

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

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

EPA’s 2014 Inventory was updated from the 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) data¹ for four stratified control technology categories.² 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 Inventory

In September 2014, EPA published new 2013 GHGRP data and refreshed data for 2011 and 2012 based on resubmissions from facilities.³ 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 GHGRP data 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 CH₄/event)

Control Category	2014 Inventory (using 2011-2012 GHGRP as of 9/1/13)	2011-2012 GHGRP (as of 8/18/14)	2013 GHGRP (as of 8/18/14)	2011-2012-2013 GHGRP (as of 8/18/14)
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

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

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

² 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.

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

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 GHGRP data submissions from facilities as of August 18, 2014.

Table 3. Updated Activity Data for HF Gas Well Completions and Workovers in 2015 Inventory

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

For the 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.

EPA solicited feedback from expert reviewers⁴ and public reviewers on several options for developing and applying revised EFs for this source in the GHG Inventory. Reviewers generally supported the use of the updated GHGRP data set, but suggested exclusion of the 2011 year reports, removal of outliers, and use of only measured data. Reviewers suggested the use of two control categories versus four, and disaggregating factors for completions versus workovers. Reviewers suggested that for the 2016 GHG Inventory, EPA review new GHGRP data (reported March 2015) for development of regional emission factors and activity data.

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

⁴ Every year, the Inventory undergoes an expert review period during which a first draft of the document is sent to a select list of technical experts outside of EPA. The purpose of the Expert Review is to encourage feedback on the methodological and data sources used in the current Inventory, especially for sources which have experienced any changes since the previous Inventory. This memorandum references feedback from 2015 Inventory expert reviewers.

April 2015

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.

Results (Estimates in 2015 Inventory)

Changes made to the emission factors for gas well completions and workovers with hydraulic fracturing resulted in a decrease in the estimate of CH₄ emissions for all years in the time series. This overall decrease due to the update to emission factors and activity data 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 below presents CH₄ emissions from HF gas well completions and workovers in the 2015 GHG Inventory.

Table 4. National Emissions (MT CH₄) by Category for HF Gas Well Completions and Workovers

Emission Source	1990	1995	2000	2005	2010	2013
HF Completions and Workovers that Vent	145,512	130,644	262,232	384,313	192,737	61,737
HF Completions and Workovers that Flare	2,154	1,934	3,882	7,422	5,352	4,100
HF Completions and Workovers with RECs	-	-	-	7,725	11,141	10,229
HF Completions and Workovers with RECs that Flare	-	-	-	3,874	5,587	10,326
Total	147,667	132,578	266,114	403,335	214,817	86,392