

# Reducing Energy Use and Energy Costs

This book is published by the Agricultural Pumping Efficiency Program ("APEP" or "Program"). The Program was developed and is managed by the Center for Irrigation Technology on the campus of California State University, Fresno. The Program is funded by the Public Goods Charge that is paid by California utility ratepayers under the auspices of the California Public Utilities Commission.

The Program is intended for agricultural water pumpers using electricity or natural gas for energy. This book presents concepts and practices that can help reduce energy use, the total energy bill and improve overall resource efficiency.



## IMPORTANT!

*The Program may be terminated or modified without notice. The Program has a limited budget. Applications for retrofit/repair rebates or pump tests are accepted on a **first-come, first-served** basis until available funds are allocated or the ending date of the program, whichever comes first - visit [www.pumpefficiency.org](http://www.pumpefficiency.org) or call (800) 845-6038 for more information.*

*California consumers are not obligated to purchase any full fee service or other service not funded by this program. This program is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.*

*Los consumidores en California no estan obligados a comprar servicios completos o adicionales que no esten cubiertos bajo este programa. Este programa esta financiado por los usuarios de servicios públicos en California bajo la jurisdiccion de la Comisión de servicios Públicos de California.*

## The Center for Irrigation Technology

The Center for Irrigation Technology (CIT) developed and manages the Agricultural Pumping Efficiency Program. CIT is dedicated to advancing water and energy management practices and efficient irrigation technology. Located on the campus of California State University, Fresno, CIT functions as an independent testing laboratory, applied research facility and educational resource to both the public and private sectors. For more information, check the CIT link at [www.pumpefficiency.org](http://www.pumpefficiency.org) or call (800) 845-6038 or (559) 278-2066.



# Table of Contents



<b>Introduction .....</b>	<b>i</b>
The Agricultural Pumping Efficiency Program (APEP)	i
APEP Resources	ii
Using this Book	iv



<b>Chapter One - Analyzing Energy Use and Costs .....</b>	<b>1.1</b>
I. How the Program Analyzes Pumping Costs	1.1
II. Why Pumping Efficiency is Important	1.4
III. Why Management of Pumping Systems is Important	1.6



<b>Chapter Two - Education .....</b>	<b>2.1</b>
IV. Know How to Specify an Efficient Pump	2.1
V. Know How to Maintain an Efficient Pump	2.11
VI. Know How Much Water Needs to be Pumped	2.18
VII. Know How Much Water Has Been Pumped	2.32



<b>Chapter Three - Helpful Information .....</b>	<b>3.1</b>
VIII. Glossary of Terms	3.1
IX. Engineering Data	3.8
X. Using the Pumping Energy Calculator	3.10



# The Agricultural Pumping Efficiency Program

The Agricultural Pumping Efficiency Program ("APEP" or "Program") is a comprehensive effort to improve energy efficiency in California's irrigated agriculture. The Program achieves these goals by:

1. Helping to install and maintain high-efficiency irrigation pumping plants in the field.
2. Helping to manage those pumping plants correctly.

The APEP offers:

## 1. Education

Educational seminars concerning pumping plant specifications and maintenance, crop water requirements, and water management are presented throughout the state. The education message has four components, all of which are covered in this book:

- a. Know how to specify an efficient pump.
- b. Know how to maintain an efficient pump.
- c. Know how much water needs to be pumped.
- d. Know how much water has been pumped.



## 2. Technical Assistance

Program personnel are available to help in locating pump efficiency testers, completing a pump retrofit/repair incentive rebate application form, or to answer general questions about pumping plant design and use. Please note that the Program does not offer site-specific engineering services. That is, we cannot help you design and install a specific pumping plant.

## 3. Pump Efficiency Tests

Rebates for pump efficiency tests are paid directly to participating pump test companies. Tests are available for working, electric- or natural gas-powered agricultural water pumps. Note that tests are not available to fulfill requirements of any public or quasi-public agency or in relation to a real estate transaction.



## 4. Incentive Rebates for Pump Retrofits and Repairs

Incentive rebates are available to individuals for retrofit/repair of working electric- or natural gas-powered agricultural water pumps. There are several important eligibility factors for incentive rebates. You are encouraged to talk to a Program representative. Complete information is provided in the APEP application or online at [www.pumpefficiency.org](http://www.pumpefficiency.org).

# APEP Resources

The Agricultural Pumping Efficiency Program has a variety of resources available at no charge.

## 1. Regional Offices and Toll-Free Assistance

The Program maintains offices throughout the state and provides toll-free assistance.

- ✓ Main Office - (800) 845-6038
- ✓ San Joaquin Valley - (800) 352-0434
- ✓ Northern California - (866) 333-8938
- ✓ Southern California - (866) 333-8939
- ✓ Central Coast - (866) 473-0847

## 2. Web Sites

The Program maintains on-line resources that can provide valuable information on water and energy savings.

- ✓ [www.pumpefficiency.org](http://www.pumpefficiency.org)

The Program web site provides summaries of all program components, a calendar of upcoming events, application forms, phone numbers, contact information, and a knowledge base. Here you can type in a word or phrase and a list of technical papers will be presented that pertain to that word or phrase. For example, you may type in “irrigation efficiency.” Several papers will be presented that define irrigation efficiency, tell how it can be measured in the field, and how you can improve your efficiency.

- ✓ [www.wateright.org](http://www.wateright.org)

This interactive web site provides the tools to develop site-specific, seasonal irrigation schedules. The site also contains educational material and reference data on water and energy management including CIMIS crop water use data.

## 3. Seminars

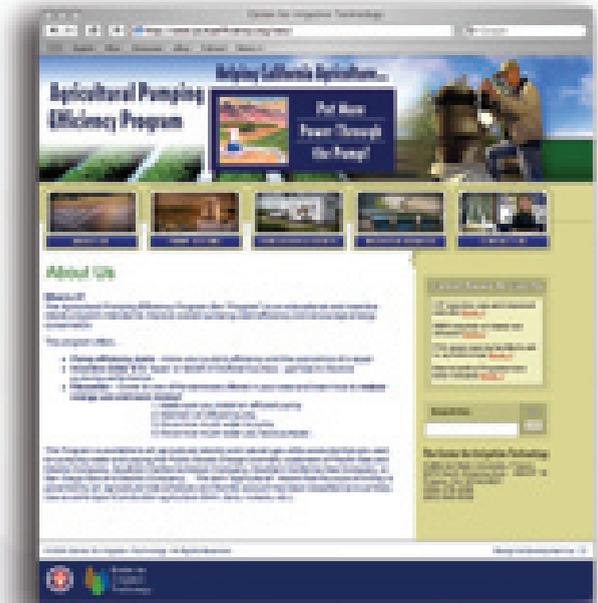
APEP offers seminars throughout California. Most of these seminars come to you via the Mobile Education Centers. Others are provided at fixed sites. Dates and locations of upcoming events are listed on the web site or you can call one of the offices to find out when a seminar will be presented in your area. All seminars are free of charge.

- ✓ **On-Site Seminars with Mobile Education Centers (MEC)**

The Program brings educational seminars to farmers in the field using two Mobile Education Centers. These are enclosed trailers with self-contained pumping plants. They are used to introduce the basic concepts of pump performance and how to specify and maintain an efficient pump. They travel around the state and are used to present educational seminars of various lengths and on different subjects.

- ✓ **Seminars at Pump Demonstration Facilities in Fresno and Chico**

Demonstration and calibration facilities are located at California State University, Fresno and California State University, Chico. These facilities are located next to fields so they can be used to demonstrate irrigation efficiency concepts as well as pumping efficiency.



## 4. Written Materials

The Program distributes several types of written materials including this book and the **Pumping Energy Calculator**. Individual brochures are available providing summary discussions of pump efficiency, flow meters, irrigation planning, specifying an efficient pump and education. Call one of our offices to have materials mailed directly to you or visit our web site at [www.pumpefficiency.org](http://www.pumpefficiency.org) for downloadable PDF versions.

### How Can a Company or Group Participate?

The Program is actively seeking partners to present the message of pumping efficiency to California agriculture. We can be part of one of your scheduled short courses or other events. You can also be part of one of our scheduled seminars. The Program message can be presented in whole or in part, and over any time frame – from one hour to two days (we prefer at least a two-hour time block).

In addition to the four main education components discussed previously, we can present concentrated sessions on various subjects such as variable frequency drives, obtaining and interpreting a pump efficiency test, seasonal irrigation scheduling, and evaluation of irrigation system performance. Call us if you have a specific topic of interest.



# Using This Book

## What is the Purpose of this Book?

The main purpose of this book is to present the four-point educational component of the Program. It also contains summary presentations of what is an efficient pumping plant and how correct management of those plants can save money for pump owners and operators.

The intent of this book is not to present a technical discussion of hydraulic science or the design of pumping plants. Rather it is intended for the layperson who wants to know what questions to ask in order to obtain, maintain, and manage efficient pump systems.

The approach of this book may appear to be unconventional to some. However, the Program has chosen this approach in order to effectively communicate with managers in the field who must make important decisions every day regarding energy use.

## Who is the Intended User of this Book?

All owners or users of an agricultural electric or natural gas utility account used to pump water, who are paying the Public Goods Charge, are eligible to participate in the Program. Typically, this includes customers of the major investor-owned utilities (i.e. Pacific Gas & Electric, Southern California Edison, etc.) The term "agriculture" means that account billing is governed by an agricultural rate schedule and the account is classified as primary production agriculture use. This would include farms, dairies, nurseries, turf farms, livestock, and cut flower operations. However, anyone who operates a pumping plant, regardless of where or how he or she purchases energy (or what type of energy - electricity, natural gas, or diesel), may be interested in the information presented in this book.

For the most part this book discusses electrical energy use. However, most of the concepts are directly applicable to natural gas users. Please contact the Program if you have questions specific to natural gas use.

## How is the Book Organized?

The book contains chapters, with several sections within each chapter.

### Chapter One - Analyzing Energy Use and Costs

Chapter One is the most technical part of this book. The sections in this chapter present how the Program analyzes energy efficiency in agriculture, and provide examples indicating why efficient hardware and proper management are important. They include:

- I. How the Program Analyzes Pumping Plant Costs - Section I introduces several equations that indicate the options for lowering pumping costs. You will see that the four main options for lowering pumping costs are:
  1. Reduce unit cost of energy - the dollars paid per therm of natural gas, gallon of diesel, or kilowatt-hour of electricity.
  2. Reduce required system pressures.
  3. Increase pumping plant efficiency.
  4. Improve pumping plant management.



- II. Why Pumping Efficiency is Important - Section II demonstrates the cost savings available from improving overall pumping plant efficiency.
- III. Why Management of Pumping Plants is Important - Section III builds on Section II by showing what happens if an efficient pump is not operated correctly.

### Chapter Two - Education

This part of the book provides individual discussions of the four parts of the Program's education message. Each section contains an overview of the message and the full text of individual brochures written for the Program. They include:

- IV. Know How to Specify an Efficient Pump - Section IV discusses the basics of pumping technology. It introduces the pump operating conditions, the pump performance curve, the components of overall pumping plant efficiency, different pump types, different power sources, and the variable frequency drive for electric-powered pumps.
- V. Know How to Maintain an Efficient Pump - Section V's emphasis is not on the "janitorial" aspects of pump maintenance. Rather it is using regular pump efficiency tests to tell you if the pump's operating condition has deteriorated or the required pump operating conditions have changed.
- VI. Know How Much Water Needs to be Pumped - water pumping for irrigation is discussed with emphasis on the individual irrigation. Every irrigation should have a purpose - to put a specific amount of water into a specific volume of soil. The **Pumping Energy Calculator**, which accompanies this book, is introduced. The calculator estimates required pumping hours per irrigation.
- VII. Know How Much Water Has Been Pumped - you need to measure water to properly manage water. Different flow meters are introduced, along with the installation requirements that result in accurate measurements of water flow rates and total water volume pumped.



### Chapter Three - Helpful Information

These sections contain information that will be helpful in understanding the book, as well as a summary of how to use the **Pumping Energy Calculator**.

- VIII. Glossary of Terms - Section VIII contains simple definitions of commonly used terms in pumping.
- IX. Engineering Data - Section IX contains common engineering constants and unit conversions used in agricultural pumping.
- X. Using the **Pumping Energy Calculator** - Section X contains examples of how to use this valuable management tool to calculate required pumping horsepower, the actual cost of pumping, required gross water application, and required hours of pumping for three common irrigation system types.