PARTNER UPDATE

FALL 2010

Register Today – 2010 Annual Implementation Workshop

November 1 to 3, 2010 • Ritz Carlton • New Orleans, Louisiana

epa.gov/gasstar/workshops/annualimplementation/2010.html

Join Natural Gas STAR and the global Methane to Markets Partnership in a discussion of methane emissions capture and use technologies and techniques

Taking advantage of the Program's continued growth and expansion, the 2010 workshop will highlight the widespread applicability of Natural Gas STAR practices by incorporating presentations from our international Partners. The Oil & Gas Methane to Markets Sub-Committee will also share its activities.

The workshop will encompass a full range of issues and activities, including:

- Greenhouse gas awareness programs and management systems
- Technology exhibits & demonstrations
- Awards Luncheon
- Successful mitigation activities & projects
- Carbon financing
- Greenhouse gas emissions reporting rulemaking—Subpart W
- Optional visits to a compressor station or gas processing plant to view methane emissions reduction practices and implementations**. NOTE:** All tour participants must have Personal Protection Equipment including hard hat, ear and eye protection, flame retardant clothing, and steel toed boots.

Register online here.

For hotel reservations, call the Ritz Carlton at (504) 524-1331 and reference the EPA Natural Gas STAR Workshop to receive the special conference rate of $169.00/night plus tax (currently 13%, plus a $2.00/room/night occupancy fee). This rate will be available until **October 11, 2010**.

Partner Profile: Empresa Nacional del Petróleo (ENAP)

In June of 2009, the National Petroleum Company of Chile, ENAP (Empresa Nacional del Petróleo), joined the Natural Gas STAR International Program and immediately began looking for profitable ways to reduce methane emissions.

ENAP is a multinational company focused on exploration, production, and refining of hydrocarbons. According to its mission statement, ENAP aims to supply the energy needs of its clients in an efficient, sustainable, and environmentally responsible manner. Given that its corporate/operating philosophy is in line with Natural Gas STAR International objectives of cost-effectively reducing methane emissions, ENAP joined the Program.

As a new Natural Gas STAR International Partner, ENAP quickly took advantage of resources provided by the Program and pursued activities to better understand methane emissions from its facilities. More specifically, ENAP chose to study methane emissions from its gas gathering and processing system in the southern tip of Chile near the Strait of Magellan. ENAP collaborated with Natural Gas STAR to conduct methane emissions pre-feasibility analyses for sixteen facilities and carried out a methane emissions field study program at seven facilities, as shown in Exhibit 1 at the entrance of the Posesión Plant. ENAP is now using the results of these efforts to develop methane emissions reduction projects. Moreover, ENAP has taken internal action to spread knowledge of the Program throughout the company. The combination of technical collaboration with the Natural Gas STAR Program and internal management of the Program has developed a strong foundation for ENAP's participation in the Program.

Exhibit 1 The Natural Gas STAR International Team with ENAP personnel at the entrance of the Posesión Plant.

Pre-Feasibility Analysis

In September of 2009, ENAP and Natural Gas STAR International completed pre-feasibility studies to identify and estimate methane emission sources in ENAP's Magallanes operations. To complete these analyses, ENAP and Natural Gas STAR International closely collaborated in reviewing detailed operational information about each facility. These studies provided initial insight into the major emitting sources in ENAP's gathering and processing system.

The pre-feasibility study began with the development of a process flowsheet to characterize each relevant equipment type (compressors, piping, valves, storage tanks, etc.). The study then estimated typical emissions rates for each anticipated emissions source for each facility using a

material balance approach. The results of the study provided gas volumes that could be captured to generate revenue in the form of increased gas sales, increased gas liquids sales, and decreased operating costs. Based on the results, ENAP identified seven facilities as candidates that would benefit most from further methane emissions detection and quantification.

Field Study

In November of 2009, a team of methane emissions detection and quantification experts traveled to the seven ENAP facilities in the Strait of Magellan to confirm findings from the pre-feasibility analysis, to pinpoint specific methane emissions sources within ENAP's system, and to measure these emissions sources. By inviting the Natural Gas STAR International measurement team to undertake this field study, ENAP became the first company in South America to carry out this type of analysis.

The field study schedule covered five gas gathering compressor stations and two processing plants:

- Posesión processing plant and 3 compressor stations within a 16 mile radius (immediately south of the Argentina border on the northern shore of the Strait of Magellan)
  - DAU-1 compressor station
  - Daniel Central compressor station
  - Central-6 compressor station
- Cullen processing plant and 2 compressor stations within a 25 mile radius (directly south of the Posesión area; on the island of Tierra del Fuego on the southern shore of the Strait of Magellan)
  - BRC compressor station
  - Sara compressor station

Exhibit 2 A measurement expert uses the GasFindIR Camera to survey the Posesión Plant.

Methane emissions detection was conducted using the GasFindIR camera. Quantification of methane emissions was conducted using turbine meters and ultrasonic meters. In addition to providing a detailed understanding of methane emissions at these facilities, the use of these instruments during the study gave ENAP first-hand experience with these technologies and techniques as illustrated in Exhibits 2, 3, and 4.

The measurement study found that the main emissions sources from the surveyed facilities originated from centrifugal compressor wet seals (at the Posesion Plant), condensate storage tanks found in various facilities, and random segments of piping and valves, as was to be expected. As a result of the study, ENAP is considering purchasing an infrared camera, evaluating potential solutions to reduce emissions from centrifugal compressor wet seals, and developing a technical solution to capture and utilize emissions from condensate storage tanks.

Exhibit 3 A measurement expert uses a turbine meter to quantify tank emission rates.

Exhibit 4 View of tank emissions using the infrared camera.

Administration of the Natural Gas STAR Program at ENAP

After joining Natural Gas STAR International, ENAP became technically involved with the Program, conducting pre-feasibility studies as well as measurement studies. ENAP worked to incorporate the concept of the Program in not only the company's management practices, but also in field operations. Internally, ENAP selected the Operational Reliability Committee to manage the Program, a strategy which would allow the Program to be followed and well-known by management representing various departments within the company. Also, during the measurement studies, ENAP organized meetings on-site between ENAP personnel and EPA, which allowed field personnel to be informed about the Program as well as the importance of identifying and reducing methane emissions.

On July 29, 2010, ENAP senior management held a meeting with Natural Gas STAR International with the goal of assessing some of the major mitigation project options. Once the presentations were finished, the interim Manager of the Exploration and Production line, Rodrigo Bloomfield, highlighted ENAP's role in innovation and how these types of projects can advance and support the company's strategy. Furthermore, he reasserted the commitment and support between ENAP and EPA to develop other initiatives related to emissions reductions.

As a result of the meeting, ENAP focused its interest on three projects: purchasing an infrared camera, implementing vapor recovery to capture condensate tank emissions, and evaluating options for reducing methane emissions from centrifugal compressors. ENAP's interest in the IR camera was based on its first-hand experience with the technology in the field study—not only did the IR camera make methane and other hydrocarbon emissions sources apparent, but it also allowed ENAP staff to identify potential facility improvement options. For example, the IR camera survey discovered a buried line leak due to corrosion affecting its fuel gas system at the DAU-1 compressor station. This discovery allowed the operations team to prioritize this system for repairs. As ENAP pursues additional methane emissions reduction options, the results will be documented and submitted as part of ENAP's Natural Gas STAR International annual reporting.

The various meetings, permanent participation of the Operational Reliability Committee, and the purchase of the infrared camera, which will be used for the periodic inspection and maintenance program, will produce a technological and operational change that will inevitably reach every ENAP employee.

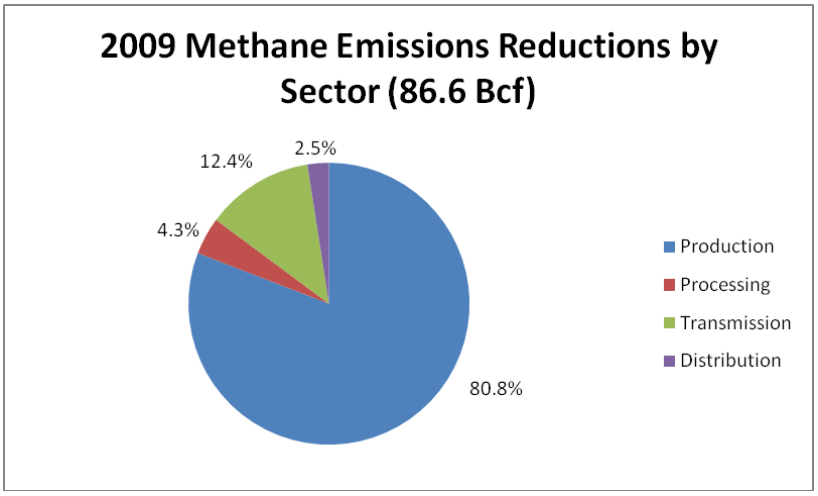
Next Steps
ENAP is presently using the results of the field studies to evaluate methane emissions reduction project options at each of the seven facilities. ENAP's implementation decisions will be based on the volume of methane emissions reduced, the costs and technical feasibility for implementing mitigation options, the revenues generated by recovered emissions of not only methane but also other heavier hydrocarbons, and other financial/operational criteria.

ENAP has kicked off its Natural Gas STAR International participation through this series of focused analyses and studies dedicated to better understand and characterize its methane emissions situation. Through its swiftness to act and continued implementation efforts, ENAP has demonstrated the significant accomplishments that can result from combining Natural Gas STAR International resources with a commitment to environmental stewardship.

Natural Gas STAR 2009 Emissions Reductions: Continuing Success

For the 2009 calendar year, the Natural Gas STAR Program reported domestic U.S. methane emissions reductions of 86.6 Bcf and international emissions reductions of 13.1 Bcf. Currently, the program has over 130 domestic Partners and 13 international Partners.

In the last 17 years, Natural Gas STAR Partner accomplishments have continued to grow, evident through the cumulative elimination of 904 Bcf domestic and 78.7 Bcf international emissions over the life of the Program.



The domestic methane emissions reductions in 2009—divided into the different sectors: production, gathering and processing, transmission, and distribution—are shown in the chart.

More information on the Natural Gas STAR Program's accomplishments can be found on the Gas STAR website at http://www.epa.gov/gasstar/accomplishments/index.html.

Prospective Projects Spotlight: Delay Compressor Blowdown

This article describes a change in operating practice to avoid the significant loss caused by compressor unit valve leaks. In many facilities, it is standard procedure to blow a compressor down to the atmosphere immediately after it is taken offline. In addition to the emissions caused by the blowdown, taking the compressor offline also results in fugitive emissions as gas from the pressurized line escapes across the compressor unit valves. Gas leaks across the closed unit valve, into the compressor case, through the blowdown stack, and into the atmosphere. In many instances, unit valve leaks are a major portion of a facility's fugitive emissions.

An alternative to explore that minimizes unit valve leaks is to hold the compressor at pressure while it is offline which allows the blowdown valve, rather than the unit valves, to serve as the barrier to the atmosphere. Natural Gas STAR Partners have reported that blowdown valve fugitives are significantly smaller on average than unit valve fugitives, which allows this project idea to provide an immediate payback based on the value of the avoided emissions. Compressor blowdown can be avoided altogether via this method or postponed until right before the compressor restart in order to minimize the fugitive emissions.

Natural Gas STAR Partners have previously reported other methods for reducing compressor emissions (see sidebar). This new project idea is a different option since it does not address the blowdown itself but recommends a change in when to do so.

Closed unit valves will leak at a rate of 1.4 Mcf/hour on average. If the compressor is kept pressurized during downtime when unit valves are closed, gas leaks will still exist but will occur through blowdown valve and compressor rod packing. The total leak rate in this pressurized case would typically be around 0.45 Mcf/hour for a 4 rod compressor. These two scenarios are illustrated in Exhibit 1.

Applicability Considerations

It is important to note that this method is not feasible for shutdowns associated with compressor maintenance, where work should not be performed near a pressured compressor case, but for down time related to off peak loading situations. Safety must be considered for each individual situation when undertaking an operational change of this sort to determine the extent to which this project idea is feasible. Keeping a compressor pressurized while idle and delaying the blowdown will also have impacts on the rod packing or shaft seals which may more typically be exposed to atmospheric pressure when the rods or shaft is stationary.

Existing Mitigation Opportunities

Common options already being implemented by Partners include:

- Keeping compressors pressurized
  - Avoids compressor blowdown
  - Pressurized restart of compressor
  - Reduces leak rate to approximately 450 scfh from the blowdown valve and rod packings
- Keeping compressors pressurized and routing gas to fuel line
  - Allows gas that would normally be vented to the atmosphere during blowdown to be used in the fuel system
  - Leaks across the unit valves continue to feed the fuel system via the vent connection
  - Leakage from the compressor packings and blowdown vent is reduced to about 125 scfh
- Keeping compressors pressurized and installing static seal
  - Eliminates rod packing leaks during shutdown when the compressor is pressurized
  - Activated when the compressor is shutdown and deactivated upon start-up
  - Leakage occurs only from the blowdown valve at about 150 scfh when at system pressure

More information available at:
epa.gov/gasstar/documents/ll_compressorsoffline.pdf

Project Economics
There is no capital cost associated with this methane emissions mitigation method. Depending on operational characteristics of each compressor, savings and emission reductions could be significant. The results of an economic analysis for a simplified scenario representative of either a reciprocating or centrifugal compressors are summarized below in Exhibit 2.

Exhibit 1: Compressor Diagram

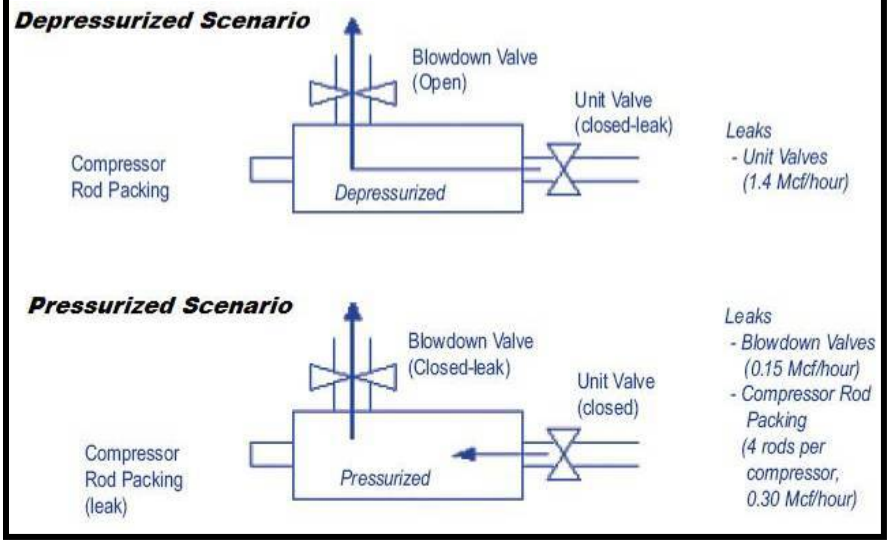


Exhibit 2: Summary of Economics for a Representative Compressor Scenario

PROJECT SUMMARY: DELAY COMPRESSOR BLOWDOWN						
	Base Load Compressor			Peak Load Compressor		
Annual Offline Hours	500			4,000		
Capital & Installation Costs	$0			$0		
Annual Labor & Maintenance Cost	$0			$0		
Methane Saved (Mcf)	475			3,800		
Gas Price per Mcf	$3	$7	$10	$3	$7	$10
Value of Gas Saved	$1,425	$3,325	$4,750	$11,400	$26,600	$38,000
Payback Period in Months	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate

Results will vary depending on the leak rates and offline hours.

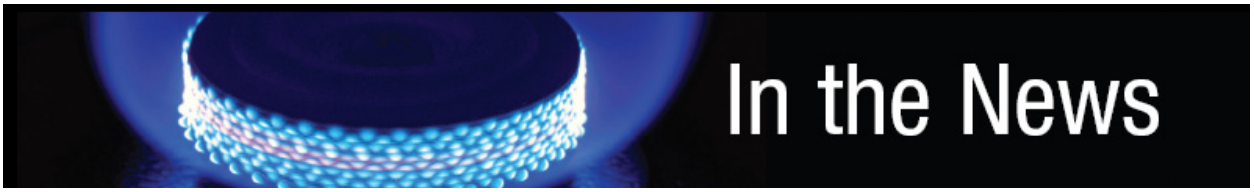
One Step Further: Offline Reciprocating Compressors Rod Packing
It is possible to reduce emissions from reciprocating compressors even further by keeping the compressor pressurized until just before restart and also installing Static Pac™ systems. The system replaces several rings (typically two) in the low-pressure side of the packing case. When the compressor is shut down, a supply of pressurized gas is used to move a piston along the outer shell of the Static Pac™ seal, wedging a lip seal into contact with the rod and eliminating or greatly reducing rod packing emissions when the compressor is idle. The payback period from implementation of this system could range from 0.3 to 8.8 years, depending on the

individual compressor and the value of the gas. More information on this technology is available at epa.gov/nrmrl/std/etv/pubs/03_tp_cook.pdf.

Conclusion
By implementing a change in the timing of compressor blowdowns, it is possible to achieve significant savings by avoiding unit valve leaks. This project idea can complement other Natural Gas STAR practices to reduce compressor emissions.

Climate Policy Update: Mandatory Reporting of Greenhouse Gases Rule, Subpart W

EPA has concluded its public comment period for the re-proposed Mandatory Greenhouse Gas Reporting Rule Subpart W – Petroleum and Natural Gas Systems. The re-proposed rule was published on March 22, 2010 and received approximately 2,000 comments. EPA expects to complete its responses to these comments and finalize the rule such that data collection can begin January 1, 2011. For more information on Subpart W, please visit epa.gov/climatechange/emissions/subpart/w.html.



OCS Oil and Gas Production Requirements to Limit Flaring and Venting

On April 16, 2010, the U.S. Department of the Interior's Minerals Management Service (now known as the Bureau of Ocean Energy Management, Regulation, and Enforcement [BOEMRE]) published a final rule in the Federal Register that sets limits on the flaring or venting of natural gas to the atmosphere. The rule establishes the criteria for natural gas flaring and venting that occurs in offshore oil and gas production and sets limits on the time gas can be flared or vented during certain operations.

In the past, BOEMRE has monitored the total amount of natural gas flared and vented, but operators have not been required to differentiate between the two categories. This rule requires reporting of gas flaring and venting as separate volumes.

If an offshore facility processes more than 2,000 barrels of oil per day, the installation of meters is required to accurately measure all flared and vented natural gas from the facility. This threshold was recommended from a GAO report, titled "Natural Gas Flaring and Venting—Opportunities to Improve Data and Reduce Emissions" (GAO-04-809). The original proposed rule was made public for comment on March 6, 2007, receiving eight comments through June 4, 2007, which were considered for the final rule.

Middle East & North Africa Forum on Flaring Reduction & Gas Utilization

May 10 to 11, 2010—Muscat, Oman
Experts from around the region and the globe met at this forum focused on specific challenges and opportunities to reduce flaring in the Middle East and North Africa region. Attendees discussed topics such as:

- Using carbon financing to make flaring reduction projects more economically viable
- Generating trans-border projects for countries and companies to jointly reduce gas flaring

Methane to Markets gave a presentation on the top five fugitive and vented emissions sources in the production sector: 1) tank venting, 2) pneumatic devices, 3) compressor seals, 4) gas well venting, and 5) fugitive emissions/leaks. The two-day event was sponsored by the Global Gas Flaring Reduction (GGFR) Partnership and Masdar. For more information and presentations, visit the forum website at menaflaringforum.org.

Methane to Markets Expansion: Recap of New Member Countries

Dominican Republic

In September 2009, Methane to Markets expanded into the Caribbean with the admission of the Dominican Republic into the Partnership. The Dominican Republic will be the Partnership's 31st Partner Government and its representatives will join the Agriculture and Landfills Subcommittees. Dominican representatives are looking to reduce methane emissions in the sugar, fruit processing, swine, and dairy sectors.

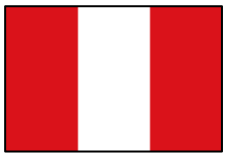
Ethiopia

Ethiopia is looking at opportunities for methane capture-and-use projects in the sectors of manure management and landfill management and will be joining the Agriculture and Landfill Subcommittees. Based on data in EPA's *Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases* report, in 2010, Ethiopia's estimated anthropogenic methane emissions ranked 23rd in the world. While livestock is the country's largest source of methane emissions, approximately 14 percent of its anthropogenic methane emissions—8.87 $MMTCO_2E$—come from agriculture (manure management), landfills, and wastewater.

Ghana

Ghana is interested in landfill and oil and gas projects and will be joining the respective subcommittees. Ghana has opportunities for methane capture and use projects in the areas of landfills and natural gas and oil systems. In the landfill sector, Ghana welcomes opportunities for establishing waste management standards and constructing engineered landfills with methane collection systems. In 2010, the Government of Ghana announced intentions to develop an Oil and Gas Industrialization Plan as a sustainable model for managing its emerging oil and gas industry. A key policy element guiding the oil industry is zero flaring, which provides additional opportunities for investment in the oil and gas industry in Ghana.

Peru



Peru joined the Partnership on June 25, 2010. The country has joined the Agriculture, Landfills, and Oil and Gas Subcommittees. Peru has an Action Plan of Adaptation and Mitigation that includes the construction of 27 landfills.

Serbia

Serbia joined the Partnership on July 20, 2010. The country is looking to join the Landfills Subcommittee.

Indonesia
Indonesia joined the Partnership on August 27, 2010. Indonesia has opportunities for ethane capture-and-reuse projects in Coal Mines and Oil and Gas Systems and is looking to join both these subcommittees.

Upcoming Events

Annual Implementation Workshop
Oil and Gas Subcommittee Meeting
New Orleans, LA
November 1 to 3, 2010

Oil & Gas Investment Asia 2010
Singapore
October 26 to 29, 2010

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