INDUSTRIAL ENERGY EFFICIENCY
ACHIEVING SUCCESS IN A DIFFICULT ENVIRONMENT

Key words Industrial Energy Efficiency
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ABSTRACT
Energy use and the resulting environmental impacts are major points of concern for the world in the 21st century. Opinions that define the challenges of sustainable energy options are as diverse as the proposed solutions. The industrial sector is a key area both from the standpoint of the amount of energy consumed and the magnitude of the energy options that exist there. However, history has shown that success in the industrial energy sector requires careful planning and consideration of the unique challenges of the manufacturing environment.

BACKGROUND
The energy challenges that the world faces in the 21st century remind many people of those present 30 years ago as the world entered the 1980’s. On April 18, 1977, US President Jimmy Carter sat before a national TV audience to deliver a speech outlining a critical new direction for the country. The nation had been rocked continuously by hard economic times with the longest recession since the Great Depression and then seen skyrocketing prices and interest rates as inflation ravaged out of control. Fully convinced that this new threat would lead to consequences that would dwarf the economic woes already in place, he outlined fundamental principles of his new energy plan. Among his points:

- “Conservation is the quickest, cheapest, most practical source of energy.”
- “We can't continue to use oil and gas for 75 % of our consumption when they make up seven percent of our domestic reserves.”
- “We must start now to develop the new, unconventional sources of energy we will rely on in the next century.”

The similarities between the issues that concerned Carter and those that are still considered to be critical areas of need 30 years later are striking. One thing is clear – many of the key elements that Jimmy Carter took so personally in 1979 did not change over the next 30 years. Oil remained a dominant factor in the energy picture for the country. Oil imports actually increased as a percentage of the country's appetite for energy, with huge impacts on the economic picture.

Pertinent questions are, "Why does the situation today have many familiar aspects to the one 30 years ago? Why didn't the challenges outlined then bring about change?" The actual answer is fairly simple, although the reasons for it are complicated – Oil prices plummeted in the time that immediately followed the 1980's Energy Crisis. As all energy prices dropped, the pressure upon individuals relaxed. Energy became cheap, talk of running out dissipated, and the economy was moving forward with much-reduced thought about energy prices.

Figure 1 shows the price of oil after adjusting for inflation from 1970 through 2009. The sharp increase following the 1973 Arab Oil Embargo is readily apparent. Throughout modern history oil has been a major factor setting the stage for the total cost of all energy. Hence, the rapid increase in oil prices in the late 1970's created the energy crisis that concerned President Carter. Oil had increased from $10 a barrel to more than $70 (in 2005 dollars). All other energy forms soon followed. Supply worries arose. There was a time in the late seventies when natural gas companies were not allowed to connect new customers because of concerns about future supply.

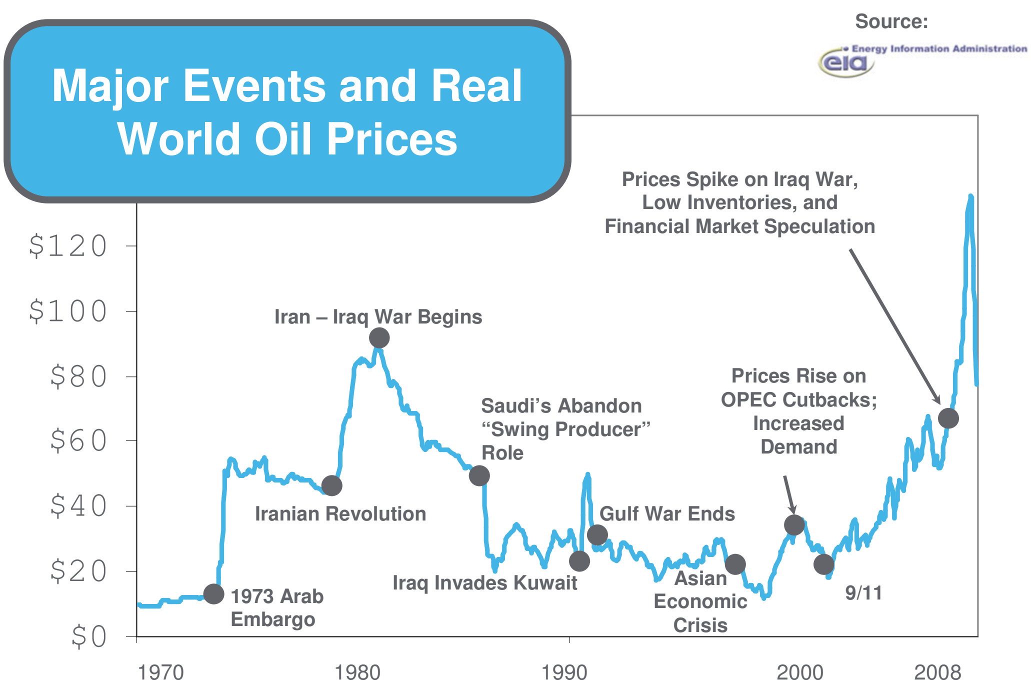


Figure 1. Inflation Adjusted Oil Prices (2005 Dollars)

For the first time in America's history, the energy engine that had fueled the Industrial Revolution was threatened. President Carter was absolutely correct in his examination of the events leading up to the crisis with which he felt confronted. However, he could not have known the events unfolding in the short-term oil markets and how they would rapidly change the world's focus on energy.

The sharp rise in oil prices in 1974 that seeded the conditions of President Carter's energy crisis had quickly changed the economies in the large oil-producing countries. Saudi Arabia was soon one of the fastest-growing economies in the world. However, the high oil prices creating such good economic times in Saudi Arabia also led to the development of oil fields in many other parts of the world. Carter's fears of running out of oil were replaced in the market with the sense there was plenty of oil as long as the world was willing to pay a higher price, which it was. Consequently, oil prices continued to rise through 1980. However, as this oil from new sources and funded by the higher prices entered the mainstream, market economics took over. Abundant supplies and high prices could not be maintained. The price fell by 1984 because so much oil had been placed in the market by the world's suppliers seeking to make the most of the high prices.

This initial price fall was followed by a decision by Saudi Arabia to abandon its role as a "swing producer" where it previously only produced the amount of oil needed to match world supply with demand. Using that strategy, it had become a victim as the other oil-producing countries had often exceeded pre-agreed production quotas. With the largest proven reserves in the world, Saudi Arabia tripled its daily production in 1985 from 2 million gallons per day to 6 million gallons per day.

The combination of Saudi Arabia raising its production levels and the continued widespread "cheating" on the quotas by many of the OPEC members flooded the market with oil and caused prices to fall more rapidly, to $17 per barrel (2005 dollars) in 1986. OPEC members saw what they had done to themselves and struggled with each other to control prices and production levels for the next 20 years among many other political events that occurred along the way. Still, oil prices were at a low level in 1985 not seen since the Arab Oil Embargo of 1973. These events in the world oil supply markets brought an end to the 1980's Energy Crisis. Market dynamics had been far more effective than energy programs put in place by government policy.

America entered the 21st century with many similarities in its energy supply issues to those that had driven the Industrial Revolution. Coal was the dominant source for fuel for electricity generation. Most industrial users and home owners alike viewed natural gas as cheap and clean. The undisputed king of transportation fuels was gasoline refined from oil. However, new energy-related concerns about global warming, financial woes from mushrooming deficits fueled in part by oil imports, and fears that terrorism might impact world energy supplies all had entered the public consciousness by the years after 2000. As shown in Figure 1, Oil prices spiked to $147 per barrel in 2008, driven again by issues that were not totally transparent, but the prices reminded the public of America's dependence on foreign resources. The fact that such a dizzying rise was followed by a rapid fall within six months showed again how market forces rapidly bring unpredictable changes in energy markets. And those changes quickly dragged the economies of the world through rapid change.

Many questions remain. Oil prices continue to pace energy prices overall. As history shows, oil prices are subject to many market forces outside of supply and demand. In

Carter's era, the factor that drove prices to historic highs was the Arab Oil Embargo. It was subsequently driven down to levels that could not have been predicted at the time by supply market issues as the OPEC nations, especially Saudi Arabia, changed major production policies.

In 2008 new historically high oil prices resulted from the influence of financial speculation in the world oil commodity markets as war erupted in the Middle East. As the financial speculation in the markets decreased and the economic times changed into what was to become the "Great Recession," prices fell by more than 50% from those highs within 12 months. Energy markets are clearly volatile places and respond to many factors.

DESIGN & SETUP: INDUSTRIAL ENERGY USE

The industrial sector produces the goods that drive the world economy. The average person on the street has no idea of the complicated industrial process or energy required to produce those goods. Fine paper must use large amounts of hardwood pulp to create the surface texture needed for writing and copy paper. It takes about 24 trees to make a ton of paper and they grow for 10 to 20 years before they are ready to be harvested. When a sheet of copy paper is tossed into the recycle bin, the average user gives little thought to the complicated processes and energy consumed to turn a tree growing in a forest to pulp, form the pulp into thin sheets in a paper machine, and then dry the product into paper. Most don't realize that paper starts out as 99% water and that over 70% of the energy used to produce paper goes to drying the water out of the sheet.

Similar stories exist in many of the goods used in modern society. The soft drink that is consumed from a can before it gets tossed aside is what consumers think about, not the large amount of electricity it takes to refine aluminum from bauxite ore. Whether the product used is a cloth made from synthetic material or a plastic bag, an industrial plant somewhere in the world used a large amount of energy to transform the raw material to the product recognized in everyday use.

Consumer expectations for industrial products and their impacts on world energy use are huge. First, since consumers don't really care who made the aluminum can they drink from, but do care how much they have to pay for the soft drink, competitive product pricing drives industry. They must place first priority on producing the products as cheaply as possible. Otherwise, consumers are just as content to drink soft drink from an aluminum can made by a lower-priced can manufacturer if it meant the price paid for the soft drink would be less. This means the cost-effective production operation is always the first priority in a manufacturing operation.

A second point relates to environmental concerns. All industrial manufacturers are people who live on the planet and usually care as much about a clean environment left for their prodigy as anyone else. Perhaps in the distant past some industrial facilities may have let their drive for lowest cost exceed their personal concerns about the environment, much to the peril of the clean air and clean water. However, in today's world most governments have some degree of environmental stewardship in their regulations that govern industrial operations. Consequently, most industrials are forced to care a great deal about the environment. Once that playing field is level, a challenge can occur if one industrial manufacturer decides to take more interest in using less energy or reducing an emission like carbon dioxide (CO_2) more than his competition. In the absence of a requirement, that "good citizen" industrial operation may put itself at an economic disadvantage if it raises its costs too much with the goal of being a better environmental steward or more efficient energy user than the competition. Doing so is easy if it reduces manufacturing costs and makes the "good citizen" more competitive. But, if the new technologies and new energy options are working through development and lead to higher costs while the "bugs are worked out," this can bring on economic cost disadvantages. A solution would be if ultimate product consumers were willing to pay more for soft drinks in cans produced using environmentally friendly but more expensive solar power, for instance. However, while there are certainly exceptions where consumers have made such choices, most of the time they do not. Part of the reason may be simple unawareness, but the truth remains that the energy options and environmental stewardship measures most likely to be implemented by industrial operations are those that do not negatively impact the costs of operation.

The fact that the industrial operations put priorities on proven concepts and technologies and will implement energy measures that are proven cost-reduction opportunities has been historically clear. Indeed, many people observe,

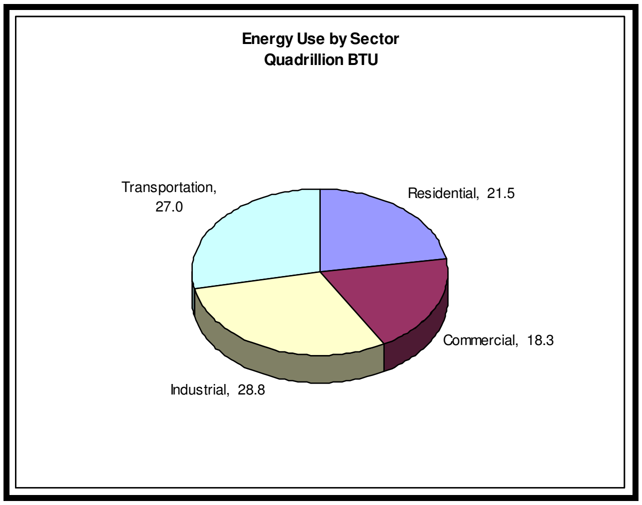
> ***Industrial operations like to be the first to be second. They readily implement cost effective changes proven by others.***

TODAY'S ENERGY PICTURE IS COMPLEX

The difficulty in predicting trends in the prices of energy and the complications of manufacturing processes have made the industrial sector a difficult place for successful implementation of innovative energy-saving technologies. And, when energy prices decreased enough in the decade of the 1990's so that energy was not in the mainstream thoughts of the public, much of the energy concern dropped out of industry as well.

The energy picture that confronts society today is more complex than that of the past. Although the shortages that worried society in the 1980's have not materialized, concern has grown that fossil fuels may not be a virtually unlimited resource. At the very least, it has become clear that the costs could rise significantly in the future as the resources get more difficult to find and extract. Environmental concerns have brought on a whole new complication with questions about the long-term impact of putting greenhouse gases in the atmosphere.

Industrial energy options have climbed back into focus. The sector highlights itself both in the amount of energy it consumes and the amount of CO_2 it produces.



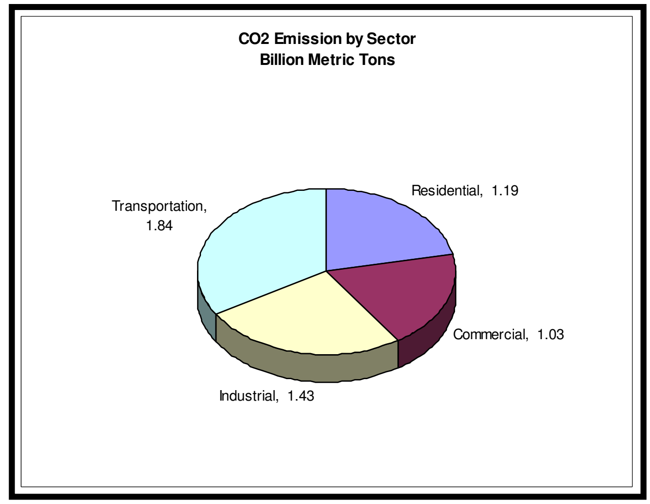


Figure 2. Energy Use and CO_2 Emissions by Sector

As shown in Figure 2, industrial consumes more energy than any other sector and ranks only behind the total transportation sector in the amount of CO_2 it produces. Consequently, it should be a major player in energy and emission policies.

THE PAST PROBLEMS

The challenge becomes how to find successful programs for the industrial sector that can reduce energy and emissions and meet the constraints placed upon the manufacturing environment to remain competitive.

The issues that confront the industrial environment are as follows:

- Production costs of operation are first priority
- Time horizons are short
- Past failures are many and often have been expensive

These problems have led to industrial energy programs being labeled as the "third rail" in much of the energy business. That is, the industrial sector has been avoided by most energy services companies. From the 1980's through today, many different strategies have been tried to present industrial plants with options for implementing energy reduction hardware, programs, and strategies with varying degrees of limited success. Consequently, while there have certainly been successes and exceptions, in the large scale:

> ***Most energy services companies today are often skeptical about working with industrials and most industrials are often skeptical about working with energy services companies.***

The reasons are mainly due to the differences in the business models of the two. The industrial manufacturing environment makes it quite different than the commercial buildings, education, and government sectors.

Performance Contracting (PC) arrangements have been quite successful in the education sector where they often provide the means for school systems to upgrade infrastructure using savings from energy projects to pay for the improvements. Similar success occurs in the government markets. However, the industrial sector proved a very difficult area for success for these type contracting vehicles. Most PC contracts require longer-term paybacks for the model to work than the typical industrial company could afford to consider. A second characteristic is the fact that the PC model is based on its ability to provide capital financing to entities that might otherwise have difficulty acquiring it. Most industrials with good business models feel they do not need the financing vehicle since they usually had access to their own capital markets.

Most of the energy reduction projects put in place in the industrial sector have been carried out by the industrial companies on their own. Unfortunately, in many cases due to the time available and the difficulties of implementing energy projects in the process environment, projects have often been limited to the most straight-forward opportunities, such as lighting. The result is that today the industrial remains the largest energy user and because of the technical diversity there, it may be the area of largest opportunity for energy and emission reduction projects. However, realizing that potential requires understanding the inherent nature of the production environment and dealing with each of the three factors mentioned earlier.

1. Production costs of operation are first priority

The production process itself always must dominate any consideration for change. In a typical industrial operation, only 5 to 10% of the cost of producing the product is represented by energy cost. Therefore, even cutting energy costs in half (a very unlikely scenario) means the impact on the cost of manufacturing will be less than 5%. However, changing a process or an energy system that might impact the production process could have major cost impacts on the operation if it affected speed, control, quality, etc. Hence, changes to improve energy use must be considered carefully and often be implemented in stages. One has to be sure that an implementation that saves 10% in the costs of energy and would lead to a total manufacturing cost improvement of less than 1% does not cause issues that cost more in the total scheme of the operation.

2. Time horizons are short

Most industrial operations are public companies owned by investors. Investors expect high rates of return and that the industrial company will be a good steward of their investment in the company. As anyone who own stocks individually or through mutual funds knows, investors want maximum gain for minimum risk. This means the industrial plant is constantly challenged for high rates of return and short-term results. Consequently, when looking at new and risky energy projects, most industrials are forced into the position of "wanting to be the first to be second," but seldom can take the risk of untried technologies or unproven innovations.

Adding to this pressure for short-term results, the modern manufacturing operations change quickly. Whole product lines come and go to meet consumer demand. As an example, how smart would it have been ten years ago to install a new energy facility with a 15 year payback at a production line making camera film? Such risks are always in the back of the mind of the decision-maker.

3. Past failures have been many and often expensive

The final area of difficulty in the industrial sector is that they have been “burned” before. Every plant engineer can tell a story of some new gadget that promised to reduce energy use or cut the costs of energy by some amount that they tried and it did not work. Much of the time the difficulty was not in the concept, but in the execution. Industrial environments are harsh and unforgiving. They are usually no place for a new technology or technique that has not been tested in practice for those situations that nobody considered when the new invention was originally conceived.

In the last 30 years, the number of such gadget innovations has only increased as our society has become more digitized and equipment has become harder for even the average plant engineer to truly understand. After a few bad experiences, the typical plant engineer decides he has no time for such “innovations” and becomes highly skeptical when claims are made.

All of these issues make the industrial energy world a difficult place for success. However, they also make the world of industrial energy a prime area of untapped opportunity. Industrial represents over $200 billion in energy spend in the US alone. The challenge is to find ways to work there without becoming victim to the same past problems. The opportunity is to convince a very technically savvy customer that there are ways to reduce energy costs and reduce environmental impacts without creating problems in the manufacturing operation.

PAST APPROACHES

Success in energy programs in the industrial sector was limited in the years following the 1980’s era. Many electric utilities who were sponsoring various programs aimed at conservation found that the sector proved a difficult one for success. Often, energy audits, either those paid for by the utility or hired by the industrials themselves, identified what appeared to be promising opportunities to yield substantial energy cost savings. However, follow-up often showed only the simplest measures with the lowest risk would be implemented. Lighting programs were usually successful as long as the projected simple payback was 2 years or less. Other measures that involved process modifications or behavioral changes often were left alone.

Therefore, as the 21st century began, the industrial energy market remained one of increasing costs and perhaps unrealized opportunity. The industrial companies themselves always have tremendous interest in reducing their formidable energy costs, but are constrained by the factors that have always been present when seeking to implement energy programs.

When the era of rising interest in reducing greenhouse gases started to emerge, the problem intensified. Industrial companies definitely have interest in reducing costs and many feel an obligation to find ways to reduce emissions, such as CO_2, both to be good citizens and to forestall mandates that might be difficult and expensive to implement. The obvious connection between reducing energy use, reducing energy costs, and increasing sustainability of energy sources and the environment is self-evident.

RESULTS: TOTAL ENERGY CONTROL

In 2005 Schneider Electric embarked on a program to develop an industrial energy program that would fit the unique needs and challenges of the industrial process environment. The program began as a concept piloted at its own US manufacturing facilities. It was targeted directly at confronting the unique requirements of industrial operations. The intent was to use the Schneider US plants to develop and refine the offer that would be subsequently expanded to other industrial plant customers.
The goals are outlined in Figure 3.

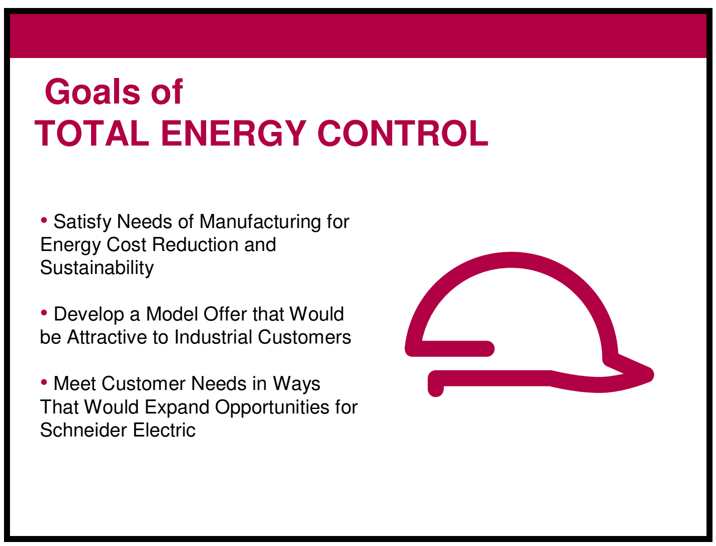


Figure 3. Total Energy Control Offer Development

As shown in the figure, the overall goal was to work with the Schneider facilities with an offer specifically targeted to overcome the past difficulties with energy programs in the industrial setting. The offer should satisfy those unique challenges of the past and provide a pathway for needs in “green” technologies and sustainability. Since Schneider manufacturing facilities have the same challenges as other industrial operations, a workable program there should be attractive to the rest of the industrial sector. Through meeting needs of industrial customers, Total Energy Control should provide opportunities for Schneider Electric in its overall business.

The program included very close cooperation with the facility management personnel who had corporate responsibility for manufacturing support and utility cost management in the facilities. Their support for a long-term approach was a critical factor for success.

None of the aspects involved a new technology. All were based on changing approaches to the energy issue and not on a promise of some miraculous invention that would solve energy problems with new technology. Instead, the concept is based on implementing change through ways to directly avoid the three major problem areas encountered in industrial energy programs in the past. Additionally, the program is more "evolutionary" than "revolutionary." That is, the approach lends itself to adapting to fit the rapidly changing world inside industrial operations without trying to get industrial operations to change themselves to fit the program. The centerpiece of the program uses engineering personnel who have many years of experience working directly with the energy systems in industrial facilities. Familiarity with manufacturing processes and how energy systems interface with those processes are key factors. The program began at the Schneider plants and was a learning process in 2005. The offer was extended to select Schneider industrial customers beginning in 2006 and soon expanded such that energy work at outside customers became the larger effort by 2008.

KEY CHARACTERISTICS OF THE TOTAL ENERGY CONTROL APPROACH

The key characteristics of the approach include addressing each of the past challenges faced by industrial energy programs directly.

CHALLENGE 1: Production costs of operation are first priority

The first area to address was the fact that in industrial operations the needs of manufacturing processes must be given first priority. Consequently, the Total Energy Control approach begins with using highly qualified engineers who are experts on the production operation as much as they are experts on energy technologies. The approach to change begins with a look at the needs of the operation first. Yet, by bringing a fresh perspective to the industrial plant, they present options that may have not been considered by the plant personnel themselves because plant personnel are forced to put most of their attention on the process itself day-to-day.

As an example, one of the cases first explored in the program with an outside customer involved looking at a plant with a combined heat and power operation (cogeneration). The plant used natural gas in the turbine to drive an electrical generator that produced much of the electricity for the operation. A Heat Recovery Steam Generator (HRSG) provided steam for the facility using waste heat from the gas turbine. Some of the steam from the HRSG goes through a steam turbine, generating more electricity before it is finally used in the manufacturing process. This type operation can be very efficient since the natural gas source is used to produce both electricity and steam for a combined efficiency that can exceed 80%, far above the typical electricity-only utility plant efficiency of 35% to 40%. The layout of the system is shown in Figure 4.

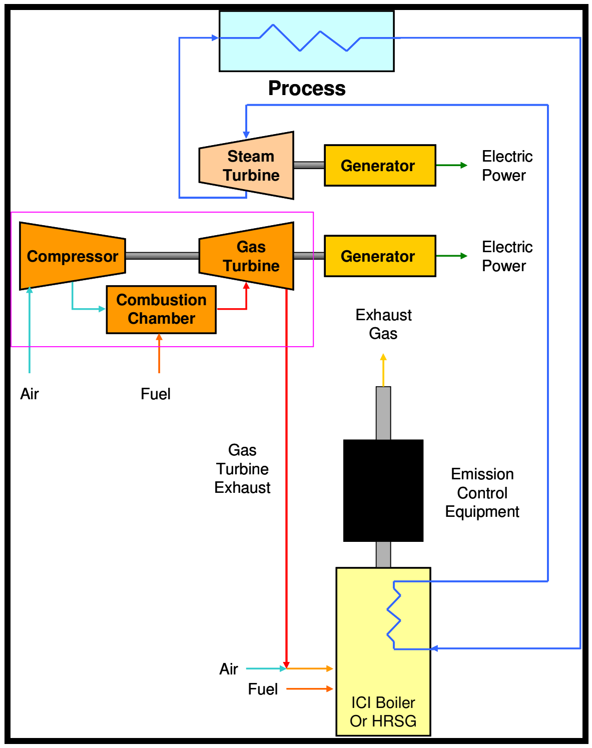


Figure 4. Energy System Schematic

The emphasis at the facility had always been to run the unit to provide as much steam as the plant required and let the amount of electricity generated "float." .In effect, the steam needed for the process always dictated the way the system operated. The original premise for this mode was solid. Normally, if the amount of waste heat generated exceeds that which is needed for steam production, this excess means extra cost and inefficient operation.

The Total Energy Control approach was the following: First, a serious look at the way steam was being used in the plant processes showed there were opportunities to use lower pressure steam in some operations. Since higher steam pressure required bypassing the steam turbine, more use of lower pressure steam meant more electrical generation was possible.

However, the greatest opportunity came from rethinking the operation to look at energy use from a total supply and demand viewpoint, as opposed to just concentrating on producing steam as needed in the plant. In the deregulated electricity market, there were many times during the year when the market price for electricity was high enough that the plant should put primary emphasis on the electricity it could generate as opposed to the steam needed in the plant. During such times, maximum electricity output was a valuable commodity on the open market. The market value was high enough that the facility could make additional money through looking beyond the needs of the plant itself. Installing a system to help the operators make such decisions produced six figures in additional income per year in this facility and had a very short payback.

Success here was built around being familiar with the manufacturing operation downstream of the generation system as well as opportunities in the deregulated electricity market. This ability to find options from a complete energy system perspective made the opportunity a success.

A second example repeated across multiple facilities involves a look at the plant's compressed air system. Compressed air is frequently among the most expensive and often the most misunderstood utility in a production operation. When problems occur due to low air pressure, the solution most often applied is to add additional compressor capacity. A better solution is often to make a detailed analysis of the system to determine the cause and look at alternative solutions. Such a look should include how compressed air is being used in the process and required pressures. Simply assuming the plant uses what it must is often an expensive choice. In multiple plants with systems ranging from a few hundred horsepower of screw compressor machines to multiple thousand horsepower of centrifugal compressors, large savings opportunities have been clear. However, finding the opportunities requires a detailed look at compressed air use in the operation itself as well as the compressed air distribution system. Such opportunities usually add significantly to the obvious (but still often neglected) need for an examination of air leaks across the operation.

CHALLENGE 2: Time horizons are short

The second aspect of the Total Energy Control approach involves looking at the issue of energy from a perspective of the need to deliver short term results on a long-term need. Industrial operations are caught in the position of needing to show savings with high rates of return, yet the energy intensive nature of the industrial sector creates huge impact on society both from an energy use and an emission perspective. Most energy consultants have found the industrial market is one where most energy audits become one-time studies that identify options, but often the options have not been put in place.

Getting beyond this frequent occurrence involves both changing the way audits are conducted and changing the way the industrial plant approaches its look at energy. The goal up-front is implementation of results, not just identification of potential opportunities. This requires commitment to ensure that options do not put the production operation at more risk than necessary. It requires management commitment by the industrial that the goal of the energy audit is not to produce a study of opportunity. The goal is to implement change that reduces the cost of energy, the amount of resources consumed, and the amount of environmental impact.

This solution again requires involvement from an industrial process perspective. It also involves teamwork to get results. The Energy Action Plan (as opposed to just an audit) must be built with options for both the short and long term. Further, quarterly updates should revisit the Energy Action Plan to review progress. On an annual basis the plan should be modified in light of lessons learned as each of the measures identified in the plan are put in place. The focus must include identifying measures that do not put production at risk and asking why any measure not implemented did not take place.

CHALLENGE 3: Past failures have been many and often expensive
The third area to address is the one that is least tangible. How does an industry choose to take a risk on a new idea or a new approach when so many times in the past the "latest and greatest" simply turned out to be a bad idea?

In the 1980's demand control systems took the energy market by storm. The concept was that anybody could save money by reducing their demand during the peak periods and benefitting from reduced utility charges. Many facilities installed control systems with great hope that by measuring the electrical demand in every billing interval, one could choose demand setpoints to initiate control of some non-critical load and reduce the billing peak. Several things made the concept more difficult than it first appeared. First, choosing setpoints was not easy. If one picked too low of a point to initiate control, then problems resulted from loads being off too much of the time. Too high of a control point meant nothing changed and no savings resulted.

A common premise was that air conditioning could be shut off for a time during a peak period and "nobody would notice." The problem with that concept is that peaks often occur on a very hot summer afternoon when most plant systems are stressed to capacity. During such times, if a control system shuts down cooling, "they notice." As a result most of the demand control systems installed in the 1980's soon were stripped of their control points and became monitoring systems. Monitoring alone is valuable, but if no action is taken to effect change, a monitoring system alone becomes just expensive, unused hardware.

Similar stories occurred with many false starts in the industrial energy area. Often, ideas were not thought through before implementation and they impacted production capacity. The result is that today most industrial managers and engineers are keenly interested in energy, but approach most changes skeptically. Changing this attitude is perhaps the greatest challenge in Total Energy Control. Convincing people who "have been burned before" requires the ability to assure them that the concept or technology is not just a trial balloon, but has either been implemented before or the idea has been carefully weighed against the impacts on the production process. Accomplishing this point usually requires familiarity with the industry. In dealing with industrial processes, the most valuable selling point of an implementation is the ability to convince the industrial manager of enough familiarity with their operation to know the risk is minimized. This is perhaps the most difficult point in the Total Energy Control process.

Total Energy Control requires (1) integration of supply and demand of energy to the process, (2) taking a long-term approach to implementing an Energy Action Plan, and (3) having the experience to consider options that have been given careful scrutiny to minimize problems. However, with this approach it is possible to succeed with energy projects on the "third rail," the industrial environment. The concept is not a revolutionary new technology, but an approach that works very hard to mitigate the factors that have made it difficult to succeed in the past.

RESULTS: SCHNEIDER PLANT TOTAL ENERGY CONTROL PROGRAM

The Total Energy Control process has been in place at Schneider US facilities since 2005. The program began with 18 of the largest manufacturing plants and has been expanded to include 51 facilities through acquisitions and incorporation of affiliates. In order to appropriately track progress, all electricity and fuel use is normalized for production and weather on a monthly basis.

It would be unfair to the great efforts by the facility personnel themselves to give the program credit for all the reductions in energy use that has occurred. However, the Total Energy Control process has been used as the catalyst for implementation. It has been successful because of commitment to the long-term plan and careful attention to the process. Just as outlined here, detailed analyses are carried out to identify energy options with careful scrutiny of how options fit within the production operation. Quarterly reviews identify progress and lay out future plans. Since the program began, over 400 opportunities have been identified at the manufacturing sites, and progress continues. Annual savings compared to prior year have increased yearly from about 4% in 2006 to almost 9% in 2009. Greenhouse gases were reduced 10% per year over the last two years. Annual cost savings are shown in Figure 5.

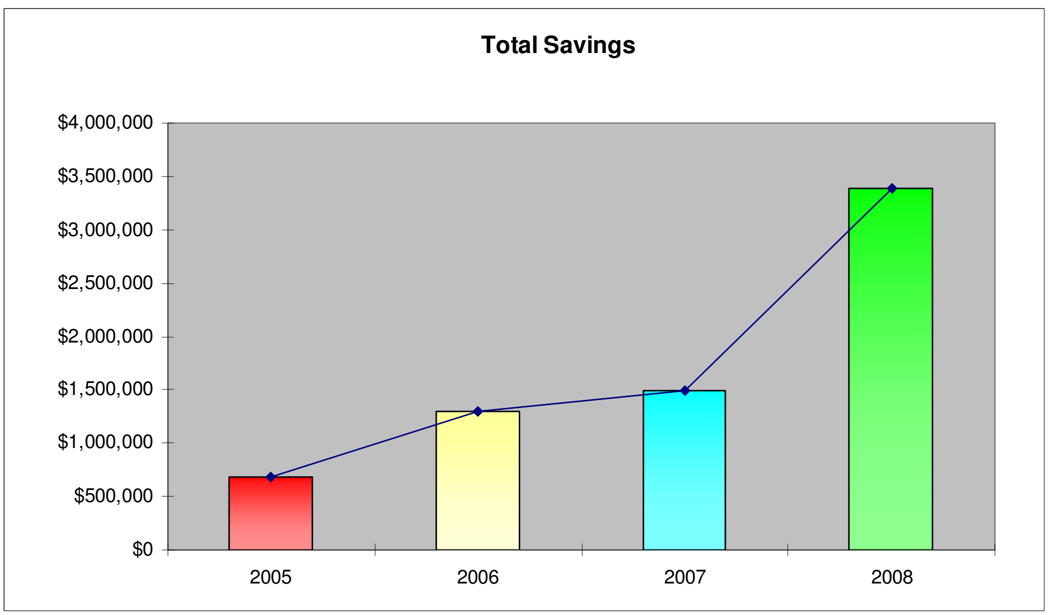


Figure 5. Schneider US Plant Energy Savings Results

CONCLUSIONS

Today the world energy picture sits at a point eerily similar to the one of the 1980's. We have again experienced a recession only exceeded in impact by the Great Depression. In 2008 energy prices spiked to the highest they had ever been, driven by forces that were not supply and demand. And then energy prices dropped precipitously. There are many commonalities with the situation of the 1980's. Yet, new challenges of global warming, sustainability, and pressured financial systems because of large oil imports add to the urgency and need.

The gyrations in energy prices continue. In the 1980's changes in OPEC supplier policies caused first a historic rise with the Arab Oil Embargo and then a precipitous drop because of the change in the market supply position of Saudi Arabia. Such issues point out how the energy picture is very subject to a host of issues outside of the control of consumers.

In 2008 concerns about supply and then large influences from market speculators drove oil prices to historic highs once again, only to be followed by a 50% decrease when the world economy softened. Such changes make it impossible to plan energy futures solely based on market price. Decisions made risk becoming outdated due to market swings. Energy planning must be done with a long-term vision. That vision must include planned directions on difficult issues, such as climate change.

The industrial sector continues to be one of the most energy-intensive areas in any nation and one that may offer the most opportunity for energy reduction, sustainability, and environmental impact reduction. This is due in no small part to the fact that most of the real opportunities in those areas still remain untapped. Many past attempts to implement such programs in the industrial environment have failed.

Success in the industrial energy area requires directly addressing those unique characteristics about the manufacturing environment that have made energy projects and programs so difficult. However, once each of those areas is addressed, change is possible. The result of such change reduces manufacturing costs, provides for long-term viability of energy resources, and reduces environmental impact on the world while allowing the sector to produce the goods that drive the world economy.