



Suggested Actions

- Prescreen the pumps in your facility.
- Survey the systems identified as priorities.

Resources

DOE and Hydraulic Institute, *Improving Pumping System Performance: A Sourcebook for Industry*.

Hydraulic Institute—HI is a non-profit industry association for pump and pump system manufacturers; it provides product standards and a forum for the exchange of industry information for management decision-making. In addition to the ANSI/HI pump standards, HI has a variety of energy-related resources for pump users and specifiers, including training, guidebooks, and more. For more information, visit www.pumps.org, www.pumplearning.org, and www.pumpsystemsmatter.org.

U.S. Department of Energy—DOE's Pumping System Assessment Tool (PSAT) can help you assess pumping system efficiency and estimate energy and cost savings. PSAT uses pump performance data from Hydraulic Institute standards and motor performance data from the MotorMaster+ database.

Visit the BestPractices Web site at www.eere.energy.gov/bestpractices for more information on PSAT and for upcoming training in improving pumping system performance and in becoming a qualified pumping system specialist.

Conduct an In-Plant Pumping System Survey

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 this pump.

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				
	2 cents per kWh	4 cents per kWh	6 cents per kWh	8 cents per kWh	10 cents per kWh
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
- 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.

About DOE's Industrial Technologies Program

The Industrial Technologies Program, through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. The Industrial Technologies Program is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

The Industrial Technologies Program encourages industry-wide efforts to boost resource productivity through a strategy called Industries of the Future (IOF). IOF focuses on the following eight energy and resource intensive industries:

- Aluminum
- Forest Products
- Metal Casting
- Petroleum
- Chemicals
- Glass
- Mining
- Steel

The Industrial Technologies Program and its BestPractices activities offer a wide variety of resources to industrial partners that cover motor, steam, compressed air, and process heating systems. For example, BestPractices software can help you decide whether to replace or rewind motors (MotorMaster+), assess the efficiency of pumping systems (PSAT), compressed air systems (AirMaster+), steam systems (Steam Scoping Tool), or determine optimal insulation thickness for pipes and pressure vessels (3E Plus). Training is available to help you or your staff learn how to use these software programs and learn more about industrial systems. Workshops are held around the country on topics such as "Capturing the Value of Steam Efficiency," "Fundamentals and Advanced Management of Compressed Air Systems," and "Motor System Management." Available technical publications range from case studies and tip sheets to sourcebooks and market assessments. The Energy Matters newsletter, for example, provides timely articles and information on comprehensive energy systems for industry. You can access these resources and more by visiting the BestPractices Web site at www.eere.energy.gov/industry/bestpractices or by contacting the EERE Information Center at 877-337-3463 or via email at www.eere.energy.gov/informationcenter/.

BestPractices is part of the Industrial Technologies Program Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and best energy-management practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

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A STRONG ENERGY PORTFOLIO FOR A STRONG AMERICA

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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