

Well Completions

Program Description

This strategy to reduce ambient ozone levels within the non-attainment area (NAA) involves requiring or encouraging industry to use green completion methods while conducting gas well completions and well workovers located in the NAA.

Well completion is the last step of drilling a gas well, and involves cleaning the well bore and reservoir immediately surrounding the well. Sand, cuttings, and reservoir fluids (including condensate) from the well are collected in an open pit or tank for disposal, and produced natural gas is vented to atmosphere. These activities also occur after well workovers (also known as fracing operations), which are conducted to stimulate or prolong production.

Well completions typically last 1 to 8 days, usually with shorter durations in eastern Colorado and longer durations in western Colorado.^{1,2} Workover operation flowback typically lasts 2 days in eastern Colorado and to 1 to 4 weeks in western Colorado. The primary area of interest for this strategy is eastern Colorado, since that is where the NAA is located.

Green completion methods allow the natural gas and condensate to be recovered and sold, rather than being lost via venting or flaring. This is accomplished using portable equipment to process the natural gas. Equipment may include tanks, gas-liquid-sand separator traps, and gas dehydration units. These methods are most effective, and thus more economical, under the following circumstances:

- High well pressure (related to basin pressure)
- High volatile organic compound (VOC) concentrations
- Large well volumes
- Long flowback periods
- Natural gas gathering lines in place

Based on these circumstances, it is more beneficial to use green completion methods on wells located in western Colorado basins (i.e. Piceance Basin) than basins in eastern Colorado (i.e. Denver Julesburg (D-J) Basin). Eastern Colorado basins are at lower pressures and have smaller volumes or flowback (20-150 thousand cubic feet per well (Mcf/well)) than western Colorado basins (approximately 22 millions cubic feet per well (MMcf/well)).^{1,2}

Air Quality/Health and Welfare Benefits

Currently, when Colorado wells are completed without green completion methods, approximately 60 percent of natural gas is vented to the atmosphere and the remainder is flared.³ However, companies participating in the Independent Petroleum Association of Mountain States (IPAMS) Phase III Western Regional Air Partnership (WRAP) emission inventory indicated that flaring is not used during completions in the D-J Basin.⁴ Both venting and flaring result in the release of criteria pollutants, VOCs, and hazardous air pollutants (HAPs). When flares burn inefficiently, additional compounds may be formed, including polycyclic aromatic hydrocarbons (PAHs), and particulate matter (PM). NO_x is formed as part of normal flare operations.

The EPA has estimated that nationally 25.2 billion cubic foot (Bcf) of natural gas can be recovered per year using green completion methods. The majority of these savings (25,000 MMcf, or 99.2 percent) come from high pressure wells. The remaining savings come from low pressure wells (181 MMcf, or 0.7 percent) and well workovers (27 MMcf, or 0.1 percent).⁵ This indicates that using green completion methods to complete wells in the NAA, which are generally low pressure wells, will not greatly reduce natural gas emissions.

Even when green completion methods are used, emissions to atmosphere are not reduced completely. For example, one company has estimated that VOC emissions were reduced 70 percent when green completion methods are used.⁴ Some companies estimate that VOC emissions from well completions in eastern Colorado range from 1.5 to 3 tons per day per well. Western Colorado well completion VOC emissions average approximately 42 tons per day per well.^{1,2}

While health benefits are not quantified here, it is understood that reducing direct emissions of VOCs will reduce air toxics and other criteria pollutants. This will reduce the incidence of human health impacts caused by pulmonary, cardiovascular, respiratory, and nervous system disease. Because ozone damages crops, forests, and other natural plant life, all would benefit if emissions are reduced. This strategy would also reduce emissions of methane and other greenhouse gases, which contribute to climate change.

Program Costs

Green completions are capable of providing a net gain of \$8-\$9 per dollar spent based on a study performed at a western Colorado facility.⁶ This represents an upper limit of cost benefits that could be expected from green completions performed in the NAA. It may not be economically feasible to use green completion methods in the NAA, where only approximately 1 day or less is needed to complete wells (in western Colorado, they take up to 8 days).

Implementation/Administration

Because well completions are temporary sources, permitting them through the Colorado Air Pollution Control Division (APCD) is not practical. It is possible that green completions will be addressed by the Colorado Oil and Gas Conservation Commission (COGCC) Application for Permit to Drill process as part of the plan to implement Department of Natural Resource (DNR)/COGCC House Bill 1341.

If the APCD addresses green completions, an existing regulatory exemption would need to be removed in order for the APCD to permit well completions. In addition, green completions would need to be defined as they relate to D-J Basin. If the process is determined to be voluntary, mandatory reporting requirements would need to be developed. This strategy has the potential to significantly increase the number of regulated sources, and has reporting, permitting, and/or compliance assurance impacts to the APCD .

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Prepared by the Colorado Air Pollution Control Division. Primary contact: Rose Waldman at 303-692-3145 and Rose.Waldman@state.co.us

¹ Regional Air Quality Council (RAQC), *White Paper: Short-Term Ozone Reduction Strategies*, December 4, 2007

² Colorado Oil and Gas Association; Noble Energy, Inc.; Anadarko Petro Corporation; *Oil and Gas VOC Emissions and Controls in the DMA*, presented December 14, 2007 at RAQC meeting

³ ENVIRON, *WRAP Area Source Emissions Inventory Projections and Control Strategy Evaluation Phase II Final Report*, September 2007

⁴ ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, February 7, 2008

⁵ Four Corners Air Quality Task Force, *Four Corners Air Quality Task Force Report of Mitigation Options, Mitigation Option: Implementation of Reduced Emission Completions (Green Completions)*, November 1, 2007

⁶ Coalition of Colorado's Local Governments and Environmental Groups, *Early Action Measures to Help Protect Human Health from Ozone Pollution*, November 1, 2007