Solar-Powered Livestock Water Pumping: Technical and Economic Feasibility

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Outline

- **Why**
  - Because it works...

- **Where**
  - Technically feasible nearly everywhere, but economically feasible...

- **How**
  - Action speaks louder than words...
Why – A mature technology

1991

Photo Credit: Steve Fletcher
Why – A mature technology

2000

Photo Credit: Steve Fletcher
Why – A mature technology

Photo Credit: Steve Fletcher – Weston County, WY
Why – Numerous manufacturers
Why – The resource

5.26 kWh/m²/day

5.17 kWh/m²/day
Why – Year-round quality

Annual Insolation, Kaycee, WY

Source: NREL PVWatts
Why – Performance and Profitability

- Reliable, robust systems
  - Wind, hail, 25-year warranties, and more
- Range enhancement
  - More, better water where and when you need it
- Price stability
  - Confident in future water pumping costs
    - Price insurance
- Labor savings
  - Often overlooked benefit

Why not everywhere (home, barn, etc.) – Cost!
Why – The death of a windmill...
Where – Characteristics of a viable project

- Existing well
  - Otherwise additional drilling costs
- Shallower wells
  - Can pump 1000+ feet, but at a cost
- Need to replace existing equipment
- Distant pastures
  - Limiting driving time to check generators
- Stationary in longer-term pasture
  - Mobile if greater rotational grazing
- Summer or winter pasture
  - More panels need for winter pumping but lower water requirements
- More than 1/8 mile from AC electricity

**Not Irrigation Systems!**
Where – Cost effectiveness: An example

- AC Pump – $700 est.
  - 10 GPM
  - 1 HP single-phase Franklin 4” Pump Motor
  - Motor starter
- Cost of gasoline – $3.00/gallon
  - Diesel $3.75
- Line Extension Cost – $20,000/mile
- Cost of AC electricity – $0.053/kWh
- Line connection charge – $27.00/month
- Generator – Honda EB5000
  - $2,500
Where – Cost effectiveness: An example

- Lorentz PS1200, HR-14 Pump – $1800 est.
- 1500 watt solar array – $4500 est. ($3/watt)
- System, with 165’ lift, will pump:
  - 5500 gpd summer
  - 4800 gpd fall/spring
  - 4000 gpd winter
  - 10 gpm maximum pump rate
- AC system assumes same pumping requirements and rates
Where – Cost effectiveness: An example

- 10-mile round trip to check the well
  - 7 days/week for generator (fueling)
  - 1 day/week for utility line powered
  - 2 days/week for solar system (don’t trust new fangled systems)
  - Assume your truck gets 15 mpg

- At 165’ lift, the AC pump will have 60 psi of pressure at outlet in order to limit the flow rate to 10 gpm.
Where – Cost effectiveness: An example

![Graph showing 5-year discounted cost vs. distance from electrical service. The graph compares AC, Solar, Solar with Incentives, and Generator costs.]
Where – Wind power

- Upfront cost lower than PV
  - PV – Approximately $3.00/watt
  - Wind – Whisper 200 $2.25/watt

- More maintenance and problems with Wyoming’s “strong” wind resource
  - Moving parts

- Allows for pumping during low light daytime conditions and at night
  - Can be used in conjunction with PV if large quantities of water are needed

Generally, solar wins…
How – Solar trackers in Wyoming
How – Fixed tilt

- Spring & Fall Equinox Sun Angles
- Winter Solstice Sun Angle
- Summer Solstice Sun Angle

- Angle equal to latitude
  - 45°
  - 0°

South
How – No batteries

Stored water = stored energy
How – Incentives

- Easy federal tax credits (2016)
  - Business Energy Investment Tax Credit: 30% on panels and electronics (not pumps)
- Accelerated depreciation (2016)
  - MACRS (6-year rapid) on solar equipment (not pumps)
- USDA Rural Development Rural Energy for America Program (REAP)
  - 25% on solar equipment (not pumps)
  - $10,000 minimum project size, so need to do more than one at a time to justify
- NRCS/Conservation District Programs
  - EQIP
- Talk to your REA!
  - Some have programs (e.g. PRECorp) use USDA grants as a pass through
How – Self-Assessment

Linked from –
http://renewables.uwyo.edu/
How – Installers

- Many pump installers in WY
  - Standard designs with single and/or poly-crystal
  - Different depths and capacity

- Local conservation districts
  - Guidance towards local installers
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