Conduct an In-Plant

In the United States, more than 2.4 million pumps, which consume more than 142 billion kWh annually, are used in industrial manufacturing processes. At an electricity cost of 5 cents per kWh, energy used for fluids transport costs more than $7.1 billion per year. Even one pump can consume substantial energy. A continuously operated centrifugal pump driven by a fully loaded 100-horsepower motor requires 726,000 kWh per year. This costs more than $36,000, assuming average electricity costs of 5 cents per kWh. Even a 10% reduction in operating costs saves $3,600 per year. Table 1 summarizes the electrical costs of operating

Table 1. Pumping Energy Costs for Pump Driven by 100-hp Motor (assuming a 90% motor efficiency)

Operating Time	Energy Costs for Various Electricity Costs				
kWh	2 cents per kWh	4 cents per kWh	6 cents per kWh	8 cents per kWh	10 cents per
1 hour	$1.60	$3.30	$4.90	$6.60	$8.20
24 hours	$39	$79	$119	$159	$198
1 month	$1,208	$2,416	$3,625	$4,833	$6,042
1 year	$14,500	$29,000	$43,600	$58,000	$72,600

Surveying Your Pumping Systems

Pumps larger than a minimum size and with significant operating hours should be surveyed to determine a baseline for your current pumping energy consumption and costs, identify inefficient pumps, determine efficiency measures, and estimate the potential for energy savings. The U.S. Department of Energy's (DOE) Pump System Energy Opportunity Screening worksheet will help you identify systems that merit a survey.

The survey team should gather pump and drive motor nameplate information and document operating schedules to develop load profiles, then obtain head/capacity curves (if available) from the pump manufacturers to document the pumping system design and operating points. The team should also note the system flow rate and pressure requirements, pump style, operating speed, number of stages, and specific gravity of the fluid being pumped. If possible, the team should also measure and note the flow rate and the suction and discharge pressures and note conditions that are associated with inefficient pump operation, including indicators such as:

- Pumps with high maintenance requirements
- Oversized pumps that operate in a throttled condition
- Cavitating or badly worn pumps
- Misapplied pumps
- Pumping systems with large flow rate or pressure variations
- Pumping systems with bypass flow
- Throttled control valves to provide fixed or variable flow rates
- Noisy pumps or valves
- Clogged pipelines or pumps
- Wear on pump impellers and casings that increase clearances between fixed and moving parts
- Excessive wear on wear rings and bearings
- Improper packing adjustment that causes binding on the pump shaft

Pumping System Survey

- Multiple pump systems where excess capacity is bypassed or excess pressure is provided
- Changes from initial design conditions. Distribution system cross-connections, parallel main lines, or changes in pipe diameter or material may change the original system curve.
- Low-flow rate, high-pressure end use applications. An entire pumping system may be operated at high pressure to meet the requirements of a single end use. A booster or dedicated pump may allow system operating pressure to be reduced.

Pumping System Efficiency Measures

Measures to improve pumping plant efficiency include:

- Shut down unnecessary pumps. Re-optimize pumping systems when a plant's water use requirements change. Use pressure switches to control the number of pumps in service when flow rate requirements vary.
- Restore internal clearances.
- Replace standard efficiency pump drive motors with NEMA Premium™ motors.
- Replace or modify oversized pumps. Install new properly sized pumps. Trim or change the pump impellers to match the output with system requirements when the pumping head exceeds system requirements. Consult with the vendor to determine the minimum impeller diameter for a pump casing.
- Meet variable flow rate requirements with an adjustable speed drive or multiple pump arrangement instead of throttling or bypassing excess flow.

RESOURCES

Hydraulic Institute (HI). Hydraulic Institute, the largest association of pump producers in North America, serves member companies and pump users worldwide by developing comprehensive industry standards, expanding knowledge by providing education and training, and serving as a forum for the exchange of industry information. In addition to the ANSI/HI pump standards, HI has a variety of resources for pump users and specifiers, including Pump LCC and VSP guidebooks, "7 Ways To Save Energy" training program and more. To download FREE executive summaries of HI's "Pump Life Cycle Costs", "Variable Speed Pumping", and an index to ANSI/HI Standards, visit www.Pumps.org and www.PumpLearning.org.

Pump Systems Matter™ (PSM). Developed by the Hydraulic Institute, PSM is an educational initiative created to assist North American pump users gain a more competitive business advantage through strategic, broad-based energy management and pump system performance optimization. PSM's mission is to provide end-users, engineering consultants and pump suppliers with tools and collaborative opportunities to integrate pump system performance optimization and efficient energy management practices into normal business operations.

PSM is seeking the active support and involvement of energy efficiency organizations, utilities, pump users, consulting engineering firms, government agencies, and other associations. For more information on PSM, to become a sponsor, or to download PSM's *FREE Pump System Improvement Modeling Tool*™ (PSIM), an educational tool designed to show pump systems engineers how modeling tools can reduce cost and conserve energy, visit www.PumpSystemsMatter.org.

U.S. Department of Energy (DOE). DOE's Industrial Technologies Program (ITP), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. ITP has launched the **Save Energy Now** initiative to help the nation's manufacturing facilities continue to thrive during a time of diminished energy supplies and rising costs. As a part of this initiative, ITP is sending DOE Energy Experts to the nation's most energy-intensive manufacturing facilities to conduct 200 Energy Savings Assessments. See www.eere.energy.gov/industry for additional information on DOE's energy efficiency activities.

BestPractices emphasizes opportunities for savings in plant systems such as motor, steam, compressed air, and process heating systems. BestPractices is a part of the Industrial Technologies Program, and offers a variety of resources addressing ways to reduce energy and maintenance costs in industrial process systems. This includes training workshops, software tools, a series of sourcebooks, case studies, tip sheets, and other materials, including several which focus on opportunities in pumping systems. For example, the Pumping System Assessment Tool (PSAT) aids in the assessment of pumping system efficiency and estimating energy and cost savings.

For more information, please contact: EERE Information Center; 1-877-EERE-INF (1-877-337-3463); www.eere.energy.gov/industry/bestpractices.