SOUTHERN CALIFORNIA EDISON®
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SCE Energy Conservation Series

Pumped and Primed to Save Energy

The information in this guide is valuable to any of our customers that operate a pumping plant to irrigate crops, landscaping or turf grass, supply water for domestic use or who provides water to an industrial process.

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 will help you manage your energy costs much more effectively. We have compiled this handy guide to help you in that effort.[1]

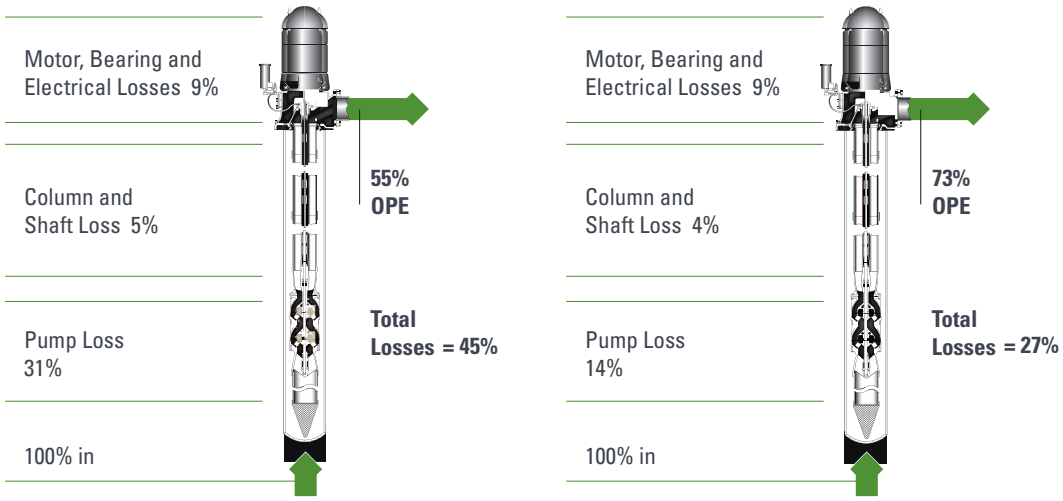
Pumps and Pumping Plants: What's the Difference?

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

The pumping plant is more than just the pump. It encompasses the pump **plus** motor equipment and controls including all associated fittings from the water source through the pump to the discharge 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, as many "working" pumps are nonetheless not working well.



Efficient Versus Inefficient Pumping Plants[2]

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

[1] *Pump Testing and Hydraulic Services Manual*, 2012.
[2] Ibid.

A pump's performance 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 Pumping Plant Efficiency (OPE) and Why It's Important

Overall Pumping Plant Efficiency 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, higher percentages indicating greater pump efficiency.

$$\frac{\text{Output HP}}{\text{Intput HP}} = \text{OPE}^{3}$$

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

Did You Know?

The **annual cost of energy** represents a significant percentage of operating expenses for most agricultural businesses and municipalities—sometimes as much as **60 to 70%**!

Only Testing Will Tell

Improving OPE could result in significant energy and energy cost savings (see accompanying charts).[4] But OPE can only be measured by a formal pump test. For this reason, we offer a program that will test your pumps.

Potential Annual Savings for Improving Overall Pumping Plant Efficiency[5]

	Inefficient	Efficient	Savings
Overall Efficiency	55%	73%	
kWh/Acre Ft.	649	511	138
Acre Ft./Year	822	822	
Annual kWh	533,472	533,472	113,472
Cost per year @ $.11/kWh	$58,682	$46,200	$12,482

Five-Year Comparison: Inefficient vs. Efficient Overall Pumping Plant Efficiency[6]

	Inefficient Plant Annual Cost @ 55% OPE	Inefficient Plant Annual Cost @73% OPE	Annual Operational Savings	Replacement Cost	Payback Yearly
Year 1	$58,682	$46,200	$12,482	$25,000	5($12,518)
Year 2	$58,682	$46,200	$12,482		5($36)
Year 3	$58,682	$46,200	$12,482		**$12,482**
Year 4	$58,682	$46,200	$12,482		**$12,482**
Year 5	$58,682	$46,200	$12,482		**$12,482**
5 Total Years	$293, 410	$231, 000	$62,410	$25,000	**$37,410**

[3] *Pump Testing and Hydraulic Services Manual*, 2012.
[4] Ibid.
[5] Ibid.
[6] Ibid.

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 in agriculture 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.

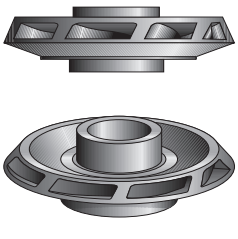
Submersible Pump:

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:

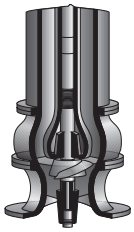
Relatively simple in design and inexpensive, horizontal pumps are centrifugal boosters that are not used for well applications.

Each of these pumps can employ different impellers depending on the application.



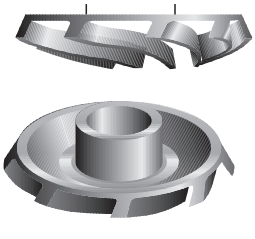
Radial Flow Impeller:

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 yearly. Booster pumps** supplied by clean water should be **tested every three years**.

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.

The Importance Of Regular Pump Testing

As explained earlier, a key stepping stone to better energy management is improving OPE, which can only be determined by way of a formal test. Pumps should be tested 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. Indeed, the overarching 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.

You'll also be interested to know that we frequently offer energy efficiency cash incentives and rebates applicable to pump plant operations.

Talk to your Account Manager about the availability of incentives in your area.

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 cost-effective over time and could have an immediate positive impact on the cost and use of energy.

Potential Energy Savings: Standard- Versus Premium-Efficiency Motors[7]

For more information, visit the U.S. Department of Energy's Best Practices website at http://www1.eere.energy.gov/.

Motor HP	Standard Efficiency Motor	Annual kWh 6000 Hours Operation	Premium Efficency Motor	Annual kWh 6000 Hours Operation	Energy Savings kWh/Year	Energy Savings $/Year
25	90	93,240	93,9	89,339	3,901	**$429**
50	91.2	184,070	94,8	177,132	6,938	**$763**
100	92.7	362,038	95,4	351,813	10,225	**$1,125**
150	93.1	540,992	95,8	525,407	15,585	**$1,714**
200	93.5	718,630	95,8	700,470	18,160	**$1,998**
250	94.2	886,696	96,0	874,219	12,750	**$1,408**

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-Speed Drives (VSDs):** For systems with oversized pumps or varying loads, consider installing a VSD. VSDs improve a pump's performance by changing its rotational speed to better match the pumping load. A VSD-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 defective booster pump control and valves
  - Pumping against a higher head than is needed to move water (false head)
  - Supplying water at a pressure exceeding state regulations

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) 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

[7] *Pump Testing and Hydraulic Services Manual*, 2012.

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, choosing the right pump, plus regular pump testing, maintenance and best practices is good for your business, and everyone who depends on the electrical grid.

Apply for SCE Energy Efficiency Solutions

We offer a variety of programs that can help you address problem areas and lower your energy costs, many of which include incentives such as hardware discounts and more. **Visit sce.com/solutions or call 1-800-736-4777.**

Contact Our Pump Testing and Hydraulic Services Department

We offer a variety of services to assist you. **Schedule a pump test at on.sce.com/pumptest** or visit one of our Education Centers:

Tulare
4175 South Laspina Street
Tulare, CA 92374
1-800-772-4822

Irwindale
6090 North Irwindale Avenue
Irwindale, CA 91702
1-800-336-2822

Additional Resources

Hydraulic Institute
pumps.org

SCE for Agricultural Businesses
sce.org/agriculture

Pump Testing and Hydraulic Services Manual. SCE, 2012.
energy.gov/eere/amo/ta

Interested In Learning More?

Choose from the many topics in our Energy Conservation Series:

- LED Lights: A Bright New Way to Conserve Energy
- Plug In To Greater Energy Savings— With Smart Plug Load Management
- Switch To a More Energy-Efficient Business—With Smart Lighting Controls
- Manufacturing Motors & Compressors: Start Your Energy-Efficient Engines
- On the Menu: Major Energy Savings With Restaurant Refrigeration
- Energy Efficiency Is In the Air: Optimizing Your HVAC
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