Basics of Overall Pump Efficiency and Cost to Move Water

Presented by Bill Green, Center for Irrigation Technology at Fresno State

2/07/18

FRESNO STATE

Center for Irrigation Technology

Pacific Gas and Electric Company®

presents

Advanced Pumping Efficiency Program 2018- 19

-Subsidized Pump Efficiency Tests

-Incentives for Pump Retrofit/ Replacement

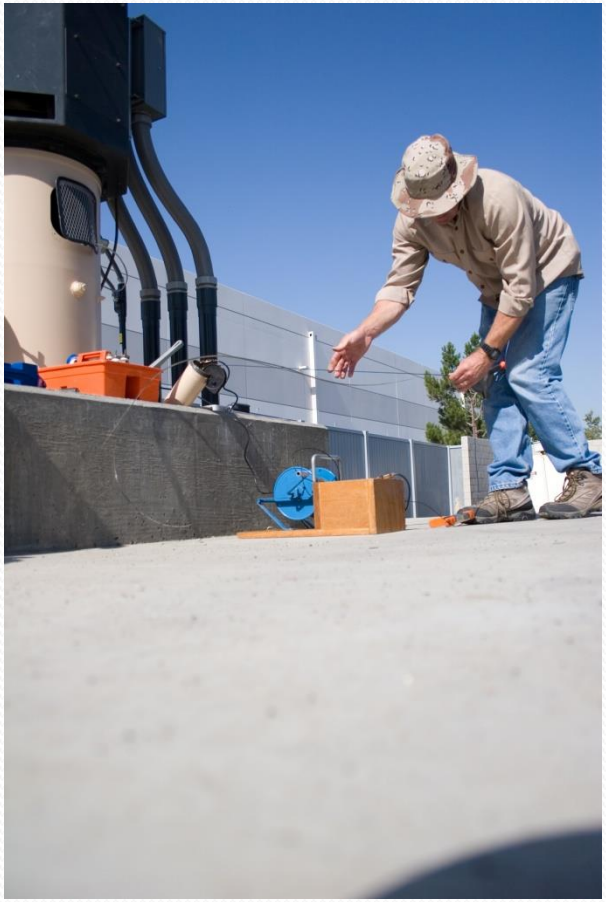
APEP

ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE

Center for Irrigation Technology

APEP offers…



1. Subsidized pump efficiency tests- always start with getting a pump test- 25+ HP
   - 2- 4 years since last test- $100 subsidy
   - 4+ years since last test- $200 subsidy
2. Incentives for pump retrofit/ repair > 25 HP
3. Technical Assistance
4. Education

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

APEP Energy Efficiency

- APEP- Advanced Pumping Efficiency Program managed by CIT for PG&E
- Over 40,000 pump efficiency tests performed
  - Overall state average OPE- 53%
  - Average OPE after repair- 63%
  - One third of the pumps tested are under 50% which is considered poor
- Millions of incentive dollars sent to farmers for increasing their OPE
- On average, pump efficiency is increased 30% under APEP, resulting in a decrease on the electric bill of 30% with the same flow and pressure output

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

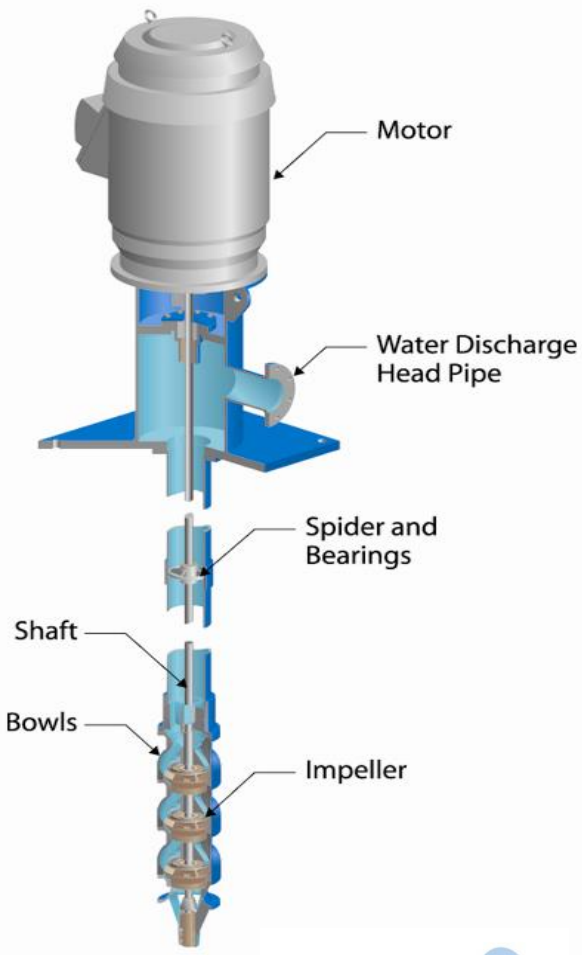
Overall Pump Efficiency- OPE

- Overall Pump Efficiency is a measurement of the power into the pumping plant versus the water power coming out of the pumping plant
- Often referred to as “Wire to Water” (power supplied from the electric wire to the pump to flow and Total Dynamic Head or Total Lift (pressure) of the pump while operating
- Sometimes also called “HPin/HPout”

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

OPE is a Combination of Efficiencies…



- Motor Efficiency – 88-95%
- Transmission Efficiency – 90-97%
- Bowl Efficiency – 60s – mid 80s

Thus, OPE = ME x TE x BE

<u>Good OPE</u>:

.67 (67%) = .93 x .96 x .75

<u>Poor OPE</u>:

.46 (46%) = .93 x .96 x .52

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

We can calculate "wire to water" pump efficiency using flow rate, TDH and kW from the SmartMeter or from a power meter attached to the pump panel…

APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Watch the Smart meter scroll through the readings…

1. First reading isn't used
2. 2nd reading is kwH. This is the total kW's X hours accumulated
3. 3rd reading is kW or real time power consumption
4. kWin X 1.34 = HPin or

   HPin X .746 = kWin

APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Calculating OPE from your readings…

$$\text{Hpin} = \frac{\text{Flow X TDH}}{\text{3960 X OPE}}$$

so….

$$\text{OPE} = \frac{\text{Flow X TDH}}{\text{3960 X HPin}}$$

kW X 1.34 = HPin

(Ex. 50 kW X 1.34 = 67 HPin

APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

OPE equation…

$$OPE = \frac{Flow \times TDH}{3960 \times HPin}$$

Flow- 800 GPM (from a flow meter)

TDH- 300 feet (sound well to know pumping water level- PWL plus discharge psi X 2.31)

Hpin- 100 (74.6 kW on the meter X 1.34)

$$\frac{800 \times 300}{3960 \times 100} \quad \text{or} \quad \frac{240{,}000}{396{,}000} = \mathbf{.61\ OPE\ or\ (61\%)\ OPE}$$

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

The cost/ acre foot to move agricultural water using electric powered pumps…

kWh/acre foot = 1.0241 X TDH/ OPE

kWh- kilowatt hours (Energy from the Meter)

TDH- Total Dynamic Head (Total lift of the pump in feet from water source + discharge pressure X 2.31)

OPE- Overall Pump Efficiency (Wire to Water)

You'll notice there's no flow rate in equation.

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

Example kWh/ ac ft

kWh/ ac ft = 1.0241 X TDH/ OPE

1.0241 - Constant

TDH - 300 feet (200 feet lift from well water source + 43 psi discharge X 2.31= 100 feet) **200 + 100 = <u>300 feet</u>**

OPE - **<u>60% or .60</u>**

kWh/ ac ft = 1.0241 X **300 ft/ .60** OPE

<u>512.1 kWh/ ac ft</u>

512.1 kWh X $.18 (estimated off- peak cost for electricity)= **$92.18/ ac ft (off peak)**

512.1 kWh X $.44 (estimated on- peak cost for electricity) = **$225.32/ ac ft (on peak)**

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

If you don't know your TDH, you can still get the cost to pump water per acre foot if you have an accurate flow meter…

Get your flow rate from your flow meter.

Example- 700 GPM

700 GPM X 60 minutes = 42,000 GPH

There is 325,851 gallons in one acre foot

325,851/ 42,000 = **7.76 hours of pumping for one acre foot**

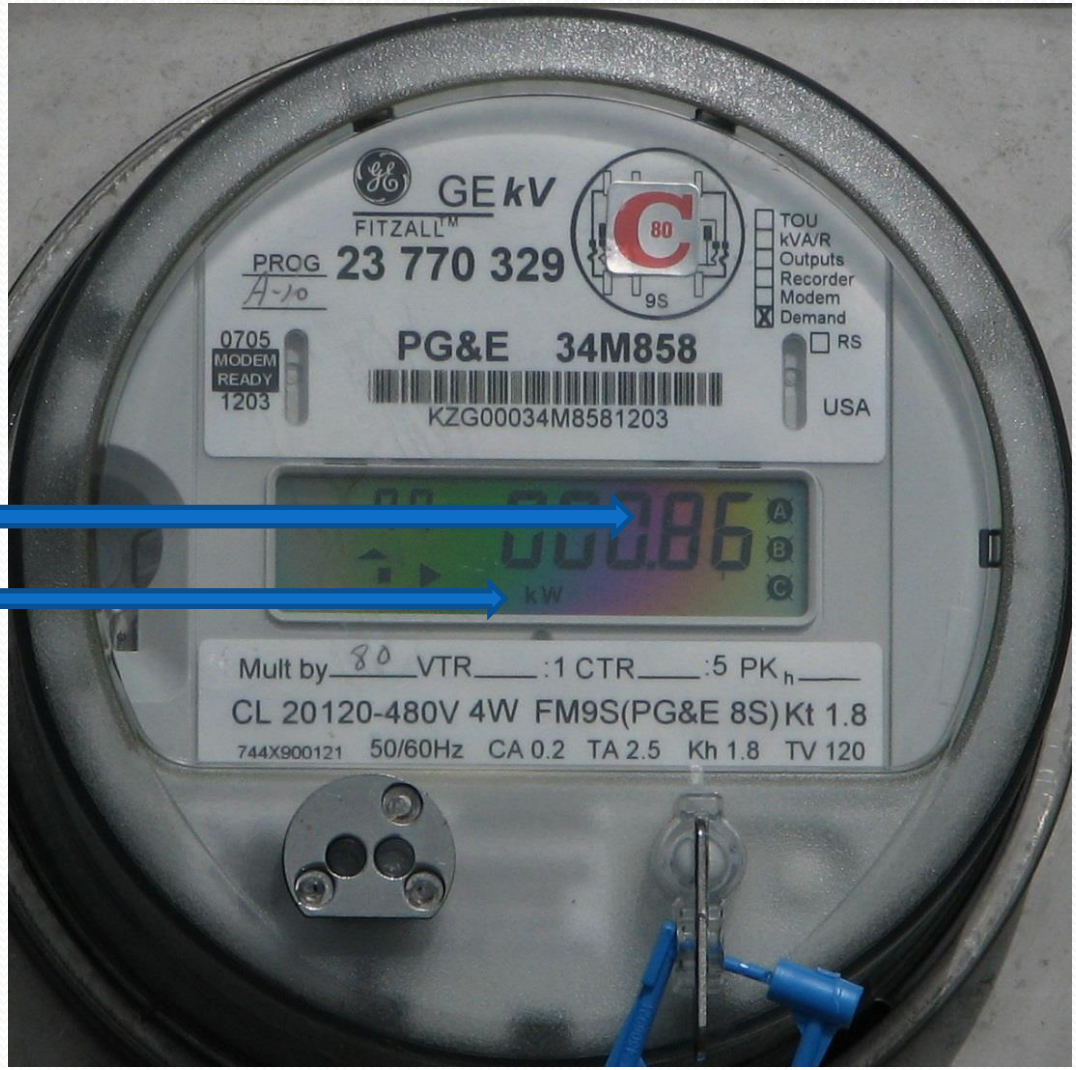
APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Next, read your SmartMeter

Let it scroll through kWh to kW like this example meter on the right that says 000.86 kW (.86)

(kW)



APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Smart Meter Mult by kW reading….

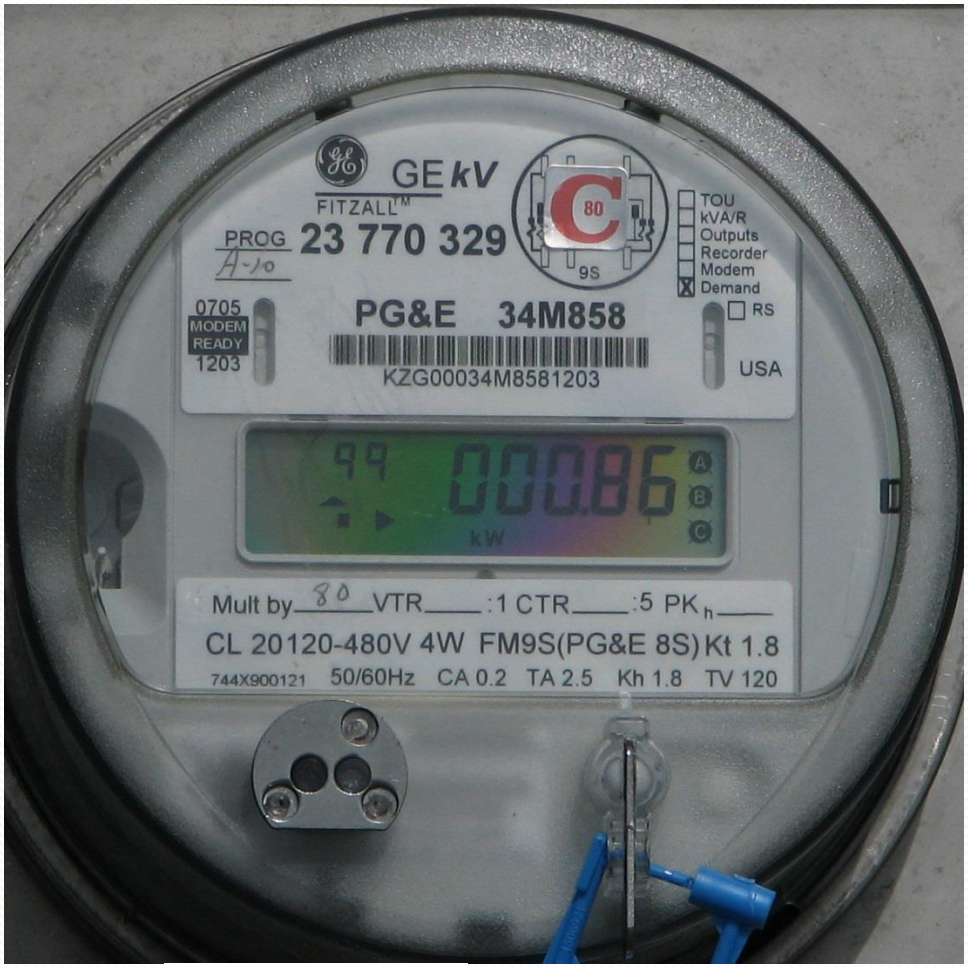
- The kW reading is 000.86 kW
- The Mult by is <u>80</u>
- <u>.86 X 80 = **68.8 kW**</u>

(68.8 kW X 1.34 = 92.2 Hpin)

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Cost to run this pump for one hour…



- 68.8 kW X $.18/ kWh (kilowatt hour) = **$12.38** per hour of run time (off-peak, rate varies by rate schedule, check your bill!!)
- You run this pump at 68.8 kW for one hour, your power bill at $.44/ kwH = **$30.27** (on- peak, rate varies by rate schedule, check your bill!!)

APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology

Cost to pump one acre foot of water…

Ex. 1

1. Off- peak cost for one hour of pumping is **$12.38**
2. Amount of hours to pump one acre foot is **7.76**
3. **$12.38 X 7.76 = $96.07** to pump one acre foot of water off- peak

Ex. 2

1. On- peak cost **$30.27**
2. **7.76** hours
3. **$30.27 X 7.76 = $234.90 (OUCH!!!)**

APEP ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE Center for Irrigation Technology

Cost per kWh varies by rate schedule, check your bill, talk to your electric utility

The example given previously were only estimates and possible cost per kWh, check your power bill. There are different rate schedules for agriculture.

Go on pge.com to make sure you have the best rate for your pump….

Thank you.

APEP
ADVANCED PUMPING EFFICIENCY PROGRAM

FRESNO STATE
Center for Irrigation Technology