Measure, Application, Segment, Industry (MASI): Finding the Remaining Energy Efficiency Potential through Market Assessment

Greg Wikler, Angie Lee, Nicole Reed Fry, Navigant Consulting, Inc.
Reginald Wilkins, Southern California Edison
Rafael Friedmann, Pacific Gas and Electric Company
Loan Nguyen, Southern California Gas Company

ABSTRACT

Energy efficiency investment for the industrial sector faces a myriad of market and business challenges. At the same time, there is an increasing need to identify opportunities for deeper program savings from these sectors. Identifying the remaining energy efficiency opportunities for these sectors requires an understanding of sector-specific technologies, customer behaviors and needs, and dynamic policies and market forces.

This paper highlights the results of a market assessment study (the Measure, Application, Segment, Industry, or MASI study) that was recently undertaken for the California investor-owned utilities (IOUs) to examine untapped energy efficiency potential across a variety of nonresidential markets, including the food processing, refineries, oil & gas production, and wastewater treatment segments.

The study leveraged recent evaluation data and industry expert knowledge to prioritize key market segments and applications with untapped energy efficiency potential. In-depth interviews with utility program managers, facility managers, and subject matter experts provided rich perspectives to inform the research.

The study addresses three key drivers in the California energy efficiency market – policy, market, and technology:

- *Policy*: An examination of federal and state policy factors such as existing codes and standards and Industry Standard Practice;
- *Market*: Insights on segment-specific business operations such as supply chain, decision making processes, facility operations, production, and seasonality;
- *Technology:* Segment-specific efficiency measures with technical and market potential that exceeds standard practice.

This paper highlights the results of the collaborative research effort, the results of which are described in more detail in the individual MASI reports. The findings will benefit implementers interested in conducting similar market studies or seeking current industry knowledge.

Introduction

Energy efficiency investment for the industrial sector faces a myriad of market and business challenges. At the same time, there is an increasing need to identify opportunities for deeper program savings from these sectors. Identifying remaining energy efficiency opportunities requires an understanding of sector-specific technologies, customer behaviors and needs, and dynamic regulatory and market forces. Furthermore, given the heterogeneous nature of this market, it is quite likely that one size does not fit all. To address these challenges, the California IOUs commissioned the Measure, Application, Segment, Industry (MASI) study, a market research study with utility program design in mind, with a goal to discover remaining energy efficiency savings opportunities in target commercial and industrial (C&I) markets. Building on previous market characterization research in California, this work sought to address program implementation information needs through deliberate and ongoing engagement with program administrators and field staff.[1] This engagement was critical to identifying key research areas, continuously reviewing findings, and obtaining feedback and further sources of information. The effort goes beyond traditional market study approaches towards a deeper collaboration with program implementers and regulators to ensure the research was relevant and credible.

Approach

The California IOUs enlisted Navigant Consulting and a technical engineering firm subcontractor, ASWB Engineering, to conduct a market research study (i.e., the MASI study) examining untapped energy efficiency potential across a variety of nonresidential markets. The team used the California Statewide Potential and Goals Model (Potential Model) and other technical literature to focus the scope of the study and first identify industries with the highest technical potential. Navigant highlighted industries with relatively high energy consumption, high remaining energy efficiency potential, and high level of interest from the California IOUs.

The team then leveraged recent evaluation data and industry expert knowledge to prioritize key market segments with untapped energy efficiency potential. Savings, cost, and market data in the Potential Model from the Rutgers University Industrial Assessment Centers Database (IAC) and other secondary literature helped identify common cost-effective energy efficiency measures in each industry.[2]

Finally, the team conducted in-depth interviews with utility account managers, subject matter experts, and industrial facility managers to understand key barriers and drivers to the market and provide industry specific findings to the California IOUs. Across the seven MASI reports, the Navigant team conducted over 100 interviews including 68 facility manager interviews, of which, 33 interviews pertain to sectors discussed in this paper.

Key Findings and Recommendations

This section summarizes industry-specific findings and recommendations from the five industrial sector-focused MASI reports: food processing, motors, refinery motors, wastewater treatment, and oil and gas.[3]

Food Processing Findings

California's food processing industry consumes more than 600 million therms of natural gas and over 3,700 million kilowatt hours of electricity per year. In fact, food processing is the third largest industrial energy user in the state (CEC 2008). Amongst the different food

[1] Previous California market research studies include but are not limited to studies completed by XENERGY for PG&E in 2001, and KEMA for PG&E in 2012, and industrial customer decision-making papers by Michael Sullivan for CPUC in 2009, and work by Neal Elliot and Christopher Russell et al. at ACEEE.
[2] The IAC was one of several secondary data sources used for this study. The IAC focuses on mid-sized manufacturing and therefore should not be considered as comprehensive for the target sectors in this study.
[3] The authors excluded findings from the two of the seven MASI reports, Chain Operations and Integrated Design for New Buildings, since the focus of the ACEEE Summer Study is Energy Efficiency in Industry.

processing industries, cheese manufacturing, wineries, and canning are the top energy consumers within California's food processing sector.

Historically, the food processing industry has been slow to adopt new technologies as the industry is heavily regulated by food safety and sanitation standards. All energy efficiency upgrades activities must not jeopardize the facility's compliance with food and safety regulations. In general, facility managers show strong interest in further understanding their energy consumption pattern at a more localized capacity. However, energy management and monitoring systems are cost-prohibitive to food processors as the industry has low profit margin and an average of less than three year payback period. Due to the lack of knowledge sharing across the food processing industry, energy efficiency knowledge gap is prevalent especially amongst smaller facilities.

Seasonality is a characteristic that impacts savings for some food processors such as the fruits and vegetable canning industry as savings can only occur during the facility's operating season. Specific to wineries, the current multi-year drought in California made it increasingly difficult to make business cases to obtain capital allocation for energy reduction projects, with higher prioritization placed on water and irrigation projects.

Using secondary literature and data from the industrial assessment database, Navigant identified the measures with highest energy savings potential in the food processing sector. Note that California Title 24 requires minimum boiler efficiency which limits the potential for boiler power burner. The following table summarizes the top measures for electric and gas savings.

Table 1. Top Measures by Electric and Gas Savings Potential for the Food Processing Industry

Rank	Electric Measures	Electric Savings (GWh/year)	Gas Measures	Gas Savings (MM therms/year)
1	Refrigeration Operations and Controls	354.6	Steam Trap Replacement	22.6
2	Fan VFD	222.0	Boiler Tune-up	17.1
3	Air Compressor CFM Reduction	123.4	Power Burner	10.3
4	High Efficiency Lighting	98.6	Air Compressor Heat Recovery	6.9
5	Properly Sized Pumps	49.9	Heat Recovery Hot Water	4.3

Food Processing Recommendations

- **Provide expert advice through energy audits in the planning stages of construction.** Two facility managers and the trade association subject matter expert expressed that a thorough energy audit would help food processing customers identify energy saving opportunities in their facilities. Additionally, receiving expert advice during the early stages of construction could allow the facility to implement energy efficient measures at a lower cost.
- **Provide energy management tools/equipment.** Four out of seven of facility managers felt that they would benefit from software tools or equipment that could help them better understand their energy consumption and target energy-intensive equipment or production areas. Utilities may help promote existing educational tools such as the BEST

Dairy Benchmarking Tool for better understanding facility energy consumption in the dairy industry and the Lawrence Berkeley National Laboratory (LBNL) “BEST-Winery: Benchmarking and Energy and Water Efficiency Savings Tool” for wineries. Industry resources such as the Pacific Energy Center Tool Lending Library by PG&E, SDG&E Energy Innovation Center Resource Library & Tool Lending Library, and SCE’s Energy Manager can all help facility managers understand and assess site and equipment level energy consumption and learn more about energy conservation.

- **Promote water recycling opportunities.** Water intensive processes are common amongst many food processing sites. According to the California Food Processing Industry Technology Roadmap, the fruits and vegetable processing industry, cheese manufacturing industry, and wineries are the most water-intensive food processing industries in California. Water recycling and conservation measures could help these sites reduce their water usage and the energy consumption associated with water use.

Industrial Sector Motors Findings

Motors significantly contribute to the energy consumption of industrial facilities. According to the 2010 Manufacturing Energy Consumption Survey (MECS), machine drives represent anywhere from 30 to 88 percent of facility electricity use depending on the industry. Navigant focused the motor study on motors for chemical, cement and building materials, wastewater treatment, and food processing industries as these industries have high machine drive usage.

Due to the increased federal efficiency standards put in place by the Energy Security and Independence Act of 2007 (EISA), the overall motors stock has become more efficient. In addition, California Title 24 implemented motor requirements reaching beyond the NEMA Premium Efficiency levels.

Navigant researched motors characteristics in the investigated sectors to further understand industry practice. Through facility manager interviews, Navigant find that motor characteristics such as size, replacement practice, and the prevalence of specialized motors varies by industry, as does awareness and interest in energy efficiency. Table 2 summarizes the findings from in-depth interviews with facility managers from the target industries.

Table 2. Summary of Motors Characteristics by Industrial Subsector

Sector	Motor Size (hp)	Repair/ Replace Practice	Industry Awareness of EE	Industry Interest in EE	Standard/ Specialized Motors	Seasonal/ Continuous
Chemicals	<10	Replace (<50 hp) Rewind (>50 hp)	Medium	Medium	Specialized	Varies
Cement/ Building Materials	10-200	Replace (<100 hp) or Green Rewind	High	High	Standard	Continuous
Wastewater	10-200	Replace (<20 hp) or Green Rewind	High	High	Standard	Continuous/ Rotating
Food Processing	<10	Rewind Specialized. Replace others	Mixed	Low	Specialized	Continuous and Seasonal

Source: Facility Managers Interviews, Navigant Analysis 2015, n=8

When deciding whether to replace a motor, facility managers across all industries prioritize payback period and facility downtime, and in some cases these factors are interrelated. For example, industries with seasonal operations such as food processing have longer payback periods for efficient motor measures since energy savings do not add up as quickly as a facility that runs continuously throughout the year. Since production is the priority for industrial facilities, facility managers prefer replacement practices that cause less interruption on production. Having spare motors on the shelf is a common practice for industrial facilities, especially when the industry has specialized motors for specific applications. It is common for facility managers to replace motors with readily available motors on the shelf in order to minimize downtime. In addition, sectors with specialized motors such as the chemical industry are more likely to rewind than replace their motors as specialized motors are expensive to purchase.

A common suggestion across motor subject matter expert interviews is to focus not on the motors themselves but on the equipment driven by those motors. For example, attaching a 1 percent more efficient motor to a 60 percent efficient pump does not give you as much energy savings as increasing the efficiency of the pump itself. Since pump efficiency can degrade by up to two percent per year,[4] this may be one area to explore for future program opportunities.

Industrial Sector Motors Recommendations

- **Consider incentives for green rewind.** Most subsectors in California have established protocols for rewinding certain motors instead of replacing them. Instead of attempting to change these customer protocols, there is a way to get savings out of quality rewinds. Dubbed "green rewinds," a quality rewind can achieve a higher motor efficiency. Rebates for green motor rewinds could encourage facilities to use a certified green-rewind shop to repair and rewind their motors. There are currently two options for best-practices certification: the Green Motors Practices Group (GMPG) Green Motors Initiative and a recently-launched accreditation program through the Electrical Apparatus Service Association, Inc. (EASA).
- **Conduct education regarding motor system efficiency.** Motor efficiency programs often overlook system efficiency. When an existing motor might be 94 percent efficient, upgrading that motor one efficiency band will not gain much efficiency if the pump attached to that motor is running at 60 percent efficiency. Incentivizing driven equipment such as pumps presents an opportunity for further efficiency gains, especially for facilities that already have highly efficient motors. Navigant understands that there are pump efficiency programs and others incentivizing more efficient driven systems, but suggests these be linked to create a comprehensive suite of options for driven systems. The suite could have rebates for high efficiency components that are most popular – fans, compressors, and pumps – and include more customized options for other technologies.

Refinery Motors Findings

With refineries located in the San Francisco Bay area, Los Angeles area, and the Central Valley, California's 20 refineries process approximately two million barrels of petroleum into a variety of products each day. A refinery produces many different products; however, the four

[4] SME interview.

basic groups include motor gasoline, aviation fuel, distillate fuel, and residual fuel (California Energy Commission Energy Almanac). Interviews indicated that refineries operate year round, with minimal scheduled and unscheduled maintenance time as “production is king.” Due to California’s large demand for gasoline, utilization rate, which is the ratio of barrels of input to the refinery operating capacity, is very important and some refineries have utilization rates as high as 95 percent.

Electric motors are used throughout the refinery and according to a 2005 study done by LBNL, represent over 80 percent of all electricity used in refineries. Major applications include: pumps (60% of motor use), air compressors (15%), fans (9%), and other applications (16%) (LBNL 2005). Refinery facility personnel and subject matter experts agreed that pumps and air compressors are the main applications of motors, with other applications including fans and mixers. The LBNL data indicated that most petroleum refineries can economically improve energy efficiency by 10-20 percent, with 10 percent of those savings coming from motor and motor applications, indicating that even a decade ago the maximum economic potential from motors and motor applications was only 1-2 percent (LBNL 2005).

The key take-away is that motor vintage and efficiency vary depending on facility and motor size. Motors typically operate close to 8,760 hours/year and the majority of motors are small and not specialized.

Table 3. Refinery Facility Motors Inventory

	Interview 1: Small Refinery	**Interview 2: Large Refinery**
Motor Vintage	1920—present	15 years–present
Motor Efficiency	Rewound several times to NEMA Premium Efficiency	78%—96%
Number of Motors	“Too many to list”	“Too many to list”
Typical Annual Runtime	8,760 hrs./year; no longer run motors lead/lag	7,500—8,000 hrs./year; No longer run motors lead/lag
Motors w/ VFDs	Several	Some VFDs installed which received utility incentives
Type of Specialized Motors	Cooling Tower Motors	Most are “off-the-shelf” to provide rapid replacement
Energy Consumed: Small vs. Large Motors (%)	80% energy consumed by motors under 100 hp	Not answered

Source: Facility Managers Interviews, Navigant Analysis 2015, n=2

In the refinery industry, increased reliability is the main driver for upgrading equipment, as the goal of the industry is to maximize production. In the past, refineries used to run two critical motors in parallel and share the annual 8,760 hours/year between the two motors. If one motor failed, then the other motor is already hooked up to run in its place. However, according to a SME who has worked at three refineries over the last three decades, this lead-lag approach is almost nonexistent in large refineries today, with refineries trending toward running both motors simultaneously to maximize production.

Another market trend that seems to differ between small and large refineries is the repair/rewind vs. replace decision. The decision matrix varies across refineries leading to the recommendation for California IOUs to continue to implement a custom approach to replace refinery motors. The small refinery interviewed repaired/rewound the majority of their motors (despite motor size) and the large refinery mainly only rewound motors over 1,000 hp. The maintenance team at the large refinery would rather replace even the large motors; however, replacement takes more time than repairing/rewinding these motors, and is often unrealistic as the goal is to get the plant back in operation as soon as possible. A utility expert indicated that their understanding was that some companies have rules of thumb for all motors sent to the shop (typically 25 Hp and larger) and that if the repair is 50% or less compared to the cost of a new motor, the refinery repairs the motor. Due to security concerns, refineries would not share their motor inventory, therefore it is difficult to get an actual account of energy savings from motors replacements.

Two facility managers and four industry experts agreed that they would not recommend that utilities run a motor early retirement program. Even though some opportunities exist, the structure of an industry that maximizes production by limiting downtimes to every two to five years, does not mesh with the current design of incentive programs that could drag a project well beyond the shutdown window, causing the refinery millions of dollars in lost production.

Refinery Motors Recommendations

- **Develop a custom approach for motor improvements.** The most favorable selection of energy efficiency opportunities should be made on a plant- specific basis (LNBL 2005). With 20 refineries operating in California, program managers seem to already be working closely with facility managers. Navigant recommends that utilities work with refineries on an individual basis to target custom motors that could be replaced. The success of taking the custom approach is supported by the fact that a California utility program manager is currently working with a refinery client to replace what is considered an inefficient 9,000-hp motor when compared to existing motors on the market. Navigant recommends that utilities particularly focus on working with smaller refineries on a case-by-case basis, as they seem to repair or rewind a much higher percentage of their motors than larger refineries, resulting in additional existing savings potential.

Wastewater Treatment Findings

Wastewater treatment facilities represent a unique subsector of the industrial sector. Though these facilities are bound by reliability constraints and consume much of the energy attributed to water infrastructure, their governance structures are largely municipal or semi-municipal. As utility agencies themselves, they do not serve overlapping areas, and therefore do not compete for business with each other. This contributes to an atmosphere of collaboration among entities in which the sharing of best practices is welcome and bragging rights emerge over the most advanced technologies.

The wastewater study focused on technologies including biogas recovery, aeration, sludge processing, variable frequency drive (VFD) pumps, and ultraviolet (UV) disinfection. In estimating technical potential, Navigant considered small and large plants separately, and defined small plants as processing, on average, 10 million gallons per day (MGD) or less of wastewater, and large plants processing more than 10 MGD. Table 4 shows electricity savings potential at wastewater treatment facilities for the technologies of interest, and Table 5 shows gas savings potential.

Table 4. Electricity Savings Potential for Selected Measures

Measure	Small Plants (≤10 MGD)		Large Plants (>10 MGD)	
	Site Saving Potential (%)[5]	CA Potential (kWh)	Site Saving Potential (%)[6]	CA Potential (kWh)
Methane/biogas recovery for electricity generation	34%	74,379,000	27%	151,884,000
High-speed turbo blowers	7.8%	28,080,000	7.8%	46,800,000
Turblex blowers	N/A	N/A	26.0%	156,000,000
Other VFD blowers[7]	8.5%	154,000	8.5%	922,000
Fine bubble diffusion	18%	131,040,000	18%	72,800,000
VFD pumps[8]	1.7%	13,860,000	7.7%	154,000,000
Low-pressure UV lamps	6.0%	9,608,000[4,]	6.0%	24,020,000
Total		345,887,000		1,538,904,000

Table 5. Natural Gas Savings Potential for Selected Measures

Measure	Small Plants (≤10 MGD)		Large Plants (>10 MGD)	
	Site Saving Potential (%)	CA Potential (kWh)	Site Saving Potential (%)	CA Potential (kWh)
Replacing natural gas usage for heating	100%	5,897,000[9]	0%	N/A

Wastewater Treatment Facility Recommendations

- **Consider plant size.** Small facilities (<10 MGD) and large facilities (>10 MGD) have vastly different energy intensities, budgeting processes, priorities, and needs. For these reasons, future studies should consider small and large facilities separately. Many large plants have captured the low-hanging fruit and are looking to the next frontier of energy savings. Utilities can serve as a resource for providing information on the most advanced features, continuing to fund pilot studies of emerging technologies, and generally helping plants develop customized solutions for their needs. Small plants on the other hand are not as sophisticated and many, because of their size, do not have the resources to invest in

[5] Source from Energy Efficiency in Water and Wastewater Facilities, EPA (2013), and Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities, EPA (2010)
[6] Ibid
[7] Improved aeration efficiency measures only apply to plants that use activated sludge. One of the interviewees did not use activated sludge; however, it was a small plant in a cold environment. Based on data from the WEF Biogas Project, we estimated that 90% of small plants use activated sludge. Of those, we assumed half would implement high-speed turbo blowers and the other half would implement VFD blowers.
[8] Interview findings suggested that most plants are already using VFD pumps in some applications, but all plants have at least some non-VFD pumps that could be converted to VFD.
[9] Calculated from percentage of California plants that have anaerobic digestion but do not use the gas for heating. Only one plant larger than 10 MGD (out of 50 total) had anaerobic digestion but did not use the biogas for heating. Source: WEF Biogas Data Collection Project.

advanced technologies. More study needs to be done on energy efficiency measures that would be appropriate for smaller plants, as well as the expected energy savings.

- **Help customers handle competing regulations:** Utilities should help customers save energy even in the presence of competing regulations from the Air Quality Management Districts in California, which restrict emissions from biogas-using equipment. Utilities may not be able to affect the regulations, but should adapt their incentives to the fact that the barrier is no longer producing biogas but making that biogas usable.
- **Focus on process as well as technology.** Utilities should look beyond specific technologies to consider how the treatment process itself can be improved. Beyond the low-hanging fruit, the logical next step for some plants could be redesigning the process.
- **Continue long-term relationship development through account managers.** California utilities should continue to be both proactive and responsive in their communications with WWTPs. Interviewees at wastewater treatment facilities consistently saw their relationship with their utility account managers as positive.
- **Continue to share industry knowledge.** Utilities should stay educated and up-to-date on advanced technologies and energy-saving measures. Since WWTPs generally do not compete with each other, they are willing to share their knowledge among themselves. Likewise, utilities must be willing and able to both share knowledge with treatment plants and learn from them in order to continue to promote energy savings in the industry.

Oil and Gas Extraction Findings

Navigant's 2013 Potential Study analysis indicated that the oil and gas extraction industry accounts for about two percent of California's industrial electricity and natural gas usage. In 2012, the five largest oil fields in California,[10] which are all located around Bakersfield in Kern County, produced 54% of the state's oil.

Most of California's working oil fields have been producing oil for more than 50 years, and enhanced oil recovery (EOR) techniques are often used to enable oil production at most locations, according to oil producers in California.

Oil extractors are divided into two categories: major producers and minor producers. Major producers, defined by the CPUC Energy Division as oil and gas producers that produce more than approximately 15,000 barrels of oil per day, account for 77% of total oil extracted in California. Smaller producers are considered minor producers. Of the seven oil producers interviewed for this study, three are major oil producers in California. Table 6 lists energy saving measures for the oil and gas sector and describes the adoption rates of these measures for major and minor producers.

Table 6. Energy Savings Opportunities in Extraction Processes

[10] Oil fields include: Midway-Sunset, Belridge South, Kern River, Cymric and Elk Hills

Measure	Major Producers	Minor Producers	New Savings Potential	Availability
	% Implemented			
Pump Off Controller	100%	50%	High	Fully Developed
MotorWise® Controller	N/A	N/A	High	Being Evaluated
Cogeneration	100%	10%	Low	Fully Developed
Pipe Resizing	100%	30%	Low	Fully Developed
Electrical Distribution	100%	10%	Low	Fully Developed
Heat Recovery/Exchanger	0%	0%	Low	Needs Evaluation
VFDs on ESPs and Injection Pumps	100%	80%	ISP	Fully Developed

Source: Facility Managers Interviews, Navigant Analysis 2015, n=7

Oil and Gas Extraction Recommendations

- **Major oil producers do not require new energy efficiency programs.** All three major oil producers uniformly stated that they were actively exploiting all available efficiency opportunities. They consider energy efficiency an integral component of their operations due to the size of their operations and the significance of energy costs. These major oil producers implement energy efficiency projects on their own, with little assistance from the IOUs. The team does not recommend that the IOUs developing new energy efficiency programs for the major oil producers.
- **Provide technical assistance and incentives to minor oil producers.** All minor oil producers interviewed stated that they have extremely limited resources to pursue energy efficiency opportunities. Due to their small size, they do not have the personnel to research which energy efficiency technologies should be considered, or the technical resources to install and operate such technologies. They also have limited financial resources for the upfront investment in new energy efficient equipment. Thus, minor oil producers might benefit from IOU programs with incentives and technical assistance.

Cross-Cutting Insights

As shown in the full MASI study results, customer purchase decisions for energy efficiency technologies vary by business objectives and operation practices. However, there are several themes consistent across all industries researched in the MASI study:

- **Sub-sector market research can help programs better understand and work within the business practices of each industry to help customer engage with energy efficiency programs.** The nature of some industries' business practices may significantly affect their willingness to engage with utilities. Some industries such as wastewater treatment exhibit an open/collaborative environment while others such as oil refineries opt for close and confidential due to the competitive nature of their business. Sub-sectors within a larger industry (e.g., wineries within food processing industry) may operate within different regulatory and business environments. It may make sense to tailor programs and market to these sub-sectors differently.

- **Main driver is payback period but some industries face other drivers and barriers.** Consistent across industries, short payback period and minimizing production downtime are the top considerations when facility managers consider equipment replacements. Program design recognizing these two barriers as well as customers' equipment replacement practices could help customers align their energy efficiency purchase decisions with other business objectives. For example, utilities might design and promote various motor programs taking into account customer's usage and replacement practices. Green motors rewind programs might work for industries with tendencies to rewind rather than replace their motors, while a custom replacement program might better fit the needs of industries with large or specialized motors.
- **Account executives and energy champions drive change in industrial sectors.** Facilities without dedicated energy personnel place energy efficiency as a low priority. Utility account executives can be a huge help to facilities with resource limitations. Account managers can work collaboratively with facility managers, guiding them to resources offered by utilities. An energy efficiency knowledge gap is more prevalent amongst smaller facilities. Technical assistance tailored to smaller facilities and localized energy monitoring offerings could encourage smaller facilities to understand their energy usage and make energy efficiency upgrades that they were not previously aware of.

Conclusion and Lessons Learned

Identifying remaining energy efficiency opportunities in commercial and industrial sectors requires an understanding of sector-specific technologies, customer behaviors and needs, and dynamic policies and market forces. To address these areas, the MASI study leveraged IOU program administrators' and field staff knowledge, recent market studies evaluation data, and industry expert knowledge to prioritize market segments with untapped energy efficiency potential. In-depth interviews with utility program administrators and field staff, facility managers, and subject matter experts added rich perspectives and depth to the research.

Structuring the study as a collaboration between researchers and the IOUs helped ensure that the study findings and recommendations were relevant to IOU program planning staff. Furthermore, the MASI study extended beyond broad market characterization to segment-specific analysis and targeted research at the application and measure level. By combining and synthesizing technical opportunities with niche-market specificity and customer-focused insights, this research can help to sustain the relevance of ratepayer energy efficiency efforts and better serve the needs of the industrial market.

In addition to capturing detailed findings and actionable recommendations for the IOUs, the researchers learned valuable lessons that are transferrable to future market studies. For example, the team found that data access can be time consuming, engaging utilities early on and articulating research objectives and collaboration needs is important for obtaining stakeholders buy-in. Periodic review sessions with stakeholders and project team are helpful to continuous improvement.

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