COOPERATIVE EXTENSION
UNIVERSITY OF CALIFORNIA

ECONOMICS

SUBJECT: Irrigation Pumping Costs

DATE: September 1976

ESTIMATING ELECTRIC POWER COST FOR PUMPING IRRIGATION WATER
P.G. & E. AGRICULTURAL POWER SCHEDULE

You can compute the electric power cost for pumping under any set of conditions by using these formulas and the applicable rate schedule. On the reverse side of this sheet we show some sample costs computed for four rates of pumping with several pumping lifts and different levels of use at 65% overall efficiency and at the PA 1 schedule shown below.

FORMULAS

Efficiency of pumping plant

$E_o = E_p \times E_m$

E_p = Efficiency of pump

E_m = Efficiency of motor

E_o = Overall efficiency

Power Required to Pump 1 Ac. Ft.

$$Kwh = 1.024 \frac{H}{E_o}$$

Kwh = Kilowatt hours

H = Head of total feet of lift

E_o = Overall efficiency expressed as a decimal

Size of Motor Required

$$HP. = \frac{G.P.M. \times H}{3960 \times E_p}$$

G.P.M. = pump discharge in gallons per minute

E_p = efficiency of pump expressed as a decimal

H = head in feet

H.P. = horsepower output of motor

EXAMPLE

800 G.P.M. 120 ft. head

E_p = .62, E_o = .55, 500 Ac. Ft. pumped

$$Kwh = \frac{1.024 \times 120}{.55} = 223 \text{ Kwh per Ac. Ft.}$$

Total Kwh used each year

500 x 223 = 111,500 Kwh

$$HP = \frac{800 \times 120}{3960 \times .62} = 39.1$$

Power cost at schedule below

Service, 40 hp.	@ $15 plus $288	$303.00
Energy 40,000 Kwh	@ $ 1.90	760.00
40,000	@ $ 1.23	492.00
31,500	@ $ .84	264.60
Total 111,500		$1,819.60
1/Energy cost adjust. 111,500	@ $.816	909.84
2/Less fuel coll. bal. adj. 111,500	@ $.042	-46.83
	Total	$2,682.61
	Per Acre Foot	5.37

P.G. & E. Agricultural Power Schedule PA 1 - Effective June 15, 1976

Connected Load hp	Monthly Service Charge	Energy charge in addition per Kwh: First 1000 Kwh per hp	Next 1000 Kwh per khp	All over 2000 Kwh per hp
2 - 4.9	$ 0 + $.75 per hp or kw	2.10¢	1.23¢	.84¢
5 - 14.9	.50 + $.65 per hp or kw	1.90	1.23	.84
15 - 49.9	1.25 + $.60 per hp or kw	1.90	1.23	.84
50 - 99.9	6.25 + $.50 per hp or kw	1.76	1.23	.84
100 - 249.9	8.25 + $.48 per hp or kw	1.68	1.23	.84
250 - 499.9	13.25 + $.46 per hp or kw	1.64	1.23	.84
500 & over	28.25 + $.43 per hp or kw	1.58	1.23	.84

1/Energy cost adjustment is a product of the total kilowatt hours used times .816¢ per Kwh. This product is to be added to each bill.

2/Fuel collection balance adjustment is a product of the total kilowatt used times .042¢ per Kwh. This product is to be subtracted from each bill.

The University of California's Cooperative Extension Programs are available to all, without regard to race, color, or national origin.
Cooperative Extension work in Agriculture and Home Economics. United States Department of Agriculture and University of California cooperating.

ELECTRIC POWER COST FOR PUMPING, BASED ON P.G. & E. POWER SCHEDULE PA-1 (June 15, 1976)

With 65% overall efficiency and a single pumping plant

Total head in feet			25	50	75	100	125	150	175	200	250	300
Kwhr. required per acre foot			39	79	118	158	197	236	276	315	394	473
Pump delivering 450 gallons per minute, 1 cu. ft. per second, 1 acre-inch per hour, 2 acre-feet per 24 hour day												
Size motor required, hp.												
Acre-feet pumped	Hours	24-hour days	power cost per acre-foot including annual service charge									
100	1200	50	$1.49	$2.73	$4.39	$5.40	$6.86	$8.26	$9.16	$10.63	$13.57	$15.74
200	2400	100	1.17	2.14	3.48	4.25	5.41	6.54	7.24	8.41	10.75	12.68
300	3600	150	.93	1.86	3.04	3.70	4.68	5.67	6.31	7.30	9.30	11.07
400	4800	200	.86	1.71	2.76	3.40	4.30	5.20	5.85	6.75	8.57	10.21
500	6000	250	.81	1.62	2.59	3.23	4.08	4.92	5.57	6.42	8.13	9.69
Pump delivering 900 gallons per minute, 2 cu. ft. per second, 2 acre-inches per hour, 4 acre-feet per 24-hour day												
Size motor required, hp.			7 1/2	15	25	30	40	50	50	60	75	100
Acre-feet pumped	Hours	24-hour days	power cost per acre-foot including annual service charge									
200	1200	50	1.36	2.70	4.13	5.33	6.78	7.86	8.73	10.08	12.51	14.98
400	2400	100	1.06	2.13	3.27	4.22	5.38	6.33	7.03	8.14	10.13	12.29
600	3600	150	.92	1.84	2.83	3.66	4.65	5.53	6.17	7.12	8.87	10.81
800	4800	200	.85	1.70	2.60	3.38	4.28	5.10	5.74	6.61	8.24	10.02
1000	6000	250	.80	1.62	2.46	3.22	4.06	4.84	5.48	6.31	7.87	9.54
Pump delivering 1350 gallons per minute, 3 cu. ft. per second, 3 acre-inches per hour, 6 acre-feet per 24-hour day												
Size motor required, hp.			15	25	40	50	60	75	100	100	125	150
Acre-feet pumped	Hours	24-hour days	power cost per acre-foot including annual service charge									
300	1200	50	1.45	2.76	4.17	5.25	6.44	7.73	9.02	9.98	12.40	14.82
600	2400	100	1.15	2.19	3.32	4.23	5.20	6.27	7.41	8.19	10.20	12.21
900	3600	150	1.01	1.89	2.89	3.69	4.54	5.48	6.57	7.20	8.98	10.75
1200	4800	200	.91	1.74	2.63	3.41	4.20	5.07	6.04	6.67	8.32	9.97
1500	6000	250	.86	1.65	2.49	2.24	3.99	4.81	5.72	6.35	9.33	9.51
Pump delivering 1800 gallons per minute, 4 cu. ft. per second, 4 acre-inches per hour, 8 acre feet per 24-hour day												
Size motor required, hp.			15	30	50	60	75	100	100	125	150	200
Acre-feet pumped	Hours	24-hour days	power cost per acre-foot including annual service charge									
400	1200	50	1.34	2.66	3.93	5.05	6.25	7.48	8.34	9.77	11.99	14.73
800	2400	100	1.06	2.11	3.16	4.08	5.06	6.14	6.84	8.03	9.87	12.17
1200	3600	150	.91	1.83	2.76	3.57	4.44	5.40	6.04	7.05	8.72	10.73
1600	4800	200	.84	1.69	2.55	3.31	4.12	5.00	5.65	6.56	8.11	9.95
2000	6000	250	.80	1.61	2.42	3.16	3.93	4.76	5.41	6.26	7.76	9.49

L. A. Horel
Research Associate

A. D. Reed
Extension Economist