

## Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Hydraulically Fractured Gas Well Completions and Workovers Estimate

### Revision Implemented in Public Review Draft

#### **Overview of Method in 2014 Inventory (estimates for 1990-2012)**

EPA’s 2014 Inventory was updated from the previous (2013) Inventory to use emission factors for hydraulically fractured gas well completions and workovers, developed from combined reporting year 2011 and 2012 Greenhouse Gas Reporting Program (GHGRP) data<sup>1</sup> for four stratified control technology categories.<sup>2</sup> For more information please see memo “Overview of Update to Methodology for Hydraulically Fractured Gas Well Completions and Workovers in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012 (2014 Inventory).”

#### **Analysis for Update in 2015 Expert Review Draft Inventory**

In September 2014, EPA published new 2013 GHGRP data and refreshed data for 2011 and 2012 based on resubmissions from facilities.<sup>3</sup> EPA reviewed the data and developed options for updated emission factors for gas well completions and workovers with hydraulic fracturing using 2013 GHGRP data alone and combined 2011-2012-2013 GHGRP data.

Table 1 below compares suites of emission factors for gas well completions and workovers with hydraulic fracturing based on GHGRP data. The first column shows the emission factors that were used in the 2014 Inventory which were developed using 2011 and 2012 GHGRP data (reflecting submissions from facilities as of September 1, 2013). The second through fourth columns show emission factors developed using the most recently published GHGRP data (reflecting submissions from facilities as of August 18, 2014). The second column shows emission factors developed using the updated GHGRP data for the years 2011 and 2012. The third column shows emission factors developed using only the GHGRP data for the year 2013. The fourth column shows emissions factors developed using GHGRP data for 2011, 2012, and 2013. Generally, emissions per event reported to the GHGRP in 2013 are lower than in previous years.

**Table 1. Methane EFs for HF Gas Well Completions and Workovers (MT CH<sub>4</sub>/event)**

<b>Control Category</b>	<b>2014 Inventory (using 2011-2012 GHGRP as of 9/1/13)</b>	<b>2011-2012 GHGRP (as of 8/18/14)</b>	<b>2013 GHGRP (as of 8/18/14)</b>	<b>2011-2012-2013 GHGRP (as of 8/18/14)</b>
Non-REC/Vent	40.6	38.0	28.8	36.8
Non-REC/Flare	5.0	5.2	3.7	4.9
REC/Vent	3.2	3.2	3.3	3.2
REC/Flare	5.9	5.4	4.0	4.9

<sup>1</sup> The GHGRP data in the 2014 Inventory reflect report submissions from facilities as of September 1, 2013.

<sup>2</sup> The four categories are: HF gas well completions and workovers that vent, flared HF gas well completions and workovers, HF gas well completions and workovers with reduced emissions completions (RECs), and HF gas well completions and workovers with RECs that flare.

<sup>3</sup> The GHGRP data published in September 2014 reflect report submissions from facilities as of August 18, 2014.

Table 2 below summarizes the activity data used in the 2014 Inventory.

**Table 2. 2014 Inventory Activity Data for HF Gas Well Completions and Workovers**

Control Category	Distribution of Events (% of Total)	
	2011	2012
Non-REC/Vent	42%	44%
Non-REC/Flare	12%	7%
REC/Vent	35%	32%
REC/Flare	12%	17%
Total # Events	11,234 events	10,664 events

Table 3 below summarizes the activity data associated with the refreshed and new GHGRP data (reflecting submissions from facilities as of August 18, 2014).

**Table 3. Updated Activity Data for HF Gas Well Completions and Workovers**

Control Category	Distribution of Events (% of Total)		
	2011	2012	2013
Non-REC/Vent	41%	34%	22%
Non-REC/Flare	12%	8%	11%
REC/Vent	35%	37%	41%
REC/Flare	12%	21%	27%
Total # Events	11,204 events	9,136 events	7,785 events

**Update in the 2015 Inventory Public Review Draft**

For the draft 2015 Inventory estimates, EPA used the suite of emission factors based on combined 2011-2012-2013 data (shown in the far right column of

Table 1) for all Inventory years. EPA used event count activity data for years 1990 through 2010 developed from DrillingInfo data, and used the most recently published GHGRP activity data for 2011, 2012, and 2013 (shown in Table 3). EPA used the 2014 Inventory’s methodology for apportioning events among the four control categories in each year.

A facility in the petroleum and natural gas systems source category of the GHGRP is required to submit annual reports if total emissions are 25,000 metric tons carbon dioxide equivalent or more. Due to the reporting threshold in the GHGRP, using data from the GHGRP alone will not provide a complete national estimate of activity data and emissions. EPA analyzed data from DrillingInfo to assess whether this data source indicates higher event counts than GHGRP and therefore may be used to generate a more complete representation of national activity. The revisions to the processing of DrillingInfo data did not result in completion and workover counts higher than those reported to GHGRP. Please see memo *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Revision to Well Counts Data* for more information on processing of DrillingInfo data.

**Preliminary Results (Estimates in 2015 Expert Review Draft)**

Changes made to the emission factors for gas well completions and workovers with hydraulic fracturing resulted in a decrease in the estimate of CH<sub>4</sub> emissions for all years in the time series. This overall decrease is accompanied by declining emissions over time, reflecting a decrease in these emissions due to impacts of the 2012 NSPS for oil and gas (in effect as of October 2012) which requires the use of control technologies for gas well completions and workovers with hydraulic fracturing.

**Table 4. National Emissions (MT CH<sub>4</sub>) by Category for HF Gas Well Completions and Workovers**

<b>Emission Source</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2013</b>
HF Completions and Workovers that Vent	114,243	108,459	247,262	367,040	192,737	61,737
HF Completions and Workovers that Flare	1,691	1,606	3,661	7,089	5,352	4,100
HF Completions and Workovers with RECs	-	-	-	7,378	11,141	10,229
HF Completions and Workovers with RECs that Flare	-	-	-	3,700	5,587	10,326
<b>Total</b>	<b>115,934</b>	<b>110,065</b>	<b>250,923</b>	<b>385,207</b>	<b>214,817</b>	<b>86,392</b>

**Request for Stakeholder Feedback**

- EPA considered several options for developing emission factors, including average factors using all years of GHGRP data (the approach used in the Expert Review draft), or use of year-specific emission factors. EPA seeks feedback on the approach selected and other options.
- EPA received comments on the 2014 Inventory recommending that EPA use only two emission factors: one for wells with controls (REC and/or flare) and one for wells without controls. In the 2015 Public Review draft, EPA retains the four-factor approach. While the approaches would produce very similar results, some transparency would be lost in using the two factor approach. Specifically, the Inventory would not distinguish between emissions from flaring versus emissions from RECs. EPA seeks feedback on whether this level of granularity is useful in the Inventory, or whether a two-factor approach is sufficient.
- Consistent with the 2014 Inventory, the 2015 Public Review draft calculates emissions for gas well completions and workovers with hydraulic fracturing using national level emission factors and national percentages for the control technology categories. EPA is considering developing and applying emission factors and/or activity data fractions for each NEMS region using the GHGRP data. EPA seeks comment on this update under consideration.
- EPA seeks feedback on the input data used to calculate emissions for this source—HF gas well completion and workover counts. Please see the memo “Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Data Source for Well Counts.”