SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead®

IMPROVE OVERALL PLANT EFFICIENCY (OPE) TO SAVE ENERGY AND MONEY

DO YOU OPERATE A PUMPING PLANT TO IRRIGATE CROPS, LANDSCAPING OR TURF GRASS, SUPPLY WATER FOR DOMESTIC USE OR PROVIDE WATER TO AN INDUSTRIAL PROCESS? IF SO, THIS INFORMATION IS FOR YOU.

Annual energy costs represent a significant percentage of operating expenses for most agricultural businesses and municipalities— sometimes as much as 60 to 70%. A significant portion of that comes from the energy required to irrigate farmable and municipal lands, parks and other public places.

Knowing and understanding your Overall Pumping Plant Efficiency (OPE) will help you manage your energy costs much more effectively. We have compiled this handy guide to help you in that effort.

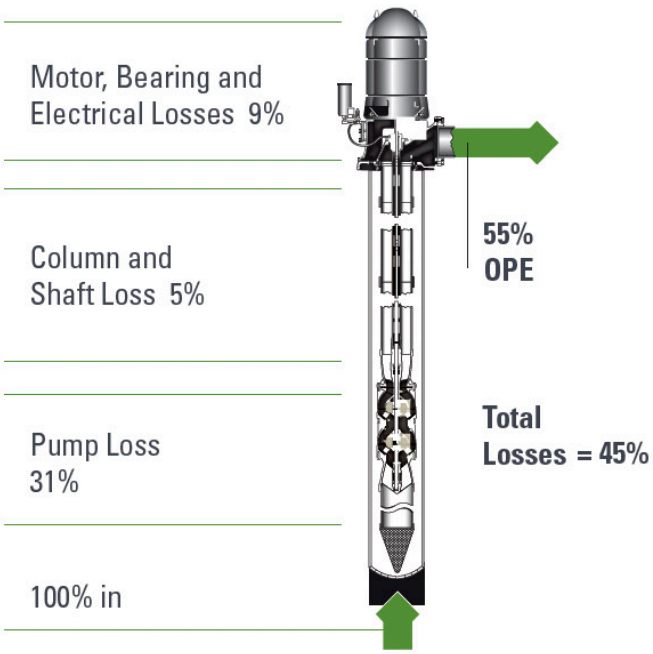
PUMPS AND PUMPING PLANTS: WHAT'S THE DIFFERENCE?

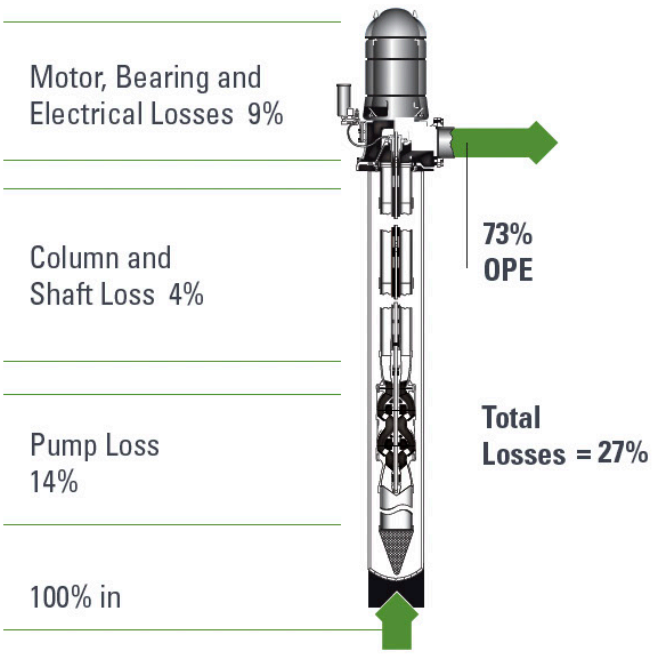
Before exploring the fundamentals of improving pump efficiency, it is important to understand the difference between a pump and the pumping plant.

A pumping plant is a comprehensive system that includes not only the pump but also the motor, equipment and controls, along with the fittings and components necessary to move water from the source through the pump and into the distribution system.

WHAT FACTORS AFFECT PUMP PERFORMANCE?

To ensure your pumps are capable of irrigating or supplying water effectively--and that you're not wasting energy– it is critical to routinely evaluate your pumping plant's operating efficiency.





Pumping plants can lose efficiency at many stages throughout the system.

OPE IS AFFECTED BY A VARIETY OF FACTORS:

- Type, size and condition of pump
- Pump speed plus total head or pump pressure
- Condition of the well
- Conversion of mechanical energy (pump) to water-energy (water flow), motor efficiency and power efficiency
- Water flow efficiency through pipes, fittings, valves, etc.

OVERALL PLANT EFFICIENCY AND WHY IT'S IMPORTANT

OPE is an important metric for all operators to know. It represents the relationship between the power consumed in kilowatts and acre feet of water delivered in gallons per minute. It's normally expressed as a percentage of how much horsepower is needed by the pumping plant to pump a given amount of water at the necessary total head.

$$\frac{\text{OUTPUT HP}}{\text{INPUT HP}} = \text{OPE}$$

ONLY TESTING WILL TELL

Improving OPE could result in significant energy and energy cost savings (see accompanying charts). But OPE can only be measured by a formal pump test. For this reason, Southern California Edison (SCE) offers no-cost and low cost pump efficiency tests for their pumping customers.

	INEFFICIENT PUMP	EFFICIENT PUMP	SAVINGS
Overall Efficiency	55%	73%	
kWh/Acre Ft.	649	511	138
Acre Ft./Year	822	822	
Annual kWh	533,472	420,000	113,472
Cost per year @ $.23/ kWh	$122,699	$96,600	$26,099

Potential Annual Savings for Improving Overall Pumping Plant Efficiency

MAKING SYSTEM CHANGES TO IMPROVE OPE CAN HELP YOU:

- Lower current pumping requirements with conscientious pumping-system management
- Reduce total energy use, which saves money
- Track trends for budgeting
- Foresee potential problems

	INEFFICIENT PLANT	EFFICIENT PLANT			PAYBACK
	Annual Cost @ 55% OPE	Annual Cost @73% OPE	Annual Operational Savings	Replacement Cost	Yearly
Year 1	$122,699	$96,600	$26,099	$75,000	($48,901)
Year 2	$122,699	$96,600	$26,099		($22,802)
Year 3	$122,699	$96,600	$26,099		$3,297
Year 4	$122,699	$96,600	$26,099		$26,099
Year 5	$122,699	$96,600	$26,099		$26,099
5 Year Totals	$613,495	$483,000	$130,495	$25,000	$55,495

Five-Year Comparison: Inefficient vs. Efficient Overall Pumping Plant Efficiency

JOB ONE: CHOOSE THE RIGHT PUMP FOR THE RIGHT APPLICATION

Matching the pump to the task is the first step in ensuring you're operating efficiently and making the best use of energy.

The principal pump type utilized is the centrifugal pump, which works by adding kinetic energy to a fluid through a spinning impeller, much as a fan blows air. The type of centrifugal pump needed for the job should be based on the water and pumping requirements.

TURBINE PUMP:

The smaller diameters found in turbine pumps make them more suitable for shallow or deep-pumping applications. What's more, their more compact design affords greater flexibility for ease of maintenance and reconfiguration.

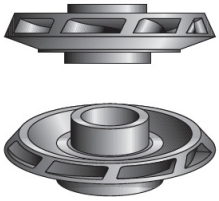
SUBMERSIBLE PUMP:

Features a waterproof electric motor connected directly to a turbine pump. They are typically used when the space above ground is at a premium or straight-line access to the water source is not possible. They are also much quieter than above-ground pumps.

HORIZONTAL PUMP:

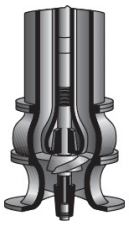
Relatively simple in design and inexpensive, horizontal pumps are centrifugal boosters that are used for moving water from one location to another. This may be moving water from one elevation to another or in series with a well when increased discharge pressure is needed.

EACH OF THESE PUMPS CAN EMPLOY DIFFERENT IMPELLERS DEPENDING ON THE APPLICATION.



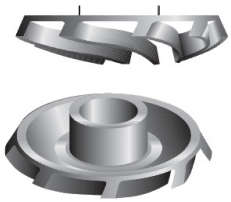
RADIAL FLOW IMPELLER:

Produce generally high pressures at lower flows and are most often used in booster pumps, horizontal centrifugal pumps and deep well applications.



AXIAL FLOW IMPELLER:

Provide very high flows at relatively low pressure and are typically used in canal lift pumps, where water flows in a straight line.



MIXED FLOW IMPELLER:

Helps water flow through and out of the impeller at an angle less than 90°.

DID YOU KNOW?

Well pumps that pump a lot of sand-filled water **should be** tested annually. Booster pumps supplied by clean water should be tested every **two to three years**.

THE IMPORTANCE OF REGULAR PUMP TESTING

As discussed previously, a key component of better energy management is improving OPE. Pumping plant OPE can only be measured with a formal test and should be performed every one-to-three years, depending on the annual usage and severity of operating conditions.

REGULAR PUMP TESTING CAN REVEAL:

- How efficiently the pump itself is working
- How well the pump management system is working including the controls and various other fittings
- If the pump is using energy most efficiently
- The potential for more serious problems
- If you have the correct type of pump in place for the job

SCE'S PUMP TEST PROGRAM CAN HELP

Because of the impact of OPE on energy demand across the State of California, we conduct complete and accurate efficiency tests on water pumps. The goal of our Pump Test Program is to help operations like yours make the most efficient use of every kilowatt of electricity to save energy and money.

WHAT WE MEASURE

Our Pump Test Program measures various aspects of your pump(s) while in operation to determine Overall Pumping Plant Efficiency:

- Rate of flow
- Total head
- Power input to the pumping plant

When your pump test is completed, you'll receive a report showing how your pump is performing—including your OPE, how much your OPE can be improved, plus how much you could save on energy costs.

DESIGNING AND MAINTAINING AN EFFICIENT SYSTEM

The performance of your pumping system is determined by many things including its basic design and configuration. That may include the type of motors used, the size of the piping, pumping pressure and more.

Making sure the system is designed correctly from the start —or properly redesigned if necessary—will prove to be costeffective over time and could have an immediate positive impact on the cost and use of energy.

THE FOLLOWING SYSTEM ELEMENTS SHOULD BE GIVEN CAREFUL CONSIDERATION:

- **Energy-Efficient Motors:** Motors are an essential part of your pumping system. But some are more energy- efficient than others. Purchasing a new high-efficiency motor may be more economical overall than repairing a damaged motor when you factor in energy savings. In fact, as the accompanying chart shows, a premium-efficiency motor could save you hundreds of dollars in energy costs each year.
- **Variable-Frequency Drives (VFD):** For systems with oversized pumps or varying loads, consider installing a VFD. VFDs improve a pump's performance by changing its rotational speed to better match the pumping load. A VFD-controlled pump can maintain pressure when the flow is changing, or constant flow when the pressure is changing. In either case, the result is optimum productivity with reduced energy usage compared to valve throttling or bypassing.
- **Excessive Pumping Pressure:** Excessive pumping pressures not only make your pumping system work inefficiently; they also waste energy. Several different things could cause this:
  a. A defective booster pump control and valves
  b. Pumping against a higher head than is needed to move water (false head)
  c. Supplying water at a pressure exceeding state regulations
  d. Check your pump pressures regularly to see that they meet but do not exceed requirements.
- **Piping System Friction Losses:** Pipelines should be sized to keep fluid velocities and Total Head losses at acceptable levels. Indeed, the best pump system designs balance capital expenditures for piping with treatment requirements, system requirements and overall energy consumption.
- **Well Conditions and Pumping Costs:** Well performance can also impact Overall Pumping Plant Efficiency along with pumping costs.

  Well-specific capacity – the well flow rate divided by the drawdown for that flow rate is influenced by such elements as aquifer conditions, well casing diameter, the well screen and more.

  Your well performance will generally degrade with time due to a variety of causes. Well screens can corrode or encrust with various deposits that reduce flow openings into the well; and gravel packs can also become plugged with silt. Attempting to pump too much water by using too big a pump for the aquifer also results in low well-specific capacity.

  Consult with your pump dealer and/or well driller if the pump test history reveals significant reduction in well-specific capacity over time.

AUTOMATED SCADA SYSTEM SAVES YOU TIME AND ENERGY

By automating key pump plant operations, an innovative Supervisory Control and Data Acquisition (SCADA) System has the potential to maximize your pumping system savings with a minimal use of manpower.

SCADA consists of a central control panel that monitors the entire pumping system. An override feature allows authorized employees to vary the operating schedule at any time or make across-the-board adjustments to different areas.

The SCADA system can be a very smart investment for most any type of operation, providing a payback of less than two years in many cases. Be sure to ask your Account Manager about this innovative solution.

BY CONSERVING ENERGY, WE ALL WIN

For more than 100 years, we've been dedicated to helping communities and other enterprises by providing reliable and affordable power plus energy-saving insights.

As this guide shows, regular pump testing is a valuable maintenance and diagnostic tool that helps ensure the efficiency, reliability, and longevity of pump systems. It allows for early detection of issues and helps in making informed maintenance and repair decisions.

ENERGY-EFFICIENCY PROGRAMS

Energy Efficiency (EE) programs can help you save energy and contribute to a clean energy future. You can directly contact a third-party company (i.e., not affiliated with SCE) for many of these programs.

Visit our Third-Party Energy-Efficiency Programs page for more information.

INTERESTED IN PUMP TESTING AND HYDRAULIC SERVICES? CONTACT US AT:

HydraulicServices-PumpTest@sce.com

1-800-634-9175

Register for free classes by visiting on.sce.com/agpumpswater or scan the QR code.