

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 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 or call (800) 845-6038 or (559) 278-2066.



Center for
Irrigation
Technology

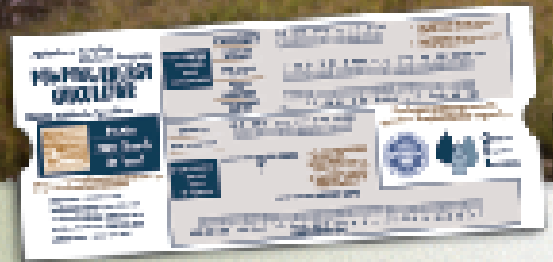
Development and management of the
Agricultural Pumping Efficiency Program by:

The Center for Irrigation Technology

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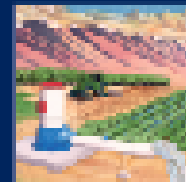
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Agricultural Pumping Efficiency Program



The Pumping Energy Calculator

Helping California...



Put More
Power Through
the Pump!



This brochure provides examples of how to use the Pumping Energy Calculator. There are six sections of the Calculator and the examples correspond with these sections.

1 Calculating Required Input Horsepower

This section solves the following equation:

$$\text{HPin} = \text{Flow} \times \text{TDH} / (39.60 \times \text{OPE})$$

Where: HPin = required input horsepower
 Flow = pump flow rate in gallons per minute
 TDH = total dynamic head in feet of water head (ft)
 39.60 = a constant
 OPE = overall pumping plant efficiency

Example: Flow = 1,000 gpm
 TDH = 100 feet
 OPE = 50%

Follow these steps:

1. Set the **Pump Flow Rate** at the **Overall Pumping Plant Efficiency** – slide the scale so that 1,000 gpm is under 50% OPE.
2. Read the **Required Input Horsepower** at the **Total Dynamic Head**. Read 50 HP at 100 feet.

IMPORTANT!

Make sure you use the appropriate TDH scale, either Feet of Water Head (the upper scale, see ft) or Pounds per Square Inch (the lower scale, see psi).

C) Furrow, Flood and Low Frequency Field Sprinkler Irrigation

This section solves the equation:

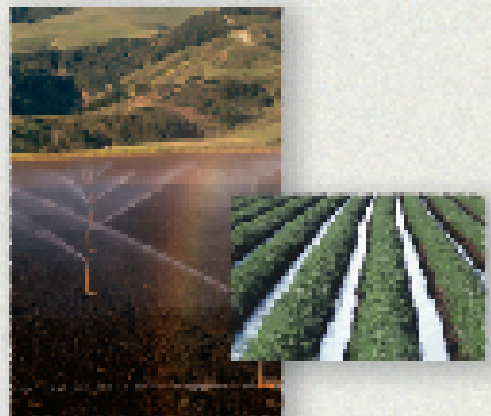
$$\text{Hours} = \text{Gross} \times \text{Acres} \times 452.5 / \text{Pump flow}$$

Where: Hours = required hours of pumping for the irrigation
 Gross = gross depth of water to apply
 Acres = acres irrigated
 452.5 = a constant
 Pump flow = pump flow in gallons per minute

Example: GPM Depth to Apply = 4 inches
 Acres in Field = 50 acres
 Pump Flow = 1,000

Follow these steps:

1. Set the **Gross Depth of Water to Apply** under the **Pump Flow Rate** – slide the scale so that 4 inches is under 1,000 gpm.
2. Read the **Required Hours of Pump Operation** for the entire irrigation above the **Acres in the Field** – read approximately 90 hours for the total irrigation above 50 acres.



B) Standard Micro Irrigation

Note that square feet per tree/vine refers to the square foot of field per tree or vine. For example, almonds on a 24 x 24 spacing have 576 square feet per tree.

This section solves the equation:

$$\text{Hours} = \text{Gross} \times \text{Area} \times .623/\text{GPH}$$

Where: Hours = required hours of pumping for a set
Gross = gross depth of water to apply
Area = square foot of field per tree or vine
.623 = a constant
GPH = total gallons per hour supplied to each tree or vine

Example: Gross = .5 inches
Area = 360 square feet per tree
GPH = 8 gph per tree

Follow these steps:

1. Set the **Gross Depth of Water to Apply** under the **Gallons Per Hour Per Tree/Vine** – slide the scale so that .5 inches is under 8 gph.
2. Read the **Required Hours of Pump Operation Per Set** above the **Area Per Tree/Vine** – read approximately 14 hours per set above 360 square feet.

Calculating Energy Costs of Pumping

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This section calculates the energy cost per acre-foot pumped. Note that this is the cost of energy only.

IMPORTANT!

This section calculates the cost of energy only. Demand charges and any other services costs are not included.

Example: Flow = 1,000 gpm
Input Horsepower = 50
Cost/kWh = \$.15

Follow these steps:

1. Set the **Input Horsepower** under the **Cost/kWh** – slide the scale so that 50 HP is under .15 \$/kWh.
2. Read approximately \$5.50 **Energy Cost Per Hour Pumping** at the arrow.
3. Read approximately \$30 **Energy Cost Per Acre-Foot Pumped** above 1,000 gpm **Pump Flow Rate**.

WATERIGHT for Seasonal Irrigation Scheduling

The Pumping Energy Calculator can be used to estimate the number of pumping hours required for individual irrigations. An important piece of required information is the gross depth of water to apply. It is always best to use one of many available methods for checking soil moisture depletions to directly measure this at the time of irrigation. However, seasonal irrigation scheduling can help you anticipate irrigations and provide a check on the estimates for net water required.

The **WATERIGHT** web site (www.wateright.org) will help you to develop a normal, seasonal irrigation schedule for either low frequency or high frequency systems. This site is dedicated to improved water management. There is a link to the **WATERIGHT** site from the Agricultural Pumping Efficiency Program's web site, www.pumpefficiency.org.

WATERIGHT also contains information on how you might be able to improve your irrigation system's performance.

3 Calculating the Gross Depth of Water to Apply

This section calculates the gross depth of water required for an irrigation given the net requirement and an irrigation efficiency. It solves the equation:

$$\text{Gross} = \text{NET}/\text{IrrEff}$$

Where: Gross = gross water application required
 Net = water required by the irrigation
 IrrEff = irrigation efficiency as a decimal (0 - 1.0)

IMPORTANT!

You need to use the individual field irrigation efficiency. It may well be that some of the gross water applied ends up as surface runoff (or even deep percolation) that is used on another field. However, for the purpose of determining how much water has to be applied to a particular field, you must use its irrigation efficiency.

Example: Net Depth Required = 2.1 Inches
 Irrigation Efficiency = 70%

Follow these steps:

1. Set the **Net Depth Required** under the **Irrigation Efficiency** – slide the scale so that 2.1 inches is under 70%.
2. Read 3.0 inches as the **Gross Depth of Water to Apply** at the arrow.

Note that you can also work backwards to check on your apparent irrigation efficiency. For example, if you knew how much water was actually applied, and how much you needed, you could calculate your apparent irrigation efficiency.

Example: Net Depth Required = 2.1 inches
 Gross Depth Applied = 4.4 inches

Follow these steps to estimate your apparent irrigation efficiency:

1. Set the **4.5 inches** (the gross depth applied) at the arrow.
2. Read **47% Irrigation efficiency** above 2.1 inches **Net Depth Required**.

(When using the calculator in this manner you can ask yourself whether 47% irrigation efficiency is acceptable.)



Calculating Required Hours of Pump Operation

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These three sections provide you with estimates of required pumping hours given a gross depth of water to apply, an irrigated area, and a pump flow rate. As with the previous example, you can work backwards with any of these scales to calculate the **Gross Depth Applied** if you know the hours of pumping and the various measures of field area.

A) Row Crop Drip Irrigation

This section solves the equation:

$$\text{Hours} = \text{Gross} \times \text{Spacing} \times .0866/\text{GPM100}$$

Where: Hours = required hours of pumping for a set
 Gross = gross depth of water to apply
 Spacing = spacing of drip tape in the field in inches
 .0866 = a constant
 GPM100 = flow rate of the drip tape in gallons per minute per 100 feet of tape

Example: GPM per 100' of Tape = .33
 Gross Depth = .5 inches
 Drip Tape Spacing = 40 inches

Follow these steps:

1. Set the **Gross Depth of Water to Apply** under the **Gallons Per Minute Per 100' of Tape** – slide the scale so that .5 inches is under .33 gpm/100'.
2. Read the **Required Hours of Pump Operation Per Set** above the **Drip Tape Spacing** – read approximately 5.25 hours per set above 40 inches **Drip Tape Spacing**.