

# **A Team Based Approach to Energy Management**

*Nels Andersen, Franklin Energy Services*

*Jerry Eaton, Masters' Academy<sup>1</sup>*

*Tim Dantoin, SAIC*

## **ABSTRACT**

Mercury Marine, headquartered in Fond du Lac, Wisconsin, is the world's leading manufacturer of marine propulsion systems. Facing increasing competition, rising costs, and smaller margins, Mercury Marine identifies ways to reduce costs and improve their profitability. This is not unique to Mercury Marine, as all American manufacturers are faced with the same issues. However, what is unique to Mercury Marine is their proactive approach to reducing energy cost and improving energy efficiency throughout their plants. Since 2000, they have reduced demand by 4 MW and saved 35M kWh by replacing inefficient equipment and processes. Starting in early 2006 they formed an energy management team encompassing their Wisconsin operations to increase the energy saving effort. This paper will document how they have achieved their success and can serve as a roadmap for other manufacturers to implement energy management teams.

The core components to Mercury Marine's success are:

- Upper management that is committed to managing energy
- Capitalization on early projects that successfully show the effectiveness of energy efficiency
- A clear understanding of how they use energy
- Creating ownership for energy use
- An empowered energy management team

## **Introduction**

From the title of this paper, one might infer that an energy management team refers to a group of core individuals within a company. However, the title refers to the whole team - upper management, those whose job it is to oversee energy purchasing and management, the empowered employees who directly interact on the core team, and the individuals from outside the company - utility, consultants, and other experts. Throughout this paper there will be many illustrations of how this team interacts and creates an effective energy management program.

Over the last 20 years, Mercury Marine has faced many of the same challenges as other American manufacturers. Rising costs and increased foreign competition meant that to survive they could not continue to operate as they had been. They did the typical cost cutting, manufacturing improvements, and quality programs as everyone else. In 2000, just as energy prices began to rise, they targeted energy efficiency as a prime area to improve their margins.

Mercury Marine, a subsidiary of Brunswick Corporation, headquarters are in Fond du Lac, WI. The Fond du Lac campus encompasses 12 plants with a total area of approximately 2M

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<sup>1</sup> Formerly of Mercury Marine.

square feet. The Fond du Lac campus is a 20 MW demand user and typically consume almost 130M kWh and 7.5M therms of natural gas annually. They have 3 additional Wisconsin operations and 13 additional facilities in North America.

## **Early Energy Efficiency Successes**

In the early 2000's, working together with the Focus on Energy program and Alliant Energy (their utility), Mercury Marine identified a number of highly visible, energy inefficient systems in their facilities using resources provided by Focus on Energy and Alliant Energy. These projects provided easily verified savings to show the effectiveness of energy efficiency. Energy efficiency was highlighted by these early successes and brought credibility to taking an active approach to reducing cost by targeting energy wasting systems.

The first significant project undertaken was replacing 33 roof top units in 2000. Twenty-nine of the units were electric and 4 gas-fired. The project entailed replacing the existing units with more energy efficient gas-fired models. The resultant annual savings were 2.5M kWh.

Next was a plant-wide lighting upgrade. They changed out all of their 400W metal halide fixtures with 320W pulse-start fixtures. Mercury Marine replaced approximately 2000 fixtures. Not only did they achieve significant energy savings (approximately 225 kW and 2M kWh) with the retrofit, but they dramatically improved the lighting quality.

Both of these projects took advantage of Focus on Energy's Energy Efficiency Performance Program, which was a performance contracting program. Thus, not only did the program provide a financial inducement to pursue the projects but required that the savings be verified through approved IPMVP methods. Both projects were verified with Option B of the IPMVP. The HVAC retrofit used stipulated equations using manufacturing curves and local weather data and the lighting retrofit used stipulated equations using the difference in wattage between the old fixtures and the new fixtures (hours of operation remained the same). Thus, the savings were conclusively proved to upper management, which brought credibility to energy efficiency projects.

Concurrent to these projects, Mercury Marine embarked upon an ambitious program to implement an energy management system / building management system (EMS/BMS). They understood that unless the various departments took ownership of their energy usage there would be no reason for them to reduce their energy impact. Departments had been back-billed on their energy usage based on an inefficient allocation system. Thus they could not immediately get credit for energy reduction projects nor could they truly manage their energy usage. Using the success of the energy saving projects implemented to date, they were able to justify installing the plant-wide EMS/BMS system. Their system allows instantaneous monitoring of many systems in the facility and precise billing for energy usage for the departments.

Their most ambitious energy efficiency project to date, initiated in 2001, was the complete re-engineering of their compressed air system. Mercury Marine operated 24 compressors totaling 4200 hp. All of the units operated independently, most fed the same compressed air loop, and there was no standardization of equipment, maintenance, or connecting users to the loop. The first step was to become educated in how compressed air is made and distributed, so with scholarships provided through Focus on Energy, key personnel attended the Compressed Air Challenge. This provided the knowledge to attack the inefficiencies in their system. Next, they had an engineering study performed on their compressed air system that was partially funded by grants from the Focus on Energy program (Foss, Krisa & Becker 2001) This

study detailed how the system operated, what the problems were, and how to correct them. The recommendation was to centralize the compressed air system and treat it as a utility. Unfortunately, with the country in a recession at the time and capital was tight, Mercury Marine was not able to immediately pursue the project even with significant incentives pledged by Alliant Energy and Focus on Energy. Approval for the project was gained about a year later and the new centralized compressed air plant was dedicated in August 2005. The new system comprises 5 250hp screw base load compressors that either are off or are fully loaded and 2 300hp VFD trim units. They also have over 30,000 gallons of storage and are able to maintain plant pressure to +/- 0.3 psi. They went from approximately 2.5 cfm/kW to over 5.5 cfm/kW, reduced their demand by over 1 MW and save over 9M kWh annually. Savings was verified by Alliant Energy, Focus on Energy, and Ingersoll-Rand, the manufacturer of the equipment. The control system for the compressor plant is web-based, so it allows them to instantly monitor how the plant is performing. Also, flowmeters located in each plant and connected to the EMS/BMS allow the facilities group to monitor and bill for compressed air usage for each department. Their compressed air system is thought to be the most efficient in the world.

Mercury Marine also implemented task lighting and exit sign retrofits, added occupancy sensors to all offices and meeting rooms, and replaced numerous motors with high efficiency models. Many of these projects took advantage of Focus on Energy grants or financing from Alliant Energy through their Shared Savings program.

These projects are what is typically termed “low-hanging fruit”, i.e. projects that are easily understood, savings are large, and paybacks are quick. Even though the above projects are good examples of energy efficiency projects, significant time, coordination, and third-party (Focus on Energy and Alliant Energy) grants and financing were needed. What can other industrial companies learn from this?

- **Find the low-hanging fruit.** Every facility has this. If you haven’t replaced your lighting in the last ten years, you can probably save 20-50% of the energy needed. How well does your compressed air system operate? Do you still use 100% outside air that is electrically heated? Are you recovering any of the heat from your exhausted air to temper incoming air? Are you recovering high-grade process heat? Depending on rates and efficiency of your current systems, any of the above might be ready to replace. If you are unsure how to evaluate projects in your facility, contact your utility or local energy conservation program. Just make sure the projects are big enough to get noticed, has a quick payback, and you are sure of the savings.
- **Build on your success.** Find a good first project and do it. Document your savings. Take those results and publicize them - get them in the departmental and operational reports, company newsletter, and local newspaper (Stanek 2007). Work with local and national organizations to have case studies written (Russell 2005a, 2005b; Semancik & Wirtz 2005). Equate the savings to your plant’s product - how many additional products need to be sold to equal the money saved. Compare the savings to how much carbon, CO<sub>2</sub>, SO<sub>x</sub>, and NO<sub>x</sub> that you are not putting into the atmosphere and how much energy equivalency to removing cars from the road, savings gallons of gasoline, or saving barrels of oil. Perhaps you can claim carbon credits. Have case studies written. For the above cited projects, Focus on Energy created case studies and articles touting Mercury Marine’s successes. Then use that information. You have built credibility within your

company, so use it to start going after other projects, to get metering to understand how you use energy and identify other opportunities, and to start energy teams.

- **Create relationships with your utility and other programs.** Your utility is not your adversary. They have a wealth of information on how your company uses energy and how others have reduced their energy usage. Many utilities provide assistance with monitoring your demand and usage in a real-time or almost real-time basis. Some utilities have grants or financing available to help implement projects. If your state has an energy conservation program like Focus on Energy, give them a call. At a minimum they probably provide incentives or financing. Some might provide training and on-site assistance. Take advantage of all the resources available to your company.

## **Beyond Low-Hanging Fruit**

The previous illustrations are the major projects implemented by Mercury Marine through 2005. However, these were all one-off projects and would not guarantee the systemic attention to energy reduction that was the corporate goal. In order to achieve that level of commitment, a plant-wide effort was required that necessitated buy-in from all departments. In order to get that, an accurate understanding of how Mercury Marine managed energy was needed. To achieve that goal, Mercury Marine teamed with their partners, Focus on Energy and Alliant Energy, to continue the plan.

## **The One-2-Five® Process**

In 2004, working with Alliant Energy, Mercury Marine participated in a One-2-Five® energy diagnostic session. The One-2-Five® process is provided by Envinta, a world leader in providing energy management baselining and best practice assessment. Essentially the One-2-Five® diagnostic is a facilitated software tool, where the customer examines ten areas in their management process, baselines the results against all of the One-2-Five® participants and also against peer companies, and provides direction in which critical areas they need to improve. A key feature to ensuring success with the One-2-Five® process is to engage upper management in the process. Mercury Marine has a culture of constantly improving all aspects of their operations so having the proper level of participation was not a problem.

The initial diagnostic gave Mercury Marine a clear plan for improving how they manage energy. Annually they have done the diagnostic session to assess if they have improved, re-benchmark against their peers, and to provide direction for the next year. This has provided them with clear goals to achieve. They have recently driven this process down to the department level. All of the departments have recently completed the Energy Achiever® diagnostic, which is a modified version of One-2-Five® designed for small to medium size customers. Thus, each department now has their own goals regarding how to manage their energy use and how to improve their energy management processes along with the overall corporate goals outlined by the One-2-Five® process. This allows real empowerment and ownership at the departmental level and engages the proper people in energy management. Through this coordinated effort, Mercury Marine scored a four-star rating in their latest One-2-Five® re-benchmarking. Only 3% of the companies participating in the One-2-Five® process have achieved this level of success and this puts Mercury Marine in the leadership of energy management (Alliant Energy 2007).

## Practical Energy Management© and Energy Teams

In 2004, the core members of the facility team participated in the first session of Practical Energy Management© (PEM). PEM is training provided by the Focus on Energy program and provides a methodology and structure to organizing energy teams, getting management buy-in, and understanding exactly where and how your facility uses energy (Focus on Energy 2002). While this might sound very similar to the One-2-Five® diagnostic, it is actually a compliment to that program. While One-2-Five® provides a facility with what to focus on regarding energy management, PEM gives the tools to achieve that success.

Armed with the One-2-Five® direction and PEM tools, Mercury Marine's facilities group worked with upper management to implement the next phase. They developed the structure for the energy team that would identify energy saving opportunities in the various plants, coordinate projects, and implement the energy management strategy. Each Mercury Marine facility in Wisconsin was part of the team, and the team cut across all functions of the operation. Thus, there was clear representation from all stakeholders in the company. First, each plant manager was made a member of the team. The plant managers are responsible for everything that goes on in their plants, so it was essential that they be part of the team. Next each plant manager designated an Energy Warden. Many of the Energy Wardens work in the maintenance department for each plant. Engaging those individuals with the role of Energy Warden is natural, as every day they deal with everyone in the plants and it is their role to make sure that all equipment functions as smoothly as possible. The role of the Energy Warden is to:

- Look for energy saving opportunities within their plants
- Promote energy efficiency - motivate people through effective communication
- Set the plant KPI's with the plant manager
- Assist in setting goals and writing action plans for energy efficiency
- Audit performance of energy savings projects and initiatives
- Write or change SOP's to reflect how to save energy and enforce the SOP's
- Recognize achievement in their plants

Once this structure was in place, Focus on Energy provided on-site PEM training for the energy team. The training was customized for Mercury Marine to provide exactly the tools that the team needed. This training occurred in May 2006 and was one of the first meetings for the energy team. The team members received the tools and knowledge they needed to be successful in their roles.

During the PEM session, the following topics were covered with the energy team:

- Basics of energy generation
- Global trends in energy use and costs
- Impacts of energy use
- Components of an effective energy management program

These topics were presented to provide the members of the energy team with an understanding of the importance of their mission and background to understand how energy impacts their operation. Small group discussions were also convened, covering topics specific to Mercury Marine.

One of the first assignments for the team resulting from the in-house PEM training was the development of key performance indicators (KPI) for determining the impact of energy in their plants. Each plant developed their own KPI that would be of benefit to their operation. Examples of KPI's are:

- kWh/unit of production
- kWh/employee
- kWh/ft<sup>2</sup>

The team meets monthly, at a pre-determined time and central location. They set and review action plans, review energy reports that are created from the EMS/BMS data, discuss audit results of various energy efficiency projects, and discuss various outreach and educational activities. They created the Mercury Marine Energy Profile, a published report which provides an annual snapshot of how they use energy and how energy impacts the operations.

This approach of creating energy teams and go-to people for each plant, facility, or department is easily duplicated by other industrial plants. The key points in developing such a program are:

- **Get management buy-in.** Unless you have support, both philosophically and financially from upper management, you will not succeed. Ultimately they control what happens in your facility, so they have to be on board. This is where the early successes, publicity, and goodwill you engendered from your first projects come in. If you include upper management every step of the way, let them know how important saving energy is to the health of your company and community, and show them the business case for pursuing it, having them approve the formation of an energy team should be easy.
- **Understand how your facility uses energy and set goals.** Use a facilitated process like One-2-Five® to understand how you use energy and where the areas of most critical need are. Follow-up with a program like PEM that gives you the knowledge and tools to act. Have strategy sessions with upper management to determine what might be the best way for your facility to create and implement an action plan. Mercury Marine's current goal is to reduce demand by 1MW and 10M kWh per year.
- **Appoint the right people to the team.** The plant manager (or equivalent) must be integral to the team. If a role similar to Mercury Marine's Energy Warden is created, it needs to be someone that is familiar with the operation, has good communication skills, and can think creatively and analytically.
- **Meet on a regular basis.** Set recurring meeting times. PEM recommends at least every two weeks. Mercury Marine has found that once a month works best for them. Each manufacturer needs to find what works for them and set meetings accordingly. However, set the meetings and keep the schedule. Do not be constantly changing the schedule to try to accommodate everyone. Team members know what the schedule is, so they should plan properly. Not everyone will be able to make every meeting - things happen. If a team member is consistently absent, it probably makes sense to replace them.

- **Keep team members motivated.** Mercury Marine keeps the team members motivated by having the meetings during noon and providing lunch, rewarding achievement, requiring each plant to periodically report on how they are implementing their respective plans, having guest speakers, and providing education. One event that Mercury Marine sponsored was a Compressed Air Leak Detection Challenge. Coordinated through the Energy Wardens, this was a month-long event, where employees were empowered to find and tag compressed air leaks. The winning plant (most leaks found and repaired) got certificates, a pizza party for each shift and recognition in the Wave (Mercury Marine's in-house newspaper). The result? For a few hundred dollars in pizza, they saved approximately \$35,000 in energy from repairing leaks.
- **Clearly document and disseminate information.** Reports need to be clear, consistent, and available. Action plans need to relate to overall goals. KPI's need to be developed, understood, and tracked. Update standard operating procedures to reflect how to optimally use the energy needed. Performance needs to be assessed and audited. Mercury Marine's sophisticated EMS/BMS allows all data to be easily retrieved, tracked, and reported. Although such a system may not be available to all industrial companies, to be serious about improving energy efficiency companies should invest in metering and monitoring at some level.
- **Continually educate your team members.** Unless they know what they are looking for, they'll never find anything. Mercury Marine publishes energy rules of thumb that allow everyone to understand how equipment and processes use energy. If someone sees a continually blowing compressed air nozzle, not producing any work, they can quickly understand how much it costs them. Bring in outside experts to provide training in specific areas - your utility or other program may have someone or direct you to the right experts. Take advantage of local training courses. Through Focus on Energy, Mercury Marine employees have been to such classes like the Compressed Air Challenge, PEM, Optimizing Fans and Pumps, Industrial Ventilation, and many others.
- **Synergize your energy team with other cost-cutting or quality initiatives.** Do you practice TQM, Six Sigma, or Kaizen? Are you going for ISO 14000 accreditation? Energy management dovetails perfectly with those types of programs. During a Green Belt event at Mercury Marine, they were looking at ways to reduce cost on a die cast machine. Unrelated to the actual process they were improving, they noticed a 50hp motor that continuously pumped hydraulic fluid. As the cylinder the pump provided fluid to was intermittently cycled, they suspected that the process could be optimized. Through calculations and trail and error, they determined that a 2.5hp motor and different pump operating for a total of 18 minutes an hour worked. Total savings was over \$20,000 annually for one machine. This resulted from having knowledgeable energy team members working with their Green Belts to deliver huge savings.

## Next Steps for Mercury Marine

The energy staff for the Wisconsin operations is now regarded as the experts within all of the North American operations of not only Mercury Marine, but of Brunswick Corporation.

Continuing with the theme of building on their success, the energy staff now is providing walk-through audits of other facilities, integrating the other North American Mercury Marine operations into the energy team, and looking to expand their impact and savings.

They are currently examining their SOP's to optimize them for energy usage. Each of the plants are required to examine their SOP's to ensure that the equipment is operated in an efficient manner. SOP's are audited for compliance. Also, the SOP for capital expenditures was modified. Capital requests now contains language ensuring that energy consumption is addressed.

Mercury Marine is also spreading the gospel of energy efficiency to other Wisconsin manufacturers. Working with Focus on Energy and other professional societies, they are ambassadors for energy efficiency and how it improves your bottom line. They have held the Compressed Air Challenge at their facility, have had numerous presentations and tours of their centralized compressed air system and the EMS/BMS, and have spoken at manufacturing and energy related events.

## Conclusion

This paper has presented the methodology undertaken by a large, well-known, US manufacturer for implementing energy management in their facility. Mercury Marine has developed a blueprint for success that can be used by many industrial facilities. The keys to their success are: identify and implement energy saving projects, use successful projects to drive the effort, use all resources available to identify projects, understand how your plant uses energy, implement a strategy, provide training, and create empowered teams.

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