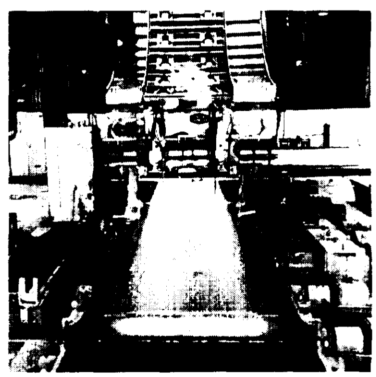
Energy in the Corporate Context 4

Corporations' internal cultures and external relationships are very important influences on industrial energy use and efficiency. The first part of this chapter discusses the internal climate and decisionmaking practices underlying investment in general, and investment in energy efficiency in particular. The second part focuses on relationships between corporations and their energy utilities and on utility efforts to improve industrial energy efficiency.



INVESTMENT IN EFFICIENCY

The improved equipment, processes, and practices described in the previous chapter enhance energy efficiency only to the extent that private companies use them in actual production settings. The investment and implementation step encompasses several major hurdles. Technical and economic feasibility are the most commonly studied of the factors influencing energy efficiency investment, but companies' general willingness to invest in process improvements, their energy awareness, and their access to information also have important impacts,

The Will to Invest

Perhaps the most important factor affecting industrial energy efficiency is the willingness of firms to invest in new technologies, whether energy-focused or not. Capital investment in modern equipment usually enhances energy efficiency, even when efficiency is not the primary purpose of the investment. The propensity to invest depends on the business climate, corporate culture, managers' personalities, and regulations. These determine the incentives for corporations in general and managers in particular to improve their production processes.

BUSINESS CLIMATE AND CORPORATE CULTURE

The working cultures of corporations emanate to a large extent from the dominant figures within those organizations. However, business climates also foster and shape corporate culture. For example, companies in young, high-growth industries tend to invest heavily in innovative products and technologies in order to build market share. In mature industries with price-based competition and low margins, companies, especially small ones, may have little incentive and few resources to invest.

A business climate imbued with strong market growth and competition is important for fostering investment. Without market growth, corporations have neither the resources nor the incentive to invest. Without competition, companies are under little pressure to invest. Competition that is vigorous, but fair, signals to companies that being profitable depends on being efficient with respect to energy as well as other production inputs. If profits are secure without investment, there will be no investment.

Competitive survival in the face of economic hard times or a vastly superior competitor can be a major impetus to aggressively improve energy costs and efficiency. For example, U.S. copper companies reduced their energy use significantly when they restructured themselves in the rnid-1980s to remain competitive in world markets.[1]

The effects of the business environment on corporate culture and managers' decisionmaking and investment behavior are illustrated in table 4-1.[2] Within these categories are managers that invest readily, ones that would invest if capital were more available, and ones that are reluctant to invest in almost any circumstance. Decisions by hands-on managers occur quickly, while those by bureaucrats are long and involved.

MANAGERS' PERSONALITIES

Corporations are not monolithic, and neither are their investment strategies. Decisions about investments are made by many managers, acting either as individuals or groups. The managers respond to different stimuli and react to situations in different ways. No one type of incentive system works for all managers. Once their basic goals regarding production quotas, reject rates, and other factors have been met, managers differ in their effort and desire to improve production processes and products. In the context of the "if it's not broke, don't fix it adage, managers differ in their ideas about what is meant by ''broke. ' For some, an operation is ''broke' only if it is not up and running. They are satisfied if they are meeting their basic goals, and only "fro' things when those goals are not being met. For other managers, an operation is ''broke" if it can be improved. These managers continue ''fixing' things until the process is producing high-quality products as efficiently as possible.

REGULATIONS

Investment can also be mandated, as in the case of environmental regulation. In some cases, mandated investment can increase the efficiency and competitiveness of companies. In other cases, regulatory mandates can lead to higher costs and greater energy use, and in severe cases, lead to plant closures and capital migration. This can happen if the mandated costs are too onerous and if foreign competitors do not face commensurate increases in production costs or tariffs. Higher costs do not, however, automatically lead to plant closures. There are tradeoffs among the costs of doing business, the costs of relocating, and the benefits of being close to markets.

---

[1] U.S. Congress, Office of Technology Assessment, *Copper: Technology and Competitiveness, OTA-E-367* (Washington DC: U.S. Government Printing Office, September 1988).

[2] The categories, which were developed to describe managers in commercial firms, are also applicable to managers in small- and medium-sized industrial firms. Managers in large firms are more difficult to categorize, because their behavior is more strongly governed by corporate cultures that are unique to their firms.

Table 4-l-Categories of Managerial Behavior

Manager type	Industry type	Management characteristics
Enlightened managers	High growth.	Early adopters of technologies who closely monitor and control energy consumption and expense, and seek to maximize equipment efficiency and reliability.
Bureaucrats	Slow, but stable, growth.	Shortsighted, risk averse, and somewhat cash constrained. Multiple decisionmakers and lengthy, formal, decision cycle.
Survival-focused	On the edge of bankruptcy.	Focus exclusively on activities that will generate cash to keep the business afloat. Emphasis on revenue generation over cost reduction. Minimize financial risks.
Hands-on managers	Business built around a somewhat price-insensitive product.	A simple decisionmaking structure anchored by a single individual who is directly involved in the daily operations of the business. Focus on decreasing operating costs more than increasing revenue. Avoids financial risks and investments in new technologies regardless of the potential benefits.
Operating cost sensitive	Volatile growth.	Prevalent concern for managing and containing operating costs. Uses a rigorous set of financial criteria to guide acquisition decisions and performance.
Innovators	Slow, but steady growth.	Commitment to innovation in product line and business as a whole. Pays more attention to operating costs and efficiencies than to initial costs of energy-related equipment. Willing to adopt new energy management technologies and invest managerial time in monitoring and controlling energy costs.
Constrained relationship seekers	Highly energy intensive and highly leveraged.	Recognize opportunities to achieve greater efficiency, but high debt loads and lack of cash prevents the acquisition of fuel-efficient technologies and the expertise to manage energy consumption.
Uninvolved	Mature products in mature markets. Slow, but occasionally volatile, growth.	Averse to adopting new technologies in particular and risk in general. Negligible concern about energy.
Complacent	Perceived price insensitive markets.	Risk averse and unwilling to invest in new technologies, and are not particularly sensitive to cost control.

SOURCE: Electric Power Research Institute, *An Overview of EPRI's Commercial Needs-Based Market Segmentation Framework,* EPRI Project No. RP2671-01 (Palo Alto, CA: Electric Power Research Institute, November 1990).

Energy Awareness

If there is a willingness to invest, the next hurdle is for managers to know how energy is used in their plants and to be aware of technologies available to improve the situation. Industrial companies view energy primarily in terms of cost. They have direct financial incentives for reducing their energy costs by improving their energy efficiency. The importance that companies attach to reducing costs in general, and energy costs in particular, varies greatly however.

To some extent, the level of companies' concern about energy is proportional to energy's share of total production costs (see figure 2-8). In industries such as steel, aluminum, cement, and industrial gases, where energy is a major portion of total costs, concern about energy efficiency is high. The existence of energy-efficiency "champi-n s , ' enlightened management, or efficiency promotion programs can also give energy a high profile in corporate decisionmaking. For example, Dow Chemical's Louisiana Division has a very successful contest for identifying and funding energy efficiency projects (box 4-A). Sudden energy price shocks or availability problems can also prompt companies to improve their energy efficiency.

The above cases notwithstanding, cutting energy costs via technical means is not a high profile concern in most industrial companies. Energy costs do not command the attention of senior management and do not garner the resources needed to implement improvements. Even in the operations divisions of firms, where cost issues are most focused, energy is but one of many concerns. An operations manager's top priorities are keeping the production line up and running smoothly, making products that meet consumer's specifications and expectations, and meeting regulatory guidelines. Energy costs tend to be secondary concerns. The general lack of concern afforded energy in many corporations is a major barrier to the implementation of energy-efficiency improvements.

Low energy awareness is less of a setback to efficiency in situations where there are new technologies with production benefits in addition to energy saving characteristics. Fortunately, many technologies fall into this category. They are implemented primarily to boost product quality, further automate production, or enhance some other characteristic. They improve energy efficiency as a side benefit. For example, continuous casting is put into steel mills primarily to improve material yields and product quality and to shorten processing times. Secondarily, the improved design of the process uses less energy per ton of steel produced.

Role of Information

Convenient information regarding new technologies and their energy characteristics is vital to efficiency implementation. Managers, especially those in small firms, do not have the time and resources for gathering and analyzing large amounts of information to support their decisions. This is particularly true when equipment fails and needs immediate replacement. There is little time to research the best available replacement technologies, and then test and tune them up once they arrive. Replacements are needed quickly, and must have minimal startup problems. Consequently, in these situations, managers usually stick with the technologies that they know well—the ones that were used before.

Providing information is a role that State and Federal Government are involved in. Utilities are also involved in disseminating information as well as conducting audits to inform companies about energy saving opportunities. Sometimes such outside organizations are successful in promoting energy efficiency technologies, because they can better deal with issues that straddle bureaucratic boundaries within fins.

Technical and Economic Feasibility

Lastly, technologies must be technologically and economically feasible to be implemented. Technologies must not only work successfully, but also be reliable, serviceable, and proven. In addition, they must be economical with respect to initial capital outlays, energy and other input prices, and costs of capital. In addition, there are various hidden costs, such as operator retraining, equipment testing and adjustment, and process downtime during installation and startup, associated with getting a technology up and ruining. These hidden costs can be sizable, but are often overlooked.

TECHNOLOGICAL FEASIBILITY

On the technical side, risk can be a large barrier to new technology implementation. Many companies are very risk averse and only invest in

Box 4-A—Dow Energy/Waste Reduction Always Pays (WRAP) Contest[1]

The Louisiana Division of Dow Chemical Co. sponsors an annual contest to generate ideas for improvements in energy use, product yield, maintenance, and waste reduction. When t he contest started in 1981, it covered only energy saving projects that cost less than $200,000 and paid for themselves within a year. The scope of the contest was expanded to include product yield projects in 1983, maintenance projects in 1986, and waste reduction projects in 1987. Today, the Energy/WRAP Contest accepts any project within this scope that saves more than $10,000 year and has a return on investment (ROI) greater than 30 percent.[2]

Employees submit ideas for cost savings to the Energy Evaluation Committee. Each submission-intentionally kept simple-must include a brief project description, a summary of utility (e.g., electricity and steam) and yield savings, ROI calculation, before-and-after sketches, and if applicable, the type and quantity of waste reduced. The incremental costs for utilities and the formula for calculating ROI are published on t he entry forms, so individuals can determine for themselves whether they have a good project. After an initial review of the entries, four or five members of the Committee discuss the proposals with the submitters. This review process is designed to evaluate projects, not people. The purpose is to ensure that all approved projects are technically viable and have a high probability of being successful. Winning individuals and teams are recognized through a formal awards presentation, where they are presented plaques by the division general manager. In addition, winners receive strong management and peer recognition in t heir own plants and departments. No monetary awards are given by the Energy Evaluation Committee to winning projects. Instead, supervisors are asked to put each individual's contest participation in the context of overall job performance and reward him or her accordingly. Later, the completed projects are audited to verify t hat each project accomplished what it was supposed to. The objective is not to find fault with unsuccessful projects, but to learn what makes good projects.

Between 1982 and 1988, there were 404 winning projects costing a total of $68 million. The average ROI each year varied between 77 and 340 percent. All but four of the projects had costs less than $2 million. In 1988, the 94 winning projects costing less than $2 million each required expenditures of $9.3 million and generated savings of $18 million per year. The savings came from fuel use (23 percent), product yield improvements (60 percent), capacity increases (14 percent), and maintenance (3 percent). The contribution of waste reduction projects is included in the product yield improvement category. From 1982 to 1991, more than 100 trillion Btus of energy have been saved. Dow credits the success of the program to the following elements.

- Top *management* support-The contest seeks out cost-effective projects and has low overhead. It does not require a new department, redeployment of people, or a million dollar budget.
- Employee recognition-Credit for thinking of, developing, and implementing projects goes to the submitters and their plants, not to the contest or to the Energy Evaluation Committee.
- Funding-The Energy Evaluation Committee does not directly control the allocation of capital. The contest's high credibility y and demonstrated past performance lead to funding within normal budgeting and capital allocation procedures,
- *Minimal paper work.*
- *Learning* experience--The contest develops and strengthens skills such as uncovering and analyzing plant problems, calculating potential savings, developing viable solutions, estimating project costs, and making presentations.
- IIdea sharing-Descriptions of every project, winners and nonwinners, are published and distributed throughout the division.
- No conflicts with plant priorities objectives-Many of the plants reexamine their priorities as part of t heir contest activities.
- No numerical goals-The contest does not set numerical goals such as the number of projects submitted or dollar savings. The overall objective is to encourage continuous improvement.

1 Kenneth E. Nelson, "Are There Any Energy Savings Left?" *Chemical Processing,* January 1989. Kenneth E. Nelson and Joseph A. Lindsly, "Case Study: Winning Ideas Reduce Waste at DOW," *Pollution Prevention Review,* spring 1991.

2 ROI calculated as annual savings or earnings X 100 / project cost.

technologies that have been proven on an industrial scale elsewhere. This aversion to risk may come from management itself or imposed on it by outside providers of financing. Regardless, many companies do not like to be the first to try expensive new process technologies. There are, of course, exceptions. Nucor recently built a new steel mill in Indiana around a thin-slab casting technology that was very unproven.

Companies also want technologies to be very reliable, because of the great costs associated with malfunctions in processing lines. For example, many companies place very high premiums on the proven reliability of a certain type of pump or fan and its manufacturer; on minimizing spare parts inventories; on simplifying maintenance; and on timely delivery of spares. They are often unwilling to switch to a different manufacturer to get a slightly more efficient pump or fan for a specific application.

Other important considerations in energy decisionmaking are the connections between energy-using technology and product quality, yield of materials, maintenance of equipment, capacity of production, and so forth. Energy conservation measures are not undertaken if managers believe that the new technologies are likely to interfere with production in any way.

ECONOMIC FEASIBILITY

Standard accounting procedures can be used to evaluate the economics of all the technical factors, including the risk, mentioned above. However, the evaluation process itself can be costly and burdensome. Small projects are therefore often evaluated solely on their initial capital outlays and cost savings (box 4-B). Factoring in the risk, hidden costs, and other difficult to quantify costs and benefits occurs through managerial intuition.

CAPITAL AND PERSONNEL AVAILABILITY

Funding is another major impediment to implementing energy efficiency improvements. Two general classes of projects, mandatory and strategic, usually have the highest -claims on companies' available investment capital, Mandatory projects focus on regulatory compliance, capitalized maintenance, replacement of essential equipment, and maintenance of product quality. Strategic projects are market development activities, such as market share enhancement, new product development, capacity expansion, and acquisitions.[3] Though discretionary, strategic projects are high priority uses of finds.

The amount of capital left over for lower-priority discretionary projects such as energy efficiency improvements and other cost cutting efforts is often small. Getting funding for energy projects can, thus, be much more difficult than the standard evaluation criteria (e.g., simple payback, internal rate of return, and net present value) would suggest. In a 1983 survey of project funding practices in large industrial firms, the Alliance to Save Energy found that many firms use capital rationing as a project funding control mechanism.[4] Under capital rationing, projects compete among themselves for a freed amount of discretionary capital, and some projects that are otherwise economically attractive do not get funded if the capital pool is too small. For firms that manage capital in this manner, the de facto internal cost of capital for discretionary projects can be extremely high, making many projects appear unattractive.

In addition to the scarcity of capital for efficiency projects, there is often a shortage of technical personnel. With many companies running as lean as possible, engineers and technicians are kept busy making sure the production lines run smoothly and in compliance with

[3] Alliance to Save Energy, *Industrial Investment in Energy Efficiency: Opportunities, Management Practices, and Tax Incentives,* July 1983.

[4] Ibid.

Box 4-B–Evaluating a Project's Financial Worth

Various methods are used to calculate the financial worth of a project to a company. They all attempt to measure the net monetary effects of a project's costs and benefits over its useful life. The costs include capital outlays, operating and maintenance disbursements, startup downtime, etc. The benefits include improved product quality, increased productivity y, energy savings, etc. Three of the more common project evaluation techniques are simple payback, return on investment, and net present value. Companies choose the technique t hat best reflects their management style and accounting practices.

Simple payback, the crudest measure, is the time in years for cumulative cash flow (net benefits) to equal the project's capital cost. This method essentially measures the time it takes for a project to pay for itself. For example, a $600,000 investment that returns $200,000 per year "pays back" in 3 years. Generally, low payback periods make projects attractive investments. Many firms are reluctant to invest in projects with paybacks greater than 2 or 3 years. However, this cutoff varies widely not only by company, but also by project size.

The more sophisticated evaluation methods, return on *investment (ROI)* and net *present value (/VPV),* explicitly take the time value of money into account. They compare a project's worth to that of other investments (including no-risk financial instruments). ROI is the discount rate that equates the value of estimated future cash flows (net benefits) arising from an investment with the initial capital outlay. NPV is the value of the future cash flows (discounted at a set rate) minus the initial capital outlay. High ROIs or NPVs make projects attractive for investment. Depending on the company and the size and risk of the investment, typical industrial projects must have ROIs of at least 15 to 30 percent to be considered attractive. Projects with 30 percent ROIs typically have paybacks in the 3 to 4 year range. The following table shows equivalent ROIs for various payback periods and project durations.

Payback and annual return on investment conversion table1

Payback period (years)	Project lifetime (years)				
	5	7	10	20	40
1	1 59%	161%	161%	161%	161%
1.5	86	90	91	91	91
2	55	60	63	63	63
2.5	37	44	47	48	48
3	25	33	37	39	39
3.5	16	25	30	32	33
4	10	19	25	28	28
4.5	4	14	20	24	25
5	0	11	17	21	22
6	—	5	12	17	18
7		0	8	14	15
8		—	5	12	13
9			2	10	12
10		—	0	8	10

1 Annual return on Investment is calculated based on a stream of equal monthly savings or benefits. For Example, a project that costs $24 and yields $1 of benefits each month for 5 years has an ROI of 55 percent (and a payback period of 2 years).

The process of estimating a project's future cash flows for ROI and NPV analysis can be very sophisticated. It may include assumptions and forecasts regarding the project's technical performance, the product's market and prices, the prices of inputs (e.g., energy, raw materials, and labor), interest rates, depreciation rates, tax rates, etc. The evaluation may be further enhanced by analyzing the effects of uncertainties regarding the various factors (i.e., sensitivity analysis) and accounting for business and technical risks. Highly sophisticated evaluations can require very costly information are therefore used only for very large projects. For smaller projects, rule-of-thumb assumptions are often made for many of the factors,

SOURCE: Office of Technology Asessment, 1993.

government regulations, These personnel are concerned primarily with the business' core activities and have little time left for discretionary concerns. Hiring additional personnel or using outside consultants to alleviate shortages of technical expertise can be expensive. Costly training is required to fully acquaint the new engineers and technicians with equipment and production processes. Furthermore, these employees become burdensome overhead if the business has to cut back to the core activities during economic hard times, Companies are reluctant to routinely hire and lay off engineering personnel through business cycles, partly because it fosters a reputation that makes attracting top-flight technical talent difficult. Using outside consultants to implement discretionary projects can also present problems. Consultants require a great amount of technical and contract oversight, and if proprietary processes are involved, may represent an unacceptable security risk.

ENERGY PRICES

Rising energy prices increase energy awareness and improve the economic feasibility of efficiency projects.[5] Likewise, declining prices cause energy awareness to wane. Because implementing a new technology saves energy in the future, companies are more sensitive to expectations of future energy prices than to the current prices in their investment decisions.[6]

The Efficiency Gap

There is much anecdotal evidence of industrial companies failing to undertake energy-saving projects that are presumably cost-effective. Industrial managers want energy efficiency projects to pay back very quickly, often in 2 years or less.[7] A payback period of 2 years represents an internal rate of return of about 60 percent, a rate much higher than the market cost of capital (box 4-B). Projects that have rates of return between the market cost of capital and the much higher internal threshold rate are presumably cost-effective, yet not undertaken. These projects fall into what has been called the ''efficiency gap. ''

The efficiency gap is caused by features such as: lack of information, uncertainty about fuel prices, uncertainty about investment benefits (i.e., equipment performance), misplaced managerial incentives, and equipment supply infrasructure problems. Industrial managers often cite lack of funds and technical personnel (discussed earlier) as the reasons that many cost-effective projects are not undertaken.

Except for the personnel aspect, these same factors apply to residential investments in energy efficiency and have been studied extensively.[8] Interpretation of these conservation-inhibiting factors is a matter of some controversy. Conservation advocates generally view the factors as market barriers, and see a role for government in helping the market encourage more energy efficiency investment. Alternatively, economists see most of these factors as a reflection of competitive markets, and argue that government intervention is neither justifiable nor beneficial. From an economist's viewpoint, many projects that are presumably cost-effective are in reality not so, because of the costs associated with these factors.

---

[5] The quantitative effects of prices on industrial energy efficiency is unclear, however. See discussion under, ' 'What Role Do Energy Prices Play?" in ch. 1.

[6] Alliance to Save Energy, op. cit., footnote 3.

[7] Marc H. Ross and Daniel Steinmeyer, ''Energy for Industry, ' *Scientific American,* vol. 263, No. 3, September 1990, pp. 89-98. Winslow H. Fuller, XENERGY Inc., "Industrial DSM—What Works and What Doesn't, " *Proceedings of ACEEE 1992 Summer Study on Energy Efficiency in Buildings* (Washington DC: 1992).

[8] Roger S. Carlsmith, William U. Chandler, James E. McMahon, and Danilo J. Santini, Oak Ridge National Laboratory, *Energy Efficiency: How Far Can We Go?* Report No. ORNLfI14- 11441, January 1990. Richard B. Howarth and Bo Andersson, Lawrence Berkeley Laboratory, "Market Barriers to Energy Efficiency, " Paper No. LBL-32541, July 1992. Ronald J. Sutherland, "Market Barriers to Energy-Efficiency Investments," *The Energy Journal,* vol. 12, No. 3, 1991.

INDUSTRIAL COMPANIES AND UTILITIES

Fuel Flexibility

As mentioned earlier, companies see energy in terms of cost. They have incentives not only to become energy efficient, but also to seek out the lowest priced, most secure energy sources. To obtain low energy prices and a margin of safety in terms of reliability, companies (especially energy-intensive ones) prefer to be as flexible as possible in their fuel use. The ability to easily switch to alternative fuels protects companies against severe energy price fluctuations and supply cutoffs. It also increases companies' bargaining power with their utilities. For example, by threatening to install cogeneration capacity, companies can push for more favorable power contracts from their utilities.

While fuel flexibility can save companies money, it may come at the expense of lower energy efficiency. Processes designed for multiple fuels are sometimes not as efficient as those designed for a single fuel. Moreover, investments made for fuel flexibility purposes use up funds that could be used for energy conservation or efficiency projects.

Industrial Companies as Energy Producers

In addition to being energy consumers, companies in several industries (e.g., pulp and paper, chemicals, and petroleum refining) are large energy producers. They, or third-party partners, produce electricity with cogeneration facilities, and sell to the grid whatever power they cannot use at the plants. The electricity sales can be a large source of revenues. As energy producers, these companies have a great deal at stake in the many rules governing electricity generation, transmission, and distribution. For example, two changes that many large industrial companies would like to see are: 1) being able to sell their power to retail customers (retail wheeling), and 2) being able to transfer power from one of their plants to another over the grid (self-wheeling). Currently, neither of these practices is allowed. Access to the electricity market affects the value of cogenerated electricity and thus the economics of constructing cogeneration facilities. Increased access to electricity markets increases the overall cogeneration potential of industry.

Demand-Side Management[9]

Demand-side management (DSM) is the planning, implementation, and monitoring of utility activities intended to modify customers' patterns of energy use. The utilities' interest in such programs is to achieve a better balance between the supply and demand for their power. By more closely matching the timing and level of their demand load with the available supply, utilities are better able to control their costs and rates. For utilities, facilitating energy savings may be less expensive than adding new supply capacity. Currently, DSM is practiced principally by electric utilities, but such programs do exist at some natural gas utilities.

Utilities have special interest in their industrial customers for several reasons. Industrial companies are large energy users that represent a major part of utilities' baseload. Indeed, most large industrial customers receive lower rates because they supply utilities with large, dependable portions of electricity demand. As large individual power loads, industrial plants also represent highly concentrated sources of load shape modification potential for utilities. In a similar vein, industrial DSM programs require fewer resources to effect a given amount of energy savings than do programs in the residential and commercial sectors, This is because industrial projects are larger, and relatively few people need to be involved to save large amounts of energy. Lastly, utilities want their industrial customers to be competitive

[9] A comprehensive look at demand-side management is presented in U.S. Congress, Office of Technology Assessment, *Energy Efficiency: Challenges and Opportunities for Electric Utilities*, OTA-E-561 (Washington DC: U.S. Government Printing Office, in press).

and financially healthy because of the jobs they provide, in the plants themselves and in the communities at large. This employment is important for sustaining the utilities' residential and commercial markets.l0

Despite the advantages of industrial DSM, it has lagged behind its counterparts in the commercial and residential sectors. The ''diversity and complexity of industrial energy uses, limited utility experience with industrial processes, and the scarcity of industrial DSM demonstrations have combined to inhibit the implementation of industrial-sector DSM.''[11]

There are several major types of DSM programs that utilities use to influence the energy decisions of their industrial customers. These include: alternative pricing, customer education and advertising, trade ally cooperation, direct customer contact, and direct incentives.12 Alternative pricing is the most common industrial DSM approach, but more and more utilities are assuming more proactive marketing and technology oriented roles.[13]

ALTERNATIVE PRICING

Utilities have traditionally relied on alternative rate designs such as time-of-use, interruptible, promotional, and variable level-of-service pricing to achieve industrial sector DSM objectives.[14] These incentives have produced the largest changes in industrial load shape for most utilities. New rate programs can be difficult to establish, however. They require review and approval by regulatory commissions.

Many companies have complex power contracts with their electric utilities. Charges are incurred for energy use (kilowatt-hour), energy demand (kilowatt peak), power factor, and various other electricity characteristics. In addition, the rates may vary by time of day and season of the year. Such time-of-use rates can be used to encourage companies to shift their energy use to off-peak periods such as the nighttime. An example, is for textile mills to run their chillers only at night (instead of all the time) and store the cool water for use during the day. These time shifts may not actually conserve energy, but they lower its costs.

EDUCATION AND ADVERTISING

Utility promotions, publicity, direct contact, advertising, and field tests and demonstrations perform valuable functions in companies' need for technology information. Advertising and/or education programs are particularly valuable for generating interest in DSM programs and technologies. Field tests and demonstrations of new technologies are receiving increasing interest. The purpose of such programs is to obtain and disseminate information on the cost, performance, reliability, and operational characteristics of the technologies. The Bonneville Power Administration (BPA) and the Tennessee Valley Authority (TVA) have active field testing and demonstration programs. The programs at BPA have included efficient aluminum smelting cathodes, adjustable-speed drives, and a pulp-refining process. At TVA, the programs have included thermal

---

10 Electric Power Research Institute, 1990 *Survey of Industrial-Sector Demand Side Management Programs,* EPRI CU-7089 (Palo Alto, CA: Electric Power Research Institute, January 1991).

11 Electric power Research Institute, ***Industrial LoadShaping:*** *An IndustrialApplication of Demand-Side Management,* EPRI CU-6726 vol.1 (Palo Alto, CA: Electric Power Research Institute, May 1990).

12 Electric Power Research Institute, *Demand Side Management, vol. 5: Industrial Markers and Programs,* EPRI *E@ M-3597* (Palo Alto, CA: Electric Power Research Institute, March 1988).

13 EPRI CU-7089, op. cit., footnote 10.

14 EPRI Cu.1'egg, op. cit., footnote 10.

storage systems, biomass cogeneration units, energy efficient motors, and microwave driers. 15

TRADE ALLY COOPERATION

Trade allies are firms, individuals, or organizations that can influence the relationship between companies and their utilities. Trade allies can be helpful in promoting energy efficient technologies to companies during critical decision phases of projects. For example, utilities may provide technology and design information to architectural and engineering (A&E) firms that design and build industrial facilities.

DIRECT CUSTOMER CONTACT

Most utilities contact their large industrial customers two or more times a year. The frequency with smaller firms is usually lower. As part of the effort, utilities may offer audits, engineering assistance, and/or feasibility studies. Some utilities offer audits to all industrial customers, others just to small customers. The reason for targeting small industrial customers is that they often lack the in-house engineering staff, knowledgeable about energy saving practices and relevant DSM technologies, that large companies have. The engineering services offered by utilities range from drafting equipment installation proposals to designing, installing, and maintaining equipment, Continued contact with the industrial customer allows the utility to:

- Identify and describe opportunities for efficient energy use and energy cost savings;
- Answer any problems or questions related to energy utilization, supply, or billing; and
- Advise customers on technologies for improving productivity and competitiveness.

DIRECT INCENTIVES

Utilities use a variety of financial incentives to “discount” the purchase cost and improve the internal rate of return of companies’ efficiency investments, Such incentives include: loans (ranging from interest-free to full-market rate), lease and purchase agreements, rebates, allowances, and buy-back or shared savings programs. A variation of this strategy is to offer the incentive to only one company in exchange for demonstrating the technology, so that other companies might become interested.[16]

Motors programs are among the most common of the direct incentives initiatives. Most promote the use of high-efficiency motors in new motor applications and as replacements for burned-out old motors, A few also promote adjustable-speed drives. The rebates are designed to cover most of the cost difference between an efficient motor and a standard motor. Minimum qualifying efficiencies are specified for each standard horsepower rating.

Motor programs have generally had very low participation rates. Among the reasons have been: 17

- Customers’ bad early experiences with high-efficiency motors due to improper sizing and installation;
- Unfamiliarity of customers and dealers with the substantial operating cost savings available with high-efficiency motors;
- Multiple decisionmakers on motor purchase decisions and difficulties in reaching the right decisionmaker;
- Customer hesitancy to shut down production lines to replace an operating motor;

---

15 EPRI EA/EM-3597, op. cit., footnote 12.

16 The National Industrial Competitiveness through efficiency: Energy, Environment, and Economics (NICE[3]) grant program, run by the Department of Energy and the Environmental Protection Agency uses a similar strategy (see ch. 1).

17 American Council for an Energy-Efficient Economy, *Lessons Learned: A Review of Utility Experience With Conservation and Load Management Programs for Commercial and Industrial Customers*, April 1990.

- A tendency by many customers to speed up motor replacements by replacing burned-out motors with identical motors, and to both speed replacements and cut capital costs by rewinding burned-out motors instead of replacing them; and
- Low rebate levels that cover only a portion of the cost of new, high-efficiency motors.

DSM: Rate and Equity Concerns

Some industrial energy users worry that DSM will ultimately raise electricity prices.[18] They argue that there is great uncertainty in the program costs and conservation benefits of DSM, and that the programs may well cost too much for the energy savings that they actually deliver. Because of the costs of DSM programs and the reduced rate base, electricity rates may increase.

There are also equity issues associated with DSM. Is it fair for a company to invest in an energy efficiency project with its own capital and later have its utility help fund a similar project at a competitor's plant?[19] This may forestall investment, as companies delay programs in order to see what DSM incentives may be offered to them. Another issue is cross-class subsidies. Should industrial customers be made to pay higher rates to cover the program costs of residential and commercial DSM programs.

One utility, Niagara Mohawk, has begun to address some of these concerns, It has an experimental conservation rebate program that allows industrial customers to pay slightly lower rates if they forgo the rebates. Under the program, an industrial company must pay for up-front conservation audits, then decide whether or not to implement the recommended conservation measures and give reasons for its decision. The utility will put up the initial capital to implement the audit recommendations and will be repaid out of the energy savings. Companies that decline the utility's offer for capital and ''opt out' out of the program get to pay $.015 per kWh less for their electricity. All companies, though, even those that "opt out," must cover 60 percent of the conservation program's cost.[20]

DSM: Experience to Date

In a recent survey, the Electric Power Research Institute identifiled 417 industrial-sector DSM programs conducted by 154 utilities.[21] Table 4-2 shows the general classes of DSM programs pertinent to the industrial sector and their reported load impacts. These programs have involved nearly 50,000 industrial customers. Some of the programs are designed exclusively for industrial customers, but more than half also apply to commercial customers, and many are designed primarily for the commercial sector.

Another survey, by the American Council for an Energy-Efficient Economy (ACEEE), found that industrial DSM programs focus primarily on equipment upgrades such as high-efficiency motors and lighting systems.[22] Few programs focus

---

18 One group espousing this viewpoint is the Electricity Consumers Resource Council (ELCON).

19 These issues of equity do not, however, apply to competitors in different utility service areas, which presumably have different rates anyway.

20 David Stipp, "Some Utilities' Plans to Cut Energy Use Cost More and Save Less Than Projected, " *The Wall Street Journal*, May 27, 1993. "Industrials Can 'Opt Out': Who Won, Who Lost in New York's New Shared Savings Experiment?, " *The Electricity Journal*, January/February 1993.

21 EPRI CU-7089, op. cit., footnote 10.

22 Jennifer A. Jordan and Steven M. Nadel, American Council for an Energy-Efficient Economy, ''Industrial Demand-Side Management Programs: What's Happened, What Works,'' *Proceedings of ACEEE 1992 Summer Study on Energy Efficiency in Buildings* (Washington, DC: 1992).

Table 4-2-industrial Demand-Side Management Programs

Technology category	Peak load reduction (kW/participant)	Load addition (kW/partlclpant)	Program features
Audit and building envelope	188		Industrial energy conservation, building shell improvements, facility energy analyses, productivity audits, and process efficiency assessments.
Heating, ventilating, and air conditioning (HVAC)	1.0 to 3.6	56.6"	Electric space heating, space cooling, ventilation, and air-quality equipment.
Lighting	12.3 to 23.0	4.8'	Efficient lamps and fixtures, task lighting, outdoor lighting, and lighting control systems.
Electrotechnology	54.8 to 7,500[b]	753.6 to 1,000	Promotion or testing of electric-driven technologies that support industrial processes.
Thermal storage	22.0 to 2,1 00'	—	Storage space heating, storage water heating, storage air-conditioning, and storage refrigeration systems.
Load control	12.0 to 383	—	Utility control of customer loads or the promotion of facility energy management systems.
Economic development		162 to 5,800[d]	Efforts to attract industry to, or retain industry within, an area by offering enhanced services or by implementing competitive pricing strategies.
Special rate	24.6 to 85,400[d,e] 32.9 to 7,000[c,d]		Offering nonstandard industrial rates, such as interruptible or time-of-use rates, that are not associated with specific technologies.
Standby generation	242 to 8,000[d]		Promotion of customer cogeneration or utility-dispatchable standby generation equipment located at the customer site.
Motor and motor drive	1.0 to 76.3[b,d]	19,500	High-efficiency motors and/or electronic adjustable speed drives.
Power quality and conditioning	f	f	Equipment for decreasing power disturbances or controlling power conversions or utility services designed to solve customer power quality problems.

a Designated as off-peak.
b Reported as equipment operating demand reduction in some cases.
c Reported as load shifted off-peak.
d Includes commercial customers.
e Reported as contracted interruptible load.
f Data not reported.

SOURCE: Electric Power Research Institute, *1990 Survey of Industrial-Sector Demand-Side Management Programs,* Report No. EPRI CU-7089 (Palo Alto, CA: Electric Power Research Institute, January 1991).

on improving the efficiency of entire manufacturing systems or processes. Roughly 60 percent of the programs surveyed offer custom measure incentive programs, such as:

- cash incentives for the incremental cost of efficient equipment,
- incentives based on energy saved or load reduced in first year (i.e., $/kWh or kW saved),
- rebates based on a percentage of materials and installation costs,
- cash grants,
- low-to-no-interest loans, and
- payback period buy-down incentives.

The most frequently covered investments are process heating and cooling measures, refrigeration improvements, and lighting and motor upgrades. About 40 percent of the programs are prescriptive measure rebates, which generally offer direct rebates for installation of high-efficiency motors, steam traps, adjustable-speed drives, and compressed-air system improvements. Rebates are calculated in terms of either dollars per unit of energy saved or percentages of project costs.

The ACEEE survey found that while a few programs had achieved significant savings and participation, on average the programs have had little impact. The average program is almost 4 years old, has seen participation by about 6 percent of the utility's industrial customers, and has cumulatively saved less than 0.4 percent of the utility's industrial energy sales at a levelized cost of $.012/lcWh. Examples of some of the more successful, or more innovative, industrial DSM programs reported in the ACEEE survey are presented in box 4-C.

Box 4-C-Examples of Industrial Demand-Side Management Programs[1]

Bonneville Power Administration: Aluminum Smelter Conservation and Modernization (Con/Mod) Program and Energy Savings Plan[2]

The Bonneville Power Administration's (BPA) Con/Mod program is the largest industrial demand-side management (DSM) program in the Nation. BPA pays the 10 participating aluminum smelters $.005 (in 1985 dollars) for each kilowatt-hour that they save through efficiency improvements. The program was begun in 1987 and was planned to last for 10 years. The near-term objective was to modernize the aluminum plants so that they would be economically viable even when aluminum prices are low. The long-term objective was to give BPA low-cost conservation by requiring Contract Demand reductions (decreases in total contract power entitlements) for the modernization projects completed by June 30, 1991? In fiscal year 1992, the program saved an average of 107 MW. Savings over the lifetime of the program have been about 4.1 percent of BPA's industrial sales. In an associated effort, the Variable Rate program, BPA offers electricity to the smelters at rates tied to the price of aluminum. BPA's Energy Savings Plan is targeted at smaller industrial customers. This custom rebate program pays customers $.15 per kilowatt-hour saved in the first year or 80 percent of the project costs, whichever is smaller. The program has saved about 5.5 percent of BPA's nonaluminum industrial sales.

Central Maine Power: **Power Partners and Efficiency Buy-Back Programs**

The Power Partners program offers energy management contracts paying $,01 per kilowatt-hour of delivered savings. Commercial and industrial customers, as well as energy service companies, are eligible to bid on these

[1] Except where noted, taken from Jennifer A. Jordan and Steven M. Nadel, American Council for an Energy-Efficient Economy, "Industrial Demand-Side Management Programs: What's Happened, What Works," *Proceedings of ACEEE 1992 Summer Study on Energy Efficiency in Buildings* (Washington, DC: 1992) and *Industrial Demand-Side Management Programs: What's Happened, What Works, What's Needed,* prepared for the Pacific Northwest Laboratories of the U.S. Department of Energy, DOE/EE/01830-H1 (Washington, DC: March, 1 993).

[2] Bonneville power Administration, Office of Energy Resources, Business Services Branch, *Aluminum Smelter Conservation/Modernization Program, FY 1992 Year End Report,* January 1993.

[3] During fiscal year 1992, BPA and the smelters agreed on a Contract Demand Reduction amount of 124.6 annual average MW.

contracts. Over its lifetime, the program has saved 1.2 percent of industrial sales and 7 percent of the eligible customers have participated.

The Efficiency Buy-Back program targets larger customers and provides incentives of up to 50 percent of project costs. Proposed projects must save at least 5 GWh per year. The program has achieved savings of about 0.9 percent of industrial energy sales with low participation at low cost.

Wisconsin Electric: Smart Money for Business Program

This combination custom and prescriptive rebate program offers commercial and industrial customers a wide variety of incentives for efficient motors, lighting, and process equipment. Over its lifetime, t he program has saved 2.5 percent of industrial energy sales at a cost of about $.021 per kilowatt-hour saved. Nearly half of the utility's industrial customers have participated in the program. The program was refined after 3 years to improve the communication with the industrial consumers. Now, utility engineers communicate with process-level personnel, such as plant engineers and maintenance operators, for smaller projects. Simultaneously, utility executives interact with industrial vice presidents for larger projects.

Puget Sound Power and Light: Industrial Conservation Incentive Program

This program, which targets the 100 largest industrial customers, offers incentives of $.02 to $.15 per kilowatt-hour saved in the first year of efficiency projects. The incentive covers about 50 to 80 percent of projects costs. The program is a very labor-intensive, full-service program. Utility personnel work with participants to analyze entire industrial systems, identify where energy and other benefits lie, oversee project bidding, assist in project design and planning, and perform energy-savings verification tests. Over its lifetime, the program has saved 2.0 percent of industrial energy sales at a cost of about $.015 per kilowatt-hour saved.

United Illuminating: Energy Opportunities Program

This program co-funds engineering studies of advanced process, energy management, cogeneration, and heat recovery measures for industrial and commercial customers. The financial incentives for project implementation are based on the projects' costs and payback periods. Incentives of $.15 per kilowatt-hour saved in the first year are offered for measures with payback periods greater than 5 years, Measures with shorter payback periods receive rebates as a percent of project cost, with rebates declining as the payback period decreases. After 2 years, t he program had a large portion of the program budget remaining so the maximum incentive was doubled to $.30 per kilowatt-hour saved in the first year. Over its lifetime, the program has saved 1.2 percent of industrial sales and 3.2 percent of the eligible customers have participated. The utility cost for t he program has been $.014 per kilowatt-hour saved.

Southern California Gas: High-Efficiency Industrial Equipment Replacement and Industrial Heat Recovery Programs

These programs are examples of natural gas DSM efforts, which are currently much less common than electric DSM activities. These programs offer industrial customers incentives to perform consultant studies and install efficient equipment. The measures most commonly funded are installation of high-efficiency boilers and burners in the efficiency program and economizers and recuperators in the heat recovery program.

Pacific Power and Light: Energy Finanswer Program

This newly-created program offers industrial customers loan financing rather than cash rebates for energy-efficiency improvement projects, The utility offers to pay 100 percent of the cost of design and implementation of a cost-effective, energy-saving project upfront, with the customer paying back the utility at the prime interest rate plus 2 percent over a period of 5 to 10 years. Customers must have a load of at least 500 kW to participate in t he program. Recently, the utility has added a guaranteed savings feature to the program format.