Strategic Energy Planning: A Roadmap to Carbon Reduction in Large Industrials

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ABSTRACT

Given the uncertainties surrounding energy prices and pending environmental regulations, there is a growing need for industrial facilities to address energy usage, greenhouse gas emissions, sustainability, and process efficiency in their planning. Operations teams and management staff often fail to adopt long-term strategic energy master plans because of resource constraints and the need to focus efforts on near-term capital improvement projects and maintenance. This can result in higher-than-necessary energy costs, unanticipated compliance issues, and lower profits. This paper will explore a tailored, strategic energy master-planning process that will guide manufacturers in making informed decisions about their facilities' infrastructure, energy management practices (such as International Organization for Standardization [ISO] 50001 and strategic energy management [SEM]), sustainability goals, and process energy efficiency improvements (energy per unit of production).

The first step is a visioning process with decision-makers to identify the desired outcomes, define the constraints, and create an information exchange culminating in a work plan that defines the development of the energy master plan. Next, a process of benchmarking, measurement and verification (M&V), assessment, analysis, financial deliberation, optioning, prioritization, and scenario analysis is developed. This results in an actionable master plan that manufacturers can implement over multiple years.

This paper will discuss this strategic-planning process for industrial facilities, the challenges these organizations face in developing and implementing the master plan, and the best approaches to overcoming the barriers within organizations. As a demonstration of the approach's success, a case study from New York State will be presented.

Introduction

It is an interesting time in the energy efficiency industry. There are substantial changes in the regulatory policy being pursued at the national and state level, which will impact the operation of the electric grid, the business models by which it operates, and the entities that are involved in the generation (including distributed energy resources), delivery, and consumption of services.

In June 2014, the Environmental Protection Agency (EPA) released its proposal for the Clean Power Plan outlining carbon pollution regulations for existing power plants under Section 111(d) of the Clean Air Act. Under the proposal, the EPA outlines state-specific carbon dioxide (CO_2) emission targets for 2030 and flexible approaches to achieve those targets. The control of emissions can occur at the source of generation or through a consumption reduction at the end-user site. One allowable approach in the proposal is to deploy energy efficiency measures (EEMs) to decrease the energy usage at the end-user site. Because efficiency is more cost-effective than shifting generation or building new energy technology, it could become a major part of many states' compliance plans.

Other examples of changing policies are New York's Reforming the Energy Vision (REV) and Clean Energy Fund (CEF) initiatives. Together, these regulatory proceedings could change how the grid is operated and how energy efficiency and distributed generation offerings are used to support the reliability, resiliency, and emissions of the overall New York system.

There is no precedent for what the final structure of these regulatory frameworks will be or how they will affect operators and consumers, but it is likely that the EEM implementations at a facility level will play a major role. In both of the above examples, it is implicit (if not explicit) that large end users, such as industrial manufacturers, will be targets for reducing their energy usage to reduce their carbon emissions and will play a key role in the execution of these regulations. The opportunities for industrial ratepayers will likely include participation in the efficiency program offerings from the states or through self-directed (and reported) efficiency efforts. In either case, industrials should be aware of the changing landscape and be prepared to take advantage of any supporting opportunities that come their way.

Plan on It

Given the trend with these pending regulations and the ongoing uncertainty surrounding energy prices, there is an elevated need for industrial facilities to address energy usage, greenhouse gas emissions, sustainability, and process efficiency in their planning cycles. An effective approach to meeting this need is to conduct a strategic planning process that results in an energy master plan (EMP). This EMP can be for a single facility, a campus, or an entire corporation, but in all cases its purpose is to guide related decisions over the planning horizon.

Operations teams and management staff, whether at the plant level or at the corporate level, often fail to adopt long-term strategies for energy related decisions because of the more immediate need of near-term capital improvement projects and maintenance. While this is understandable, this approach does not capture the enormous value of a longer-term roadmap for energy utilization, SEM, and continuous improvement in industrial facilities. Although short-term planning prevails, most will likely agree that longer-term planning has deep benefits for large industrials. "For large operations, campus facilities, or companies with multiple locations, an energy audit alone may not be sufficient to cover all the mitigating factors needed to be addressed. What such a company needs is a clearly written road map to achieving its energy and sustainability objectives."[1] This concept is embodied in the ISO 50001, the standard for energy management in which the ISO recommends the development of an energy management system (EMS) through a planning process that includes a review of energy utilization, the development of baselines, the establishment of performance indices, and the identification of opportunities – all resulting in action plans for implementation. Though this type of planning is a good idea, there are many reasons why it is often not adopted.

One key challenge is that there are many stakeholders at various organizational levels (site, regional, corporate) that must be involved. It can seem daunting to engage all of the parties in the exploration, development, and ultimate approval of such a plan. The key to success is having a clearly defined process, getting buy-in of the executive leadership, and administering the process in an organized, direct manner through excellent communication.

In this paper, we will define an organized approach to guide the establishment of a strategic energy plan for industrials (the process also works for single large facilities, campus-style complexes, or a portfolio of facilities across a division, region, or entire corporation). This

[1] http://biomassmagazine.com/articles/5035/energy-master-plans-streamline-operational-efficiency-reduce-costs

approach can be used to support end-user goals of pursuing ISO 50001 certification, reaching sustainability goals, or improving the bottom line; it can also serve as the basis for a programmatic offering by those challenged to deliver state-level carbon reductions.

The Process

Most large organizations understand the need to plan. They likely have budget plans, capital expenditure plans, site development plans, staffing plans, and strategic plans. Integrating an EMP into the existing landscape should not be a foreign concept.

Common to all of these planning efforts is a well-defined process with clear steps, specific ownership for tasks, buy-in and agreement at multiple levels, and active engagement of all the parties involved. Likewise, a clear process for the EMP is critical to establishing a viable long-term plan for best-practice energy efficiency and sustainability habits. Developing and maintaining the EMP will ensure that major facility projects will be implemented in a manner that includes effective prioritization and important interactive effects associated with corporate-wide resource utilization.

Figure 1 illustrates the phased approach for the planning process. Each step is discussed in the following sections.

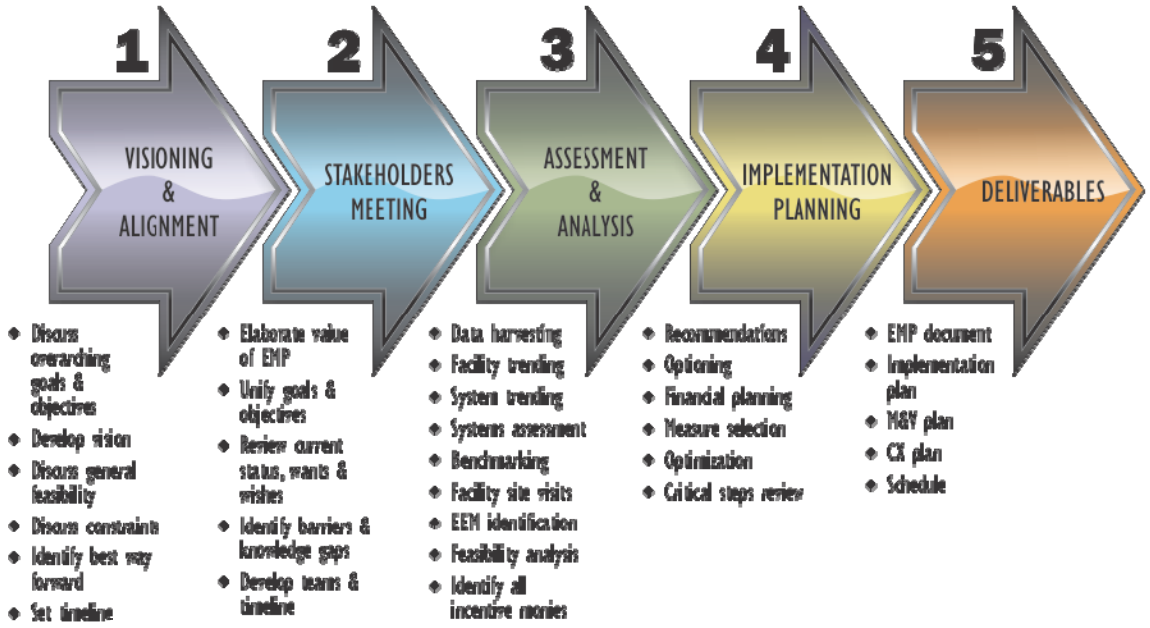

Figure 1: Steps for a Successful EMP Process[2]

Visioning and Alignment

The first step is to agree on goals. Deciding what energy planning will mean for the organization and achieving this alignment with all of the concerned parties is paramount to initiating

[2] ERS EMP document: Eversource Training Seminar, Dec 2014, Portsmouth, NH

the planning process and keeping it on track. Groundwork needs to be established through discussions with the parties that will drive and champion the process. The discussions can be brief but must identify the stakeholders and how best to catalyze the effort. It is critical to engage executive leadership and obtain their support for the approach and for allocation of resources. This will facilitate getting the maximum impact from the energy planning process.

Defining the scope and scale in a manner that fits the organization is also important. Assuming the entire concept is new to the organization, the team leading the effort should look for short-term energy savings that make the case for long-term potential impact to generate a proof of concept. These "internal champions" will shape the process to best fit their organization's goals and constraints.

The earliest organizational steps of the process can be aided by an external facilitator or an independent third party. The outside consultant can provide the catalyst that so many organizations need to adopt a new process. In many states, ratepayer-funded efficiency programs and or industrial self-direct programs will absorb some or all of the cost for the external resources.[3]

Stakeholder Meeting

The second step is to hold a dedicated meeting to facilitate the dialogue that is so critical to the long-term planning process. This "stakeholder meeting" is the point at which the team is expanded to include all of the concerned parties critical to a successful implementation. This singular event provides the foundation for the EMP. The goal of master planning is not to glorify an energy audit, but to build a culture of continuous improvement for energy-related topics within the company. Achieving this level of cultural transformation requires understanding and agreement across multiple functions and at all levels of the organization.

From the production floor to the highest level of management, representation at this meeting is mandatory for every department relevant to energy efficiency decisions. This is often greeted with resistance for various reasons: people are busy; many feel that manufacturing environments change quickly and so there is limited value in planning; higher-ups may not immediately see the value; and organizations are often reluctant to change. The importance of getting everyone to the table cannot be stressed enough. The stakeholder meeting is often the first time the assembled players have sat down together to talk about energy issues. It needs to be well-planned, structured, and facilitated by an organized team. A block of time needs to be allocated for a review of relevant prior work and ongoing efforts, a discussion of the successes and failures, and an identification of the bottlenecks and any "mismatched motivations" that might be present, such as where capital purchases and operating costs fall under different organizational control. While the underlying objectives are to establish the beginning of what should be an ongoing dialogue and to achieve a mutual understanding and acceptance of this effort; the primary goal of the meeting is to identify and gather everything that is needed to draft a work plan.

To be sure, preparation for this event requires a time commitment from the participants to provide the broad level of information required to develop an accurate plan. Shorter stakeholder meetings can and will occur as needed, but from the start it is important to be sure that the relevant concerns, issues, opportunities, and interests of all the players are known and understood by the core

[3] http://swenergy.org/publications/documents/Utility_SEM_programs_03-2013.pdf

team that will be leading the EMP effort. The intent is to obtain all of the relevant information to identify any gaps and set the objectives.

Establishing the key goals, needs, and wishes while identifying the hurdles will help the team understand what is achievable and define the actionable activities required to proceed. The work plan developed after this meeting will incorporate the issues identified and define the framework for the planning process, balancing all relevant goals with the corporate objectives and practical realities. The work plan will guide the development of more detailed tasks for the assessments and integration of results later in the process.

Assessment and Analysis

The prior two stages in the planning process consisted primarily of discussions, meetings, and operational reconnaissance in efforts to align all of the parties and motivate them to take action. The next step in the process is to acquire the data and information necessary to conduct the assessments and analyses to follow. The up-front tasks to accomplish are as follows:

- Review the details of prior efforts and understand the capital plans.
- Develop a building inventory (if a campus or broad-level effort) and set energy usage targets.
- Review any active proposals.
- Review the budgets and preliminary economics.

Each of these tasks is discussed further below.

Review the details of prior efforts and understand the capital plans – Most organizations will have some project history and active planning; thus, during this phase the goal is to identify the most critical efforts that will have relevancy to the energy efficiency planning process. The team will have been made aware of all ongoing projects during the stakeholder meeting and work plan development; the next task is to develop a complete understanding and priority in order to sync with the corporate objectives. Capital improvement plans will have a direct impact on the facility and project prioritization.

Develop a building inventory and set energy usage targets – The first active analytical task is to establish the usage across the targeted facilities to understand how the energy is used in the buildings and throughout the specific manufacturing processes at the facilities. A review of each facility's actual consumption (from its utility bills) will provide the information needed to establish a baseline energy intensity of the facilities, the manufacturing processes, or both, depending on the operations. The development of such a baseline for individual processes may be challenging to obtain, as energy specific to a process is not always measured and thus may require additional data monitoring for a period of time. In some cases for companies with multiple similar facilities and process lines, comparison benchmarking can be developed to determine if any particular facility or process has been optimized or not; the process involves standardizing the energy use on a per-unit-of-production basis, normalizing it for known variables, and comparing the resultant energy metrics to other similar sites. This process will help characterize the operations and facilitate the prioritization of energy projects.

In production environments, it is important to establish the energy usage targets in relation to production activity. This review of the historical consumption should be cross-referenced with the production data to develop a baseline energy usage per unit of production. In other types of large facilities, such as hospitals or universities, the metrics may differ; sometimes straight energy use intensity (EUI) on a per-square-foot basis can be helpful. Identifying these targets can define the scope of the specific equipment, processes, and other activities that should be analyzed to identify the energy efficiency opportunities.

Review any active proposals – If the facility has an active list of open proposals for energy efficiency projects, these should be reviewed. Many of these potential projects will have merit, some may not, and most will benefit from this review to ensure the validity, accuracy, and completeness as they relate to the larger goals of the planning process. This review should focus on the energy and technology aspects and comment on the feasibility and appropriateness of each project for the intended site.

Review the budgets and preliminary economics – At this point, there should be a first pass at identifying a global level of annual spending that the organization will allocate for implementation of projects to help calibrate the efforts for investigating the opportunities for improvement. While the long-term objective should be to have the EMP dictate the size of the budget allocation, in reality the capital expenditures available may guide the process and dictate the comprehensiveness of the EMP. It should be expected that the planning effort will be in direct correlation to the size of the budget. The team will have an idea about the opportunities from the initial discussions; layering in the possible spending limits will allow them to size the effort to have the greatest impact.

By the end of this portfolio review, the team will have established a firm order of tasks and acquired a complete understanding of where to focus the assessment and analysis efforts, which come next.

On with the Assessments

The individual assessment components will complete the picture to inform the corporate-wide planning process. While energy audits and specific efficiency assessments will dominate this work, the effort is broader and should include a range of energy issues. The major areas that should be considered to varying degrees across the portfolio of sites include the following:

- Energy audits and specific efficiency opportunities
- Renewable energy opportunity identification
- Combined heat and power (CHP) and other on-site generation opportunities
- Fuel source and supply review
- Greenhouse gas reduction opportunities
- Financial-incentive and external-funding identification
- Total cost of ownership and life cycle costs
- Employee engagement opportunities (behavioral)

The level of technical analysis required for each of these will differ based on the needs of the site and the projects being identified.

Energy Audits and Opportunity Assessments

The planning effort will include the comprehensive assessment of a range of energy efficiency opportunities using a variety of study approaches. The intent of the EMP is not to perform detailed audits and studies of each and every building, but to plan and optimize the assessment strategies as necessary. While some facilities will merit full audit studies, others may only require a high-level perspective to identify EEMs and their likely corporate-wide and building-specific impacts (energy savings, costs, economics, and priorities). The target measure categories should include (but not be limited to) the following:

- Facility infrastructure (lighting, controls, HVAC, data centers, plug loads, etc.)
- Industrial process changes and process control
- Industrial HVAC (ventilation, process heating, process cooling, controls)
- Cross-cutting technologies (motors and drives, compressed air, refrigeration, dust collection, etc.)
- Demand management
- Specialized end-use technologies
- Overall corporate sustainability (assessing opportunities for the integration of general green building, fleet transportation, and sustainability objectives with energy and resource efficiency plans)

In addition to addressing the areas listed above, the array of activities may also include:

- **New construction, expansion, or major renovation review** – In addition to recommendations for existing facilities, the effort should review and enhance the approaches for addressing any new construction or expansion projects to introduce higher levels of state-of-the-art and emerging technologies and improve overall building performance.
- **Retrocommissioning and recommissioning assessments** – In addition to capital expenditure projects, the EMP will develop targeted recommendations for retro-, re-, and ongoing commissioning activities. The objective of such efforts is continuous energy optimization, with ongoing improvement based on best practices.

- **Zoning and local ordinances** – Local zoning and city ordinances will impact energy planning. Cities around the world are implementing mandates for audits and energy efficiency activities; the plan should identify these mandates and how to comply.
- **Renewables and other generation** – Opportunities for solar PV, solar thermal, parking lot solar canopies, wind energy, and CHP generation opportunities can be in the mix. During the execution of the work plan, the development of any generating resources that have been evaluated and are of interest will have been identified.
- **Fuel source and supply** – The strategic consideration of the negotiation of rates and long-term supply contracts will be part of the most comprehensive EMP document. While planning for efficiency can be done for a facility of any size, some of these sourcing issues may only be appropriate for larger facilities.
- **Greenhouse gas tools** – The EMP effort should report greenhouse gas impacts. Greenhouse gas impact evaluation tools that use actual electrical generation fuel mix and known combustion fuels should be used to facilitate the impact analysis.
- **Identification of financial incentives** – An investigation should be done for all of the opportunities of potential project funding, thereby improving the economic attractiveness of the projects. Utility efficiency programs, clean energy funds, and private ESCOs and performance contractors are potential sources for funding and project development. From these sources, the financial incentives can have a significant impact on a project's viability.
- **Employee engagement** – The actions of individual employees in the facilities have a significant impact on the energy use of the buildings and processes. The planning effort should investigate the existing employee practices to identify where behavior changes can reduce energy consumption. Common opportunities include shutting down processes during employee breaks, publicly posting facility and/or process energy usage, establishing standard operating procedures, inviting suggestions and hosting competitions to identify areas of waste, such as compressed air leaks. Engaging employees at all levels of the organization to actively think about the energy they use can significantly increase energy savings.

Implementation Planning

The implementation planning step is the prioritization of the identified EEMs that align with the interests and constraints of the organization. With all of the technical reviews, energy audits, and specific assessments complete, an optioning exercise to debate the merits of opportunities and understand objections and alternatives should be undertaken to develop a prioritized list of projects.

In addition to economic considerations, issues such as process and equipment reliability, product quality, complexity of implementation, and problem systems should be included in the prioritization exercise. Financial metrics such as simple payback, return on investment (ROI), and life-cycle cost provide different levels of information. Depending on the asset under consideration, certain metrics may be more appropriate than others. Non-energy benefits such a maintenance savings and occupant satisfaction should be factored in to the greatest extent possible. Additionally, the timing of the firm's financial capacity to absorb any investment burden along with all tax credits and utility incentives should be included in the economic analysis to provide a complete picture for making decisions. Finally, quick wins are always beneficial to building momentum and, as such, ease of completion should be part of the consideration.

Critical Steps Review

It is important to identify the necessary steps required to implement the suite of prioritized projects, including outlining the actions required for internal approval, design stages, logistics, and any other critical concerns that would need to be addressed for a successful deployment of the plan.

Preferred Solution and Final Report

Throughout the process, the team will develop key pieces of the final plan document. These individual pieces will need to be pulled into a cohesive document that reflects the firm's goals and objectives. Working with the stakeholder group, the team will determine the criteria for the selection of the best energy plan options. With these criteria, the plan will deliver attractive, cost-effective, economically advantageous, and greenhouse gas-mitigating scenarios that rise to the top.

The EMP will include a list of projects, likely separated into capital investment project and operational expense projects. The final scenario, which will encapsulate the optimized set of recommendations, will be clear, rational, well thought-out, prioritized, cost-effective, and defensible. The business case(s) for each project proposal will be clearly documented. Some of the criteria used during the development of the plan include the level of savings, project time frames and funding support, risk, revenue impacts, capital outlay demands, image and PR, utility and/or tax incentives, and deferred maintenance expenditures. Ultimately, the document should include the following:

- An EMP document that encompasses all of the studies, findings, and recommendations
- An "executive summary" document, suitable for a broader audience, that will provide a high-level overview of the goals and final recommendations for the effort
- An implementation plan that addresses the prioritized recommendations along with a high-level timeline for key projects
- A commissioning (Cx) plan that outlines the activities required to commission the systems installations put forth by the plan
- A plan for M&V for the implemented projects to verify their optimized operation and achievement of reduction goals

End-User Example

To illustrate the intensive approaches for motivating continuous improvement by industrial customers, we have included an example of the strategic energy planning process in action as shown for Steinway & Sons, a renowned manufacturer of world-class pianos since 1853.

Steinway & Sons' corporate headquarters and main manufacturing plant are located in the Astoria neighborhood of Queens, New York – just across the East River from downtown Manhattan. Steinway has had a remarkable history of working with the New York State Energy Research and Development Authority (NYSERDA) and participating in a number of its programs for operational improvement, energy reductions, and cost savings.

With rising energy prices and global competition, Steinway faces the same challenges that many United States' manufacturing facilities have in remaining competitive: trimming costs and improving productivity. For over a decade, Steinway has been applying improvement approaches to its manufacturing processes. In 2006, the company embarked on a strategic planning effort using a similar process as described above to address its energy usage in the plant. Since then, it has taken definitive actions to improve its supply-side energy purchases, reduce energy consumption and demand in the plant, and improve its productivity. Information about the building and the main elements of each phase of the project are presented below in bulleted format to emphasize what was most critical

Facility Background

- Location – Astoria, New York (New York City)
- Facility description – 150-year-old brick mill
- Size – 500,000 square feet
- Envelope – Seriously drafty
- Space types – Office and manufacturing
- Operating schedule – 1+ shift, 5 days/week

Visioning/Alignment/Stakeholders

Visioning

- The new chief financial officer (CFO) was driving an initiative to reduce costs.
- A recent vice president (VP) of manufacturing and a recent plant manager were personal champions of efficiency improvements.
- The department heads wanted better control of the environmental conditions to improve the quality and reduce rework.

Alignment

- Agreement to apply continuous improvement approach to energy usage
- Wanted pro forma for cost-effectiveness (including productivity, scrap, and rework)

Stakeholders

- CFO
- VP of manufacturing
- Plant manager
- Department heads

Assessment and Analysis

- Conducted baseline assessment
- Conducted comprehensive facility assessments
- Established list of measures, savings, and implementation costs

Optioning and Prioritization

- EEM (traditional, shorter-payback items)
- Closed-loop, variable-volume dust collection

- Solar thermal cooling/process heating
- New process line heating, ventilation, and air conditioning (HVAC) system
- Economic development rate assessment
- Dry-kiln and retrocommissioning efforts

Implementation

- Implementation of Energy Efficiency Measures (2007)
- Closed Loop Variable Volume Dust Collection (2009)
- Solar Thermal Cooling/Process Heating (2009/2010)
- New Process Line HVAC (2011)
- Economic Development Rate Assessment (2012)
- Dry Kiln & Retro-Commissioning Study (2014/2015)

Annual Savings

- Energy savings = >2,000,000 kWh
- Demand savings = ≈200 kW
- Annual savings = $350,000

Programmatic Opportunity

Program administrators (PAs) have an opportunity to join with their industrial customers in this process. All over the country PAs are seeking new approaches to achieving significantly expanded energy reduction goals. At the same time industrial customers often argue that they do not receive value for their investment in energy efficiency programs. Large industrial energy-use customers represent a viable pool to target and, if engaged deliberately and effectively, can yield a large percentage of the overall savings required for a successful, cost-effective program. This can be achieved by forming a partnership to develop an EMP, which fosters participation by the largest customers in a program's service territory.

To secure such savings, it is necessary to develop excellent relationships with the decision-makers at the candidate facilities and to set targets for energy efficiency implementation. Such agreements and targets can take the form of goal-setting memorandums of understanding (MOUs), which lay out the energy and demand savings goals, targeted measure categories to be pursued, technical assistance and support to be provided, commissioning requirements, M&V requirements, and enhanced incentive or rate structures.

The development and implementation of a successful MOU program involves similar steps as described in the strategic energy planning process above, but moves beyond planning into the implementation and verification phases. The process can be modified to meet the needs of the parties involved, but the steps are similar and the outcome is quantified targets with agreed-upon actions that result in verified reductions.

Successful programs that have pursued the MOU approach are evident in leading initiatives by National Grid and Eversource in their New England territories and have engaged industrial firms such as Gillette, EMC, BAE Systems, AstraZeneca, and Whole Foods, as well as universities and hospitals such as MIT, Brown, UMass, and Boston University Medical Center. These are typical multi-year agreements that identify the reduction goals with targets per year. They are often accompanied by internal campaigns (behavioral component) to improve the

engagement with the staff and with the external press or social media campaigns to broaden the public's awareness of the activities. At MIT, the first MOU agreement with Eversource (previously NSTAR) had a 3-year target of 15% energy reduction (savings of over 34 million kilowatt-hours) across the campus.

Closing

Dynamic drivers are at play in the efficiency industry, increasing the need to reduce carbon emissions, curtail energy usage at peak times, and lower overall consumption. The deployment of cost-effective EEMs in a well-planned and strategic manner will facilitate reaching targets, fulfilling compliance demands, and lowering overall operation costs. An avenue to achieving these results and reductions is to engage customers in an organized planning process that results in a commitment to take action and achieve targeted reductions for clearly identified projects.

For large organizations, the roadblock to implementation is not always money or interest; it is often more structural. They often need an outside force to bring all the pieces together and secure agreement within and across the organization. Numerous examples have shown that the engagement of the organization by involving senior executives with key facilities personnel and other stakeholders in dialogue, supported by meaningful technical assistance (often from a third party), can result in a road map for action and yield committed long-term savings. Whether they are in the form of a strategic energy plan or in conjunction with an MOU, such agreements often align with corporate sustainability and compliance mandates and provide a streamlined process for readily incorporating efficiency and carbon reductions into corporate goals and methods.