Colombia: Gas Capture, Compression, Utilization, and Social Responsibility

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Agenda

• Overview
  – Oxy’s participation and accomplishments in Natural gas Star and Methane to Market programs
  – Oxy’s Best Practices and Technologies on flaring and venting reduction and natural gas utilization in the U.S., Latin American, and Middle East Operations

• Colombia Case Studies
  – Gas Capture, Compression, and Power Generation, and Social Responsibility
Oxy’s Natural Gas Star Program: Participation and Accomplishments

History:
• OXY Signed in 2004
• 17 Bcf (41 million tonne CO₂e) methane reduction in the U.S.
  – Equivalent of removing 1.2 million passenger vehicles per year

• EPA Awards:
  – 2006: Implementation Manager of the Year
  – 2008 Production Partner of the Year
Methane-to-Markets Program

History:
• OXY Signed in 2005
• Oxy Colombia sponsored the first international workshop in the region
• With EPA’s assistance identified and working on three major projects in Colombia
  – Gas Capture/VRU Project at PF1, PF2, and Cari Care
• Working on projects in the Argentina
• EPA Award:
  – 2005: International Partner of the Year
Natural Gas Star International

- Oxy signed as one of the Founding Charter Member: September 2006
- Oxy submitted the Implementation Plan for International Projects in 2008
# Oxy’s Experience: US and International Operations

<table>
<thead>
<tr>
<th>TECHNOLOGIES</th>
<th>COUNTRIES APPLIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor Recovery Units (VRUs)</td>
<td>US, Qatar, Colombia, Argentina</td>
</tr>
<tr>
<td>Storage Tank Removal and Consolidation</td>
<td>US, Colombia, Argentina</td>
</tr>
<tr>
<td>Applying Protective Tank Coating</td>
<td>US, Oman, Argentina</td>
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<tr>
<td>Converting IC engines to electric</td>
<td>US, Argentina</td>
</tr>
<tr>
<td>Upgrading Compressor Packing</td>
<td>US</td>
</tr>
<tr>
<td>Connecting Process Safety Values (PSVs) to Flare</td>
<td>US, Oman, Qatar, Colombia</td>
</tr>
<tr>
<td>Fugitive Monitoring Programs</td>
<td>US</td>
</tr>
<tr>
<td>Installation of Non-Selective Catalytic Reduction (NSCR) control</td>
<td>US, Qatar, (Argentina, Colombia)</td>
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Oxy’s Best Practices and Reduction Technologies

Oxy’s Methane Emission Reduction in the US: 17 BCF:
To achieve these results, Oxy has employed these Natural Gas Star methane emission reduction technologies and best practices.

- Install VRUs: 27.2%
- Fugitive Leak detection: 27.1%
- Reduced Emission Completions: 24.7%
- Install Electric Motors: 17.6%
- Convert to Instrument Air Systems: 2.7%
- Other: 1.5%
# Oxy International Methane Emission Reduction Proposed Projects for 2008 - 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Technology / Project Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina, Colombia, Oman</td>
<td>Install vapor recovery units on crude oil storage tanks</td>
</tr>
<tr>
<td>Colombia</td>
<td>Replace burst plates with secondary relief valves</td>
</tr>
<tr>
<td>Colombia</td>
<td>Replace flare and line due to mechanical integrity</td>
</tr>
<tr>
<td>Colombia</td>
<td>Fugitive emission inspection</td>
</tr>
<tr>
<td>Argentina</td>
<td>Connect production well casing to vapor recovery unit</td>
</tr>
<tr>
<td>Argentina</td>
<td>Eliminate unnecessary equipment and/or systems</td>
</tr>
<tr>
<td>Argentina, Colombia, Oman, Qatar</td>
<td>Reduce flaring of gas by installing compression</td>
</tr>
<tr>
<td>Argentina, Colombia</td>
<td>Use previously vented gas to run electric generators</td>
</tr>
</tbody>
</table>
Flare Reduction Projects

• Oxy has completed several flare reduction projects in Oman and Qatar.

• These projects involve capturing previously flared gas and routing to a pipeline.

• In some instances, compression is added in order to reinject the gas into the formation or export for further treatment.
Colombia Case Study: Cano Limon

Llanos Norte: 25 Years; >1 bbl oil production:

Oil Production: 97,171 BOPD
Produced Water: 2.5 Million BWPD
Number of Wells: 355
Production facilities: PF1; PF2; Caricare
### Gas characteristics to engines

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>PF1 %</th>
<th>PF2 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>9.67</td>
<td>9.54</td>
</tr>
<tr>
<td>Ethane</td>
<td>1.5</td>
<td>0.65</td>
</tr>
<tr>
<td>Propane</td>
<td>5.66</td>
<td>2.94</td>
</tr>
<tr>
<td>i-Butane</td>
<td>5.76</td>
<td>3.61</td>
</tr>
<tr>
<td>n-Butane</td>
<td>8.99</td>
<td>5.49</td>
</tr>
<tr>
<td>Hydrocarbon</td>
<td>31.47</td>
<td>22.23</td>
</tr>
<tr>
<td>Inert gas</td>
<td>67.93</td>
<td>77.27</td>
</tr>
</tbody>
</table>

| MMSCFD |   1.07   |   2.07   |

- 12 -
Rotary Screw Compressors & Turbine Generator

Hy-Bon Screw Compressor

Solar Saturn Generator
## Total Costs

<table>
<thead>
<tr>
<th>Annual</th>
<th>PF1</th>
<th>PF2</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPEX (U$ million)</td>
<td>4.75 – 6.5</td>
<td>8.5 – 11.75</td>
<td>13.25 – 18.25</td>
</tr>
<tr>
<td>OPEX (U$ million)</td>
<td>0.03 – 0.05</td>
<td>0.03 – 0.05</td>
<td>0.06 – 0.10</td>
</tr>
</tbody>
</table>

CAPEX = Capital Expenditure  
OPEX = Operation and Maintenance costs
La Cira Infantas (LCI) Project Area
LCI: Social Environment

- 11,000 inhabitants
- 2700 families
- 30 neighborhoods
- 17% illiteracy
- Tradition of Labor Strife
- Previous Guerrilla territory
- Current Paramilitary influence
- Political fragmentation power struggles
- 250 NGOs & Social Organizations
- Widespread poverty
- Unemployment 30%
Working with Our Stakeholders

Contact Priority

(-) Project viability impact (+)

National Government
Associations
Opinion leaders

Communities
Local & Regional Government
Churches

Media
Labor union
ECP Employees

NGO’s
Political Organizations

Congress

First level
Second level
Third level
Working with our Neighbors

Residential Gas Supply

<table>
<thead>
<tr>
<th>Items</th>
<th>Initial</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Wells</td>
<td>1700</td>
<td>1925</td>
</tr>
<tr>
<td>Well Connections</td>
<td>382</td>
<td>178</td>
</tr>
<tr>
<td>House Connections</td>
<td>1656</td>
<td>310</td>
</tr>
</tbody>
</table>

LPG Supply Provided: 1,540 houses
Summary

- Oxy experience with Gas Capture, Compression, Utilization, and Power Generation have been beneficial
- Pay Back on projects have ranged widely: 2 months to 8 years depending upon the type and magnitude of the projects
- We realized and recognized the need to implement solutions integrating social, economic, and environmental dimensions of project for substantiality
- EPA’s technical assistance and resources have been highly valuable
- Technical barriers vary and include:
  - Lack of familiarity, benefits, and options of technologies
  - Lack of readily available measurement techniques and instruments (especially in some international locations)
  - Lack of outlet/stranded capacity for recovered gas
    - Spare compression capacity to boost gas to pipeline pressure
    - On-site fuel use
    - Gas processing plant in the vicinity to recover gas liquids
    - Perceived or short-term high capital costs of recovery technologies