Natural Gas & Petroleum Systems: Other Updates under Consideration for the 2019 GHGI

EPA Workshop

October 17, 2018

OVERVIEW

- **Topic area 1: Incorporation of GHGRP data**
  - HF oil well completions and workovers
  - N_2O emissions from flaring
  - Transmission pipeline blowdowns
- **Topic area 2: Improvements to well-related activity data**
  - Well drilling
  - Well completions and workovers
  - Definition of oil vs. gas well
  - Identification of HF wells
- **Topic area 3: Anomalous leak events**

Topic Area 1: Incorporation of GHGRP Data

Incorporating GHGRP Data: HF Oil Well Completions & Workovers

- Current GHGI methodology
  - HF oil well completions
    - Controlled and uncontrolled CH_4 EFs calculated from 2015 NSPS OOOOa data
    - Activity developed by analyzing DrillingInfo data on well-level dates of completion or first reported production
    - Assumptions applied to develop AFs for apportioning total counts into control categories: from 2008 forward, 7% of completions are RECs (based on 2008 CO and WY REC regulations)
  - HF oil well workovers
    - GHGI does not distinguish HF from non-HF, uses an EF developed for conventional wells and an assumption that 7.5% of all oil wells are worked over in each year
  - CO_2 emissions based on CO_2 EFs developed by applying a default production segment ratio of CO_2-to-CH_4 gas content

Incorporating GHGRP Data: HF Oil Well Completions & Workovers (cont.)

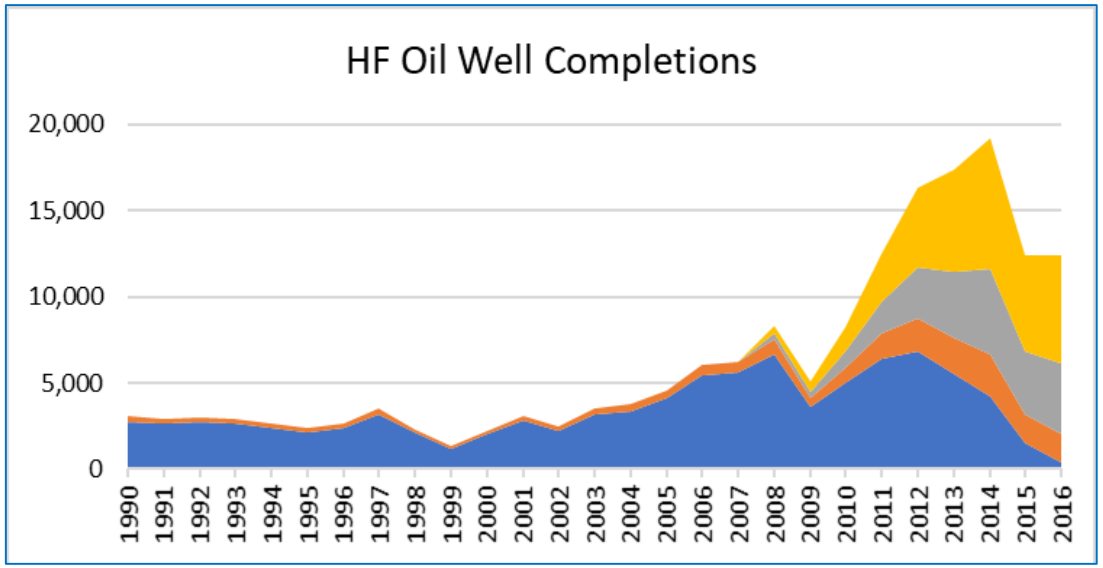
- Available data from GHGRP
  - HF oil well events newly reported under subpart W as of RY2016
  - 4 control categories (same as those for HF gas well events)

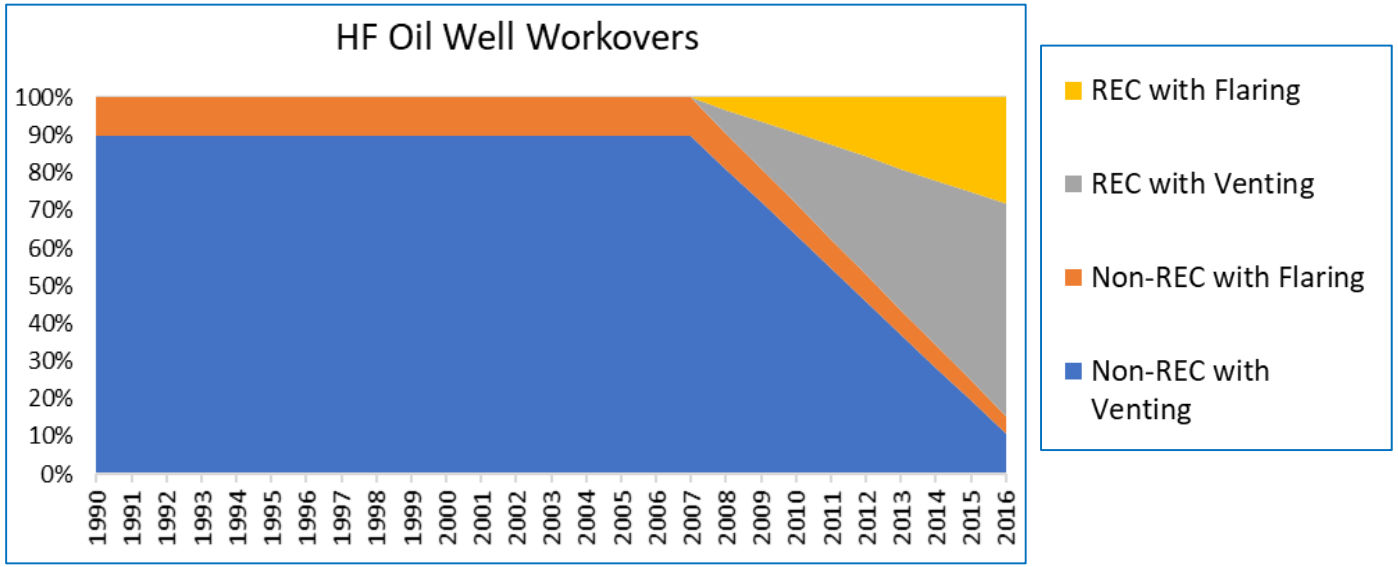
- Subpart W Calculated EFs, Year 2016

Event Type	Control Category	CH_4 EF (mt/event)		CO_2 EF (mt/event)	
		2018 GHGI	Subpart W	2018 GHGI	Subpart W
Non-REC	Vent	6.8	36.0	0.4	0.8
	Flare		1.1		248.8
REC	Vent	0.3	1.3	0.02	0.1
	Flare		2.6		287.1

Incorporating GHGRP Data: HF Oil Well Completions & Workovers (cont.)

- Activity factors for 4 control categories over the time series
  - Apply parallel approach as used for gas well events in the GHGI
  - Incorporate current HF oil well-specific assumptions for control category split over the time series





- Separately consider improvements to national activity estimates (based on DrillingInfo data)

Incorporating GHGRP Data: HF Oil Well Completions & Workovers (cont.)

- Stakeholder feedback received thus far has generally supported incorporation of GHGRP data for this source

Preliminary National Activity and Emissions Estimates, Select Years

Data Element	1990	2000	2005	2010	2015	2016
HF oil well completions (#)	3,075	2,246	4,594	8,188	12,438	12,438
HF oil well workovers (#)	846	848	947	1,235	1,916	1,884
Total CH_4 emissions (kt)	128	101	180	222	95	46
2018 GHGI CH_4 emissions (kt)	*21*	*15*	*31*	*52*	*79*	*79*
Total CO_2 emissions (kt)	100	79	142	688	2,179	2,402
2018 GHGI CO_2 emissions (kt)	*1*	*1*	*2*	*3*	*4*	*4*

Incorporating GHGRP Data: Flaring N_2O Emissions

- Flaring N_2O emissions are not currently in GHGI
  - N_2O from fuel combustion accounted for in the Energy chapter of the GHGI
- EPA is considering applying existing source-specific CH_4 methodologies to develop N_2O EFs directly from GHGRP data
- EPA estimated national total year 2016 N_2O emissions from flaring as approximately 200 mt (<0.1 MMT CO_2e)

Emission Source	Reported GHGRP N_2O (mt)	Est. National N_2O (mt)
Natural Gas & Petroleum Production	**96**	**148**
Tank Flaring	9.3	16.7
Associated Gas	21.6	26.9
NG: Flared Gas Well Completions and Workovers	2.1	2.3
Petro: Flared Oil Well HF Completions and Workovers	18.2	52.5
Miscellaneous Production Flaring	7.7	10.4
Well Testing	0.0	0.1
Gathering and Boosting Stations	25.9	28.0
Offshore Production	10.9	10.9
Natural Gas Processing	**10**	**16**
Flare Stacks	10.4	15.5
Transmission and Storage	**0.2**	**0.2**
Transmission Station Flare Stacks	0.0	0.0
Storage Station Flare Stacks	0.0	0.0
LNG Storage Station Flare Stacks	0.0	0.0
LNG Import/Export Station Flare Stacks	0.2	0.2
Petroleum Refining	**36**	**36**
Flare Stacks	36.0	36.0

Incorporating GHGRP Data: Transmission Pipeline Blowdowns

- Current GHGI methodology
  - CH_4 emissions are calculated using an EF from GRI/EPA 1996 and annual transmission pipeline miles from DOT/PHMSA.
  - CO_2 emissions based on CO_2 EFs developed by applying a default downstream gas profile of 93.4% CH_4 and 1.0% CO_2.
- Newly reported GHGRP source as of RY2016
  - EPA calculated an EF from subpart W RY2016 data, which reflect approximately 50% of the total transmission pipeline mileage estimated in the current GHGI (147,000 of 300,000 miles).
- EPA seeks stakeholder feedback on how to incorporate Subpart W-based EFs in the 2019 GHGI

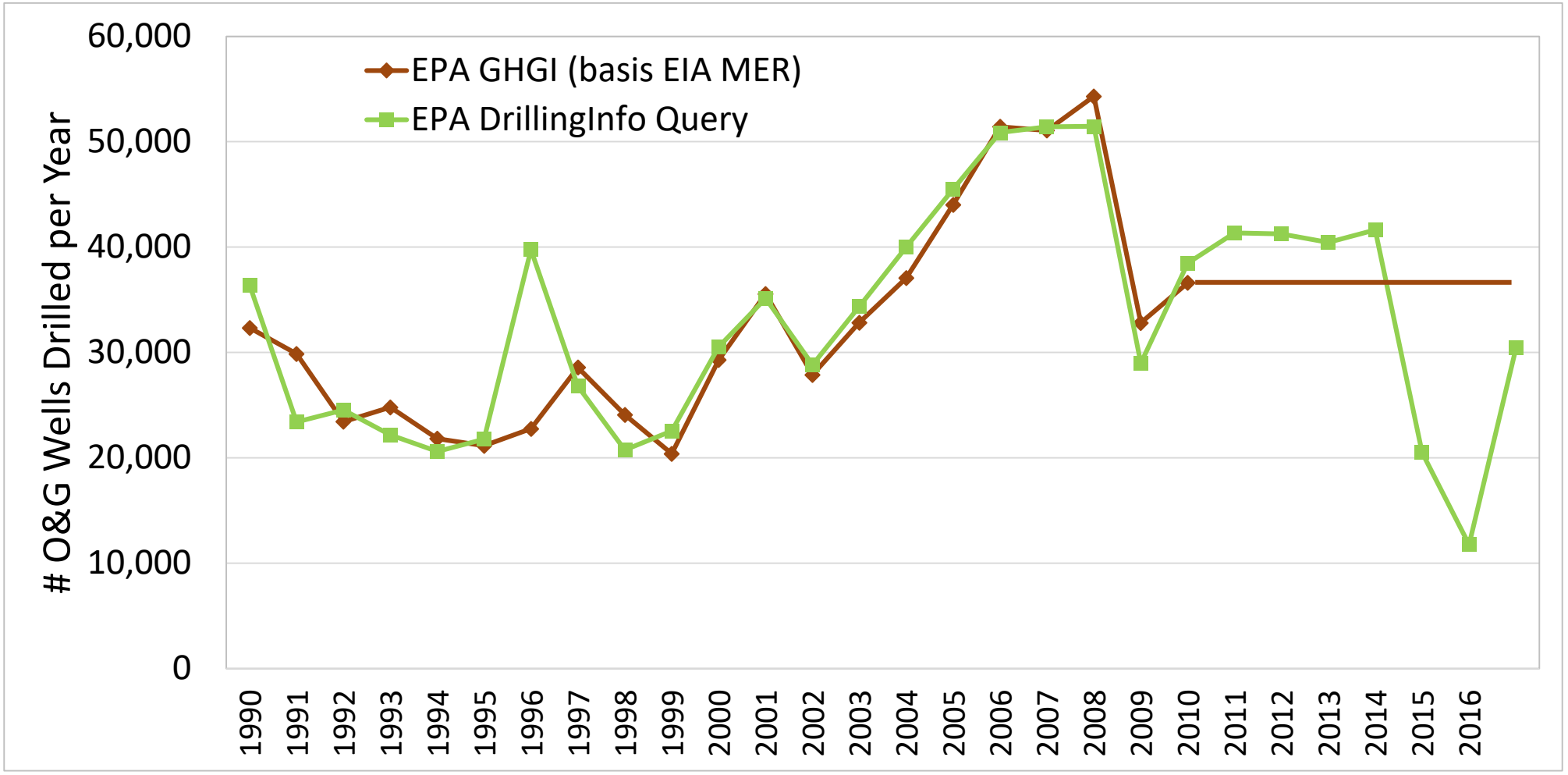
Data Source	CH_4 mt/mile	CO_2 mt/mile
Current GHGI	0.6	0.01
Subpart W (RY2016)	1.2	0.02

Topic Area 2: Improvements to Well-Related Activity Data

Well-Related Activity Data: Well Drilling

- DOE/EIA no longer maintains the well drilling activity data set within its *Monthly Energy Review* publication (only covers through 2010)
- GHGI requires a new data source for the entire time series, or at least 2011 forward
- EPA reviewed other EIA data sets and sought stakeholder feedback
- EPA developed a DrillingInfo-based methodology: count all wells in time series year "N" with spud date within year "N" ***or*** blank spud date and first production within year "N+1"
- Stakeholder feedback received thus far has generally supported the DrillingInfo-based update

Well-Related Activity Data: Well Drilling (Cont.)



Well-Related Activity Data: Well Completions and Workovers

- EPA is continuing to review GHGRP data and seek stakeholder feedback to consider its use in updated methodologies and/or to inform improvements (e.g., updating the DrillingInfo analysis methodologies)

Activity Data Element	Current Basis
Non-HF gas well completion counts	Scaled from base year 1992 counts (1996 GRI/EPA study)
Non-HF oil well completion counts	#Oil wells drilled (EIA) minus #HF oil well completions (DrillingInfo)
HF gas well completions	Subpart W as-reported counts
HF oil well completions	DrillingInfo analysis
Workover rates	• 1% for HF wells • 4.35% for non-HF gas • 7.5% for non-HF oil

Well-Related Activity Data: Well Completions and Workovers (Cont.)

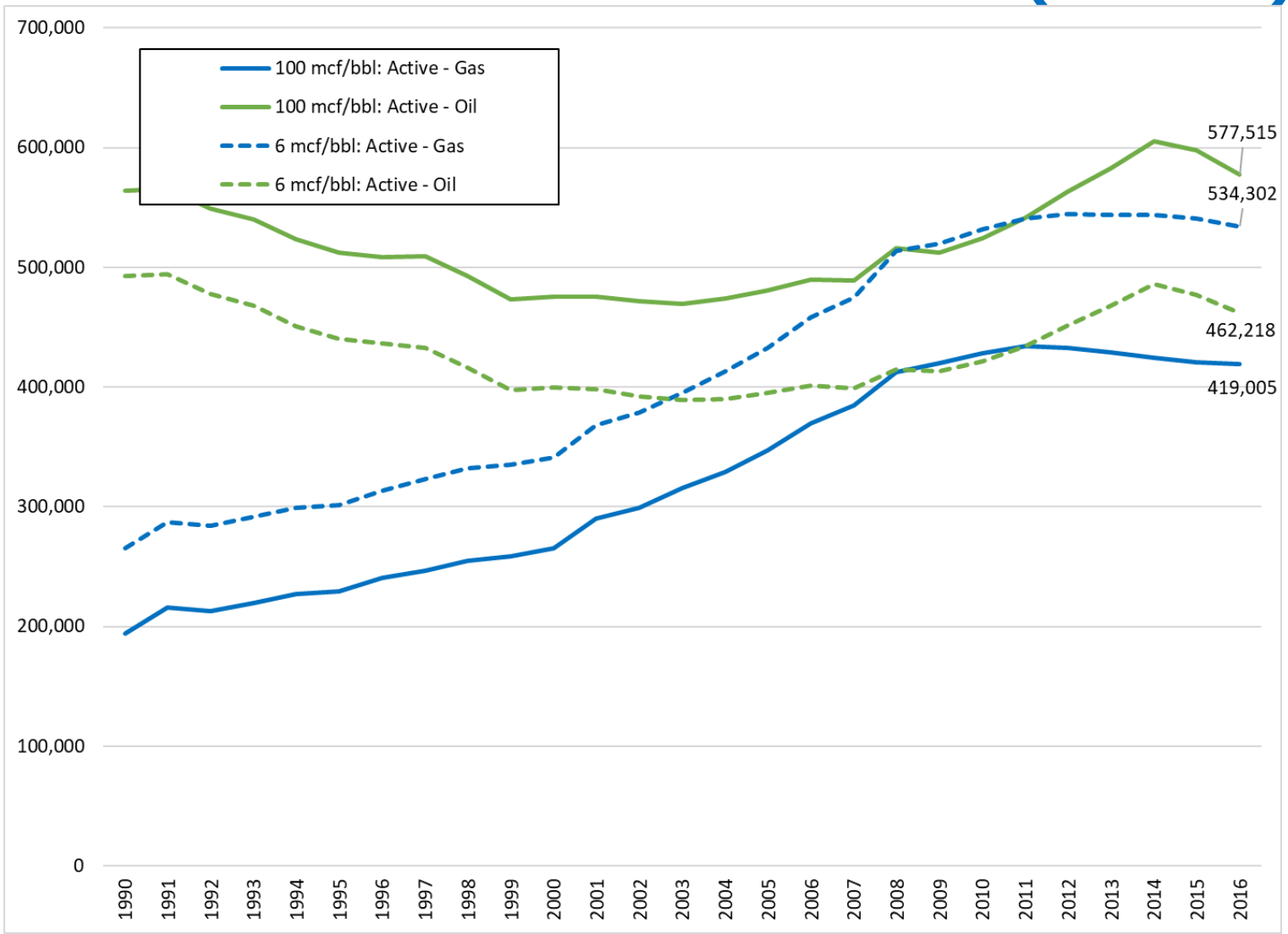
- Stakeholders have recommended using available GHGRP data to update the GHGI specifically for the following types of gas well events:

Activity Data Element	Current GHGI			GHGRP As-reported	
	Current Basis	2015	2016	2015	2016
Non-HF gas well completion counts	Scaled from 400 events/year in 1992	786	770	108	88
Non-HF gas well workover counts	4.35% of active non-HF gas wells	7,549	7,315	18,031	14,957
HF gas well workovers	1% of active HF gas wells	2,521	2,487	263	103

Well-Related Activity Data: Definition of Oil vs. Gas Well

- Current GHGI methodology based on DrillingInfo data analysis:
  - Gas-to-oil ratio (GOR) of 100 mcf/bbl used to delineate “oil” from “gas” wells
- EPA reviewed data reported under GHGRP subpart W to evaluate how reported GOR values compare to the current GHGI assumptions
  - For most oil wells reported under subpart W (73% of RY2015-2016 data), the sub-basin level average GOR falls within the current GHGI definition (≤100 mcf/bbl); while a significant fraction (27%) have higher average GORs.
  - At a lower delineation threshold (e.g., 6 mcf/bbl), an even higher fraction of subpart W oil wells (roughly 50%) would be considered gas wells in the GHGI.
  - Therefore, EPA finds support for the current approach to delineate oil versus gas wells.

Well-Related Activity Data: Definition of Oil vs. Gas Well (Cont.)



Well-Related Activity Data: Heavy vs. Light Crude Equipment Service

- The current GHGI uses separate EFs and activity data for wellheads, separators, and headers in heavy crude (<20^{o} API gravity) versus light crude service
  - Current assumptions developed in the 1990's
  - 7% of oil wells produce heavy crude; 93% produce light crude
  - 10% of separators in heavy crude service; 90% in light crude service
- EPA reviewed available data from subpart W data to consider how GHGI methodology can account for changing trends over time
  - Approximately 18-19% of subpart W wellheads produce heavy crude in recent years; significantly higher than current assumption
  - Note that earlier analysis used production split as surrogate for well count split, which might actually significantly differ

Well-Related Activity Data: Heavy vs. Light Crude Equipment Service (Cont.)

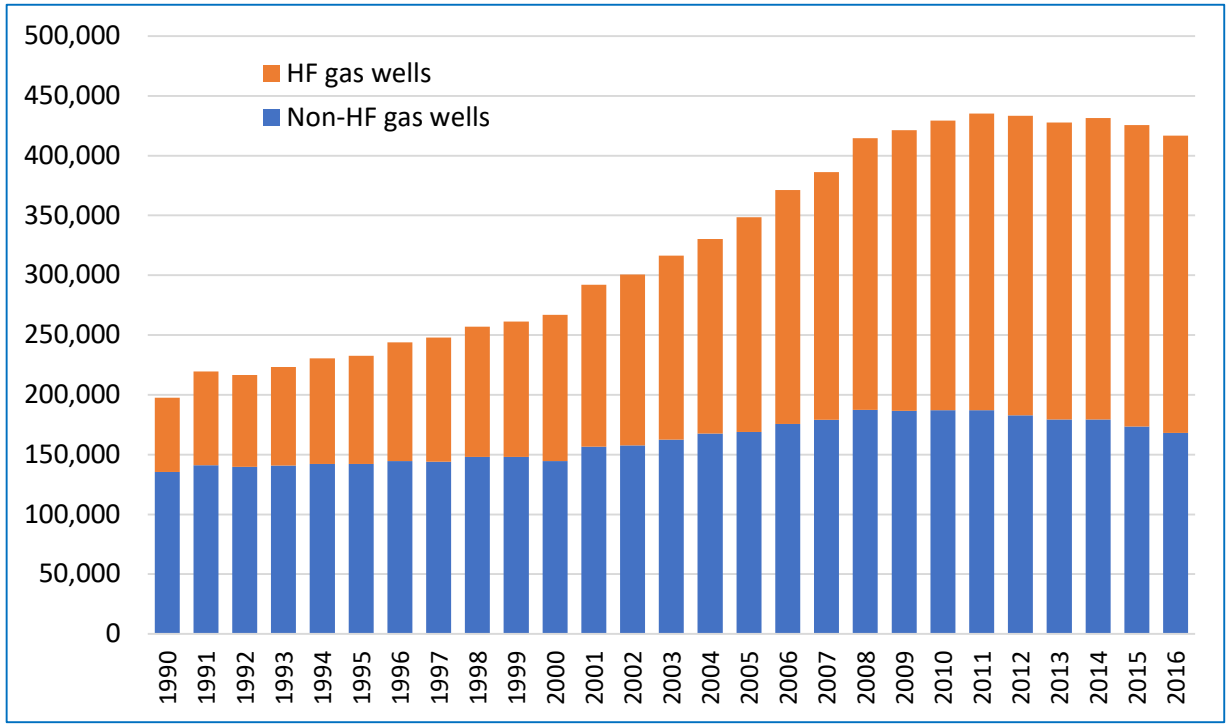
- EPA also analyzed state-level production data from EIA regarding heavy versus light crude production (replicating 1990's methodology).
  - Approximately 4-5% of Lower 48 production is heavy crude, similar to existing assumption
- EPA is considering using subpart W data to estimate the split between heavy and light crude wellheads in recent years and/or develop crude type-specific activity factors (e.g., separators per heavy or light crude wellhead).

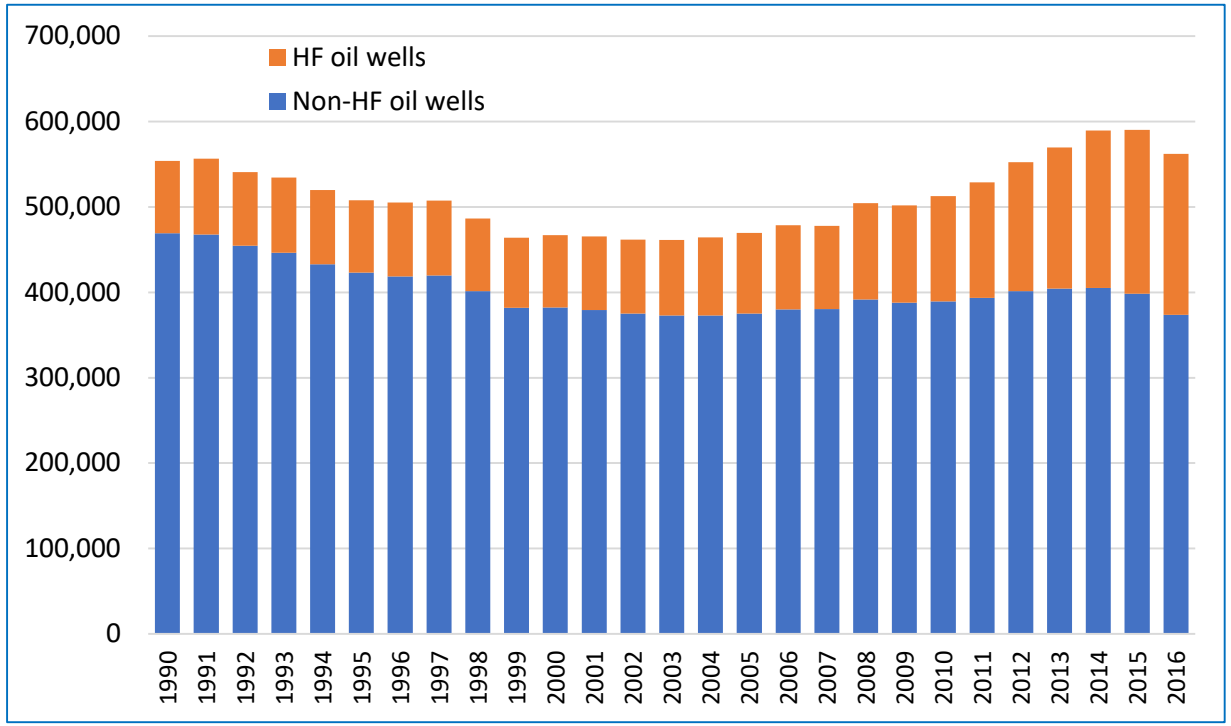
Well-Related Activity Data: Identification of HF Wells

- The current GHGI methodology identifies HF wells as those horizontally drilled (based on DrillingInfo data) and/or located in a shale, low permeability, or coalbed formation
- EPA is identifying options to revise this methodology to improve accuracy and increase transparency
- In year 2016, EIA estimates 670,000 total active HF wells; the current GHGI estimates 440,000 HF wells
- Stakeholder feedback received thus far has generally supported review of GHGRP data to inform potential improvements

Well-Related Activity Data: Identification of HF Wells (Cont.)

2018 GHGI Active Gas & Oil Well Counts





Topic Area 3: Anomalous Leak Events

Anomalous Leak Events

- In recent GHGIs, EPA incorporated an emissions estimate for the Aliso Canyon gas leak during years 2015 and 2016 in the storage well category.
  - EPA used the California Air Resources Board (CARB) published estimate of the methane release from the leak.
- EPA seeks stakeholder feedback on existing data sources or suggested methodologies for identifying similar events across natural gas and petroleum systems, with emissions beyond what is likely accounted for in GHGI emission factors.
  - For example, February 2018 blowout at XTO Energy's Schnegg Well in Ohio

Stakeholder Feedback Requests

- ***Refer to EPA memos posted online for additional details and specific stakeholder feedback requests***
  - Well-related Activity Data Updates Under Consideration (June 2018)
  - Incorporating GHGRP Data (June 2018)

- https://www.epa.gov/ghgemissions/stakeholder-process-natural-gas-and-petroleum-systems-1990-2017-inventory