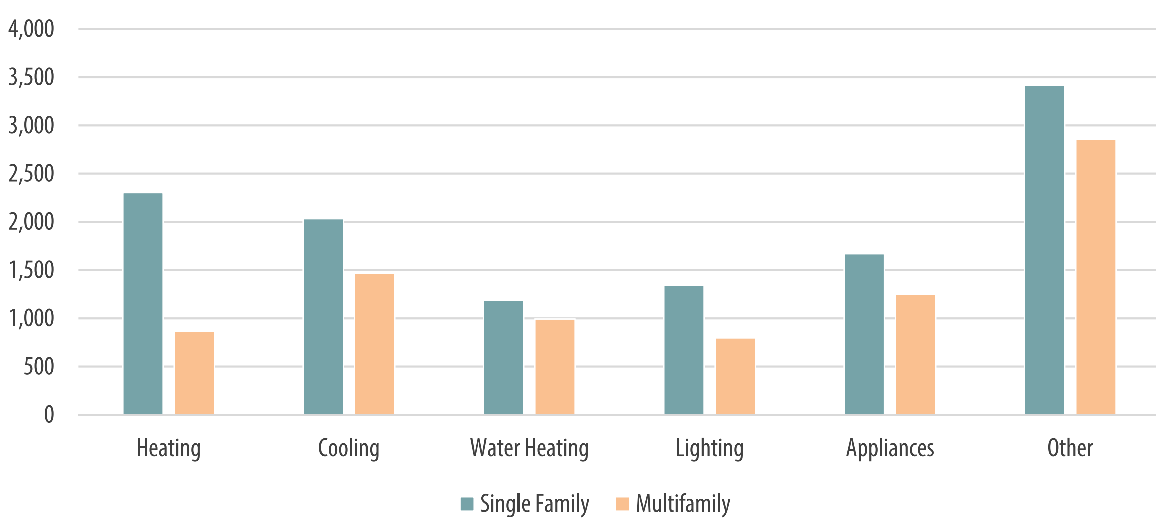


4.3 SECTOR LOAD DETAIL

4.3.1 Residential Sector

The residential electric calibration effort led to a housing-type specific end-use intensity breakdown as shown below in Figure 4-3. Overall, we estimated single-family consumption to be just shy of 12,000 kWh per year, and multifamily homes to be about 8,200 kWh per year. The "Other" end use is the leading end-use among both housing types. This reflects the increasing prominence of electronics and other plug in load devices.

FIGURE 4-3 RESIDENTIAL ELECTRIC END-USE BREAKDOWN BY HOUSING TYPE



4.3.2 Commercial Sector

Figure 4-4 provides a breakdown of commercial electric sales by building type. Mercantile (25%) and Office (20%) are the leading contributors of stand-alone building types to the total commercial electric sales.[25]

FIGURE 4-4 COMMERCIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE

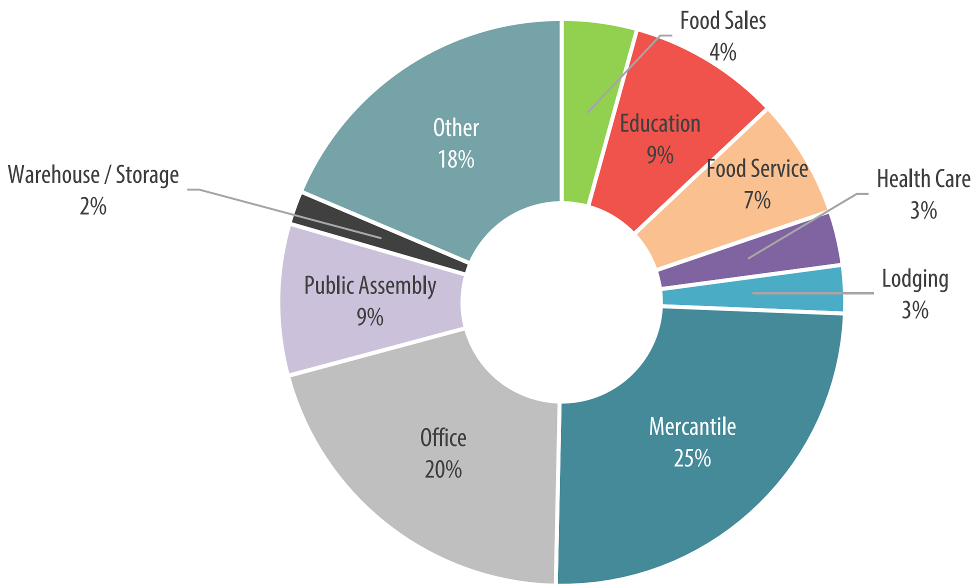
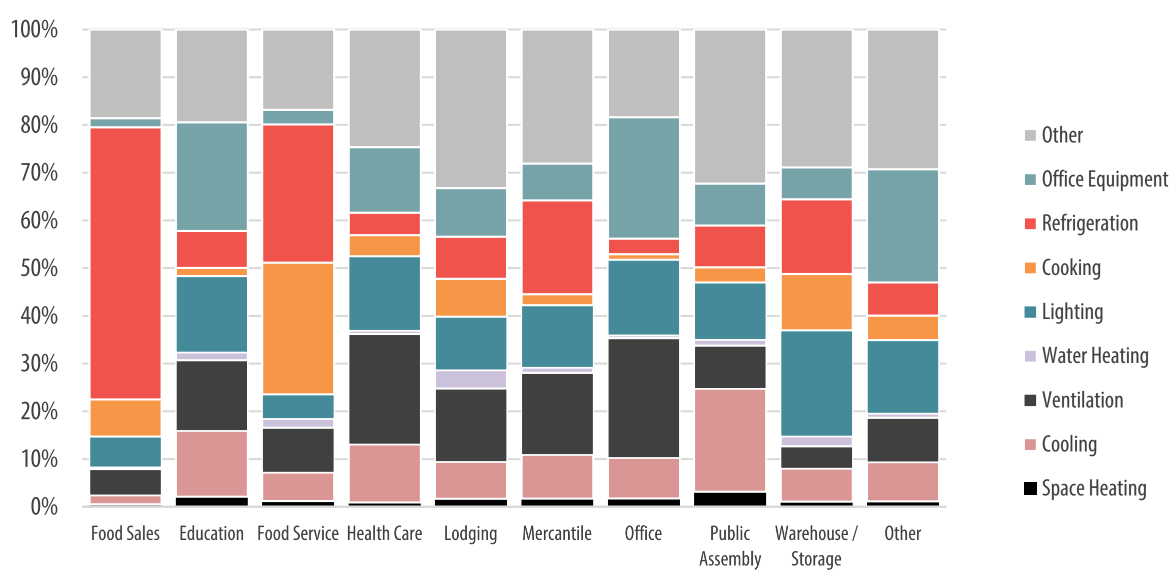


Figure 4-5 provides an illustration of the leading end-uses across all building types in the commercial sector. Ventilation, lighting, and refrigeration are prominent across most of the building types.

FIGURE 4-5 COMMERCIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE



[25] "Other" building types include buildings that engage in several different activities, a majority of which are commercial (e.g. retail space), though the single largest activity may be industrial or agricultural; "other" also includes miscellaneous buildings that do not fit into any other category.

4.3.3 Industrial Sector

Figure 4-6 provides a breakdown of industrial electric sales by industry type. Food (24%), Chemicals (8%), Paper (8%), Fabricated Metals (8%), and Miscellaneous (44%) are the leading industry types contributing to industrial electric sales.

FIGURE 4-6 INDUSTRIAL ELECTRIC INDUSTRY TYPE BREAKDOWN

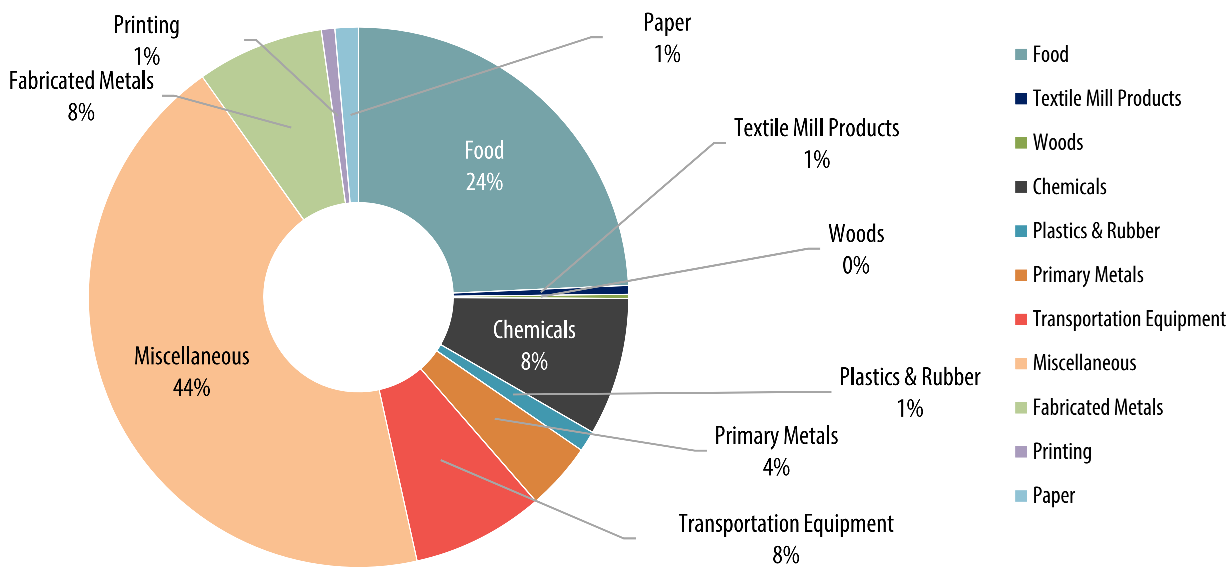
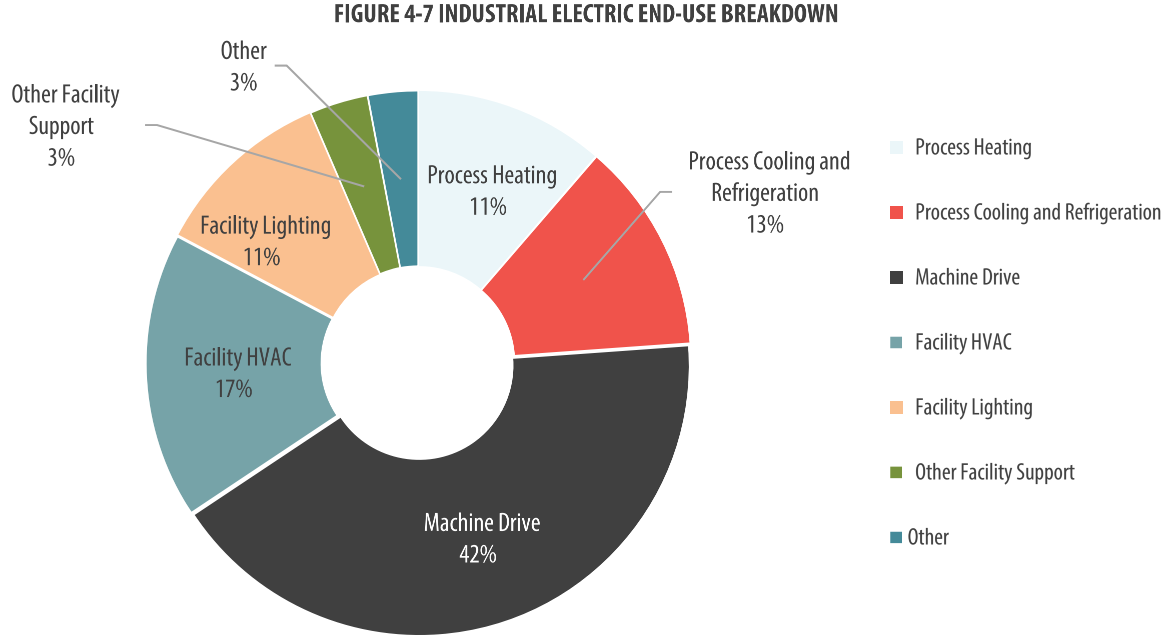


Figure 4-7 provides a breakdown of the industrial electric sales end use. Machine Drive (42%) and Facility HVAC (17%) are the leading end-uses.

FIGURE 4-7 INDUSTRIAL ELECTRIC END-USE BREAKDOWN



5 Residential Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the residential sector. The cost-effectiveness results and budgets for the RAP scenario are also provided.

5.1 SCOPE OF MEASURES & END USES ANALYZED

There were 187 total unique electric measures included in the analysis. Table 5-1 provides the number of measures by end-use and fuel type (the full list of residential measures is provided in Appendix B). The measure list was developed based on a review of current IPL programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 5-1 RESIDENTIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Appliances	28
Audit	3
Behavioral	6
HVAC Equipment	45
Lighting	15
Miscellaneous	6
New Construction	4
Plug Loads	9
HVAC Shell	55
Water Heating	16

5.2 RESIDENTIAL ELECTRIC POTENTIAL

Figure 5-1 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 3-year technical potential is 22.4% of forecasted sales, and the economic potential is 19.0% of forecasted sales. The 3-year MAP is 11.3% and the RAP is 6.9%.

FIGURE 5-1 RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF RESIDENTIAL SALES)

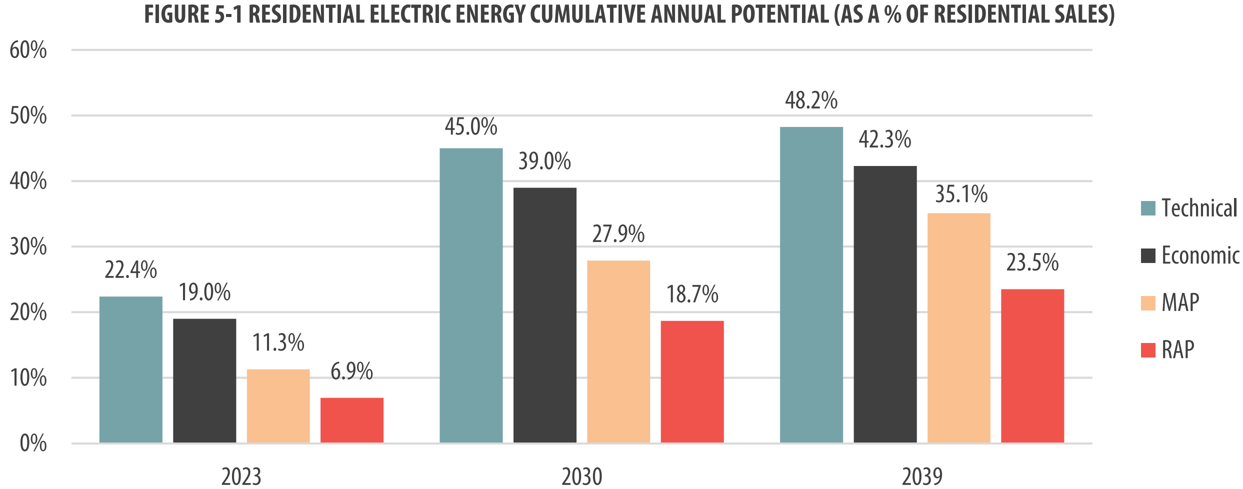


Table 5-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP increases to nearly 7% cumulative annual savings over the next three years.

TABLE 5-2 RESIDENTIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
MWh					
Technical	443,322	818,857	1,182,808	2,604,874	3,116,819
Economic	401,929	706,729	1,003,079	2,255,197	2,732,750
MAP	244,657	414,183	595,903	1,612,643	2,267,253
RAP	175,436	266,884	365,671	1,079,971	1,518,517
Forecasted Sales	5,157,382	5,223,774	5,284,520	5,788,077	6,462,180
Energy Savings (as % of Forecast)					
Technical	8.6%	15.7%	22.4%	45.0%	48.2%
Economic	7.8%	13.5%	19.0%	39.0%	42.3%
MAP	4.7%	7.9%	11.3%	27.9%	35.1%
RAP	3.4%	5.1%	6.9%	18.7%	23.5%

Table 5-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 3.1% to 3.4% per year over the next three years.

TABLE 5-3 RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
MWh					
Technical	443,322	426,679	416,391	247,610	270,960
Economic	401,929	377,942	365,341	214,307	233,397
MAP	244,657	244,314	251,929	190,090	222,905
RAP	175,436	164,092	164,881	171,594	164,489
Forecasted Sales	5,157,382	5,223,774	5,284,520	5,788,077	6,462,180
Energy Savings (as % of Forecast)					
Technical	8.6%	8.2%	7.9%	4.3%	4.2%
Economic	7.8%	7.2%	6.9%	3.7%	3.6%
MAP	4.7%	4.7%	4.8%	3.3%	3.4%
RAP	3.4%	3.1%	3.1%	3.0%	2.5%

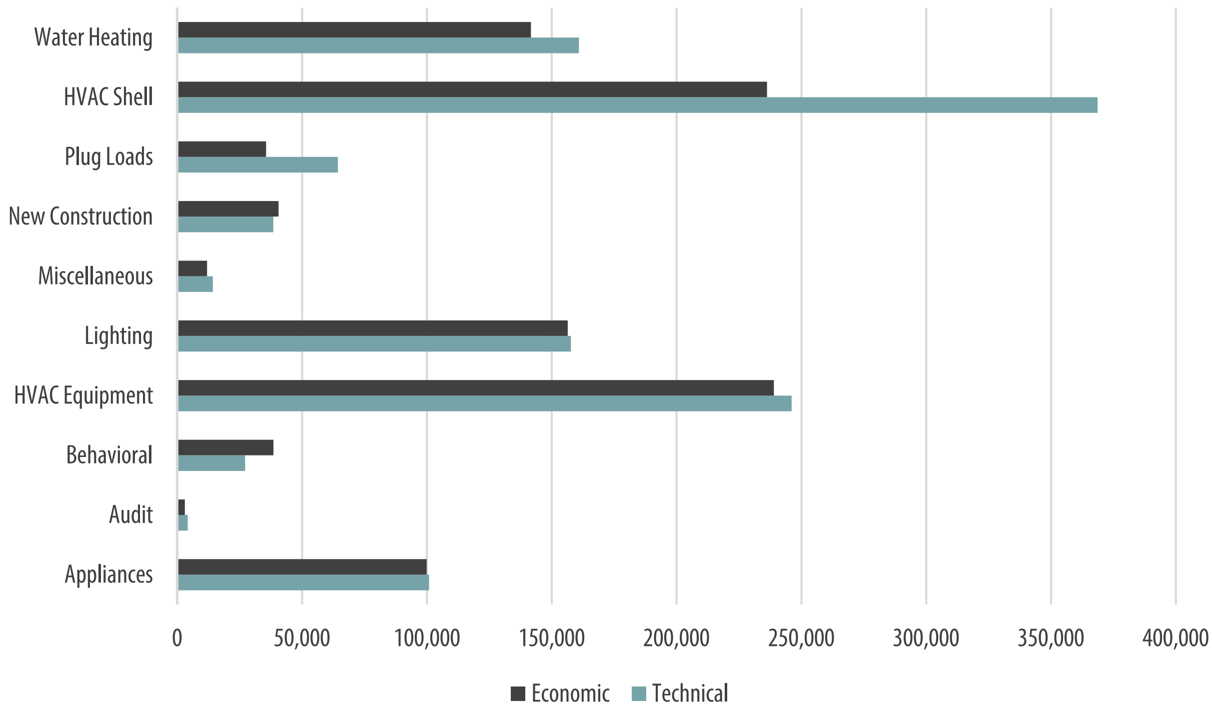
Technical & Economic Potential

Table 5-4 provides cumulative annual technical and economic potential results across the 2021-2023 timeframe, as well as for 2030 and 2039. Figure 5-2 shows a comparison of the technical and economic potential (3-year) by end use. The HVAC Shell and HVAC Equipment are by far the leading end-uses among technical and economic potential.

TABLE 5-4 TECHNICAL AND ECONOMIC RESIDENTIAL ELECTRIC POTENTIAL

	2021	2022	2023	2030	2039
Energy (MWh)					
Technical	443,322	818,857	1,182,808	2,604,874	3,116,819
Economic	401,929	706,729	1,003,079	2,255,197	2,732,750
Peak Demand (MW)					
Technical	85	167	247	563	686
Economic	72	135	196	466	575

FIGURE 5-2 3-YEAR TECHNICAL AND ECONOMIC RESIDENTIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 5-3 illustrates the cumulative annual MAP results by end use across the 2021-2023 timeframe. Like technical and economic potential, HVAC Shell and HVAC Equipment are the leading end uses. Water Heating, Lighting, and Appliances also have significant MAP.

FIGURE 5-3 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

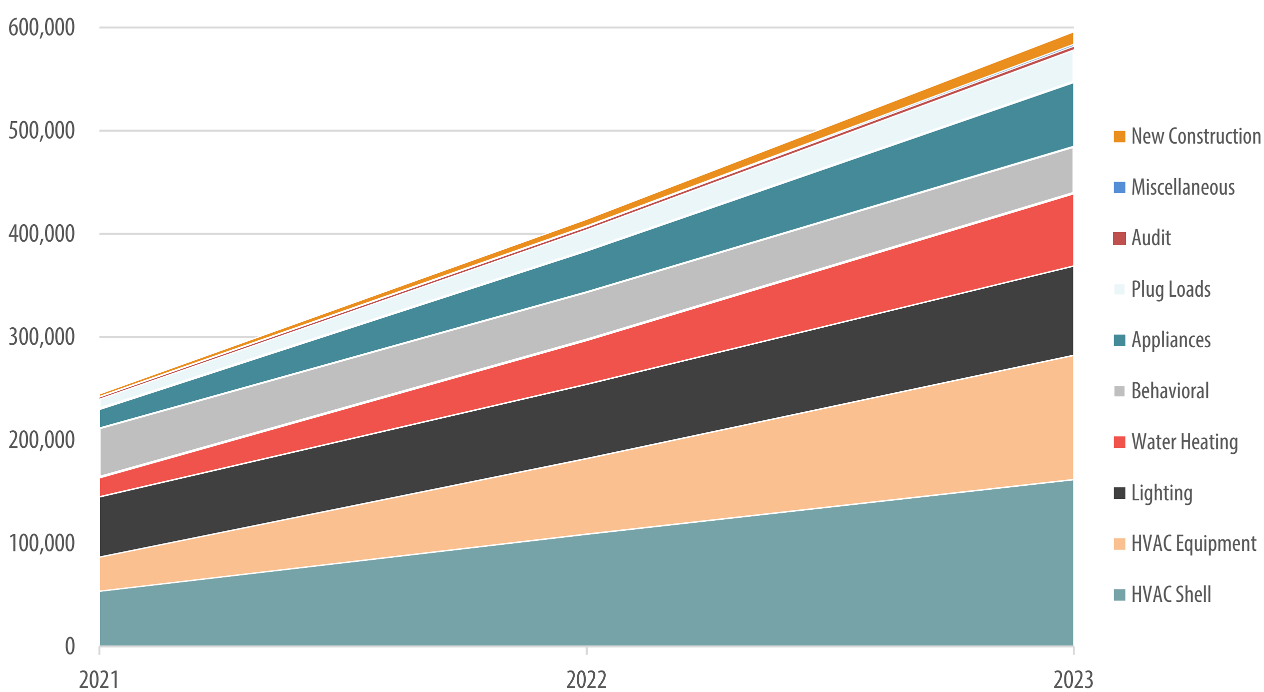


Table 5-5 provides the incremental and cumulative annual MAP across the 2021-2023 timeframe, as well as for 2030 and 2039. HVAC Shell, HVAC Equipment, Lighting, and the Behavioral end uses provide the greatest incremental annual MAP over the next three years.

TABLE 5-5 RESIDENTIAL ELECTRIC MAP BY END-USE

End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Appliances	18,656	21,543	22,839	17,977	20,341
Audit	1,537	2,221	3,066	3,570	1,806
Behavioral[26]	47,718	46,600	45,238	40,186	38,538
HVAC Equipment	33,084	40,516	48,038	39,687	56,260
Lighting	58,384	37,015	30,062	4,374	10,397
Miscellaneous[27]	414	619	884	2,160	2,477
New Construction	2,477	3,971	5,511	12,490	10,973
Plug Loads	9,878	10,652	11,096	13,775	16,956
HVAC Shell	53,561	56,619	55,922	16,992	21,388
Water Heating	18,946	24,558	29,273	38,880	43,768
Total	244,657	244,314	251,929	190,090	222,905
% of Forecasted Sales	4.7%	4.7%	4.8%	3.3%	3.4%
Incremental Annual MW					
Total	44.7	46.9	48.5	33.2	43.8
% of Forecasted Demand	4.0%	4.2%	4.3%	2.8%	3.4%
Cumulative Annual MWh[28]					
Appliances	18,656	40,188	62,543	181,163	234,853
Audit	1,537	2,221	3,066	3,570	1,806
Behavioral	47,718	46,600	45,238	42,069	43,846
HVAC Equipment	33,084	73,223	120,515	468,563	766,806
Lighting	58,384	71,944	86,589	116,397	73,591
Miscellaneous	414	1,033	1,918	14,859	26,877
New Construction	2,477	6,517	12,066	83,992	189,730
Plug Loads	9,878	20,531	31,627	74,682	90,447
HVAC Shell	53,561	108,912	161,775	334,152	380,447
Water Heating	18,946	43,015	70,567	293,198	458,849
Total	244,657	414,183	595,903	1,612,643	2,267,253
% of Forecasted Sales	4.7%	7.9%	11.3%	27.9%	35.1%
Cumulative Annual MW					
Total	44.7	81.3	118.9	318.4	464.4
% of Forecasted Demand	4.0%	7.2%	10.5%	26.9%	36.2%

[26] The behavioral end-use includes home energy reports and home energy management systems (HEMs).

[27] Miscellaneous consists of pool heater, efficient pool pumps, motors and timers, and well pumps.

[28] Audit measures and most Behavioral measures have a one-year assumed measure life. For this reason, Audit savings are the same for both incremental and cumulative annual, and there is only a minor difference between incremental and cumulative annual savings for Behavioral measures.

Realistic Achievable Potential

Figure 5-4 illustrates the cumulative annual RAP results by end use across the 2021-2023 timeframe. HVAC Equipment and Lighting are the leading end uses over the first three years. The HVAC Shell, Behavioral, and Water Heating end uses also have significant potential in the RAP scenario of this timeframe.

FIGURE 5-4 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

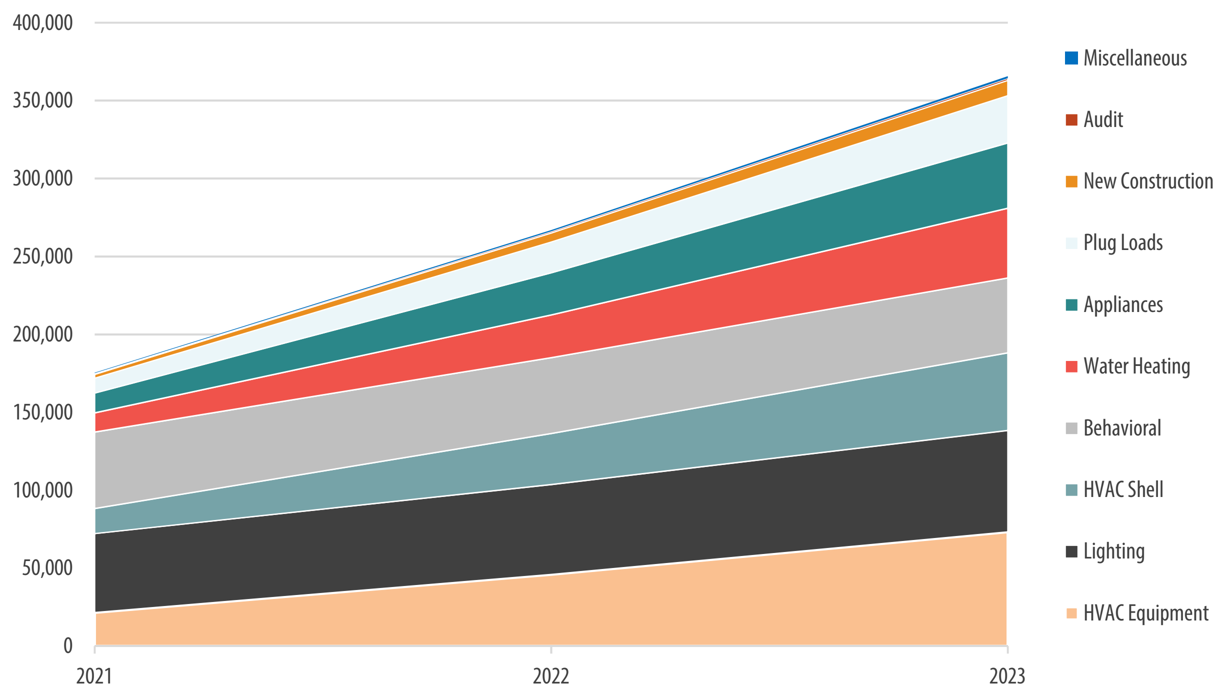


Table 5-6 provides the incremental and cumulative annual RAP across the 2021-2023 timeframe, as well as for 2030 and 2039. HVAC Shell, HVAC Equipment, Lighting, and the Behavioral end uses provide the greatest incremental annual MAP over the next three years.

TABLE 5-6 RESIDENTIAL ELECTRIC RAP BY END-USE

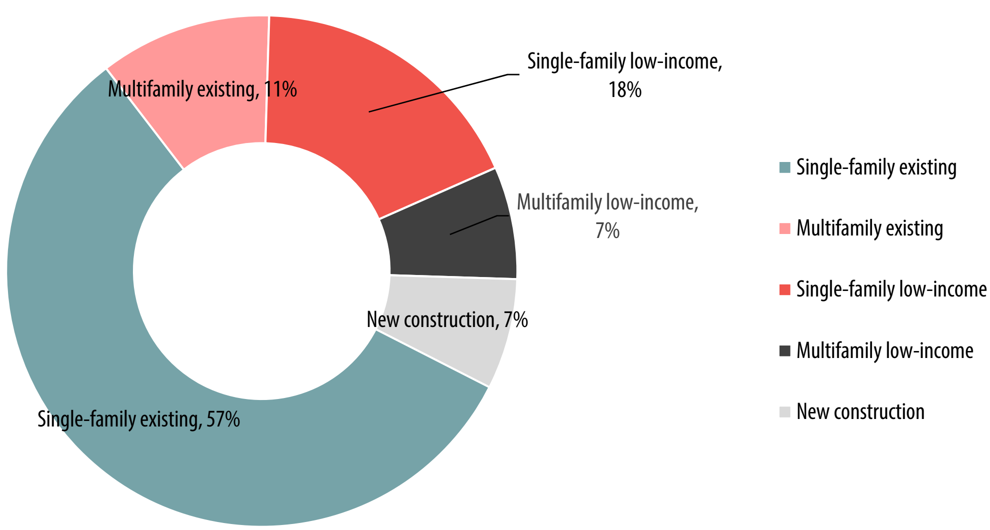
End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Appliances	12,718	14,299	15,192	14,736	15,642
Audit	781	1,035	1,354	4,041	2,302
Behavioral[29]	49,063	48,657	48,057	44,940	45,323
HVAC Equipment	21,534	24,526	27,485	33,577	25,174
Lighting	50,665	29,513	22,359	5,108	9,745
Miscellaneous[30]	328	438	572	1,683	1,889
New Construction	2,424	3,291	3,917	6,016	5,363
Plug Loads	9,546	10,217	10,633	13,558	16,927
HVAC Shell	16,070	16,901	17,574	14,698	8,515
Water Heating	12,306	15,217	17,740	33,238	33,611
Total	175,436	164,092	164,881	171,594	164,489

[29] The behavioral end-use includes home energy reports and home energy management systems (HEMs).
[30] Miscellaneous consists of pool heater, efficient pool pumps, motors and timers, and well pumps.

End Use	2021	2022	2023	2030	2039
% of Forecasted Sales	3.4%	3.1%	3.1%	3.0%	2.5%
Incremental Annual MW					
Total	30.0	30.4	31.0	29.5	28.8
% of Forecasted Demand	2.7%	2.7%	2.7%	2.5%	2.2%
Cumulative Annual MWh[31]					
Appliances	12,718	27,015	41,890	136,801	174,298
Audit	781	1,035	1,354	4,041	2,302
Behavioral	49,063	48,657	48,057	45,878	50,641
HVAC Equipment	21,534	45,977	73,258	298,296	460,561
Lighting	50,665	57,643	65,110	93,649	75,854
Miscellaneous	328	766	1,338	10,062	20,789
New Construction	2,424	5,796	9,767	47,187	98,778
Plug Loads	9,546	19,763	30,395	73,679	89,992
HVAC Shell	16,070	32,741	49,796	158,391	225,785
Water Heating	12,306	27,491	44,706	211,988	319,517
Total	175,436	266,884	365,671	1,079,971	1,518,517
% of Forecasted Sales	3.4%	5.1%	6.9%	18.7%	23.5%
Cumulative Annual MW					
Total	30.0	50.5	71.3	215.6	301.6
% of Forecasted Demand	2.7%	4.5%	6.3%	18.2%	23.5%

Figure 5-5 illustrates a market segmentation of the RAP in the residential sector by 2023. More than half of the RAP is associated with single-family existing homes that are not low-income, whereas the total low-income potential is about 25% of the RAP.[32]

FIGURE 5-5 2023 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT



[31] Audit measures and most Behavioral measures have a one-year assumed measure life. For this reason, Audit savings are the same for both incremental and cumulative annual, and there is only a minor difference between incremental and cumulative annual savings for Behavioral measures.

[32] The low-income measures in the RAP analysis did not have to pass the UCT.

RAP Benefits & Costs

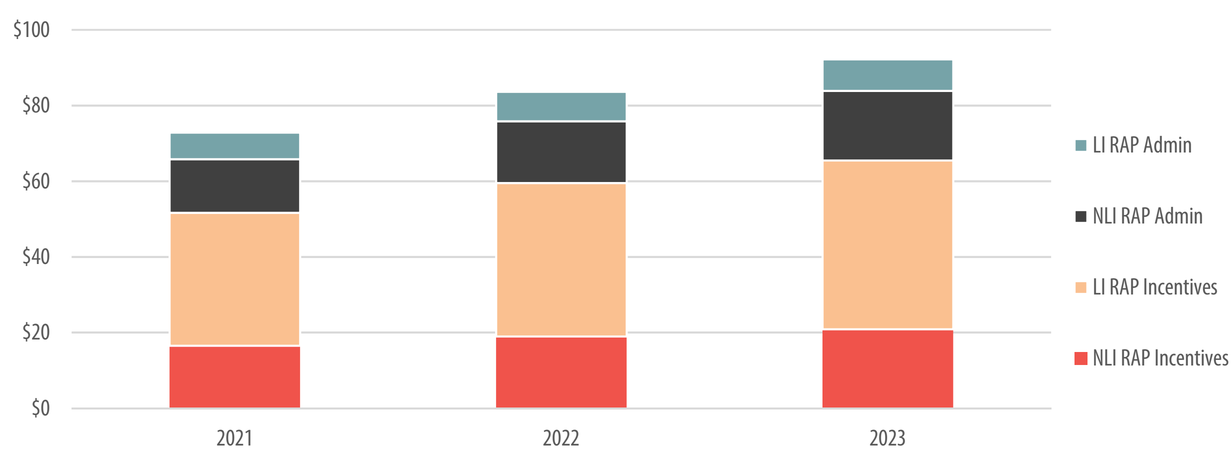
Table 5-7 provides the net present value (NPV) benefits and cost, as calculated using the UCT, across the 2021-2039 timeframe for the RAP scenario. The overall UCT ratio is 0.961. However, if low-income measures were removed, the overall UCT ratio would be nearly 1.5.

TABLE 5-7 RESIDENTIAL NPV BENEFITS & COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Overall Results			
Appliances	$110.6	$107.3	1.03
Audit	$1.7	$47.8	0.03
Behavioral	$38.9	$30.4	1.28
HVAC Equipment	$427.5	$504.1	0.85
Lighting	$60.3	$75.9	0.80
Miscellaneous	$18.7	$4.8	3.89
New Construction	$75.9	$42.5	1.79
Plug Loads	$47.1	$32.4	1.46
HVAC Shell	$151.4	$146.6	1.03
Water Heating	$141.3	$122.7	1.15
Total	$1,073.4	$1,114.3	0.96
Excluding Low-Income			
Appliances	$81.9	$35.5	2.31
Audit	$1.5	$32.5	0.05
Behavioral	$38.9	$30.4	1.28
HVAC Equipment	$292.5	$153.8	1.90
Lighting	$56.1	$68.2	0.82
Miscellaneous	$18.7	$4.8	3.89
New Construction	$75.9	$42.5	1.79
Plug Loads	$45.8	$26.3	1.74
HVAC Shell	$105.5	$80.4	1.31
Water Heating	$127.2	$106.2	1.20
Total	$844.0	$580.6	1.45

Figure 5-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2021-2023 timeframe. These budgets are further divided into low-income (LI) and not low-income (NLI) components. The low-income incentive portion of the budget is about 48% of the RAP budget. The RAP budgets rise from $73 million to about $92 million from 2021 to 2023.

FIGURE 5-6 ANNUAL BUDGETS FOR RESIDENTIAL RAP ($ IN MILLIONS)



6 Commercial Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the commercial sector. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided.

6.1 SCOPE OF MEASURES & END USES ANALYZED

There were 237 total electric measures included in the analysis. Table 6-1 provides the number of measures by end-use (the full list of commercial measures is provided in Appendix C). The measure list was developed based on a review of current IPL programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 6-1 COMMERCIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Space Heating	31
Cooling	75
Ventilation	11
Water Heating	17
Lighting	32
Cooking	8
Refrigeration	29
Office Equipment	14
Behavioral	4
Other	16

6.2 COMMERCIAL ELECTRIC POTENTIAL

Figure 6-1 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 3-year technical potential is 15.6% of forecasted sales, and the economic potential is 13.9% of forecasted sales. The 3-year MAP is 10.9% and the RAP is 4.3%.

FIGURE 6-1 COMMERCIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL SALES)

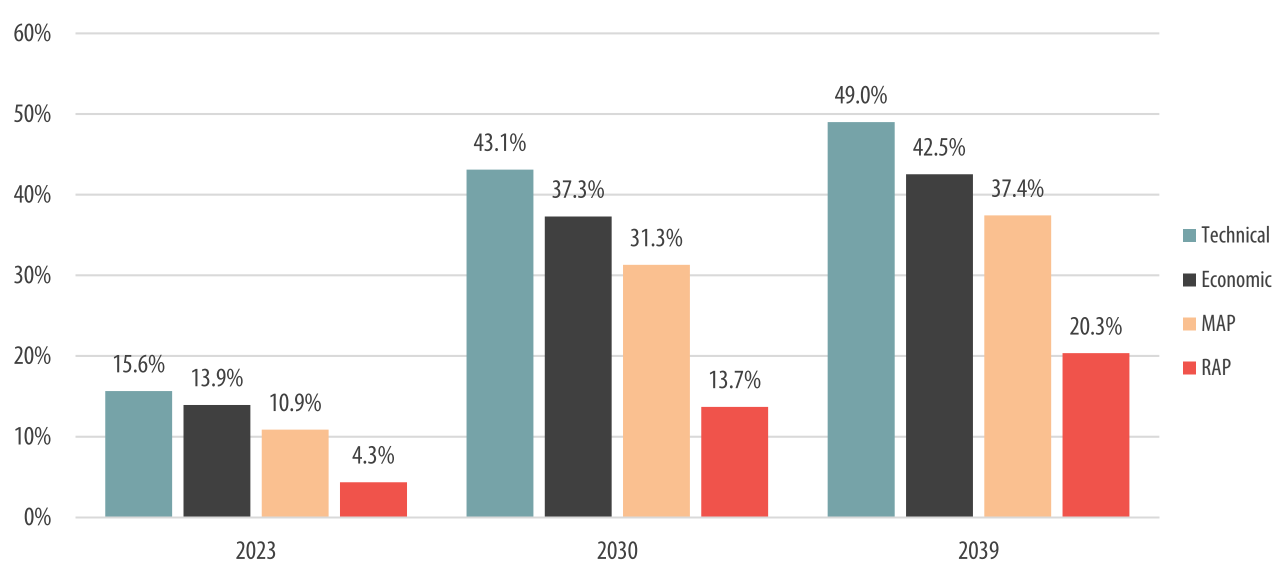


Table 6-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 3.8% after three years and rises to 17.7% by 2039.

TABLE 6-2 COMMERCIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
Energy (MWh)					
Technical	297,674	601,207	923,248	2,595,884	3,034,939
Economic	262,141	535,268	821,276	2,245,705	2,634,454
MAP	191,773	407,732	640,739	1,884,672	2,317,654
RAP	87,433	172,729	256,487	824,507	1,259,861
Forecasted Sales	6,660,103	6,737,966	6,769,949	6,911,159	7,107,737
Energy Savings (as % of Forecast)					
Technical	4.5%	8.9%	13.6%	37.6%	42.7%
Economic	3.9%	8.0%	12.2%	32.6%	37.2%
MAP	2.9%	6.1%	9.5%	27.3%	32.7%
RAP	1.3%	2.6%	3.8%	11.9%	17.7%

Table 6-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.5% to 2.6% per year over the next six years.

TABLE 6-3 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
Energy (MWh)					
Technical	297,674	336,201	364,988	325,343	444,368
Economic	262,141	293,165	314,792	283,520	387,432
MAP	191,773	226,960	253,410	249,796	343,413
RAP	87,433	87,790	88,538	128,764	163,720
Forecasted Sales	6,660,103	6,737,966	6,769,949	6,911,159	7,107,737
Energy Savings (as % of Forecast)					
Technical	4.5%	5.0%	5.4%	4.7%	6.3%
Economic	3.9%	4.4%	4.7%	4.1%	5.5%
MAP	2.9%	3.4%	3.7%	3.6%	4.8%
RAP	1.3%	1.3%	1.3%	1.9%	2.3%

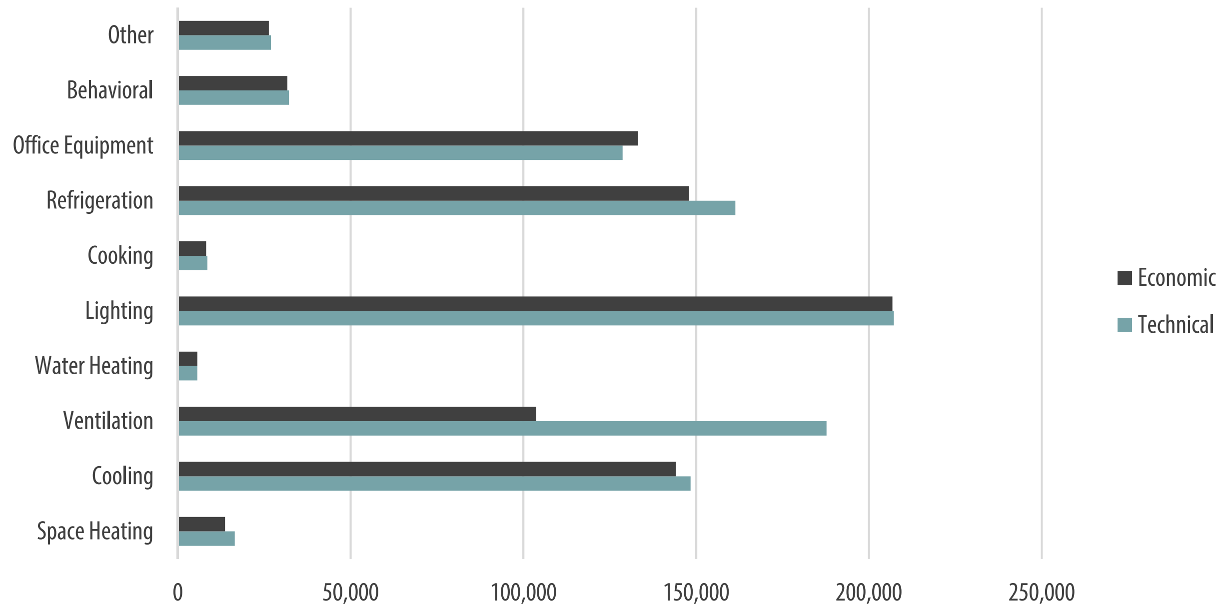
Technical & Economic Potential

Table 6-4 provides cumulative annual technical and economic potential results across the 2021-2023 timeframe, as well as for 2030 and 2039. Figure 6-2 shows a comparison of the technical and economic potential (6-year) by end use. Lighting, Ventilation, and Cooling are the leading stand-alone end uses among technical and economic potential.

TABLE 6-4 TECHNICAL & ECONOMIC COMMERCIAL ELECTRIC POTENTIAL

	2021	2022	2023	2030	2039
Energy (MWh)					
Technical	297,674	601,207	923,248	2,595,884	3,034,939
Economic	262,141	535,268	821,276	2,245,705	2,634,454
Peak Demand (MW)					
Technical	58	123	197	683	782
Economic	36	75	119	362	415

FIGURE 6-2 3-YEAR TECHNICAL AND ECONOMIC COMMERCIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 6-3 illustrates the cumulative annual MAP results by end use across the 2021-2023 timeframe. Like technical and economic potential, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant MAP.

FIGURE 6-3 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

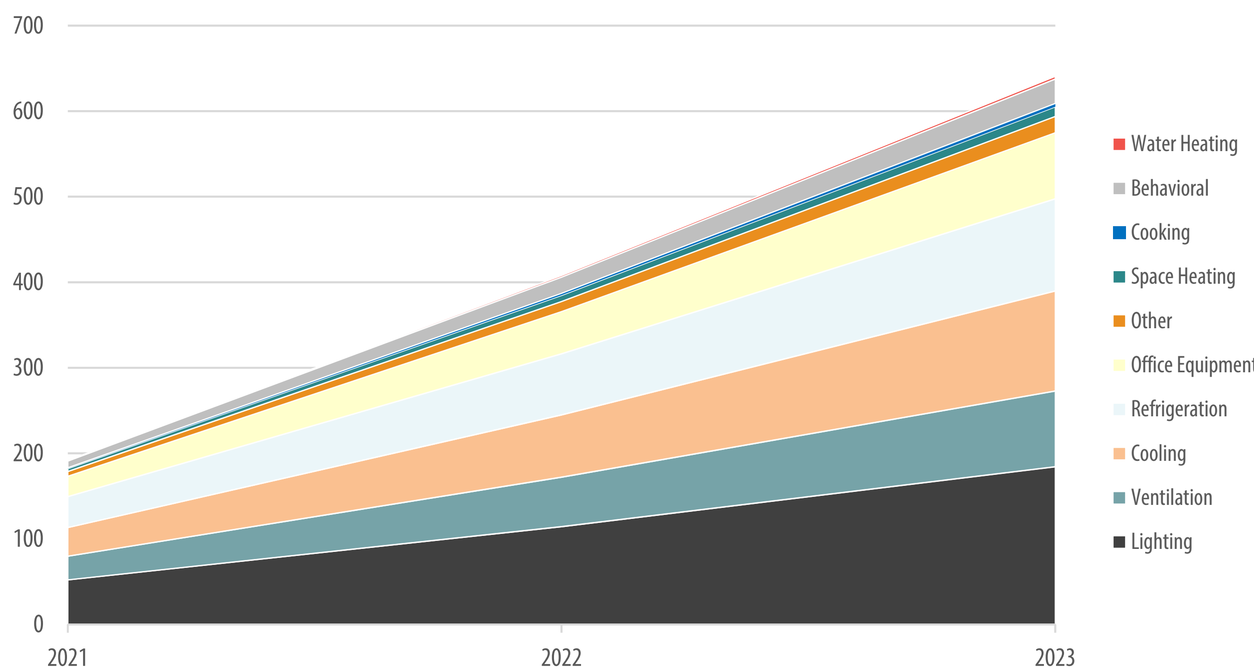


Table 6-5 provides the incremental and cumulative annual MAP across the 2021-2023 timeframe, as well as for 2030 and 2039. The incremental MAP ranges from 2.9% to 3.7% of forecasted sales across the initial three-year timeframe. Cumulative annual MAP rises to 32.7% by 2039.

TABLE 6-5 COMMERCIAL ELECTRIC MAP BY END-USE

End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Space Heating	3,353	3,803	4,090	2,987	2,288
Cooling	33,453	39,299	44,232	39,320	35,727
Ventilation	27,730	30,029	30,780	5,743	36,793
Water Heating	818	1,037	1,244	1,587	1,258
Lighting	52,076	62,293	69,953	24,807	69,473
Cooking	1,043	1,298	1,550	2,387	2,415
Refrigeration	36,037	40,930	43,420	38,565	48,926
Office Equipment	23,819	25,685	27,851	38,233	39,339
Behavioral	7,843	14,811	20,103	76,212	81,477
Other	5,599	7,774	10,186	19,955	25,717
Total	191,773	226,960	253,410	249,796	343,413
% of Forecasted Sales	2.9%	3.4%	3.7%	3.6%	4.8%
Incremental Annual MW					
Total	28.8	34.5	39.8	31.2	43.0
% of Forecasted Demand	3.8%	4.5%	5.2%	3.9%	4.9%
Cumulative Annual MWh					
Space Heating	3,353	7,156	11,246	33,498	40,177
Cooling	33,453	72,752	116,985	409,286	491,096
Ventilation	27,730	57,760	88,540	205,732	254,366
Water Heating	818	1,856	3,100	11,943	15,633
Lighting	52,076	114,369	184,322	493,419	576,132
Cooking	1,043	2,342	3,892	19,035	28,770
Refrigeration	36,037	71,355	107,638	297,886	386,331
Office Equipment	23,819	49,504	77,355	233,030	310,834
Behavioral	7,843	18,915	28,559	111,574	123,588
Other	5,599	11,723	19,104	69,270	90,728
Total	191,773	407,732	640,739	1,884,672	2,317,654
% of Forecasted Sales	2.9%	6.1%	9.5%	27.3%	32.7%
Cumulative Annual MW					
Total	28.8	62.5	100.7	319.4	375.3
% of Forecasted Demand	3.8%	8.2%	13.1%	39.6%	43.2%

Realistic Achievable Potential

Figure 6-4 illustrates the cumulative annual RAP results by end use across the 2020-2023 timeframe. Like MAP, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant RAP.

FIGURE 6-4 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

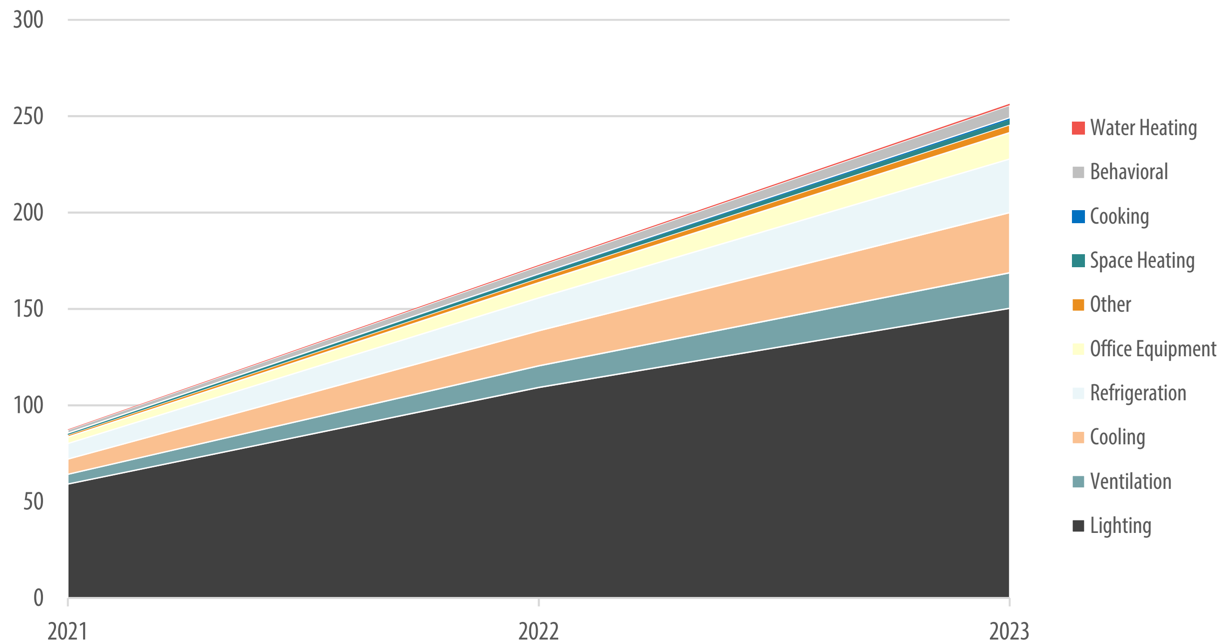


Table 6-6 provides the incremental and cumulative annual RAP across the 2021-2023 timeframe, as well as for 2030 and 2039. The incremental RAP is consistent at 1.3% of forecasted sales across the initial three-year timeframe. Cumulative annual RAP rises to 17.7% by 2039.

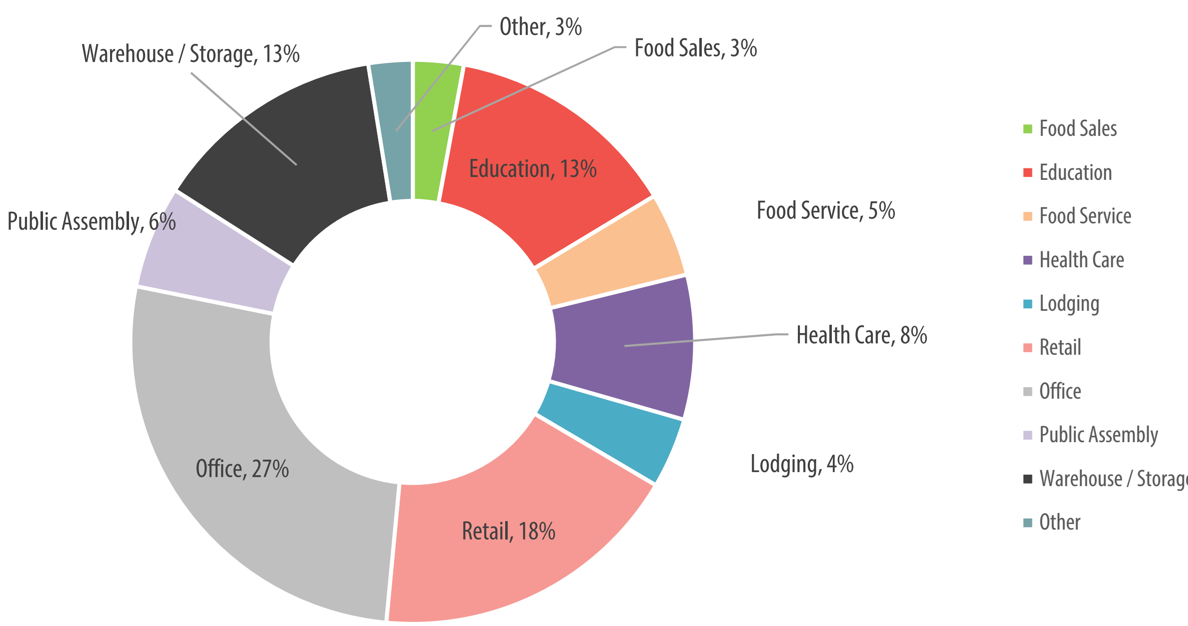
TABLE 6-6 COMMERCIAL ELECTRIC RAP BY END-USE

End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Space Heating	683	868	1,062	1,816	1,212
Cooling	7,859	10,342	13,051	27,415	22,656
Ventilation	5,055	6,192	7,159	8,232	7,878
Water Heating	209	272	344	822	924
Lighting	59,173	50,101	41,063	14,771	29,873
Cooking	239	318	407	1,112	1,381
Refrigeration	8,105	10,291	12,700	24,308	28,666
Office Equipment	3,371	4,526	5,815	14,418	15,777
Behavioral	1,629	3,233	4,648	27,225	43,475
Other	1,111	1,649	2,288	8,646	11,877
Total	87,433	87,790	88,538	128,764	163,720
% of Forecasted Sales	1.3%	1.3%	1.3%	1.9%	2.3%
Incremental Annual MW					
Total	16.4	16.2	16.2	18.8	24.3
% of Forecasted Demand	2.2%	2.1%	2.1%	2.3%	2.8%
Cumulative Annual MWh					
Space Heating	683	1,550	2,612	13,635	22,370
Cooling	7,859	18,201	31,253	178,959	293,650
Ventilation	5,055	11,246	18,405	81,482	116,321
Water Heating	209	481	825	4,938	8,748

End Use	2021	2022	2023	2030	2039
Lighting	59,173	109,273	150,336	264,291	335,180
Cooking	239	557	965	6,717	14,953
Refrigeration	8,105	17,006	27,775	133,355	207,863
Office Equipment	3,371	7,897	13,712	75,871	149,742
Behavioral	1,629	4,092	6,496	39,168	64,956
Other	1,111	2,424	4,107	26,092	46,079
Total	87,433	172,729	256,487	824,507	1,259,861
% of Forecasted Sales	1.3%	2.6%	3.8%	11.9%	17.7%
Cumulative Annual MW					
Total	16.4	32.5	48.3	155.7	225.6
% of Forecasted Demand	2.2%	4.3%	6.3%	19.3%	26.0%

Figure 6-5 illustrates a market segmentation of the RAP in the commercial sector by 2023. Retail, Office, and Education are the leading building types.

FIGURE 6-5 2023 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT



RAP Benefits & Costs

Table 6-7 provides the NPV benefits and cost, as calculated using the UCT, across the 2021-2039 timeframe for the RAP scenario. Cooling and Cooking are the most cost-effective end-uses. Cooling, lighting, and refrigeration provides the most significant NPV benefits.

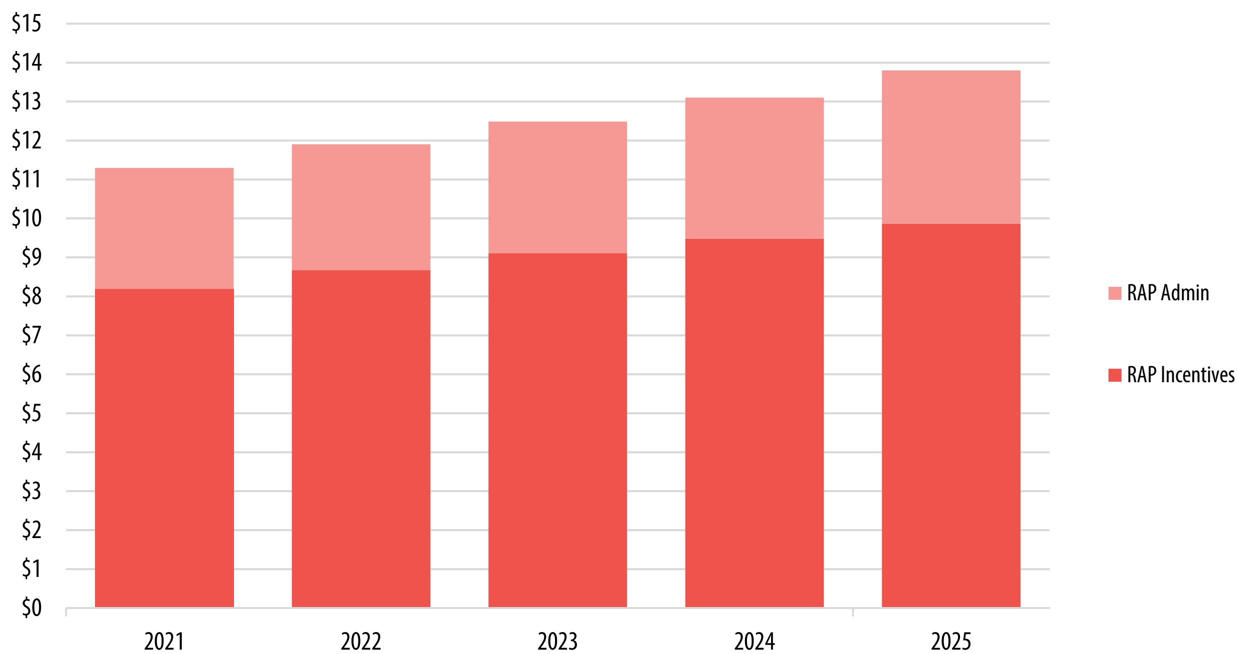
TABLE 6-7 COMMERCIAL NPV BENEFITS & COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Space Heating	$7.88	$2.85	2.76
Cooling	$636.45	$44.60	14.27
Ventilation	$37.62	$21.05	1.79
Water Heating	$2.83	$0.42	6.72
Lighting	$181.94	$39.89	4.56
Cooking	$9.54	$1.19	8.04

End Use	NPV Benefits	NPV Costs	UCT Ratio
Refrigeration	$114.59	$20.53	5.58
Office Equipment	$45.41	$11.47	3.96
Behavioral	$27.33	$17.41	1.57
Other	$25.33	$6.12	4.14
Total	**$1,088.92**	**$165.53**	**6.58**

Figure 6-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2021-2023 timeframe. The incentives rise from $8.2 million to $9.1 million, and overall budgets rise from $11.3 million to $12.8 million by 2023.

FIGURE 6-6 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS)



6.3 COMMERCIAL POTENTIAL INCLUDING OPT-OUT CUSTOMERS

Table 6-8 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, excluding opt-out customers. This is the same information provided in Section 6.2. The cumulative annual energy savings across the 19-year study timeframe are also shown in the far-right column. Table 6-9 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, including opt-out customers. The cumulative annual energy savings across the 19-year study timeframe are also shown in the far-right column.

The 19-year RAP is 1,259,861 MWh excluding opt-out customers. This figure rises to 1,368,560 MWh with opt-out customers included.

TABLE 6-8 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – EXCLUDING OPT-OUT CUSTOMERS

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	297,674	336,201	364,988	325,343	444,368	3,034,939
Economic	262,141	293,165	314,792	283,520	387,432	2,634,454
MAP	191,773	226,960	253,410	249,796	343,413	2,317,654

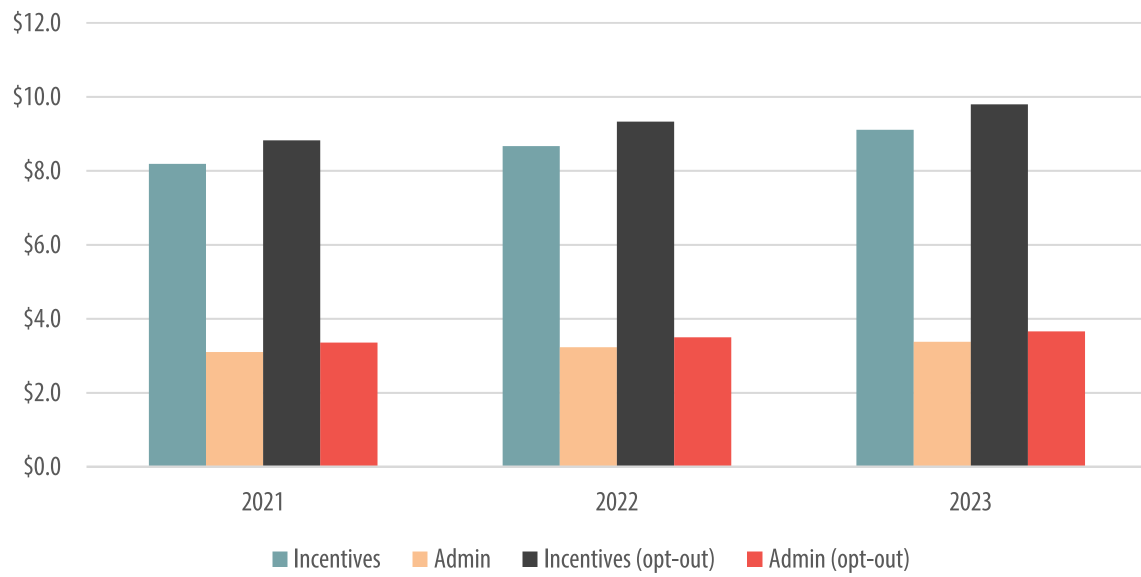
	2021	2022	2023	2030	2039	2039 (cumulative)
RAP	87,433	87,790	88,538	128,764	163,720	1,259,861
Forecasted Sales	6,660,103	6,737,966	6,769,949	6,911,159	7,107,737	7,107,737
Energy Savings (as % of Forecast)						
Technical	4.5%	5.0%	5.4%	4.7%	6.3%	42.7%
Economic	3.9%	4.4%	4.6%	4.1%	5.5%	37.1%
MAP	2.9%	3.4%	3.7%	3.6%	4.8%	32.6%
RAP	1.3%	1.3%	1.3%	1.9%	2.3%	17.7%

TABLE 6-9 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – INCLUDING OPT-OUT CUSTOMERS[33]

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	319,987	361,894	393,318	355,466	483,353	3,271,659
Economic	282,388	316,313	340,107	311,127	422,935	2,845,631
MAP	217,686	257,080	286,837	309,561	396,535	2,503,275
RAP	105,544	105,937	106,745	109,342	190,102	1,368,560
Forecasted Sales	6,660,103	6,737,966	6,769,949	6,911,159	7,107,737	7,107,737
Energy Savings (as % of Forecast)						
Technical	4.8%	5.4%	5.8%	5.1%	6.8%	46.0%
Economic	4.2%	4.7%	5.0%	4.5%	6.0%	40.0%
MAP	3.3%	3.8%	4.2%	4.5%	5.6%	35.2%
RAP	1.6%	1.6%	1.6%	1.6%	2.7%	19.3%

Figure 6-7 provides the budget for the RAP scenario, with and without opt-out customers. The budget is broken into incentive and admin budgets for each year of the 2021-2023 timeframe. The overall budgets without opt-out customers rise from $11.3 million to $12.5 million by 2023. The budgets with opt-out customers included increase from $12.2 million to $13.5 million by 2023.

FIGURE 6-7 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS) – WITH AND WITHOUT OPT-OUT CUSTOMERS



[33] Due to limited number of commercial opt-out customers and minor changes in building segmentation, savings as a percentage of sales is negligible out to three decimal places.

7 Industrial Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the industrial sector. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided. The results in this section exclude the savings and sales forecast associated with opt-out customers

7.1 SCOPE OF MEASURES & END USES ANALYZED

There were 130 total unique electric measures included in the analysis. Table 7-1 provides number of measures by end-use (the full list of industrial measures is provided in Appendix D). The measure list was developed based on a review of current IPL programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 7-1 INDUSTRIAL ENERGY EFFICIENCY MEASURES – BY END USE

End-Use	Number of Unique Measures
Computers & Office Equipment	6
Water Heating	6
Ventilation	7
Space Cooling	25
Space Heating	16
Lighting	16
Other	7
Machine Drive	21
Process Heating and Cooling	10
Agriculture	16

7.2 INDUSTRIAL ELECTRIC POTENTIAL

Figure 7-1 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 3-year technical potential is 6.5% of forecasted sales, and the economic potential is 6.4% of forecasted sales. The 3-year MAP is 4.9% and the RAP is 1.9%.

FIGURE 7-1 INDUSTRIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF INDUSTRIAL SALES)

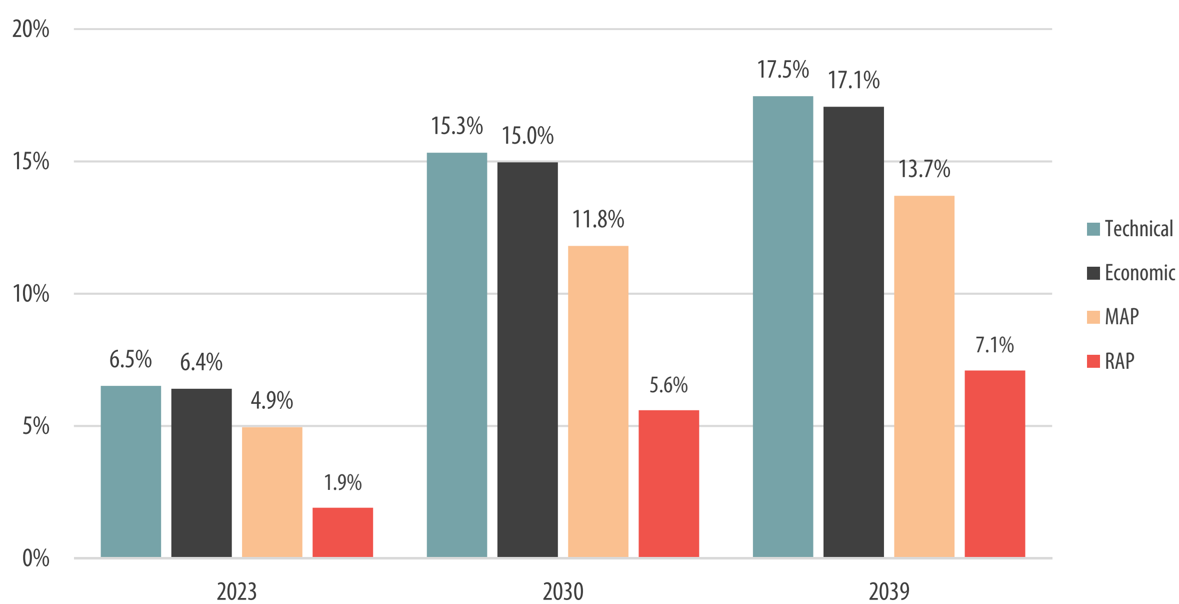


Table 7-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 1.9% after three years.

TABLE 7-2 INDUSTRIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
MWh					
Technical	36,120	75,747	116,387	279,651	327,626
Economic	35,568	74,549	114,461	272,943	320,107
MAP	27,112	57,268	88,461	215,300	257,046
RAP	11,073	22,402	34,051	102,090	133,159
Forecasted Sales	1,758,134	1,778,752	1,787,199	1,824,401	1,876,218
Energy Savings (as % of Forecast)					
Technical	2.1%	4.3%	6.5%	15.3%	17.5%
Economic	2.0%	4.2%	6.4%	15.0%	17.1%
MAP	1.5%	3.2%	4.9%	11.8%	13.7%
RAP	0.6%	1.3%	1.9%	5.6%	7.1%

Table 7-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 0.6% to 0.7% per year over the next three years.

TABLE 7-3 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2021	2022	2023	2030	2039
MWh					
Technical	36,120	41,420	44,609	31,108	56,280
Economic	35,568	40,774	43,880	30,622	55,999
MAP	27,112	31,400	33,941	23,031	43,434
RAP	11,073	12,149	13,001	15,566	21,577
Forecasted Sales	1,758,134	1,778,752	1,787,199	1,824,401	1,876,218
Energy Savings (as % of Forecast)					
Technical	2.1%	2.3%	2.5%	1.7%	3.0%
Economic	2.0%	2.3%	2.5%	1.7%	3.0%
MAP	1.5%	1.8%	1.9%	1.3%	2.3%
RAP	0.6%	0.7%	0.7%	0.9%	1.2%

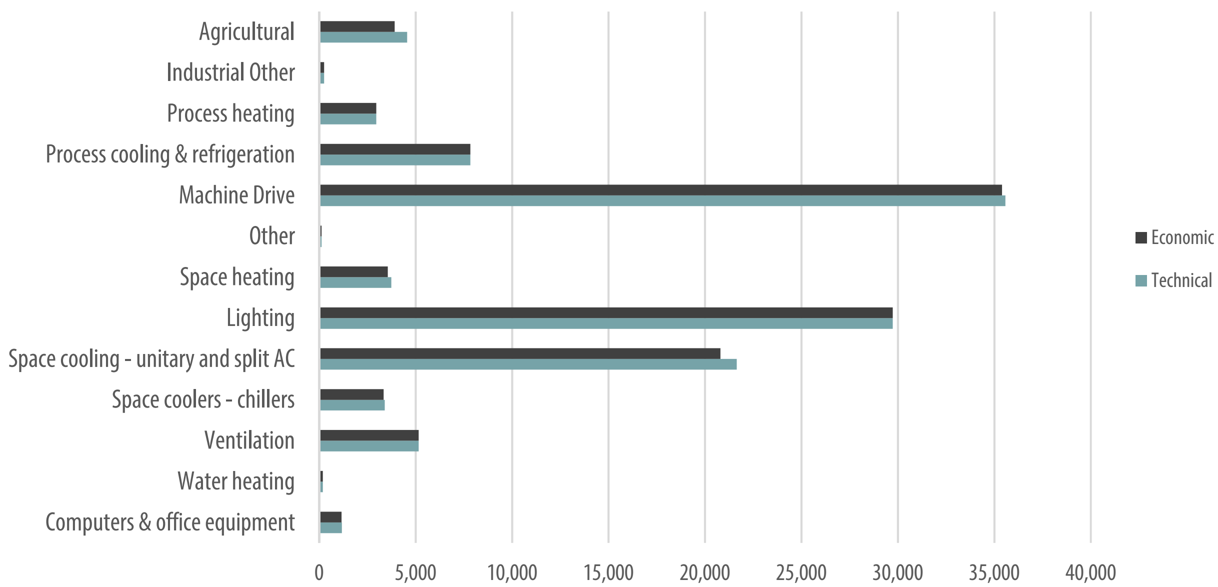
Technical & Economic Potential

Table 7-4 provides cumulative annual technical and economic potential results from 2021-2023, 2030, and 2039. Figure 7-2 shows a comparison of the technical and economic potential (6-year) by end use. Machine drive, Lighting, and Space Cooling are the leading stand-alone end uses among technical and economic potential.

TABLE 7-4 TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL

	2021	2022	2023	2030	2039
Energy (MWh)					
Technical	36,120	75,747	116,387	279,651	327,626
Economic	35,568	74,549	114,461	272,943	320,107
Peak Demand (MW)					
Technical	9	17	25	62	71
Economic	7	16	25	58	71

FIGURE 7-2 THREE-YEAR TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 7-3 illustrates the cumulative annual MAP results by end use across the 2021-2023 timeframe. Like technical and economic potential, Machine Drive, Lighting, and Space Cooling are the leading end uses. Ventilation and Agriculture also have significant MAP.

FIGURE 7-3 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL MWH) MAP POTENTIAL BY END-USE

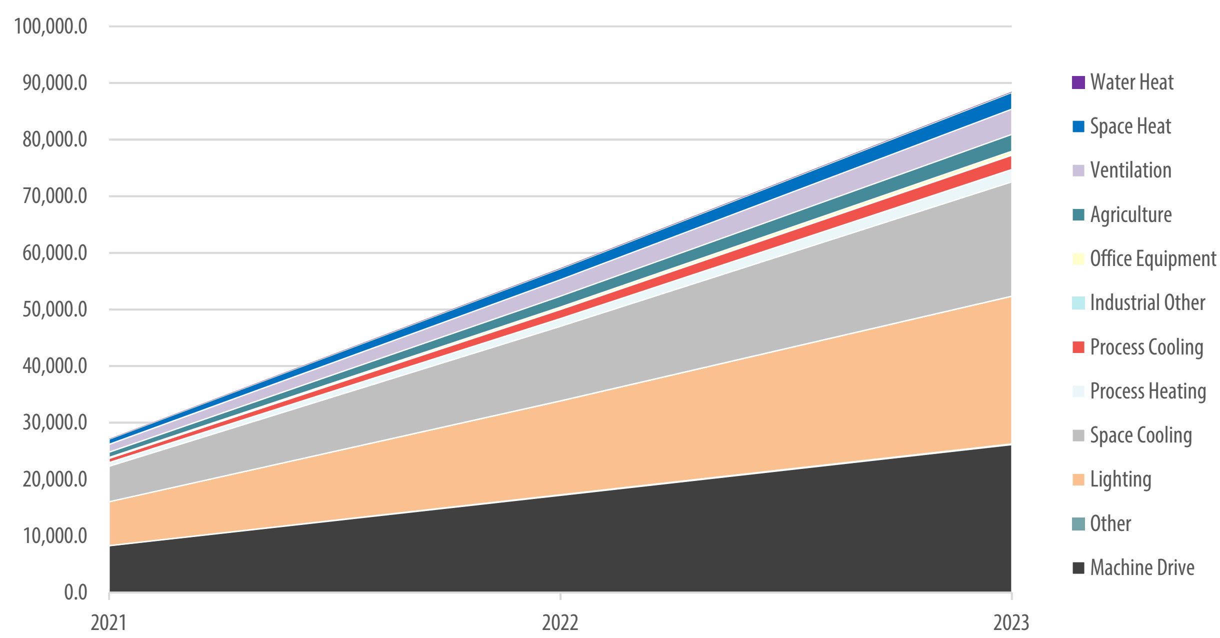


Table 7-5 provides the incremental and cumulative annual MAP across the 2021-2023 timeframe, as well as for 2030 and 2039. The incremental MAP ranges from 1.5% to 1.9% of forecasted sales across the three-year timeframe and 2.3% by 2039. Cumulative annual MAP rises to 4.95% by 2023 and 13.7% by 2039.

TABLE 7-5 INDUSTRIAL ELECTRIC MAP BY END-USE

End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Computers & office equipment	166	205	239	335	351
Water heating	30	31	34	36	42
Ventilation	1,373	1,575	1,658	655	1,859
Space coolers - chillers	882	929	915	476	1,117
Space cooling - unitary and split AC	5,381	6,102	6,434	4,227	8,691
Lighting	7,747	8,993	9,775	5,452	10,733
Space heating	915	1,031	1,071	560	1,433
Other	30	37	44	40	53
Machine Drive	8,260	9,567	10,348	7,567	13,649
Process cooling & refrigeration	730	978	1,210	1,741	2,367
Process heating	639	880	1,112	1,519	2,135
Industrial Other	28	53	83	220	229
Agricultural	931	1,019	1,016	204	777
Total	27,112	31,400	33,941	23,031	43,434
% of Forecasted Sales	1.54%	1.77%	1.90%	1.26%	2.31%
Incremental Annual MW					
Total	6	7	7	5	10
% of Forecasted Demand	0.6%	0.7%	0.7%	0.5%	0.8%
Cumulative Annual MWh					

End Use	2021	2022	2023	2030	2039
Computers & office equipment	166	372	611	1,398	1,492
Water heating	30	61	95	362	464
Ventilation	1,373	2,906	4,469	9,874	11,038
Space coolers - chillers	882	1,798	2,683	5,652	7,344
Space cooling - unitary and split AC	5,381	11,362	17,525	43,824	58,430
Lighting	7,747	16,610	26,092	67,760	73,986
Space heating	915	1,925	2,948	6,684	9,165
Other	30	67	112	472	544
Machine Drive	8,260	17,185	26,133	59,275	68,772
Process cooling & refrigeration	730	1,587	2,525	7,614	11,360
Process heating	639	1,384	2,192	5,426	6,035
Industrial Other	28	64	109	487	916
Agricultural	931	1,950	2,966	6,471	7,499
Total	27,112	57,268	88,461	215,300	257,046
% of Forecasted Sales	1.54%	3.22%	4.95%	11.80%	13.70%
Cumulative Annual MW					
Total	6	12	19	46	57
% of Forecasted Demand	0.6%	1.2%	1.9%	4.3%	4.9%

Realistic Achievable Potential

Figure 7-4 illustrates the cumulative annual RAP results by end use across the 2021-2023 timeframe. Like MAP, Machine Drive, Lighting, and Space Cooling are the leading end uses. Ventilation and Agriculture also have significant RAP.

FIGURE 7-4 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL MWH) RAP POTENTIAL BY END-USE

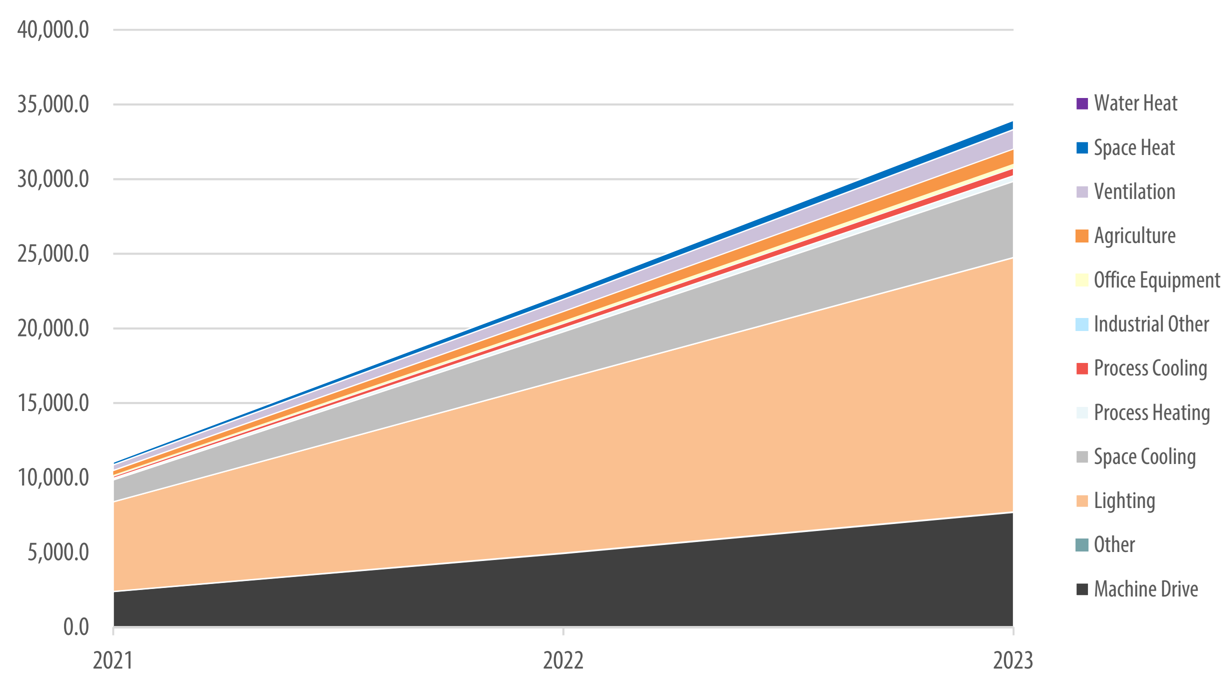


Table 7-6 provides the incremental and cumulative annual RAP across the 2021-2023 timeframe, as well as 2030 and 2039. The incremental RAP ranges from 0.6% to 0.7% of forecasted sales across the three-year timeframe and 1.2% by 2039. Cumulative annual RAP rises to 1.9% by 2023 and 7.1% by 2039.

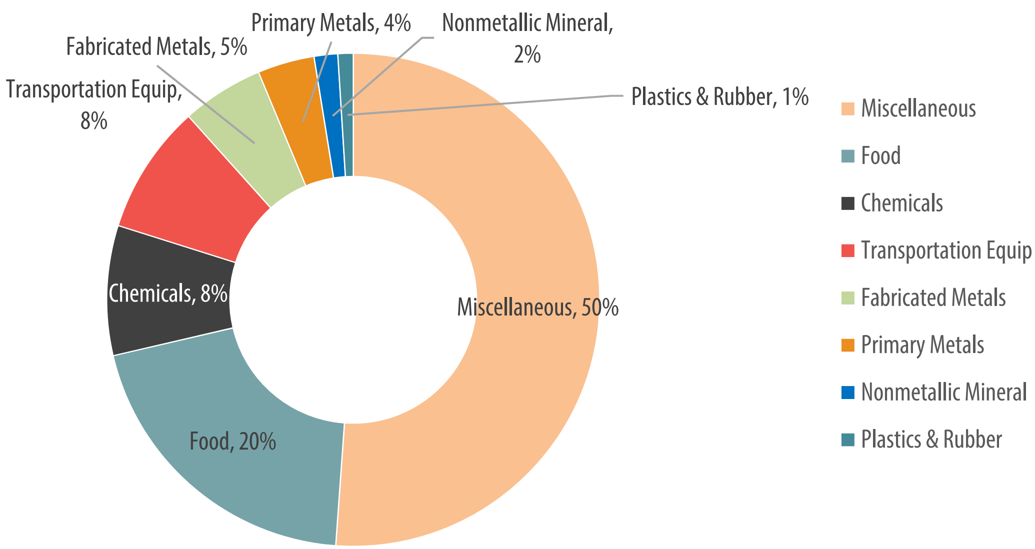
TABLE 7-6 INDUSTRIAL ELECTRIC RAP BY END-USE

End Use	2021	2022	2023	2030	2039
Incremental Annual MWh					
Computers & office equipment	73	89	105	191	200
Water heating	5	7	9	24	21
Ventilation	379	437	487	311	548
Space coolers - chillers	186	211	231	221	341
Space cooling - unitary and split AC	1,282	1,501	1,699	1,959	2,889
Lighting	6,001	6,306	6,497	9,228	12,481
Space heating	205	237	265	241	397
Other	7	10	13	32	24
Machine Drive	2,375	2,711	2,992	2,760	3,812
Process cooling & refrigeration	149	174	195	204	318
Process heating	108	127	142	96	169
Industrial Other	3	5	7	25	33
Agricultural	299	334	358	273	343
Total	11,073	12,149	13,001	15,566	21,577
% of Forecasted Sales	0.6%	0.7%	0.7%	0.9%	1.2%
Incremental Annual MW					
Total	2	2	2	2	3
% of Forecasted Demand	0.2%	0.2%	0.2%	0.2%	0.3%
Cumulative Annual MWh					
Computers & office equipment	73	161	266	738	845
Water heating	5	13	22	149	261
Ventilation	379	816	1,303	4,436	5,576
Space coolers - chillers	186	397	628	2,053	2,836
Space cooling - unitary and split AC	1,282	2,783	4,482	17,412	25,388
Lighting	6,001	11,642	17,033	42,602	50,791
Space heating	205	442	707	2,491	3,447
Other	7	17	30	195	326
Machine Drive	2,375	4,931	7,677	25,282	34,019
Process cooling & refrigeration	149	323	518	2,056	3,481
Process heating	108	235	377	1,334	1,718
Industrial Other	3	8	15	134	414
Agricultural	299	634	992	3,207	4,058
Total	11,073	22,402	34,051	102,090	133,159
% of Forecasted Sales	0.6%	1.3%	1.9%	5.6%	7.1%
Cumulative Annual MW					

End Use	2021	2022	2023	2030	2039
Total	2	3	4	13	19
% of Forecasted Demand	0.2%	0.3%	0.4%	1.2%	1.6%

Figure 7-5 illustrates a market segmentation of the RAP in the industrial sector by 2023. Food, chemicals, fabricated metals, nonmetallic minerals, and miscellaneous industrial are the leading market segments.

FIGURE 7-5 2025 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT[34]



RAP Benefits & Costs

Table 7-7 provides the NPV benefits and cost, as calculated using the UCT, across the 2021-2039 timeframe for the RAP scenario. Machine Drive is the most cost-effective end-use, and Facility HVAC provides the greatest NPV benefits.

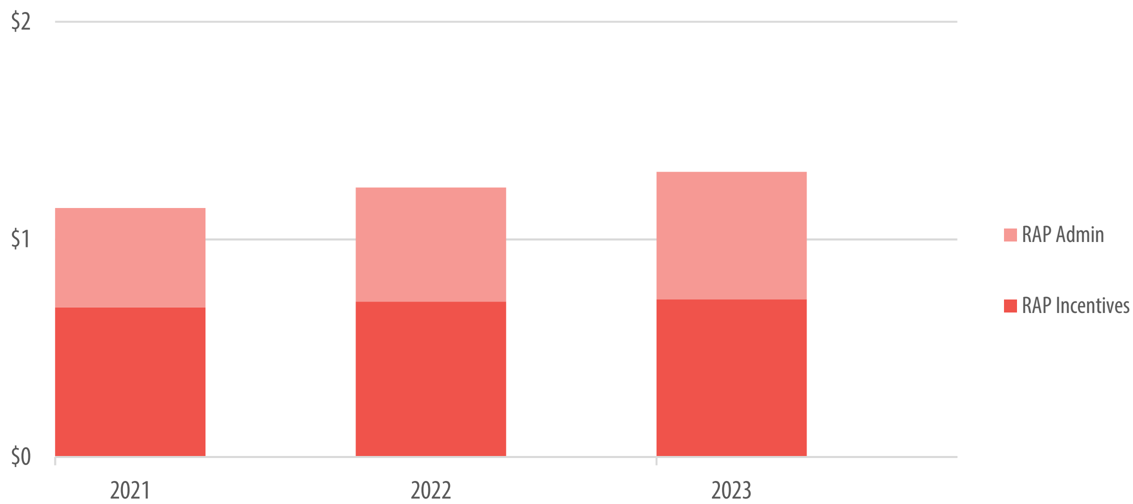
TABLE 7-7 INDUSTRIAL NPV BENEFITS AND COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Machine Drive	$24.64	$2.23	11.1
Facility HVAC	$31.46	$4.77	6.6
Facility Lighting	$29.35	$8.10	3.6
Other Facility Support	$0.85	$0.11	7.7
Process Cooling and Refrigeration	$1.97	$0.19	10.4
Process Heating	$1.05	$0.12	8.6
Other	$0.40	$0.07	5.5
Total	$89.71	$15.59	5.8

Figure 7-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2021-2023 timeframe. The incentives rise from $0.68 million to $0.72 million, and overall budgets rise from $1.2 million to $1.3 million by 2023.

[34] "Wholesale/Retail" and "Services" industrial types include industrial buildings that devote a minority percentage of floor space to commercial activities like wholesale and retail trade, and construction, healthcare, education and accommodation & food service. Automotive related industries are divided between plastics, rubber, and machinery based on their NAICS codes.

FIGURE 7-6 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS)



7.3 INDUSTRIAL POTENTIAL INCLUDING OPT-OUT CUSTOMERS

Table 7-8 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, excluding opt-out customers. This is the same information provided in Section 7.2. The cumulative annual energy savings across the 19-year study timeframe are also shown in the far-right column. Table 7-9 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, including opt-out customers.[35] The cumulative annual energy savings across the 19-year study timeframe are also shown in the far-right column.

The 19-year RAP is 7.1%, excluding opt-out customers. This figure increases to 11.8%, with opt-out customers included. The energy savings of the RAP rises from 133,159 MWh to 222,156 MWh when the opt-out customers are included in the analysis.

TABLE 7-8 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – EXCLUDING OPT-OUT CUSTOMERS

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	36,120	41,420	44,609	31,108	56,280	327,626
Economic	35,568	40,774	43,880	30,622	55,999	320,107
MAP	27,112	31,400	33,941	23,031	43,434	257,046
RAP	11,073	12,149	13,001	15,566	21,577	133,159
Forecasted Sales	1,758,134	1,778,752	1,787,199	1,824,401	1,876,218	1,876,218
Energy Savings (as % of Forecast)						
Technical	2.1%	2.3%	2.5%	1.7%	3.0%	17.5%
Economic	2.0%	2.3%	2.5%	1.7%	3.0%	17.1%
MAP	1.5%	1.8%	1.9%	1.3%	2.3%	13.7%
RAP	0.6%	0.7%	0.7%	0.9%	1.2%	7.1%

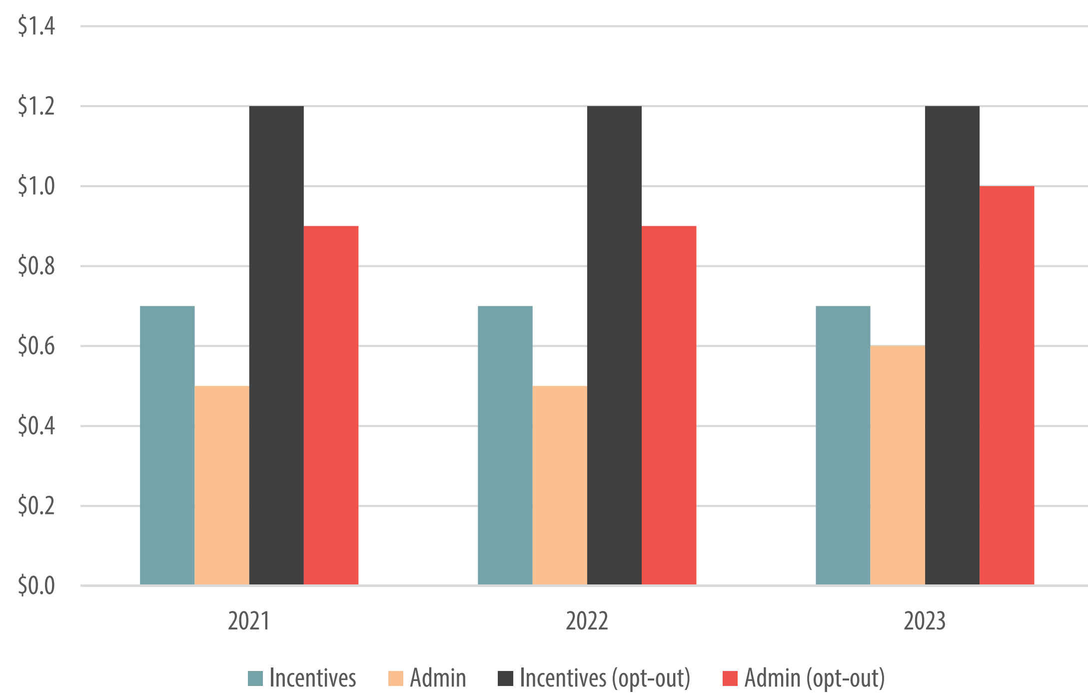
[35] Note the increase in the forecasted sales with opt-out customers included.

TABLE 7-9 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – INCLUDING OPT-OUT CUSTOMERS

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	64,747	74,252	79,969	55,786	100,910	587,157
Economic	63,759	73,093	78,664	54,916	100,404	573,695
MAP	48,586	56,273	60,829	41,292	77,855	460,561
RAP	19,181	21,114	22,647	25,391	38,043	222,156
Forecasted Sales	1,758,134	1,778,752	1,787,199	1,824,401	1,876,218	1,876,218
Energy Savings (as % of Forecast)						
Technical	3.7%	4.2%	4.5%	3.1%	5.4%	31.3%
Economic	3.6%	4.1%	4.4%	3.0%	5.4%	30.6%
MAP	2.8%	3.2%	3.4%	2.3%	4.1%	24.5%
RAP	1.1%	1.2%	1.3%	1.4%	2.0%	11.8%

Figure 7-7 provides the budget for the RAP scenario, with and without opt-out customers. The budget is broken into incentive and admin budgets for each year of the 2021-2023 timeframe. The overall budgets without opt-out customers rise from $1.2 million to $1.3 million by 2023. The budgets with opt-out customers included increase from $2.1 million to $2.2 million by 2023.

FIGURE 7-7 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS) – WITH & WITHOUT OPT-OUT CUSTOMERS



8 Demand Response Potential

This section provides the results of the MAP and RAP potential for the demand response analysis. Results are broken down by sector and program. The cost-effectiveness results and budgets for the MAP and RAP scenarios are also provided. Section 3.5 provides a description of the demand response methodology. Additional demand response results details are provided in Appendix G.

8.1 TOTAL DEMAND RESPONSE POTENTIAL

Table 8-1 and Table 8-2 show the achievable cumulative annual potential savings for the Years 1-3, 10 and 19. Achievable potential includes a participation rate to estimate the realistic number of customers that are expected to participate in each cost-effective demand response program option. These values are at the customer meter. The MAP assumes the maximum participation that would happen in the real-world, while the realistically achievable potential (RAP) discounts MAP by considering barriers to program implementation that could limit the amount of savings achieved. Asterisked programs were those that were found to be not cost-effective, providing 0 achievable potential.

TABLE 8-1 MAP SAVINGS BY PROGRAM

	Program	2021 (MW)	2022 (MW)	2023 (MW)	2030 (MW)	2039 (MW)
Residential	DLC AC - Switch	39	37	36	23	0
	DLC AC - Thermostat	15	22	29	79	151
	DLC Space Heating	4	13	27	42	45
	DLC Water Heating	9	30	64	101	108
	DLC Electric Vehicles*	0	0	0	0	0
	Total	67	102	155	245	304
Non-Residential	DLC AC - Switch*	0	0	0	0	0
	DLC AC - Thermostat	0	1	1	5	9
	DLC Space Heating	0	1	3	5	5
	DLC Water Heating	1	3	6	9	9
	Ice Storage Cooling Rate*	0	0	0	0	0
	DLC Lighting*	0	0	0	0	0
	Curtailable (Day Of)	22	54	63	68	70
	Curtailable (Day Ahead)	41	100	117	127	129
	Total (Curtailable Day Of)	24	59	73	86	92
	Total (Curtailable Day Ahead)	43	105	127	145	152
Residential & Commercial Total (Curtailable Day Of)		91	161	228	331	397
Residential & Commercial Total (Curtailable Day Ahead)		111	207	282	390	456

TABLE 8-2 RAP SAVINGS BY PROGRAM

	Program	2021 (MW)	2022 (MW)	2023 (MW)	2030 (MW)	2039 (MW)
Residential	DLC AC - Switch	39	37	36	23	0
	DLC AC - Thermostat	13	18	22	56	105
	DLC Space Heating	3	9	20	32	34
	DLC Water Heating	6	19	41	65	69
	DLC Electric Vehicles*	0	0	0	0	0
	Total	61	84	119	176	208
Non-Residential	DLC AC - Switch*	0	0	0	0	0
	DLC AC - Thermostat	0	0	1	2	4
	DLC Space Heating	0	0	1	1	1
	DLC Water Heating	0	1	3	4	4
	Ice Storage Cooling Rate*	0	0	0	0	0
	DLC Lighting*	0	0	0	0	0
	Curtailable (Day Of)	12	28	33	36	36
	Curtailable (Day Ahead)	21	52	61	66	68
	Total (Curtailable Day Of)	12	30	37	43	45
	Total (Curtailable Day Ahead)	22	54	65	73	76
Residential & Commercial Total (Curtailable Day Of)		73	114	155	218	253
Residential & Commercial Total (Curtailable Day Ahead)		83	138	184	249	284

Benefits & Costs

Table 8-3 and Table 8-4 show the MAP and RAP budget requirement (for only cost-effective programs) across the 2021-2039 timeframe that would be required to achieve the cumulative annual potential for each of the thermostat scenarios. The current and future hardware and software cost of a Demand Response Management System and the cost of non-equipment incentives are included in these budgets.

TABLE 8-3 SUMMARY OF MAP BUDGET REQUIREMENTS

	Curtailable Day Of	Curtailable Day Ahead
2021	$9,323,563	$10,637,361
2022	$17,924,342	$21,806,580
2023	$22,697,064	$28,100,280
2030	$20,810,931	$27,941,815
2039	$26,113,047	$34,781,953

TABLE 8-4 SUMMARY OF RAP BUDGET REQUIREMENTS

	Curtailable Day Of	Curtailable Day Ahead
2021	$6,148,493	$6,513,787
2022	$10,313,497	$11,400,882
2023	$14,876,821	$16,397,937
2030	$11,069,432	$13,080,488
2039	$13,753,683	$16,198,493

Table 8-5 and Table 8-6 show the MAP and RAP residential NPVs of the total benefits, costs, and savings, along with the UCT ratio for each program for the length of the study. The study period is 2021 to 2039. Two scenarios were looked at for the curtailable rate program: day of notifications and day ahead notifications. Asterisked programs were those that were found to be not cost-effective, providing 0 achievable potential.

TABLE 8-5 MAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC - Switch	$38,751,981	$11,101,437	3.49
	DLC AC - Thermostat	$118,021,492	$49,502,428	2.38
	DLC Space Heating	$59,753,588	$12,623,599	4.73
	DLC Water Heating	$143,661,898	$85,044,280	1.69
	DLC Electric Vehicles*	$4,503,262	$20,442,597	0.22
Non-Residential	DLC AC - Switch*	$65,605	$508,128	0.13
	DLC AC - Thermostat	$6,658,610	$3,890,618	1.71
	DLC Space Heating	$6,422,980	$1,980,113	3.24
	DLC Water Heating	$12,486,975	$6,641,713	1.88
	Ice Storage Cooling Rate*	$3,315,135	$23,508,572	0.14
	DLC Lighting*	$1,058,230	$4,907,195	0.22
	Curtailable (Day Of)	$136,746,749	$136,417,949	1.00
	Curtailable (Day Ahead)	$136,746,749	$136,417,949	1.00

TABLE 8-6 RAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC - Switch	$38,751,751	$11,095,762	3.49
	DLC AC - Thermostat	$84,460,054	$35,120,192	2.40
	DLC Space Heating	$44,761,294	$9,434,070	4.74
	DLC Water Heating	$91,709,001	$54,500,796	1.68
	DLC Electric Vehicles*	$2,730,501	$13,508,218	0.20
Non-Residential	DLC AC - Switch*	$65,605	$508,116	0.13
	DLC AC - Thermostat	$2,803,417	$1,999,243	1.40
	DLC Space Heating	$1,374,696	$1,136,329	1.21
	DLC Water Heating	$5,458,587	$3,404,591	1.60
	Ice Storage Cooling Rate*	$654,273	$5,632,429	0.12
	DLC Lighting*	$227,344	$1,851,493	0.12
	Curtailable (Day Of)	$38,575,756	$20,719,844	1.86
	Curtailable (Day Ahead)	$71,567,702	$38,444,116	1.86

VOLUME II

Appendices

prepared for

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APPENDIX A. DSM Market Potential Study Sources

This appendix catalogs many of the data sources used in this study, grouped by major activity. In general, GDS attempted to utilize IPL-specific data, where available. When IPL-specific data was not available or reliable, GDS leveraged secondary data from nearby or regional sources.

A.1 MARKET RESEARCH

Market research studies were used to understand home and business characteristics and equipment stock characteristics. The GDS Team conducted primary data collection activities in the residential, commercial, and industrial sectors to gather information on residential dwellings and nonresidential facilities. In addition, the primary data collection collected additional equipment and efficiency characteristics. The MPS also relied on available secondary research to supplement the primary data collection activities.

- ***IPL Residential Self-Report Survey:*** GDS collected data on 231 residential dwellings from a mail/web survey. A total of 30 questions were included in the survey, seeking to collect information about ownership of electric appliances; the type, fuel, and age of heating, ventilation, and air conditioning (HVAC) and water heating equipment in the home; the types of energy improvements that may have been made to the home, and demographic information.
- ***IPL Residential On-Site Survey:*** GDS collected data on 68 residential dwellings via an on-site survey from trained field staff. The purpose of the site-visits was to collect more detailed end-use and housing characteristics that are difficult to collect in a self-report survey. On-site data collection focused on accurate inventory counts of residential lighting and make/model information of key electric equipment and appliances.
- ***IPL Residential Willingness to Participate Survey:*** GDS collected willingness to participate data on 4 major residential end-uses given varying incentive levels. GDS collected responses from 875 residential consumers via an on-line/e-mail survey.
- ***IPL Commercial Primary Market Research:*** A detailed end use survey was then completed by technicians to collect detailed research data and WTP information from site representatives. GDS collected data in 68 commercial facilities to better understand electric equipment saturation and efficiency characteristics.
- ***IPL Industrial Primary Market Research***: A total of 40 site visits were conducted for the industrial sector, in which WTP and detailed end-use information was collected. Survey data was leveraged to determine the remaining factors for several end-uses, including motors, interior and exterior lighting and fixture measures.
- ***EIA/DOE Industrial Data:*** Including the DOE Industrial Electric Motor Systems Market Opportunities Report, the DOE Assessment of the Market for Compressed Air Efficiency Services, and EIA Industrial Demand Module of the National Energy Modeling System.
- ***US American Community Survey:*** Public Use Microdata Survey data was used to estimate the percent of low-income households (using annual household income and number of people per household) in the IPL service territory.
- ***Energy Star Shipment Data:*** Energy Star shipment data provides a detailed historical estimate of the percent of shipped equipment/appliances that meet ENERGY STAR standards. Over the long-term, this serves as a proxy for the percent of the market that could be considered energy efficient.

A.2 FORECAST CALIBRATION

The forecast calibration effort was used to create a detailed segmentation of IPL's load forecast and ensure that estimated savings would not overstate future potential. IPL supplied GDS with the most recent load forecast and data collected via primary research activities was used to further refine the existing load forecast.

- ***IPL Load Forecast:*** The 2016 Long-Term Electric Energy and Demand load forecast consists of the most recent ITRON load forecast completed for IPL for 2016-2036. Future years were escalated by a compound average annual growth rate.
- ***IPL Commercial and Industrial Customer Database:*** The 2017 historical commercial and industrial data utilized rate codes and existing NAICS code to segment historical sales by commercial building type and/or industry type.
- ***InfoUSA***: GDS utilized a third-party dataset that provided additional commercial and industrial business information, including NAICS codes, to supplement the building/industry types codes supplied by IPL.
- ***EIA Commercial Building Energy Consumption Survey:*** GDS updated the ITRON load forecast to utilize more recent information for the East North-Central region from the EIA 2012 CBECS survey.
- ***EIA Manufacturing Energy Consumption Survey:*** GDS used the 2014 study to further refine the industrial load forecast by end-use.
- ***BEopt:*** GDS developed residential building prototypes from the market research effort to develop detailed consumption estimates by end-use and calibrated these models to IPL's residential load forecasts.

A.3 ENERGY EFFICIENCY MEASURE DATA

The energy efficiency measure analysis developed per unit savings, cost, and useful life assumptions for each energy efficiency measure in the residential, commercial, and industrial sectors. Preference was given to IPL-specific evaluated savings and/or deemed savings/algorithms in the Indiana TRM.

- ***2016 & 2017 IPL EM&V Report (Cadmus):*** For the development of savings estimates of measures already offered by IPL, GDS either used the estimates from the most recent evaluation reports or used the evaluation methodology to develop forward looking savings projections.
- ***Indiana TRM v2.2:*** In the absence of evaluation data, GDS attempted to leverage the Indiana TRM. Assumptions and algorithms were based off the IN TRM to the extent practical.
- ***IPL 2018 & 2019 DSM Portfolio Summary:*** Historical incentive estimates and in some cases, incremental measure costs, were based on the IPL DSM Portfolio Summary.
- ***Other TRMs:*** In some cases, TRM's or deemed measure databases from other states were more applicable than the IN TRM due to more currently available estimates and the more appropriate use of updated federal standards. The Illinois TRM and the Michigan Energy Measures Database were the primary non-Indiana TRMs used.
- ***Other Secondary Sources:*** In some cases, following the source hierarchy listed above was not enough to develop savings estimates. In these cases, GDS leveraged other secondary research documents such as ACEEE emerging technology reports.

A.4 DEMAND RESPONSE MEASURE ANALYSIS

The DR analysis developed per unit savings, cost, and useful life assumptions for select demand response programs.

- ***IPL programs / 2012 FERC DR Survey:*** Demand reductions were based on load reductions found in IPL's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies.
- ***Indiana TRM v2.2:*** In the absence of evaluation data, GDS attempted to leverage the Indiana TRM. Assumptions and algorithms were based off the IN TRM to the extent practical.
- ***Comverge:*** Comverge provided an estimate of the load control switch cost and useful life.
- ***Nest and Ecobee:*** Nest and Ecobee product data was used to develop equipment cost assumptions.
- ***Other DR Potential Studies:*** In the absence of the previous data, GDS used other demand response potential studies completed for other utilities.

A.5 AVOIDED COST/ECONOMIC ANALYSIS

Avoided costs and related economic assumptions were used to assess cost-effectiveness. In addition, historical incentive levels were tied to willingness-to-participate (WTP) research to assess long-term market adoption in the achievable potential scenario.

- ***Electric Avoided Costs:*** Avoided cost values for electric energy, electric capacity, and avoided transmission and distribution (T&D) were provided by IPL as part of an initial data request. Electric energy is based on an annual system marginal cost. For years outside of the avoided cost forecast timeframe, future year avoided costs are escalated by the rate of inflation.
- ***Other Economic Assumptions:*** Includes the discount rate, inflation rate, line loss assumptions and reserve margin requirement. All economic assumptions were provided by IPL and consistent with economic modeling assumptions used for other utility planning efforts.
- ***2019 DSM Portfolio Summary:*** 2021 direct measure/program non-incentive costs were calibrated to recent projected levels using the 2019 Portfolio Summary
- ***Primary Market Research:*** As noted above, the GDS Team completed IPL-specific research in the residential, commercial, and industrial sectors regarding customer willingness-to-purchase and install energy efficient equipment at various incentive levels. This IPL-specific customer data was used to determine long-term adoption rates by end-use for the MAP and RAP achievable potential scenarios.

APPENDIX B. Residential Market Potential Study Measure Detail

available in electronic format

APPENDIX C. Commercial Market Potential Study Measure Detail

available in electronic format

APPENDIX D. Industrial Market Potential Study Measure Detail

available in electronic format

APPENDIX E. DSM Market Potential Study Commercial Opt-Out Results

This section provides the potential results for technical, economic, MAP and RAP for the commercial sector, with opt-out customers included. The cost-effectiveness results and budgets for the RAP scenario are also provided.

E.1 SCOPE OF MEASURES & END USES ANALYZED

There were 237 total unique electric measures included in the analysis. Table E-1 provides number of measures by end-use (the full list of industrial measures is provided in Appendix D). The measure list was developed based on a review of current IPL programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE E-1 COMMERCIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Space Heating	31
Cooling	75
Ventilation	11
Water Heating	17
Lighting	32
Cooking	8
Refrigeration	29
Office Equipment	14
Behavioral	4
Other	16

E.2 COMMERCIAL ELECTRIC POTENTIAL

Figure E-1 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 19-year technical potential is 46.0% of forecasted sales, and the economic potential is 40.0% of forecasted sales. The 19-year MAP is 35.2% and the RAP is 17.7%.

FIGURE E-1 COMMERCIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF INDUSTRIAL SALES)

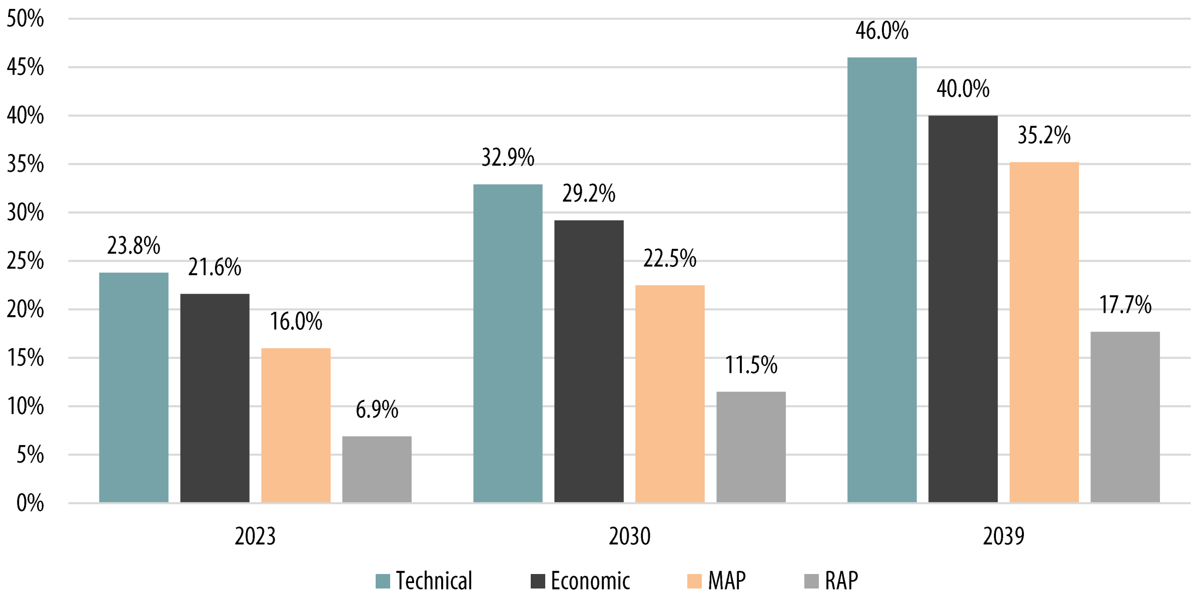


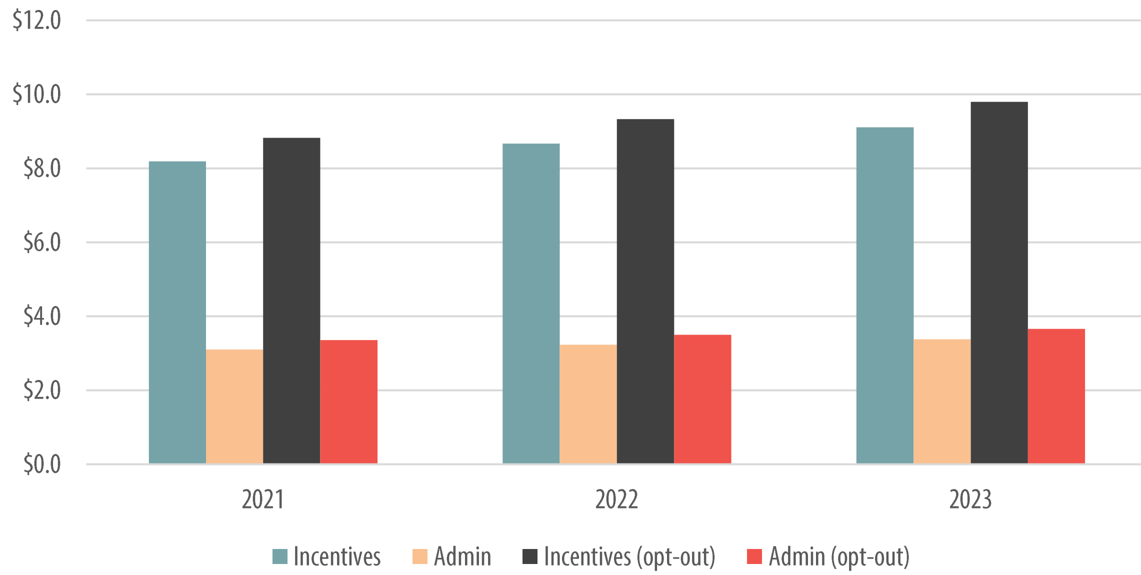
Table E-2 provides the incremental annual technical, economic, MAP and RAP energy savings, as well as 2039 cumulative total energy savings in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP is steady at 1.6% per year over the next three years, and 2.7% by 2039, with a cumulative total of 19.3% by 2039.

TABLE E-2 INCREMENTAL ANNUAL ENERGY SAVINGS & 2039 CUMULATIVE TOTAL ENERGY SAVINGS

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	319,987	361,894	393,318	355,466	483,353	3,271,659
Economic	282,388	316,313	340,107	311,127	422,935	2,845,631
MAP	217,686	257,080	286,837	309,561	396,535	2,503,275
RAP	105,544	105,937	106,745	109,342	190,102	1,368,560
Forecasted Sales	6,660,103	6,737,966	6,769,949	6,911,159	7,107,737	7,107,737
Energy Savings (as % of Forecast)						
Technical	4.8%	5.4%	5.8%	5.1%	6.8%	46.0%
Economic	4.2%	4.7%	5.0%	4.5%	6.0%	40.0%
MAP	3.3%	3.8%	4.2%	4.5%	5.6%	35.2%
RAP	1.6%	1.6%	1.6%	1.6%	2.7%	19.3%

Figure F-2 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2023 timeframe. The incentives rise from $8.9 million to $9.7 million over the next three years, and overall budgets rise from $12.2 million to $13.3 million by 2023 for the Opt-outs included scenario.

FIGURE E-2 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS) – WITH & WITHOUT OPT-OUT CUSTOMERS



APPENDIX F. DSM Market Potential Study Industrial Opt-Out Results

This section provides the potential results for technical, economic, MAP and RAP for the industrial sector, with opt-out customers included. The cost-effectiveness results and budgets for the RAP scenario are also provided.

F.1 SCOPE OF MEASURES & END USES ANALYZED

There were 130 total unique electric measures included in the analysis. Table F-1 provides number of measures by end-use (the full list of industrial measures is provided in Appendix D). The measure list was developed based on a review of current IPL programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE F-1 INDUSTRIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Computers & Office Equipment	6
Water Heating	6
Ventilation	7
Space Cooling	25
Space Heating	16
Lighting	16
Other	7
Machine Drive	21
Process Heating and Cooling	10
Agriculture	16

F.2 INDUSTRIAL ELECTRIC POTENTIAL

Figure F-1 provides the technical, economic, MAP and RAP results for the 3-year, 10-year, and 19-year timeframes. The 19-year technical potential is 31.3% of forecasted sales, and the economic potential is 30.6% of forecasted sales. The 19-year MAP is 24.5% and the RAP is 11.8%.

FIGURE F-1 INDUSTRIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF INDUSTRIAL SALES)

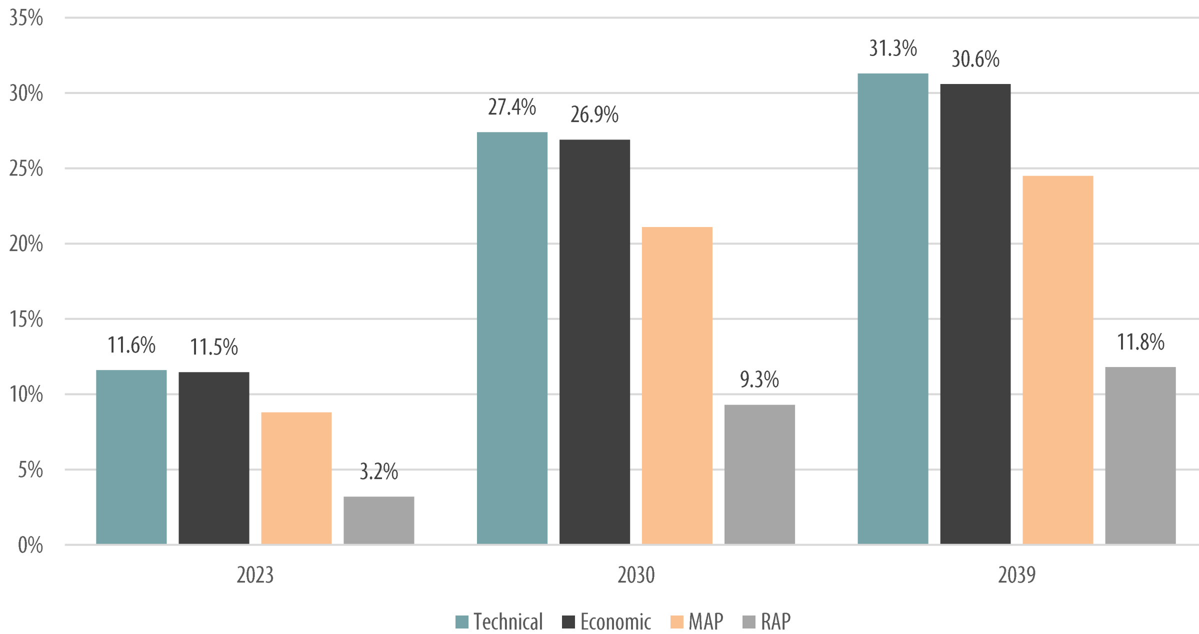


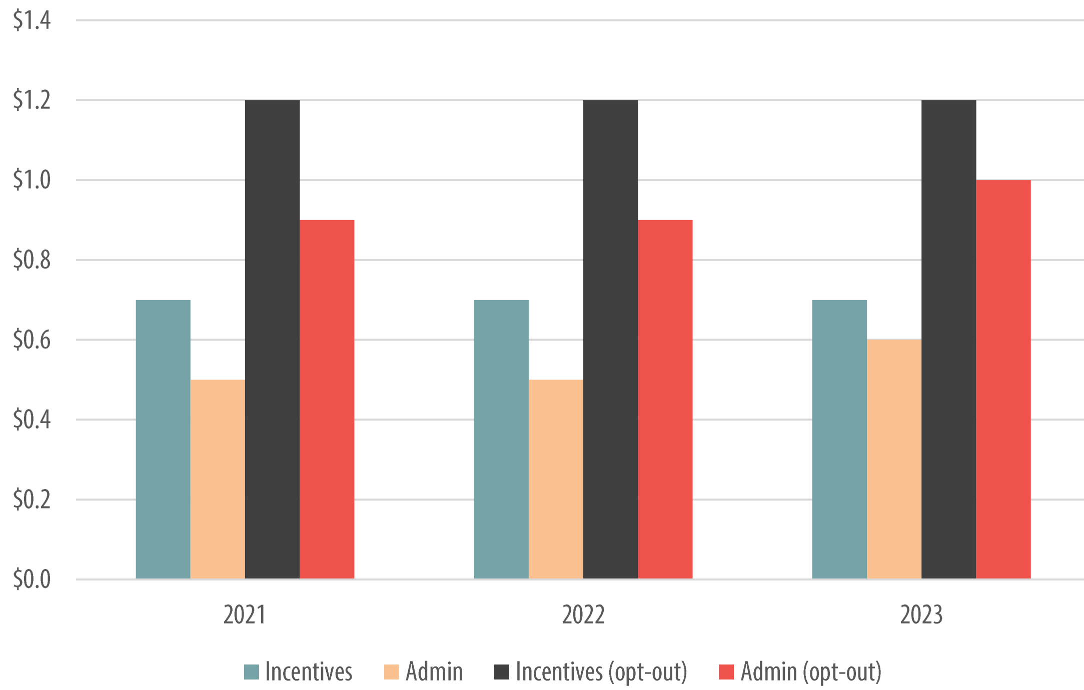
Table F-2 provides the incremental annual technical, economic, MAP and RAP energy savings, as well as 2039 cumulative total energy savings in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 1.1% to 1.4% per year over the next three years, and 2.0% by 2039, with a cumulative total of 11.8% by 2039.

TABLE F-2 INCREMENTAL ANNUAL ENERGY SAVINGS & 2039 CUMULATIVE TOTAL ENERGY SAVINGS

	2021	2022	2023	2030	2039	2039 (cumulative)
MWh						
Technical	64,747	74,252	79,969	55,786	100,910	587,157
Economic	63,759	73,093	78,664	54,916	100,404	573,695
MAP	48,586	56,273	60,829	41,292	77,855	460,561
RAP	19,181	21,114	22,647	25,391	38,043	222,156
Forecasted Sales	1,758,134	1,778,752	1,787,199	1,824,401	1,876,218	1,876,218
Energy Savings (as % of Forecast)						
Technical	3.7%	4.2%	4.5%	3.1%	5.4%	31.3%
Economic	3.6%	4.1%	4.4%	3.0%	5.4%	30.6%
MAP	2.8%	3.2%	3.4%	2.3%	4.1%	24.5%
RAP	1.1%	1.2%	1.3%	1.4%	2.0%	11.8%

Figure F-2 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2023 timeframe. The incentives are steady at $1.2 million, and overall budgets rise from $2.1 million to $2.2 million by 2023 for the Opt-outs included scenario.

FIGURE F-2 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS) – WITH & WITHOUT OPT-OUT CUSTOMERS



APPENDIX G. Demand Response Methodology

G.1 DEMAND RESPONSE PROGRAM OPTIONS

Table G-1 provides a brief description of the demand response program options considered and identifies the eligible customer segment for each demand response program that was considered in this study.

TABLE G-1 DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS

DR Program Option	Program Description	Eligible Markets
DLC AC (Switch)	The compressor of the air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle). GDS looked at both the one-way communicating Cannon switches and two-way communicating L+G switches. Both switch options were assumed to be phased out as customers switch to thermostats over time.	Residential and Non-Residential Customers
DLC AC (Smart Thermostat)	The system operator can remotely raise the AC's thermostat set point during peak load conditions, lowering AC load. GDS looked at the three options IPL currently has: a customer is given a free thermostat to participate along with an annual incentive, a customer is given a rebate through the marketplace or a storefront along with an annual incentive, or the customer brings an existing thermostat and is only given an annual incentive.	Residential and Non-Residential Customers
DLC Space Heating	The system operator can remotely lower the HVAC's thermostat set point during winter peak load conditions, lowering the heating load. This program is an add-on to the DLC AC Thermostat program. Only participants in the AC Thermostat program would be allowed to participate in the Space Heating program.	Residential and Non-Residential Customers
DLC Water Heaters	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 8 hours.	Residential and Non-Residential Customers
Ice Storage Cooling Rate	The use of a cold storage medium such as ice, chilled water, or other liquids. Off-peak energy is used to produce chilled water or ice for use in cooling during peak hours. The cool storage process is limited to off-peak periods.	Large Non-Residential Customers
DLC Lighting	Part of the lighting load is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours.	Non-Residential Customers
Curtailable Rate (Day Of)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	Non-Residential Customers

DR Program Option	Program Description	Eligible Markets
Curtailable Rate (Day Ahead)	A discounted rate is offered to the customer for agreeing to interrupt or curtail load during peak period.	Non-Residential Customers

G.2 DEMAND RESPONSE POTENTIAL ASSESSMENT APPROACH

The analysis for this study was conducted using the GDS DR Model. The GDS DR Model is an Excel spreadsheet tool that allows the user to determine the achievable potential for a demand response program based on the following two basic equations that can be chosen to be the model user.

ACHIEVABLE POTENTIAL. The cost-effective demand response potential that can practically be attained in a real-world program delivery scenario, if a certain level of market penetration can be attained are included in this scenario. Achievable potential considers real-world barriers to convincing customers to participate in cost-effective demand response programs. Achievable savings potential savings is a subset of economic potential.

If the model user chooses to base the estimated potential demand reduction on a per customer CP load reduction value, then:

$$\textit{Achievable DR Potential} = \textit{Potentially Eligible Customers} \times \textit{Eligible Customer Participation Rate} \times \textit{CP kW Load Reduction Per Participant}$$

The framework for assessing the cost-effectiveness of demand response programs is based *on A Framework for Evaluating the Cost-Effectiveness of Demand Response, prepared for the National Forum on the National Action Plan (NAPA) on Demand Response*.[1] Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.[2] GDS utilized this guide to define avoided ancillary services and energy and/or capacity price suppression benefits. Appendix A contains a table from the report summarizing the energy efficiency cost and benefits including in all five major benefit cost tests.

The GDS Demand Response Model determines the estimated savings for each demand response program by performing an extensive review of all benefits and cost associated with each program. GDS developed the model such that the value of future programs could be determined and to help facilitate demand response program planning strategies. The model contains approximately 50 required inputs for each program including: expected life, CP kW load reductions, proposed rebate levels, program related expenses such as vendor service fees, marketing and evaluation cost and on-going O&M expenses. This model and future program planning features can be used to standardize the cost-effectiveness screening process between IPL departments interested in the deployment of demand response resources.

For this study, the Utility Cost Test (UCT) test was used to determine the cost-effectiveness of each demand response program. Benefits are based on avoided demand, energy (including load shifting), wholesale cost reductions and T&D costs. Costs include incremental program equipment costs (such as

[1] Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.
[2] National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, May 18, 2017, Prepared by The National Efficiency Screening Project

control switches or smart thermostats), fixed program capital costs (such as the cost of a central controller), program administrative, marketing, and evaluation costs. Incremental equipment program costs are included for both new and replacement units (such as control switches) to account for units that are replaced at the end of their useful life.

Achievable potential is broken into maximum and realistic achievable potential in this study:

MAP represents an estimate of the maximum cost-effective demand response potential that can be achieved over the 19-year study period. For this study, this is defined as customer participation in demand response program options that reflect a "best practices" estimate of what could eventually be achieved. MAP assumes no barriers to effective delivery of programs.

RAP represents an estimate of the amount of demand response potential that can be realistically achieved over the 19-year study period. For this study, this is defined as achieving customer participation in demand response program options that reflect a realistic estimate of what could eventually be achieved assuming typical or "average" industry experience. RAP is a discounted MAP, by considering program barriers that limit participation, therefore reducing savings that could be achieved.

This potential study evaluated DR potential for two achievable potential scenarios:

1. *Curtailable Day of Scenario*
2. *Curtailable Day Ahead Scenario*

G.3 AVOIDED COSTS & OTHER ECONOMIC ASSUMPTIONS

Demand response avoided costs were consistent with those utilized in the energy efficiency potential analysis and were provided by IPL. Avoided electric generation capacity refers to the demand response program benefit resulting from a reduction in the need for new peaking generation capacity. Demand response can also produce energy related benefits. If the demand response option is considered "load shifting", such as direct load control of electric water heating, the consumption of energy is shifted from the control period to the period immediately following the period of control. For this study, GDS assumed that the energy is shifted with no loss of energy. For power suppliers, this shift in the timing of energy use can produce benefits from either the production of energy from lower cost resources or the purchase of energy at a lower rate. If the program is not considered to be "load shifting" the measure is turned off during peak control hours, and the energy is saved altogether. Demand response programs can also potentially delay the construction of new transmission and distribution lines and facilities, which is reflected in avoided T&D costs.

The discount rate used in this study is 6.24%. A peak demand line loss factor of 5.28% and a reserve margin of 7.9 % (for firm load reduction such as direct load control) were also applied to demand reductions at the customer meter. These values were provided by IPL.

The useful life of a smart thermostat is assumed to be 12 years[3]. Load control switches have a useful life of 12 years[4]. This life was used for all direct load control measures in this study.

The number of control units per participant was assumed to be 1 for all direct load control programs using switches (such as water heaters and air conditioning switches), because load control switches can control

[3] 2018 DSM Portfolio Summary, Measure DATA tab
[4] 2018 DSM Portfolio Summary, Measure DATA tab

up to two units. However, for controllable thermostats, some participants have more than one thermostat. The average number of residential thermostats per single family home was assumed to be 1.055[5]. The average number of non-residential thermostats per buildings was assumed to be 1.808[6].

G.4 CUSTOMER PARTICIPATION

The assumed level of customer participation for each demand response program option is a key driver of achievable demand response potential estimates. Customer participation rates reflect the total number of eligible customers that are likely to participate in a demand response program. An eligible customer is defined as a customer that is eligible to participate in a demand response program. For DLC programs, eligibility is determined by whether a customer has the end use equipment that will be controlled[7]. The eligible customers for each program is shown in Table G-2 and Table G-3.

TABLE G-2 ELIGIBLE RESIDENTIAL CUSTOMERS IN EACH DEMAND RESPONSE PROGRAM OPTION

DR Program Option	Saturation	Source / Description
DLC AC (Switch)	93.8% of residential customers	GDS IPL Saturation Study - Saturation of Central AC
DLC AC (Thermostat)	93.8% of residential customers	GDS IPL Saturation Study - Saturation of Central AC
DLC Space Heating	42.7% of residential customers	GDS IPL Saturation Study - Saturation of Space Heating
DLC Water Heaters	47.6% of residential customers	GDS IPL Saturation Study - Saturation of Electric Water Heaters
DLC Room AC	24.2% of residential customers	GDS IPL Saturation Study - Saturation of Room AC

TABLE G-3 ELIGIBLE NON-RESIDENTIAL CUSTOMERS IN EACH DEMAND RESPONSE PROGRAM OPTION

DR Program Option	Saturation	Source / Description
DLC AC (Switch)	84% of non-residential customers	GDS IPL Saturation Study - Saturation of Central AC
DLC AC (Thermostat)	81.5% of non-residential customers	GDS IPL Saturation Study - Saturation of Central AC
DLC Space Heating	38.37% of non-residential customers	CBECS Table B26 - Saturation of Space Heating in the East North Central Region
DLC Water Heaters	54.41% of non-residential customers	GDS IPL Saturation Study - Saturation of Electric Water Heaters
Ice Storage Cooling Rate	62% of non-residential customers	CBECS Table B40 - Saturation of Chillers in the East North Central Region

[5] Calculated number of central AC units per number of homes from IPL saturation study.
[6] Calculated number of central AC units per number of buildings from IPL saturation study.

DR Program Option	Saturation	Source / Description
DLC Lighting	15.1% of non-residential customers	GDS IPL Saturation Study - Saturation of T12 Lighting
Curtailable Rate (Day Of)	100% of non-residential customers	DSA/GDS Assumption
Curtailable Rate (Day Ahead)	100% of non-residential customers	DSA/GDS Assumption

G.4.1 Existing Demand Response Programs

IPL has offered their Direct Load Control program for many years. This program offers incentives to members who enroll central AC using switches (residential and non-residential) or smart thermostats (residential only). However, IPL plans to transition the DLC AC switch program to be controlled with smart thermostats instead. GDS assumed that the DLC AC switch program would be ended by phased out by the end of the 19-year study and these customers would be transitioned to using thermostats to participate in the program. A cost-effective analysis was still run for these programs, with the assumption that no new switches would be installed and participation would steadily decline until 2039.

G.4.2 Hierarchy

Double-counting savings from demand response programs that affect the same end uses is a common issue that must be addressed when calculating the demand response savings potential. For example, a direct load control program of air conditioning and a rate program both assume load reduction of the customers' air conditioners. For this reason, it is typically assumed that customers cannot participate in programs that affect the same end uses. However, in this study, none of the programs interacted with each other. All residential programs considered were direct load control. Only small non-residential customers were eligible for direct load control programs, and large non-residential customers were eligible for the Ice Storage Cooling Rate and Curtailable Rate. Therefore, a hierarchy was not necessary for these programs.

G.4.3 Participation Rates

The assumed "steady state" participation rates used in this potential study and the sources upon which each assumption is based are shown in Table G-5 for residential and non-residential customers, respectively. The steady state participation rate represents the enrollment rate once the fully achievable participation has been reached. Participation rates are expressed as a percentage of eligible customers. Program participation and impacts (demand reductions) are assumed to begin in 2020. The main sources of participant rates are several studies completed by the Brattle Group. Additional detail about participation rates and sources are shown in Table G-5.

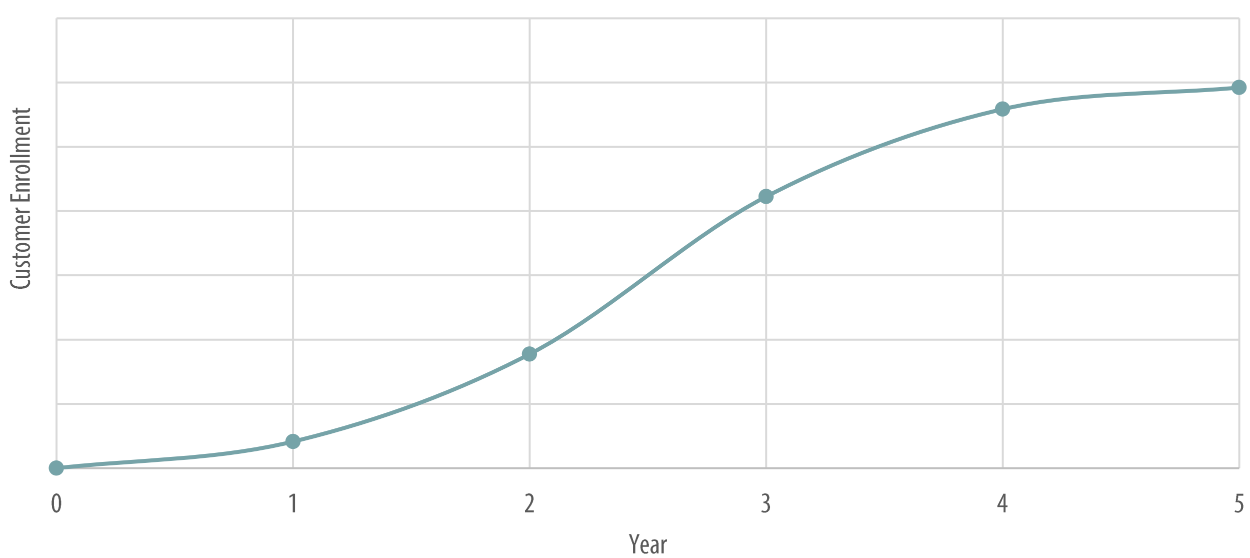
TABLE G-5 STEADY STATE PARTICIPATION RATES FOR DEMAND RESPONSE PROGRAM OPTIONS

DR Program Options	MAP Steady State Participation Rate	RAP Steady State Participation Rate	Source
RESIDENTIAL			
DLC AC (Switch)	0% *(existing program declining to 0 participants)*	0% *(existing program declining to 0 participants)*	IPL
DLC AC (Thermostat)	36%	25%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Space Heating	20%	15%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Water Heaters	36%	23%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Room AC	31%	20%	GDS Survey of 20 utilities (75th percentile for MAP and 50th percentile for RAP).
DLC Electric Vehicle Charging	94%	57%	MAP: Used TOU with enabling technology take rate as most electric cars are equipped with a built-in technology that allows the vehicle to charge at specific times. (Opt-Out); RAP: Plug-in Electric Vehicle and Infrastructure Analysis September 2015, Prepared for the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy by Idaho National Lab. (Opt-In)
NON-RESIDENTIAL			
DLC AC (Switch)	0% *(existing program declining to 0 participants)*	0% *(existing program declining to 0 participants)*	IPL
DLC AC (Thermostat)	19%	8%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.

DR Program Options	MAP Steady State Participation Rate	RAP Steady State Participation Rate	Source
DLC Space Heating	14%	3%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Water Heaters	16%	7%	FERC 2012 DR Survey Data (75th percentile for MAP, 50th percentile for RAP)
Ice Storage Cooling Rate	0.81	0.16	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Lighting	14%	3%	Used Direct Load - Air Conditioning take rate from PGE Brattle Group Study. FERC 2012 DR survey data contained only one program targeting lighting with a take rate of .6%. A general search for such programs by GDS also produced no useful results.

Customer participation in new demand response programs is assumed to reach the steady state take rate over a five-year period. The path to steady state customer participation follows an "S-shaped" curve, in which participation growth accelerates over the first half of the five-year period, and then slows over the second half of the period (see Figure G-1). Existing programs have already gone through this ramp-up period, so they were escalated linearly to the final participation rate.

FIGURE G-1 ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE



G.5 LOAD REDUCTION ASSUMPTIONS

Table G-6 presents the residential and non-residential per participant CP demand reduction impact assumptions for each demand response program option at the customer meter. Demand reductions were based on load reductions found in IPL's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies.

TABLE G-6 PER PARTICIPANT CP DEMAND REDUCTION ASSUMPTIONS

DR Program Options	Per Participant CP Demand Reduction	Source
RESIDENTIAL		
DLC AC (Switch)	0.78 for one way Cannon switch, 0.58 kW for two way L+G switch	IPL
DLC AC (Thermostat)	0.7 kW	IPL
DLC Space Heating	1 kW	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Water Heaters	0.4 kW Summer, 0.8 kW Winter	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Room AC	0.04 kW	Cost-effectiveness of CECONY Demand Response Programs , 2013
DLC Electric Vehicle Charging	0.28 kW	Xcel Energy pilot program on EV control
NON-RESIDENTIAL		
DLC AC (Switch)	0.31 kW	IPL
DLC AC (Thermostat)	0.2759	Used ratio of switch to thermostat for residential and applied to C&I switch reduction
DLC Space Heating	1.5 kW	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
DLC Water Heaters	0.6 kW Summer, 1.2 kW Winter	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Ice Storage Cooling Rate	19.4 kW	MISO DR, EE, DG Potential Study: Supplemental Program Slides. Value for Local Resource Zone 5

DR Program Options	Per Participant CP Demand Reduction	Source
DLC Lighting	8.94% of coincident peak load	Business Energy Advisor/E Source, Strategies for C&I Demand Response; LIGHTING CALIFORNIA'S FUTURE: COST-EFFECTIVE DEMAND RESPONSE, Prepared For: California Energy Commission By: NEV Electronics, LLC, California Lighting Technology Center, 2011; Lighting Controls Association, Lighting Control and Demand Response, By Craig DiLouie, on May 20, 2014; Demonstration and Evaluation of lighting technologies and Applications, Lighting Research Center, Field Test Issue 6, 2011; What is the relation between energy consumption savings and peak load savings and how can this affect future energy conservation requirements? - Study conducted by the City of Toronto.

G.6 PROGRAM COSTS

One-time program development costs of $400,000[8] were included in the first year of the analysis for new programs. This cost was split between similar programs that would be comparable to start up. No program development costs are assumed for programs that already exist. It was assumed that there would be a cost of $50[9] per new participant for marketing. Marketing costs are assumed to be 33.3% higher for MAP. There was assumed to be an annual administrative cost of $30,000 per program. All program costs were escalated each year by the general rate of inflation assumed for this study. Table G-7 shows the equipment cost assumptions.

TABLE G-7 EQUIPMENT COST ASSUMPTIONS

Device	Cost	Applicable DR Programs	Source
One-way communicating load control switch	$70 equipment + $150 for installation	DLC programs controlled by switches	Comverge
Two-way communicating load control switch using Wi-Fi	$95 + $150 for installation	DLC programs controlled by switches	Comverge
Smart controllable thermostat (such as Nest or Ecobee)	$150 for thermostat + $150 installation	DLC AC Thermostat (Free thermostat option)	IPL
Smart controllable thermostat (such as Nest or Ecobee)	$50 one time incentive to join program + $50 rebate if buying through the program ($0 rebate if joining with existing thermostat)	DLC AC Thermostat (BYOT option)	IPL

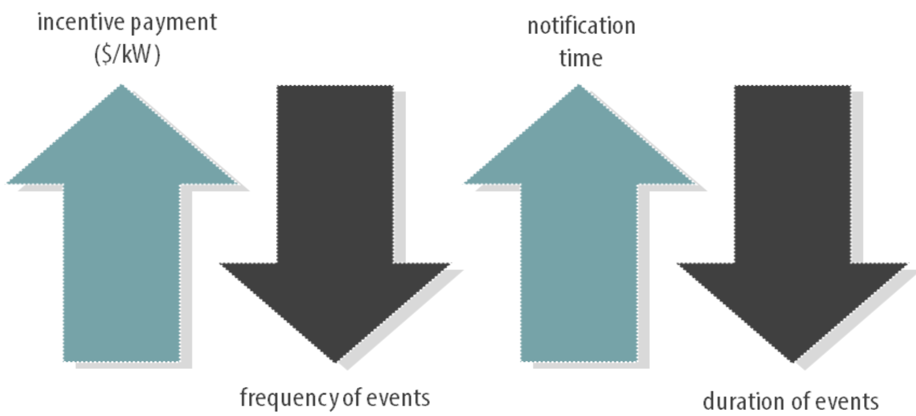
[8] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011
[9] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011

G.7 LOAD CURTAILMENT PROGRAM

G.7.1 Modeling Demand Response Potential

One of the most prominent forms of demand response among non-residential customers is load curtailment agreements where the utility, or an aggregator on the utility's behalf, enters financial agreements with businesses to reduce load when dispatched. Load curtailment potential is driven by a few key factors – incentive payments, the frequency of events, the duration of events, and the level of notification participants are given about pending events. The directional effect these factors have on DR potential is shown in Figure G-2.

FIGURE G-2 DRIVERS OF DR POTENTIAL



Several different estimates of DR potential can be produced by turning levers related to these four inputs. Rather than producing several different scenario-based estimates, the research team made several simplifying assumptions regarding program design. Components of program design include how many DR events will be called, how long the DR events will last, how far in advance participants are notified of the upcoming DR event, and the incentive payment participants receive (the amount and how it is distributed – annually, monthly, per event, etc.). Table G-8 describes some of the program design inputs/assumptions the research team used in estimating DR potential. Other relevant inputs – such as the peak load forecast and avoided costs – are described in the table as well.

TABLE G-7 SUMMARY OF INPUT ASSUMPTIONS FOR LOAD CURTAILMENT MODELING

Input Variable	Sources, Notes, and Assumptions
Peak Load Forecast	The peak load forecast used in developing potential estimates was provided by IPL. The forecast, created in October of 2017, runs through 2027. For the remaining years in the study horizon, the peak forecast was escalated by a rate identical to the observed escalation rate (from 2018-2027) in IPL's peak forecast.
	The summer peak load forecast was disaggregated into peak load forecasts by sector using peak load shares provided by IPL. Load curtailment potential was examined separately for the Small C&I and Large C&I classes and customers who opt out of energy efficiency were not excluded from the eligible peak load.
Avoided Cost of Generation Capacity ($/kW-year)	Avoided costs of generation capacity were provided by IPL.

Input Variable	Sources, Notes, and Assumptions
Avoided Transmission and Distribution Capacity ($/kW-year)	We assumed a starting point of $10/kW-year for each transmission and distribution ($20/kW-year T&D total) in 2020. These values were escalated by 2% annually.
Program Design (# of events, event duration, notification level)	Previous Indiana research suggests relatively short DR events would serve the region better than relatively long events, as summer peaks are concentrated between 2:00 PM and 6:00 PM.[10] Thus, our estimates of potential assume a four-hour event duration. We're also assuming that there will be an average of seven summer events will be called (28 total event hours for the summer).
	Results were calculated for both a "day-ahead" notification design and a "day-of" notification design. "Day-ahead" notification assumes a ~24-hour notice, and "day-of" notification assumes a 3-to-6-hour notice. Potential is higher under the "day-ahead" notification design, as this provides participants greater opportunities to shift energy-intensive tasks to off-peak periods.
Participant Incentive	For C&I DR, our team modeled the incentive as a reservation payment. This is an annual payment provided to the participant. In exchange, the participant agrees to curtail load when events are dispatched. For realistic achievable potential, our approach to setting incentive levels involved optimizing net benefits. To determine the optimal incentive level, the research team performed a simulation where the critical input was the incentive level and the critical output was the net benefit of the DR program. The simulation leveraged several of the inputs discussed herein. The results indicated that the optimal incentive level in 2020 is $21/kW-year.
	For maximum achievable potential, the goal of the simulation was not to optimize net benefits. Instead, we used the simulation to determine the greatest possible incentive level that would produce a cost-effective program (e.g, largest incentive value such that the Utility Cost Test ratio does not fall below 1). The results indicated an incentive level of $39/kW-year should be used in estimating maximum achievable potential for summer 2020.
	In both cases, the incentive level is escalated annually at a rate that matches the growth rate of avoided costs. This growth rate is largely driven by the generation component (avoided cost of generation capacity was provided by IPL).
Price Elasticity of Demand Coefficients	The price elasticity of demand coefficients used in this research were derived from two years of DR performance data for C&I DR participants in Pennsylvania. Information about sector (small/large), incentive levels, and the peak load share of each participant was used in the development of the elasticity coefficients. Traditional elasticity formulas were used.

Leveraging the inputs discussed above, our team developed potential estimates via a "top-down" approach. At a high level, the approach entails disaggregating the peak load forecast into peak load forecasts by sector, and then combining these forecasts with the price elasticity of demand coefficients to estimate potential. Price elasticity of demand can be thought of as the percentage change in the

[10] Potential for Peak Demand Reduction in Indiana. Prepared for Indiana AEE by Demand Side Analytics, 2018.

quantity of electricity demanded divided by the percentage change in the price (including an incentive) of DR:

$$Elasticity = \frac{\%\ change\ in\ Quantity}{\%\ change\ in\ Price}$$

Rearranging the terms in the elasticity equation yields the following:

$$\%\ change\ in\ Quantity = (Elasticity)\ \times\ (\%\ change\ in\ Price)$$

Note that "% change in Quantity" can also be expressed as:

$$\%\ change\ in\ Quantity = \frac{(Summer\ peak -\ DR\ potential) - Summer\ Peak}{Summer\ Peak} * 100\%$$

Combing these two "% change in Quantity" equations yields:

$$(Elasticity)\ \times\ (\%\ change\ in\ Price) = \frac{(Summer\ peak -\ DR\ potential) - Summer\ Peak}{Summer\ Peak} * 100\%$$

By making assumptions about price elasticity, the percentage change in price (related to electric retail rates and the incentive level), and the summer peak load, it is possible to estimate how much DR potential exists in each market segment by solving for "DR potential". It is important to note that the estimates of C&I DR potential discussed in this section are not incremental to existing IPL C&I DR programs. That is, we are not estimating how much DR potential exists beyond the existing IPL C&I DR resources. It is also important to note that this top-down methodology produces estimates of DR potential at the system-level (inclusive of line losses).

APPENDIX H. 2020 DSM Plan Refresh

In addition to completing the IPL Market Potential Study for the 2021-2039 planning period, the GDS team also completed an updated analysis for IPL's 2020 DSM plan (the "2020 Refresh"). 2020 is the 3rd and final year of the 3-year DSM plan approved in Cause No. 44945. In the Settlement Agreement (approved in Cause No. 44945), IPL agreed to work with the stakeholders to try to identify additional cost-effective energy savings in 2020. GDS, with review and input from IPL's stakeholders, completed an analysis to compare the 2020 "refresh" potential with the current approved plan. Among other factors considered, the analysis sought to determine if any recent changes to existing codes and standards have reduced the expected savings potential in 2020, or whether new technologies have entered the market that could cost effectively result in additional savings opportunities.[1]

The potential 2020 energy savings, as identified by GDS, for the residential and business customers are in the two sections below. These savings estimates are projections and do not take into consideration market barriers and program delivery constraints. As prescribed in the IPL Settlement Agreement, IPL and the other members of the IPL Oversight Board conducted a technical workshop on May 2nd with the implementation vendor CLEAResult; the EM&V consultant Cadmus and the MPS consultant GDS to review the 2020 MPS modeling results and determine program modifications that should be considered for the 2020 DSM Portfolio.

The modeling results, shown in Table 1 and Table 2below, served as the starting point for this collaborative exercise. Prior to the technical workshop, IPL requested that CLEAResult review the savings estimates developed by GDS to determine, based on their extensive experience in program delivery, which opportunities had promise and might be reasonable to pursue. Cadmus also reviewed the modeling results and provided their input from an EM&V perspective.

At the workshop, the IPL OSB members reviewed and discussed the findings by Cadmus and CLEAResult. Some DSM program additions suggested by GDS were considered impractical in the market at this time. Other program suggestions will be given additional consideration.

The next step in the 2020 Refresh process is for IPL to work with the implementation vendor CLEAResult to determine the cost to deliver the program modifications that were recommended in the refresh and discussed during the technical workshop. Once cost effectiveness is determined, the cost effective program modifications will then be compiled into a proposed 2020 Portfolio summary for review and approval by the IPL OSB. The proposed 2020 Portfolio summary should be complete by early Q4.

[1] GDS planning assumptions are current and are consistent with either the IN TRM or recent EM&V results. Thus, measure level savings may vary from those used to develop IPL's 2019 Portfolio summary or in plan development for IPL's filing in Cause No. 44945.

As previously indicated, these savings estimates are projections and do not take into consideration market barriers and program delivery constraints. As agreed to in the Settlement Agreement in Cause No. 44945, IPL will rely on input from CLEAResult and Cadmus to determine which revisions are practical and achievable in the market and to finalize the plan for 2020. Ultimately, any changes to the 2020 DSM Portfolio will require approval of the IPL OSB.

2020 Residential Energy Savings Potential

Residential results were developed using the GDS Market Potential Study models, and historical IPL program net-to-gross ("NTG") ratios. The NTG ratios were applied to the gross savings at the measure level. Table H-1 shows projected 2020 Gross and Net savings potential for each residential IPL program, as well as program budgets and cost per net kWh saved. Estimated residential gross energy savings in 2020 are 107,854 MWh, while total 2020 net savings are projected to be 88,710 MWh. Net peak demand savings are projected to be 15.1 MW. The total estimated 2020 residential sector program budget is nearly $22.2 million, which yields an average acquisition cost of $0.222 per kWh of projected savings. The Peer Comparison Reports program yields the greatest amount of projected net savings in 2020 at the lowest acquisition cost on a first-year basis. The Lighting & Appliances program provides the second highest projection of net savings at the second lowest acquisition cost on a first-year basis. The Whole Home program has the third greatest amount of projected net savings, but at an estimated first-year acquisition cost higher than all other programs except the Income Qualified Weatherization program. Though the budget and savings for the IQW program are higher than the 2019 planning estimates, the 2020 projections were calibrated to consider the 2019 estimates.

TABLE H-1 RESIDENTIAL 2020 ENERGY SAVINGS POTENTIAL

	Gross MWh	Net MWh	Net MW	Budget	$/Net kWh
Residential Program					
Lighting & Appliances	36,494	21,632	2.41	$4,347,002	$0.201
Not Currently Offered	2,651	2,651	0.93	$933,648	$0.352
Emerging Technology	2,111	2,111	0.46	$765,436	$0.363
Income Qualified Weatherization	2,830	2,830	0.51	$2,426,981	$0.858
Appliance Recycling	3,494	2,458	0.43	$739,223	$0.301
Whole Home	15,214	11,968	3.57	$8,409,143	$0.703
Peer Comparison Reports	35,069	35,069	5.57	$1,499,575	$0.043
School Kits	4,239	4,239	0.69	$1,006,168	$0.237
Multifamily Direct Install	4,890	4,890	0.55	$1,842,039	$0.377
Online Kits	863	863	0.00	$194,782	$0.226
Total	**107,854**	**88,710**	**15.10**	**$22,163,997**	**$0.250**

2020 Commercial & Industrial Energy Savings Potential

Commercial and Industrial results were developed using the GDS Market Potential Study models, and historical IPL program NTG ratios were applied to the gross savings at the measure level, based on whether measures were described as Prescriptive, Custom, Emerging technologies, or Small Business Direct Install.

Table H-2 shows projected 2020 Gross and Net savings potential by IPL C&I program, as well as program budgets and cost per net kWh saved. The total C&I 2020 gross savings potential is projected to be 97,915 MWh, while total 2020 net savings potential is projected to be 74,776 MWh. Net peak demand savings are projected to be nearly 13.4 MW. The total 2020 C&I budget is projected to be nearly $11.9 million, resulting in an average first-year cost per net KWh saved of $0.159 per kWh. The Prescriptive program is projected to have net 2020 savings of 51,457 MWh and a budget of just over $7.6 million, the Custom program is projected to have net savings of 17,790 MWh and a budget of just over $2.9 million, the Small Business Direct Install program ("SBDI") is projected to have net savings of 4,171 MWh and a budget of just over $1.0 million, and Emerging Technologies are projected to have 2020 net savings of 1,357 MWh and an associated budget of nearly $178,000.

TABLE H-2 – COMMERCIAL & INDUSTRIAL 2020 ENERGY SAVINGS POTENTIAL

	Gross MWh	Net MWh	Net MW	Budget	$/Net kWh
C&I Program					
Prescriptive	71,088	51,457	9.36	$7,665,863	$0.149
Custom	21,078	17,790	3.13	$2,943,701	$0.165
SBDI	4,391	4,171	0.63	$1,077,131	$0.258
Emerging	1,358	1,357	0.25	$177,609	$0.131
Total	**97,915**	**74,776**	**13.37**	**$11,864,304**	**$0.159**

GDS Associates, Inc.
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DATA DRIVEN RESEARCH AND INSIGHTS

Thorpe Energy Services

prepared for

INDIANAPOLIS POWER & LIGHT COMPANY

2018 Demand Side Management Market Potential Study

August 13, 2019

FINAL REPORT

prepared by

GDS ASSOCIATES INC
DEMAND SIDE ANALYTICS
THORPE ENERGY SERVICES

IPL 2019 IRP

Attachments 5.2 a-c (MPS Appendices B, C & D) are provided electronically

IPL 2019 IRP

Attachment 5.3 (Decrement Load Shapes Summary) is provided electronically

IPL 2019 IRP

Confidential Attachment 5.4 (Avoided Cost) is provided electronically in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 5.5 (IPL 2019 IRP – Capital Costs) is provided electronically in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.1 (Wood Mackenzie H1 2018 No Federal Carbon Case Report) is provided in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.2 (Wood Mackenzie H1 2018 Federal Carbon Case Report) is provided in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.3 (Wood Mackenzie H1 2018 Federal Carbon Case Report - MISO) is provided in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.4 (Wood Mackenzie – H1 2018 Supply, Demand Energy, Federal Carbon Case) is provided electronically in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.5 (Wood Mackenzie – H1 2018 Supply, Demand Energy, No Carbon Case) is provided electronically in the Confidential IRP

IPL 2019 IRP

Confidential Attachment 7.6 (Annual Generator Fuel Prices) is provided electronically in the Confidential IRP

Figure 1 | Annual Energy (TWh) for Reference Case Portfolios 1a – 5a

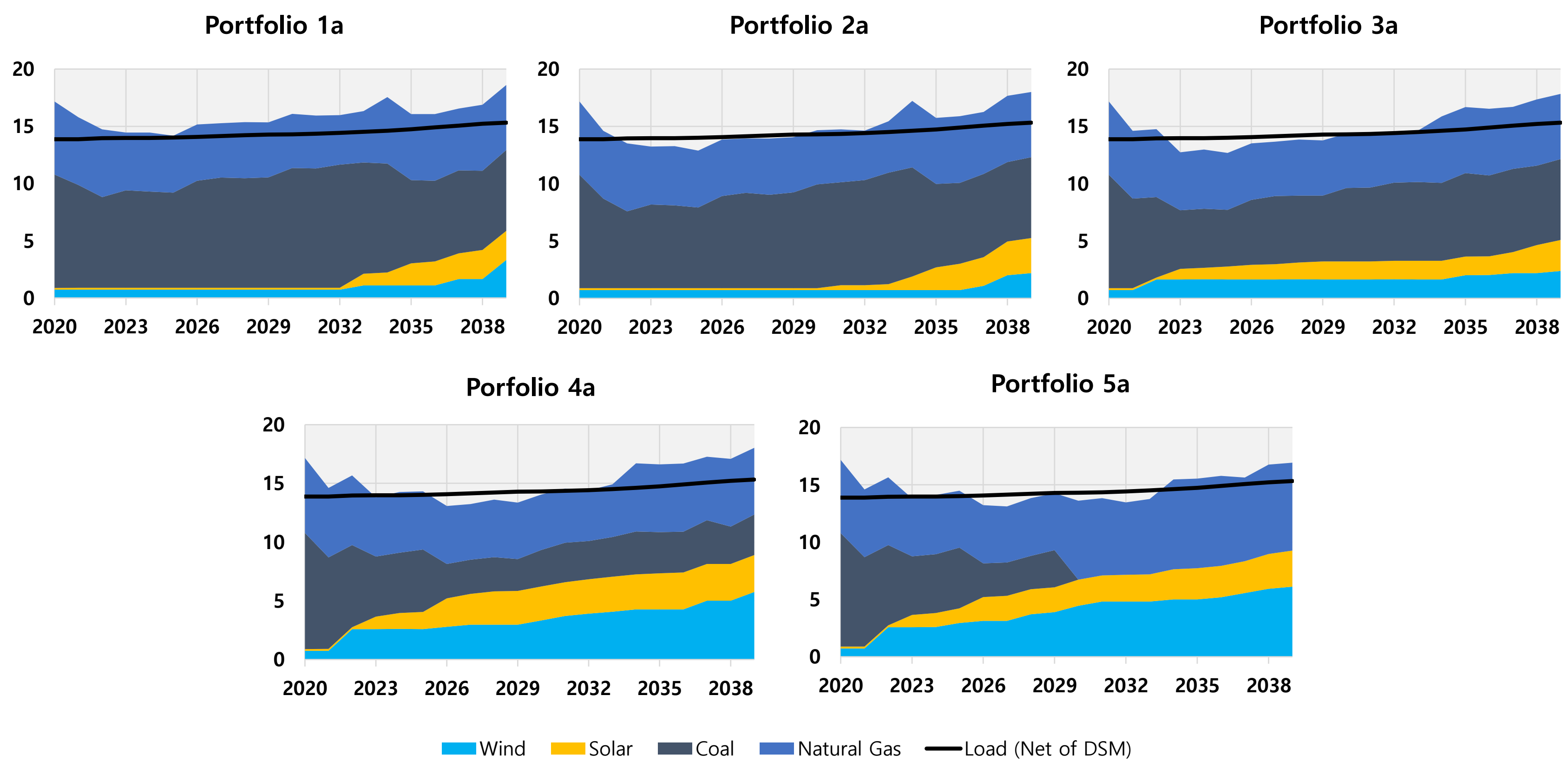


Figure 2 | Annual Energy (TWh) for Scenario A Portfolios 1a – 5a

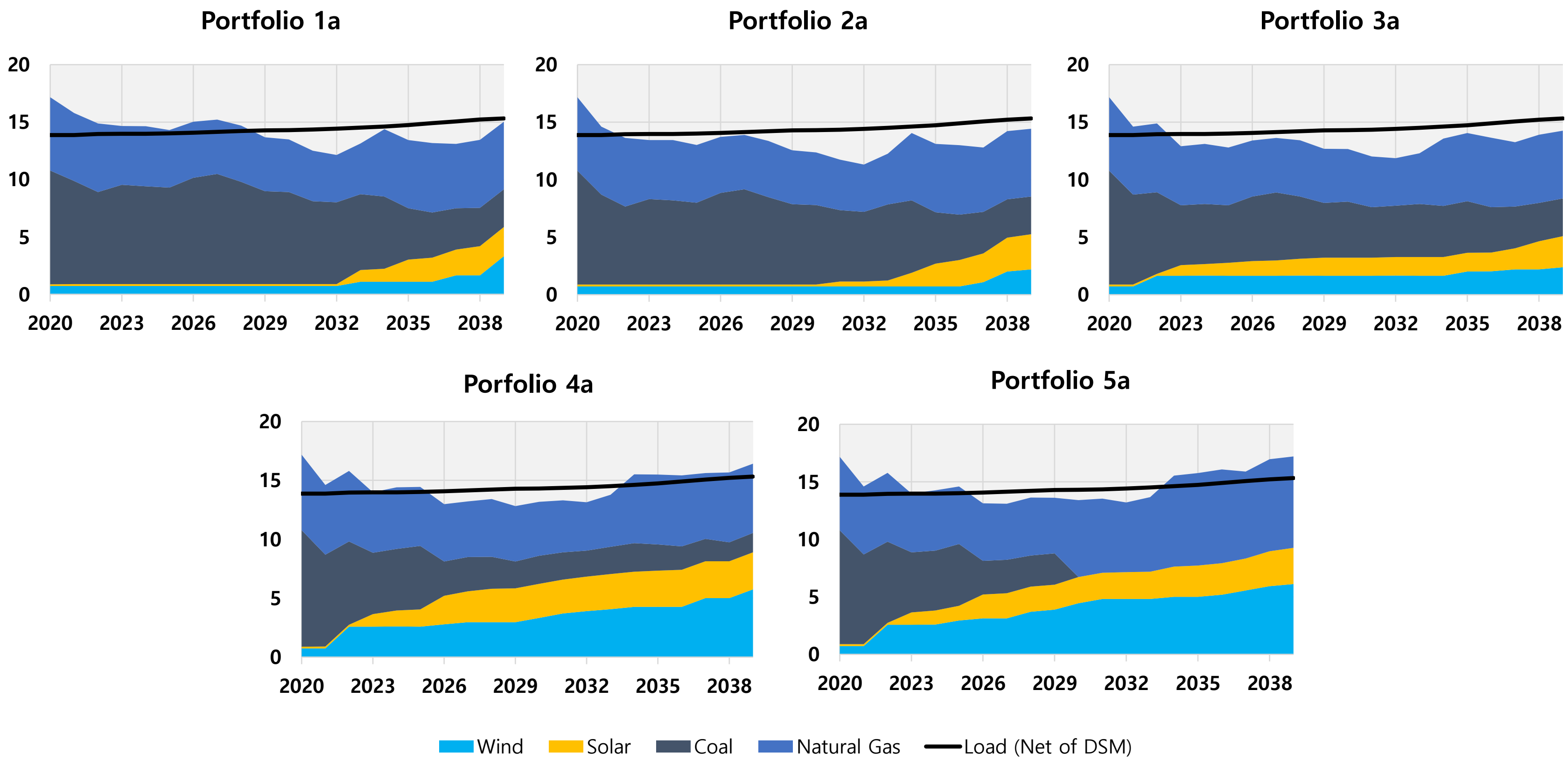


Figure 3 | Annual Energy (TWh) for Scenario B Portfolios 1a – 5a

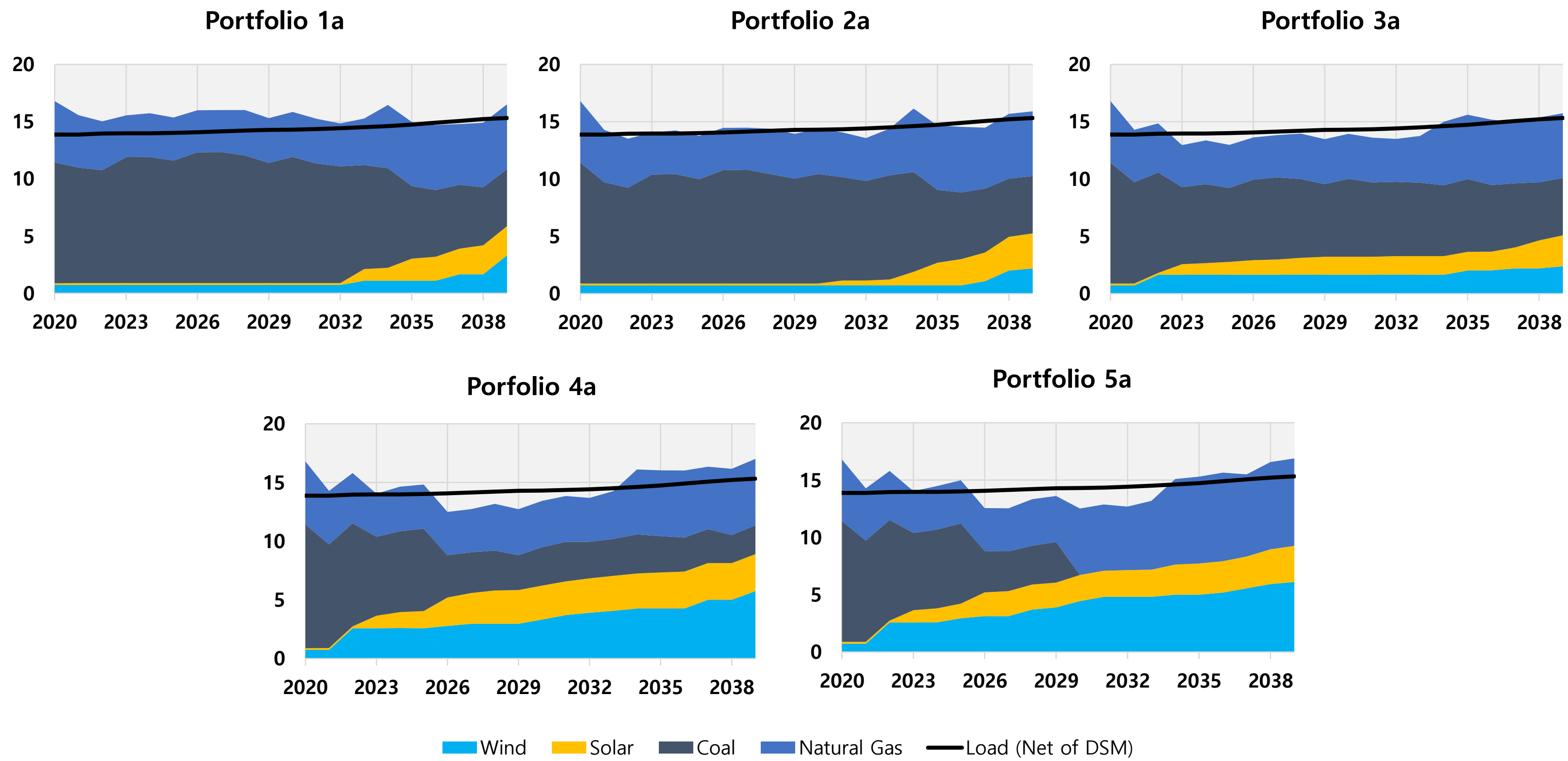


Figure 4 | Annual Energy (TWh) for Scenario C Portfolios 1a – 5a

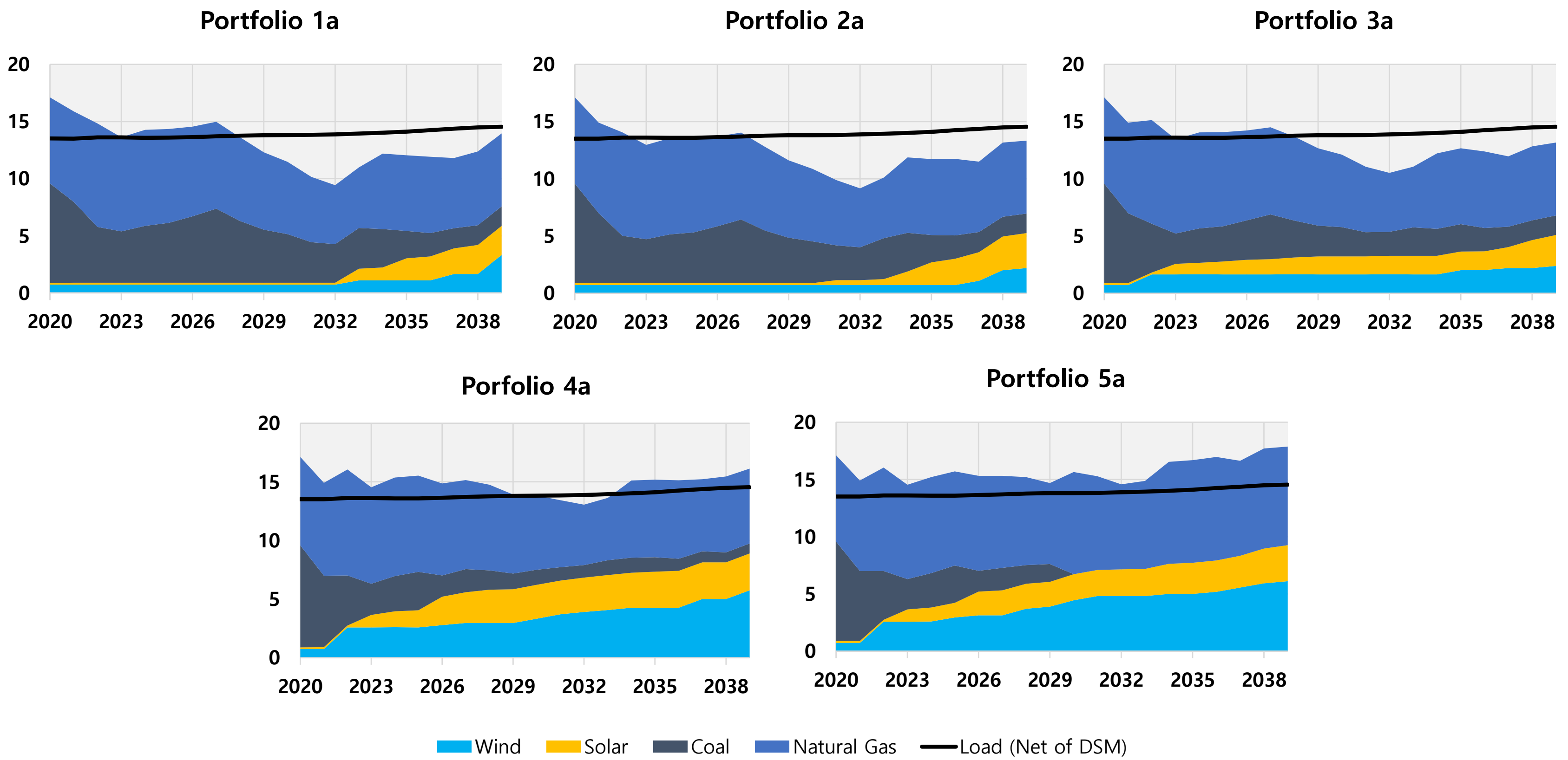


Figure 5 | Annual Energy (TWh) for Scenario D Portfolios 1a – 5a

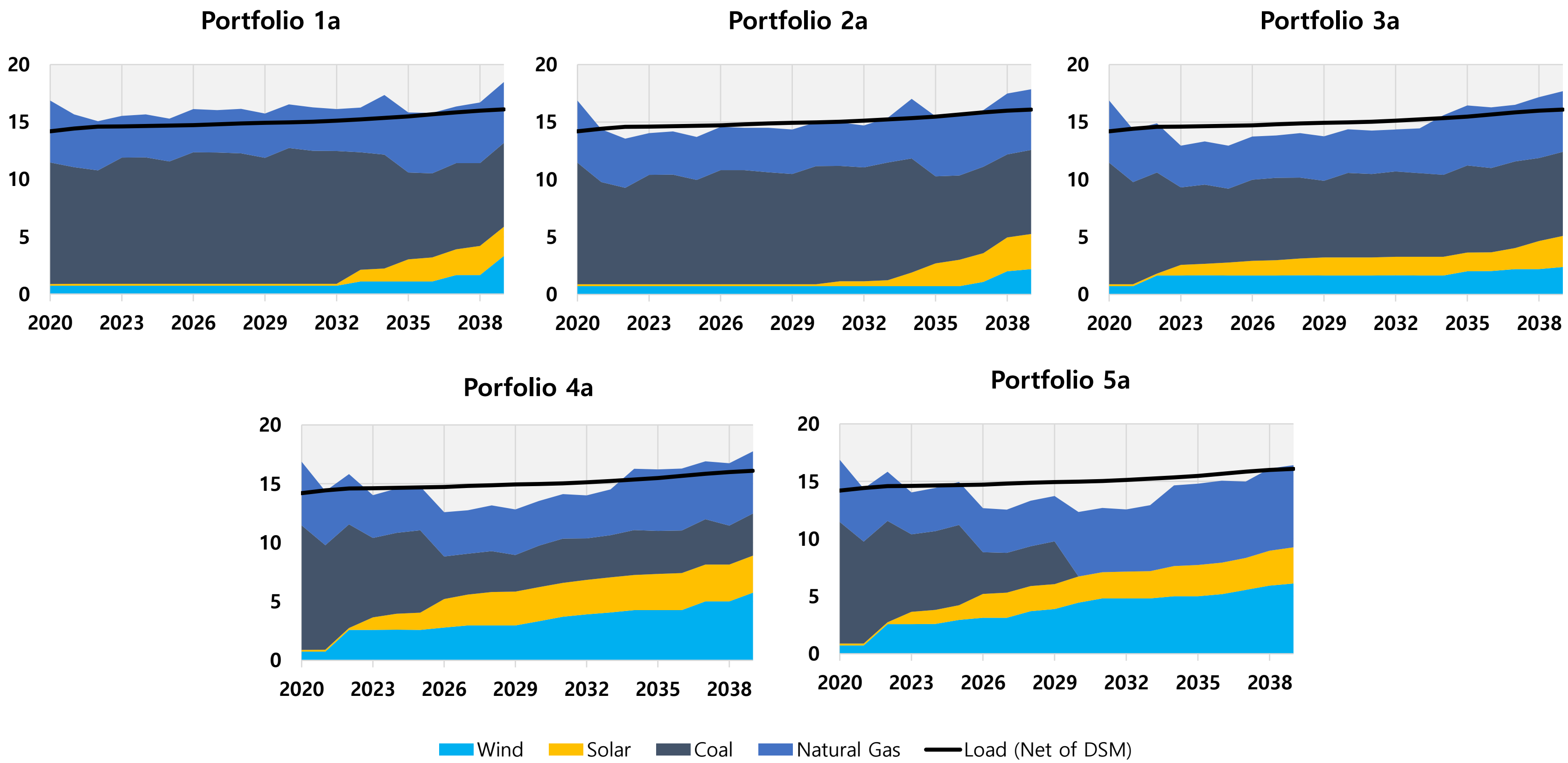


Figure 6 | Annual Energy (TWh) for Reference Case Portfolios 1b – 5b

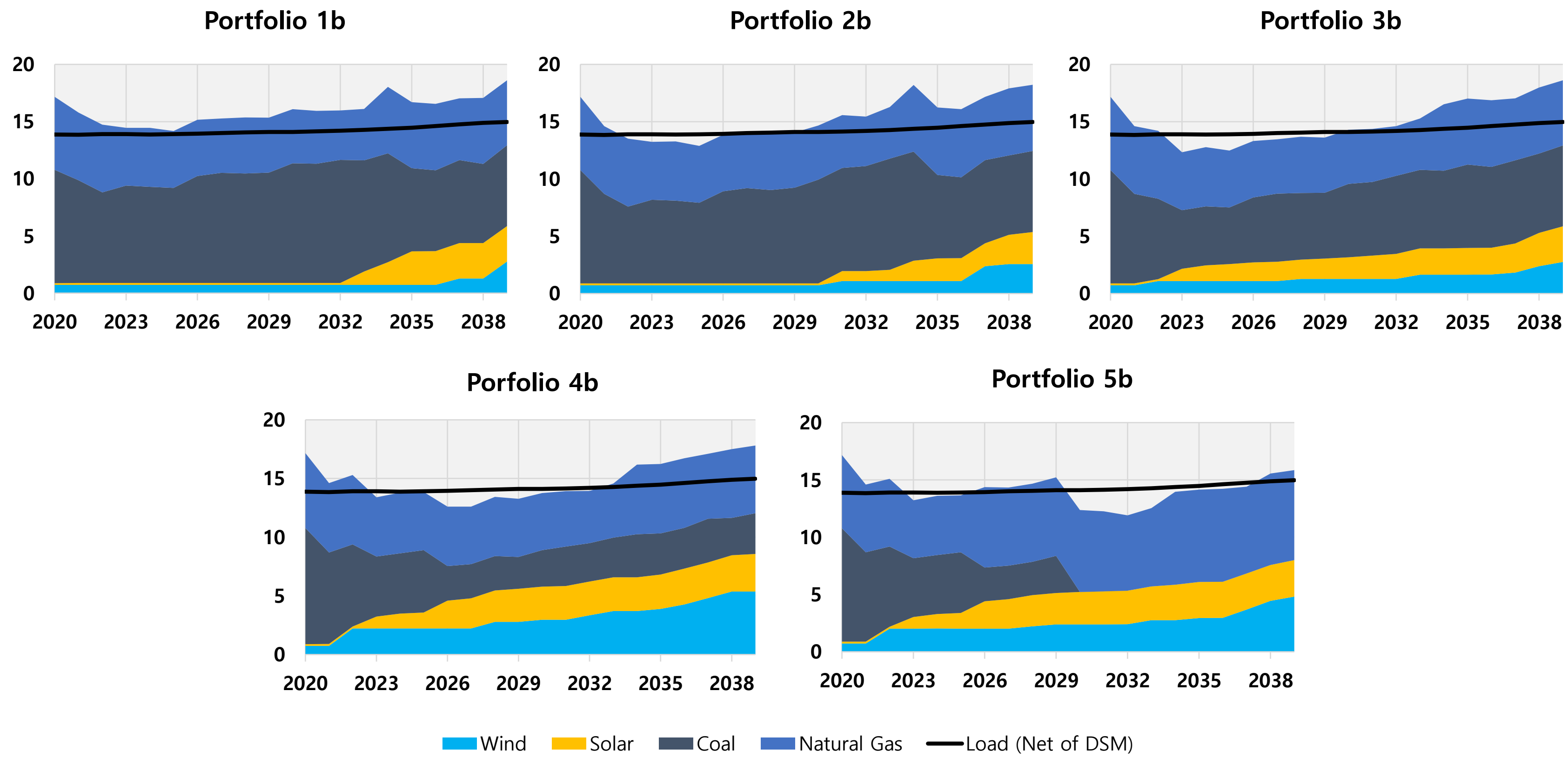


Figure 7 | Annual Energy (TWh) for Scenario A Portfolios 1b – 5b

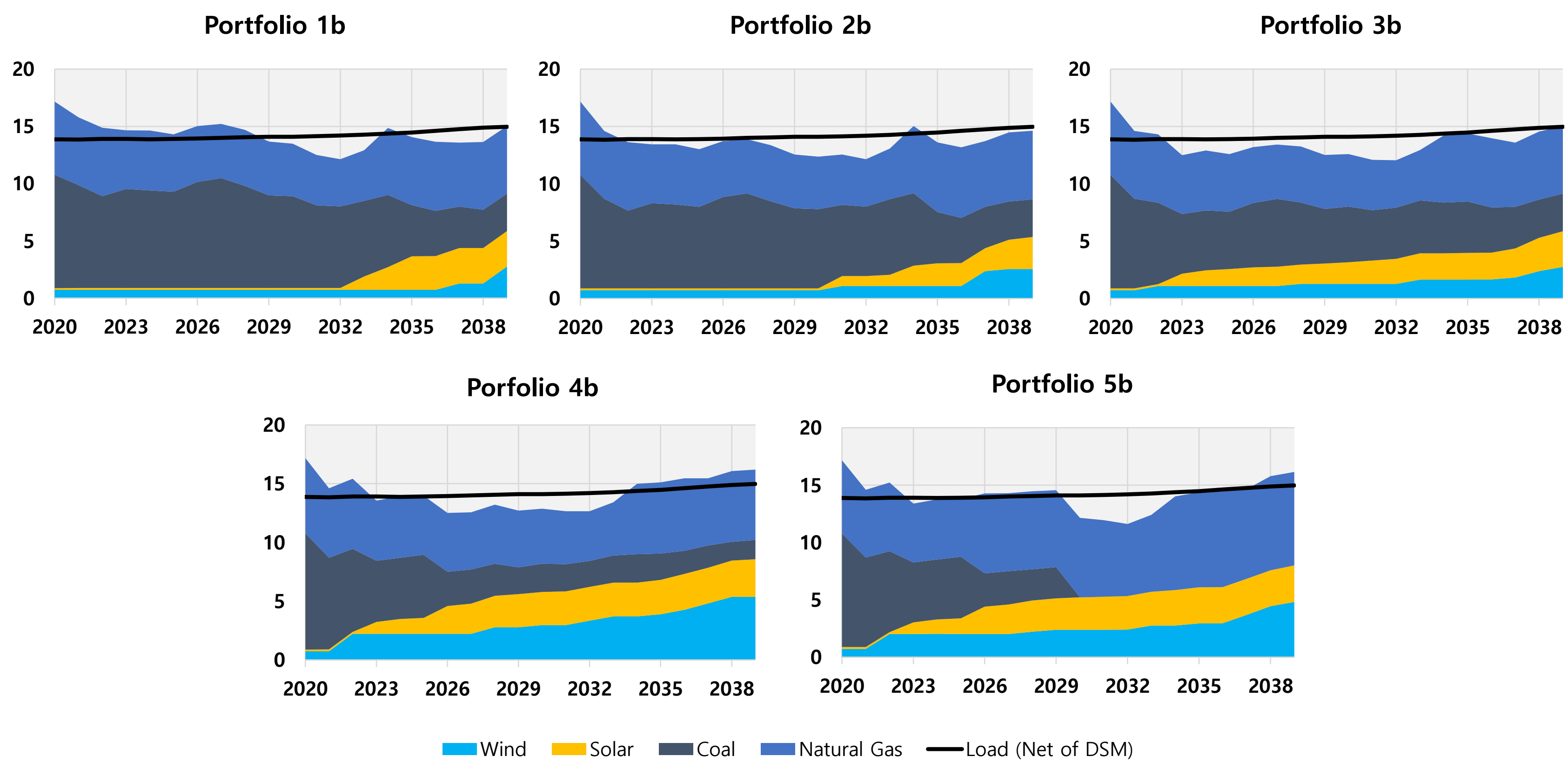


Figure 8 | Annual Energy (TWh) for Scenario B Portfolios 1b – 5b

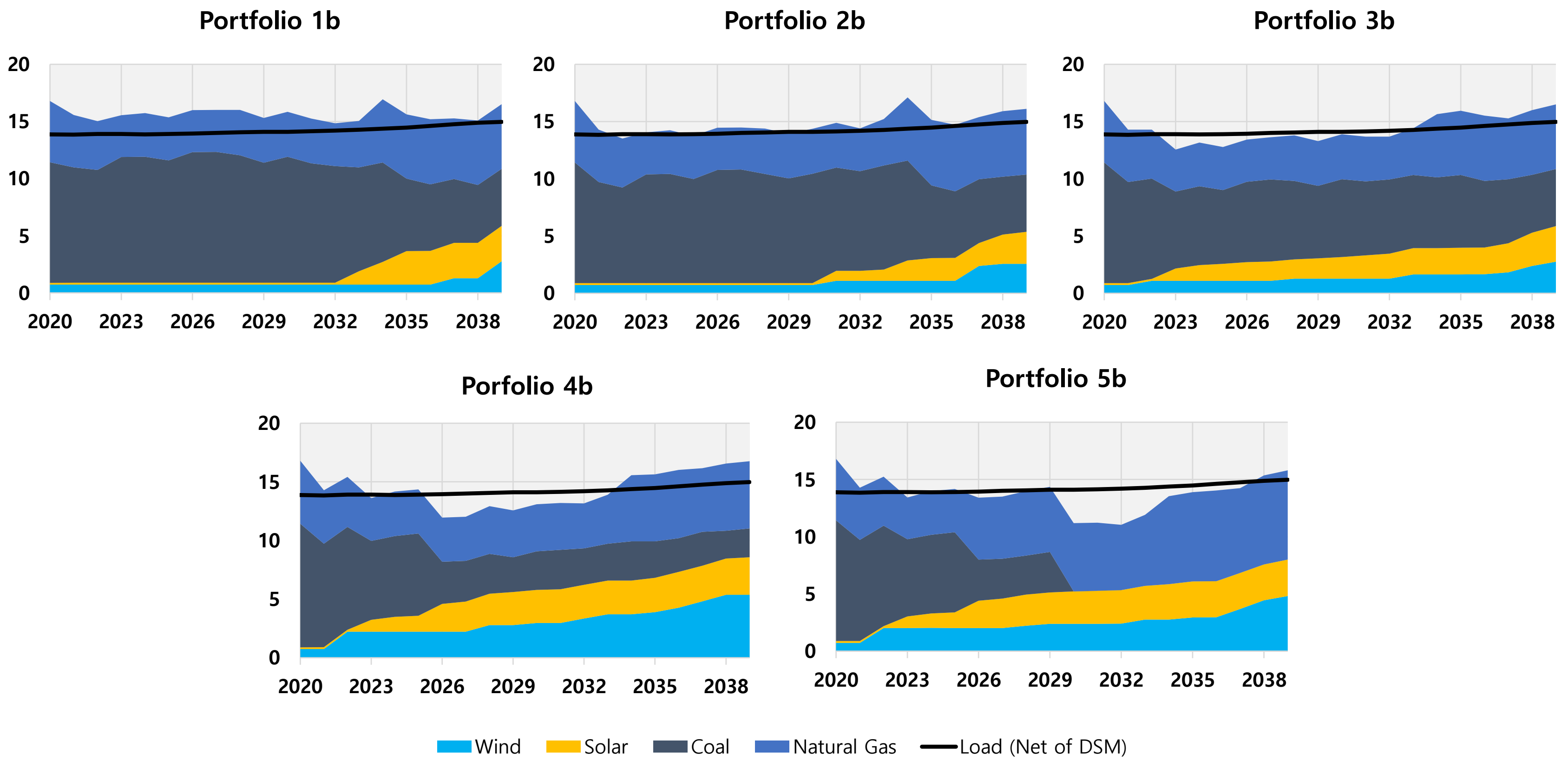


Figure 9 | Annual Energy (TWh) for Scenario C Portfolios 1b – 5b

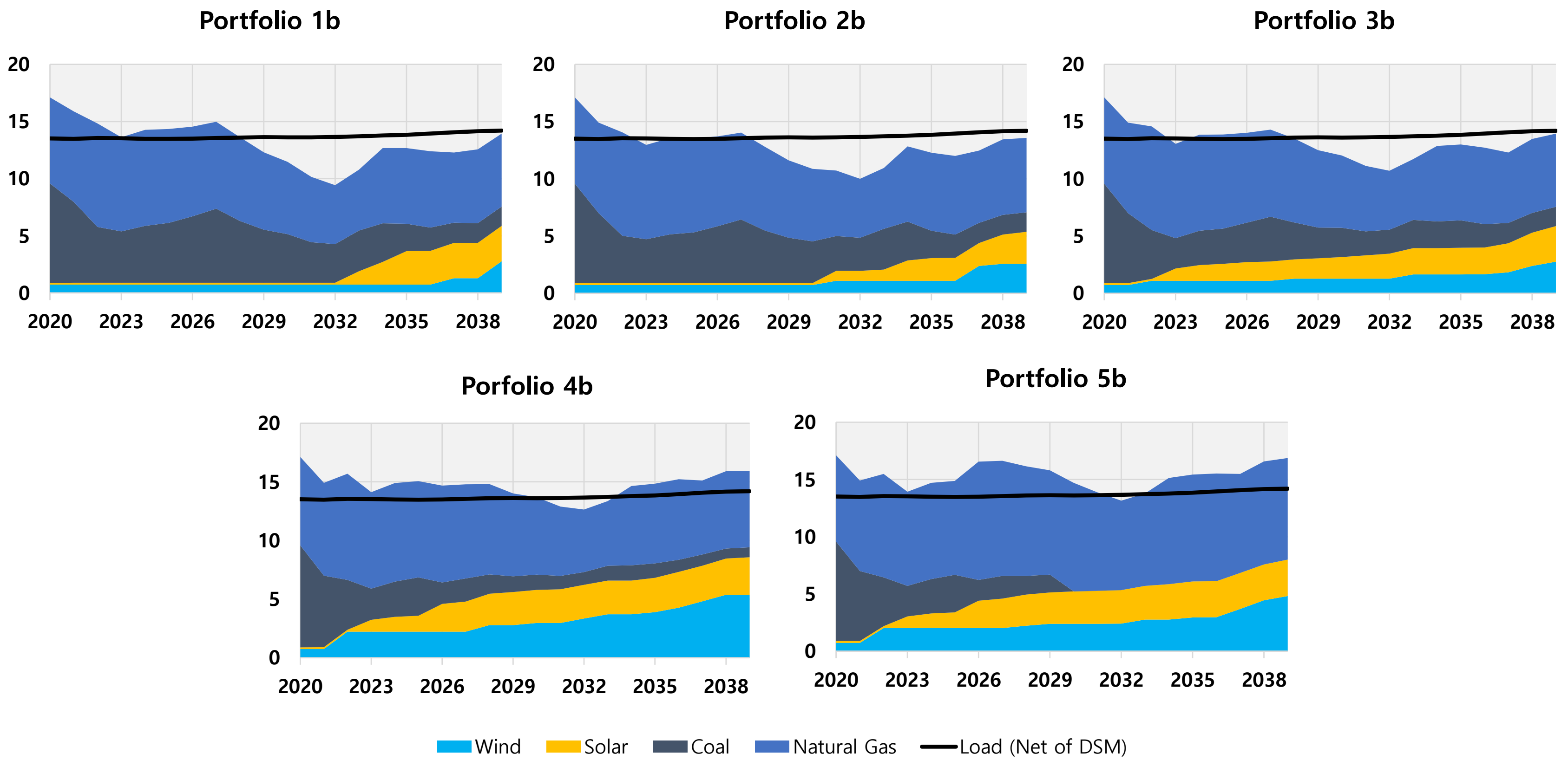


Figure 10 | Annual Energy (TWh) for Scenario D Portfolios 1b – 5b

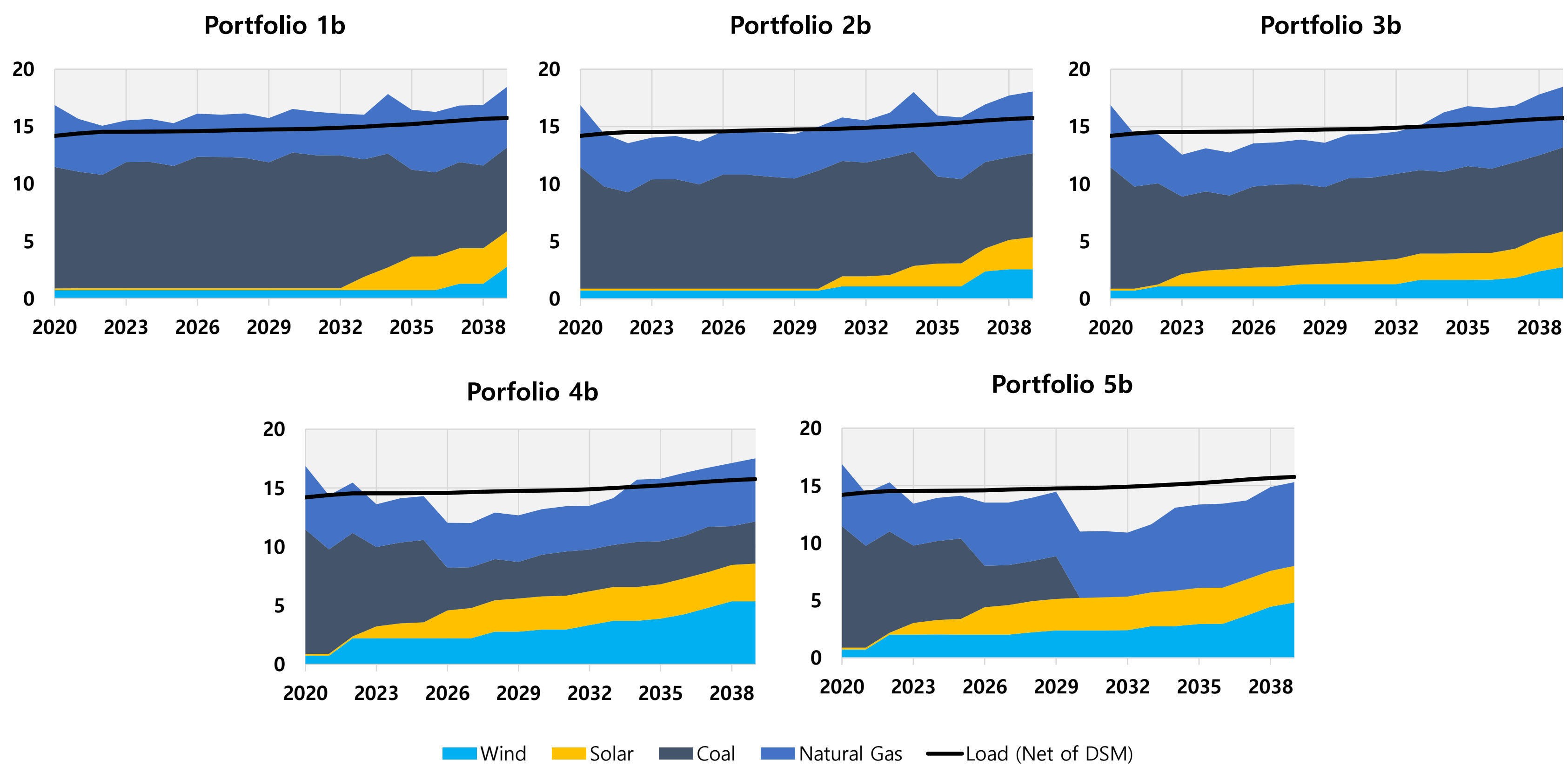


Figure 11 | Annual Energy (TWh) for Reference Case Portfolios 1c – 5c

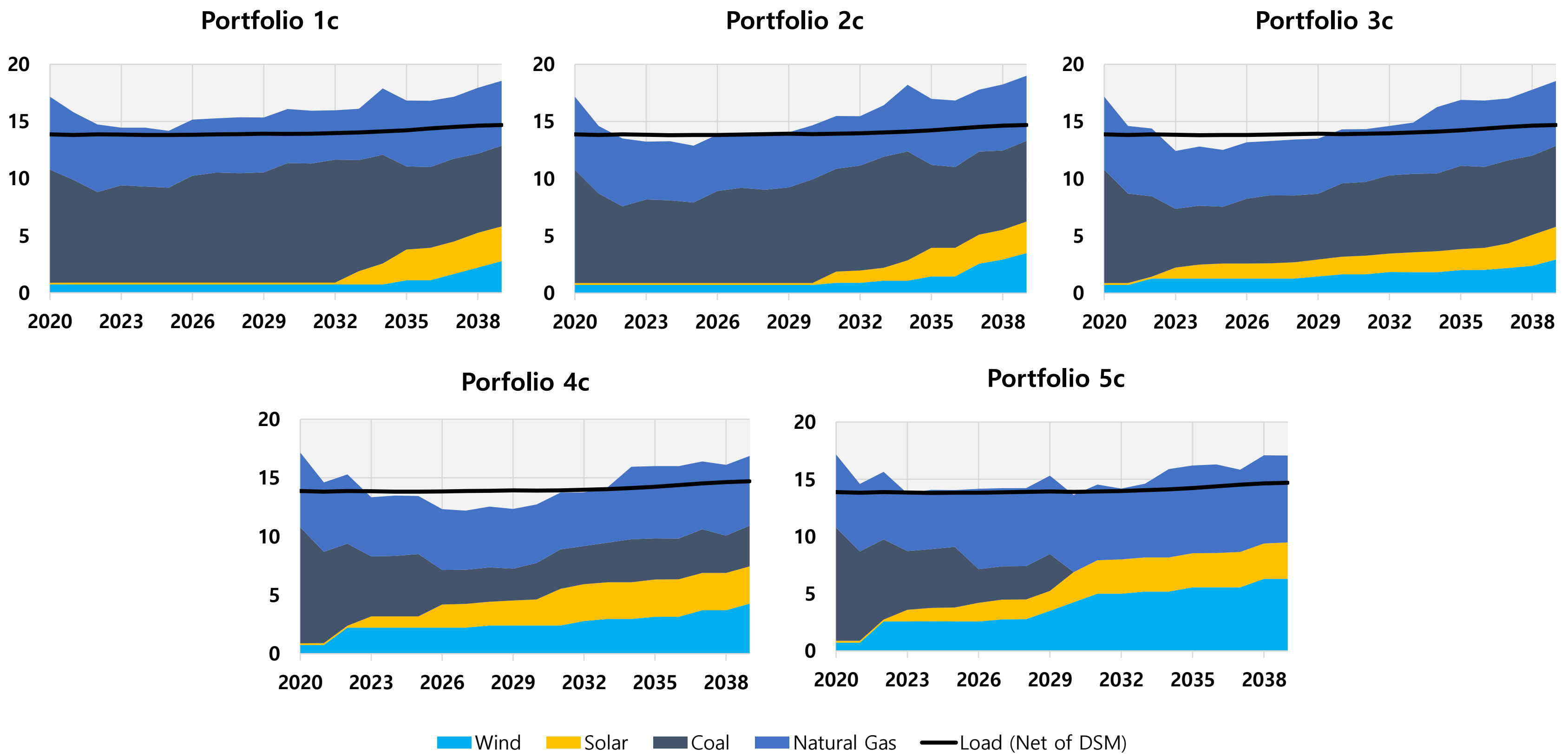


Figure 12 | Annual Energy (TWh) for Scenario A Portfolios 1c – 5c

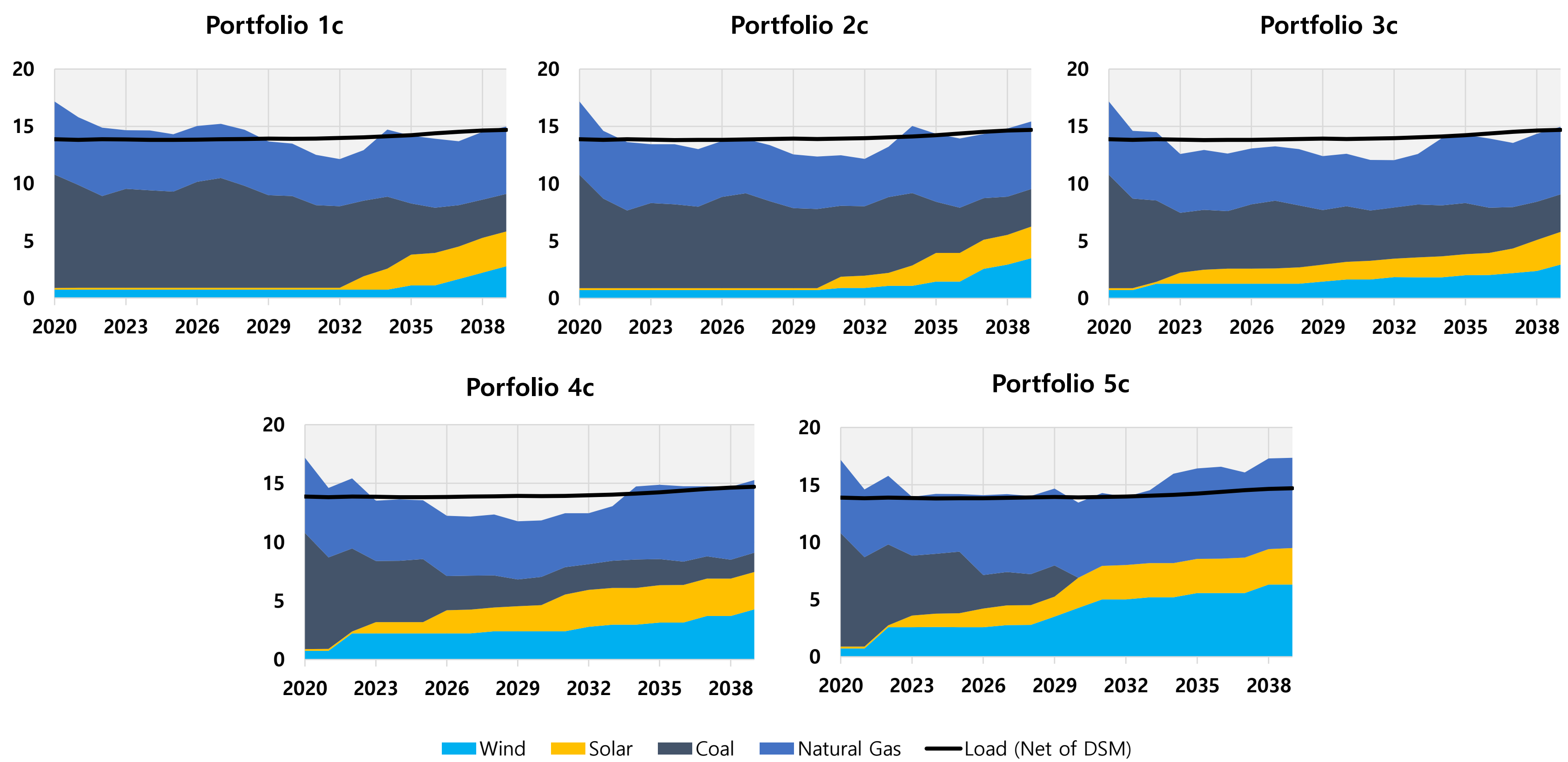


Figure 13 | Annual Energy (TWh) for Scenario B Portfolios 1c – 5c

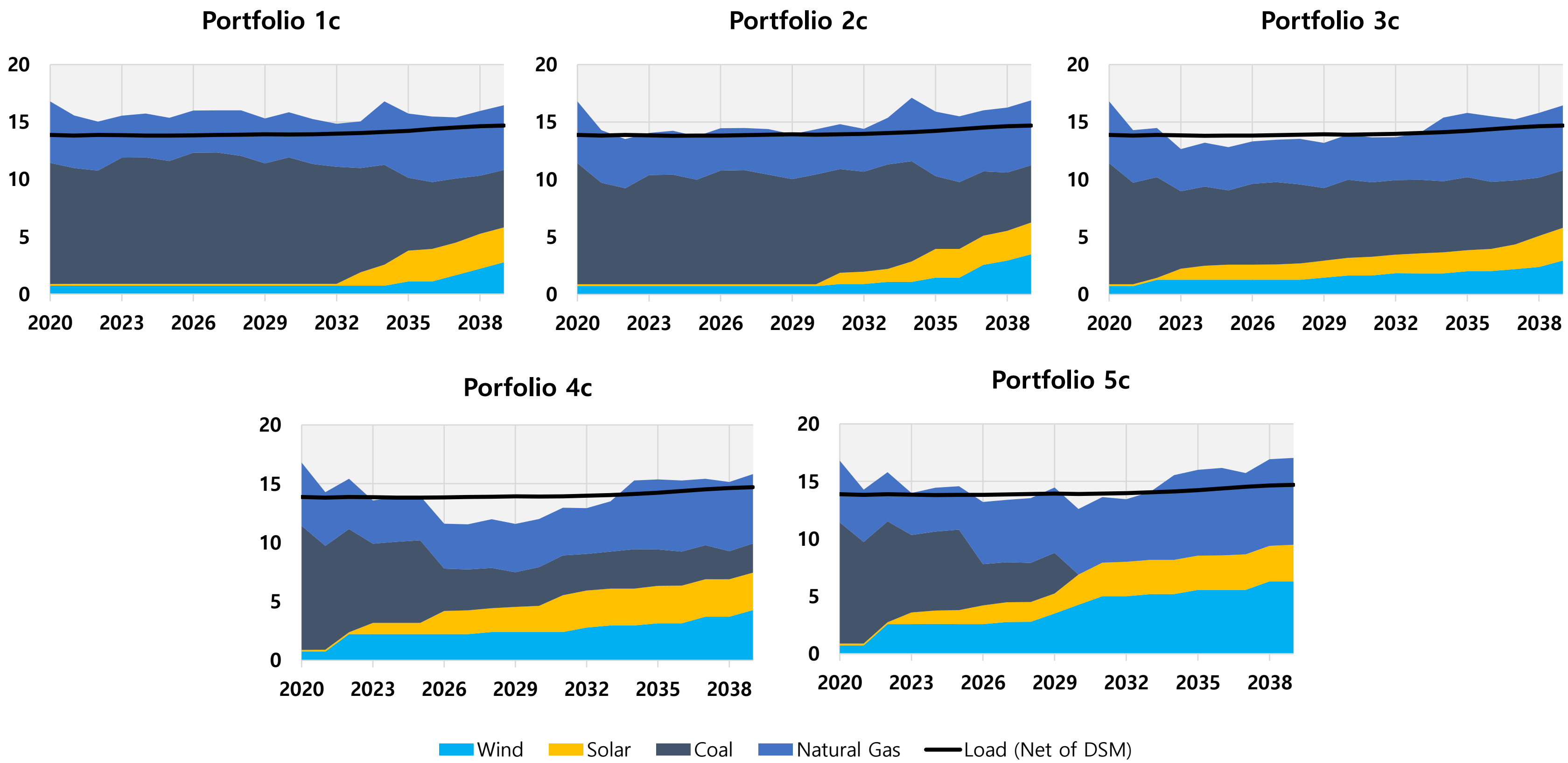


Figure 14 | Annual Energy (TWh) for Scenario C Portfolios 1c – 5c

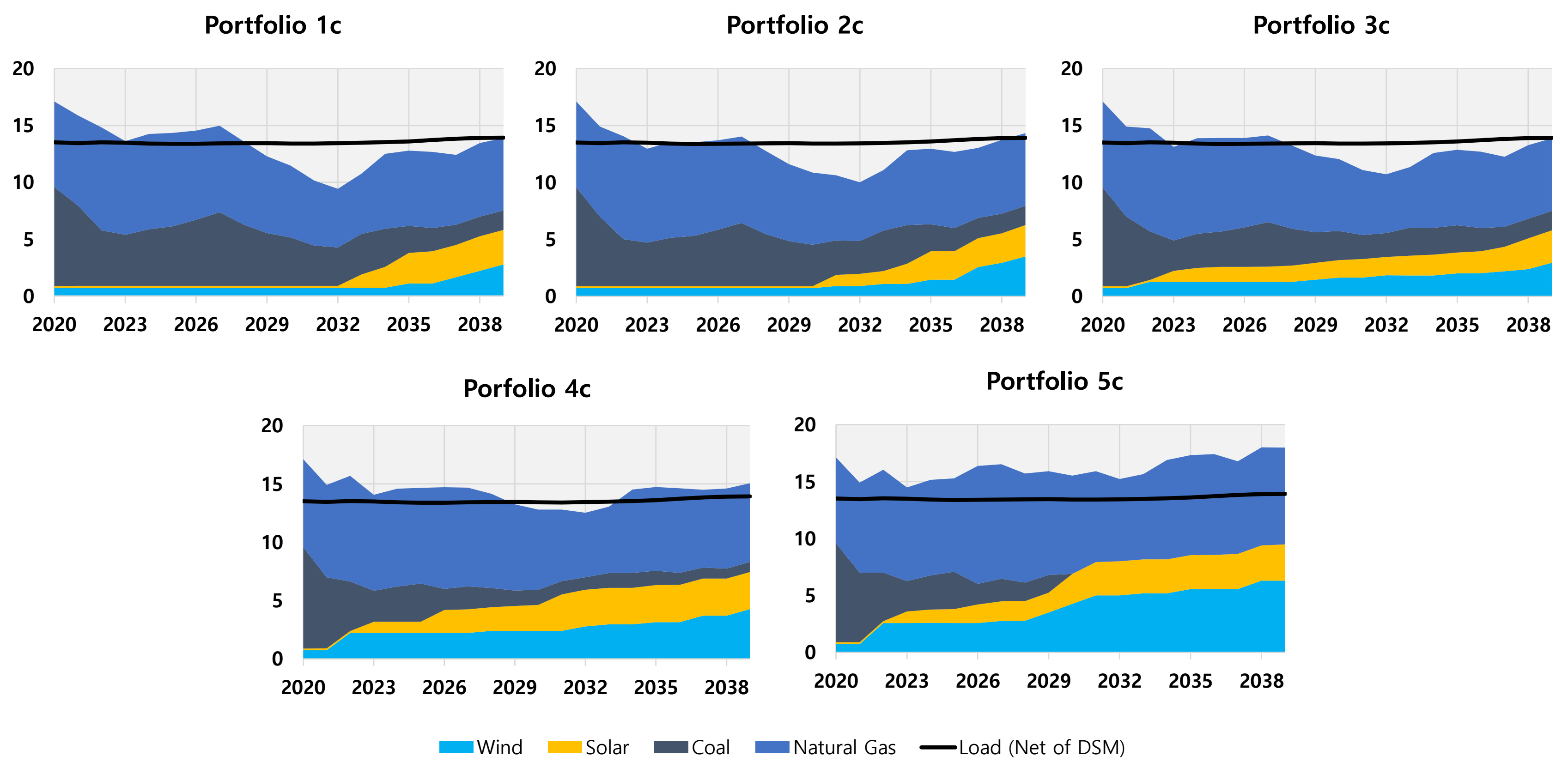
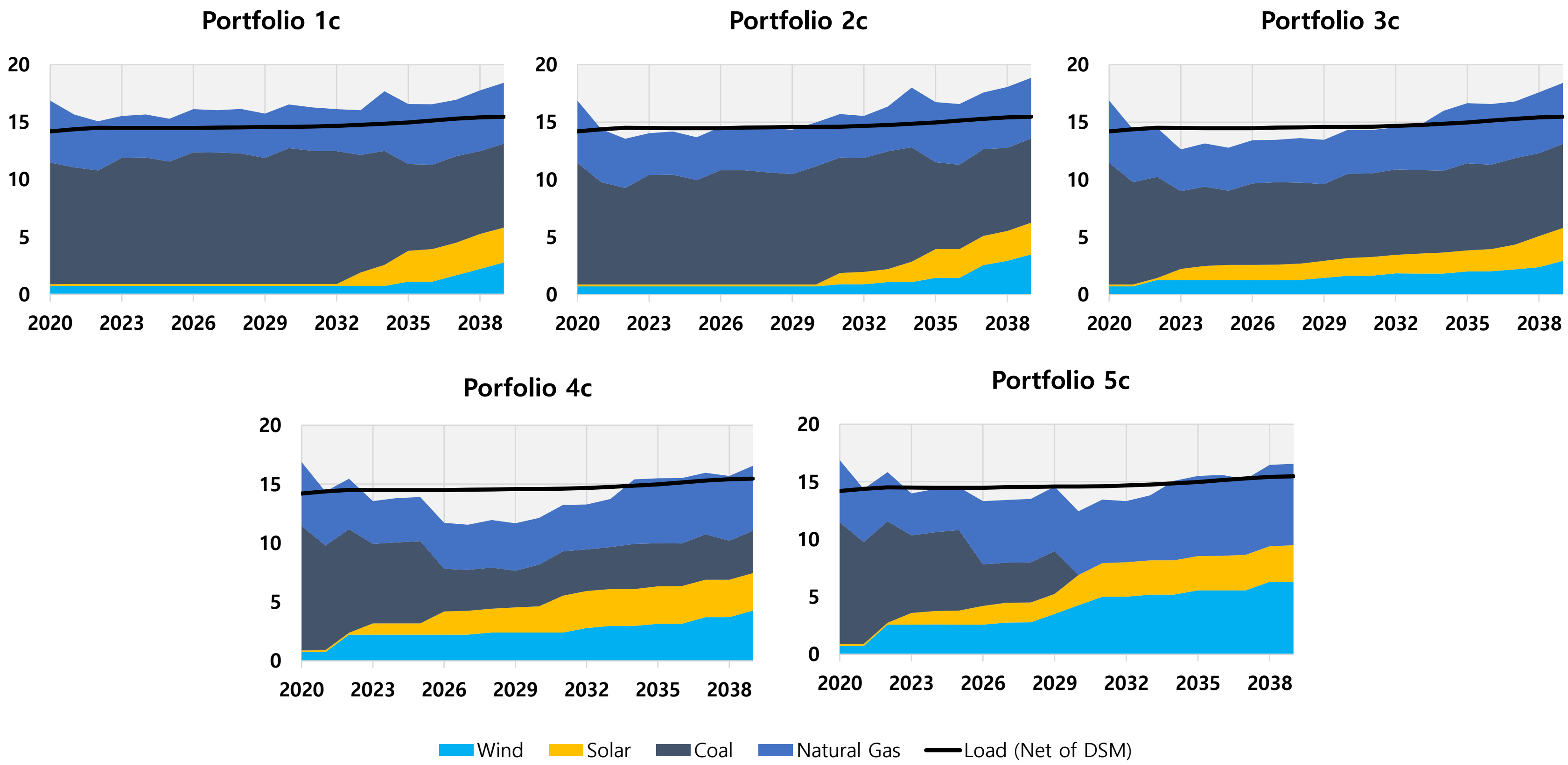


Figure 15 | Annual Energy (TWh) for Scenario D Portfolios 1c – 5c



Indianapolis Power & Light
Portfolio 1a

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,373**	**3,370**	**3,366**	**3,328**	**3,327**	**3,326**	**3,326**	**3,325**	**3,324**	**3,324**	**3,134**	**3,133**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	20	20	55
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	119	129	231	243	254	282	277
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	95	190	475	494	494	532	532
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	15	27	40	54	67	80	94	107	120	132	143	154	163	172	180	181	184	185	187
Subtotal: New Resources	**2**	**17**	**29**	**42**	**56**	**69**	**83**	**97**	**110**	**123**	**135**	**146**	**157**	**388**	**810**	**1,206**	**1,238**	**1,263**	**1,331**	**1,364**
Total Resources	**3,381**	**3,391**	**3,400**	**3,409**	**3,383**	**3,396**	**3,409**	**3,422**	**3,435**	**3,447**	**3,459**	**3,281**	**3,290**	**3,296**	**3,323**	**3,352**	**3,383**	**3,408**	**3,475**	**3,508**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**21.8%**	**20.9%**	**20.4%**	**18.5%**	**17.9%**	**17.2%**	**16.4%**	**15.9%**	**15.6%**	**15.2%**	**8.5%**	**7.8%**	**7.3%**	**7.3%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**

Indianapolis Power & Light

Portfolio 2a

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**3,141**	**3,102**	**3,102**	**3,101**	**3,100**	**3,100**	**3,099**	**3,098**	**2,909**	**2,908**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	27	31
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	38	37	49	136	238	269	285	330	336
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	152	171	171	190	475	475	475	475	494
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	15	27	40	54	67	80	94	107	120	132	143	154	163	172	180	181	184	185	187
Subtotal: New Resources	**2**	**17**	**29**	**42**	**56**	**69**	**83**	**97**	**110**	**123**	**135**	**336**	**364**	**387**	**809**	**1,204**	**1,236**	**1,263**	**1,329**	**1,361**
Total Resources	**3,381**	**3,165**	**3,174**	**3,183**	**3,158**	**3,171**	**3,184**	**3,197**	**3,209**	**3,222**	**3,234**	**3,245**	**3,272**	**3,294**	**3,322**	**3,351**	**3,382**	**3,408**	**3,474**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.7%**	**12.9%**	**12.4%**	**10.6%**	**10.1%**	**9.5%**	**8.8%**	**8.3%**	**8.0%**	**7.7%**	**7.3%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light
Portfolio 3a

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,736**	**2,735**	**2,734**	**2,734**	**2,733**	**2,543**	**2,543**	**2,542**	**2,147**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	20	20	20	20	20	20	20	20	20	20	20	20	20	27	27	31	31	35
New Utility-Scale Solar	0	0	0	168	177	186	205	205	221	227	218	210	212	203	197	191	186	205	270	295
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	38	76	76	76	95	95	95	114	323	342	361	475	494	532	532	532	532
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	15	27	40	54	67	80	94	107	120	132	143	154	163	172	180	181	184	185	187
Subtotal: New Resources	**2**	**17**	**49**	**268**	**328**	**351**	**383**	**416**	**445**	**464**	**487**	**699**	**730**	**750**	**1,175**	**1,204**	**1,238**	**1,263**	**1,330**	**1,362**
Total Resources	**3,381**	**3,165**	**3,194**	**3,043**	**3,065**	**3,087**	**3,118**	**3,151**	**3,179**	**3,198**	**3,220**	**3,242**	**3,273**	**3,292**	**3,322**	**3,351**	**3,383**	**3,408**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.7%**	**13.6%**	**7.5%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light

Portfolio 4a

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	523	523	523	523	523	523	523	523	523	523
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**2,247**	**2,058**	**2,057**	**2,056**	**1,661**	**1,661**	**1,660**	**1,660**	**1,659**	**1,659**
New Wind	0	0	12	20	20	27	43	47	47	47	55	62	66	70	74	74	74	90	90	105
New Utility-Scale Solar	0	0	0	202	250	255	419	436	451	437	421	405	402	392	381	383	378	366	354	348
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	323	323	323	342	361	570	589	608	722	741	779	798	874	893
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	15	27	40	54	67	80	94	107	120	132	143	154	163	172	180	181	184	185	187
Subtotal: New Resources	**2**	**17**	**41**	**263**	**325**	**351**	**867**	**903**	**930**	**949**	**972**	**1,184**	**1,214**	**1,237**	**1,660**	**1,690**	**1,723**	**1,749**	**1,815**	**1,846**
Total Resources	**3,381**	**3,165**	**3,186**	**3,039**	**3,062**	**3,087**	**3,117**	**3,152**	**3,179**	**3,197**	**3,219**	**3,242**	**3,271**	**3,293**	**3,322**	**3,350**	**3,383**	**3,408**	**3,474**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.7%**	**13.3%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light

Portfolio 5a

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	0	0	0	0	0	0	0	0	0	0
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**1,724**	**1,535**	**1,534**	**1,533**	**1,138**	**1,138**	**1,137**	**1,137**	**1,136**	**1,136**
New Wind	0	0	39	39	39	47	51	51	62	66	78	86	86	86	90	90	94	101	109	113
New Utility-Scale Solar	0	0	0	202	218	216	353	356	340	324	328	315	314	308	333	337	326	322	342	348
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	19	19	285	304	323	342	551	760	779	798	874	893	931	950	988	1,007
New Gas CC	0	0	0	0	0	0	0	0	0	0	308	308	308	308	615	615	615	615	615	615
New Gas CT	0	0	0	0	0	0	95	95	95	95	95	95	95	95	95	95	95	95	95	95
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	15	27	40	54	67	80	94	107	120	132	143	154	163	172	180	181	184	185	187
Subtotal: New Resources	**2**	**17**	**68**	**283**	**332**	**350**	**866**	**902**	**930**	**950**	**1,494**	**1,710**	**1,738**	**1,761**	**2,182**	**2,213**	**2,246**	**2,271**	**2,339**	**2,370**
Total Resources	**3,381**	**3,165**	**3,213**	**3,058**	**3,069**	**3,086**	**3,116**	**3,152**	**3,179**	**3,198**	**3,218**	**3,244**	**3,272**	**3,294**	**3,321**	**3,351**	**3,383**	**3,408**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.7%**	**14.3%**	**8.0%**	**7.5%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light

Portfolio 1b

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,373**	**3,370**	**3,366**	**3,328**	**3,327**	**3,326**	**3,326**	**3,325**	**3,324**	**3,324**	**3,134**	**3,133**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	43
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	140	245	363	352	360	348	342
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	38	38	304	342	342	418	418
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	19	36	53	69	86	103	119	136	152	167	180	193	205	216	228	232	237	242	247
Subtotal: New Resources	**2**	**22**	**38**	**55**	**71**	**88**	**105**	**122**	**139**	**155**	**170**	**183**	**196**	**387**	**810**	**1,206**	**1,238**	**1,262**	**1,331**	**1,362**
Total Resources	**3,381**	**3,395**	**3,409**	**3,421**	**3,399**	**3,415**	**3,431**	**3,447**	**3,464**	**3,479**	**3,494**	**3,318**	**3,330**	**3,294**	**3,322**	**3,353**	**3,383**	**3,407**	**3,476**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**21.9%**	**21.2%**	**20.8%**	**19.0%**	**18.6%**	**18.0%**	**17.3%**	**16.9%**	**16.7%**	**16.3%**	**9.7%**	**9.1%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**

Indianapolis Power & Light

Portfolio 2b

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**3,141**	**3,102**	**3,102**	**3,101**	**3,100**	**3,100**	**3,099**	**3,098**	**2,909**	**2,908**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	8	35	39	39
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	105	102	112	218	238	230	223	282	307
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	38	57	57	57	323	361	361	361	361
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	95	95	95	95
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	19	36	53	69	86	103	119	136	152	167	180	193	205	216	228	232	237	242	247
Subtotal: New Resources	**2**	**22**	**38**	**55**	**71**	**88**	**105**	**122**	**139**	**155**	**170**	**334**	**363**	**385**	**809**	**1,202**	**1,238**	**1,263**	**1,330**	**1,360**
Total Resources	**3,381**	**3,170**	**3,183**	**3,196**	**3,174**	**3,190**	**3,206**	**3,222**	**3,239**	**3,254**	**3,269**	**3,243**	**3,271**	**3,293**	**3,322**	**3,349**	**3,383**	**3,408**	**3,475**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.8%**	**13.2%**	**12.9%**	**11.2%**	**10.8%**	**10.2%**	**9.6%**	**9.3%**	**9.1%**	**8.8%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light
Portfolio 3b

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,736**	**2,735**	**2,734**	**2,734**	**2,733**	**2,543**	**2,543**	**2,542**	**2,147**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	8	8	8	8	8	8	12	12	12	12	12	20	20	20	20	23	35	43
New Utility-Scale Solar	0	0	0	202	250	255	270	267	255	259	265	278	292	294	286	284	275	291	324	342
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	19	38	38	38	228	228	228	342	361	399	399	418	418
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	19	36	53	69	86	103	119	136	152	167	180	193	205	216	228	232	237	242	247
Subtotal: New Resources	**2**	**22**	**46**	**264**	**329**	**351**	**382**	**415**	**444**	**464**	**485**	**701**	**728**	**750**	**1,174**	**1,204**	**1,237**	**1,262**	**1,331**	**1,362**
Total Resources	**3,381**	**3,170**	**3,191**	**3,039**	**3,066**	**3,087**	**3,118**	**3,150**	**3,178**	**3,197**	**3,218**	**3,244**	**3,271**	**3,292**	**3,321**	**3,350**	**3,383**	**3,407**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.8%**	**13.5%**	**7.3%**	**7.4%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light
Portfolio 4b

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	523	523	523	523	523	523	523	523	523	523
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**2,247**	**2,058**	**2,057**	**2,056**	**1,661**	**1,661**	**1,660**	**1,660**	**1,659**	**1,659**
New Wind	0	0	31	31	31	31	31	31	43	43	47	47	55	62	62	66	74	86	98	98
New Utility-Scale Solar	0	0	0	190	229	235	409	427	425	429	413	405	394	378	367	363	365	353	348	354
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	228	228	228	228	247	456	475	494	608	627	646	665	722	741
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	95	95	95	95	95	95	95	95	95	95	95	95	95	95
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	19	36	53	69	86	103	119	136	152	167	180	193	205	216	228	232	237	242	247
Subtotal: New Resources	**2**	**22**	**69**	**276**	**331**	**354**	**868**	**903**	**930**	**950**	**972**	**1,186**	**1,215**	**1,238**	**1,659**	**1,690**	**1,723**	**1,747**	**1,816**	**1,846**
Total Resources	**3,381**	**3,170**	**3,215**	**3,052**	**3,068**	**3,090**	**3,118**	**3,152**	**3,178**	**3,198**	**3,220**	**3,244**	**3,272**	**3,294**	**3,321**	**3,351**	**3,383**	**3,407**	**3,475**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.8%**	**14.3%**	**7.8%**	**7.5%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light
Portfolio 5b

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	0	0	0	0	0	0	0	0	0	0
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**1,724**	**1,535**	**1,534**	**1,533**	**1,138**	**1,138**	**1,137**	**1,137**	**1,136**	**1,136**
New Wind	0	0	27	27	27	27	27	27	31	35	35	35	35	43	43	47	47	62	78	86
New Utility-Scale Solar	0	0	0	190	229	235	409	427	434	413	413	405	402	385	394	389	378	366	354	354
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	19	19	19	38	285	494	513	532	627	646	684	703	760	779
New Gas CC	0	0	0	0	0	0	308	308	308	308	308	308	308	308	615	615	615	615	615	615
New Gas CT	0	0	0	0	0	0	0	0	0	0	284	284	284	284	284	284	284	284	284	284
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	19	36	53	69	86	103	119	136	152	167	180	193	205	216	228	232	237	242	247
Subtotal: New Resources	**2**	**22**	**66**	**272**	**327**	**351**	**868**	**903**	**930**	**948**	**1,496**	**1,709**	**1,738**	**1,760**	**2,183**	**2,213**	**2,244**	**2,272**	**2,337**	**2,370**
Total Resources	**3,381**	**3,170**	**3,211**	**3,048**	**3,064**	**3,087**	**3,118**	**3,152**	**3,179**	**3,196**	**3,220**	**3,244**	**3,272**	**3,294**	**3,322**	**3,351**	**3,381**	**3,408**	**3,473**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**13.8%**	**14.2%**	**7.6%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light

Portfolio 1c

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,373**	**3,370**	**3,366**	**3,328**	**3,327**	**3,326**	**3,326**	**3,325**	**3,324**	**3,324**	**3,134**	**3,133**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	20	31	43
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	140	224	330	339	329	342	336
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	285	304	323	361	380
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	23	41	60	80	100	120	141	160	178	197	212	226	242	255	268	274	279	284	291
Subtotal: New Resources	**2**	**25**	**43**	**62**	**82**	**102**	**123**	**143**	**163**	**181**	**200**	**215**	**229**	**385**	**809**	**1,202**	**1,236**	**1,262**	**1,330**	**1,363**
Total Resources	**3,381**	**3,398**	**3,414**	**3,429**	**3,410**	**3,429**	**3,449**	**3,469**	**3,488**	**3,505**	**3,524**	**3,349**	**3,362**	**3,293**	**3,322**	**3,348**	**3,382**	**3,407**	**3,475**	**3,507**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**22.1%**	**21.4%**	**21.1%**	**19.4%**	**19.1%**	**18.6%**	**18.0%**	**17.7%**	**17.5%**	**17.3%**	**10.7%**	**10.2%**	**7.2%**	**7.2%**	**7.1%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**

Indianapolis Power & Light
Portfolio 2c

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,374	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**3,141**	**3,102**	**3,102**	**3,101**	**3,100**	**3,100**	**3,099**	**3,098**	**2,909**	**2,908**	**2,908**	**2,513**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	0	0	0	0	0	0	0	0	0	4	4	8	8	16	16	39	47	59
New Utility-Scale Solar	0	0	0	0	0	0	0	0	0	0	0	120	131	133	218	304	294	291	288	301
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	304	342	342	399	399
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	23	41	60	80	100	120	141	160	178	197	212	226	242	255	268	274	279	284	291
Subtotal: New Resources	**2**	**25**	**43**	**62**	**82**	**102**	**123**	**143**	**163**	**181**	**200**	**339**	**364**	**386**	**810**	**1,202**	**1,237**	**1,263**	**1,330**	**1,362**
Total Resources	**3,381**	**3,173**	**3,188**	**3,203**	**3,185**	**3,204**	**3,224**	**3,244**	**3,263**	**3,280**	**3,298**	**3,248**	**3,272**	**3,293**	**3,323**	**3,348**	**3,383**	**3,408**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**14.0%**	**13.4%**	**13.1%**	**11.5%**	**11.3%**	**10.8%**	**10.3%**	**10.1%**	**10.0%**	**9.8%**	**7.4%**	**7.3%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light

Portfolio 3c

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009	1,009
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,736**	**2,735**	**2,734**	**2,734**	**2,733**	**2,543**	**2,543**	**2,542**	**2,147**	**2,146**	**2,146**	**2,145**	**2,145**	**2,144**
New Wind	0	0	12	12	12	12	12	12	12	16	20	20	23	23	23	27	27	31	35	47
New Utility-Scale Solar	0	0	0	179	218	225	214	205	213	211	211	218	212	217	224	218	224	242	300	313
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	19	19	19	38	57	57	57	57	247	266	266	361	380	399	399	399	399
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	23	41	60	80	100	120	141	160	178	197	212	226	242	255	268	274	279	284	291
Subtotal: New Resources	**2**	**25**	**55**	**272**	**332**	**358**	**386**	**417**	**444**	**464**	**487**	**699**	**730**	**752**	**1,175**	**1,204**	**1,236**	**1,262**	**1,330**	**1,362**
Total Resources	**3,381**	**3,173**	**3,200**	**3,048**	**3,068**	**3,094**	**3,122**	**3,152**	**3,178**	**3,198**	**3,220**	**3,242**	**3,272**	**3,294**	**3,322**	**3,350**	**3,381**	**3,408**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**14.0%**	**13.8%**	**7.6%**	**7.5%**	**7.5%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Indianapolis Power & Light
Portfolio 4c

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	523	523	523	523	523	523	523	523	523	523
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**2,247**	**2,058**	**2,057**	**2,056**	**1,661**	**1,661**	**1,660**	**1,660**	**1,659**	**1,659**
New Wind	0	0	0	0	0	16	31	31	35	35	35	35	43	47	47	51	51	62	62	74
New Utility-Scale Solar	0	0	0	179	166	157	335	329	315	316	320	443	431	413	401	396	384	372	360	354
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	19	76	76	190	209	228	228	228	304	323	342	361	380	418	437	513	532
New Gas CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	308	308	308	308	308
New Gas CT	0	0	0	0	0	0	190	190	190	190	190	190	190	190	284	284	284	284	284	284
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	23	41	60	80	100	120	141	160	178	197	212	226	242	255	268	274	279	284	291
Subtotal: New Resources	**2**	**25**	**43**	**261**	**325**	**351**	**868**	**903**	**930**	**949**	**972**	**1,186**	**1,215**	**1,237**	**1,659**	**1,690**	**1,722**	**1,746**	**1,816**	**1,848**
Total Resources	**3,381**	**3,173**	**3,188**	**3,036**	**3,062**	**3,087**	**3,118**	**3,152**	**3,179**	**3,197**	**3,220**	**3,244**	**3,272**	**3,293**	**3,321**	**3,351**	**3,382**	**3,406**	**3,475**	**3,506**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**14.0%**	**13.4%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.3%**

Indianapolis Power & Light
Portfolio 5c

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Existing Coal	1,599	1,374	1,374	1,009	1,009	1,009	523	523	523	523	0	0	0	0	0	0	0	0	0	0
Existing Natural Gas	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,633	1,444	1,444	1,444	1,050	1,050	1,050	1,050	1,050	1,050
Existing Oil	37	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Other (Wind/Solar/DR)	54	49	46	42	40	39	39	38	37	37	36	35	35	34	33	33	32	31	31	30
Existing CVR / ACLM / Rider 17	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Subtotal: Existing Resources	**3,378**	**3,148**	**3,145**	**2,775**	**2,737**	**2,736**	**2,250**	**2,249**	**2,249**	**2,248**	**1,724**	**1,535**	**1,534**	**1,533**	**1,138**	**1,138**	**1,137**	**1,137**	**1,136**	**1,136**
New Wind	0	0	0	12	16	23	35	43	43	59	74	90	90	94	94	101	101	101	117	117
New Utility-Scale Solar	0	0	0	190	208	206	270	276	264	251	382	413	409	392	381	370	358	360	348	354
New Distributed Solar	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5
New Battery Storage	0	0	0	0	19	19	133	133	152	152	532	684	703	722	836	855	893	912	969	988
New Gas CC	0	0	0	0	0	0	308	308	308	308	308	308	308	308	615	615	615	615	615	615
New Gas CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Aero CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Reciprocating Engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New DSM	0	23	41	60	80	100	120	141	160	178	197	212	226	242	255	268	274	279	284	291
Subtotal: New Resources	**2**	**25**	**43**	**264**	**325**	**350**	**868**	**903**	**929**	**950**	**1,496**	**1,709**	**1,738**	**1,760**	**2,184**	**2,212**	**2,246**	**2,271**	**2,338**	**2,370**
Total Resources	**3,381**	**3,173**	**3,188**	**3,040**	**3,062**	**3,086**	**3,118**	**3,152**	**3,177**	**3,198**	**3,220**	**3,244**	**3,272**	**3,294**	**3,322**	**3,350**	**3,383**	**3,407**	**3,474**	**3,505**
Base Peak Load Forecast	2,772	2,783	2,810	2,829	2,852	2,875	2,904	2,934	2,957	2,974	2,993	3,012	3,035	3,054	3,077	3,100	3,128	3,148	3,208	3,234
EV Peak Load	1	1	2	2	3	4	5	6	7	9	11	13	16	18	21	24	27	30	33	35
Base Peak Load Plus EV	2,773	2,784	2,812	2,831	2,855	2,879	2,908	2,940	2,964	2,982	3,003	3,025	3,051	3,072	3,098	3,125	3,155	3,178	3,241	3,269
Reserve Margin	**21.9%**	**14.0%**	**13.4%**	**7.4%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**	**7.2%**

Figure 1 | Market Purchases/Sales of Portfolios 2a – 5a Compared to Portfolio 1a in the Reference Case

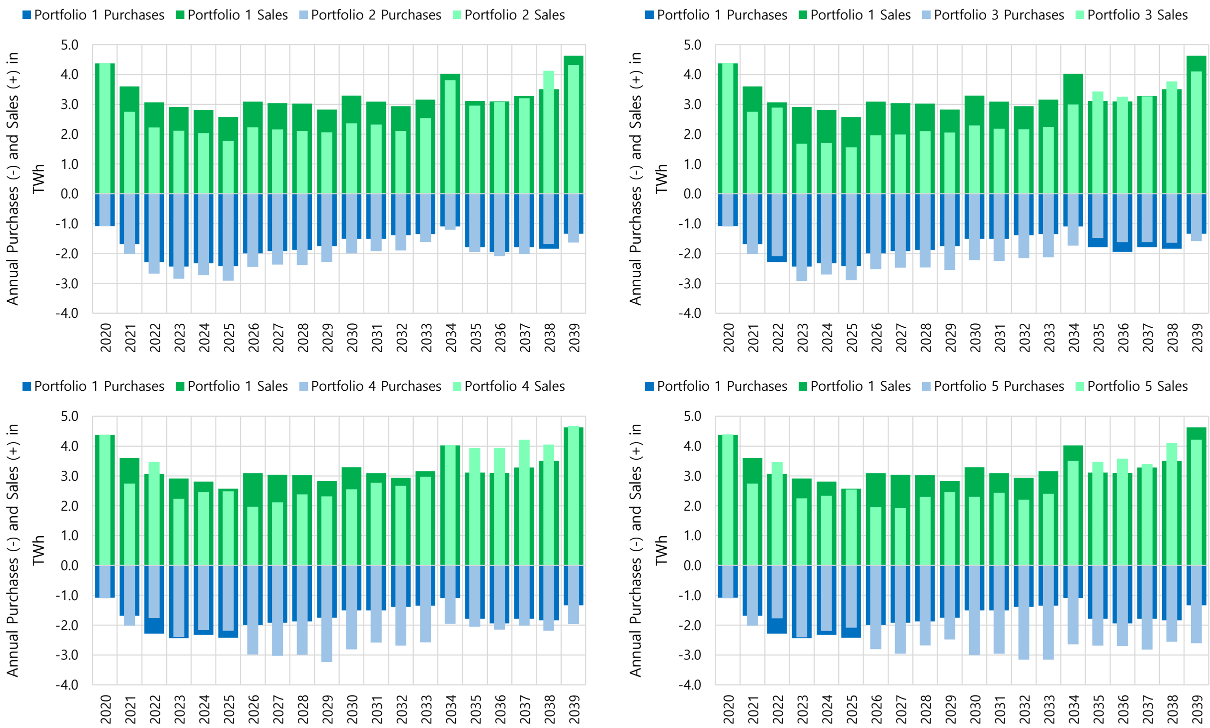


Figure 2 | Market Purchases/Sales of Portfolios 2a – 5a Compared to Portfolio 1a in Scenario A

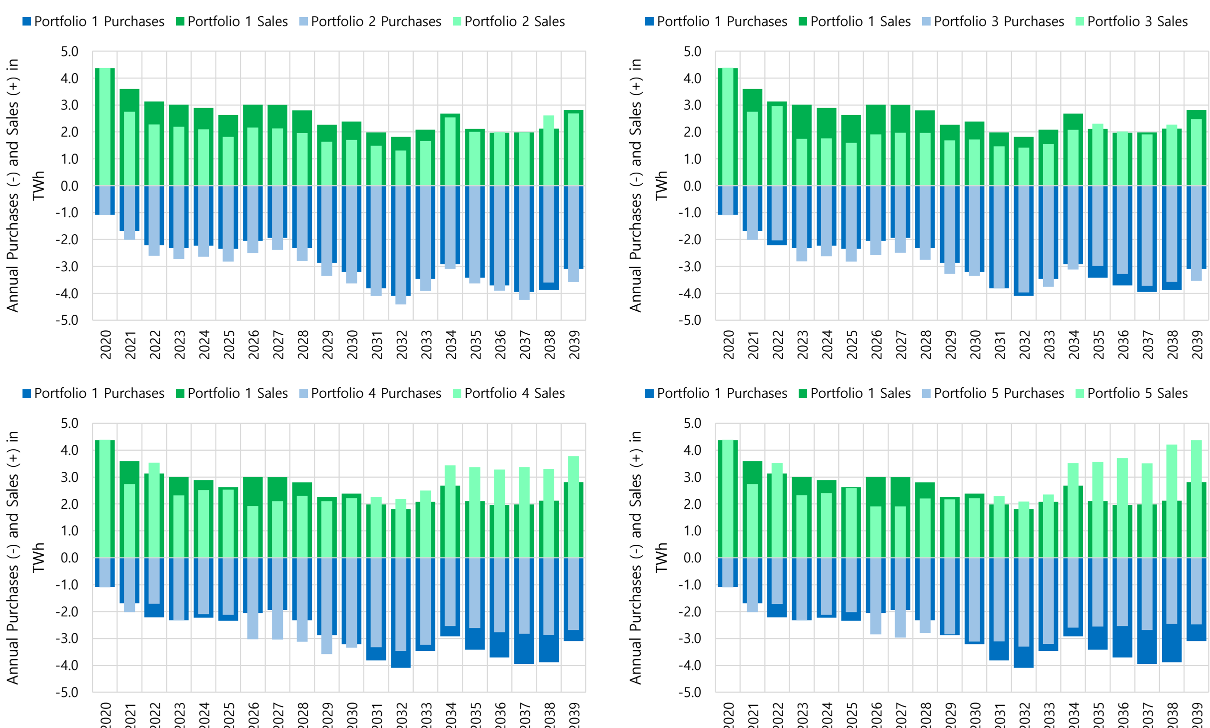


Figure 3 | Market Purchases/Sales of Portfolios 2b – 5b Compared to Portfolio 1b in the Reference Case

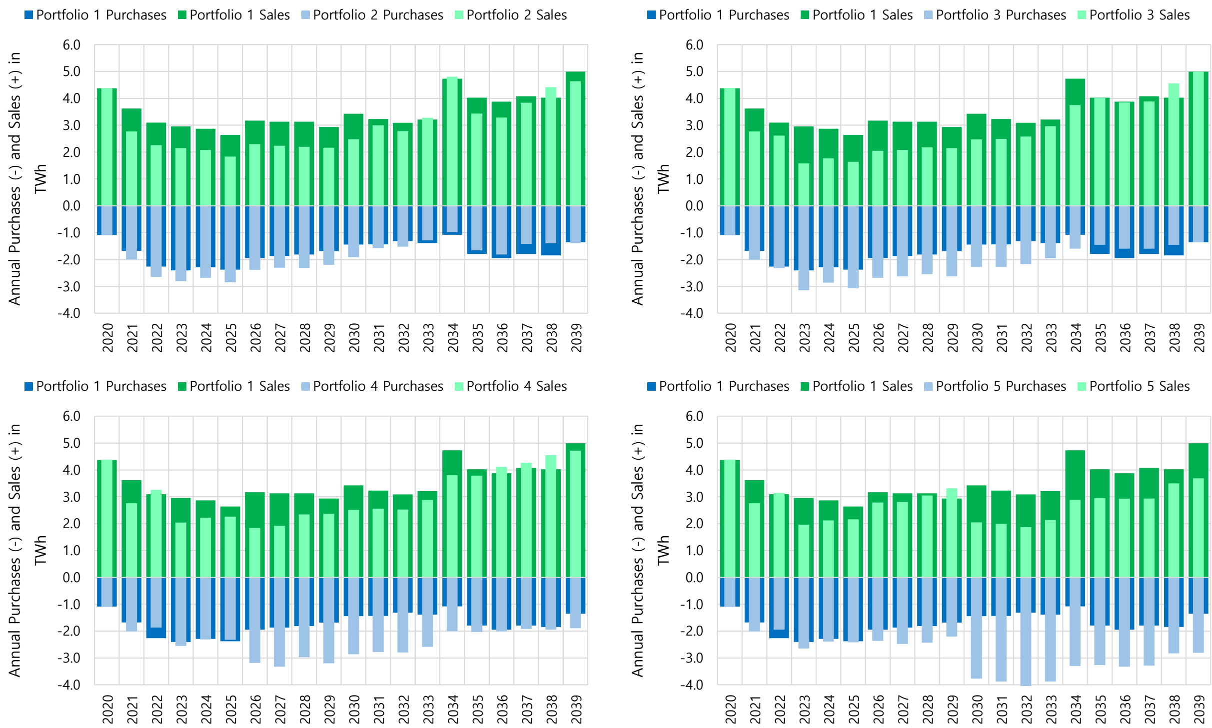


Figure 4 | Market Purchases/Sales of Portfolios 2b – 5b Compared to Portfolio 1b in Scenario A

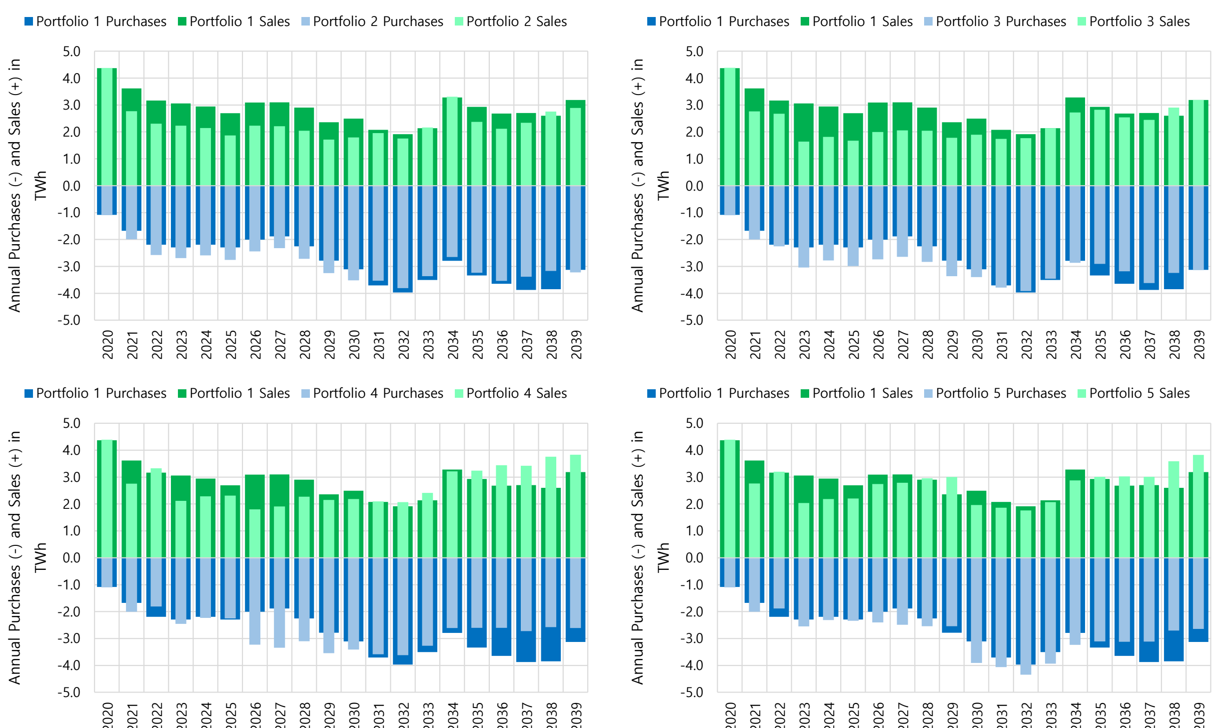


Figure 5 | Market Purchases/Sales of Portfolios 2c – 5c Compared to Portfolio 1c in the Reference Case

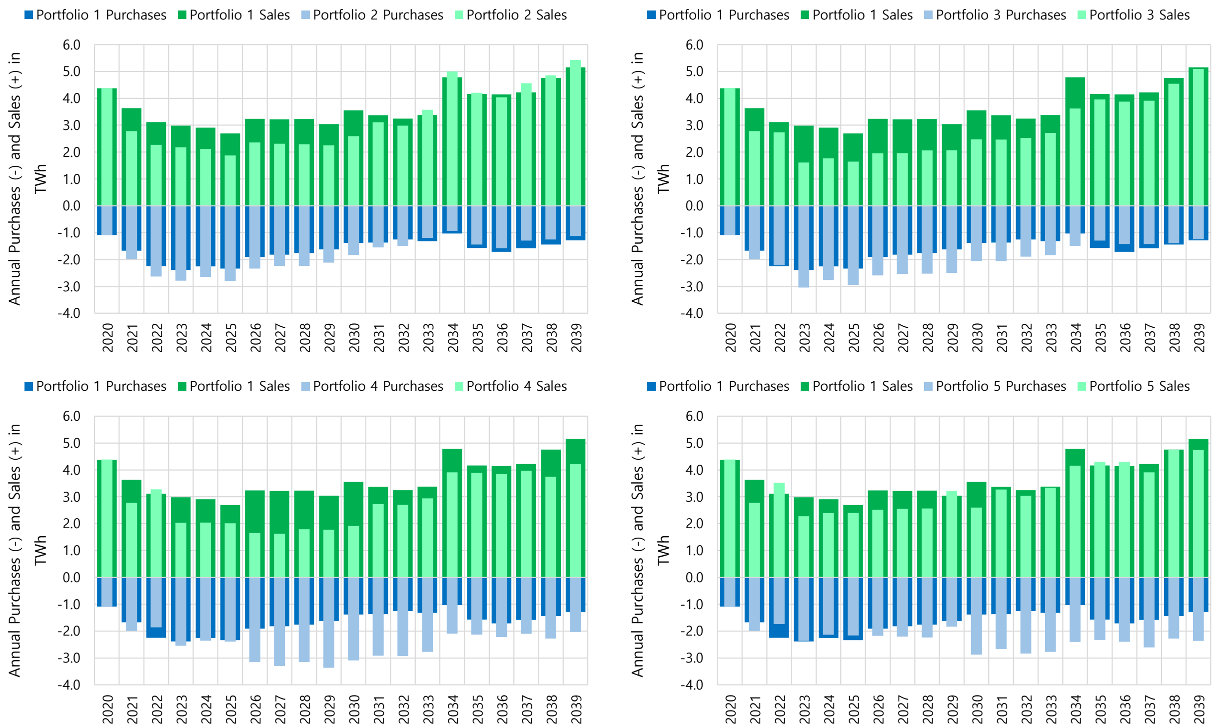


Figure 6 | Market Purchases/Sales of Portfolios 2c – 5c Compared to Portfolio 1c in Scenario A