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

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epa.gov/gasstar

Solar Power Applications

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

Source: SunPumper
Dehydrators and Chemical Injection Pumps: Methane Losses

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

![Pie chart showing methane losses from various sources](chart.png)


Natural Gas STAR reductions data shown as published in the inventory.

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
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.

Solar Powered Chemical Injection Pump Applications

- Methanol injection for hydrate inhibition
- Foaming agent injection to reduce well unloading
- Corrosion inhibitor injection
- \(\text{O}_2/\text{H}_2\text{S}\) Scavenger injection

Source: Western Gas Resources
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

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
Industry Experience: Western Gas Resources

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

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Installation Cost:</td>
<td>$2,250</td>
</tr>
<tr>
<td>Annual Methanol Cost:</td>
<td>$2,519</td>
</tr>
<tr>
<td>Annual Gas Savings (Mcf):</td>
<td>800</td>
</tr>
<tr>
<td>Value of Gas:</td>
<td>$5,600</td>
</tr>
<tr>
<td>Payback (Months):</td>
<td>9</td>
</tr>
</tbody>
</table>

- 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

\[ \text{kW} = \text{KiloWatt} \]

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

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
Industry Experience: BP (Canada)

Summary of major equipment costs

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

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?