Industrial Energy Management Systems

Digital systems collect and organize energy use data to improve process efficiency
Get the Energy Info

In today’s environment of rising energy costs, it is more important than ever to be able to “tune” the energy use on the plant floor. New systems make that practical.

A5 CNG for Industry. A revolution is quietly taking place for both in-plant equipment and local fleet vehicles: CNG.

A7 Save Steam. Replacing a boiler can be a great step to improve plant efficiency. But don’t forget to eliminate the energy waste downstream, too.

A9 Three Ways to Save Heating Energy. Building heat is a major energy expense in most of the U.S. and Canada. Here are three ideas for lowering building heating costs.

A11 Bi-Fuel Diesel Generators. These systems use natural gas to replace up to 90% of the diesel fuel oil needed for standby generators. Doing so, they add improved fuel security and may also lower operating costs.
New Tools Make Energy Management a Reality

Conserving Energy, Improving Productivity

**PROCESS MANAGERS HAVE LONG SEARCHED** for ways to reduce the energy component in industrial budgets. Most low-hanging energy fruit has already been harvested. But managers understand that there are significant additional savings out there, if they can be identified.

With new industrial energy management tools, it is now possible to harvest additional energy savings. One key is to employ new energy management systems to acquire accurate, detailed process energy use information, compile it, and make it available to facility and process managers.

**DOE Program Finds Large Energy Saving Opportunities**

Over the past three years, DOE’s Save Energy Now program has evaluated hundreds of industrial plants and has found immediate opportunities for energy savings, and just importantly, has documented the need for accurate process energy use information. In an example cited by the Alliance to Save Energy, 3M Corporation in 2000 made a commitment to strenuously look for opportunities for energy savings in its industrial processes. Between that time and 2005, the company was able to decrease the energy intensity of its products by 27%. Additional savings have been identified since that time.

Gas and electric utilities are an increasingly valuable source of information on energy use patterns. Darin Ostrowsky of Manitoba Hydro was a recent presenter at a Technology and Market Assessment Forum sponsored by the Energy Solutions Center. He described how his firm, a gas and electric utility, offers customers participation in a program called Enertrend. Using revenue metering equipment already in place, owners can gain online access to hourly, daily and monthly usage for both gas and electricity including peak electric demand.

Ostrowsky notes, “Simply having this basic information can help identify processes and buildings that are good potential targets for more detailed energy use analysis.” Ostrowsky indicates that many industrial customers are already participating in the program.

Quick Tool for Plant-Wide Energy Snapshot

Available from DOE’s Industrial Technologies Program is a range of software tools to support the industrial energy manager. At the most basic level is the Quick Plant Energy Profiler, or Quick PEP, an online software tool that helps industrial plant personnel quickly understand how energy is being used at their plant and give a snapshot of potential energy saving.

**Utilities Offer Insights from Revenue Meter Data**

System-wide energy management improvements at Eastman Kodak Company’s facility in Rochester, New York resulted in energy savings of 16% in 2006 and another 11% in 2007.
Other tools from DOE include energy analysis software for fans, motors, heating equipment, pumps and steam systems. These programs can be used in conjunction with detailed information on processes or building energy efficiency.

**Getting Down to Detailed Monitoring**

For this, owners need digital monitoring and data processing tools to collect detailed information on energy usage at dozens or hundreds of points within the manufacturing environment. In the past data collection was done with mechanical or electrical analog metering. Today’s data collection uses compact digital sensors that send data to a central collection point.

Systems such as the DeltaV automation system from Emerson Process Management are designed to perform a broad range of data collection and process management functions.

**Putting the Data Where You Can Use It**

DeltaV is capable of handling a wide range of communications protocols, and can output real time reports to control rooms or other locations on the factory floor, and can be enabled to transmit the data via land line or secure web links to remote locations anywhere.

According to Mike Simpson from Emerson, many industrial users are using the platform to measure and analyze energy use in ways that until now have not been possible. He notes that wireless data transmission has become practical for the industrial environment, collecting data from otherwise difficult to reach locations.

**Share Data with Enterprise Manager**

Simpson notes that the collected information can be shared with sophisticated enterprise-wide data systems such as the OSIsoft platform and others. The high quality data output from these systems is ideal for use in industry-specific energy analysis tools such as those offered by the DOE’s Industrial Technologies Program, and others. In addition to energy analysis this energy data is invaluable for product pricing, purchasing, inventory control, continuous improvement programs, and process supervision.

An example of implementation of such a program is an undertaking by Eastman Kodak Company to evaluate process energy efficiency at manufacturing facilities in New York, Massachusetts and Colorado. According to James Breeze from Kodak, the firm made a top-down commitment to improving energy efficiency in 2004, and began a detailed evaluation of their processes from an energy efficiency perspective. Data was ultimately processed using an OSIsoft system, then tabulated and widely distributed internally.

**Kodak Finds New Areas for Savings**

As a result, Kodak was able to make a wide range of changes in its buildings and processes. In some areas they found they were over-ventilating buildings with excessive air turnover, creating unnecessary heating and cooling demands. In other cases they were able to adjust processes and optimize equipment. Breeze says, “This system gave us the ability to make decisions on consolidating processes to optimize energy use. Having detailed energy use data motivated everyone to participate in this process.”

Because of the system improvements, Kodak was able to reduce energy use 16% in 2006 and another 11% in 2007. Breeze notes, “We’re continuing to find places for energy reduction.” Breeze indicates, “We achieved savings not just in energy costs, but in operating and maintenance expense, and in depreciation.” He points out that they have achieved total savings to date in excess of $27 million. According to Breeze, the simple payback for the projects was less than one year.

Regardless of the scale of your industrial plant, from a small plating business to a huge petrochemical complex, controlling your energy usage is critical for profitability. Just in time, a full suite of energy measurement and analytical tools is available. Perhaps it’s time for your business to climb on board.
AFTER DECADES OF TENTATIVE STEPS, North America is beginning to catch up with many other regions of the world in the use of compressed natural gas (CNG) motor vehicles. A wide range of vehicles, including transit buses, refuse trucks, concrete trucks, local delivery vehicles, utility line maintenance trucks, lift trucks and municipal fleet vehicles are leading the charge.

Potential Becoming Reality in North America
For years energy experts touted the potential of CNG. With soaring diesel fuel and gasoline prices, increasing requirements to lower motor vehicle emissions, and tax incentives, CNG motor fuel is catching on in both the U.S. and Canada. An estimated 120,000 CNG vehicles are already on the road in the U.S., and the number is rapidly increasing.

Ron Smith from Adrianus Resources is a consultant to the CNG transportation industry and a passionate believer in CNG. Smith says the overall trend of interest in CNG vehicles is upward. “It has been dramatic for the last six months, with the soaring cost of diesel fuel. I’ve never seen this level of interest in the 16 years I’ve been in this industry.”

Transit Buses Leaders in CNG
Smith notes that today in the U.S., about almost 13 percent of all transit buses are powered by natural gas. “The CNG engines in these buses give good torque and are designed for a range of 400 miles.” Fuel cost comparisons change daily, but Smith indicates that commonly the fuel cost ranges between 40% and 75% of the cost of diesel.

CNG engine emissions are far lower than even the cleanest diesel engine. As an example of the trends toward changeover, Smith cites the city of Visalia in the San Joaquin Valley in California. After studying the economics of a changeover, the city converted nearly 400 vehicles — 90% of the city’s fleet — to CNG. Subsequent to that decision, several surrounding municipalities took similar steps. “They were quick to see the benefits,” says Smith.

Refuse Trucks a Logical Market
McNeilus, an Oshkosh Corporation company, is a major manufacturer of refuse hauling trucks. According to Brian Butler, a McNeilus sales representative on the West Coast, many customers in his area are today selecting trucks powered by CNG. Butler explains, “Partly it is motivated by the need to comply with regulations of the South Coast Air Quality Management District (SCAQMD).” These rules require refuse haulers with fleets of 15 or more vehicles, when leasing or buying new vehicles, to acquire vehicles that use one of the qualifying ‘alternate fuels’, rather than continuing to rely on diesel. According to Butler, a high proportion of this market is currently choosing CNG.

Both Air Quality Compliance and Fuel Savings
Butler notes, “But it’s not just compliance with the air quality rules; it’s fuel economy as well. With diesel fuel costs now approaching $5 a gallon, the CNG option looks great. Fuel prices are hitting the refuse haulers hard, and they are seeing CNG as a great solution.”

Heil is another manufacturer of refuse and recycling truck bodies. According to Shannon Harrop, director of product management for Heil, interest in CNG trucks is soaring, and units are being shipped throughout the United States. He feels the current trend is being driven by high diesel fuel costs.

Heil has been providing CNG trucks to the Culver City, California refuse fleet. The fleet currently includes eight CNG vehicles, with seven more on order. As conventional diesel units reach the end of their service lives, they are being replaced with CNG trucks. According to Paul Condran, equipment maintenance manager for Heil, “We needed the fuel savings, but it was the air quality regulations that made the decision to go to CNG.”

Toyota’s CNG powered lift truck is a logical solution for industrial and warehouse facilities needing to replace propane powered pneumatic tire lift trucks.”
Culver City, the benefits of CNG vehicles outweigh any disadvantages. “We’d prefer running natural gas over anything volatile like gasoline,” he says.

Recently UPS, the world’s largest package delivery company, announced the planned addition this year of 300 new CNG-powered delivery trucks to its existing fleet of 800 CNG trucks. The existing trucks are deployed in California, Texas and Georgia. The chassis for the new trucks will be provided by Freightliner Custom Chassis Corp., and the engines are by Cummins-Westport.

**Refill CNG Tank Nightly**

For refuse haulers and local delivery trucks, it is practical to have on-board CNG tanks that hold fuel sufficient for 250 miles of use. Larger users refuel their CNG trucks at night, using a dedicated time-fill system at the truck home station. Currently, in the U.S., there are 1,200 public CNG refill stations.

**Interest in CNG Now Widespread**

Although much of the initial growth in the technology was driven by rules of the California Air Resources Board (CARB) and the SCAQMD, the interest in CNG is now widespread. Smith says, “We’re seeing systems being put in throughout the U.S. and Canada. Owners like the operating economies. They like the engine life extension. They like the low emissions characteristic.” He indicates that paybacks range from almost instant to two or three years.

He reminds clients to include in their calculations federal and state rebates and tax credits. A refuse truck costing $200,000 may have an additional cost of $50,000 for a CNG system. However, tax credits of $32,000 reduce the premium on this truck to $18,000. Dramatically lower fuel costs and fuels credits often make it a very short payback.

**Two Engine Manufacturers**

Currently there are two manufacturers of heavy-duty automotive CNG engines in the U.S. – Cummins-Westport and Emissions Solutions, Inc. Cummins has been in the market for a long period and manufactures an estimated 20,000 engines annually. Cummins offerings include an 8.9 liter in-line six cylinder engine that produces 320 hp and was specifically designed for CNG fuel in heavy- and medium-duty trucks and transit buses.

Emissions Solutions produces a 7.6 liter turbocharged in-line six cylinder engine that meets clean air standards in those states that offer clean air incentives. The engine produces from 175 to 265 hp, depending on how it is equipped.

**Conversion of Gasoline Engines for Trucks**

In addition, with the installation of conversion kits, many large gasoline engines can be converted to CNG operation. Baytech Corporation offers EPA and CARB-certified CNG conversion kits for General Motors and Isuzu vehicles and engines. BAF Technologies offers kits for a range of engines by Ford and other manufacturers. IMPCO and FuelTek also offer certified conversion systems.

**Is CNG Ready for Prime Time?**

According to Dick Duffy from PSE&G, a gas and electric utility in New Jersey, some industries have converted their fleets of lift trucks and some other industrial vehicles from propane to CNG. Duffy says, “The attraction is low emissions and lower operating costs.” He indicates that CNG conversions for lift trucks have been especially attractive for companies that need to operate pneumatic-tire lift trucks both indoors and on irregular terrain outside. Toyota offers a factory-built CNG lift truck for this market.

“The market for NGVs around the world is skyrocketing,” says Richard Kolodziej, president of NGVAmerica, the national trade association for NGVs. “Over 1 million NGVs were added worldwide last year. In the U.S., NGVs displaced about 250 million gallons of petroleum in 2007, which was a 30 percent jump from 2006. Our goal is to reach 10 billion gallons in the next 15 years. The way things are going, that’s doable.”
STEAM POWERS MANY INDUSTRIAL PROCESSES, but is also potentially a huge source of undetected energy waste. Fortunately, we have the tools to eliminate this waste, and again harness steam as the efficient servant.

**DOE Program Demonstrates the Possibilities**
The Industrial Technologies Program of the DOE instituted its Save Energy Now program to offer detailed energy assessments to industry. Over 500 assessments of large industrial users have been performed. One major area for energy savings identified is reducing wasted energy in steam systems. In some cases, where an older boiler is highly inefficient, boiler replacement is a priority solution. But the benefit of an efficient new boiler is lost if the steam system has leaks or other deficiencies.

**Dow Chemical Plant Energy Search is Fruitful**
A recent Save Energy Now assessment at Dow Chemical Company's petrochemical plant in Hahnville, Louisiana zeroed in on opportunities for natural gas savings by improving the plant’s steam system. Riyaz Papar of Hudson Technologies worked with plant staff to identify several opportunities for natural gas savings, using DOE’s Steam System Assessment Tool (SSAT) to model and evaluate the existing steam system.

Dow knew there were inefficiencies in the system and the SSAT made it compelling to make changes immediately. Changes included starting a continuing program for steam trap evaluation and repair, instituting a steam leak management program, improving steam system insulation levels and increasing condensate recovery levels.

**Payback of SIX WEEKS**
With an investment of approximately $225,000 in these immediate steam system improvements, the company was able to realize annual savings in natural gas amounting to 272,000 MMBtu, valued at $1.9 million. The payback for this project was an astonishing six weeks. Medium-term opportunities for savings were also identified to annually save an additional $400,000.

Glenn Hahn from Spirax Sarco Energy Services indicates that similar opportunities can be found in many industrial steam systems. Hahn was a recent presenter at an Energy Solutions Center Technology and Market Assessment Forum (TMAF). He says op-
I tell people that many steam systems are like hot air balloons with a lot of big holes in them. They may still work, but it takes a lot more energy to keep them going if you don’t fix the holes.”

— Glenn Hahn, Spirax Sarco Energy Services

opportunities for paybacks of much less than a year are common, and often the only missing element is the will to make the improvements. “I tell people that many steam systems are like hot air balloons with a lot of big holes in them. They may still work, but it takes a lot more energy to keep them going if you don’t fix the holes.”

Top Ten Causes of Steam System Energy Waste
One Industry Expert’s View
1. System old age and related component failure
2. Contamination in steam and steam lines
3. Poor quality steam
4. Insufficient steam trap maintenance
5. Inadequate system inspections
6. Misapplication of traps and other equipment
7. Insufficient labor to perform necessary maintenance
8. Lack of experienced personnel
9. Failure to understand root causes of steam problems
10. Lack of ownership of maintenance tasks

Steam Traps a Good Target
The steam trap serves the dual purposes of removing non-condensable gases from the system, and allowing the efficient return of condensate to the feedwater.

Hahn recommends a complete survey of all system steam traps to identify those that need repair, replacement or adjustment. Spirax Sarco and many other firms offer on-site audits of industrial steam systems, with special attention given to steam traps. He indicates that a high percentage of installed steam traps are not functioning properly.

Inspection More Than a Walk-Through
In the absence of automated monitoring, regular system inspections and checks are required. “This is more than just looking for leaks,” says Hahn. “The person assigned to do the inspections needs to understand manufacturers’ specs and follow them.”

For customers who do not have automated monitoring systems, the only reasonable alternative to regular inspections by qualified plant staff is to outsource the system inspection responsibility to a qualified steam system inspection contractor.

One example of the dollar savings available with steam trap inspection is the experience of Velsicol Chemical Company. By instituting regular steam trap inspections and training personnel to recognize steam trap failure, Velsicol reduced annual energy consumption by 27,308 million Btu—a 17% decrease.

On a Btu per pound of production basis, Velsicol reduced their plant energy consumption by 28%. Annual fuel costs were reduced $80,000. This reduced annual consumption of treatment chemicals by 1,000 pounds, saving over $20,000 per year.

Automatic Monitoring Systems Offer Continuous Status Reports
Several companies offer automated monitoring systems that continuously evaluate steam system performance and can identify steam traps and other equipment that is malfunctioning. It is essential that the data on system performance be not only collected, but the results need to be understood and acted upon.

A major provider of automated systems, as well as a wide range of other steam system equipment, is Armstrong International. The company’s SteamEye® steam monitoring system observes steam system operation including trap performance, Chris Gibbs from Armstrong International explains that the system, combined with Armstrong’s SteamStar™ data measurement platform, can alert operators instantly of failures of steam equipment, including traps, pressure reducing valves, safety relief valves and condensate pumps.

Gibbs, a recent presenter at an Energy Solutions Center TMAF, indicates that the system can be integrated with a building automation system (BAS) or plant energy management system using a built-in Mod-Bus connection. Condensate return is another major opportunity for energy and dollar savings. DOE says the heat energy remaining in condensate can be more than 10% of the total steam energy content.

Pipe Insulation Upgrades
Repairing or replacing pipe insulation wherever necessary is also important. If the insulation is wet from condensate or any other source, the origin of the moisture should be found and repaired, and the insulation dried or replaced. Wet insulation is almost worthless.

The North American Insulation Manufacturers Association has developed a software package (3E Plus) that determines the optimum thickness for a wide variety of insulating materials. 3E Plus is available at no cost at http://www.pipeinsulation.org.

Make Steam Do Useful Work
The DOE’s Office of Industrial Technology has numerous tools available for general scoping and detailed calculation of potential steam energy savings. The Energy Solutions Center website, www. CleanBoiler.org also has many useful references that will help you improve your steam system. Now it’s time to get your steam system back into shape.
New Heating Options

FOR INDUSTRIAL BUILDINGS

3 Ways to Heat Your Building for Less

IN MANY PARTS OF NORTH AMERICA, space heating is the largest element of industrial building energy use. This is especially true as our economy evolves from heavy manufacturing toward more light manufacturing, assembly operations, warehousing, and distribution. Important options for new and existing buildings can dramatically reduce the cost of building heating. We’ll look at three technologies that promise to reduce the cost of heating industrial buildings.

The High-Efficiency Radiant Solution
Overhead radiant heating is a sweet idea for many manufacturing and warehousing operations because of its flexibility, incremental design, and high energy efficiency. Modern natural gas-fired infrared units can convert a very high proportion of the input energy into infrared, heating spaces quietly and without drafts.

Plant Looked for Economical Solution
Units of this type have been installed in a Syncreon Automotive plant in Oshawa, Ontario. The 312,000 square foot plant receives, assembles and ships a wide range of parts for the automotive industry. While the plant was under construction in 1999 the firm solicited input from their natural gas supplier, Enbridge, as to the best and most appropriate heating system. The base plan was to use indirect-fired gas unit heaters. However Enbridge was able to demonstrate that high-efficiency infrared heaters would conserve energy and with a financial incentive from Enbridge of $23,484, would have a payback of just over two years. The calculated annual savings at the time was $87,298 over the base case.

High Proportion of Infrared Output
The heaters installed at the Syncreon plant are the supraSchwank radiant heater design by Schwank. These have very high combustion efficiencies, with over 80% of the output energy emitted as infrared. Each unit has an individual spark ignition and flame monitoring system, and units can be mounted close to the ceiling space without overheating. According to Bob Alcott of Schwank, these heaters are designed specifically for industrial application, and come in output sizes from 7.7 kW (27,000 Btu/h) to 30.8 kW (105,000 Btu/h).

The High Efficiency Industrial Space Heater Solution
Many manufacturing, warehouse and distribution buildings need space heating systems that are both economical to install and will operate efficiently. Because these buildings require ventilation, owners sometimes install makeup air heaters sized to meet the full heating requirement of the building. However, this approach ignores the fact that excessive reliance on makeup air heaters will pressurize the building, forcing heated air out through every crack and opening. An alternative is to use high-output direct-fired gas heaters that introduce far smaller volumes of heated air into the building, allowing building pressures to stay in balance and reducing energy use. An example of such a product is the S-Series Blow-Thru® industrial space heater from Cambridge Engineering. Because of its blow-through design, the blower, belts and bearings are all on the cool, upstream side of the burner. This design allows the unit to operate with a 160°F temperature rise, far higher than achievable with most makeup air heaters, which use a temperature-limiting draw-through design.

Frank Horstmann from Cambridge was a recent presenter at a Technology and Market Assessment Forum sponsored by the Energy Solutions Center. Horstmann stresses, “We emphasize that this is something different from a makeup air heater. A makeup heater’s role is to provide temp-
pered building air to offset ventilation volumes. The S-Series is designed to actually heat the building efficiently regardless of the outdoor temperature.

**Replacing Older Steam System**
An example of a building that was successfully retrofitted with high efficiency direct-fired heaters is the North American headquarters and manufacturing plant of Durr Industries in Plymouth, Michigan. In 2006 the company decommissioned its steam boiler heating system and replaced it with Cambridge Blow-Thru® heaters for the plants and a hydronic boiler system for the office. After the conversion, the annual natural gas consumption for the plant was reduced by 23%, or 6697 MCF.

Gordon Harbison from Durr Industries indicates, “We have been very satisfied with the decision to change from our steam-based system, especially with the savings generated and our reduced natural gas consumption. The shop levels are much more consistent throughout, increasing our worker comfort levels.” Harbison explains that the project had a payback of less than three years. He notes, “This is of course controlled by the fluctuating price of natural gas, but no one at Durr is disappointed in the savings or the decision to install.”

**The Heat Recovery Solution**
A third approach to improving building energy efficiency is to capture heat that would otherwise be released along with ventilation air. This is not a new idea, but equipment is now being offered that accomplishes this goal with higher efficiency and reliability than earlier systems. Techniques include simple air-to-air heat exchangers or glycol run-around loops with coils in both the exhaust and supply air streams for sensible heat recovery, and more complex systems such as desiccant heat wheels.

Louis Tremblay of Union Gas in Ontario notes that the long and cold winters in that region prompt owners to choose a variety of heat recovery systems. He mentions specifically desiccant heat recovery systems by Munters as being popular, as well as heat recovery systems by Canadian companies Innergytech and Engineered Air.

An interesting new approach is the BKM Reverse-Flow ventilation air heat recovery system. Ottawa consulting engineer Byron Landry has extensive experience designing installations using this system. Landry says, “This technology captures waste sensible heat from building exhaust air using a damper system rather than conventional fixed plates or heat wheels. A two position damper directs the flow of exhaust air through one of two banks of plates.”

Outdoor air makeup is drawn through, at the same time, through the opposite heat exchanger. The dampers flip every 70 seconds to maintain continuous heat recovery as the opposite bank is being energized. Landry says that these systems achieve efficiencies ranging from 80% to 90%, compared to 30% to 70% for conventional fixed air-to-air heat recovery devices. “We’ve had good experience with these BKM units in terms of reliability, because the damper mechanism is the only moving part.”

**Each Situation Different**
Another variety of the sophisticated new generation of heat recovery units is the family of units from ComEnCo, which include units for heat recovery from industrial processes. The firm specializes in custom solutions for heat recovery from manufacturing plants, designing systems that can salvage what would otherwise be waste heat from process exhausts up to 900° F. Raymond Hsu from ComEnCo emphasizes that each industrial application is different. “It’s like going to the doctor. There are many different diagnoses, so the treatments vary according to the needs of the building.”

**Finding the Right Solution**
These are three of the prominent families of technologies that are being deployed to increase energy efficiency and reduce emissions in heating industrial facilities. We hope this article provides some insight in helping find the solution that is exactly right for your building today.
Add Security

BI-FUEL GENERATORS

THE CONCEPT IS SIMPLE: Diesel engines used for standby or intermittent electric generation can be modified to replace a high proportion of their diesel fuel requirement with natural gas. Some bi-fuel engine-generator sets are available as original equipment. Alternatively, many existing diesel-fuel powered engines can be modified to accept natural gas. This gives owners energy source flexibility, increased fuel supply security and often, lower operating costs than burning straight diesel fuel.

When Disaster Strikes

After natural disasters or during bad weather conditions, the need for standby generation is critical. Data and communication centers, food processing plants, water treatment and bottling plants, pumping stations, plastics plants, and many other operations critically need standby power. Yet at these times it is often difficult or impossible to get deliveries of diesel fuel. This experience was widespread following Hurricane Katrina.

Experience has shown that natural gas supplies are commonly available even after diesel fuel deliveries have stopped. With bi-fuel capability, a facility that previously had a fuel supply sufficient for less than 24 hours of operation can now run three to five days before a diesel fuel refill is required.

Using Diesel Fuel to Pilot Combustion

Because natural gas alone does not have the compression combustion characteristic of diesel fuel, the bi-fuel engine depends on some quantity of diesel fuel to serve as the pilot for combustion. Depending on the engine characteristics, this required proportion of diesel fuel may range from 10% to 50%.

In most cases where diesel engines are converted to bi-fuel operation, the principle of “fumigation” is employed to mix a metered quantity of natural gas with the incoming combustion air. Using this system, natural gas delivery pressure can remain low, and no changes are required in the fuel injection process. Sophisticated controls assure that as the natural gas proportion increases, diesel fuel injection decreases.

Candidates for conversion to bi-fuel operation include a wide range of diesel engine-powered generators. Often a good application is a standby generator which is critical for an industrial operation, but the on-site supply of diesel fuel is limited. If the engine is also used in an electric peak-shaving capacity, or for cogeneration, this can become an even more attractive choice because of reduced fuel costs and lower engine emissions with natural gas.

If the generator is operated a significant number of hours, the fuel cost savings may be significant.

Comparing Natural Gas Cost to Diesel Fuel

Energy managers need to check local energy cost comparisons. Diesel fuel has an energy content of about 144,000 Btu per gallon. Thus you need to multiply the delivered fuel price per gallon by 6.944 to get the cost per million Btu ($/MMBtu). If the price of diesel is $3.00 per gallon, it is equivalent to natural gas at $20.83/ MMBtu. Because the fuel efficiency of the engine is similar with either fuel, bi-fuel operation will save this owner money any...
Generac 600 kW factory-built bi-fuel generator can run at natural gas levels up to 90%, greatly extending the life of onsite diesel fuel supplies and dramatically reducing operating costs. Photo courtesy Generac.

Expertise Needed to Complete Conversion

In a recent presentation at a Technology and Market Assessment Forum sponsored by the Energy Solutions Center, Renner emphasized that the conversion to dual fuel involves more than installing a few pieces of equipment on the engine. “We feel the onsite support for the installation is really important.” His firm offers systems and support for a wide range of stationary diesel generation types.

An example of a conversion done by Innovative Technology Group is an 800 kW generator at a printing plant in New York that was converted to dual fuel operation. This approach was chosen to reduce operating costs and to extend the life of the engine because of lower operating costs when operating on natural gas. The owners also benefited by reducing the onsite storage requirement for diesel fuel.

Another provider of bi-fuel conversions is GTI-Altronics. According to Jason Green from the firm, the conversions meet current emission Tier 2 and Tier 3 emissions limitations, and can be installed on a wide range of engines with both mechanical and electronically controlled fuel delivery systems. Green notes that with growing concerns about fuel supply security, many owners are looking very hard at the bi-fuel solution.

Bi-Fuel Gensets from the Factory

Generac Corporation currently manufactures an engine that is factory equipped for bi-fuel operation. The current bi-fuel offering is a 600 kW engine that is designed to use up to 90% natural gas as fuel. According to Mike Lehman at Wolter Power Systems in Milwaukee, Wisconsin, this genset meets the stringent new U.S. EPA standards for stationary engines. It is being successfully installed by owners who want the ability to operate for extended periods without refueling. He notes that recent natural disasters have shown the value of extending the operating hours available from the quantity of diesel fuel on site.

An example of a firm that embraced the bi-fuel concept using the Generac engine-generator set is Yamaha Motor Corporation. Because of a series of power interruptions at a new office and distribution center in Pleasant Prairie, Wisconsin, Yamaha determined they needed standby generation. They also were concerned about the possibility of a winter blizzard stopping diesel fuel deliveries. After considering all the options, they chose Wolter Power Systems to design and install a bi-fuel engine-generator system.

Down to 10% Diesel Fuel Operation

The Generac engine starts on 100% diesel fuel and then gradually increases the amount of natural gas fed into the combustion air stream, reaching a proportion of 10% diesel and 90% natural gas. The fuel blend follows specific fuel mixture algorithms. The company was so pleased with the results that they chose to have Wolter install bi-fuel engines at two other U.S. facilities.

Is Bi-Fuel Right for You?

Is bi-fuel operation a good idea for your industrial site? It requires an existing engine generator in good operating condition, or the willingness to purchase a unit. If you already have a large storage capacity for diesel fuel and you seldom run the engine, it may not be worth the expense to do the conversion. But for many owners of diesel standby generators, adding the bi-fuel option can add security and reduce operating costs.