Memo

MA ENERGY EFFICIENCY ADVISORY COUNCIL

→ CONSULTANT TEAM

To: **Energy Efficiency Advisory Council**

From: **EEAC Consultants**

Date: **March 15th 2017**

Subject: **Manufacturing Process**

EXECUTIVE SUMMARY

Process as an energy efficiency end use refers to savings from equipment used in manufacturing facilities to produce goods. For both gas and electric Program Administrators, process has been an important end use in Massachusetts' C&I efficiency portfolio. The 2016-2018 plan set targets for higher process savings compared to savings attained in past terms, which indicates that this end use is increasingly important to the continued high performance of the Massachusetts Energy Efficiency Programs. The purpose of this memo is to provide an overview of manufacturing and process energy efficiency in the Commonwealth, and to identify potential opportunities to further increase savings from this important business sector.

Summary of Key Process Statistics

Topic	Industrial Process Savings
Contribution to C&I gross annual 2015 savings	8% of C&I electric and 26% of C&I gas[1]
Cost to achieve (incentives only)	$0.01 per lifetime kWh and $0.10 per lifetime therm
Current market activity	Growing overall
Projected market w/ increased PA activity	Very good

Manufacturing Process Market

Key industrial businesses with high process energy consumption include manufacturing, water and waste water treatment facilities, data centers, and large scale laundries. This memo focuses on manufacturing process. With annual output valued at over $45 billion, manufacturing is a significant part of the Massachusetts economy, contributing 10% to the gross state product in 2014. The manufacturing sector in Massachusetts is dominated by high technology, chemical, and fabricated metal products. There are over 19,000 manufacturer sites in the Massachusetts Program Administrators' (PA) territory, representing 16% of electricity consumption and 18% of gas usage in the state.

Massachusetts Process Savings

In 2015, process contributed proportionally more to statewide savings than it did to statewide consumption.[2] This comparison indicates a high savings yield for process, further proving its value as a resource to the C&I portfolio. Savings from process have been increasing almost every year since 2011. Examining process performance by PA illuminates key differences in engagement with manufacturers. For electric programs, Eversource and National Grid achieved higher participation rates and more savings as a percent of usage than smaller PAs. For gas programs, Eversource had the highest participation and savings compared to other PAs. The gas programs

[1] Draft Final 2015 C&I Expedited Customer Profile Report Tables 3-5 and 4-2

[2] It is important to recognize that not all manufacturer energy usage is due to process. Manufacturers have other ends uses too.

had fewer participants and lower savings as a percentage of usage by manufacturers compared to electric programs.

Technical Support Example: *Leidos provides energy advisor services to customers. Since Leidos started working with manufacturers in National Grid territory in 2015, about 76% of projects involve process equipment or compressed air, motors, and drives associated with the process.*

Massachusetts PAs have effectively engaged manufacturers through the use of account managers, MOUs, and technical support. These program approaches specifically target large customers. Process end uses often require complex and highly customized custom measures that are costly to identify, quantify, and implement. However, custom process projects tend to be larger and more cost-effective than many other measures, in spite of the development challenges. Program approaches and the custom nature of process have likely prevented savings from small and medium sized manufactures. Strategies to increase savings for all customers are discussed in more detail in this memo.

Opportunities for Energy Savings from Process Efficiency

BARRIERS	OPPORTUNITIES
Risk Aversion: If a customer does not trust or understand a potential efficiency measure, the investment is seen as risky.	Partner with customers through account management to support trials under controlled conditions and meter the results to prove energy savings. Successes can be shared through case studies and best practice exchanges.
Energy Metrics: Lack of understanding of energy usage and metrics. Some use plant level energy consumption as a proxy measure of production.	The Massachusetts efficiency programs are currently supporting the use of temporary data loggers to identify one-time capital project opportunities; supporting the installation of permanent measurement equipment and integrated EMIS would enable broader, longer-term savings over time.
Financing: A lack of available capital/compelling information for the key decision makers can stall and prevent projects.	The Massachusetts Pro Forma economic analysis tool is a powerful way to demonstrate the value of a project in the language of senior management. Use other non-energy benefits to sell a project, but document this so the programs get proper credit.
Variations in Service: Different PA implementation strategies result in different approaches toward manufacturers.	Spread best practices and account manager resources from the best performing PAs to the others in a more unified, statewide approach. This would allow for more specialization to better serve customer sectors.
Serving Small Customers: Medium or small manufacturers may have specialized process needs that the Small Business program is unable to address.	There is opportunity to work with more manufacturers though expanded account management for Tier 2 customers or engagement through the Small Business program.
Customized Expertise: There must be enough savings to justify the cost of the Technical Assistance study, or the project will not be cost effective.	A systems approach focusing on discrete systems used in manufacturing, such as compressed air, may reduce expenses. Combining systems initiatives with the Small Business program could be effective as long as contractors are trained to recognize custom opportunities.
Realizing Operational, Maintenance, and Behavioral Savings: Programs are not equipped to claim these types of savings easily.	Other states have implemented EMIS and SEM programs, which claim savings from operational and behavioral changes, and document the difference between the baseline operational period and the treatment period. SEM programs also drive increased traditional retrofit projects.
Baselines: Lack of established process equipment efficiency baselines. The condition of existing equipment complicates the distinction of the project.	Through good documentation of project baselines, PA involvement, and customer motivations, the PAs can increase realization rates and improve the retention of claimed savings through the evaluation process.
Attribution: PAs can lose savings if they do not document the customer's reasons for moving forward.	PAs need to document their involvement and sales approach from the start so evaluators can understand the program's role in advancing the project and correctly attribute savings.

INTRODUCTION

Energy and demand savings resulting from improvements in manufacturing and non-manufacturing processes are increasingly important to the continued high performance of the Massachusetts Energy Efficiency Programs.

The following business types typically have significant process-related energy use.

- → Industrial manufacturing
- → Water and waste water treatment facilities
- → Data centers
- → Large scale laundries

The Consultant Team prepared this memo to summarize the current state of process energy efficiency in the state, review the Program Administrators' (PAs') progress in obtaining savings from this important end use, and identify potential opportunities to build on recent growth by further increasing savings from process efficiency. The memo focuses primarily on industrial manufacturing opportunities.

What is Process?

Process - a series of steps or actions to achieve an end.

Processes typically include the use of chemical, physical, electrical, or mechanical steps to manufacture a product or provide a service at a large scale.

Manufacturing processes in Massachusetts include the production of a broad array of goods, ranging from sneakers to missile defense systems to the paper that US currency is printed on. Manufacturing process end uses are varied and related to the equipment that is directly involved in manufacturing goods (e.g., heating, mixing, pumping). Each manufacturer has unique requirements and highly custom equipment and operations at each customer site.

Non-manufacturing processes include large-scale laundry, water treatment, data centers, etc. The end use equipment for each type of non-industrial process is highly specialized, although the equipment is somewhat common between businesses that provide similar services or outputs. For instance, all data centers have Uninterruptable Power Supplies as part of their process.

OVERVIEW OF MANUFACTURING PROCESS-RELATED ACTIVITY IN MASSACHUSETTS

Characteristics of Process Energy Consumption

With annual output valued at over $45 billion, manufacturing is a significant part of the Massachusetts economy, contributing 10% to the gross state product in 2014. About half of this output, $23 billion, is exported to other countries, bringing money into both the state and the United States. Manufacturers employ over 7% of the state workforce, nearly a quarter million employees.[3]

As seen in Exhibit 1, the manufacturing sector in Massachusetts is dominated by high technology, chemical, and fabricated metal products. There are over 19,000 manufacturer sites in the Massachusetts PAs' territory, representing 16% of electricity consumption and 18% of gas usage in the state. In order to provide some sense of scale, Exhibit 2 shows the range of manufacturers by usage size and estimated annual costs for electricity.[4, 5]

[3] http://www.nam.org/Data-and-Reports/State-Manufacturing-Data/State-Manufacturing-Data/March-2016/Manufacturing-Facts--Massachusetts/

[4] C&I Onsite Assessment page 325

[5] The 2015 C&I Customer Profile provides more insight and lists a range of industry classifications in the goods-producing supersector group. These include 9573 electric accounts for manufacturers, along with 628 agriculture, 8578 construction, and 95 mining accounts.

Exhibit 1 Massachusetts Top 10 Manufacturing Sectors by Output (millions, 2013 data)[6]

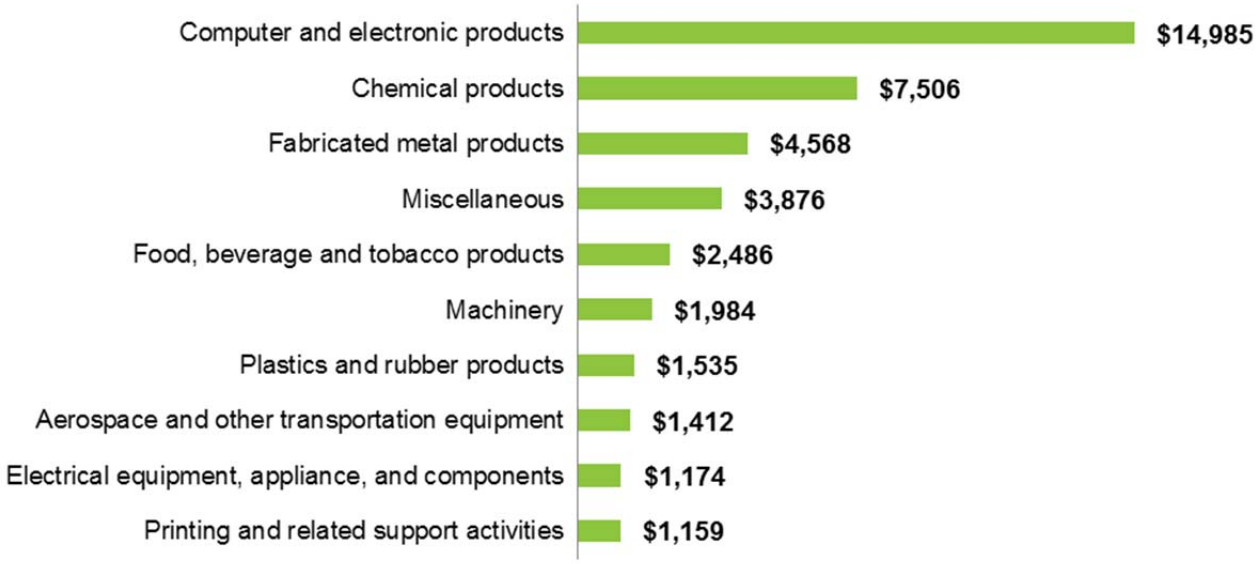


Exhibit 2 Massachusetts Manufacturer Count and Electric Cost by Size

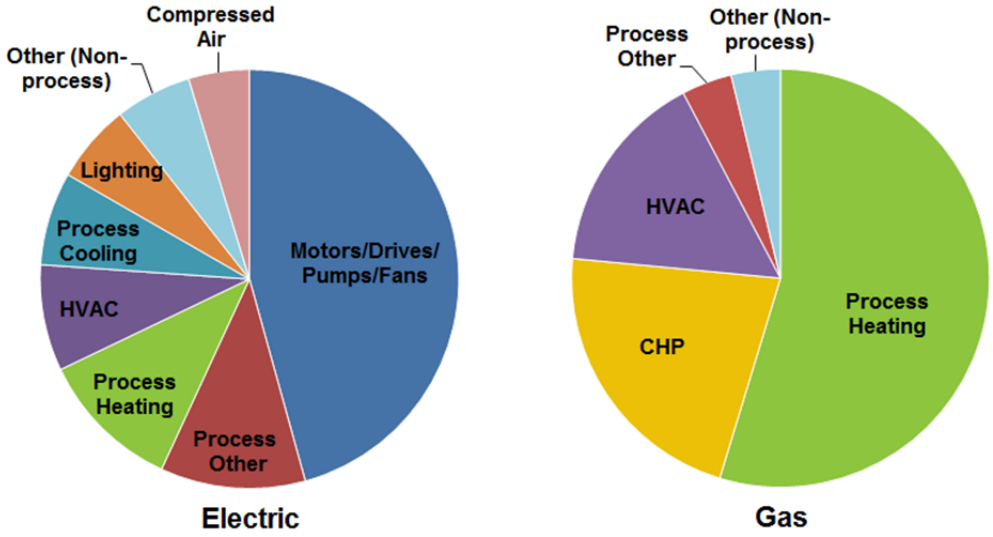
Manufacturer Size	Small	Medium	Large
Annual Usage (kWh)	Less than 300,000	Between 300,000 and 4,500,000	More than 4,500,000
Manufacturer Count	18,000	950	230
Annual Electric Cost per Manufacturer[7]	Less than $42,000	Between $42,000 and $495,000	More than $495,000

Exhibit 3 shows the distribution of energy use in manufacturing facilities in Massachusetts. Although the largest electric end-use is motors, drives, pumps, and fans, these are primarily used as part of the processes in a manufacturing facility, and therefore should be addressed as an opportunity to reduce process-related energy consumption.

[6] National Association of Manufacturers Massachusetts Factsheet

[7] These are estimated costs, based on assumed blended rates.

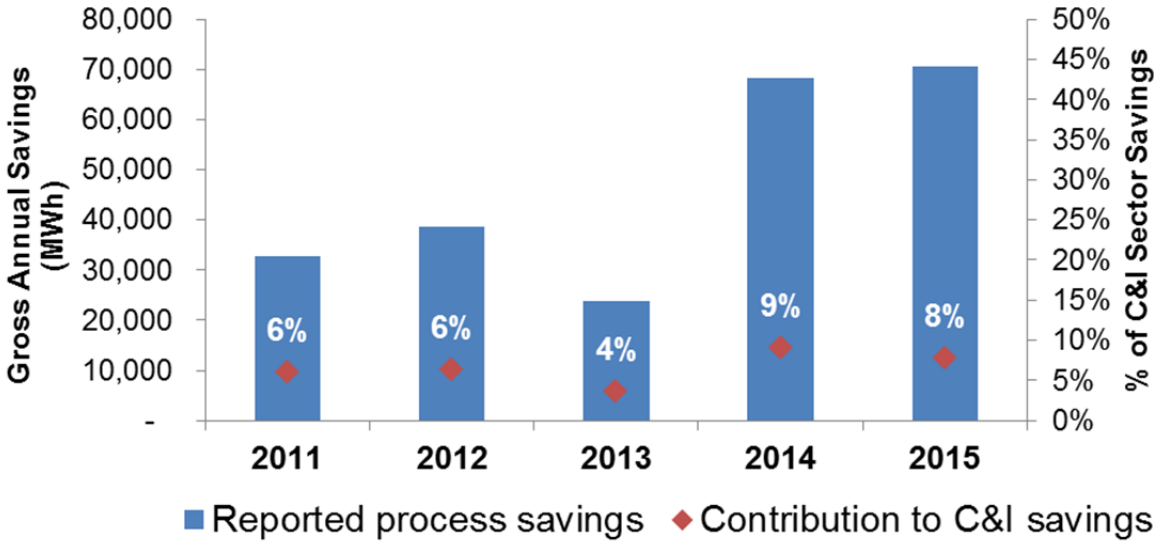
Exhibit 3 Massachusetts Manufacturer Energy End Use[8]



Current Savings Trends for Process End Uses[9]

PA-supported energy savings from process end-uses have increased over the last two years for which we have data, 2014 and 2015. Lifetime net electric savings peaked in 2014 when process savings totaled 900,000 lifetime MWh and accounted for 10% of all C&I savings. As seen in Exhibit 4, annual gross electric process savings peaked in 2015 and totaled 70,470 MWh.

Exhibit 4 Electric Process Savings

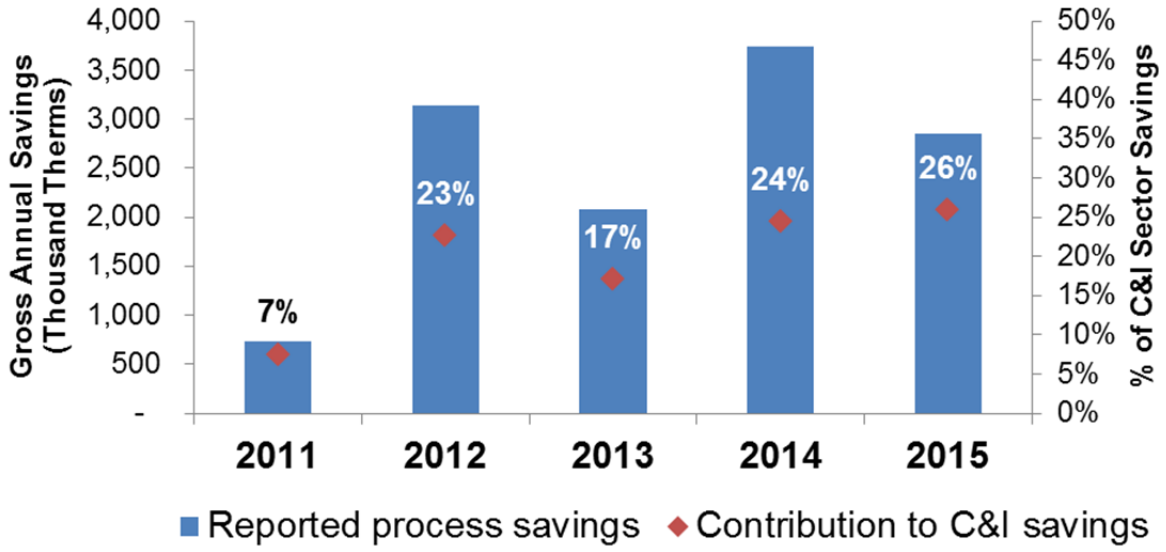


[8] National Grid MA EE Potential Study October 2015, pages 57 and 58

[9] In this section process refers to both manufacturing and non-industrial end uses classified as process.

Gas process savings are an even larger portion of the overall C&I savings portfolio at 26% of total annual savings in 2015. The magnitude of gas savings from process peaked in 2014 at 3,740,540 annual therms. See Exhibit 5 for historic gas process savings.

Exhibit 5 Gas Process Savings



Process end uses make up a disproportionate share of savings as compared to their share of energy use. The C&I Customer Profile Reports use a statistic called "contribution ratio" which compares the contribution of savings for an end use to the energy consumption for the same end use. The contribution ratio is calculated as follows:

$$\frac{\text{Proportion of the PAs Total Savings from Process}}{\text{Proportion of PAs Total Consumption from Process}}$$

The statewide electric process contribution ratio for 2015 was 13.3, and the gas contribution ratio was 2.6.[10] The fact that both these ratios are significantly larger than 1 indicates that process energy efficiency is a very important resource to the C&I portfolio.

Current Program Administrator Performance

Over the five year span from 2011-2015, the Massachusetts PAs worked with about 2,000 manufacturing customers, representing about 16% of total manufacturing customers.[11] The participating manufacturers represent 75% of all electricity consumed by manufacturers,[12] indicating that non-participants are smaller than average.

There is a range of performance with respect to PA engagement with manufacturers. Eversource and National Grid achieved both higher participation rates and more savings as a percent of usage in 2015 than did the smaller electric PAs. CLC and Unitil have lower participation rates and lower savings achieved.[13] See Exhibit 6.

[10] 2015 C&I Expedited Profile Report, Figure 3-5 and Table 4-2
[11] C&I Comprehensive Customer Profile report, Table 5-37
[12] Ibid, Table 5-38
[13] Draft C&I Comprehensive Customer Profile report, Tables 5-71. 5-72, 5-73, 5-74

Exhibit 6 2015 Electric Manufacturer Participants, Savings, and Usage by PA

Program Administrator	Participation Rates[14]	Savings Rate[15]	Manufacturer Savings as % of PA C&I Savings	Manufacturer Usage as % of PA C&I Usage	Manufacturer Contribution Ratio
Eversource	24%	5.5%	17%	10%	1.6
National Grid	16%	4.6%	32%	23%	1.4
CLC	6%	1.6%	1%	2%	0.5
Unitil	12%	0.8%	18%	56%	0.3

As seen in Exhibit 6, the percentage of Eversource and National Grid manufacturer savings as a share of all C&I savings are greater than the percentage of manufacture usage as a share of all C&I usage, resulting in a contribution ratio above 1. For CLC and Unitil the savings percentages are lower than the usage percentages, resulting in a contribution ratio lower than 1. In short, Eversource and National Grid did a better job in 2015 of engaging with and claiming savings from their manufacturing customers.

The gas programs had fewer participants and lower savings as a percentage of usage by manufacturers as compared to electric programs.[16]

Exhibit 7 2015 Gas Manufacturer Participants, Savings, and Usage by PA

Program Administrator	Participation Rate	Savings Rate	Manufacturer Savings as % of PA C&I Savings	Manufacturer Usage as % of PA C&I Usage	Manufacturer Contribution Ratio
Columbia	2.2%	0.4%	13%	22%	0.6
Eversource	3.6%	2.8%	43%	23%	1.8
National Grid	1.2%	0.7%	9%	14%	0.7
No data available for Berkshire, Liberty, or Unitil					

As seen in Exhibit 7, Eversource had the highest participation and savings rates for manufacturer gas customers, and was the only Program Administrator for whom we have data that achieved a contribution ratio greater than 1.

The exhibits above show savings from manufacturers as a proxy for process savings. However, it is important to understand that not all savings from manufacturers are from improving the manufacturing process. Some savings are from other end uses such as lighting or HVAC projects, for example. About 66% of Eversource's manufacturing savings were from process projects in 2015, but only 13% of National Grid's savings from manufacturers were from process.[17] National Grid's ratio of process savings to non-process savings from manufacturers is increasing as the result of a different engagement approach, as described in the next section.

[14] Participation Rate is the number of manufacturers who participated divided by the total number of manufacturers in that PA territory.

[15] Savings Rate is the amount of manufacturer savings divided by the manufacturing population usage in kWh.

[16] Draft C&I Comprehensive Customer Profile report, Tables 6-66 through 6-71

[17] Calculated by dividing process savings from Table 5-59 and 5-60 by savings from manufacturers in Table 5-64 and Table 5-65

OPPORTUNITIES FOR ENERGY SAVINGS FROM PROCESS EFFICIENCY

Manufacturing processes use a wide variety of equipment to do productive work. Measures that save energy can be a new piece of machinery that is inherently more efficient by design, such as process chillers[18] or a more efficient mixing machine in a hummus factory[19], or from improving the function of existing equipment through the use of insulation, controls, variable speed drives, or other modifications. Sometimes energy can be saved through conservation measures such as turning equipment off when not needed. How equipment is operated and maintained can have an impact on energy use, so efficiency measures can also include improved maintenance practices such as fixing compressed air leaks or changes in operation such as turning down the pressure set point of a compressed air system.

Because process end uses are complex and highly customized, custom measures are the most common way that PAs support the adoption of process efficiency measures. Custom measures require a significant investment in project development costs, including designing efficient solutions and developing estimates of energy and operational impacts. This initial investment pays off because custom process projects tend to be larger and more cost-effective than many other measures, in spite of the development challenges. The need for outside support to implement these complex projects is discussed further below.

SUMMARY OF MASSACHUSETTS PROCESS RELATED PROGRAM ACTIVITES

This section addresses the strategies the Massachusetts PAs are using to engage manufacturing customers and the performance of those strategies in achieving process energy savings.

Customer Engagement Practices

The PAs use multiple outreach methods to engage manufacturing customers because they are diverse in size and product type. All C&I customers served by the PAs are eligible to participate in the MassSave New Construction, Retrofit, and Upstream programs. Customers who consume less than 1.5 million kWh annually (1.0 million for Unitil) are also eligible to participate in the Small Business program.

The Upstream and regular retrofit prescriptive programs are mostly focused on lighting and HVAC measures, where hours of use and savings are fairly predictable and savings are deemed. By contrast, the nature of process measures usually requires a custom approach and therefore different outreach strategies. In most cases, complex process energy efficiency retrofits require an independent third-party engineer with specific knowledge and expertise to facilitate savings quantification, project design, and implementation. To help with the cost of engineering, PA customers are eligible for an incentive to help share the cost of Technical Assistance studies. The sections below describe the most common strategies used to identify and quantify process projects in Massachusetts. Please note that most of the methods described below are focused on the largest customers, as defined by energy usage.

ACCOUNT MANAGEMENT

To engage with their largest customers, the PAs have dedicated account managers (AMs). The PAs have different structures for their account managers with varying duties, numbers of assigned accounts, customer size ranges for which AMs are deployed, and level of specialization. For instance, Eversource deploys AMs to customers in its top two consumption quartiles,[20] assigns them by industry sector[21] to align with AM training and expertise, and limits the number of customers assigned to each AM. National Grid revamped its sales approach in 2014 and deploys account development and commercial representatives by geographic region to establish direct relationships with customers in the largest consumption quartile. To serve customers in the second and third

[18] http://www.masssave.com/~/media/Files/Business/Case-Study/NP_I0033_CI_CaseStudies_Gentex.pdf

[19] http://www.masssave.com/~/media/Files/Business/Case-Study/NP_I0011_CI_CaseStudies_Cedars.pdf

[20] Eversource pioneered the practice of dividing its customer base into consumption quartiles and then tailoring strategies for industry sectors, such as for manufacturers, hospitals or universities, that transcend the size categories. This recognizes that customer similarities are driven more by the business in which a customer is engaged than by its size, while also allowing for size related differences in their outreach strategies.

[21] Industry sectors include manufacturing, restaurants, college and university, hospitals, hotels, grocery, etc.

quartiles, National Grid dedicates sales people to work with trade allies to increase participation.[22] The smaller PAs typically have one or two account representatives working with their largest 30 to 100 customers across all industry sectors. With the exception of the Cape Light Compact, which only provides efficiency services, small PA account managers typically are responsible for a variety of energy-related topics ranging from billing issues to power quality in addition to energy efficiency. Where a customer receives electric and gas service from different PAs, account representatives endeavor to coordinate on energy efficiency activities in order to streamline service to the customer.

MEMORANDA OF UNDERSTANDING

For the very largest customers, including large manufacturers, the PAs use Memoranda of Understanding[23] (MOU) to facilitate longer term energy efficiency projects that achieve greater depth and comprehensiveness. The MOU identifies shared goals, defines the relationship between the customer and the PAs, and outlines a plan to achieve the goals; it may also specify incentive structures.

TECHNICAL SUPPORT

In order to provide sector-specific services to its largest manufacturer customers, National Grid and Eversource maintain contracts with Leidos, a large engineering firm offering specialization in industrial energy efficiency. Leidos provides energy advisor services primarily to National Grid customers, helping them identify energy efficiency opportunities and providing project management to support their implementation. Since Leidos started working with manufacturers in National Grid territory in 2015, about 76% of projects involve process equipment or compressed air, motors, and drives associated with the process. The remaining completed or active projects are non-process savings such as lighting or HVAC.[24]

The value of technical support was demonstrated by the Accelerated Rebate Pilot. Offered in Massachusetts by the PAs from 2013 to 2015, the pilot program gave the five largest customers of each PA the option to self-direct their own contribution to energy efficiency funds. Customers were offered the chance to claim up to 100% of project costs as incentives for efficiency measures, not to exceed 90% of their total annual contributions to the energy efficiency fund, and were ineligible for any other program services such as technical assistance. Less than half of the eligible customers participated, while some that did reported that, in hindsight, they could have done better with the regular programs. Despite the opportunity for higher incentives, other participants did zero energy efficiency upgrades for some of the years they were part of the pilot. Despite the fact that this was intended to be a self-direct pilot, most participating customers required significant PA support and expertise to complete projects.

SMALL BUSINESS PROGRAM

At least one PA has used the Small Business program to realize process savings, but the vast majority of savings resulting from the Small Business program are from lighting, with small amounts of HVAC and refrigeration end uses.

BARRIERS TO ENERGY EFFICIENCY SAVINGS IN MANUFACTURING PROCESSES

There are many barriers to all efficiency projects, and a project must clear every barrier or it will not happen. Efficiency programs are designed to overcome barriers to drive projects and produce savings. Key barriers typical of process projects are outlined below.

Market Barriers

Risk Aversion: Manufacturers are in business to make a product and their processes are critically important to their financial well-being. Changes that could impact production quality, cause safety issues, or increase downtime are very undesirable for these customers. For some customers, if a piece of equipment does not meet expectations it can cause a complete shutdown of the process, resulting in large costs from down time, restarting the process, and ruined product. If customers do not trust or understand a potential efficiency measure, the investment is seen as risky, and the possible energy savings are perceived as being not worth this risk.

[22] National Grid "Sales and Program Operations – Update on Commercial Sales Changes and Focus" April, 2014

[23] National Grid calls such agreements Strategic Energy Management Plans (SEMP)

[24] Data from the National Grid Industrial Initiative information sheet, for both Massachusetts and Rhode Island.

Energy Metrics: Some manufacturers use plant level energy consumption as a proxy measure of production. From this perspective, increasing energy use means more units produced and a growing business. Reducing consumption is seen as inhibiting or reducing production, and an indicator of poor production performance. This perspective may be because multiple production lines with different energy uses and schedules can complicate the understanding of how and when energy is used in a manufacturing plant, For example, manufacturers may not track production at the same time the relevant energy is being used, making time alignment with energy use difficult, especially if energy data are limited to monthly intervals. It may also be hard to understand where energy is being used in a plant, and what metrics are important to monitor. Some manufacturers develop Key Performance Indicators (KPIs) that incorporate energy use per production unit into business performance analytics, but many manufacturers do not have the understanding of energy usage, data collection equipment, or software necessary to develop meaningful and useful KPIs.

Confidentiality: Because industry information pertaining to processes is often proprietary, there may be strict confidentiality requirements associated with projects that involve process end uses. While this can create barriers to researching and understanding the specifics of process improvement projects, customer confidentiality requirements must be honored if PAs are to work effectively with their manufacturing customers.

Financial Barriers

Financial barriers can come in several forms: financial officers' demand for a short payback on investment, a lack of available capital, or a lack of compelling information for the key decision makers. Some manufacturers require a very short simple payback before they will consider an efficiency project because of market and economic uncertainty. Efficiency projects must compete with other forms of investment, and are often seen as a low priority by customer senior management. Manufacturers may be part of a multinational company, with the key decision makers located outside the Commonwealth, which can impair the flow of information needed to make a decision to invest in energy efficiency projects.

Structural Barriers

Variations in Service: There are differences between PA implementation strategies that result in different approaches to manufacturing customers. Eversource has set up teams of internal staff where an account manager, who is essentially a sales person, has engineers available to them for technical support. National Grid has account managers, but also outsources outreach and technical support for manufacturers to Leidos. The smaller PAs do provide account management, but very few people may be assigned to a wide range of customers in the territory, which limits the amount of time and understanding that can be achieved for a specific customer's process and business. When AMs must work with a whole range of different customer types, it limits their ability to speak the customers' language and to truly understand their business.

Serving Small Customers: Most manufacturers are relatively small, even though the few large customers represent much of the energy consumption, and therefore savings. Given the smaller energy savings potential per customer, it is not cost effective to provide account management to all small customers. Manufacturers who fall into the medium or small business classes may have specialized process needs that the Small Business program is unable to address, leaving a void in program delivery for these customers.

Customized Expertise: Because manufacturing process projects are typically custom, it is difficult to identify process opportunities in medium and smaller manufacturers. Even if opportunities are identified at smaller manufacturers, the cost-effectiveness of a process project may be marginal because Technical Assistance studies are expensive. If a Technical Assistance study costs $10,000 to identify and quantify potential savings, there must be enough savings to justify the cost of the study, or the project will not be cost-effective. A small manufacturer process project may not have the energy use and potential savings to cover the cost of the study.

Technical Barriers

Realizing Operational, Maintenance, and Behavioral Savings: How equipment is operated and maintained can have a large impact on energy use. Common examples are failed steam traps or compressed air leaks that can cost tens of thousands of dollars annually if not repaired; the PAs are able to claim savings for these types of projects. There are other examples such as when equipment is left on when not needed or is redundant, or equipment that is not maintained properly such that it uses more energy than necessary, The set points or

operational parameters and how machinery is used also plays a big part in energy use. The programs are not currently equipped to identify, document, measure, and claim these types of savings easily.

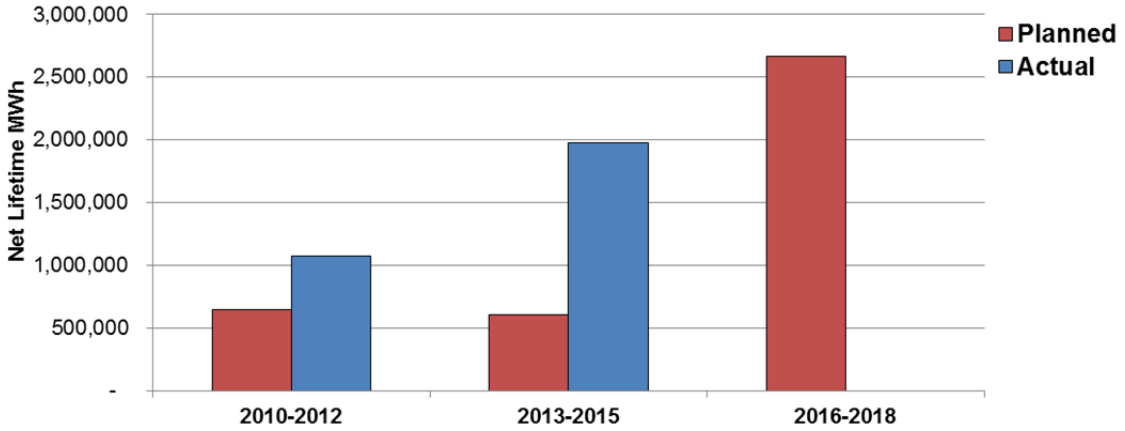
Baselines: Establishing the appropriate baseline against which energy savings are measured is another challenge in achieving savings from process end-uses. There are no codes or standards for manufacturing equipment, so there is usually no established baseline for efficiency. In addition, the equipment that is to be replaced may be decades old, and fully or partly functional. This complicates the decision regarding whether the project should be treated as a market opportunity (i.e., failed or obsolete equipment was being replaced, regardless of energy issues) or a retrofit (i.e., retiring equipment early specifically to achieve energy savings). This distinction between retrofit and market opportunity is important to the calculation of both energy savings and the incentives offered by the PA. Where end-of-life replacements usually are compared against a baseline of lowest currently available efficiency, early retirements may realize savings compared to older, lower efficiency equipment.

Attribution: In addition, because energy alone may not be enough of a reason to move a project, the PAs may be successful in causing the project to happen by using the other benefits as selling points in addition to savings energy. This approach could cause them to lose savings if it is not properly documented that the PAs were the driver of the project completion, regardless of the mix of customer's reasons for moving forward.

STRATEGIES TO OVERCOME BARRIERS

The PAs are planning for increased process savings for the 2016-2018 Three Year Plan as compared to previous plans. This indicates that the PAs see good potential for continued increases in the amount of process savings that can be realized through 2018. The Consultants present here a number of strategies that could help meet the planned goals.

Exhibit 8 Lifetime Electric Process Savings by 3 Year Plan



Overcoming Market Barriers

Risk Aversion: Market barriers such as a lack of trust in efficiency measures and equipment, which may be unfamiliar to the customer, and a lack of knowledge about energy use can be overcome through attentive account management that builds trust between the customer and the Program Administrator. When an account manager starts with basic process projects (e.g., compressed air[25]) and builds on these successes, customers gain confidence over time. AMs with industry specific expertise who understand the customer's business and who can help their customer identify and pursue opportunities to improve the efficiency of their processes are most valuable and can build trust faster. Case studies of successful process projects are also a useful tool in reducing the perception of risk.

[25] Compressed air can be considered the gateway to process projects, as it is typically critical to the process, and usually offers very good opportunity for savings. The supply side (compressors, dryers, storage), distribution system (condensate traps, filters and piping), and the demand side of a compressed air system all are sources of savings.

The PAs currently partner with customers to prove the efficacy, reliability, and safety of new technologies and equipment. These "early adopters" provide an opportunity to prove the technology's reliability and efficiency under monitored conditions. Positive results reduce other customers' perception of risk. The PAs should continue to seek out opportunities to work with early adopter customers to demonstrate the feasibility of new efficiency measures.

For smaller customers, where a PA investment in account management is less cost effective from the PA perspective, bringing together groups of manufactures with similar systems can help reduce the perception of risk. For example, customers with compressed air, pumping, or refrigeration systems could collaborate at a "Best Practices Exchange" facilitated by the PA. The testimonial of one customer is usually very persuasive to others, and should be leveraged as much as possible. Efficiency Vermont has successfully used this technique with ice rink operators, for example, to increase awareness about opportunities to save energy in making and maintaining ice.[26]

Energy Metrics: Although electric and gas meters do not save energy themselves, they can provide valuable insight and enable a clear understanding of consumption that informs decisions regarding investment in energy efficiency. Energy Management Information Systems (EMIS)[27] use meters and software to collect and display energy performance in order to make energy use understandable and to drive action. These data can also form the basis for developing customer specific KPIs. Tracking actual energy performance through the EMIS and comparing it to KPIs will help customers and PAs identify and quantify energy savings opportunities. KPIs that incorporate energy use can identify and quantify more efficient ways to manufacture goods, regardless of production volume. An energy-per-unit KPI can demonstrate energy savings even if total manufacturing volume and energy use increases at the plant, as long as the energy use per unit decreases. Businesses using advanced process management systems such as Six Sigma can hold managers and system operators accountable for the energy use of the operations they oversee and reward them for improved or high energy performance relative to the KPIs. The Massachusetts efficiency programs are currently supporting the use of temporary data loggers to identify one-time capital project opportunities; supporting the installation of permanent measurement equipment and integrated EMIS would enable broader, longer-term savings over time.[28]

Confidentiality: In addition to establishing trust though account management, the PAs and relevant contractors should be prepared to enter into non-disclosure agreements when necessary. The PAs are already very aware and protective of customer data.

Overcoming Financial Barriers

To best support manufacturing customer investments in energy efficiency, AMs need to learn the customer's business and speak their language; they must develop relationships with decision makers such as the CFO in addition to engaging with facility or engineering personnel who may have limited budget authority. Through this process, the AM can understand the customer's criteria and process for making capital project decisions. This knowledge will enable the AM to help their technical team to develop efficiency project proposals that address the financial investment criteria in language that will resonate with the customer. The Massachusetts PAs have a very good "pro forma" financial analysis tool to support presentation of projects in terms of return on investment, rate of return, net present value, and cash flow. Understanding the customer's investment criteria and framing projects in a way that clearly satisfies the customer specific requirements is effective at persuading the CFO and other senior managers to move forward with a project. While use of the Massachusetts financial analysis tool does occur, it is not used consistently. Additional efficiency projects could be accomplished with broader use of this important asset.

Overcoming Structural Barriers

Variations in Service: If an account manager has municipalities, manufacturers, hospitals, and institutions to

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[26] http://www.castleton.edu/news-media/article/spartan-arena-showcased-at-best-practices-exchange/

[27] Natural Resources Canada provides an overview of EMIS here: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/publications/infosource/pub/cipec/EMIS-Manual-and-Tool-and-Part-D-Reference.zip

[28] Efficiency Nova Scotia has a specific EMIS program, http://aceee.org/files/proceedings/2015/data/papers/1-88.pdf

manage, it is a more difficult job to learn and manage all these customer types than if they focused on just manufacturers, or even just a specific segment of manufacturers such as electronics manufacturing. Individually, the PAs do not have the personnel or resources to provide specialized expertise and support to all of the various manufacturing customer types and processes. A statewide approach managed through the MassSave brand would allow for greater coverage and more specialization. This would be especially helpful for the smaller PAs. A statewide approach would allow account managers to focus on the types of customers they know best and leverage their knowledge and experience across PA territories to best serve manufacturers throughout the Commonwealth. As an example, the two existing specialists in combined heat and power (CHP) work specifically for Eversource and National Grid, but their expertise would be valuable in other PA territories.

Serving Small Customers: For small and medium sized manufacturing customers, where it is expensive from the PAs perspective to provide account management, a systems approach may make sense. A systems approach focuses on discrete systems used in manufacturing, such as compressed air, chiller, or process boilers systems. The PAs are employing this approach with grocery stores to address refrigeration systems. It probably makes sense to address compressed air systems first, as it is very common amongst manufacturers of all sizes to use compressed air. However, there may also be good opportunities with other process systems such as steam, ovens, pumping, industrial refrigeration, or process cooling. Combining systems initiatives with the Small Business program could be effective as long as the Small Business contractors are adequately trained to recognize custom opportunities beyond the regular prescriptive measures, and are able to either develop the custom opportunity themselves or call in a partner. Towards this end, the PAs are actively working to improve the knowledge of Small Business contractors in Massachusetts.[29]

Overcoming Technical Barriers

Realizing Operational, Maintenance and Behavioral Savings: Understanding how and when energy is used in a complex process is challenging without the type of information provided by an EMIS. Taking action to make long term-operational changes is difficult without some kind of documented management structure. Strategic Energy Management (SEM) provides a solution. SEM is a recurring process of creating a plan, putting the plan into action, checking for results, and acting to make corrections or changes (Plan, Do, Check, Act). SEM helps businesses optimize their entire operation from an energy perspective, and provides a feedback loop to drive changes. As a result, SEM can increase awareness of opportunities in process improvements and justify investments to realize those opportunities. When a SEM program is combined with an EMIS, this approach provides a basis for identifying, measuring, attributing, and claiming savings. The PAs are currently researching SEM programs and are considering their integration into current program offerings.[30]

Baselines: To accurately establish the baseline for a process measure, the PA must determine and document the factors that influenced the customer in deciding whether or not to pursue the project and to what extent. Efficiency Vermont developed an approach to this need by building a documentation and project categorization checklist into their existing project screening tool. In addition, they have made a concerted effort to demonstrate the effectiveness of their program in driving projects and savings by documenting program involvement at every step of the project, from identifying the opportunity through quantifying project benefits for the customer.

Attribution: It is also possible to increase the attractiveness of an energy efficiency project by aligning the project with other manufacturing objectives. Maintenance savings, product quality, facility reliability, or an increase in production capacity may enable projects to move forward that would not be desirable to a customer based on energy savings alone. Improvements in efficiency can also mean a reduction in waste or in harmful emissions. Savvy account managers and sales people develop a complete package, highlighting all of the project benefits as a means to increase their success in selling efficiency projects. When selling projects using non-energy benefits, the PAs need to document their involvement and their sales approach from the start so that evaluators can understand the program's role in advancing the project and correctly attribute savings.

[29] https://www.maeep.org/event-display/434

[30] More information about SEM and programs can be found here: http://ma-eeac.org/wordpress/wp-content/uploads/Energy-Productivity-Memo-3-10-16-1.pdf

CONCLUSIONS

The manufacturing sector is an important part of the Massachusetts economy. Energy efficiency savings from manufacturers and from process end uses are an important and growing part of the Massachusetts PA C&I portfolio. The Program Administrators anticipate an increase in process savings in the current Three Year Plan as compared to prior plans. Further increases may be possible in the 2019-2021 Three Year Plan. Potential strategies to increase the upward trend as discussed in this memo are summarized below.

1. Reduce the perception of risk: New technology must be proven before most manufacturers will invest in something new. The PAs can accelerate adoption of new technologies by partnering with customers through account management to support trials under controlled conditions and meter the results to prove energy savings. Successes can be shared and publicized through case studies and best practice exchanges.

2. Create energy metrics: Support the installation of meters and software to make energy use more visible, to better track consumption and production, and to create meaningful key performance metrics so that customers can better manage their energy use.

3. Ensure confidentiality: Continue to value and protect customer confidentiality, through the use of Non-Disclosure Agreements when necessary.

4. Lower financial barriers: The Massachusetts Pro Forma economic analysis tool is a powerful way to demonstrate the value of a project in the language of a senior management. Use other non-energy benefits to sell a project, but document this so the programs get proper credit.

5. Address variations in service: Spread best practices and AM resources from the best performing PAs to the others in a more unified, statewide MassSave approach. This would allow for more specialization to better serve customer sectors.

6. Serve small customers: While the PAs are well engaged with most of their large customers, there is opportunity to work with more manufacturers though expanded account management for Tier 2 customers or engagement through the Small Business program.

7. Realize operational, maintenance and behavioral savings: Other states and provinces have implemented SEM and EMIS programs to realize cost-effective savings from manufacturing process. These programs claim savings from operational and behavioral changes, and document the difference between the baseline operational period and the treatment period. SEM programs also have the effect of driving increased traditional retrofit projects.

8. Accurately identify baselines and document attribution: Through good documentation of project baselines, PA involvement, and customer motivations, the PAs can increase realization rates and improve the retention of claimed savings through the evaluation process.