**ANALYSIS OF CO-PRODUCING WELL COMPLETIONS**
**DECEMBER 2013 (UPDATED MARCH 2014)**

EDF has previously analyzed methane emissions from co-producing completions based on 2012 completion reports from approximately 4,000 wells in the Bakken, Eagle Ford, and Wattenberg fields. This analysis used initial production data as a basis for understanding completion emissions, and calculated a potential emissions factor for these wells of 15.7 tons of methane per completion (compared to an estimate of 0.0076 tons of methane per completion in the 2011 annual inventory).[1] The analysis also estimated the costs of applying reduced emission completions ("REC") to these wells using assumptions from the technical documentation accompanying Subpart OOOO and, for the entire set of wells, determined that these costs averaged about $2,480/ton methane reduced.

In addition to this analysis, a recently-released study by researchers at the University of Texas[2] includes new empirical data directly measuring potential methane emissions from co-producing well completions. As discussed below, this data is largely consistent with our earlier analysis of the 2012 completion reports and, indeed, shows that our estimate of oil well completion emissions was conservatively low. Table 1 below presents summary data from that study on six well completions in which some amount of hydrocarbon liquids were produced, providing further information on completion emissions from these wells and the potential for emission reductions through REC technology.[3] We have also included the completion reports from the underlying dataset.

***Summary of Updated Analysis***

**TABLE 1: Summary of Potential Completion Emissions from Co-Producing Wells**

| Site Name | HC Produced (bbl) | Gas Produced (scf) | Potential Methane Emissions (scf) | Actual Emissions (scf) | % Reduction | % Hydrocarbon liquids | % Gas | Data analyzed? | Flowback Duration (hours) | REC or Flare |
|---|---|---|---|---|---|---|---|---|---|---|
| **GC-1** | 1,594 | 6,449,900 | 5,005,000 | 106,000 | 97.9 | 52 | 37 | Y | 75 | Flare |
| **GC-2** | 1,323 | 5,645,000 | 4,250,000 | 91,000 | 97.8 | 51 | 39 | Y | 76 | Flare |
| **GC-3** | 2,395 | 26,363,000 | 21,500,000 | 264,000 | 98.8 | 29 | 56 | Y | 28 | REC |
| **GC-4** | 1,682 | 24,353,000 | 13,000,000 | 180,000 | 98.6 | 24 | 60 | Y | 28 | REC |
| **GC-6** | 448 | 13,755,000 | 12,20,000 | 247,000 | 98.0 | 13 | 69 | N* | 164 | Flare |
| **GC-7** | 1,543 | 5,413,000 | 4,320,000 | 90,000 | 97.9 | 56 | 35 | N* | 108 | Flare |

*Data not used in developing average emissions factor in the University of Texas study because, in these completion flowbacks, the study team was unable to collect complete emission data for the initial flow to the open tank.

[1] *See* U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2011 Annex 3 at A-204 (April 2013), *available at* http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Annex-3-Additional-Source-or-Sink-Categories.pdf.

[2] David T. Allen et al., *Measurements of methane emissions at natural gas production sites in the United States*, PNAS Early Edition (2013), *available at* www.pnas.org/cgi/doi/10.1073/pnas.1304880110.

[3] The underlying study analyzed a total of 26 well completions.

**TABLE 2: Summary of Resource Value from Co-producing Completions**

| Site Name | Hydrocarbon Liquids Value[4] | Gas Value[5] | % Hydrocarbon Liquids Value | % Gas Value |
|---|---|---|---|---|
| **GC-1** | $159,400.00 | $25,799.60 | 86.1 | 13.9 |
| **GC-2** | $132,300.00 | $22,580.00 | 85.4 | 14.6 |
| **GC-3** | $239,500.00 | $105,452.00 | 69.4 | 30.6 |
| **GC-4** | $168,200.00 | $97,412.00 | 63.3 | 36.7 |
| **GC-6** | $44,800.00 | $55,020.00 | 44.9 | 55.1 |
| **GC-7** | $154,300.00 | $21,652.00 | 87.7 | 12.3 |

In NSPS OOOO, EPA defines a "gas well" or "natural gas well" as "an onshore well drilled principally for production of natural gas."[6] Depending on how this definition is interpreted, several or all of these wells may not need to perform RECs under Subpart OOOO's REC requirements because the value of the liquids produced exceeds the value of the gas produced. These wells, however, produced substantial pollution, with an average potential emissions factor of 193.5 metric tons of methane (compared to a potential emissions factor of about 150 metric tons of methane for gas wells that EPA used in the NSPS). Moreover, the UT data shows that completion emissions from these wells can be effectively reduced using the same clean air measures that NSPS OOOO requires for gas wells, including RECs and high efficiency flaring.

The state of Colorado requires reduced emission completions on "on oil and gas wells where reservoir pressure, formation productivity, and wellbore conditions are likely to enable the well to be capable of naturally flowing hydrocarbon gas in flammable or greater concentrations at a stabilized rate in excess of five hundred (500) MCFD to the surface."[7] Under this definition, all of the wells in the UT dataset would be required to perform green completions.

[4] Assuming $100/barrel.

[5] Assuming $4/Mcf.

[6] 40 C.F.R. 60.5430.

[7] *See* Co. Oil & Gas Conserv. Comm'n ("COGCC") Rule 805(b)(3)(A). The Rule does not require green completion practices for exploratory wells (that are not sufficiently proximate to sales lines) or where green completion practices are otherwise not technically and economically feasible.

### *Co-producing REC Cost Analysis for UT Wells*

Using information on the cost of RECs drawn from EPA's 2011 technical support document for the NSPS, we determined the cost-effectiveness of RECs for these six wells both before and after taking account of savings from recovered product. As shown in the table below, we determined that RECs on these wells would yield significant net savings.

| **Potential Emission Factor**[8] | **REC Cost**[9] | **Cost effectiveness (with savings)** | **Cost effectiveness (without savings)** |
|---|---|---|---|
| 193.5 metric tons $CH_4$ | $29,022 | -132.7* | 153.8 |

* On average, these wells would achieve net savings of $25,630 by selling gas recovered during completions.

[8] For this figure we averaged the methane emissions of the six wells, yielding a figure of 10,030,000 scf, and applied the EPA conversion factor of 19.26 g $CH_4$/scf.

[9] Figure provided by EPA, *Oil and Natural Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, Background Technical Support Document for Proposed Standards* (July 2011), *available at* http://www.epa.gov/airquality/oilandgas/pdfs/20110728tsd.pdf.