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Understanding Greenhouse Gas Emissions from Unconventional Natural Gas Production



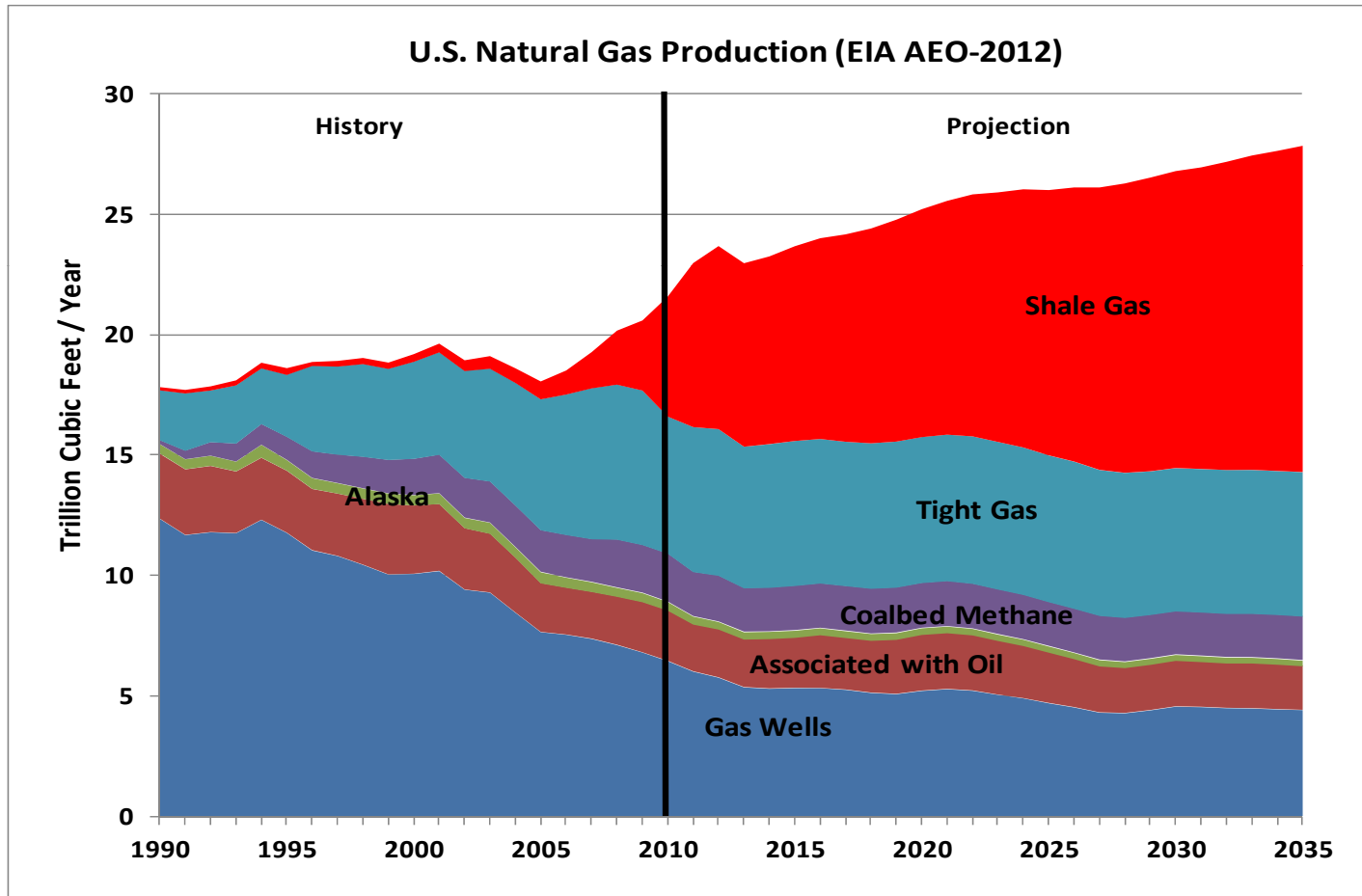
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Emerging Role of New Natural Gas Production Techniques

- Natural gas produced from shale formations is a “paradigm shift” for U.S. energy supplies
- In 2005, shale gas accounted for only 4% of U.S. natural gas production
- By 2035, EIA projects that shale and tight gas production combined will account for over 70%
- Shale gas and tight gas produced through hydraulic fracturing is essential to the growth of U.S. energy supplies

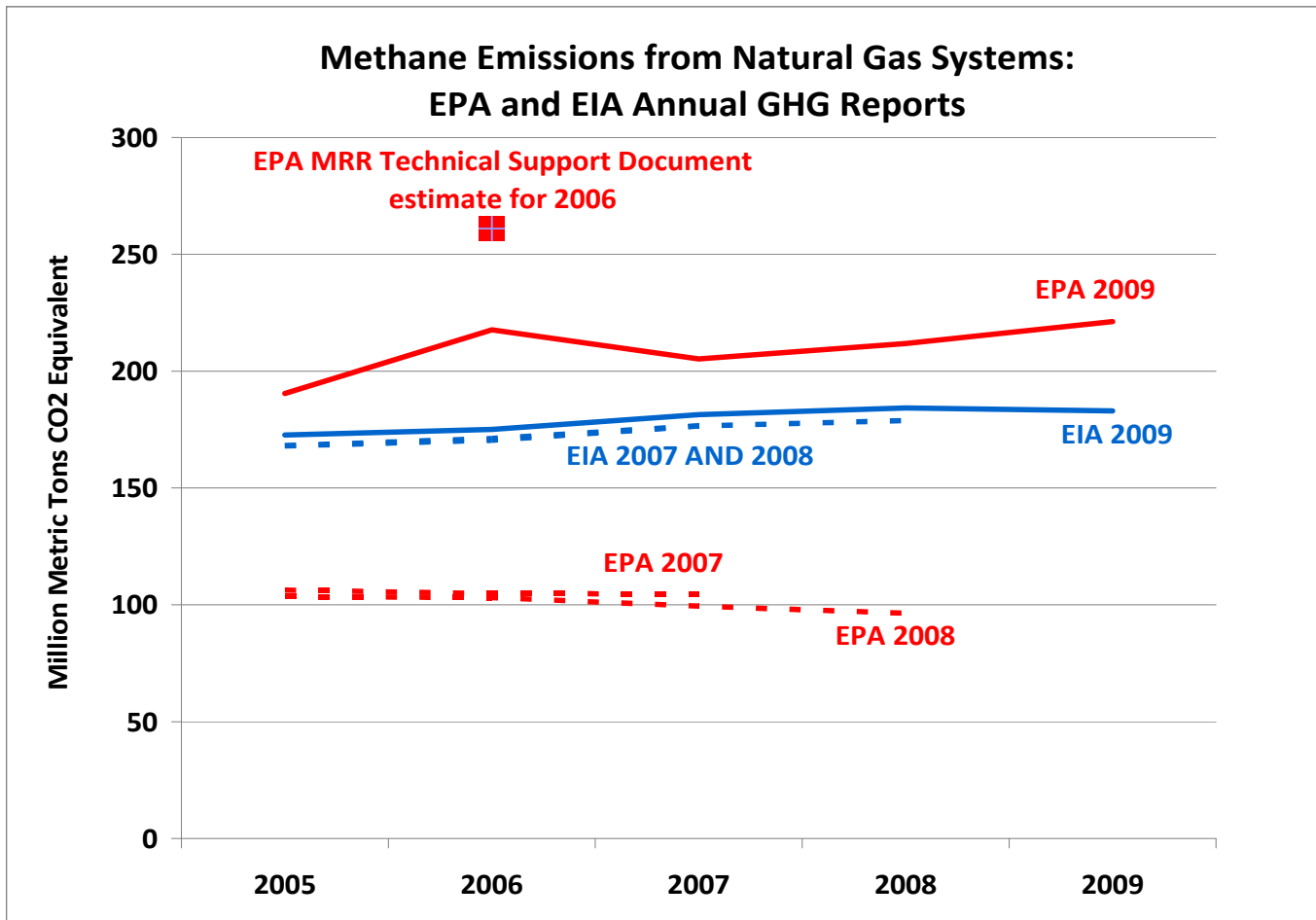
U.S. Natural Gas Production History and Projection Estimates



Methane Emissions Estimate in National GHG Inventory

- In 2011 EPA published the 2009 national GHG inventory, which included revised methods for methane emissions estimates from natural gas
- The revised methods focused on methane emissions estimate for unconventional natural gas production
- The revised estimate was based on data from four sources representing approximately 8,800 wells

Impact of Methane Emissions Recalculations on Natural Gas Systems Emissions Estimates



Impact of EPA's Revised Emission Factors

- For the 2009 inventory, EPA split the estimation of emissions from producing gas wells into conventional (i.e. without fracturing), and unconventional (i.e., with hydraulic fracturing).
- Based on the limited data available to EPA, gas wells with hydraulic fracturing activities were assigned an emission factor that is over 3,000 times higher than the one used for gas wells without hydraulic fracturing.
- The new data led many researchers to reassess the lifecycle GHG emissions of natural gas produced by unconventional techniques such as hydraulic fracturing

API/ANGA Survey

Objective:

- Enhance data availability for LCA studies, inventories and other assessments that support national policy development

Timeframe

- Data collection (Aug. – Nov, 2011); Analysis (Jan - April 2012)

Approach

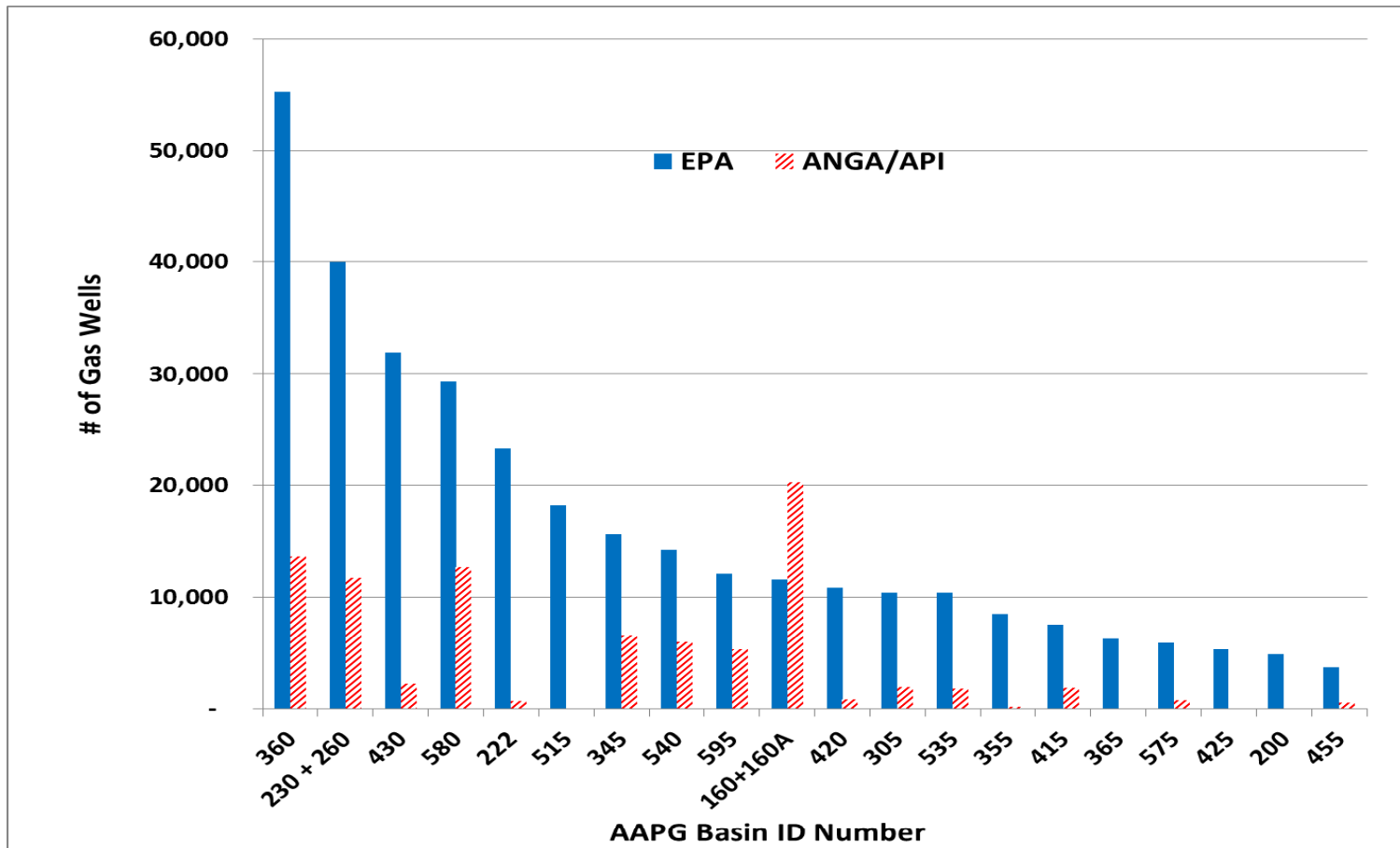
- Gather activity data from unconventional natural gas production to improve its characterization in nationwide GHG inventory



Gas Well Data

- ▶ API/ANGA survey activity data
 - over 20 companies covering nearly 91,000 wells and 19 of the 21 producing geological basins.
- ▶ Represents the most comprehensive data set ever compiled for natural gas operations
 - A much more accurate picture of operations and emissions

Comparison of EPA to API/ANGA Gas Well Count Data by AAPG Basin



Gas Well Completions Database

- The API/ANGA survey obtained data for over 7,300 gas well completions
- EPA reported close to 4,900 completions for the 2010 national inventory
- IHS database reports over 11,000 completions in 2010
- API/ANGA data provides more information about completions with hydraulic fracturing, where new data is needed

Comparisons of Gas Well Completions Counts

	Completions without Hydraulic Fracturing		Completions with Hydraulic Fracturing		Total Completions
	<i># Completions</i>	<i>% of Total</i>	<i># Completions</i>	<i>% of Total</i>	
2010 National Well Completions (from EPA 2012 report)	702	14	4,169	86	4,871
API/ANGA Survey Well Completions	540	7	6,821	93	7,361
Well Completions from IHS	7,178	39	11,274	61	18,452

Differences highlight need for consistency of well completions accounting

Refracturing Definition and Rate

- Well refracturing (workover) as defined for survey
“A re-completion to a different zone in an existing well or a re-stimulation of the same zone in an existing well”.
- Emissions associated with well workover operations are typically similar to those of the original completion

Overall emissions will depend on both the emission factor assumed for each completion/workover and the rate of performing such workovers

EPA's Assumed Emission Factors and Activity Rate

- Starting with the 2009 inventory, gas well completions and workovers emission factors used for national inventory:
 - ~ 2,400 scf of CH₄/event without hydraulic fracturing,
 - 7,623,000 scf CH₄/event with hydraulic fracturing
- EPA also assumed that the refracturing (workover) rate for unconventional wells is 10% per year
- The combination of these new emission factors and high activity rate led to the substantial increase in emissions estimated for the 2009 and 2010 natural gas systems contribution to the national GHG inventory

API/ANGA Refracturing Rate Results

- The API/ANGA survey obtained information from
 - First phase - over 91,000 wells
 - Second phase - some 69,000 unconventional gas wells (used for computing a refracturing rate)
- The refracturing rate obtained from survey
 - **2.31%** - based on the **total** of 1,593 workovers for the 69,034 wells reporting
 - **1.15%** - based on 727 workovers for 63,084 wells reporting (if excluding the Rocky Mountain Region)
 - **4.68%** - based on 906 workovers reported for 19,370 for the Rocky Mountain Region (AAPG 540)

GAS WELL WORKOVER EMISSIONS COMPARISON

NEMS Region	Well type	2010 EPA National Inventory # workover	Adjusted # workovers (based on API/ANGA survey)	2010 EPA National Inventory		Revised Emissions, tonnes CH ₄ (based on ANGA/API survey)	<u>API/ANGA-</u> <u>EPA</u> <u>EPA</u> % Difference
				Emission Factor, scf CH ₄ /workover	Estimated Emissions, tonnes CH ₄ *		
Northeast	W/O HF	8,208	8,208	2,607	409	409	
	W/HF	0	0	7,694,435	0	0	
Mid- Con	W/O HF	3,888	3,888	2,574	191	191	
	With Hydraulic Fracturing	1,328	153	7,672,247	194,950	22,462**	-89%
Rocky Mtn	W/O HF	3,822	3,822	2,373	174	174	
	W/HF	2,342	1,100	7,194,624	322,402	151,432**	-53%
Southwest	W/O HF	1,803	1,803	2,508	87	87	
	W/HF	1,374	158	7,387,499	194,217	22,382**	-89%
Gulf Coast	W/O HF	3,300	3,300	2,755	174	174	
	W/HF	0	0	8,127,942	0	0	
TOTAL					712,605	197,311	-72%

API/ANGA Survey Conclusions

- The API/ANGA survey provides an important contribution to estimating national GHG emissions
- It seems that EPA has overstated GHG emissions from unconventional natural gas production
- Needs for further investigation:
 - Improved consistency in the national well count
 - Definitions of conventional vs. unconventional production
 - Better classification of the types and rates of industry activities for representation in the national inventory
 - Updated emission factors representing current practices and operations including emission reductions at the source level

In Summary

- Treatment of emission reductions in national inventory is misleading
- Emission factor for completions/workovers with hydraulic fracturing is significantly overestimated
- Subpart W reporting will provide more detailed emissions information for updating the national GHG emissions inventory
- Industry is ready to work collaboratively with EPA to share data and improve emission estimation methods

Thanks for your attention

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