Evergy
2019 DSM Potential Study

Final Report

Volume 1: Executive Summary

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Eureka Facts supported ICF in conducting the appliance saturation survey.

Introduction

Evergy engaged ICF to conduct this demand side management (DSM) potential study. It assessed technical, economic, and achievable potential in the residential, commercial, and industrial sectors within Evergy's service areas in Missouri, Evergy Missouri Metro and Evergy Missouri West. The study covers energy efficiency, demand response, demand-side rates, and combined heat and power.

ICF assessed five achievable potential scenarios including Realistic Achievable Potential (RAP), RAP-, RAP+, Missouri Energy Efficiency Investment Act (MEEIA), and Maximum Achievable Potential (MAP) for energy efficiency, demand response and demand side rates. ICF modeled additional stand-alone scenarios for demand response and demand side rates.

As part of the study, ICF conducted an appliance saturation analysis to collect a variety of appliance and end-use data from customers across multiple service territories in Missouri and Kansas, including residential, commercial, and industrial accounts. It included a web and mail survey of residential customers and a computer-assisted telephone interviewing (CATI) survey of business customers. The results of this analysis were used in the market characterization and baseline electricity load analysis in the study.

This study will be used to satisfy the demand-side analysis requirements of the Missouri resource planning regulations at 4 CSR 240-22, particularly Chapter 22.050. In addition, the study also takes into consideration the requirements of demand-side programs under the MEEIA regulations at 4 CSR 240-20.092, 20.093, and 20.094.

Report Organization

This report includes five volumes:

- Volume 1: Executive Summary
- Volume 2: Appliance Saturation Study
- Volume 3: Potential Study
- Volume 4: Program Descriptions
- Volume 5: Appendices

This document is Volume 1: Executive Summary

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1. Analysis Overview and Summary of Results

The analysis consisted of three stages: survey of appliance saturation, market characterization and load forecast, and potential estimation for energy efficiency, demand response, demand side rates, and combined heat and power programs. An overview of the project flow and the corresponding outcomes at each stage is shown in Figure 1-1.

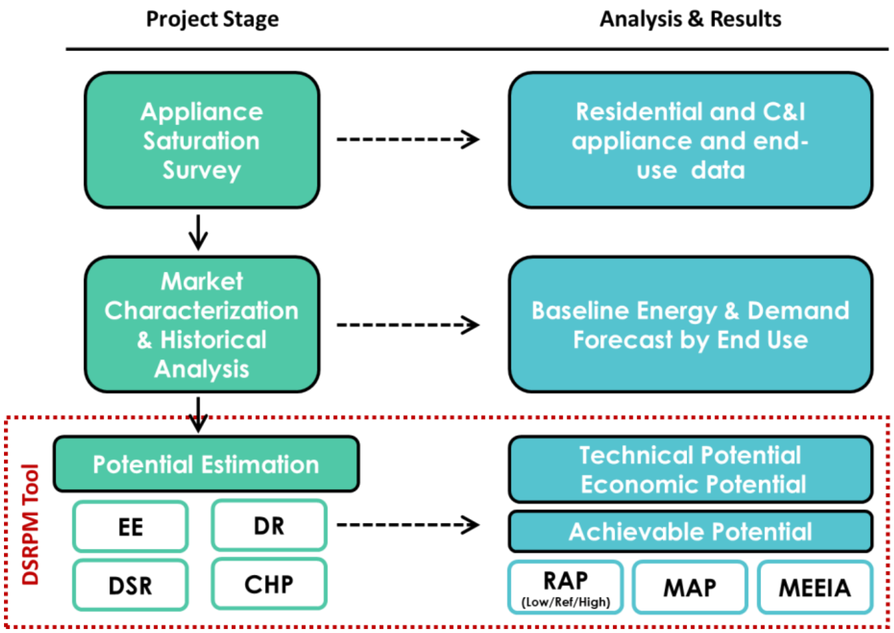

Figure 1-1 Overall analysis flowchart

Subsequent chapters provide details of the approach for appliance saturation survey, market characterization, and potential estimation. This chapter presents a brief description of the potentials and the summary of results.

1.1 Technical, Economic, and Achievable Potential Definitions

Figure 1-2 represents the types of potentials evaluated in this study, the definitions of which directly correspond to the potentials outlined by National Action Plan for Energy Efficiency (NAPEE) in their *Guide for Conducting Energy Efficiency Potential Studies.*[1] The technical potential quantifies an upper bound of how much energy and demand could be reduced, subject to the feasibility constraint such as the best that the market currently has to offer. The economic potential is also a theoretical maximum, but within the boundaries of cost-effectiveness. The achievable potential applies various real-world barriers and constraints to the economic potential.

Five achievable potential scenarios were developed: Realistic Achievable Potential (RAP), RAP-, RAP+, Missouri Energy Efficiency Investment Act (MEEIA), and Maximum Achievable Potential (MAP). RAP is the reference case for expected levels of program performance, and RAP- and RAP+ are variants of RAP that assume lower and higher performance levels. In the MEEIA scenario, Evergy has energy

[1] National Action Plan for Energy Efficiency (2007). Guideline for Conducting Energy Efficiency Potential Studies https://www.epa.gov/sites/production/files/2015-08/documents/potential_guide_0.pdf

savings targets of 1.9% of sales and one percent of incremental demand savings each year. MAP is the upper limit of achievable potential.

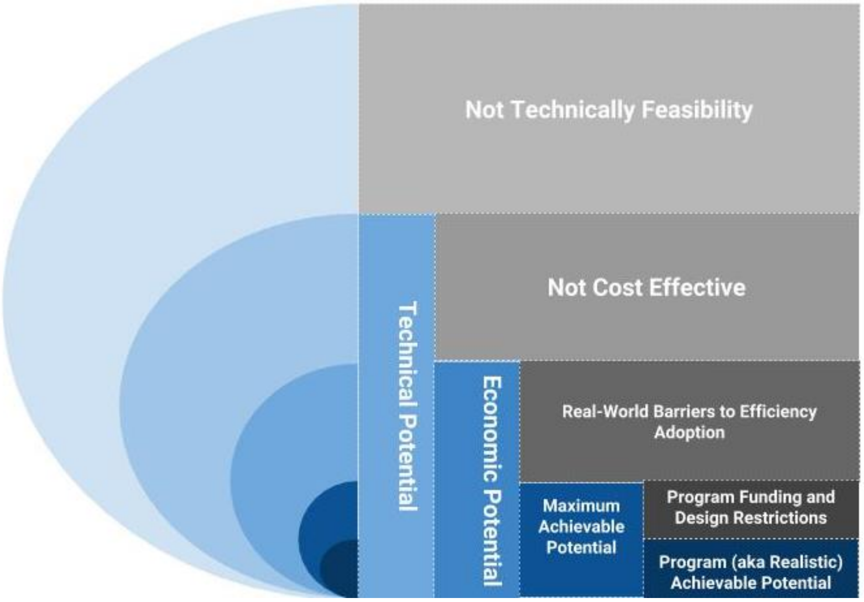

Figure 1-2 Technical, economic, and various levels of achievable potential

1.2 Summary of Savings

A brief summary of the energy and demand savings from the two scenarios of primary interest—RAP and MEEIA—are shown in Table 1-1-1.

Table 1-1 Achievable Potential by Resource Category (Annual GWh & Summer Peak MW)

	2023	2024	2025	2032	2042
Baseline Energy Sales – GWh	**18,035**	**18,138**	**18,214**	**18,905**	**20,144**
Baseline Demand – MW	**3,317**	**3,333**	**3,349**	**3,465**	**3,545**
RAP Scenario – GWh Savings					
Energy Efficiency	108.2	219.5	312.6	708.9	790.2
Demand Response	46.4	119.7	176.4	346.9	335.8
Demand Side Rates	0.5	1.7	3.3	19.4	21.2
% of Baseline Sales	*0.8%*	*1.8%*	*2.8%*	*6.0%*	*6.4%*
MEEIA Scenario – GWh Savings					
Energy Efficiency	199.4	414.4	580.1	1,272.5	1,637.3
Demand Response	3.5	9.0	13.4	26.5	27.5
Demand Side Rates	0.7	2.3	4.3	28.8	32.5
% of Baseline Sales	*1.1%*	*2.3%*	*3.4%*	*7.4%*	*9.5%*
RAP Scenario – MW Savings					
Energy Efficiency	39.9	71.1	96.6	201.5	235.3
Demand Response	156.4	198.6	232.3	350.6	351.1
Demand Side Rates	2.7	8.3	15.6	93.0	101.3
% of Baseline Sales	*6.0%*	*8.3%*	*10.3%*	*18.6%*	*19.4%*
MEEIA Scenario – MW Savings					

Energy Efficiency	45.1	91.7	127.2	270.4	338.9
Demand Response	172.5	208.0	233.6	347.9	365.6
Demand Side Rates	3.6	11.3	21.3	134.9	149.4
% of Baseline Sales	*6.7%*	*9.4%*	*11.4%*	*21.7%*	*24.0%*

2. Appliance Saturation Analysis

In 2019, ICF conducted an Appliance Saturation Study to collect a variety of appliance and end-use data from Evergy customers across multiple service territories, including residential, commercial, and industrial accounts. It included a web and mail survey of residential customers and a computer-assisted telephone interviewing (CATI) survey of business customers.

2.1 Residential Findings

Residential Heating & Cooling

- The most common residential heating system across all service territories was natural gas central warm air furnaces with ducts and vents (58.2% of customers had this system).
- The age of the heating system was almost evenly split across the four response options, with approximately one-quarter of systems in each category (0-5 years old; 5-10 years old; 10-15 years old; more than 15 years old). Evergy Kansas Central heating systems were somewhat older (28.4% were over 15 years old); Evergy Kansas Metro systems were newer (29.6% were less than five years).
- More than half of homes across all service territories had no supplemental heating (56.1%). Among those who did have supplemental heating, the most common system was electric heater.
- The most common cooling system was central air conditioning (87.4%). Residents of Evergy Missouri West territory were relatively more likely to report using an air-source heat pump to cool their homes (6.8%).
- Thirty percent of homes had a cooling system that was under five years old; Evergy Kansas central cooling systems were slightly older than those in other service territories.
- Seventy percent of respondents reported having a ceiling fan (70.7%).
- Nearly one-quarter of homes across all service territories had no supplemental cooling (22.9%).

Residential Thermostat Control

- Just over half of homes had a manual thermostat (52.2%) and 42.7% had a programmable thermostat. Almost all devices controlled both heating and cooling.
- Of those with a programmable thermostat:
  - Half of customers ran their device on programmed settings for most of the year (50.1%) while one-quarter manually adjusted it like a traditional thermostat (25.9%).
  - Nearly 60% reported that their device was NOT Wi-fi enabled (58.2%).
  - Nearly 7% had a “smart thermostat” that adjusted heating and cooling based on past behavior.
- All respondents were asked how interested they were in having a next generation “smart” thermostat in their home. Just under one-third of customers showed interest in the technology, rating it an 8, 9, or 10 (31.9%). The mean level of interest, based on all responses, was 5.

Water Heating

- The most common water heating system was a natural gas central standard task (54.8%). Just under one-third of respondents had an electric standard tank (31.9%).
- The most common water heating tank size was **40 gallons** (41.7% of all customers), though one in five customers did not know the size of their tank.

Appliances

Nearly every home reported owning a:

- **Refrigerator (99.8%)**
- **Microwave (97.5%)**
- **LCD or LED Flat Screen TV (94.9%)**

- Customers in Evergy Kansas Metro were more likely to have a dishwasher (93%) compared to all customers (82.7%).
- Between one-quarter and one-third of customers had a second refrigerator (29.3%), and about 5% of customers had a third.
- Customers in more rural regions (Evergy Missouri West and Evergy Kansas Central) were more likely to have standalone freezers.
- Just over half of all customers had a cable set-top box, and 42.9% had a streaming device such as Apple TV or Roku.
- One-quarter of customers reported having a smart speaker like a Google Home or Amazon Alexa.
- 71.7% of customers had a laptop computer. The mean number of laptops per household was 1.5, with 42.5% owning one, 19.7% owning two, and 9.5% owning three or more. The mean number of tablets per households was 1.5, with 35.5% owning one device, 16.2% owning two, and 7.6% owning three or more.

Lighting and Energy Efficiency

Across all service territories, the largest proportion of respondents reported using conventional or incandescent lamps (36.5%) and just over one-third reported using LED bulbs (34%). The remaining respondents report using another lamp or fixture (29.5%).

All respondents were asked whether they had undertaken any of a list of actions to save energy in their homes in the previous five years:

- The most-selected option was a tune-up to the cooling system so that it operates more efficiently (35.8%). Other popular actions were tune-ups to the heating system (32.1%) and weather stripping to windows or doors (33.1%). At the same time, over one-third of customers said they did not undertake any of the listed actions (35.5%).
- A majority of respondents reported using ceiling fans (70.5%) and turning down heating or cooling at night or when they are away (65.9%).

A majority of respondents had previously heard of the ENERGY STAR® label (74.2%), with almost 80% of customers in Evergy Kansas Metro reporting previous awareness. Residents of Evergy Kansas Central were less likely to have heard of the label (68.1%) than respondents in other service territories. As a point of comparison, a 2016 study found that 85% of households had seen or heard of the ENERGY STAR label, without a visual aid.[2]

Customers who were familiar with the ENERGY STAR® label were also asked at what frequency they would buy an ENERGY STAR rated model. Just over half of this group said they would "always" purchase the ENERGY STAR model (53.4%).

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[2] EPA Office of Air and Radiation, Climate Protection Partnerships Division. National Awareness of ENERGY STAR® for 2016: Analysis of 2016 CEE Household Survey. U.S. EPA, 2017.

Across both Missouri-based territories, residents were most familiar with the utility's heating and cooling rebates and the thermostat program (about 47% of customers were familiar with either program).

2.2 Commercial & Industrial Findings

Building Characteristics

- Half of all businesses reported a total square footage under 5,000 square feet (50.3%).
- Overall, just over 68% of businesses own their space, however this varies considerably by business type. Data centers, lodging, and worship organizations were more likely to own their buildings, whereas healthcare and food service businesses were more likely to rent their space.

One-third of C&I customers reported having **traditional office-based businesses and retail businesses** (33.7%).

Heating & Cooling

- Just under one-half of all businesses with some heating had a central furnace as their **primary heating system** (46.9%).
- The **most common fuel type** for the primary heating system was natural gas (62.3%), followed by electricity (25%).
- The **most common cooling system** was a residential-style central air-conditioner (37.8%).
- Just under one-half of businesses with some heating or cooling used a **programmable thermostat** to control their heating and/or cooling systems (48%).
- The **most common type of water heating system** was a self-contained or stand-alone storage water heater/boiler (20.9%), although just under 20% of respondents were unsure about their system. The most common fuels used for water heating were natural gas (42.8%) and electricity (39.2%).

81.9% of businesses said that more than 90% of the space their business occupied at the sampled location was **heated.**

64.9% of businesses said more than 90% of the space their business occupied at the sampled location had **cooling.**

Seven percent of businesses reported no cooling.

Lighting

- The most common lighting control system was a manual – single switch (78.2%).
- Just under three-quarters of businesses said they had exterior lighting (73.8%). Among these respondents, 47.6% used a photocell/daylighting sensor to control their exterior lights (47.6%).

The most common lighting system was **linear or tubular fluorescent lights** (58.6% of all lights) followed by **LED lamps** that replace linear fluorescent lights (27.8%).

Appliances and Other Characteristics

- Over half of the businesses had some kitchen facilities onsite (57%).
- Two-thirds of businesses reported having no warehouse or storage space on site (66.1%).
- Just under three-quarters (72.4%) reported having a computer monitor on site.
- Just under one-quarter of businesses reported having fans and blowers on site (23.8%) while just under one-fifth had compressed air systems (18%). On average, less than half of the different motor types had variable frequency drives.

Energy Efficiency

- Evergy's Missouri-based customers were more aware of the utility's standard rebate system than the custom program, with half of businesses having heard of the standard program (49.2%). Only one-third of businesses were aware of the custom rebate program (34.1%).
- The majority of businesses had not implemented any energy-efficiency measures related to lighting, heating/cooling, and water heating at their locations in the past three years, although four in ten businesses had replaced traditional incandescent lights with CFLs, LEDs, or higher-efficiency light bulbs in lighting fixtures (40.6%).

"SOLAR"

The most mentioned response when businesses were asked what additional energy efficiency programs and/or rebates would like to see their utility offer.

"Lower Rates" and "More/Bigger Rebates" and "LED" were also mentioned frequently.

3. Potential Study

3.1 Baseline Energy Use

The study developed a market characterization as a first step for forecasting energy use and end use intensities. The market characterization estimated sectoral energy use and the related energy end-uses.

Energy Use Summary

Total electricity use across the residential, commercial, and industrial sectors for Evergy in 2019 was 17,028 GWh. A summary of electricity use by sector is presented in Table 3-1. As shown in Figure 3-1, the commercial and residential sectors are somewhat comparable in size with 45% and 39% of use, respectively. The industrial sector is slightly smaller in terms of overall consumption, at 16%. In terms of peak demand, the total summer peak in 2019 was 3,049 MW and the winter peak was 2,202 MW.

Table 3-1 Baseline Energy and Demand for 2019

Sector	Annual Electricity Use (GWh)	% of Sales	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	6,552	38%	1,521	982
Commercial	7,743	45%	1,183	911
Industrial	2,733	16%	345	309
Total	**17,028**	**100%**	**3,049**	**2,202**

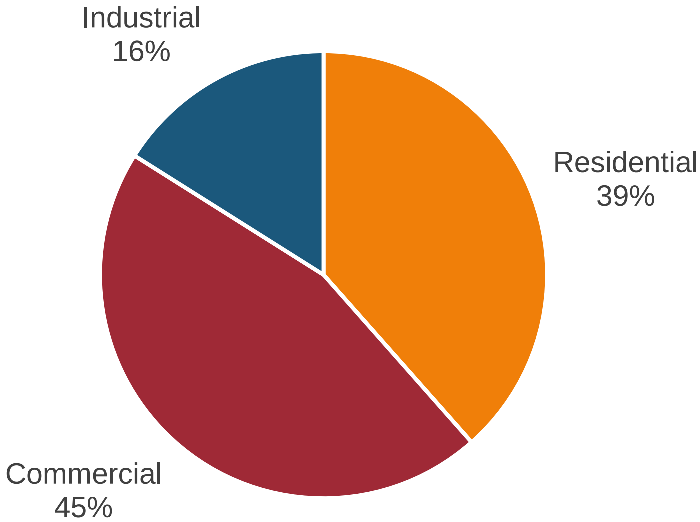

Figure 3-1 Baseline energy use split by sector

3.2 Energy Efficiency

Approach

For energy efficiency, ICF first calculated electricity use baselines in Evergy's service areas using primary data gathered during the study and secondary data from the U.S. Department of Energy (DOE). Baseline analyses were performed for each sector and end use. This baseline data was combined with measure data to calculate the eligible stock, which is the market size for each efficiency measure.

Technical and economic potential were then estimated. Technical potential was calculated as the savings resulting from implementing the most technically efficient measures. Economic potential was calculated as the cost-effective subset of technical potential.

The RAP scenarios are as defined in the previous chapter. In the MEEIA scenario, Evergy has energy savings target of 1.9% of sales and the portfolio is optimized to check if that target can be reached. MAP is the upper limit of achievable potential, where customer incentives equal 100% of measure incremental costs.

Key Takeaways

Technical potential equals a fifth of load in 2023 and three-quarters of this is economic. Residential economic potential is 68% of technical potential, commercial economic potential is 82% of technical and industrial sector economic potential is 86% of technical potential.

Technical and economic potential by end use widely varies by sector. In the residential sector, space heating and cooling comprise 69% of technical potential and 62% of economic potential, while lighting accounts for 11% of technical and 15% of economic, followed by water heating (7% and 9% for technical and economic, respectively). In the commercial sector, lighting is the most important end use, with 38% of technical potential and 40% of economic, followed by space cooling, which accounts for a 24% of technical potential and 18% of economic, then refrigeration (16% and 18% for technical and economic). In the industrial sector, measures that improve plant efficiency, such as pumps, fans, and process heating, constitute 64% of technical potential and 57% of economic potential, and measures that address facility efficiency (space lighting, heating, and cooling) account for 36% of technical potential and 43% of economic potential.

If Evergy continues with its current program designs, load growth could flatten in the short-term before starting to climb through the remainder of the forecast period; in the RAP scenario, load is 4% lower than the baseline over the long run. If Evergy expands current programs and adds new programs, load growth could decline in the short-run before flattening in the medium-term then slowly increasing through 2042; in the MEEIA scenario, load is 8% lower than baseline in the long-run.

Savings levels in the RAP scenario are at the 57th percentile of a benchmarking class of energy efficiency program portfolios administered by 26 investor owned utilities in the U.S. central region in the short-term. This means RAP achieves more savings in the short-term than over half of the comparison group. This increases to the 96th percentile in the MEEIA scenario, meaning performance levels in the MEEIA scenario are higher than 96% of comparable utilities' savings.

Residential savings in the RAP scenario are dominated by lighting. But in the MEEIA scenario, heating, ventilation, and air conditioning (HVAC) is equally important as lighting, and overall savings are more diverse than they are in the RAP scenario. For example, in the MEEIA scenario savings from water heating measures triple because heat pump water heaters are modeled midstream and appliance recycling adds freezer and refrigerator savings.

Prescriptive measures through the Standard program account for most commercial savings in the RAP scenario, but moving prescriptive lighting midstream and expanding the Custom program pushes Custom ahead of Standard in the MEEIA scenario. The Small Business program nearly doubles in the MEEIA scenario. Commercial savings is lighting-driven in both the RAP and MEEIA scenarios, although savings by end use diversifies in the MEEIA scenario. For example, savings from motors grows 350%.

Industrial savings is mostly Standard lighting in the RAP scenario, but Custom becomes the most important industrial offering in the MEEIA scenario as the program expands three-fold over RAP levels, mostly through efficiency improvements to pumps and process heating.

Summary of Results

The impact of energy efficiency programs on baseline load growth is shown in Figure 3-2, and the savings numbers for select years are provided in Table 3-2.

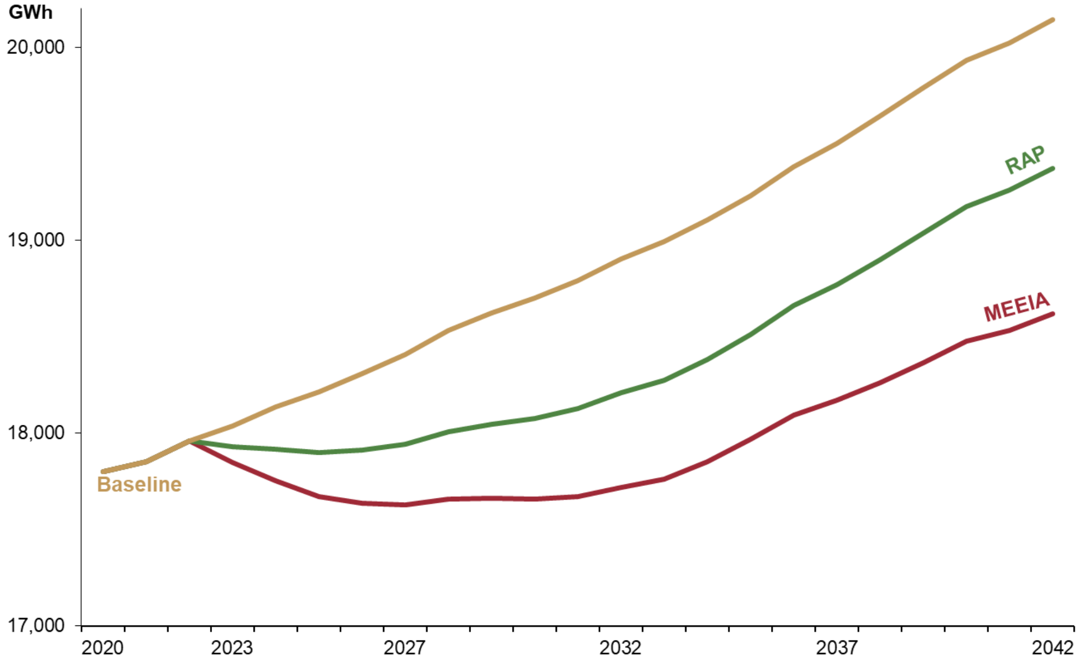

Figure 3-2 Summary of baseline and measure-level EE potential projections

Table 3-2 Summary of EE Potential by Scenario for Selected Years

	2023	2024	2025	2032	2042
Baseline Projection (in GWh)	18,035.3	18,137.9	18,214.3	18,904.5	20,143.8
RAP	107.8	222.3	316.8	697.3	770.1
MEEIA	186.2	387.3	542.1	1,187.7	1,526.9
Economic	2,798.2	2,927.8	3,024.5	3,076.4	1,352.7
Technical	3,677.2	3,751.3	3,801.3	3,814.2	2,829.0
Cumulative as % of Baseline					
RAP	0.6%	1.2%	1.8%	3.9%	4.3%
MEEIA	1.0%	2.1%	3.0%	6.6%	8.5%
Economic	15.5%	16.2%	16.8%	17.1%	7.5%
Technical	20.4%	20.8%	21.1%	21.1%	15.7%

A comparison of the RAP and MEEIA scenarios, along with the savings as percentage of baseline is shown in Figure 3-3, whereas Table 3-3 and Figure 3-4 break down the GWh savings by sector.

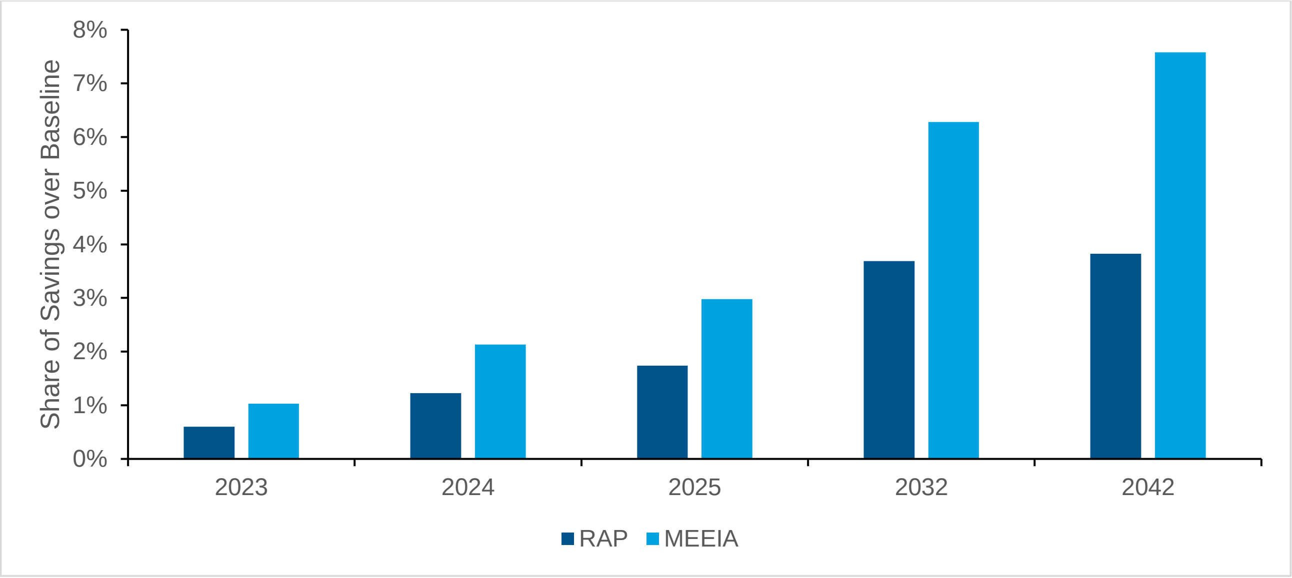

Figure 3-3 Summary of EE potential for RAP & MEEIA for selected years

Table 3-3 Summary of Measure-level EE Potential (GWh) by Sector

	2023	2024	2025	2032	2042
RAP Scenario					
Residential	56.3	90.2	123.4	336.1	424.9
Commercial	40.4	103.8	152.6	299.8	288.7
Industrial	11.1	28.3	40.8	61.3	56.6
MEEIA Scenario					
Residential	81.7	128.8	178.2	480.6	621.2
Commercial	87.5	217.6	308.0	624.5	815.9
Industrial	16.9	40.9	56.0	82.6	89.8

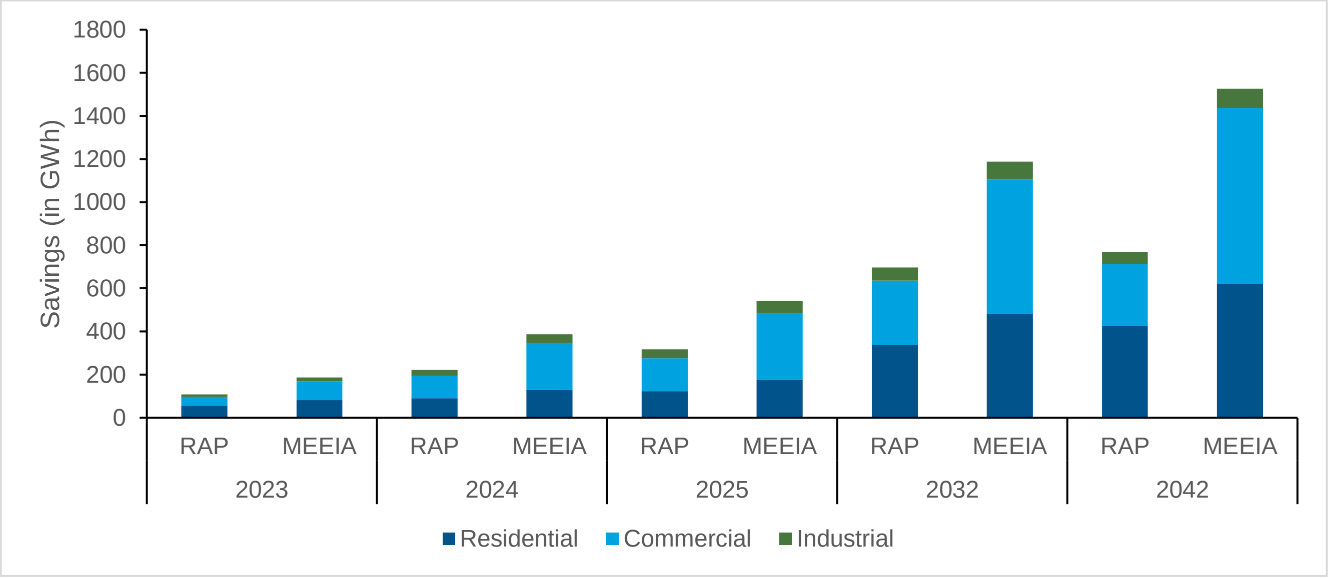

Figure 3-4 Summary of measure-level EE potential by sector

3.3 Demand Response and Demand Side Rates

Approach

The **demand response (DR) and demand side rate (DSR)** component of this potential study assessed technical, economic, and achievable potential in the residential, commercial, and industrial sectors within Evergy's service areas. While technical and economic potential are theoretical concepts for DR and DSR, the achievable potential scenarios provide a comprehensive view of the potential that can be achieved under various assumptions.

The study framework follows the same basic outline as energy efficiency, but the details of the methodology adopted vary significantly for DR and DSR. Appliance Saturation Analysis data was the primary source to estimate the market size for the DR programs, while AMI saturation (at 100%) determined the market size for the rates. The baseline kW usage was guided by the energy usage and simulations for various building types, and the peaks were approximated at various breakdowns—building type and end use. The technical and economic potentials used an unconventional approach of determining the (cost-effective) mix of programs that resulted in the maximum savings.

Six achievable potential scenarios were developed for DR and DSR, with the additional scenario being "Stand-Alone Potential". As in the case of energy efficiency, RAP is the reference case, and RAP- and RAP+ are variants of RAP assuming lower/higher participation levels. The MEEIA scenario was modeled to meet the target of 1% incremental demand each year, in conjunction with the energy efficiency portfolio. MAP is the upper limit of achievable potential when programs are implemented in the hierarchy assumed, while the Stand-Alone Potential aims to provide the absolute maximum potential if the programs were implemented independently and individually.

Key Takeaways

Technical potential equals 41% of peak demand in 2032 and all of this is economic when the screening is done at measure level, similar to the energy efficiency portfolio. Residential potential is 54% of residential load, commercial potential is 23% of commercial load and industrial potential is 5% of industrial load, with the loads being calculated as system peak coincident loads.

Technical and economic potentials by end use widely vary by sector. In the residential sector, space cooling comprises 81% of technical potential, while water heating accounts for 12% of technical and the rest of the end uses take up 7%. In the commercial sector, space cooling is the most important end use, with 65% of technical potential, followed by refrigeration, which accounts for 20%. In the industrial sector, motors accounts for 34% of technical potential, followed by pumps, which accounts for 20%.

If Evergy implements the programs in RAP scenario and achieves the RAP participation levels, load will be 12% lower than the baseline over the long run.

RAP potential is dominated by existing programs i.e. Residential and Small Business Smart Thermostats and C&I Business Demand Response. Smart Thermostats contribute 68% of residential savings, while C&I Business Demand Response constitutes 72% of C&I savings.

Summary of Results

The impact of demand response and demand side rate programs on the baseline summer peak demand growth is shown in Figure 3-5, and the savings numbers for select years are provided in Table 3-4.

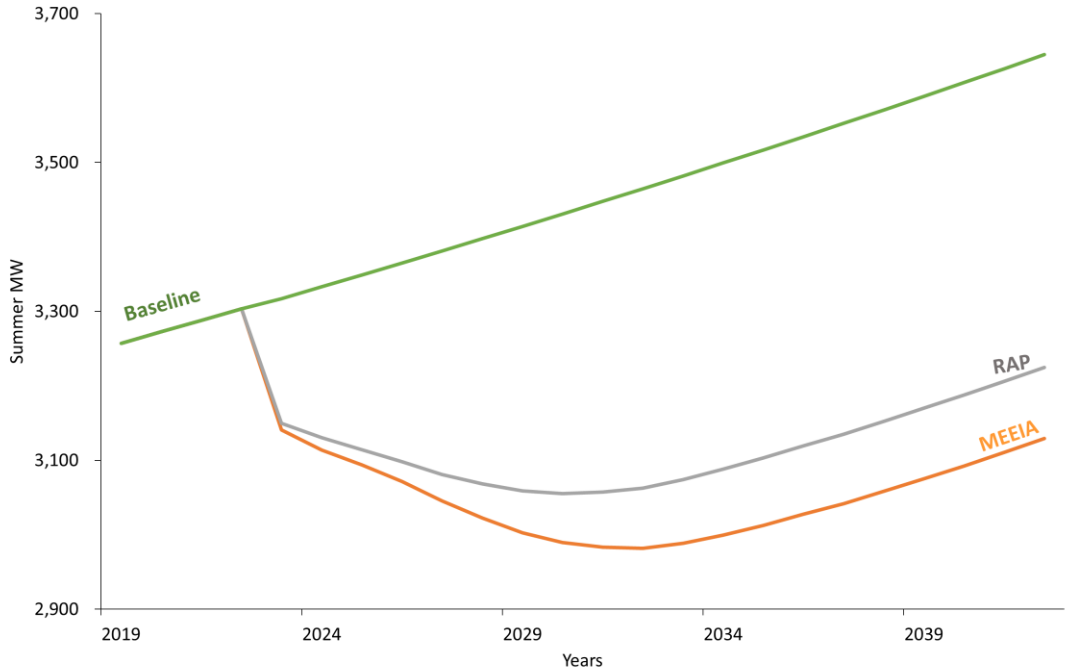

Figure 3-5 Baseline and achievable DR & DSR potential forecasts (summer peak MW)

Table 3-4 Overall Summary of DR & DSR Achievable Potential, selected years

	2023	2024	2025	2032	2042
Baseline Projection (in MW)	3317	3333	3349	3465	3545
RAP (in MW)	167.6	202.6	234.5	402.2	419.7
MEEIA (in MW)	176.2	219.3	254.9	483.0	515.3
Cumulative % of Baseline					
RAP (in %)	5.1%	6.1%	7.0%	11.6%	11.8%
MEEIA (in %)	5.3%	6.6%	7.6%	13.9%	14.5%

The RAP results at a program level are shown in Table 3-5 and Figure 3-6.

Table 3-5 Realistic Achievable Potential by Program (Summer Peak)

	2023	2024	2025	2032	2042	2042 as % Baseline
Baseline Projection (in MW)	**3317.2**	**3332.9**	**3348.9**	**3464.7**	**3545.0**	
Achievable Potential (in MW)	**154.6**	**186.5**	**215.5**	**366.1**	**380.8**	**10.7%**
Business Demand Response	47.2	54.8	60.6	71.9	72.1	2.0%
Hot Tubs	0.0	0.0	0.0	0.0	0.0	0.0%
Real Time Pricing	0.0	0.0	0.0	5.5	7.6	0.2%
Smart Thermostat	104.3	122.3	137.1	187.3	191.2	5.4%
Thermal Storage	0.1	0.3	0.6	3.4	3.7	0.1%
Time of Use	2.5	7.6	14.3	80.0	85.5	2.4%
Water Heater DLC	0.5	1.6	3.0	18.1	20.6	0.6%

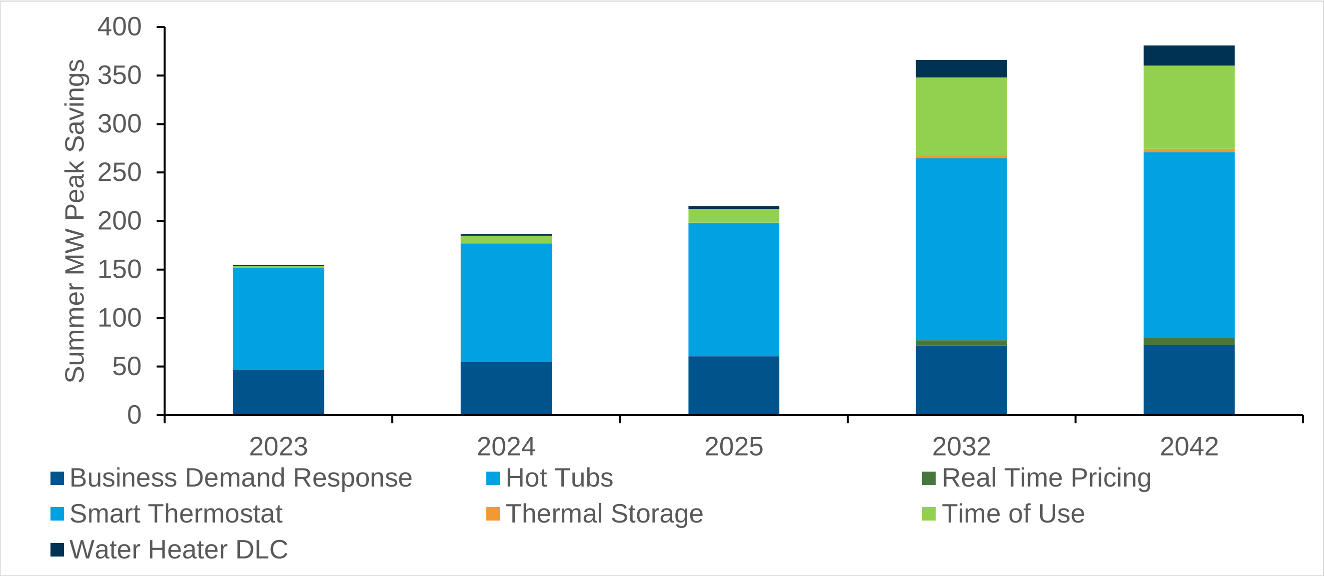

Figure 3-6 Summer RAP peak savings, selected years - all sectors

3.4 Combined Heat and Power

Approach

ICF also conducted a market potential assessment for **combined heat and power (CHP)** in Evergy's Missouri territories. The state of Missouri has been exploring the potential benefits of CHP in terms of both resilience and energy efficiency. The Missouri Department of Natural Resources, Division of Energy has been actively involved in multiple Department of Energy (DOE) Accelerators related to CHP and has held CHP summits focused on CHP for resilience in the Healthcare and Education sectors throughout the state. Officials have also participated in regulatory proceedings and provided testimony to the Missouri Public Service Commission (PSC) regarding to highlight CHP energy savings and resilience benefits for future growth and deployment.

As a final consideration for demand-side programs, ICF conducted a market potential assessment for combined heat and power (CHP) in Evergy's Missouri territories.

CHP is unlike most energy efficiency measures for several reasons, including:

- CHP systems generate electricity, rather than conserve it. The increase in efficiency occurs as a result of heat recovery and avoided T&D line losses.
- CHP systems are sized to cover baseload electric and thermal requirements throughout the year, so a single installation can produce a large amount of energy savings.
- CHP systems are complex machines that require specialized maintenance.
- A CHP system represents a substantial capital investment.

CHP saves energy through two mechanisms: 1) avoided line loss from electricity delivery, and 2) avoided boiler fuel for heating loads displaced by recovered CHP heat. The energy efficiency benefits of CHP are summarized in Figure 3-7.

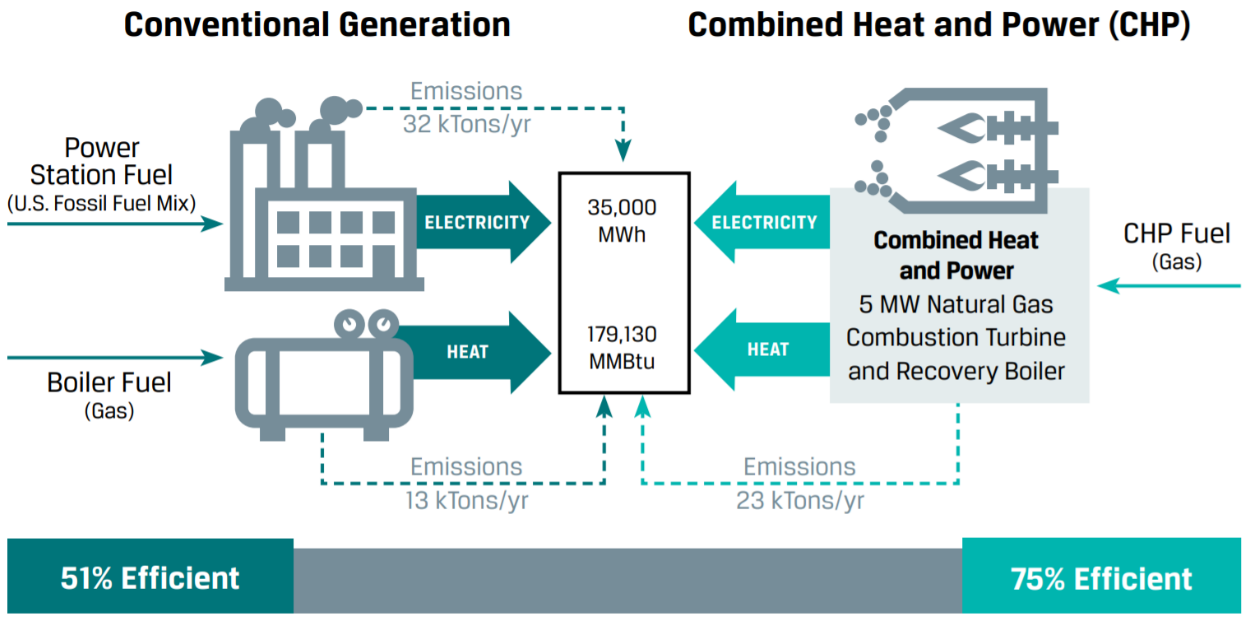

Figure 3-7 CHP Efficiency benefits

In order to estimate the technical potential for CHP in Evergy's Missouri territories, ICF matched customer data from Evergy with its CHP Technical Potential and CHP Installation databases. The analysis used electricity consumption data, combined with thermal-to-electric load ratios, to determine the potential size of a baseload CHP installation for each customer. It then compared expected cost, performance, and energy bill savings for CHPs in that size range to separate heat and utility power purchases.

After characterizing the technical potential, as well as the economic potential and expected market adoption of CHP in Evergy's Missouri territories, ICF applied the Total Resource Cost test to evaluate the benefit/cost ratio and the economic and achievable potential at the program level.

Key Takeaways

There is 270 MW of technical potential for CHP. This potential is primarily centered in food processing, hospitals, chemicals, data centers, and commercial buildings.

Despite the potential, economics for CHP in Evergy Missouri's service area were not found to be favorable, and they are not expected to improve in the near term. Only 10 facilities, or 1.2% of all potential sites, are estimated to have a payback period under 15 years. These facilities total 3.2 MW of potential. In addition, no potential CHP site within Evergy's territory passes a TRC test when estimated costs and benefits are applied. Despite there being a high number of potential CHP sites within Evergy's Missouri service areas, CHP is not currently a recommended resource for energy efficiency.

Summary of results

ICF estimated 270 MW of technical potential in the Missouri territories, broken down by size range and territory in Figure 3-8.

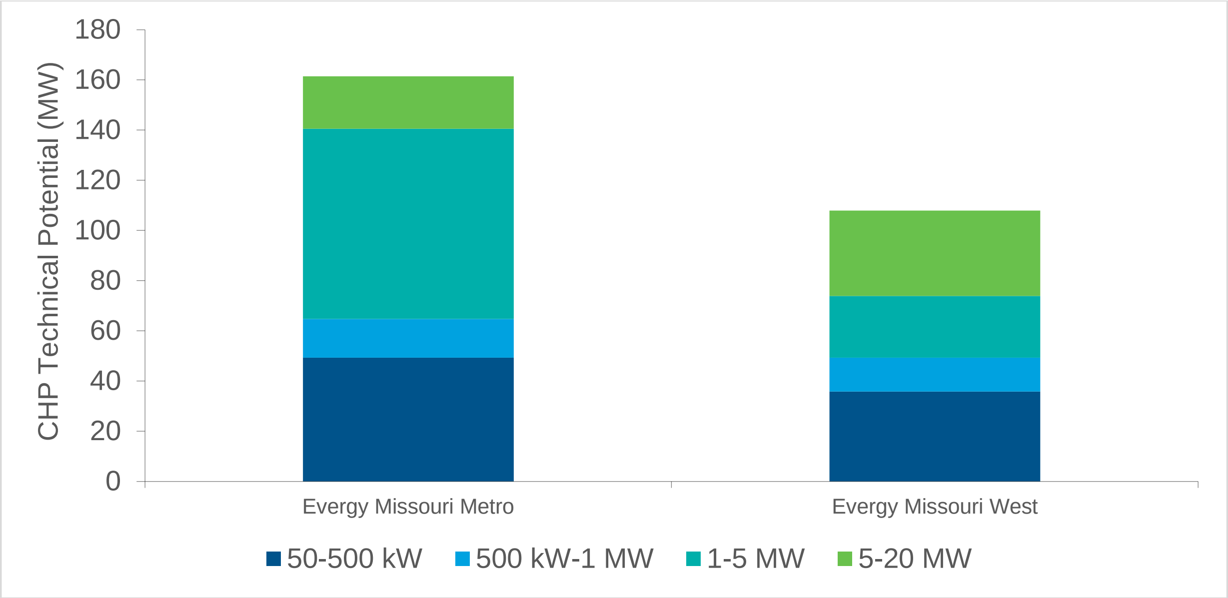

Figure 3-8 Technical potential for CHP in the Evergy MO West and Metro territories

Throughout both of Evergy's Missouri territories, there were no facilities estimated to have potential to install a CHP system over 20 MW in size. Typically, these installations occur at large industrial facilities, and they can be some of the most economical CHP systems.

To model the economic feasibility of CHP within Evergy's service area, ICF applied Evergy energy rates and CHP cost and performance values from the 2016 DOE CHP Fact Sheet series to sites with technical potential for CHP. ICF found two customers that could achieve a payback period under 10 years, and eight additional customers able to achieve a 10 to 15-year payback.

Due to challenging economics for CHP in the absence of incentives, there is no adoption expected for the baseline scenario. This aligns with what has been seen in the Missouri CHP market recently, with only one CHP system installed in Evergy territories over the past ten years, a five MW boiler/steam turbine at a district energy plant.[3]

Table 3-6 Evergy TRC Results for CHP

CHP Size Range	Representative System	Life (years)	TRC Ratio (2023)
<500 kW	100 kW Recip Engine	15	0.77
500-999 kW	633 kW Recip Engine	15	0.91
1-5 MW	3.3 MW Recip Engine	15	0.94
5-20 MW	10.7 MW Gas Turbine	20	0.98
>20 MW	20.4 MW Gas Turbine	20	1.11

ICF applied TRC tests to the lowest cost CHP options, incorporating CHP electricity benefits, displaced boiler benefits, CHP system costs, CHP fuel consumption, utility administration costs, and federal tax credits, as applicable. The results from this test (see Table 3-6) show that only gas turbines larger than 20 MW are estimated to have a TRC ratio greater than one for projects starting in 2023.

[3] U.S. Department of Energy, CHP Installation Database, maintained by ICF, https://doe.icfwebservices.com/chpdb/

As noted earlier, there are no buildings within Evergy Missouri's service area that can host a 20 MW CHP system when sized to on-site power requirements. Therefore, there is no achievable potential for CHP in either of Evergy's Missouri territories.

When UTC tests were applied assuming a generous CHP incentive (up to 50% of project costs, capped at $2 million), CHP systems over 500 kW in size were able to achieve a UTC Ratio higher than one. However, since no systems pass the TRC test, no achievable potential was modeled.

4. Reference Guide

The following key assumptions were made in the study.

The following key assumptions were made in the study:

- **Technical potential** is the level of energy and demand savings that would result from installing the most technically efficient measures available for each end-use, regardless of cost. It is the upper bound of how much could theoretically be saved.
- **Economic potential** is the cost-effective subset of technical potential based on the Total Resource Cost test.
- **Achievable potential** is the amount of energy savings that can realistically be achievable by energy efficiency programs.
- **Level of savings used in the analysis:**
  - **Savings at meter** are reported only in the baseline analysis.
  - For all other purposes, including cost-effectiveness testing and reporting, savings are **at generator.**
- **Low income/income eligible**: Defined for the purposes of the study consistent with Evergy's income eligible program requirements.[4]
- **Dollar denomination**: Program costs are reported in nominal dollars in the Appendix. Evergy's assumption for inflation is 2.5% per year.
- **Opt-outs**: Savings impact levels, e.g. megawatt hour (MWh) savings as a % of MWh sales, do not account for opt-outs[5].
- **Demand response and demand-side rates opt-in and opt-out mode of program delivery**: All demand response and demand side rate programs were assumed to be opt-in programs, except Time of Use in MAP scenario only.
- **Economic screening**: All measures were screened for cost effectiveness using the Total Resource Cost (TRC) test. All programs were screened for cost effectiveness using the Societal Test, the TRC test, the Program Administrator Cost (PAC) test, the Participant Cost Test (PCT), and the Ratepayer Impact Measure (RIM) test. Benefits and costs used in these tests are consistent with Missouri Public Service Commission rules. The primary benefit-cost test is the TRC.
- **Gross program kWh savings**: Program kilowatt hour (kWh) savings for a specific period of performance as calculated and reported by the administrator in the conduct of program evaluation, measurement, and verification (EM&V), prior to application of any "ex post"/net savings adjustments specific to the program for the same performance period. Additionally, gross savings do not account for any net-to-gross assumptions/factors developed for the purposes of program planning; "ex ante" program kWh savings if the jurisdictional definition of "ex ante" excludes the application of all net-to-gross planning assumptions.
- **Net program kWh savings**: Program kWh savings for a specific period of performance as calculated in the conduct of program EM&V, inclusive of all net savings adjustments or factors (free-ridership, spillover, etc.) required by the administrator's regulator for calculating program net-to-gross ratios and/or net savings; "ex post" program kWh savings.
- **Naturally occurring energy efficiency**: Energy savings resulting from actions taken by Evergy customers in the absence of any help from Evergy's energy efficiency programs.

[4] https://www.evergy.com/ways-to-save/programs/energy-efficiency/income-eligible-weatherization

[5] A customer may opt-out of funding DSM programs in Missouri if (a) they have at least one account with 5MW of demand or more, (b) the sum of all their accounts have at least 2.5 MW of demand, or (c) they are an interstate pipeline pumping station.

- **Codes & standards assumptions**:
    - Energy Independence and Security Act of 2007 (EISA 2007): due to pending litigation over Tier 2 of EISA 2007 it was assumed that minimum energy performance standards for general service light bulbs do not change over the time horizon of the study. The exception is the RAP- scenario where it was assumed that Tier 2 is implemented in 2023.
    - New Federal minimum energy performance standards for heat pumps go into effect in 2023.

      Building new construction: the ICC 2018 International Energy Conservation Code (IECC) is the current energy code in Missouri. It references ASHRAE Standard 90.1-2016 for commercial construction.
- **Fallback**: It was assumed that customers implementing energy efficiency measures as a result of Evergy programs would implement the same measures in the future once the existing measures expire, but without help from Evergy programs.

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