Solar Power Applications for Methane Emission Mitigation

Lessons Learned from the
Natural Gas STAR Program

Marathon Oil Company, and

The Independent Petroleum Association of Mountain States

Producers Technology Transfer Workshop
Denver, Colorado
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epa.gov/gasstar

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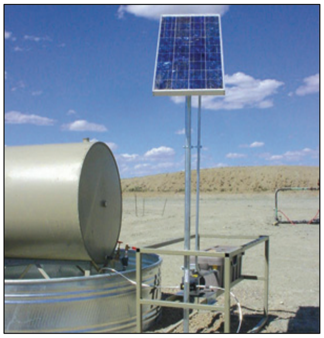
Solar Power Applications

- Methane Losses
- Methane Savings
- Is Recovery Profitable?
- Industry Experience
- Discussion



Source: SunPumper

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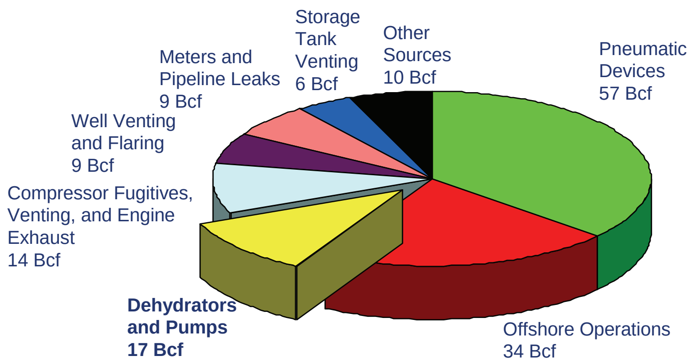
Dehydrators and Chemical Injection Pumps: Methane Losses

- Dehydrators and chemical injection pumps contributed over 17 Bcf of methane emissions in 2005



EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2005.* April, 2007. Available on the web at: http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissions.html
Natural Gas STAR reductions data shown as published in the inventory.

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Methane Recovery: Replace Dehydrators with Methanol Injection

- Gas hydrate formation presents a serious problem to gas wells and flow lines
- Hydrate formation can be avoided by removing water (dehydration) from the gas stream or lowering water's dew point (inhibition)
- Glycol dehydrators may not operate effectively at low temperatures
  - Methanol injection in wells prevents hydrate plugging
  - Methanol injection in flow lines has been reported as a cost-effective alternative to glycol dehydrators

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Methanol Injection Pumps

- Chemical injection pumps are used to inject methanol and other chemicals at the well site
- Injection pumps are often pneumatic gas-powered at remote production locations
  - Solar injection pumps can replace gas-powered pumps to save gas losses, reduce methane emissions
- Solar injection pumps can handle a range of throughputs and injection pressures
  - Max output 38 – 100 gallons per day[1]
  - Max injection pressure 1200 – 3000 psig[1]

1 - Values based on various SunPumper injection pump models

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Solar Powered Chemical Injection Pump Applications

- Methanol injection for hydrate inhibition
- Foaming agent injection to reduce well unloading
- Corrosion inhibitor injection
- O_2/H_2S Scavenger injection

Source: Western Gas Resources

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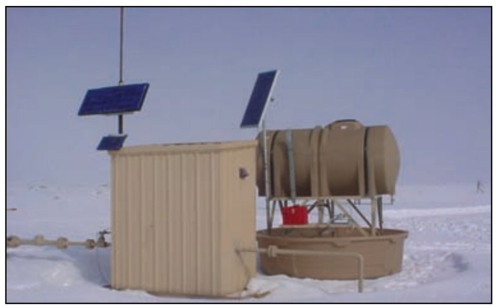
Industry Experience: Western Gas Resources

- Cold winter temperatures and low gathering pressure led to hydrate formation and downtime when glycol pumps froze up
- Solar powered methanol injection pumps were installed at 70+ locations



Source: Western Gas Resources

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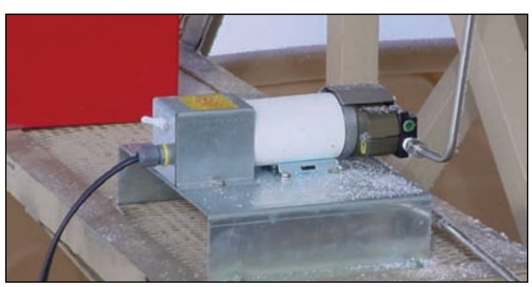
Industry Experience: Western Gas Resources

- Replacing dehydrators with methanol injection saved an average of 800 Mcf/yr
- Methanol injection pumps were installed at an average cost of $2,250 per installation



Source: Western Gas Resources

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Industry Experience: Western Gas Resources

- Methanol injection pump replacing a 2 MMcf/day glycol dehydrator

Installation Cost:	$2,250
Annual Methanol Cost:	$2,519
Annual Gas Savings (Mcf):	800
Value of Gas:	$5,600
Payback (Months):	9

- Methanol costs are estimated at $1.15/gal with 3 gallons injected/MMcf gas
- Gas price at $7/Mcf

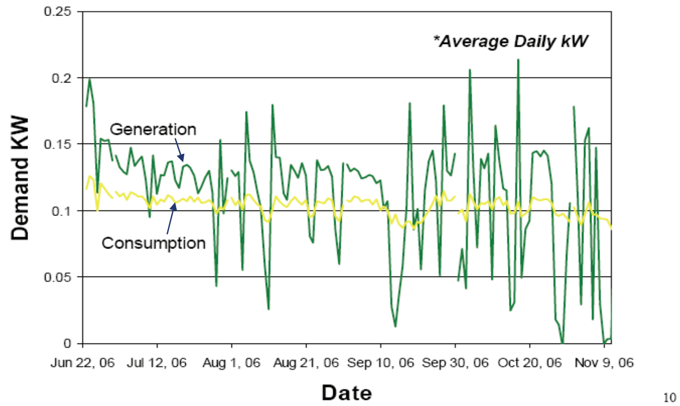
Low Emissions Wellsite: BP (Canada)

- BP replaced fuel gas pneumatics with electrical devices powered by solar energy
  - Solar, pressure and wind energy were converted into electricity, which was stored in a bank of batteries
  - The electricity was used to power electrical pneumatic equipment via an air compressor
- 9 – 150 watts (W) generated by each solar panel (during daylight hours)
  - $1,000/ panel capital cost
  - $1,000/ solar stand capital cost

Source: BP

Industry Experience: BP (Canada)

- Daily Demand Profile



kW = KiloWatt

Note: Generation is sum of the total electricity generated by wind, solar, and pressure energy

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Industry Experience: BP (Canada)

- Cost
  - Total new installations ~$10-15k greater in cost
  - Retrofit with an IA compressor ~ $24-30k
  - Payback period of 4 years with no greenhouse gas (GHG) credits

Source: BP

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Industry Experience: BP (Canada)

- Summary of major equipment costs

Unit	Cost/Unit
Wind (400 W)	$6,000 - $7,000
Solar Panel (150 W)	$1,000/Panel
Solar Stand	$1,000
Turbine (100W)	TBD (Pilot)
Battery Box	$450/box
Battery (140 A-hr, 12V)	$320/battery
IA Compressor + Control Panel	$11,000
Pump (Electric vs. Pneumatic)	Similar Price
Valve (Electric vs. Pneumatic)	Electric 100-150% Greater

Source: BP

Discussion Questions

- To what extent are you implementing these opportunities?
- Can you suggest other applications for these technologies?
- How could these opportunities be improved upon or altered for use in your operation?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing these technologies?