It's all about the margins: Where does energy efficiency fit for industrial segments?

Julia Vetromile
DNV KEMA Energy and Sustainability
155 Grand Avenue, Suite 500
Oakland, California 94612
USA
julia.vetromile@dnvkema.com

Keywords

risk management, energy-saving behaviours, industrial energy saving, competitiveness, sub-sector, market failures, overcoming barriers, behavioural change, business strategy

Abstract

Energy efficiency potential in the industrial sector is 15 to 20 % of current usage, according to international studies. Despite programs, policies and regulations, this potential has not been reached. Research into selected industrial segments indicates key factors framing how companies react to energy efficiency opportunities.

A common framing of industrial behaviour regarding energy efficiency is a rational economic model. Under this model, consumers' rational self-interest to reduce costs will be the primary motivation to undertake energy efficiency investments. Under this model, the policy required to achieve energy efficiency focuses on providing information about energy efficiency opportunities and alternatives, and incentives to improve the economics or business reasons for investing. This paper explores industrial responses to energy efficiency opportunities, and poses that the rational economic model may not describe all decision making behaviour.

Capital investment decisions within industrial segments are influenced by the constraints of their business environment. Industries that are highly cyclic, for example, may be more resistant to investment. During up-cycles, production capacity may be too valuable to sacrifice for capital projects; in down-cycles, financing may not be available. For highly regulated industries, regulatory requirements drive capital investment; once regulatory criteria are addressed, changes are difficult.

Different business models within industry call for tailored interventions. We examine factors consistent within a segment, as well as factors relevant for many segments. Cross-cutting factors include competitive characteristics, vertical or horizontal integration, and energy as a percent of operating cost. Producers of specialty products, with high value added from production, have higher margins for investment. Large, vertically-integrated corporations likely have sophisticated approaches to energy, and may seek a green image for branding. For these customers, programs with goals and public rewards, like meeting ISO 50001 standards, would be appropriate. Commodity producers on tight margins are more resistant to changes. Therefore, focusing on measuring current operations, with technical support for developing projects to drive down operating costs will likely work better.

This paper discusses these factors, providing insights and recommendations for more effective interventions for energy efficiency program designers, voluntary agreement development and policy makers.

Introduction

The industrial manufacturing sector consumes one third of the world's energy; in 2007 this was 127 Exajoules (UNIDO 2010). International studies found a potential for 15 to 20% improvement in industrialized countries (UNIDO 2010, McKinsey 2009, European Parliament, Industry Research and Energy 2010), representing significant opportunities for energy efficiency. One study also noted that their methods may well underpredict the actual savings potential (U.S. National Academy of Sciences. 2010). Over the years, policy makers and program planners have developed a range of options to encourage ener-

gy efficiency in industry. Although there is much more to learn, the knowledge base has expanded such that successful strategies are known. Studies and consulting experience of leading businesses and technologies have identified best practices. Countries, states, and ministries have developed laws, regulations, codes, standards, guidance documents, and incentives. In the U.S, public utilities have developed a range of programs to improve energy efficiency. The range of achievements as well as the potential indicate that more opportunity awaits. The question becomes how to tap greater efficiency potential faster.

This paper explores factors in industrial decision making. Many market forces and behavioural processes beyond simple energy cost drive industrial customer decision making (Sullivan 2009). The logic of most energy efficiency programs and policies assumes that industrial energy efficiency decisions will be based on the economics. Thus, if an energy saving action is in the financial interest of the organization, it will likely be undertaken. In this paper this approach is referred to as the rational economic model. The rational economic model logic consists of two steps: 1) provide sufficient information to the decision makers and 2) provide an incentive to perform the energy efficiency actions (Sullivan 2009). The incentives may be of various forms: regulatory, cash payments, tax deductions or payment avoidance.

The experience to-date with these incentives indicates that there are still large untapped opportunities. This begs the question as to what else is needed to get the industrial segment to embrace all the energy efficiency opportunities. That is the focus of the research forming the basis of this paper.

METHODOLOGY

This paper is based on primary and secondary research in the industrial sector, as well as the author's experience working in manufacturing and later in consulting. In particular, this paper is informed from a recently completed strategic industrial research project on energy efficiency decision making funded by the two largest investor owned utilities in California, Pacific Gas and Electric Company and Southern California Edison Company. The purpose of the research was to improve the design and implementation of industrial energy efficiency programs. Building on earlier studies, energy-consulting firm KEMA, Inc (a division of DNV KEMA Energy and Sustainability) developed a series of market intelligence reports on eight energy-intensive segments: Cement, Chemicals, Glass, Metalworking, Minerals, Paper, Plastics, and Water/Wastewater. As part of this research, KEMA took an in-depth look at decision-making, cycles of innovation, and barriers to energy efficiency. Primary research included two phases: an industry leader meeting via Webinar and one-on-one interviews conducted with stakeholders in each segment investigated. Industry leader meeting attendees included energy managers from various manufacturers, technical consultants and representatives from KEMA, American Council for an Efficient Economy, and utilities. KEMA also conducted a limited number of one-on-one interviews with major energy users in California to solicit input from those unable to attend the industry leader meeting and confirm feedback from the meeting. Interviewees included corporate energy managers and plant operations staff. KEMA focused primarily on the larger customers in each sector.

In addition to those industrial studies, the research for this paper included reviewing ongoing program efforts in the U.S, as well as a sample of industrial efficiency standards and laws throughout the world.

Rational Economic Model for Industrial Energy Efficiency Decision making

A common framing of industrial behaviour regarding energy efficiency is a rational economic model. Under this model, consumers' rational self-interest to reduce costs will be the primary motivation to undertake energy efficiency investments. Under this model, the policy required to achieve energy efficiency focuses on providing information about energy efficiency opportunities and alternatives, and incentives to improve the economics or business reasons for investing (Sullivan 2009). The incentives could be tax breaks as in South Africa, regulatory requirements as in Australia, or rebates as in American utility energy efficiency programs (South African Bureau of Standards YEAR; Australia Department of Resources, Energy and Tourism 2008; Electric Power Research Institute 2009).

The economic rational model clearly is only one part of industrial behaviour, as demonstrated by numerous studies showing significant economic potential that has not been realized (KEMA and LBNL 2005, McKinsey 2009, Electric Power Research Institute 2009,US National Academy of Sciences 2011). However, KEMA's research into the driving factors for energy efficiency actions in specific industrial segments also identified barriers and non-economic explanations for behaviour.

One non-economic explanation of behaviour is risk aversion in a regulatory environment. Highly regulated industries tend to be especially unwilling to make changes that increase even slightly the risk of non- compliance. Public water and wastewater treatment plant operations managers were highly risk averse to make any change. The advantage of a cost reduction in energy bills was not sufficient to overcome the public and personal risk of a temporary failure to meet discharge requirements. If discharge requirements were not met, there could be fines, negative publicity and a sense of failure of civic duty. The positive consequences of the cost reduction would barely be noticed by anyone, but failure could be highly embarrassing. Many cost-effective projects are rejected in this industry (KEMA 2012g). One participant in a group meeting mentioned a manager who didn't want to do a lighting upgrade, because it would distract the engineer from his primary responsibilities to meet regulatory standards.

Generally, industrial decision making around energy efficiency will be influenced by the business models of the company, competitive factors, regulatory constraints, and economic conditions in which each organization operates. Additionally, as behavioural economics research has shown, decision making may be based on factors that are not addressed in a strictly rational economic model (Kahneman 2011).

Consider the beginning of a typical day in a manufacturing facility for a manager or supervisor, based on the author's years of experience in manufacturing. The supervisor walks through his or her department, and observes the staff and operations. Are all safety requirements being met? She checks into the laboratory, and makes sure quality standards and metrics are on target. She checks the key indicators for environ-

mental and regulatory compliance. Production is the major focus, and the supervisor gathers information and data to determine any trends affecting reliability, quality, or maintenance concerns. Staff motivation and labour relations may need to be addressed. The supervisor is also concerned about costs, including labour, raw materials and energy. And beyond all these factors required to keep production going, the supervisor must always remember the priorities of her manager. From this portrait, the relatively low priority of energy efficiency stands out, regardless of the economic benefits foregone by such prioritization. In a given organization, responsibility for energy and its efficient use may be assigned to particular staff, but the overall priority in the organization will be subject to the same types of priorities as the supervisor in this example. The exception is when management makes energy efficiency a priority. As management text books point out, initiatives supported by management are the ones that get done (Kotler and Keller 2012).

What Works for Energy Efficiency: Best Practices

The recognition that management drives successful endeavours informs international energy efficiency approaches. The energy efficiency laws in Japan (Matsuta 2009), for example, require adopting management practices. The International Organization for Standardization (ISO) follows the model by establishing standards for creating systems to manage quality (ISO 9000), regulations (ISO 14000), and now, energy (ISO 50001) (ISO 2012).

In the United States, successful strategies for achieving energy efficiency goals have been identified by both the departments of energy and environmental protection. The U.S. Department of Energy, Energy Efficiency and Renewables department has documented case studies from its Better Plants Program and the pilot stage of the Superior Energy Performance program (US DOE 2012). The U.S. Environmental Protection Agency developed a corporate energy management program under the ENERGY STAR label (US EPA 2012)

A recent Pew Climate Center study documents best practices and leading aggressive energy efficiency strategies of corporations seeking to reduce energy (Prindle 2010). The study distilled seven habits at companies that were highly efficient. These results were based on survey responses from 100 companies in the United States, as well as six case studies. These habits are:

- Efficiency is a core strategy
- Real and sustained leadership and organizational support exists
- Company has effective targets and goals
- Tracking and measurement systems for energy are in place
- Resources for energy efficiency are substantial
- Energy efficiency strategy shows results
- Communication of results is effective (Prindle 2010)

The Pew study also identifies a methodology for companies to becomes leaders in energy efficiency. This methodology is consistent with observations and approaches by other sources, including DOE's programs.

The path forward for organizations that want to develop as leaders in energy efficiency begins with creating a corporate strategy. The first step is get senior management to fully endorse the energy efficiency strategy (Prindle 2010). Similarly, case studies from DOE's Superior Energy Performance program pilot demonstration found that management commitment and involvement was a key factor in the success (Brown 2011).

Another key step is to create a broad reach for the energy efficiency team, moving beyond a single corporate unit such as the corporate sustainability group (Prindle 2010). For example, Nissan North America, Inc considers their corporate sustainability as a cross-functional business approach that is reinforced throughout the organization. Incentives, resources, and financing are provided by Nissan's management team to support projects and initiatives (Roden 2011).

One participant in KEMA's research described how the CEO was invited to the corporate energy efficiency team meetings. Although he rarely showed up, the team members were highly motivated to be fully prepared with their agenda items because they wanted to be at their best with company leadership (KEMA 2012a). These regular meetings on energy use provide focus for change. Another idea expressed was for several energy managers to converge on a facility for a day long "treasure hunt" for energy efficiency, brainstorming ideas and looking at costs.

Once management has embraced their commitment to energy efficiency leadership, and resources are provided, the next step is to develop a plan for energy management and collect data (Prindle 2010). In the US *Better Plants* program, guidance is provided to conduct an intial evaluation of their energy use, and then develop a roadmap for achieving company wide energy savings, reducing energy intensity by 25 % or more over 10 years (DOE 2011). Under Australia's Energy Management law the assessment is required, and the regulated organizations must develop a business case describing their response to the assessment (Australia 2011). Tools have been developed to assist businesses in their plans and assessments of opportunity (DNV KEMA 2012).

Energy assessments work best when carried out by experts with sector specific knowledge in depth. Companies appreciate assistance in identifying the projects that make a big difference. (KEMA 2012a) Across sectors, research participants expressed frustration with auditors who were only able to provide a limited set of recommendations for commonly used equipment. (KEMA 2012a-g)

Establishing a baseline of business as usual energy consumption and energy intensity is the next step. To do this, the organization must determine what data to gather, plan the metrics that the organization will track, and measure relevant parameters that affect energy use (DOE 2011). Designing a reporting system integrated into the existing accounting and other company information systems assists in setting metrics and developing baseline performance levels (Prindle 2010).

Like ISO 50001, programs, regulations, and standards designed for high performance typically recommend setting goals to reduce energy consumption or energy intensity (DOE 2011, Australia 2008, Japan 2009, Navigant 2010). During the launch of the program, management should communicate the goals, structure and plans to achieve energy performance improve-

ments. The management plan should include accountability for performance (Prindle 2011).

Once the strategy is in place and the energy management plan is implemented, measurement allows assessment of performance. Sophisticated controls can provide operators with real time energy information, so they can react to process discrepancies. Real time energy monitoring and control systems can be web-based so that remote viewers can see how the plant is operating and using fuels (KEMA 2012a).

As with any initiative, adjustment and adaptation will likely be needed to new conditions or understanding (Prindle 2010). Companies that see themselves as leaders recommend announcing successes and providing rewards for energy performance achievements (Sturtevant 2010).

Imagine again the supervisor in the manufacturing plant that has adopted a management standard approach to energy efficiency. Now energy efficiency is part of her daily routine, one of the many factors that must be addressed as part of her job. She will have goals for energy efficiency achievements, as will her superiors and subordinates. She will review energy management data just as she reviews production, quality and safety data. She will communicate successes to the team, and enjoy rewards for achievements.

When Energy Efficiency Doesn't Happen – Barriers

Let us now consider what keeps energy efficiency from happening. Several identified barriers (Vetromile 2011) are the mirror image of best practices:

- Lack of sponsorship from all levels
- Organizational disconnects
- Insufficient employee awareness and involvement
- Allocation of capital and staff
- Lack of staff time/expertise
- Lack of knowledge of energy efficiency

For these barriers, the research question becomes what policies will drive companies toward management systems and best practices. In countries with laws that mandate energy management systems, attention can be addressed toward developing metrics or scores to assess the underlying causes of these barriers. For example, a gap analysis of a given company can be performed that scores an organization's readiness for complying with ISO 50001 (DNV KEMA 2012). In countries without laws or regulations, voluntary programs can be developed to provide incentives for energy efficiency. The U.S Superior Energy Performance and Better Plants programs engage leaders in energy efficiency and sustainability. In the Netherlands, for over 15 years a voluntary agreement scheme drives industrial sectors (and commercial and service sectors) to meet energy efficiency targets. The voluntary agreements and associated obligations and benefits are negotiated between the government and industrial representatives (trade associations, or individual companies) and signed by the individual participating companies. Currently, the third generation of the voluntary agreements are in place. Particpants are obliged to submit energy efficiency plans aiming at the negotiated energy efficiency goals and a yearly report on their progress. In return participants benefit by easier (environmental) permitting procedures and regulations, tax reductions, and they get paid government support (consulting, peer groups, technological feasibility studies). Since the benefits are highly valued, participation in the agreement is the norm resulting in an average of 2.4 % improvement per year in energy intensity over more than 15 years.

Information can be a significant barrier to decision making towards energy efficiency. For example, recent studies in California found that many customers had limited knowledge of the incentive programs for energy efficiency for which they were eligible (KEMA 2012 a-g). Small and medium companies are more difficult to reach and inform (European Parliament 2010).

Other barriers to energy efficiency arise from broader issues. Some industrial segments are more risk averse to change, especially highly regulated organizations like publicly owned wastewater treatment plants or pharmaceutical companies. Pharmaceutical companies in the U.S. complete a rigorous process before they are permitted to produce a new drug. The production process itself is regulated, and modifications to the process require regulatory approval. The cost of the approval process must be factored in when considering changes for any reason, including energy efficiency.

Another barrier can be quantification of the improvements. Effective metrics are needed to properly calculate the improvement, normalizing for production, weather, raw materials and other relevant factors. This barrier arises when an incentive (or consequence) is available, but the organization can't effectively demonstrate whether their efforts will meet the goal. Measurement and evaluation protocols and methodologies are needed to meet the needs of each program, standard or regulation.

Given that engaging management is the critical factor to achieve significant progress, research into why management chooses to become involved may be needed. For larger corporation, goals around sustainability can lead to an interest in energy efficiency. The challenge is to bring the value of energy efficiency to smaller and less interested organizations. Cultural context is also important in developing policies, as cultural norms define reasonable and approved behaviours.

Limitations of the Rational Economic Model

The rational economic model is a limited viewpoint for energy efficiency. This model does not take into account the non-economic factors which may be driving decisions, such as risk aversion or concern about meeting quality or regulatory metrics. Psychologists have shown that rationality in human decision making does not always best describe how decisions are made. Daniel Kahneman and other behavioural scientists in the economics field have identified common patterns that may result in decisions that don't reflect the economic value of the project (Kahneman 2011).

Group decision making, common in selecting among alternative projects, also may have styles that are not economically rational. These styles may be designed to resolve conflict, which may be dependent on other factors than the economics of the energy efficiency action (Sullivan 2009). Group dynamics will affect how decisions are made.

Poor experience in the past with a particular technology can be a barrier to energy efficiency. For example, early adopters for the variable frequency drives at an early stage in their development, in the 1980s, experienced bad results. Although now these variable frequency drives are a proven technology, the early adopter facilities are risk averse to trying it again.

Tailoring Energy Efficiency Interventions for Business Types and Cycles

Many non-energy factors will determine how decisions are made around energy efficiency, regardless of whether or not an energy management system is in place. The business model, organizational resources, competitive and economic factors, and regulatory requirements all play a part in decisions.

A company's business model describes how a firm conducts business and creates value, and its approach to the marketplace (Zott, Amit & Massa, 2010). For example, vertically integrated companies in the cement manufacturing industry may control the upstream cement quarries, and downstream ready-mix concrete operations. This ensures a captive market for the gravel and cement products, and mitigates the influence of the actions of other companies. Many large players in the glass industry have a similar business model, typically vertically integrated to control their raw materials (KEMA 2012c). In both these highly consolidated industries, a small number of businesses dominate. KEMA's recent research in California found that well integrated companies were also more likely to have existing management systems that are amenable to energy management approaches such as ISO 50001. Not surprisingly, our research found that the companies with the most sophisticated approach to energy efficiency were most likely to be large, multi-national firms where energy use is a significant cost of operation (KEMA 2012 a-g).

Commodity producers and specialty manufacturers have very different business models which affect decisions around energy efficiency. For example, a chemical manufacturer producing a commodity chemical will compete primarily on price, and profitability will be connected to price. Specialty manufacturers compete on quality and schedule, meeting the demands of a niche market. For consumer products, such as laundry detergent, brand loyalty and product differentiation, as well as price, are important (KEMA 2012a). In the metalworking segment, basic metal producers with bulk-metal products like hot rolled steel create commodity products that sell to a global market. Basic metal operations are both capital and energy intensive, conditions which favour the largest players. Applied metal producers, which take basic metal inputs and manufacture targeted products like metal cans, fit the specialty producer model most frequently. This industrial segment is diverse, focuses on niche markets, and has low barriers to entry due to low capital requirements. Because this segment is highly fragmented and includes many small and medium enterprises, encouraging energy efficiency change is challenging (KEMA 2012d). Overall, commodity businesses will be receptive to energy efficiency that lowers their costs and improves reliability. Specialty manufacturers will be risk averse to changes that they perceive can affect quality. However, they may be more open to capital investment, because their margins may not be as not as tight as commodity businesses.

Business cycles also affect receptivity to energy efficiency. When business in good, companies do not want to sacrifice production for energy efficiency projects. And when business is slow, companies may not be receptive to committing the resources to energy efficiency in uncertain times (KEMA 2012a).

One of the factors that emerged from the industrial segment research as indicators of greater receptivity to energy efficiency was the size and reach of the organization (Weber, Vetromile and Friedman 2011). Large, multi-national companies were more likely to have corporate goals for energy efficiency and sustainability. Another consistent pattern detected was European or non-US parent corporations that required energy efficiency goals for all divisions. For U.S based companies, the relative interest in energy efficiency varied by the organization without an apparent pattern. The most interested were the largest consumers, but not all large consumers were equally engaged in energy efficiency (KEMA 2012 a-g). Regional companies tend to be dominant where a local presence is valuable and consolidation is not widespread, such as plastics and metalworking. Smaller organizations were generally less interested in energy efficiency projects, but interested in understanding better the allocation of energy consumption to specific unit operations. For example, one participant noted that attention to energy is given when there are significant changes in current cost, either up or down. This suggests that policies that encourage data collection and end-use measurement could be a starting point to engage these customers. Studies in Europe found that the transaction costs to seek out energy efficiency discourage investment, and mechanisms such as subsidies, loan and credit guarantees should be considered (European Parliament 2010).

Drivers of Energy Decision Making

In KEMA's research on decision making around energy efficiency focused on planning and investment priorities and the cycle of innovation.

PLANNING AND INVESTMENT PRIORITIES

In KEMA's research, companies reported more interest in energy efficiency when it was a higher percent of their cost. However, even the very energy intensive industries, such as glass manufacturing, reported that management interest in efficiency made a difference. (KEMA 2012c). Energy efficiency is considered a strategic investment due to the high capital and time-intensive process involved (KEMA 2012c).

Capital projects for energy efficiency fit best when timed with product or process improvement projects. These projects may be on an 8 year or more cycle (Allyn and Brockway 2010). For example, plants with large continuously operating equipment like industrial kilns, require periodic repairs. The kiln lining requires assessment and refurbishing after about 8–10 years of operation. When the kiln must be out of operation for lining repairs, plant management typically takes advantage of the opportunity to complete other repairs, test other systems, and make needed upgrades. In the glass industry, study participants noted that most repairs and innovations are planned around an 8-year cycle, coinciding with how long a furnace typically lasts before it must be serviced or changed out (KEMA 2012c). Energy efficiency projects can be implemented conveniently when

timed to coincide with needed repairs. Achieving the requisite timing requires continuing attention by management; otherwise it is easy to forget the energy efficiency components until it is too late to include them in the repair or down time schedule.

The biggest challenge for companies is making large capital investments without affecting production (KEMA 2012c). Timing must be carefully considered, especially when permits or processes requiring demonstration of meeting regulatory requirements are needed. In highly regulated industries such as pharmaceuticals, it is easiest to enact energy efficiency and sustainability into the master specifications when designing a new facility rather than retrofitting. (KEMA 2012b)

Investment criteria may vary based on the business unit as well as economic status. In the U.S, a payback period of 2–3 years often is acceptable in a good year, but in times of recession this will be even shorter (KEMA 2012c). This criterion is inconsistent with the rational economic model, which implies that even paybacks of ten years are consistent with other non-energy efficiency investment choices.

Regardless of sector, companies will prioritize low-cost/no cost behavioural changes (KEMA 2012 a–g).

Other determining factors for investment include: safety, regulatory compliance, return on investment, and meeting customer requirements of product quality (KEMA 2012c). Manufacturers look favourably upon value-added investments such as lighting upgrades, which save energy as well as promote safety and productivity due to increased light levels (KEMA 2012c).

SHARING INFORMATION

Manufacturing is by nature a proprietary industry, and companies need proper avenues of communication to avoid anti-trust limitations. Industry trade groups and working groups provide a valuable opportunity to share technical information and best practices (KEMA 2012b and 2012c). Presenting and networking at trade conferences provide invaluable opportunities for understanding key issues and standard practices (KEMA 2012b).

Participants in the KEMA studies expressed concern about understanding the true value of products and services designed to improve energy efficiency. On the one hand, companies stated that vendors are considered the true experts for innovative products. On the other hand, companies are inundated with vendors claiming to have new energy efficient technologies, and it is difficult to distinguish the real advancements from the "snake oil" sellers (KEMA 2012a and 2012c). Companies wanted a clearinghouse of vetted ideas, offered by credible organizations (KEMA 2012a).

Industry also expressed needs to drive the energy efficiency aspect to motivate vendors and work closely with them to provide energy efficient products. Facilities managers pointed out that in the equipment procurement or replacement process, vendors must be specifically told to incorporate energy efficient technologies (KEMA 2012b).

CYCLE OF INNOVATION

Manufacturers are risk averse to invest in capital-intensive experimental technologies. If the technology does not succeed, they could lose years of planning as well as fail to meet regulatory requirements (KEMA 2012c)

Manufacturers are more likely to make smaller replacements in their plants that may easily be undone if the replacement fails (KEMA 2012c).

Companies are also concerned with energy efficiency in regards to product innovation. New products for energy efficient buildings, such as lighter weight ceramics and flat glass, will drive innovation (KEMA 2012d). As new codes and standards push for more energy efficient building materials, innovation is encouraged in the manufacturing sectors to create better products. Innovative energy efficient products may be ready, but changes in codes and standards will push these products out. One research participant felt that the industry is slow to move, and there are no leaders pushing toward energy efficiency innovation (KEMA 2012c). The container glass industry has recently introduced a new lightweight eco-series bottle created with less glass, which results in energy savings per glass in production as well as transportation (KEMA 2012c).

Given that innovation and capital investment can be major hurdles to surmount, plant managers are often interested in smaller, easier to implement projects such as variable frequency drives, lighting, and systems control and monitoring (KEMA 2012b).

Moving Forward

Based on both primary and secondary research on industrial decision making, KEMA's research suggests a number of opportunities to improve energy efficiency in industry (KEMA 2012 a–g).

- *Build on Companies' Internal Goals and Programs*. The most sophisticated companies have established strong internal energy efficiency programs. Creating incentives or regulations that further enable the energy-savvy customers to achieve savings have low market barriers. For example, programs or agencies could offer benchmarking for specific unit operations or technical and management assistance for companies seeking to achieve or exceed ISO 50001 certification.
- *Develop an industry specific contact channel*. This could be a monthly electronic newsletter or email. Use these low-cost channels to keep energy efficiency a priority. Continuous, relevant information that can illustrate the possibilities for energy efficiency is another way to remind customers of energy and money savings that accrue through the adoption of energy savings technologies and practices.
- *Target trade associations and existing industry working groups*. In California, working groups were established to assist industry in meeting global warming standards under the Global Warming Solutions Act (Assembly Bill 32). Similarly, the US Environmental Protection Agency set up working groups by industry to share best practices. Partnerships with trade associations and working groups can assist with communications about industry specific programs, and provide a neutral forum for sharing energy efficiency successes.
- *Develop approaches that incentivize energy efficiency at the time of planned upgrades*. Companies will continue to invest in plants where long-term markets are perceived. Major up-

grades are likely to be on a long term cycle, with a planning horizon of as much as 10 years. Program administrators will need to pay attention to contacting the potential participant repeatedly as the time to make the decision approaches.

- *Communicate energy efficiency goals, incentives, opportunities and requirements effectively*. In California, many customers cited a lack of understanding of opportunities and incentives provided in utility programs. The communication of energy efficiency programs and policies must be expressed in ways that the CEO, or most employees outside of the energy management group, can understand.
- *Integrate Energy Efficiency with Permits and Regulatory Requirements*. As part of large-scale projects, companies are looking for technical or procedural assistance to combine energy efficiency when required to upgrade to meet environmental or other regulatory requirements. Perhaps environmental regulatory agencies should establish a set of questions about energy efficiency upgrades as part of permit application processes.
- *Provide industry specific audits and recommendations*. This would include "best practices" and equipment that is not only energy efficient, but also conforms to the specific need of its industrial use. Best practices can be identified for a given industry, based on experience from leading markets. For example, DNV KEMA's assessment tool includes best practices from Denmark and Sweden where continual energy improvement has been practiced for many years.
- *Encourage low-cost improvements*. Consider expanding credit for energy efficiency generated from structural, maintenance and behavioural achievements. Regulatory approaches and voluntary programs that focus on low- and no-cost items can engage customers with limited financial options, such as improving reliability through a predictive maintenance program, lighting retrofits, upgrading combustion burners, or installing sub-metering, variable speed drives on motors or energy controls.
- *Target corporate engineers and sustainability managers even if they are outside the country requiring the energy efficiency improvements*. This could be done cost-effectively through electronic delivery of information.
- *Design innovative policies, programs and pilots to address a range of needs*. Highly sophisticated companies are potential candidates for programs leading to certification under ISO 50001 or higher levels of performance such as the U.S. DOE's Superior Energy Performance. Other firms that are less engaged or more cautious may be receptive to shorter term continual improvement programs like the Energy Trust of Oregon's "Kaizen Blitz" pilot program and the Puget Sound Energy's Resource Conservation Manager Program. The Kaizen Blitz program offers an initial audit and one year of technical assistance, but requires the participants to set goals and implement fast payback options (Navigant 2010). The PSE program offers grants for a resource conservation manager, and incentives for energy efficiency improvements. This program focuses on and rewards improvements in behaviour and utility cost accounting (Puget Sound Energy 2010).
- *Engage the uninterested in measurement*. One of the biggest challenges in the industrial sector is getting participation. One opportunity for engaging the less interested customers is to focus on the measurement of their energy use, and assist them in breaking down their bill to specific operations. This can then highlight energy efficiency opportunities.

Beyond these recommendations directly on research results, there are broader questions that should be addressed by the energy efficiency community. Perhaps the most significant is simply stated: How can we move beyond the rational economic model?

The field of behavioural economics has developed a body of knowledge on decision making. How can this knowledge be applied to energy efficiency policy?

In the U.S., companies have been observed to act outside their economic interest regarding energy efficiency standards to be consistent with the group position (Goldstein 2007). In KEMA's research, trade associations and working groups were found to be a useful source for neutral energy efficiency information exchange. How can group cohesion be harnessed to improve energy efficiency?

Overall, the energy efficiency community has accomplished significant gains in the industrial sector. Policies that move beyond the limitations of the rational economic model and harness the power of industries needs can realize more of the potential in the industrial sector.

References

Allyn, Jeremy (Harrison Steel) and Brockway, Walt (Alcoa Aluminum). 2010. Energy Partnerships. DOE ITP Thursday Webcasts for Industry. October 7.

Australia Department of Resources, Energy and Tourism 2008. Energy Savings Management Guide: How to Estimate, Measure, Evaluate and Track Energy Efficiency Opportunities.

Brown, Jessica; Bill Meffort and Kathey Ferland 2011. Experience with Superior Energy Performance Implementation Projects. American Council for an Energy Efficient Economy (ACEEE) Summer Study on Industrial Energy Efficiency. July.

Electric Power Research Institute. 2009. Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030). 1016987 Technical Report. January.

European Parliament, Industry Research and Energy 2010. Overview of Energy Efficiency measures of European industry. Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy. Industry, Research and Energy. December. IP/A/ITRE/NT/2010-08, PE 451.483. EN.

http://www.affiliatedrecon.com/studies/OR/Energy_Trust/General/ETO-Kaizen-Blitz-Pilot.PDF

DNV KEMA 2012. Energy Saving Identification Tool.

Goldstein, David. 2007. Saving Energy, Growing Jobs: How Enviromental Protection Promotes Economic Growth, Profitability, Innovation, and Competition. Bay Tree Publishing. Berkeley, California.

International Organization for Standardization (ISO). Undated. Understand the basics: Management system. http://

www.iso.org/iso/iso_catalogue/management_and_leadership_standards/management_system_basics

Kahneman, Daniel. 2011. Thinking Fast and Slow. Published by Farrar, Straus, and Giroux. New York.

KEMA and Lawrence Berkeley National Laboratory, 2005. California Statewide Industrial Sector Energy Efficiency Potential Study. Prepared for Pacific Gas and Electric Company.

KEMA, Inc 2012a. Industrial Sectors Market Characterization: Cement Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

KEMA, Inc 2012b. Industrial Sectors Market Characterization: Chemicals Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

KEMA, Inc 2012c. Industrial Sectors Market Charac0terization: Glass Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

KEMA, Inc 2012d. Industrial Sectors Market Characterization: Metalworking Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. February. http://www.calmac.org

KEMA, Inc 2012e. Industrial Sectors Market Characterization: Minerals Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

KEMA, Inc 2012f. Industrial Sectors Market Characterization: Paper Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

KEMA, Inc 2012g. Industrial Sectors Market Characterization: Plastics Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. February. http://www.calmac.org

KEMA, Inc 2012h. Industrial Sectors Market Characterization: Water and Wastewater Treatment Industry. Prepared for Pacific Gas & Electric and Southern California Edison by KEMA Inc, A division of DNV KEMA Sustainability and Energy. Oakland, California. January. http://www.calmac.org

Kotler, Phillip and Keller, Kevin. 2012. Marketing Management, 14th Edition.

Matsuta, Akihiro 2009. Introduction of Benchmarks under the Energy Efficiency Law in Japan. Energy Efficiency and Conservation Division. Agency for Natural Resources and Energy. Minitry of Economy, Trade and Industry, Japan http://www.ceps.eu/files/task_force/2009/07/6AkihiroMATSUTA.pdf

McKinsey & Co. 2009. Unlocking Energy Efficiency in the U.S. Economy. July. http://www.mckinsey.com/clientservice/electricpowernaturalgas/downloads/US_energy_efficiency_exc_summary.PDF

Navigant. 2010. Kaizen Blitz Pilot, Report One. Prepared for Energy Trust of Oregon. October 2010

Northwest Energy Efficiency Alliance. Continuous Improvement for Industry website. http://www.energyimprovement.org/index.html

Prindle, William. 2010. From Shop Floor to Top Floor: Best Business Practices in Energy Efficiency. ICF International. Prepared for Pew Center of Global Climate Change. April.

Roden, Ken. 2011. Nissan North America, Inc.: Creating an Energy Culture. ACEEE Summer Study on Industrial Energy Efficiency. July

South African Bureau of Standards. South African National Standard (SANS). Measurement and Verification of Energy Savings

Sturtevant, Don 2010. The Role of the Energy Manager: The Simplot Way. Webinar presentation as part of the U.S. Department of Energy Industrial Technologies Program. 1 July.

Sullivan, Michael, 2009 Behavioral Assumptions Underlying Energy Efficiency Programs for Business. California Institute for Energy and Environment. Oakland, California. January. http://uc-ciee.org/behavior-decision-making/1/375/99/nested (http://uc-ciee.org/downloads/ba_ee_prog_bus_wp.pdf)

United Nations Industrial Development Organization (UNIDO) 2010. Global Industrial Energy Efficiency Benchmarking: An Energy Policy Tool November. http://www.unido.org/fileadmin/user_media/Services/Energy_and_Climate_Change/Energy_Efficiency/Benchmarking_%20Energy_%20Policy_Tool.pdf

U.S. Department of Energy, Energy Efficiency and Renewable Energy. 2011. Guide for Better Buildings, Better Plants Program Partners. Taking a Bold Pledge to Reduce the Nation's Energy and Carbon Footprint. November. http://www1.eere.energy.gov/manufacturing/pdfs/betterplants_guide.pdf

U.S. Department of Energy, Energy Efficiency and Renewable Energy. 2012. Case Studies. Advanced Manufacturing Office. http://www1.eere.energy.gov/manufacturing/tech_deployment/case_studies.html

U.S. Environmental Protection Agency. 2012. ENERGY STAR for Industry. http://www.energystar.gov/index.cfm?c=industry.bus_industry

U.S. National Academy of Sciences. 2010. Real Prospects for Energy Efficiency in the United States. Washington, D.C.

Vetromile, Julia. 2011. Powering Up Existing Tools to Accelerate Efficiency in Industry. ACEEE Summer Study on Industrial Energy Efficiency. July.

Weber, Susan, Vetromile, Julia and Friedmann, Rafael. 2011. Driving Business Decisions; a Look at Business Drivers of Industrial Energy Efficiency. ACEEE Summer Study on Industrial Energy Efficiency. July.