Helium: A Commercial Discussion: Helium Market Fundamentals, Processing and Marketing, IACX Otis Plant Case Study*

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Search and Discovery Article #70212 (2016)**
Posted February 15, 2016

*Adapted from oral presentation given at AAPG Mid-Continent Section meeting in Tulsa, Oklahoma, October 4-6, 2015
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Abstract

IACX Energy operates a gas gathering and processing system in central Kansas (its ‘Otis’ system), which gathers gas from Barton, Rush, Ellsworth and Rice counties. The gas, which is, on average, 25% N₂, 1.25% helium, is aggregated to a facility near Otis, KS, where nitrogen is removed, NGLs are extracted, and helium is purified before the residual methane is delivered to an intrastate pipeline system for sale. Before IACX took over operation of the gathering pipelines in 2008 and started up its Otis facility, gas from this system was shut in (the gas had previously been consumed as fuel in the Bushton gas processing complex; but that particular use for the gas evaporated in 2006). Once IACX’s facility became operational, IACX not only began providing a market for the nitrogen-laden natural gas, it also began serving as a market for the helium contained in the gas. Between then and now, the price received by producers for the helium contained in their gas has steadily increased, significantly adding to the netback value of the gas. In some instances (depending on the specific helium concentration and wellhead volume), producers are realizing helium prices well in excess of $100/Mcf (1.25% helium at the wellhead and $100/Mcf translates to $1.25/Mcf of producers' realized value from helium alone). Helium prices, by and large, move independently of prices for hydrocarbons, and have served as a veritable hedge against natural gas and NGL prices in recent years.

Selected References


HELUM: A COMMERCIAL DISCUSSION

Helium Market Fundamentals, Processing and Marketing
IACX Otis Plant Case Study

AAPG Mid-Con Section Meeting
October 5th, 2015
Tulsa, OK
Helium Quick Facts

Primary Uses
- MRI machines ➔ largest single use
- Semiconductor/fiber optic manufacturing
- Lift gas
- Breathing mixtures
- Purging/inerting
- Leak detection
- For many applications, there is no substitute

Helium Properties
- Second lightest element
- Boiling point of -452°F
- High thermal conductivity
- Inert
- Small
Helium Uses – Global & Domestic

2014 – Demand by Application

**U.S. HELIUM DEMAND**

1.9 Bcf

- Lifting: 18%
- Other Gas: 1%
- MRI: 31%
- Diving/Welding: 12%
- Atmos/Pres/Purg: 5%
- Lab/Spec/Chromat: 15%
- Leak Detect: 5%
- Electronics: 7%
- Other Cryo: 6%

**GLOBAL HELIUM DEMAND**

6.0 Bcf

- Lifting: 17%
- Other Gas: 4%
- MRI: 20%
- Diving/Welding: 11%
- Atmos/Pres/Purg: 4%
- Lab/Spec/Chromat: 15%
- Leak Detect: 6%
- Other Cryo: 7%
- Electronics: 18%

(1) Sources: JR Campbell & Associates; USGS
Existing US Helium Infrastructure

Significance of BLM

- Historically, helium produced in the US was, in essence, sold to, and stockpiled by, the federal government
- Helium produced as a byproduct of natural gas in the Hugoton stored in a reservoir north of Amarillo via a 400 mile pipeline running between Cliffside and Bushton
- Helium Privatization Act of 1996
- Currently six crude helium plants and six refineries along BLM pipeline
  - refineries liquefy helium sold by the BLM, as well as native gas produced by Hugoton fields
- Pricing prior to 2015 determined solely based on formula established within HPA to recover govt’s cost of capital for helium program
  - Not a true representation of market value
- Auction format has recently been implemented for a portion of federal helium sold each year
- Very little price transparency; minimal value ultimately passed through to producers
- Opacity of market and low realized value has unsurprisingly have hindered helium development

Sources: BLM, IACK Energy, public company filings
US Helium Production

Historical and Projected

In 2014, the U.S. Federal Helium Reserve provided roughly 1/6th (1 Bcf of a 6 Bcf market) of global helium supply and much of the global market’s storage and supply flexibility. The Reserve is set to wind down by 2021.

- Critical supply source; provides some measure of price transparency
- Annual BLM helium sales have declined from >2.0 Bcf in 2012 to approximately 900 MMcf in 2015
- Significant new supplies – domestically and abroad – will be needed to offset BLM declines.

Aside from crude helium supplied by US BLM, helium has traditionally been supplied in the US from natural gas processing in the Mid-Continent, Rockies and Four Corners

- At > 1.4 Bcf annually, XOM Chute Creek facility will provide stable base of supply for years to come
- Native Hugoton production is, generally, tied to BLM pipeline system and subject to legacy incumbent infrastructure and contracts
  - Economic incentive isn’t there to explore for helium within existing dedications, where producers receive very little, if any, value for helium
- Other US supply to come from Denbury/AP/MTG Riley Ridge (WY), Kinder Morgan/Air Products Doe Canyon; each ~200 MMcf/year

U.S. Supply/Demand Balance

Sources: BLM, JR Campbell & Assoc.
(1) Note: “Other” includes supply from Doe Canyon, Riley Ridge, IACX Energy
Global Helium Demand Estimates
Shift to Asian Markets

- Between 2015 and 2020, annual worldwide demand is projected to increase from approximately 6.0 Bcf to just under 7.0 Bcf
- Both overall demand, and demand growth, expected to shift from the Americas and Europe to Asia
- Asian growth driven by increased access to healthcare (MRI), continued electronics demand (domestic demand and IT component exports), and general economic activity
- On the supply side, both Algeria, and, to a much larger degree, Qatar have filled the decline wedge left by US BLM, and have become critical to overall global supply stability

**GLOBAL HELIUM DEMAND BY REGION**

**Worldwide Supply/Demand**

*Sources: USGS, Cryogas, JR Campbell & Associates*
Helium Pricing

Gaseous Helium

Effects of increased supply from Algeria & Qatar

(1) Sources: BLM, Cryogas, JR Campbell & Assoc.
Helium Accumulations
Mid-Continent and Beyond

U.S. Helium Producing Basins & Helium Shows

Legend
- Helium Pipeline
  - BLM
  - Private
- Helium Content
  - >5.0%
  - 3.1% - 5.0%
  - 1.1% - 3.0%
  - 0.4% - 1.0%
  - Less than 0.4%
  - No Samples

Helium Content by Field

<table>
<thead>
<tr>
<th>Helium Producing Field</th>
<th>Helium Content</th>
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<tbody>
<tr>
<td>Navajo-Chambers</td>
<td>9.0%</td>
</tr>
<tr>
<td>Pinta Dome</td>
<td>8.0%</td>
</tr>
<tr>
<td>Rattlesnake</td>
<td>7.8%</td>
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<tr>
<td>Harley Dome</td>
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<td>Table Mesa</td>
<td>5.7%</td>
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<td>Keyes</td>
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<td>Cliffside Helium Storage</td>
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<tr>
<td>Riley Ridge</td>
<td>0.6%</td>
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<tr>
<td>Hugoton/Panhandle</td>
<td>0.5%</td>
</tr>
<tr>
<td>Church Buttes</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

(1) Sources: BLM, IACX
(2) Source: World Helium Resources and the Perspectives of Helium Industry Development, Yakutseni V.P., 2014
Helium is associated with other inert gases, usually nitrogen

Mid-Continent Helium
Nitrogen-Helium Correlation

- Almost all gas streams with commercial quantities of helium contain high levels of other inerts (unfortunately the inverse isn’t the case)
- Most standard gas analyses do not test for helium

Sources: O&G Journal; IACX Energy

Scatter plot analysis based on IACX study of more than 10,000 gas analyses, primarily from BLM database of North American gas analyses. Pulled samples showing incidents of helium content greater than 0.3%.
Helium Purification
Methodologies

PSA Plants

<table>
<thead>
<tr>
<th></th>
<th>PSA</th>
<th>Liquefaction</th>
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<td>Volume</td>
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<td>100-150 Mcfd+</td>
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<tr>
<td>Pressure</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Purity</td>
<td>Crude to 99.999</td>
<td>Pure liquid</td>
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<tr>
<td>Comments</td>
<td>Flexible, turn down capability, good markets</td>
<td>Most efficient, inflexible process, deepest market</td>
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</tbody>
</table>
IACX Otis System
Central Kansas Infrastructure

- Central Kansas Uplift
- Gas, on average, is ~1.25% helium, 750 Btu/Scf (25% N₂)
- IACX operates 200 miles of gathering and its Otis plant
  - N₂ rejection
  - Helium purification
  - Compression
  - Dehydration
  - NGL recovery
- Methane quality must be upgraded to meet pipeline spec of 950 Btu/Scf
- Without helium, economics wouldn’t be there for producer or midstream company
Otis Facility Case Study
Helium Adding Value to Low-Btu Gas

(1) Graph illustrates wellhead value of gas stream, before processing costs, pipeline losses, and fees. Avg gas composition at Otis is 1.25% He, 750 Btu/Scf
# Netback Potential

## Helium Adding Value to Low-Btu Gas

**Helium Impact on Wellhead Gas Value**

*Chart illustrates helium value on a netback basis at various potential wellhead helium concentrations and realized helium prices.*

<table>
<thead>
<tr>
<th>Wellhead Helium Content</th>
<th>$50.00</th>
<th>$75.00</th>
<th>$100.00</th>
<th>$125.00</th>
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<td>$13.50</td>
<td>$15.75</td>
<td>$18.00</td>
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</tbody>
</table>

(1) Note: chart does not take into account any capex, opex, processing fees, etc.