Life Inside a Corporate Energy Consumer

Raymond P. Baker, Rohm and Haas Co.

ABSTRACT

Case Study: Life inside an Industrial Energy Consumer - or - Effective Energy Management: Strategy and Reality, Goals and Metrics, Plans and Actions and Lessons Learned.

Energy cost reduction efforts at Rohm and Haas, a global specialty materials manufacturing company, have lead to over 20% per pound of product energy usage reduction since 1997, with an annual value of over $40 million in 2004. The intent of this paper is to chronicle these efforts, including: the business case for change; the company environmental background; the corporate strategy and programs that were implemented including the corporate metrics program and site based programs; and highlights of the tools used and the lessons learned.

Rohm and Haas Company

Rohm and Haas is a specialty materials company, with annual sales revenue of approximately US $7 billion. The company's high-quality, global workforce, of more than 17,000 people and network of more than 100 manufacturing, technical research, and customer service sites in more than 27 countries focus on delivering technically advanced products and services that enable the creation of leading-edge consumer goods and other products found in the following end-use markets: building and construction; electronic devices, computers, hardware and communications equipment; packaging; household and personal care products; automotive products; paper products; retail food and hypermarket/supercenters; and pharmaceuticals.

Rohm and Haas is organized into six business groups: Coatings, Electronic Materials, Adhesives and Sealants, Performance Chemicals, Salt, and Monomers. Each business group manages its own cost structure, including energy, and is accountable for its performance.

The company, traded under the "ROH" symbol on the New York Stock Exchange, is a member of the American Chemistry Council and is dedicated to the principles of Responsible Care and Sustainable Development.

Effective Energy Management

The Business Case

Reduction of energy usage and costs will increase profits and provides competitive advantages. Energy is neither a critical component nor valued aspect of the company's products. On the contrary, the energy used to produce and deliver products to the market place is an unwanted contribution, which in certain respects is negatively valued by the marketplace. A common theme amongst the differing objectives of Rohm and Haas's six business groups is the need to continuously reduce the cost of doing business. The use of energy, and its cost, is found right in the cross hairs of this objective. Profitable growth is also a fundamental objective of the company. Considering the potential of a carbon constrained future energy market, the ability to

successfully manage and reduce the energy intensity of the company's product offerings is essential to the growth strategy.

The Environmental Background

In response to the energy crisis of the 1970's Rohm and Haas had an active program to reduce energy usage. In the 1980's other priorities pushed aside the programmatic approach. In the early 1990's the financial strength of the company allowed for reinvestment in the utility infrastructure, helping keep costs down. In the late 1990's the drive for competitive advantage began to reignite more targeted energy efforts, in particular at the company's largest facility. In 1999 the acquisition of Morton International led directly to the formation of a corporate energy team and a new company wide programmatic approach. Since 1999, the prominence of issues such as sustainable development, climate change and the sharply rising energy costs of the last few years have kept energy in the fore front.

The focus of this paper is on the activities since 1997. To summarize the circumstances at that time, energy costs represented a small but significant percent of sales; there was one large commodity-type production facility representing around half of the total energy cost with many smaller specialty production sites representing the other half; all sites were run by technical staff, mostly engineers, which for the most part had successfully leveraged the prosperous 1990s to update and maintain the sites in good and reasonably efficient status; business priorities were demanding ever lower costs with lower capital investment.

The energy value (cost) chain within the company consisted of: fence-line procurement of commodity energy sources, primarily electricity and natural gas with some fuel oil and minor other sources; the utility infrastructure where the commodities are converted to other useful utilities such as compressed air, heating, and cooling utilities distributed to the process users; and the process users themselves.

Strategy and Reality

What You Want Is Energy Excellence as Defined by:

- Minimize purchase costs through an active procurement effort that reviews and manages all the variables such as: rates, tariffs, competition bill analysis, understanding of consumption patterns, etc.
- Minimize costs to convert and distribute utilities on site through such efforts as: behavioral change, maintenance, high-return capital changes, medium- and low- return changes and possibly performance contracting
- Minimize process consumption through behavioral change, process improvement, capital projects.
- Constant vigilance: that is avoid the temptation for short term fixes – these do not yield year in and year out results.

What You Get, i.e. The Realities at Rohm and Haas Are:

- Capital is tight, and cost savings take fourth place to growth, environmental health and safety, and maintenance requirements (although each usually provides opportunity for cost based upgrading).

- Resources are even tighter: a single project that would net a good return may be attractive, but a dozen smaller efforts to get the same result are hard to staff.
- While corporate management is supportive and establishes goals, local management must respond to many pressures. The cost savings benefits of energy efforts alone are often not enough to warrant allocation of scarce resources.
- Operations staff sometimes sees energy efficiency in opposition to other priorities such as production requirements, reliability and operability.

Goals and Metrics

The Value Is in Goal Setting and Accountability

Without goal setting and clear accountability, progress is left to serendipity. While balancing pressures will always exist, the use of goals with accountability has yielded steady progress. The results show that the use of goal setting and accountability moves energy cost issues at the local level from being a nuisance to being an engrained reality, where continuous improvement becomes the rule.

At Rohm and Haas the goal is simple: Deliver year on year energy cost savings.

Rohm and Haas Metrics system

Since 1999 Rohm and Haas has set corporate goals for energy and water cost and usage reduction. In the first two years, progress was measured by collecting the assigned savings values of implemented projects including: capital investment, procurement activities, operational changes and maintenance. While capturing the good work being done, this methodology was far less than comprehensive. At a minimum, it missed gains and losses through behavioral efforts and ignored projects yielding negative results. (For example, the new energy consumption required by the installation of a new air pollution control device would not be accounted for.) Beginning in 2001, Rohm and Haas deployed a corporate-wide comprehensive metrics system. This system, dubbed EEMetrics for Eco-Efficiency, measures our energy usage, period, and does not rely on a summing of the value of implemented projects. (Results on positive projects are still collected for broad dissemination so that the learning may be leveraged across the company.)

The objectives for the design of the EEMetrics system were to:

- Focus on energy and water consumption, making energy and water consumption an explicit part of company performance
- Accurately measure actual production, energy and water usage, enabling internal benchmarking and encouraging conservation
- Promote Responsible Care / Sustainable Development, meeting environmental reporting needs including greenhouse gas emissions

The EEMetrics system as implemented is a web based system utilizing an SQL database. Each production unit measures and reports monthly its energy (and water) consumption and cost and its production rate. This data is identified by the business line, the production technology used, the type of energy purchased and the plant site. This data is then easily manipulated to provide a variety of useful analyses.

Plans and Actions

Corporate Programs

To implement the strategy, a corporate energy team was established. It included:

- stakeholder team - manufacturing managers, plant managers, capital manager
- working team - energy engineers, process engineers, plant technical managers, external experts (including *ad hoc* members as needed)

Goal – The initial goal to reduce energy consumption per pound of product by 15 percent within five years was achieved in three years. The subsequent goal has been to continue to reduce consumption by at least one percent per year, each year. To date, this goal has been exceeded by multiples each year.

Attack Plan and Targets – Prioritize larger sites with leveraged processes (i.e. those practiced at more than one site). Employ external resources to augment internal efforts and provide "outside in" perspective. This included two DOE Plant Wide Assessments with matching funds up to $100,000.

Site Based Programs

At the largest site, an energy team similar to the corporate team was established. Other sites developed expanded roles for individuals to become energy champions. The most successful sites have embraced local, tangible metrics and engrained energy reduction into their day to day activities.

Tools

Many tools are available to help with system design, continuous improvement and maintenance. Rohm and Haas's experience includes:

Energy assessments (continuous improvement, not a once-and-done tool). The energy value chain in a facility consists of the procurement of raw energy sources at the facility fence line, the plant systems that convert the purchased energy sources to useful utilities and the utility consuming processes. A thorough energy assessment evaluates costs savings opportunities in all three of these areas.

- Determine the recent past utility usage patterns
  - look for billing abnormalities and potential mis-billing, competitive rate opportunities etc.
- Determine the total cost to produce utilities on-site
  - include purchased utility costs as well as maintenance, labor, etc. The delivered cost can be two to three times the fence line cost
- Trace the costs through the conversion equipment down to the end use consumers
  - a money flow diagram
- Determine any means to reduce the end use, such as
  - turn equipment off when not in use,

    - alternative utilities,
    - load shifting,
    - variable speed drives,
    - process redesign, etc.
- Determine any means to reduce the utility conversion costs, such as
    - upgrading to higher efficiency equipment,
    - alternative equipment like combined heat and power systems,
    - system redesign,
    - reducing leaks and losses, etc.
- Assess and prioritize the various opportunities
    - develop a strategic plan for implementation

Pinch analysis (a system design tool). Pinch analysis determines the minimum cooling and heating requirements of a process, assuming the maximum level of process-to-process heat exchange can be applied. The objective is to identify heat exchange opportunities that would lower the overall heating and cooling utility usage. This tool may also be applied to water use or any material use.

Monitoring and targeting (a continuous improvement / behavior modification tool). This is an operational tool to provide useful, real time feedback to the operators so that they can make better decisions with regard to energy use. This is accomplished by installing meters that would provide the operator station with real-time energy performance data for the higher-cost users identified in the money flow diagram.

Energy management systems (a continuous improvement / behavior modification tool). These systems can provide both the real-time feedback of monitoring and targeting in addition to the capability for on-line optimization of complex systems.

Leak, maintenance and thermal imaging audits (maintenance tools). These tools reduce utility losses for steam, compressed air and other gas systems. These are typically performed by external specialists who survey the systems, identify needed repairs and often implement the repairs. The size and complexity of the systems dictate the need for an initial energy audit and the appropriate frequency for any repeated audits.

Lessons Learned

High performing Rohm and Haas sites were surveyed to determine their view point on critical success factors. The following summarizes the feedback. No attempt was made to quantify the data.

What Are your Top Reasons for Success?

- Work force awareness
- Cost savings driver
- Spiking energy costs
- Formation of energy teams
- Stabilizing production planning and scheduling

- ISO 14001 targets and objectives
- New capital allowed energy optimization
- Leadership: plan and follow up
- Awareness of opportunity
- Corporate goal convinced the plant staff how serious company was for saving energy

What Is Needed for Continued Success?

- Plant staff awareness – seminars, postings etc.
- Budgeting for required steam trap maintenance programs etc.
- Continuous monitoring and team focus
- Best practice continuous improvement activities in conjunction with cycle time reductions
- Overcoming resistance to change and doubts about effectiveness (still want to run two pumps vs. one)
- Capital investment in some new equipment
- Performance monitoring and belief in continuous improvement

What Has Been your Experience with External Tools or Services?

- If managed, well very beneficial, e.g. steam trap surveys
- Use of electric utility tool to monitor power usage has helped reduce peaks and overall usage
- Root cause analysis and management-by-objective very useful
- Government support and programs help identify opportunities

What Remain as your Biggest Challenges Ahead?

- Diminishing value of implementing lower-payback projects
- Capital availability – maintenance replacement or environmental health and safety projects present savings opportunities
- Limitations of technical resources
- Still have lots of easy improvements to make
- Workforce morale (enthusiasm)
- Convincing everyone of the benefits

What Are your Next Steps?

- Workforce vigilance
- Monitor results – measure improvements and contribution to financial bottom line
- Continue team approach – look for next tier of savings
- Introduce new techniques and add investments
- Sub-metering to assess usage
- Brainstorming with internal and external resources to identify new opportunities
- Continue to implement identified opportunities.

Conclusions

Rohm and Haas has been fairly successful over the last decade in effecting energy cost reductions. These reductions have come as a result of a variety activities and efforts within the company. The following summary, subjectively gleaned from these experiences, is intended to represent a best practice for current and future energy management at Rohm and Haas.

Excellence in Manufacturing Energy Management Has the Following Characteristics:

- Energy consumption and cost performance is a fully-integrated manufacturing performance parameter
  - Each operations team is held accountable for its energy consumption and cost performance as assessed, weighted and appropriately balanced with other key parameters as a measure of overall performance.
- Programs are in place to routinely:
  - monitor on-going usage,
  - assess energy consumption and cost,
  - identify reduction opportunities and
  - implement remedial actions.
- Consumption is measured and reported on a basis that can be:
  - easily related to an operational unit,
  - measured per pound of product,
  - identified for each operational area,
  - both real-time and periodic and
  - presented to whole operating staff.
- The optimal consumption is known and used as a benchmark against actual:
  - The ideal energy requirements per pound of product are known,
  - The difference between actual and optimal consumption is assessed, categorized and areas of opportunity are prioritized,
  - Causes of increased consumption above the optimal are identified, categorized and their relative contribution is calculated and
  - This assessment is made monthly.
- Each site undergoes a complete energy assessment (cost and consumption):
  - With external expert and peer participants
  - Performed at least every third year.
- Active and aggressive competitive purchasing is employed:
  - A thorough market analysis of energy commodities is available to the site energy purchaser,
  - Operational requirements and maximum flexibility of the facility are known,
  - Optimal contracts are negotiated,
  - Daily scheduling and interruptible options are taken advantage of and
  - Bills are analyzed for errors and detailed consumption data is kept.
- Reduction opportunities are developed, prioritized and implemented:
  - A portfolio of potential improvement projects is maintained,
  - The portfolio process has a champion and
  - The portfolio is reviewed periodically – at least annually.

- Necessary Managerial Support Includes:
  - A clear energy policy is maintained by senior management outlining goals and expectations,
  - Routine and quality communication of current performance and new opportunities,
  - Visible cultural reinforcement, e.g. in house energy achievement awards and provision of resources and
  - Barriers to high performance are addressed e.g. needed resources are allocated as needed.