

Irrigation Energy Options and Considerations

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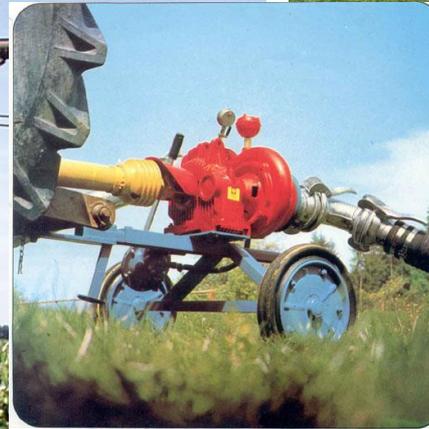
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<https://www.canr.msu.edu/irrigation/>

Power Options to Run Your Irrigation System



Irrigation power cost vary on:

- power source
- power cost
- system pressure

Average fuel cost for pumping NE. USA: 2016
Cost per acre inch of irrigation water

Energy source Pressure	Electric	Diesel / propane
Low <35 psi	\$1.76	\$2.56 / 2.30
Med. 35 to 95 psi	\$2.48	\$3.76 / 3.27
High >100psi	\$ 3.56	\$ 4.87 / 3.90

Day to Day Power Operation Costs

Gasoline (\$/gallon)	Diesel (\$/gallon)	Propane (\$/gallon)	Electricity (kw-hr)
1.00	1.31	.79	10.4
1.10	1.44	.87	11.4
1.20	1.57	.95	12.5
1.30	1.70	1.03	13.5
1.40	1.83	1.11	14.6
1.50	1.97	1.19	15.6
1.60	2.10	1.26	16.7
1.70	2.23	1.34	17.7
1.80	2.36	1.42	18.7
1.90	2.49	1.50	19.8
2.00	2.62	1.58	20.8
2.10	2.75	1.66	21.8
2.20	2.88	1.74	22.8
2.30	3.01	1.82	23.9
2.40	3.14	1.90	25.0
2.50	3.27	1.98	26.0
2.60	3.40	2.06	27.0
2.70	3.53	2.13	28.1
2.80	3.67	2.22	29.1
2.90	3.80	2.29	30.1
3.00	3.93	2.37	31.2
3.10	4.06	2.45	32.2
3.20	4.19	2.53	33.2
3.30	4.32	2.61	34.3
3.40	4.55	2.69	35.3

Table 2. Comparative Costs of Various Energy Sources to Obtain Equal Work Output per Dollar Spent

Adapted from AE-111
 “Comparable Costs of Various Energy Sources for Irrigation Pumping”

Power Options

- All Electric System
 - electric to power the pump
 - electric to drive irrigation unit

Do you have access to a 3-phase, 480V power line?



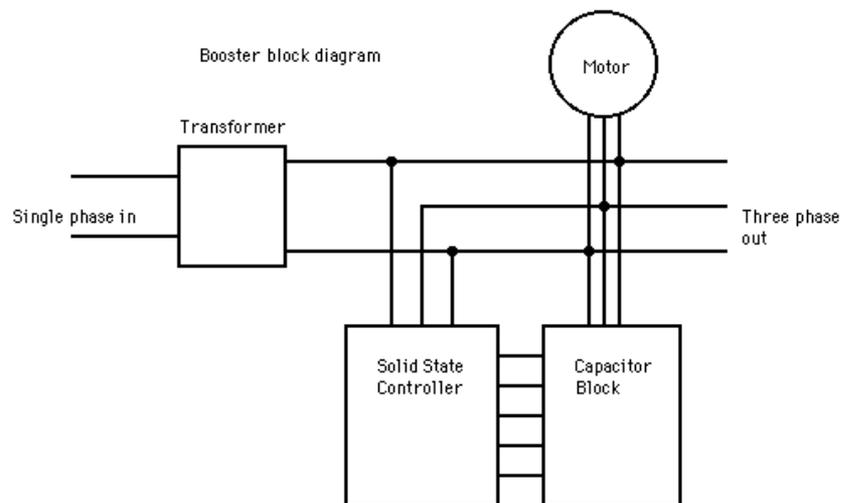
Variable Frequency Drives

- Common for 20 Hp and less
- Recently 50+ Hp have been marketed
- Allows an effective use of portion of the total out put.
(cornering arm, low psi /high psi combinations)
- Can be fed single phase powered to create 3 phase
- Takes an additional 5% energy at full output.
- Programing for slow start-up minimize brown out issues for power company.



Phase Converters

- Single phase to 3-phase conversion
- Used to drive pump and pivot or just pivot.
- Slow start-up minimize brown out issues for power company.



All Engine Power System

Engine power to pump water

Commonly used with High psi

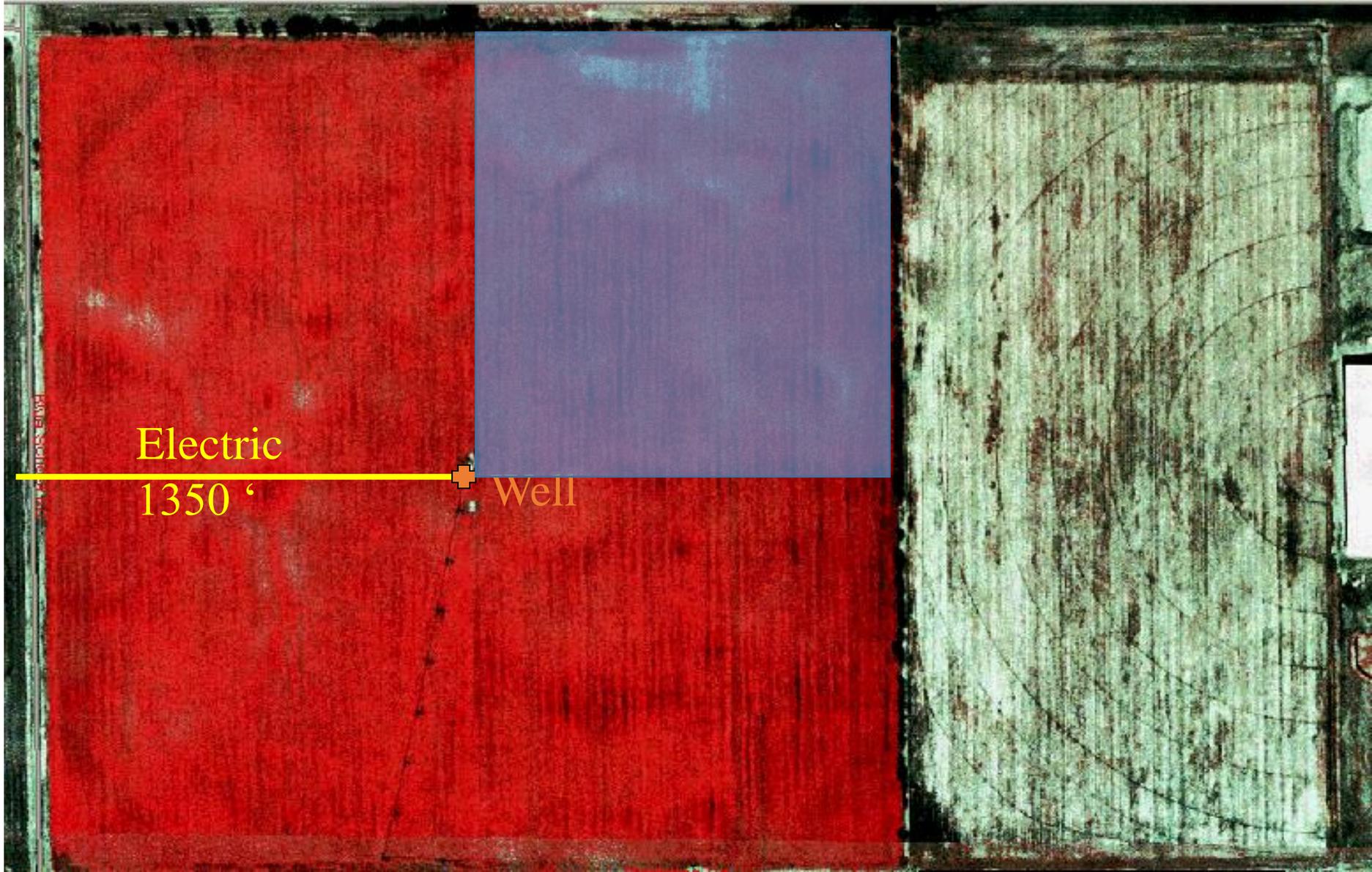
- Solid set irrigation units
- Soft hose & hand hose irrigation units (water drive)

Engine powers 3 phase, belt driven generator or hydraulic pump to drive pivots.



Example- All Electric System

100 acres, 750 gpm, 45 psi.



Example- All Electric System

100 acres, 750 gpm, 45 psi.

	Cost	Salvage value
Electric Co. install fee	\$1,750	0
200 amp disconnect	\$500	\$100
1350' buried electric cable * \$2.50 per ft.	\$3,375	0
Well panel	\$1,000	\$250
40 hp pump	\$3,000	\$1,000
Totals	\$9,625	\$1,350

Estimating Annual Irrigation Operation Costs

100 Acre Water Supply – 3 phase electric pump

Annual Ownership Cost

Depreciation: $(\text{original cost} - \text{salvage value}) / \text{years of use} = \506

Interest: $\text{interest rate} * \text{average investment value} = \303

Repair: estimated to between 2 to 5% of original cost = \$80

Taxes: personal property tax: Michigan – no, Indiana = \$96

Insurance: estimated at 0.5% * Average Investment Value = \$48

Total Ownership Cost = \$1,034

Operating Cost (total actual annual cost / 100 acre * 7")

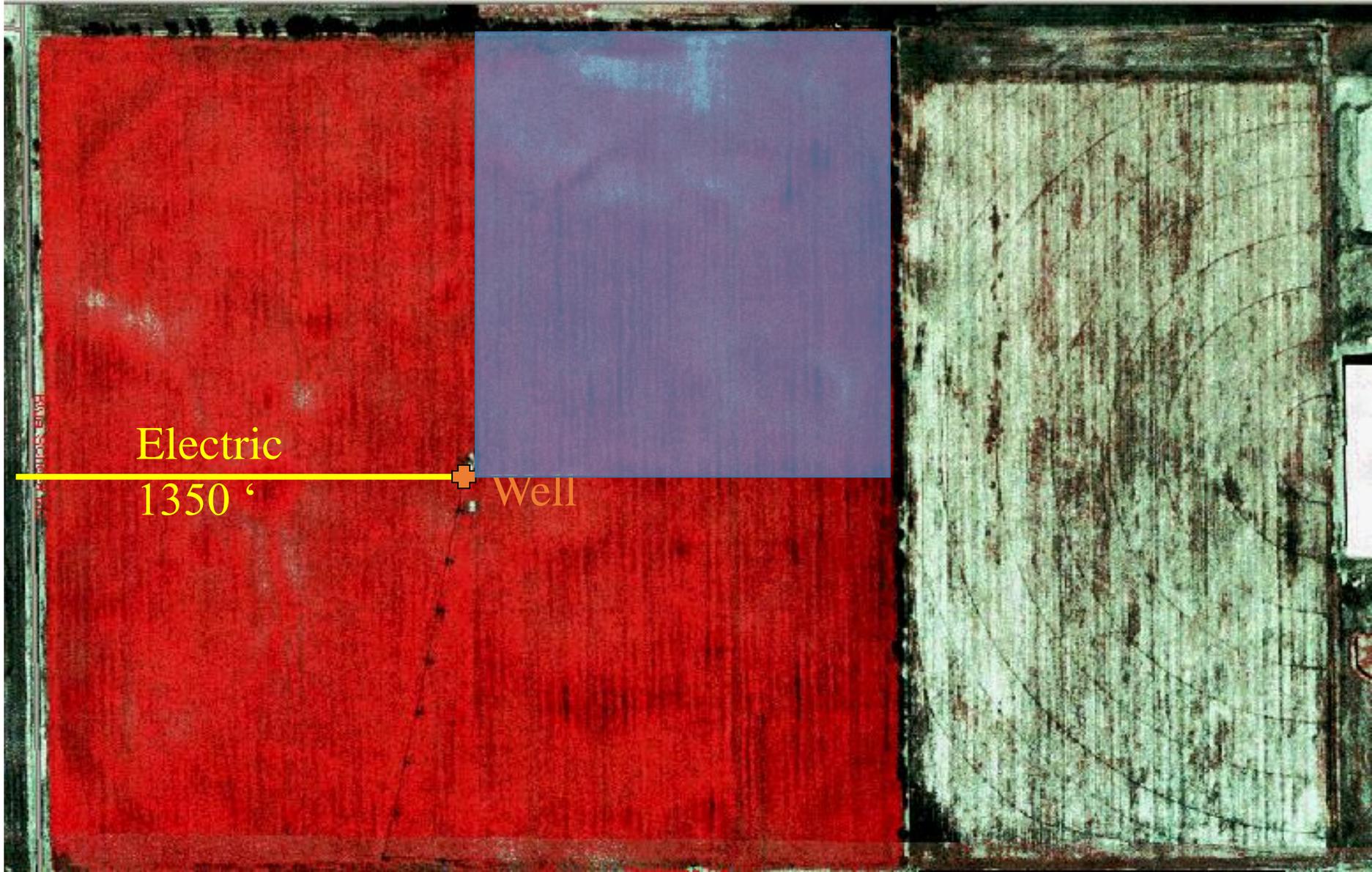
\$2.50/ acre in. * 700 acre inches = \$1,750 annually

Total Operating cost annually = \$1,960

Grand Total Estimated Annual Cost = Operating cost + Ownership Cost

Grand Total Estimated Annual Cost = \$1,960 + \$1,034 = \$2,994

Example- All Electric System/ with Phase converter
or variable frequency drive
100 acres, 750 gpm, 45 psi.



Example- All Electric System/ with Phase Converter or Variable Frequency Drive

100 acres, 750 gpm, 45 psi.

	Cost	Salvage value
Electric Co. install fee	\$1,750	0
200 amp disconnect	\$500	\$100
Phase Converter/Variable Frequency Drive	\$3000	\$1000
1350' buried electric cable * \$2.50 per ft.	\$3,375	0
Well panel	\$1,000	\$250
40 hp pump	\$3,000	\$1,000
Totals	\$12,625	\$2,350

Estimating Annual Irrigation Operation Costs

Example- All Electric System/ with Phase converter or variable frequency drive **100 Acre Water Supply**

Annual Ownership Cost

Depreciation: (original cost - salvage value)/years of use = \$506

Interest: interest rate * average investment value = \$303

Repair: estimated to between 2 to 5% of original cost = \$80

Taxes: personal property tax: Michigan-0 , Indiana = \$126

Insurance: estimated at 0.5% * Average Investment Value = \$13

Total Annual Ownership Cost = \$1,279

Operating Cost (total actual annual cost / 100 acre * 7")

\$2.50/ acre in. * 700 acre inches = \$1,750 annually

Total Operating cost annually = \$1,960

Total Annual Cost = Operating cost + Ownership Cost

Grand Total Estimated Annual Cost = \$1,960 + \$1,279 = \$3,239

Example- Diesel Pump and Generator

100 acres, 750 gpm, 45 lbs.



Example- Diesel Engine and Generator

100 acres, 750 gpm, 45 lbs.

	Cost	Salvage value
Diesel engine & pump	\$20,000	3,500
Right angle drive	\$4,000	\$500
Generator cost	\$3,000	\$1,000
Totals	\$27,000	\$6,000

Estimating Annual Irrigation Operation Costs 100 Acre Water Supply - Diesel Engine, Right angle drive and Generator

Annual Ownership Cost

Depreciation: (original cost - salvage value)/years of use = \$2,200

Interest: interest rate * average investment value = \$800

Repair: estimated to between 2 to 5% of original cost = \$600

Taxes: personal property tax: Michigan – 0 , Indiana = 270

Insurance: estimated at 0.5% * Average Investment Value = \$135

Total Ownership Cost \$4,005 /year

Operating Cost (total actual annual cost / 100 acre * 7”)

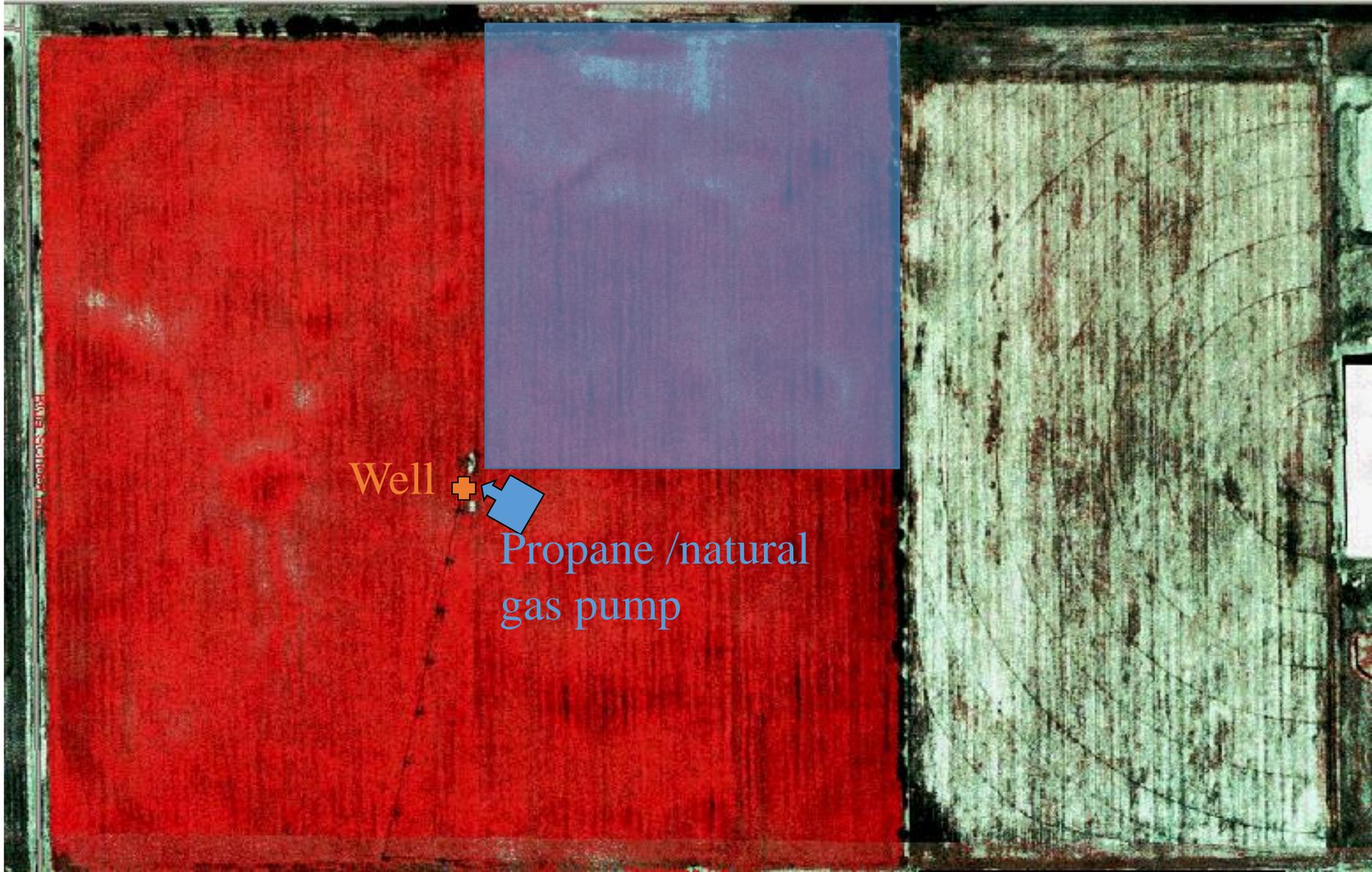
\$2.50/ acre in. * 700 acre inches = \$4,550/year

Total Operating cost annually = \$4,760

Grand Total Estimated Annual Cost = Operating cost + Ownership Cost

Grand Total Estimated Annual Cost = \$4,005 + \$4,760 = \$8,765

Example- Propane/natural gas Engine and Generator -142 acres, 750 gpm, 45 lbs.



Well



Propane /natural
gas pump

Example- Propane/Natural Gas and Generator - 100 acres, 750 gpm, 45 lbs.

	Cost	Salvage value
Nat. Gas engine	\$12,000	2,000
Right angle drive	\$4,000	\$500
Generator cost	\$3,000	\$1,000
Totals	\$19,000	\$4,500

Estimating Annual Irrigation Operation Costs 100 Acre Water Supply – Propane/Natural gas engine, Right angle drive and generator

Ownership Cost

Depreciation: (original cost - salvage value)/years of use = \$1,550

Interest: interest rate * average investment value = \$562.50

Repair: estimated to between 2 to 5% of original cost = \$240

Taxes: personal property tax: Michigan – 0, Indiana = \$190

Insurance: estimated at 0.5% * Average Investment Value = \$95

Total Ownership Cost \$2,638 /year

Operating Cost (total actual annual cost / 100 acre * 7”)

\$3.50/ acre in. * 700 acre inches = \$2,450 /year

Total Operating cost annually = \$2,660

Grand Total Estimated Annual Cost = Operating cost + Ownership Cost

Grand Total Estimated Annual Cost = \$2,638 + \$2,660 = \$5,298

Irrigation Energy Options- Decision consideration
Always do your own home work, every situation is different

Quick and dirty cost comparisons
high cost to low cost

Annual energy cost

gasoline > diesel > propane > electricity

Initial equipment and infrastructure cost

diesel > propane > gasoline > electricity

Annual maintenance, repairs, labor

diesel > gasoline > propane > electricity

Investigate Propane....

- About 1/3 saving in pumping cost (\$2.50 diesel = \$1.50 propane)
- Less fuel theft problems
- Minimal environmental storage, exhaust concerns
- Off season use grain drying tank
- No water in fuel issues
- Lower initial investment



If considering electric, what are the Electric Load Management Options your utility offers Electric Irrigation System Operators?

Commercial Energy Rate

Off peak electric rate cost/kWh

On peak electric rate cost/kWh

Time of day operation restrictions

Shut down concessions

All considered actual rate can be from 2.3 cent to 14.7 cents ? Kilowatt hour.

Estimated Annual Cost/Acre

10 yr. investment period, - salvage value, 5% interest,
7" application/yr. , 100 acres

	Diesel engine + generator	Natural gas engine + generator	Single phase to 3 phase converter	3# Phase at pole
Total Annual Ownership Cost/ acre	\$40.05	\$26.38	\$12.79	\$10.34
Total Annual Operating Cost / Acre	\$47.60	\$26.60	\$19.60	\$19.60
Grand Total Annual Cost/Acre	\$87.65	\$52.98	\$32.39	\$29.94

\$87.65-29.94 x 100 acres = **\$5771** annually for 10 yrs. at 5% interest

Present Value of an Annuity

$$PV_{\text{Ordinary Annuity}} = C * \left[\frac{1 - (1 + i)^{-n}}{i} \right]$$

C = Cash flow per period (payment amount)

i = Interest rate

n = Number of payments (in this calculator, derived from the payment interval and number of years)

$$PV_{\text{Ordinary Annuity}} = C * \left[\frac{1 - (1 + i)^{-n}}{i} \right]$$

C = Cash flow per period (payment amount)

i = Interest rate

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Present Value of an Annuity- calculator

Payment amount (\$):

Interest rate (%):

Number of years (#):

Payment interval:

Calculate Present Value of Annuity

Reset

Present value:

