The Challenge of Impacting Process Energy Use: Successes from Using the "Cluster" Program Approach

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ABSTRACT

Energy used for industrial processes at most manufacturing companies is the largest part of their energy use. Yet impacting this use has always been a challenge for energy efficiency programs. To address the barriers in affecting process energy, Wisconsin's Focus on Energy program deployed a "cluster" approach to impact energy use in this hard-to-reach market area. The Focus on Energy program targeted four clusters in FY05: Pulp and Paper, Food Processing, Metal Casting, and Plastics.

The cluster approach brings together a team of diverse experts within a specific industrial market segment. The two key types of experts on a cluster team are the cluster leaders and the cluster process energy engineers. The cluster leaders brought the key knowledge and understanding of process and business issues, typically having 20+ years of experience in the industry at an executive level. They provided the strategic direction and high level network. The process energy engineers provided the technical muscle and field investigations necessary to bring together the technical details of projects and case studies of best practice solutions. The cluster initiatives provided a high level, systematic approach to defining energy efficiency best practices for process energy use and effectively promoting these best practices in each industry area. This paper describes Focus on Energy's implementation of the cluster approach, the lessons learned and the strategic plans developed for further impact on process energy use in each industrial cluster.

Introduction

Impacting process energy use in manufacturing facilities has always been a challenge for utility or state energy efficiency programs because it is tied so closely to a company's core business. Their focus on issues around productivity, quality and reliability usually trump even the consideration of opportunities to reduce energy costs within the process. Promoting and affecting energy efficiency has typically been much easier in the auxiliary areas such as compressed air, lighting and HVAC. These areas typically do not directly impact the manufacturing process, so changes and cost reduction strategies for these systems are more readily accepted. Yet energy used for industrial processes at most manufacturing companies is the largest part of their energy use.

With these challenges and large potential opportunities in mind, Wisconsin's Focus on Energy program designed an effort to dig deeper into process energy issues and opportunities to create a larger impact on reducing manufacturing process energy use. The Focus on Energy program is public/private partnership funded by the rate-payers of Wisconsin to promote energy efficiency and renewable energy. To clarify the authors' perspective, SAIC provides the program design, management and implementation for the Focus on Energy industrial sector program. The design of the Cluster program within the Focus on Energy industrial program is

built around targeting key groups of energy intensive end-use customers that we call "clusters". The four clusters we tackled were Pulp and Paper, Food Processing, Metalcasting and Plastics.

Cluster Energy Use Profiles

These four cluster industries consume much of the energy for the industrial sector. The industrial sector in Wisconsin uses 35% (24,154,000 MWh) of the electricity and 36% (1,420,000,000 therms) of the natural gas consumed in the state (Wisconsin Division of Energy 2004). It also uses another 81 trillion Btu of coal, 19 trillion Btu of petroleum, and 28 trillion Btu of renewable energy (Center for Technology Transfer 2004). The four target industrial clusters represent about 58% of the electric energy used and 79% of the natural gas used in the industrial sector. With much of the energy for these clusters used for processes, it becomes a natural, but still difficult target for program efforts.

Of the four clusters, the Pulp and Paper cluster is by far the largest energy using cluster in the state with close to a half billion dollars in annual energy costs or about 30% of the total industrial energy use. Wisconsin has led the nation in papermaking for over 45 years with shipments from paper companies of over $12 billion annually and the forest products industry employs over 100,000 people in the state (Center 2004). In 2001, a roadmap for the Pulp and Paper industry was created that began to lay some ground work on energy and process issues within the industry (Energy Center of Wisconsin 2001). For these important reasons, the largest amount of resources were devoted for efforts in this cluster.

But the other three clusters also represent significant energy use in the state. Table 1 shows the percentage of industrial energy consumption and an estimate of the percentage of savings potential within each target cluster when compared to the savings potential for the total industrial sector. This information was obtained from the Wisconsin Focus on Energy Major Markets Study in 2001 (Xenergy 2001).

Table 1: Industrial Energy Consumption and Savings Potential by Cluster

Cluster	Industrial kWh (% of Total)	Potential kWh Savings (% of Total)	Industrial Therms (% of Total)	Potential Therm Savings (% of Total)
Forest Products	30	38	18	25
Food Processing	13	13	18	24
Metal Casting	10	4	33	20
Chemicals/Plastics	5	7	10	9
TOTAL	58%	62%	79%	78%

This table shows that the four target clusters represent not only a significant portion of the energy used in the industrial sector, but also a large portion of the potential savings within the industrial sector.

Cluster Approach

The main objectives for the cluster approach was to first identify key energy efficiency best practices for processes and then find effective methods to promote these best practices within each cluster. The cluster teams were designed to overcome the following program barriers to reaching these program objectives:

- Knowledge of processes issues
- Knowledge of technical solutions and best practices
- Network within the cluster for process best practice promotion
- Understanding and influence on business case within cluster

The Focus on Energy industrial program has 10 qualified energy advisors in the field that assist end-users and equipment suppliers with technical support and "unbiased" information related to efficiency opportunities. But these advisors typically have a broad energy efficiency technical expertise that is mostly related to the auxiliary types of systems such as lighting, HVAC and compressed air systems. They usually do not have a deep understanding or experience in process issues. Therefore, the cluster teams needed to overcome this barrier with increase technical expertise in processes and efficiency best practices that may be appropriate for specific clusters. Also missing from the program was strong networking relationships within the clusters that reached into the executive level. Therefore, the design of the cluster teams was to include one or more individuals that would provide the technical expertise to identify efficiency best practices for the process (Cluster Process Engineer) and individuals that would provide a network to higher level executives in the cluster (Cluster Leaders).

In early 2004, program management solicited assistance from industry leaders, associations, and state government to identify experts to support the development and dissemination of Best Practices in process manufacturing for these four key industries.
Through an RFP process at least one Cluster Leader with 20 or more years in the industry familiar with the manufacturing processes, and a Cluster Engineer, who understands process energy issues in those industries, were selected for each Cluster industry team.

This approach brings together a team of diverse experts within a specific industrial market segment. The cluster leaders brought the key knowledge and understanding of process and business issues at an executive level. They also provided the strategic direction and high-level network. The process energy engineers provided the technical muscle and field investigations necessary to bring together the technical details of projects and case studies of best practice solutions.

Once the Cluster teams were created, the next step was to begin building a strategy or work plan to identify and promote best practices. This work plan included laying out the major demographics of the cluster market such as key customers, significant equipment and service suppliers, and industry associations. The plans called for initial contacts with industry associations within each cluster to let them know about our cluster team plans and to begin developing a stronger working relationship. Then we reached out to the key end-users in the cluster to probe more deeply with an in person survey on what process issues were hot for them and to also determine what best practices they may have already completed.

We also performed literature searches to find all best practice information available. For some clusters, like for the Pulp and Paper cluster, we found a lot of good references that helped identify many possible best practices such as "Energy Conservation Opportunities 1981-2004, Pulp and Paper Technical Association of Canada" and "Results of DOE/OIT Plant-Wide Energy Assessments in the Forest Products Industry, 2002 Fall TAPPI Technical Conference". For other clusters, like within the Plastics industry, the solid references for best practices were limited.

Best Practice Identification

Our primary objective for the literature search was to mine already identified best practices and to use the best of these. We added the good best practices from our literature search to the best practices from team members experience or best practices uncovered during our survey process of end-users. Each best practice identified was summarized in a report template that included:

- Best Practice Description
- Primary area/Process
- Typical Energy Savings
- Return on Investment
- Stage of Market Acceptance
- Specific Limitations and Applications
- Other Environmental Benefits
- Typical Productivity Impacts
- References used
- Practical Notes
- Ideas on Promotion

Each Cluster developed a set of best practices. The most best practices were, not surprisingly, found in the Pulp and Paper cluster. The following are the number of best practices identified for each cluster at the time of this writing:

- Pulp and Paper: 55 best practices
- Food Processing: 12 best practices
- Metalcasting: 5 best practices
- Plastics: 10 best practices

The Pulp and Paper best practices were spread over 7 major processes found in the Pulp and Paper cluster. These included best practices of Dryer Management Systems and Efficient Fiber Re-Pulping Blades. For the Pulp and Paper Cluster we are publishing a "Best Practices Guidebook" (Focus on Energy 2005) that summarizes the best practices identified and includes a section on benchmarking the process energy use. Many of the Food Processing best practices were related to the refrigeration systems and heat recovery. Metalcasting was the most difficult to identify economic best practices that iron foundries could effectively apply with significant energy savings. The Plastics cluster developed best practices that not only looked at equipment and system energy use efficiency, but also at the use of different materials to reduce the energy needed for processing the materials.

The following is a sample the best practices identified within each cluster:

- Pulp and Paper
  - Dryer Management Systems
  - Efficient Fiber Pulping Blades
  - Capture Whitewater Waste Heat to Pre-Heat Mill Water
  - Install Automated Chip Handling and Thickness Screening System

- Food Processing
  - Recovery of Heat from Dryer Exhaust Stream
  - Micro Filtration to Concentrate Solutions
  - Free Cooling for Process Cooling
  - Refrigeration Optimization Best Practices
- Metalcasting
  - Coreless Furnace Tap Temperature Reduction
  - Return Dust Collector Exhaust to Foundry
- Plastics
  - Converting Electric Thermoforming to Catalytic Gas Fired
  - Converting Electric Calrod Thermoforming to Ceramic/Quartz
  - Pulse Cooling
  - Plasticizing Compounds

Most of the best practices that were identified were already known to the industry, but the process allowed our team experts in the clusters to determine, from all the information collected, which best practices would be the best to promote and push in the cluster. The cluster leaders also developed the best approach to promoting the best practices. One of the early successes we have had in promotion of the Best Practices in the Pulp and Paper cluster is with efficient re-pulping blades. These can save about 20% of the energy over the presently installed blades saving about 500,000 kWh per year with a payback of 7 months to 2.5 years depending on the installation's complexity.

Best Practice Promotion

The first step for promotion was to team with a key association in the cluster to put together a meeting with key cluster end-users. At this initial meeting we presented the cluster team and their strategic work plan to obtain feedback from the industry leaders and to begin to encourage their participation in the process. This laid the foundation for our calls to them during our field in-person needs assessment and best practice survey process. The key associations we worked with in each cluster included:

- Pulp and Paper:
  - Wisconsin Paper Council
  - Lake States TAPPI
  - American Forest and Paper Association Vision 2020
- Food Processing:
  - Midwest Food Processors Association
  - Wisconsin Cheese Makers
  - University of Wisconsin (UW) – Madison, Food Sciences Department
- Metalcasting:
  - Wisconsin Cast Metals Association
  - American Foundry Society
- Plastics:
  - Society of Plastic Engineers

- American Plastics Society
- UW-Platteville Center for Plastics Processing Technology

The second main task for promotion of the best practices was to help the key associations facilitate an energy efficiency seminar for their constituents. This was accomplished by either fitting in an association's regular conference or developing a separate seminar, usually over a full day, with the association. These seminars proved to be an excellent way to present our best practices and to receive feedback.

Other ways that we are using to promote the best practices is to deliver the information to customers and industry stakeholders through Best Practice information sheets, case study write-ups, specialized energy management trainings, industry newsletters, and web pages. One of the primary deliverables from the process engineering effort on the team is to develop case studies on 2 to 5 of the best practices within each cluster. Most of the case studies will have measured data that verifies energy savings and documents process impacts. The case studies will be used to substantiate the best practice impact and will be prominent and very useful in our promotional channels.

As a way for end-users to understand how a best practice may benefit their facility we are developing simplified spreadsheet tools to calculate a first-cut estimate of the savings for their facility. These spreadsheet tools will also be used by Focus field energy advisor to pre-screen possible candidates for the best practices. This will allow the energy advisor to identify more opportunities within the process energy use in these clusters, when before they would just focus on the auxiliary equipment.

Finally, all of our cluster team members are networked within the cluster and this provides a great personal approach to best practice promotion from a known relationship. This personal network has been invaluable to more effectively reach the cluster industries at higher levels. Many of the cluster team members, especially the process engineers, are continually meeting with industries within the cluster to discuss best practices and to collect data for case studies. During these efforts they are delving in more depth with the customer on other possible best practices opportunities within their facility.

Lessons Learned

At the time of this writing the cluster teams have been engaged in this process for 6 to 8 months. Each team has a unique diversity of expertise and approaches. The Pulp and Paper cluster team is the largest with 5 members and has been the most active. They also have much more opportunities for efficiency projects than the other three clusters. One lesson is that it is not only important to bring together a solid team of experts with strong cluster experience, but once the team is assembled it is as equally important to determine how best to use their talents and network. Each team will have its strength areas and provide their own unique opportunities. Most of the team experts will know their industry well, but they may not be able to clearly see how best to promote energy efficiency issues from a program perspective. Good management of this team is a key to effective and successful results.

Working with associations is a real key to success, but it is important to listen and probe to find how energy efficiency will fit within each cluster association. Some associations will fit better with the promotion of best practices than others. Each association is geared for different

levels of staff within the industries, so it is important to quickly understand which target audience each association will provide.

Along with the unbiased nature of a state program, one of the other most valuable services that the cluster approach provides is the development of case studies focused on process energy savings. The depth of quality technical information from process case studies is just beginning to come in from the cluster efforts, but is critical for our promotion of key best practices.

Conclusion

The cluster initiatives provided a high level, systematic approach to defining energy efficiency best practices for process energy use and effectively promoting these best practices in each industry area through the team and association networks. The approach significantly overcame the four program barriers listed in the beginning of this paper and the momentum is building toward more impact on efficiency within the cluster processes. The future strategic plan for these cluster efforts includes continuing to build solid case studies of best practices for each cluster to reduce project risk and uncertainty. We will also continue to work with the associations to provide education and training opportunities through their conferences.

Plans include integrating the process best practices within the Focus on Energy's Practical Energy Management© (PEM) approach that provides a standard template for energy management. PEM training seminars will be held for cluster specific industries with a special PEM implementation support structure to ensure that the customers are able to complete their energy management plans. We will tie the PEM training to our Tool Lending Library that cluster members can use to evaluate their own best practice opportunities. The process best practices developed will provide greater saving opportunities within their largest energy using equipment. We will increase the intensity of our search for new best practices by teaming with the Center for Technology Transfer in Wisconsin to concentrate on innovative technologies. Finally, a one-stop web site for each cluster will be developed to provide easy access to the best practice materials as they are developed.

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