

CO₂ Revisions Under Consideration for the 2018 GHGI

Stakeholder Workshop

June 22, 2017

OVERVIEW

- Current GHGI CO₂ Methodology
- Available Subpart W Data
- CO₂ Revisions Under Consideration
 - Production Sources
 - Processing Sources
 - Transmission and Storage Sources
- National Emissions Estimates

Current GHGI Methodology: CO₂-to-CH₄ Gas Content Ratio

- Most sources calculate CO₂ EFs using CH₄ EFs and an assumed ratio of CO₂-to-CH₄ gas content
 - Methodology is used for certain venting and fugitive emissions, which are predominantly CH₄ with minimal CO₂ emissions

$$\text{CO}_2 \text{ EF} = \text{CH}_4 \text{ EF} * \left(\frac{\text{CO}_2 \text{ content}}{\text{CH}_4 \text{ content}} \right)$$

- Default CO₂ and CH₄ gas content values are used and vary by segment
- A different methodology is applied to calculate CO₂ EFs for tanks, AGR, and combustion sources (e.g., flares)

Current GHGI Methodology: CO₂-to-CH₄ Gas Content Ratio (Default Values)

Segment	CH ₄ Content (vol%)	CO ₂ Content (vol%)
Production – North East region	78.8	3.04
Production – Mid Central region		0.79
Production – Gulf Coast region		2.17
Production – South West region		3.81
Production – Rocky Mountain region		7.58
Production – West Coast region		0.16
Processing – Before CO ₂ removal	87.0	3.45
Processing – After CO ₂ removal		1.0
Transmission and Underground NG Storage	93.4	1.0
LNG Storage and LNG Import/Export	93.4	1.16
Distribution	93.4	1.0

Current GHGI Methodology: Source-Specific

- Oil and Condensate Tanks
 - CO₂ EFs developed using API TankCalc software
- AGR units at processing plants
 - The difference in the default CO₂ content before and after CO₂ removal is assumed to be emitted (3.45% - 1.0% = 2.45% of processing plant gas throughput)

Current GHGI Methodology: Source-Specific (Flaring)

- Production and processing flaring emissions
 - Second largest source of oil and gas CO₂ emissions in the current GHGI
 - Based on EIA “Vented and Flared” volumes, which represent a balancing factor to reconcile upstream and downstream gas volumes, and is gas that is potentially emitted to the atmosphere during production or processing operations
 - GHGI assumes all EIA Vented and Flared gas is flared
 - Calculated under a single line item in the GHGI. EIA data cannot distinguish between gas production, petroleum production, and gas processing emissions. As a result, GHGI assigns all emissions to gas production
- Transmission and storage and distribution flaring not included in current GHGI

Available Subpart W Data

- Subpart W activity and emissions data are used in the current GHGI to calculate CH₄ emissions for several production, processing, and transmission and storage sources
- For these sources, CO₂ emissions data from subpart W have not yet been incorporated into the GHGI
 - Facilities use an identical reporting structure for CO₂ and CH₄. Therefore, where subpart W CH₄ data have been used, the CO₂ data may be incorporated in an identical manner

Available Subpart W Data

- Subpart W data for AGR vents (CO₂) and flare stacks (both CH₄ and CO₂) have not been incorporated into GHGI
- Flare stacks data available for:
 - Production (“miscellaneous flaring”) - reported under “flare stacks” source if emissions originate from sources not otherwise covered. For example, production tank flaring is reported under the tanks source and not under flare stacks
 - Transmission compression, underground natural gas storage, LNG storage and LNG import and export equipment. As of RY2015, all flaring emissions are reported under flare stacks

REVISIONS UNDER CONSIDERATION:
SOURCES WITH EXISTING SUBPART
W-BASED CH₄ METHODOLOGY

Production CO₂ EFs – Associated Gas

- Subpart W RY2011-RY2015 data

Year	Associated Gas Venting			Associated Gas Flaring		
	#Venting Wells	Venting CO ₂ Emissions (MMT)	Venting EF (kg/well)	#Flaring Wells	Flaring CO ₂ Emissions (MMT)	Flaring EF (kg/well)
2011	8,863	0.012	1,336	5,628	3.72	661,723
2012	8,554	0.016	1,902	7,259	6.88	948,057
2013	6,980	0.005	773	8,880	9.61	1,081,842
2014	7,264	0.013	1,754	12,189	11.05	906,608
2015	4,286	0.011	2,675	21,606	10.31	477,254

Production CO₂ EFs – Tanks

- Subpart W RY2015 data

Tank Category	Oil Tanks EF (kg/bbl)	Condensate Tanks EF (kg/bbl)
Large Tanks with Flaring	7.16	8.44
Large Tanks with VRU	0.040	0.12
Large Tanks without Controls	0.016	0.020
Small Tanks with Flaring	0.26	1.95
Small Tanks without Flares	0.078	0.28
Malfunctioning Dump Valves	0.013	8.28E-05

Production CO₂ EFs – Gas Well Completions & Workovers

- Subpart W RY2011-RY2013 data. EF equals average of all three years

Category	# of Events			CO ₂ Emissions (mt)			CO ₂ EF (kg/event)
	2011	2012	2013	2011	2012	2013	
Non-REC/Vent	3,901	2,370	1,308	11,700	2,681	7,214	2,849
Non-REC/Flared	1,171	538	422	1,203,235	363,631	192,235	825,481
REC/Vent	2,224	1,283	1,566	3,745	151	995	964
REC/Flared	818	968	1,129	485,313	387,280	460,691	457,387

Processing Grouped Sources

- Subpart W RY2015 data

Emission Source	CO ₂ Emissions (mt)	Activity Count (plants or compressors)		CO ₂ EF (kg/compressor or kg/plant)
Reciprocating compressors	7,818	2,662	compressors	2,937
Centrifugal compressors with wet seals	1,259	264	compressors	4,768
Centrifugal compressors with dry seals	20	214	compressors	400
Dehydrators	7,433	467	plants	15,916
Flares	4,503,224	467	plants	9,642,878
Plant fugitives	2,291	467	plants	4,906
Plant Grouped Sources	4,522,046	467	plants	9,683,181

Other CO₂ Emission Sources

- Production
 - Pneumatic Controllers (subpart W RY2014 data)
 - Pneumatic Pumps (subpart W RY2014 data)
 - Liquids Unloading (subpart W RY2011-2015 data)
- Processing
 - Blowdowns and Venting (subpart W RY2015 data)
- Transmission and Storage
 - Pneumatic Controllers (subpart W RY2011-2015 data)

REVISIONS UNDER CONSIDERATION:
SOURCES WITHOUT EXISTING
SUBPART W-BASED CH₄
METHODOLOGY

Miscellaneous Production Flaring

- Assigned subpart W RY2015 flaring emissions to gas and oil production based on ratio of reported gas/oil well counts for each facility

Total CO ₂ Emissions (mt)	Natural Gas Production			Oil Production		
	CO ₂ Emissions (mt)	Total Gas Wells	CO ₂ EF (kg/well)	CO ₂ Emissions (mt)	Total Oil Wells	CO ₂ EF (kg/well)
3,779,110	1,299,672	307,737	4,223	2,479,438	219,433	11,299

Processing – AGR

- Applied similar methodology as other processing sources using subpart W data; total reported AGR emissions divided by total reported plant count for each RY

Year	CO ₂ Emissions (mt)	Activity Count (plants)	CO ₂ EF (kg/plant)
2011	16,093,040	374	43,029,519
2012	15,692,240	403	38,938,561
2013	13,201,139	438	30,139,587
2014	12,559,555	479	26,220,366
2015	10,048,285	467	21,516,669

Transmission & Storage Flares

- Subpart W RY2015 data
- Total reported emissions divided by total reported station count

Station Type	Total # Stations	# Stations With Flares	# Flares	Total CO ₂ Emissions (mt)	CO ₂ EF (kg/station)
Transmission	521	16	24	28,511	54,723
Underground Storage	53	8	21	3,576	67,479
LNG Storage	7	2	2	259	37,042
LNG Import	7	2	3	77,420	11,059,970

National Emissions for 2015 (mt CO₂), from 2017 GHGI compared with proposed update

Industry Segment & Emission Source	Natural Gas Systems		Petroleum Systems	
	2017 GHGI	Draft Update	2017 GHGI	Draft Update
Production	18,585,048	4,855,904	640,443	44,233,703
Associated Gas			826	28,582,015
Tanks	30,426	1,108,346	519,934	8,643,876
Miscellaneous Flaring	17,628,522	1,860,355	incl. w/NG	6,864,989
Gas HF Completions/Workovers	91,965	1,129,883		
Other Production Sources	834,135	757,319	119,683	142,823
Processing	23,713,206	20,826,478		
AGR Vents	23,643,456	14,351,618		
Plant Grouped Sources	63,662	6,458,775		
Blowdowns/Venting & Pneumatics	5,837	16,085		
Transmission & Storage	38,694	250,095		
Flares	0	211,664		
Other Transmission Sources	38,694	38,431		
Distribution	13,988	13,988		
Refining			2,926,666	2,926,666
Source Category Total	42,350,936	25,946,465	3,567,110	47,160,369
Source Category Difference	-16,404,470		+43,593,260	
TOTAL Difference		+27,188,789		

Emissions for sources that were not under consideration were kept constant between the 2017 and 2018 GHGI for purposes of this table.

Requests for Stakeholder Feedback

1. The general approach of using subpart W reported CO₂ emissions data to revise the current CO₂ emissions calculation methodology
2. Developing an emissions per well EF for miscellaneous production flaring
3. Years of subpart W data to include for miscellaneous production flaring and transmission and storage flares
4. Time series considerations for transmission and storage flares; apply the subpart W EFs to all years or assume flares did not operate in 1990 (i.e., an EF of 0)