

**Center for Biological Diversity \* Clean Air Task Force \* Earthjustice \* Earthworks \*  
Natural Resources Defense Council \* Sierra Club \* WildEarth Guardians**

February 17, 2012

EPA Administrator Lisa Jackson

EPA Assistant Administrator for Air Gina McCarthy

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Re: RFC 12003 – Concerning EPA’s Methane Emissions Estimates for Unconventional  
Natural Gas Well Completions

Dear Administrator Jackson:

We are writing regarding a “request for correction” under the Information Quality Act (IQA), filed with EPA this past December by the U.S. Chamber of Commerce, a private industry lobbying organization. The Chamber requests that EPA abandon its estimate of emissions resulting from the completion of unconventional natural gas wells, claiming, on the basis of two industry reports, that EPA’s figures are inaccurate, and that EPA’s figures are improperly influencing ongoing rulemakings and academic debates. See Chamber Request for Correction, RFC 12003 (“RFC”) at2-3.

In fact, EPA’s emissions figures are well supported by a wide range of independent analyses and manifestly meet the quality, objectivity, utility, and integrity standards of the IQA. Moreover, the rulemakings the Chamber attacks – EPA’s long-delayed efforts to finally promulgate comprehensive emissions standards for the oil and gas sector – would be unaffected even if the EPA emissions estimates which the Chamber alleges are too high were to be substantially lowered. Likewise, the academic and policy discussion touching on EPA’s emissions estimates is active and critical, betraying no undue influence from the agency’s work.

The Chamber’s request is, in short, utterly without merit. Therefore, although we strongly support the agency’s continuing efforts to better characterize the oil and gas industry’s emissions, and encourage further research in this general area, EPA must deny the Chamber’s request.

## I. Background

### A. EPA's Limited Obligations Under the Information Quality Act – and the Chamber's Critique

The IQA requires only that the Office of Management and Budget (OMB) “issue guidelines” that “provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information” those agencies disseminate. 44 U.S.C. § 3516 Stat. Note (codifying Pub. L. 106-554). OMB’s guidelines, in turn, define data quality terms and direct Federal agencies to establish “flexible” mechanisms to correct erroneous data “where appropriate.” *See* 67 Fed. Reg. 8,452, 8,459-60 (Feb. 22, 2002).

EPA’s own guidelines are the relevant guideposts for the Chamber’s request. *See* EPA, *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* (“EPA Guidelines”) (2002). The only standard in those guidelines at issue here is the agency’s commitment to standards of objectivity – that is, to presenting “accurate, reliable, and unbiased” information. *Id.* at 15-16. EPA invites requests for correction, and states that it will address them thoughtfully, based in part on whether “corrective action is appropriate” at all, and upon the “significance of the error.” *Id.* at 31-32.

The Chamber belatedly requests that EPA correct a figure in its “technical support document” (TSD) for Subpart W of the agency’s greenhouse gas reporting program, which the agency issued in November 2010. The TSD figure updates a 1996 EPA/Gas Research Institute (EPA/GRI) study, conducted long before the boom in unconventional gas production, which, as a result, assumed that gas well completions produced almost no methane emissions. *See, e.g.*, TSD at 8-9 (discussing the need for these updates).

Specifically, the Chamber objects to EPA’s estimate that uncontrolled unconventional gas wells emit, on average, 9,175 Mcf of natural gas per completion. RFC at 2-3. EPA arrived at this estimate by gathering independent data from several industry and government sources, as it transparently explains in the TSD.

Unconventional well completions are more complex and time-consuming than conventional well completions, and can emit a great deal more methane. Because EPA’s old figures did not take this difference into account, those figures were inaccurate, and as a result EPA’s inventory of methane from the US gas industry became less and less accurate as the industry transitioned to unconventional gas sources. Shale gas produced using unconventional techniques grew from under 5% of the U.S. gas supply in 1996, when the EPA/GRI study was done, to nearly a quarter of supply today, and, according to the Energy Information Administration, is on its way to constituting almost half (49%) of supply by 2035. U.S. Energy Information Administration, *Annual Energy Outlook 2012 Early Release Overview* (Jan. 2012) at 1-2. Moreover, since hydraulic

fracturing is now being used on tight sandstone and coal bed methane wells, in addition to shale gas wells, “unconventional well completions” are even more numerous than shale gas well completions, and an even larger fraction of well completions than before.

Because it did not, and could not, anticipate these shifts in production techniques, the old EPA/GRI Study estimates that only 36.65 Mcf of methane are released into the air during each well completion, TSD at 86, an amount far below even the most conservative current industry estimate for unconventional completion emissions. Yet the Chamber nonetheless argues that EPA should abandon its efforts to account for this national shift in gas production methods as an “error.” But EPA cannot avoid taking this major change in gas production methods into account, as the Chamber requests, without violating its own IQA guidelines—the old figures clearly do not constitute accurate and reliable information on which to base updated regulations.

**B. Contrary to the Chamber’s Assertions, EPA’s Estimates of Natural Gas Emissions from Uncontrolled Unconventional Gas Wells are Reasonable and Reflect Accurate, Reliable and Current Empirical Information.**

EPA’s updated figure is based upon four sets of emission estimates. The first of these estimates is based on EPA’s analysis of the Energy Information Administration’s data, to determine natural gas emissions from the nearly 8,000 unconventional wells completed in 2002. EPA essentially averaged the total emissions that were attributable to unconventional wells over the unconventional wells in this population, to come up with an estimate of ~6,000 Mcf of emissions per well. TSD at 86 (citing EPA, *Green Completions*, Natural Gas STAR Producer’s Technology Transfer Workshop (Sept. 21, 2004) at 4).

EPA also drew from three sets of “green completions” data. In a green completion, most if not all wellhead emissions are captured, rather than vented or flared. As a result, reports of the volume of gas captured for sale (not released into the air) during a green completion provide a very reasonable estimate of the volume of natural gas which would have been emitted during the well completion if not captured. TSD at 86-87. The first of these data points is based on data from Devon Energy, reporting that the company recovered an average of 11,900 Mcf of natural gas per green completion across 30 unconventional wells in the Fort Worth Basin. *Id.* (citing *Green Completions* at 13). EPA also had data from Weatherford, estimating approximately 700 Mcf of natural gas per completion based on three test green completions in the Fruitland coalbed methane formations in Colorado. *Id.* (citing *Green Completions* at 14). Finally, and perhaps most significantly, EPA also drew on a 2007 report on 1,064 green completions in tight sandstones in Colorado, which captured 23,701 Mcf of gas per well (though EPA rounded down to 20,000 Mcf of gas per well). *Id.* (citing EPA, *Reducing Methane Emissions During Completion Operations* (Sept. 2007) at 14).

Averaging all of these data points, EPA concluded that approximately 9,175 Mcf of natural gas, including over 7,000 Mcf of methane, is emitted into the atmosphere in each uncontrolled unconventional gas well completion. TSD at 87.

The Chamber roots its objection to this estimate in two reports, by two industry consulting firms, IHS CERA and URS. These reports were submitted to EPA during the comment period for its ongoing oil and natural gas production sector emissions standards rulemaking and EPA is considering them in that docket.<sup>1</sup> The Chamber nonetheless later filed its separate request for correction, resubmitting the reports to the agency.

In its request, the Chamber argues, based on the IHS CERA report, that EPA erred by taking a simple average of the four data points, that it should not have used green completion data at all, and that EPA assumptions about the percentage of emissions vented rather than flared improperly influenced the 9,175 Mcf figure. RFC at 3-4. Then, based on the URS Report, which provides a sample of emissions from industry-selected wells to argue that average emissions are 765 Mcf/completion, the Chamber argues that actual well emissions are “1200% lower” than EPA’s estimates, that green completions are more common than EPA supposes, and that flaring (as opposed to venting) is more commonly used than EPA estimates. RFC at 4. Because of these supposed errors, the Chamber argues that EPA’s estimate is contrary to the IQA and the relevant IQA guidelines. *Id.* at 4-5.

We retained an independent oil and gas expert, Ms. Susan Harvey, to review the data before EPA, and the data included in the reports submitted by the Chamber. As the attached report from Harvey Consulting demonstrates in more detail, the Chamber’s arguments (where they are not wholly irrelevant) lack foundation.<sup>2</sup> EPA’s estimates are well within the range of reasonable accuracy, and are supported by additional data. Moreover, even if completion emissions were somewhat lower, important regulatory decisions based on those estimates would not be meaningfully affected. Because EPA’s estimates meet the baseline standard of “objectivity, utility[,] and integrity,” they are consistent with the IQA guidelines.

## **II. The Chamber’s Request Is Irrational and Unreasonable – It is Not Supported By Its Own Reports, and Is Directly Contradicted By Independent Data**

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<sup>1</sup> See, e.g. EPA-HQ-OAR-2010-0505-4241 (NSPS docket comments attaching URS study); EPA-HQ-OAR-2010-0505-4233 (same, attaching both URS study and IHS CERA study).

<sup>2</sup> Attached as Ex 1, along with Ms. Harvey’s CV. We note that Ms. Harvey’s memorandum has been drafted as a response to comments filed by the American Natural Gas Alliance and the American Petroleum Institute in EPA’s new source performance standards rulemaking document, and so discusses those comments. Because those comments are based, in relevant part, on the industry reports the Chamber cites, the Harvey Report is directly on point in these circumstances as well.

The Chamber's request fails for many reasons. EPA's analysis is well-supported, both on its own data and by other independent reports; the Chamber's criticisms, on the other hand, have no substantial support. Moreover, some of the "errors" it identifies simply have nothing to do with the 9,175 Mcf/completion figure and so are irrelevant.

#### **A. The Chamber's Criticisms Are Without Merit**

The Chamber argues that the URS/ANGA data show that uncontrolled well completion gas emissions are much lower than EPA estimates, and, based on the IHS CERA report, both that EPA should not have averaged its data points together, and that the data from green completions does not meaningfully address well completion estimates. RFC at 3-4. Each of these criticisms is wrong.

##### **i. The Chamber's Alternate Emissions Figure Is Unsupported**

The Chamber argues that data from the URS study shows that the "actual" emissions from unconventional well completions are just 765 Mcf of natural gas per completion. RFC at 4. This conclusion is totally unsupported, and is contradicted by the available independent data.

To begin with, the Chamber's claims are based upon an entirely unrepresentative data set, contained within the URS study. That study presents a sample of just under 1200 wells (of which 1,076 received green completions) gathered from companies which are members of America's Natural Gas Alliance (ANGA), an industry association. See RFC at 4; URS Report at 2-3. As the attached Harvey Consulting report makes clear, the ANGA/URS data is simply not representative of the universe of relevant wells. URS collected data from 7 ANGA oil and gas exploration and production companies (two of which performed no green completions); there are at least 95 large and 6,329 small such companies in the country, Harvey Report at 4, meaning that the URS data covers just 0.1% of all such companies. *Id.* Likewise, more than 27,000 new gas wells are drilled annually, meaning that URS's sample represents just 4.3% of all wells drilled each year. *Id.*

The Chamber bases its emissions estimate upon an unrepresentative subsample of this already cherry-picked collection of wells. It points to a collection of just 98 wells which did not have green completions within the URS dataset. See URS Report at Table 6. Thus, the Chamber's claim is based on a grand total of 0.36% of the 27,000 wells drilled each year. Worse, the wells without green completions in the URS sample are *not* representative because they are the very wells on which operators have explicitly decided *not* to perform a green completion. Such wells "are commonly low flow rate and low-pressure wells." Harvey Report at 6. Thus, as the Harvey Report explains, "by definition," such wells "would not be representative of the higher gas flow rate and higher gas pressure" wells on which green completions would ordinarily be performed,

or could be performed. *Id.* The conclusions drawn from URS survey of a few non-representative wells, in short, are essentially meaningless.

In contrast, available independent evidence shows that well completion emissions are very likely to be at or near the level EPA's estimates, if not above them. First, 2001 data from the Energy Information Administration recorded that the average initial gas flow rate from all U.S. wells completed between 1996 and 2000 was 1,900 Mcf/day during the completion; assuming just 5.8 days per completion, as ANGA and URS do, this translates to 11,020 Mcf/completion – a somewhat *higher* figure than EPA's. See Harvey Report at 9 (citing EIA data). Moreover, many green completions take longer than 5.8 days (EPA assumes up to 10 days, based on industry data, O&G TSD at 4-16), so using a 5.8 day period to calculate emissions is conservative.

Likewise, 2008 data from ALL Consulting reported a range of flow rates during completion for shale gas plays varying from 415 to 3,100 Mcf/day across most shale plays. Harvey Report at 10 (citing ALL Consulting data). Using the conservative 5.8 day completion estimate from URS/ANGA, these emissions rates translate into between 2,407 Mcf/completion to 17,980 Mcf/completion, bracketing EPA's 9,175 Mcf/completion figure, and well above URS's 765 Mcf/completion figure. *Id.* Indeed, recent data from a Simmons & Co. report indicate a range of 4,000 – 7,000 Mcf/day even for *conventional* well completions, and 1,200 – 3,000 Mcf/day for completions in unconventional sand wells; the combined range from 1,200-7,000 Mcf/day translates into between 6,900 Mcf and 40,600 Mcf of methane emissions per completion. Harvey Report at 10 (citing Simmons Consulting data). These figures, too, suggest that EPA's estimate is not only reasonable but may be a low estimate of uncontrolled well emissions.

Moreover, a survey of 2009 EIA data on gas production for *all* wells – including low-pressure wells, aging wells, conventional wells and so on – and covering all periods, not just completions, gives a national production rate of 148.5 Mcf/day, which would translate into 861 Mcf per completion using the 5.8 day figure. See Harvey Report at 7. But, of course, EPA's 9,175 Mcf/completion number is for *completions* on unconventional wells – unlike the national average rate, it reflects the earliest production from unconventional wells which will produce more than an average well, averaged over its lifetime. Thus, the emissions from *those well completions*, as the 2001 EIA data, the ALL Consulting and Simmons & Co figures demonstrate, are far higher. The fact that URS's 765 Mcf/completion figure is, instead, close to the national average production rate for *all* wells, including those measured long after completion or which produce very little, shows how unreasonably low that estimate is.

Finally, very recent empirical atmospheric measurements demonstrate that, if anything, natural gas production systems emit more, not less, than EPA estimates. Researchers affiliated with the National Oceanic and Atmospheric Administration and the University of Colorado have recently released a peer-reviewed study documenting very high levels

of alkanes (including methane) near an unconventional gas field in the Denver-Julesberg Basin of Colorado. See Gabrielle Pétron *et al.*, *Hydrocarbon Emissions in the Colorado Front Range – A Pilot Study*, *Journal of Geophysical Research*, *in press* (2012).<sup>3</sup> The researchers compared their results to emissions calculated from EPA’s inventory estimates for oil and gas production sources, concluding that “[t]he methane source in Colorado is most likely underestimated by at least a factor of two.” *Id.* at 43. Although the paper does not differentiate between methane coming from completions and other sources in the production sector, it recognizes that completion venting emissions are contributing to the high methane levels. *Id.* at 32. Thus, the Pétron *et al.* study, at a minimum, demonstrates that gas production operations as a whole (and completions in particular) are large methane sources and, collectively, are larger than EPA supposes. It thus further shows that the Chamber’s argument that EPA’s figures are too *high* is wholly unsupported by the evidence.

In short, all available national data supports well completion emission rates in the thousands of Mcf per well (if not the tens of thousands of Mcf for some wells). No data confirms the extremely low completion figures calculated by URS on the basis of its tiny sample of unrepresentative low-flow wells.

**ii. The Chamber’s Procedural Arguments Also Miss the Mark**

With its own figure hopelessly off-base, the Chamber is reduced to arguing that EPA has made procedural errors in two regards. Neither charge sticks.

First, the Chamber suggests that EPA should not have averaged together its four emissions figures, pointing out, on the basis of the IHS CERA report, that each of the four figures is based on different numbers of wells. RFC at 3. But even if the Chamber is right that EPA should have combined the data points differently (and it offers no alternative methodology), this point does not support its argument that EPA’s figures are far too high. The table below shows EPA’s four data points, and the number of wells supporting each:

<b>Emissions (Mcf/completion)</b>	700	11,900	23,701	~6,000
<b>Number of Wells Supporting Estimate</b>	3	30	1,064	7782

Presumably, the Chamber would prefer that EPA weight estimates supported by larger samples more strongly. As the chart suggests, the figures supported by large numbers of wells are 23,701 and approximately 6,000 Mcf/completion; these figures, though disparate, bracket EPA’s average 9,175 Mcf figure, and are consistent with the estimates discussed above, which are all in the thousands of Mcf per completion. Indeed, simply

<sup>3</sup> Attached as Ex 2.

weighting each average by the number of well completions it represents gives an average of 8,138 Mcf / completion, over ten times greater than the URS/ANGA figure. Only EPA's least-well-supported figure – the 700 Mcf figure that EPA based on three experimental wells<sup>4</sup> - jibes with the URS/ANGA estimate on which the Chamber relies.

The Chamber might also argue that EPA should give more weight to data points based upon directly measured wells. But two of EPA's three directly measured data points are *higher* than EPA's 9,175 Mcf estimate – the 11,900 Mcf figure based upon 30 wells and the 23,701 Mcf figure based upon 1,064 wells. EPA would presumably still weight these samples more heavily than the 3 wells in the Fruitland experience, and so, again would likely wind up with a higher figure than it is currently using.

In short, the Chamber's "averaging" argument is simply not persuasive.

The Chamber's other procedural argument is no more compelling. It posits, based on the IHS CERA report, that EPA's numbers are high because three of its four data points are based on green completion data. However, one of EPA's data points and the one with the largest well sample size – the 6,000 Mcf figure – is not based on green completion data at all, and is still far higher than the URS/ANGA figure. Moreover, it is supported by the independent data analyses discussed above. So, again, even if EPA's data is imperfect, it is clearly not so beyond the bounds of reasonableness as to be inaccurate for IQA purposes. On the contrary, EPA has presented useful information based on the most accurate data available, and the Chamber has not provided any reason to believe EPA's figures are not accurate.

## **B. Several of the Chamber's Criticisms Are Not Just Wrong, But Irrelevant**

The Chamber also argues that EPA's 9,175 Mcf natural gas per completion emissions estimate is somehow flawed (the Chamber does not say how) by the agency's determination that roughly 15% of wells have green completions annually, and that 51% of emissions from the remaining wells are flared rather than vented. These estimates have no bearing whatsoever on EPA's baseline emissions figure, and, in any event, are supported on the evidence before EPA.

To begin with, the figure that the Chamber is attacking is an estimate of how much methane would be emitted during an unconventional well completion *with no controls*,

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<sup>4</sup> This 700 Mcf figure should, if anything, be further discounted because it is based on green completions in a coalbed methane play. The production profile of coalbed methane wells differs from that of shale gas or tight gas wells. In order to produce gas, coalbed methane formations must first be "dewatered." As water is produced from the formation, gas begins to flow. This means that, unlike other unconventional well types, the initial gas production rate in coalbed methane wells is low, and increases as more and more water is produced, eventually reaching some peak rate. In shale gas and tight gas, the highest gas production rate in the life of the well is the initial production rate. Consequently, the emissions per completion of coalbed methane wells are not representative of other unconventional well types.

yet it is attacking that estimate by citing EPA determinations regarding how *controlled* wells behave. This attack does not make sense. Uncontrolled completion emissions depend upon the geology of the producing formation and the process used to stimulate the well, but do not, of course, depend on how those emissions are treated once they reach the surface. To put the point simply: When calculating the emissions of an uncontrolled well behaves, the emissions of controlled wells, or which controls are used at *those* wells, are not relevant. Thus, EPA's estimates of *uncontrolled* well emissions have nothing to do with EPA's separate analyses of available emissions controls.

But even if the Chamber's critiques mattered, they would still be wrong. First, the Chamber argues that EPA is wrong to think that only ~15% of all wells receive green completions. It bases its argument, once again, on the unrepresentative URS data. 92% of the wells in that sample had green completions, URS Report at 3; the Chamber seeks to extrapolate this figure to argue that *most* wells nationally – not just in the self-selected industry sample – had green completions. This approach does not make sense. Simply put: There is absolutely no reason to suppose that a tiny, industry-selected sample of companies performing green completions says *anything* about the percentage of such completions performed nationwide.

To the contrary: industry-wide data, including an EPA analysis that was independent of the figure the Chamber challenges, and reports by the American Petroleum Institute (API), demonstrate that the URS sample is not representative. In a control technology analysis that did not depend upon EPA's completion figure, EPA estimated that about 15% (a range of 14-19%) of U.S. wells used green completions – a figure which translates into 3,000 to 4,000 green completions annually. See EPA, *Oil and Natural Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution* ("O&G TSD") (2011) at 123. In comments on EPA's proposed new source performance standards (NSPS) for the industry, API likewise reported that there are approximately 300 green completion equipment units in existence, which could perform up to 4,000 green completions annually – a figure identical to EPA's upper-end estimate. See API Comments at 94; Harvey Report at 2.

To state the obvious, then: available evidence demonstrates that 92% of the 27,000 wells drilled annually cannot possibly be receiving green completions. Under a strong revised set of oil and gas new source performance standards, the share of wells completed in this way must and will rise as operators are required to consistently employ this profitable, and important pollution control measure. Such rules will also provide a very strong incentive for the rapid manufacture of more green completion equipment.<sup>5</sup> But, without such standards, URS's figure cannot be taken as representative of the industry as a whole.

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<sup>5</sup> We note that API argues, elsewhere, that it will take several years to produce sufficient equipment. We do not agree with this assessment: The industry's rapid ramp-up in the shale gas plays demonstrates that

The Chamber's second claimed error – this time over EPA's finding that approximately 51% of wells without green completions are flared and the remainder vented, see TSD at 88, RFC at 3-4 – is also unconvincing. This estimate simply does not bear at all on the 9,175 Mcf/completion figure for uncontrolled wells (that gas or its combustion products are emitted into the atmosphere whether vented or flared; when calculating methane emissions for the greenhouse gas inventory, flaring is accounted for separately of the 9,175 Mcf/completion factor). Whether or not gas is vented or flared, it is not captured and sold, meaning that the venting vs. flaring question does not speak to the agency's efforts to promote more capture, rather than either of these alternatives.

The Chamber's criticisms on these grounds, in short, are both immaterial and wrong.

### **C. In Sum, The Chamber's Data Quality Arguments Fail**

The Chamber's arguments are, in short, either irrelevant, wrong, or both – and are universally contradicted by independent emissions data and by atmospheric measurements. In fact, they are directly contradicted even by the American Petroleum Institute, which is often highly critical of EPA. In comments on EPA's proposed emissions standards, API offered a few caveats, but largely used EPA's estimates, accepting, for the sake of argument, that they are "as reasonable an estimate as anyone is likely to develop," and basing its own calculations on EPA's figures. API Comments, Attachment G at 6. We agree with API that EPA's figures are manifestly reasonable. They are, in fact, plainly accurate, as they fall squarely in the range of accepted emissions estimates for this industry. As such, they are consistent with the IOA's objectivity and accuracy requirements, and do not warrant correction.

### **III. The Chamber Errs in Asserting That the Data Show that EPA's Emissions Figures Should be Altered In Ways Which Could Substantively Affect the Agency's Rulemaking Decisions or Academic and Policy Debates**

Moreover, even if EPA's 9,175 Mcf/completion figure were not entirely accurate, any remaining inaccuracy is insignificant. Most importantly, that figure could fall substantially without altering EPA's conclusions regarding the form of its recently proposed new source performance standards. Thus, though EPA certainly can and should continuously improve its emissions estimates in response to new information, the Chamber cannot show that that process could cause EPA to retreat from its wellhead emissions regulations. On the contrary, the data support EPA's updated emissions estimates.

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it can rapidly produce new equipment when it chooses to do so and the NSPS will require such production to ramp-up quickly.

Further, the emissions figure has also had no improper influence on government and independent research, despite the Chamber's claims. Instead, it has been part of an ongoing healthy scientific dialogue.

#### **A. The Form of the Proposed New Source Performance Standards Is Not Sensitive to EPA's Particular Emissions Estimates**

The Chamber observes that EPA's proposed New Source Performance Standards (NSPS), which require green completions in most circumstances for unconventional well completions, are justified in part on the 9,175 Mcf/completion figure. See RFC at 7; see also O&G TSD at Table 4-8. Naturally so: companies which capture gas can resell it, offsetting the cost of controlling volatile organic compounds and other pollutants emitted during completions. But while the Chamber implies that this cost of control decision is very sensitive to EPA's precise emissions estimate, that conclusion is actually quite durable, both legally and technically, and would not change even if EPA altered its estimates substantially in response to new information.

This is because EPA is to require emissions controls consistent with the best "system of emission reduction," 42 U.S.C. § 7411(a)(1), a question it answers in part by showing that the "costs of using the technology are not exorbitant." *Lignite Energy Council*, 198 F.3d 930, 933 (D.C. Cir. 1999). This is a low hurdle: The question is not whether individual wells, or even individual companies can bear the cost, but whether the cost of new source control is "greater than the industry could bear and survive." *Portland Cement Ass'n v. EPA*, 513 F.2d 506, 508 (D.C. Cir. 1975). In the context of green completions, this means that even if wells emitted substantially less gas – and so less gas could be captured and sold to offset emissions control costs – green completions would still be required by law, provided that their costs were not truly exorbitant. In fact, EPA has shown that, under most circumstances, green completions not only do not impose unreasonable costs, but are actually *profitable* at the emissions rates it estimates.

To show as much, we have assembled a wide range of cost estimates for green completions, including those which EPA used in the NSPS rulemaking. As the table shows, this cost of control analysis responds to both emissions estimates and the cost of natural gas. More importantly, it demonstrates that both emissions and prices must fall to very low numbers before the cost of control is equal to the revenues from captured gas. Importantly, this "break-even" point is, of course, not the minimum point at which EPA could impose controls under the standard articulated above – but merely demonstrates that the industry breaks even at emissions rates well below EPA's estimates.

Source	Year	\$/ well	Mcf / well			Mcf / well
			Total expense per well	Volume of NG required for break-even at following prices*		
			2.5 \$/Mcf	4 \$/Mcf	5.5 \$/Mcf	Volume of saved NG as reported
EPA Lessons Learned <sup>6</sup> (purchased equipment)	2011	8,850**	3,540	2,213	1,609	10,800
EPA Lessons Learned (rented equipment)	2011	33,000	13,200	8,250	6,000	10,800
EPA - NSPS TSD <sup>7</sup>	2008	33,237	13,295	8,309	6,043	8,258
EPA <sup>8</sup>	2005	14,000	5,600	3,500	2,545	7,000
Devon Energy <sup>9, 10, 11</sup>	2004, '05, '07	8,700	3,480	2,175	1,582	11,740
BP <sup>12, 13</sup>	2005, '07	12,264	4,906	3,066	2,230	7,500
Williams <sup>14</sup>	2006	14,444	5,777	3,611	2,626	22,515
Simple average (of above data)		17,785	7,114	4,446	3,234	11,230

\* Does not account for revenue from condensates

\*\* Based on an equipment cost of \$500,000 that is spread out over 5 years, and annual costs of \$121,250. The equipment is expected to serve over 5 years and 25 well completions per year. Time value of money is neglected.

<sup>6</sup> U.S. EPA, Lessons Learned from Natural Gas STAR Partners, Reduced Emissions Completions for Hydraulically Fractured Natural Gas Wells, 2011

<sup>7</sup> U.S. EPA New Source Performance Standards, Technical Support Document (NSPS TSD), pages 4-15 – 4-18.

<sup>8</sup> U.S. EPA Natural Gas STAR, Cost-Effective Methane Emission Reductions for Small and Mid-Size Natural Gas Producers, Corpus Christi, Texas, November 1, 2005.

<sup>9</sup> U.S. EPA, ExxonMobil Production Company, and American Petroleum Institute, Green Completions, Lessons Learned from Natural Gas STAR, Producers Technology Transfer Workshop, September 21, 2004.

<sup>10</sup> Devon Energy, EPA Natural Gas STAR Program Presentation, March 2007.

<sup>11</sup> U.S. EPA and Devon Energy, Reduced Emissions Completions (Green Completions), Lessons Learned from Natural Gas STAR, Producers Technology Transfer Workshop, Casper, Wyoming, August 30, 2005.

<sup>12</sup> Ibid.

<sup>13</sup> Gordon Reid Smith, Natural Gas Industry Green House Gas Control & Business Opportunity, Presentation, 2007.

<sup>14</sup> The Williams Companies, "Reducing Methane Emissions During Completion Operations – Economics Volume Recovered." Williams Production RMT – Piceance Basin Operations. 2007 Natural Gas Star - Production Technology Transfer Workshop. September 11, 2007.

The table shows that EPA's projected expenses for green completions in its NSPS rulemaking are higher than many estimates provided by many oil and gas companies, and are also higher than some past EPA estimates. As a result, cost comparisons based on the NSPS figures are quite conservative. Even a comparison based on the NSPS cost figures, however, shows that producers who capture 8,309 Mcf of gas break-even with gas at \$4/Mcf. Using a broader range of green completion cost estimates, the break-even point at this gas price ranges from just over 2,000 Mcf to 8,309 Mcf per completion – all hundreds to thousands of Mcf below EPA's 9,175 Mcf/completion figure. At higher gas prices, this break-even point falls still lower – down to as low as just over 1,600 Mcf per well. Thus, emissions from wells could in fact be significantly below EPA's current reasonable and best estimate without causing the agency to alter its determination that green completions impose reasonable costs on the industry.

Moreover, it is important to note that this break-even analysis is conservative because it does not account for any revenue from condensates, which would be captured along with gas. Condensates can be expected to provide about \$7,000 in revenue per completion.<sup>15</sup> Depending on the scenario above, this revenue would either more than compensate for any natural gas shortfall for breaking even, or significantly mitigate any shortfall.

Importantly, though gas prices are presently at record lows, the EIA and independent analysts all project gas prices to be well above \$4/Mcf (in 2010 dollars) within the next five years, as the attached report from Synapse Energy Economics demonstrates.<sup>16</sup> Although the EIA's Annual Energy Outlook for 2012 reflects the recent drop in prices, it projects wellhead prices of over \$4/Mcf (in 2010 dollars) by 2017, climbing above \$5 by 2025. See EIA, Annual Energy Outlook 2012, Table A13.<sup>17</sup> Thus, most gas completions will hit the break-even point over the life of the rule, even at emissions figures well below EPA's estimates.

In short, even if gas prices stay very low (which is unlikely), gas capture will offset the costs of green completions sufficiently to prevent those costs from being anywhere near "exorbitant" for the industry as a whole, and, in fact, gas capture is likely to allow the industry to break-even, or even profit, from EPA's proposed rules. Even if EPA were to lower its estimate somewhat, within the bounds of available data, these cost conclusions would not change – green completions would still impose only reasonable costs on the industry. There is, therefore, no reason to think that the precise 9,175 Mcf/completion figure EPA derived is driving EPA's analysis in the proposed rule. Although that figure is certainly reasonable and accurate, EPA would be required to

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<sup>15</sup> U.S. EPA, Lessons Learned from Natural Gas STAR Partners, Reduced Emissions Completions for Hydraulically Fractured Natural Gas Wells, 2011

<sup>16</sup> Attached as Ex. 3.

<sup>17</sup> Attached as Ex. 4.

impose a green completion requirement even if the figure were to be lowered substantially.

## **B. EPA's Emissions Figures Have Not Otherwise Unduly Influenced the Debate**

The Chamber, finally, offers that EPA's figures have unduly influenced several other studies by the Department of Energy (DOE), the National Energy Technology Lab (NETL), and Cornell University, and so warrant correction. Even if EPA's figures were inaccurate, the Chamber's arguments would be wrong because the cited studies do not accept EPA's figures uncritically but, instead, carefully and independently considered EPA's estimates as part of a larger analysis. The EPA figures, in other words, are being discussed in a robust academic debate, precisely as they should be – and are being treated, appropriately, as reasonable, but not dispositive. There is no reason for EPA to “correct” its work in response to the Chamber's erroneous arguments, or to prevent undue damage to the debate over these estimates; rather, the agency should simply monitor the discussion and learn from it.

For instance, the NETL report the Chamber cites, which is a life-cycle analysis of the industry's overall emissions, carefully parsed EPA's figures and explicitly accounted for any uncertainty. *See generally* Timothy J. Skone, NETL, *Life Cycle Greenhouse Gas Inventory of Natural Gas Extraction, Delivery, and Electricity Production* (2011). NETL began with EPA's figures, but “made adjustments” to distinguish between different types of gas wells, and to account for variability in industry practices over the years. *See id.* at 32-34. NETL also carefully checked its own results to ensure that they were not overly sensitive to any one emissions assumption (including estimates of completion emissions), and to understand how its conclusions would vary with different figures. *See id.* at 24-25. Thus, there is no evidence that the NETL study was improperly influenced by EPA's figures.

The Cornell paper, by Howarth *et al.*, which is also a life-cycle analysis, similarly offers no support for the Chamber's argument. *See generally* Howarth *et al.*, *Methane and the Greenhouse-Gas Footprint of Natural Gas from Shale Formations*, 106 *Climatic Change* 679 (2011). That study, too, begins by relying on EPA's completion emissions figures, *see id.* at 681, but does not end there. Instead, the Howarth paper draws from a range of completion emissions for different shale plays, not just EPA's numbers, *see id.* at 682. There is no evidence that EPA's particular figure dispositively influenced that paper's completion emissions estimates – even if such influence were problematic, which it is not.

Notably, the Cornell and NETL papers disagree with each other as to the ultimate magnitude of the gas industry's life-cycle emissions. *Compare* NETL Report at iv (concluding that gas life-cycle emissions when used for electricity are well below those of coal); Howarth *et al.* at 687 (concluding that gas life-cycle emissions when used for electricity are likely equivalent to, or higher, than of coal). So, if EPA's supposed “error”

is somehow unduly affecting the conclusions of research papers, as the Chamber argues, see RFC at 6, it would have to be doing so in opposite directions at once. Of course, it is not: EPA's conclusions are relevant to the debate, but they plainly are not dispositively shaping this academic dispute, as they constitute the partial bases for papers which come to diametrically opposed conclusions.

Finally, the DOE report that the Chamber cites offers the Chamber no support. That report does not even cite EPA's figures. See DOE, Secretary of Energy Advisory Board, *Shale Gas Production Subcommittee 90-Day Report* (Aug. 18, 2011). The Chamber quotes DOE as referring to a "pessimistic conclusion about the greenhouse gas footprint of shale production and use," RFC at 6, but DOE was *not* referring to EPA's completion estimate. Instead, DOE was discussing the conclusions of Howarth *et al.*, see DOE Report at 17, without endorsing them: the Chamber's partial quotation omits the next phrase, which states that, in DOE's view, that pessimistic conclusion is "not widely accepted," *id.* DOE then called for further debate on the broad question of the industry's greenhouse gas emissions, *id.*, leaving EPA's analysis of the narrow completion emissions issue undisturbed and uncited.

In short, the Chamber offers no evidence that anybody has unduly "relied on EPA's flawed estimate," as it asserts, RFC at 6. Instead, EPA's estimate, which is not flawed, has been cited in a vigorous academic debate – a debate which it has not settled, and which will, if anything, ultimately act to further improve our knowledge of emissions associated with oil and gas production. There is no reason for EPA to withdraw its figure; rather, it should welcome the ongoing discussion to which it has contributed.

### III. Conclusion

The Chamber's request is, in sum, composed entirely of irrelevant and unsupported arguments. EPA's completion emission estimate is well-supported, and within the range of emissions figures provided by numerous independent data sources. It therefore represents accurate, reliable and current information about well completion emissions, consistent with the Agency's own IQA guidelines, and EPA must deny the Chamber's request.<sup>18</sup>

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<sup>18</sup> Indeed, EPA might opt not even to respond to the Chamber's request separately from its response to comments on the NSPS. EPA does not divorce its IQA processes from the agency's daily activities, consistent with OMB's direction that the IQA guidelines are to be "appl[ied] in a common-sense and workable manner" that does not "impose unnecessary burdens." See 67 Fed. Reg. at 8,453. Therefore, EPA "generally [will] not consider [an IQA] complaint that could have been submitted as a timely comment in the rulemaking or other action but was submitted after the comment period." EPA Guidelines at 33. EPA generally responds, if at all, to such issues in the response to comments on the affected agency action, rather than in a separate document. *Id.* Here, the URS and IHS CERA reports are already in the NSPS docket, and EPA can respond to them there, rather than in a separate, extraneous, proceeding.

Sincerely,

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**Exhibit 1**

# HARVEY CONSULTING, LLC.

*Oil & Gas, Environmental, Regulatory Compliance, and Training*

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## Memorandum

Date: February 13, 2012

To: Meleah Geertsma, NRDC  
Craig Segall, Sierra Club

Re: **Review of Reduced Emission Completion Estimates Used by EPA and Critiques of EPA's Estimates Completed by IHS CERA, URS (for ANGA) and API**

This memo responds to your request to review the Reduced Emission Completion (REC) estimates used by the Environmental Protection Agency (EPA) in the proposed New Source Performance Standards (NSPS) for the Oil and Gas Industry Sector (Docket ID No. EPA-HQ-OAR-2010-0505) and respond to the America's Natural Gas Alliance's (ANGA) and American Petroleum Institute's (API) critiques of EPA's estimates. This memorandum responds to three questions:

**Question No. 1:** EPA estimates that 15% of all U.S. wells use Reduced Emission Completions (RECs), whereas American Petroleum Institute (API) assumes 20% and America's Natural Gas Alliance (ANGA) assumes 92%. Is EPA's 15% estimate well supported?

EPA's proposed rule assumes that industry currently has a capacity to complete approximately 3,000 to 4,000 REC jobs per year in the United States.<sup>1</sup>

EPA assumes that 9,313 new gas wells and 12,050 existing gas wells will be drilled and hydraulically fractured in the U.S., and 8,258 Mcf/well (methane) could be captured using REC equipment.<sup>2</sup> As a result, EPA forecasts the need for 21,363 REC jobs per year.

Assuming there is a need for 21,363 REC jobs per year, and there is currently capacity to complete 3,000-4,000 REC jobs per year, EPA's estimates show that 14-19% of wells are currently receiving REC control.

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<sup>1</sup> EPA, Technical Support Document for Standards of Performance for New Stationary Sources: Oil and Natural Gas Production and Natural Gas Transmission and Distribution; National Emission Standards for Hazardous Air Pollutants From Oil and Natural Gas Production Facilities; and National Emission Standards for Hazardous Air Pollutants From Natural Gas Transmission and Storage Facilities, Docket ID No. EPA-HQ-OAR-2010-0505, 2011, p. 123 of 604.

<sup>2</sup> EPA, Regulatory Impact Analysis, Proposed New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry, July 2011, p. 3-21.

3,000 REC capacity/ 21,363 REC jobs needed = 14% of wells use REC  
4,000 REC capacity/ 21,363 REC jobs needed = 19% of wells use REC

API reports that there are 300 REC units in operation, with the ability to complete 4,000 REC jobs per year.<sup>3</sup> API's estimate agrees with EPA's upper-end estimate of 4,000 REC jobs per year.

API estimates that an additional 16,000 wells per year could be processed by REC if there were sufficient REC capacity.<sup>4</sup> API estimates that 20% of U.S. gas well emissions are currently being captured with REC units.

4,000 REC capacity/ 20,000 REC jobs needed = 20% of wells use REC

The only significant difference in the EPA and API estimates is the assumed REC equipment capacity. EPA assumes less capacity (3,000-4,000 REC jobs per year) than API's estimate of 4,000 REC jobs per year.

ANGA does not provide any data on the number of RECs currently in service to support its analysis.

Based on currently available REC equipment capacity EPA estimates that only 14-19% of wells are currently controlled using RECs. API estimates 20%. ANGA does not provide data on REC equipment availability.

On November 30, 2011, ANGA submitted comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505. ANGA's comments included a November 28, 2011 analysis by URS on 1,174 wells completed by ANGA members.<sup>5</sup> All of the 1,174 wells were new wells, except two.

The purpose of the URS study was to determine whether EPA's assumption that only 15% of well emissions are currently captured using REC equipment is correct. The URS study concluded that 92% of U.S. well emissions are captured by RECs, and EPA has underestimated industry's REC use.

URS' analysis reportedly compiled gas well completion data on 1,174 wells that was supplied by seven upstream exploration and production (E&P) companies in the U.S. URS found that of the 1,174 wells it studied, 98 wells were completed without REC emission control. The remaining 1,076 wells used REC emission control. From this data URS concludes that 92% of the wells in its study were completed using REC techniques.

1,076 wells used REC/ 1,174 wells surveyed by URS = 92% of wells in survey used REC

ANGA's URS study does not include any data on the number of RECs currently in service to support its analysis. The study goes no further than to document that 1,076 REC jobs were completed during an 8 month period (January – August 2011) by five member companies. URS's survey data was based on seven companies, so two of the seven completed no REC jobs.

<sup>3</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Page 94.

<sup>4</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Page 94. API estimates that emissions could be controlled from 20,000 wells/yr and there is REC capacity for 4,000 wells/yr; therefore, there is a shortfall in REC capacity of 16,000 wells/yr.

<sup>5</sup> ANGA comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011.

Assuming that RECs would continue at the same rate for the remaining four months of the year, an annualized REC total of 1,614 jobs was estimated by HCLLC for the purposes of this analysis.

1,076 RECs in 8 months = 1,614 RECs in 12 months

Using API's estimate of 300 REC units capable of completing 4,000 RECs per year in the U.S., and ANGA's annualized estimate of 1,614 RECs per year completed by five companies, HCLLC's calculations show that five of ANGA's member companies are using 40% of the U.S. REC capacity.

1,614 RECs per year completed by 5 companies/ 4,000 REC total U.S. current capacity = 40%

If, as ANGA postulates, all of its 30 members are completing wells using RECs at a rate of 92%, its 30-member organization alone would use all of the available U.S. REC capacity. Yet, REC use is reported by a number of companies that are not ANGA members. EPA's Natural Gas Star Program documents this REC use. Therefore, it appears that ANGA's REC use data on five of its 30 members are anomalous; these companies likely use REC methods at a higher, disproportionate rate than would be indicated across all U.S. wells.

There is insufficient U.S. equipment capacity in place to comport with ANGA's assertion that 92% of all new and recompleted wells use REC equipment. While a 92% REC equipment use rate may be true for the five companies surveyed, these data are not indicative of the national average, which EPA relies on for its rulemaking.

By comparison, API reports that approximately 70% of new shale gas well completions used REC equipment.<sup>6</sup> However, this number drops dramatically when conventional gas well completions and recompletions are factored into the equation. API estimates an overall 20% REC usage for well completions and recompletions including shale wells.

A 92% REC equipment use rate for all new and recompleted gas wells in the U.S. is not physically possible, because there is insufficient equipment available in the U.S. at this time to meet that demand.

API has requested that EPA delay the implementation of REC rules to provide industry with enough time to fabricate the extra 1,300 REC units that are needed to meet current and future REC demand.<sup>7</sup> API acknowledges there is a substantial inventory of eligible gas well REC candidates that are not implementing emission control due to the lack of available equipment. API's conclusion that there is a substantial shortfall in REC equipment capacity in the U.S. is discordant with ANGA's conclusion that 92% of well completions are controlled using REC equipment.

API points out that without EPA rulemaking, voluntary investment in REC equipment fabrication is unlikely. API's conclusion supports the need for mandatory rulemaking to fuel investment in manufacturing the 1,300 REC units needed by industry.

*A related problem with meeting the equipment demand is the availability of capital to fund the necessary new equipment given the current economic conditions and credit availability. Manufacture of a single set of high-pressure code compliant REC equipment is expected to cost about \$467,000 per set. With the estimated 1,300 additional sets*

<sup>6</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Attachment G, p.3

<sup>7</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Page 32.

*necessary this implies a capital investment in excess of \$600 MM to manufacture the equipment. **The majority of the pressure vessel manufacturers are not large companies and will likely not commit the capital and effort to expanding the equipment base until the rule is finalized and detailed requirements are known.***<sup>8</sup>

API does not comment on the financial capacity of the gas exploration companies themselves to fund REC equipment fabrication. . An accelerated timeframe for EPA's rulemaking may be possible if gas exploration companies fund the investment in REC equipment, rather than relying small companies to take the financial risk prior to a final rule being issued.

API advises EPA that 1,300 additional REC units are needed to capture emissions from all well completions eligible for REC controls. API states that rulemaking will be required to prompt REC investment. API's conclusion that there is a 1,300 REC unit shortfall is discordant with ANGA's position that 92% of all completions use REC equipment.

There are two important questions to raise about ANGA's URS study:

1. Is the data statistically significant? In other words, can the conclusions reached using the limited dataset in the study be extrapolated across all U.S. wells?
2. Is there sufficient REC equipment capacity in the U.S. to meet URS' 92% REC estimate?

ANGA's data is not statistically significant on a national scale. ANGA collected data from seven of 30 member companies on 1,174 wells; in the U.S. more than 490,000 gas wells exist and more than 27,000 new gas wells are drilled each year. ANGA's data do not reflect operations in all gas producing states. ANGA's data only represent 0.2% of all U.S. gas wells and 4.3% of all new wells.

1,174 wells in ANGA URS Study/ 490,000 U.S. gas wells = 0.2%  
1,172new wells in ANGA URS Study/ 27,000 new U.S. gas wells = 4.3%

ANGA's data only represent 0.2% of all U.S. gas wells and 4.3% of all new gas wells drilled each year.

ANGA has 30 member companies<sup>9</sup> comprised mainly of independent oil and gas exploration and production companies. Many of ANGA's member companies are focused on new shale gas development, as evidenced by Figures 4 and 5 in URS' study showing that the 1,174 well data set primarily correlates to new drilling associated with shale gas plays.

EPA reports that there are 95 large and 6,329 small oil and gas exploration and production companies operating in the U.S. for a total of 6,424 companies.<sup>10</sup> The data URS collected on 1,174 wells from seven of ANGA's member companies reflects only 0.1% of U.S. oil and gas exploration and production companies, and 7% of large companies.

7 ANGA companies in URS dataset/ 6,424 U.S. E&P companies = 0.1% of all U.S. E&P companies  
7 ANGA companies in URS dataset/ 95 large U.S. E&P companies = 7% of large U.S. E&P companies

<sup>8</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Pages 94-95.

<sup>9</sup> <http://www.anga.us/about-us/our-members>

<sup>10</sup> EPA, Regulatory Impact Analysis, Proposed New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry, July 2011, p. 2-38.

URS data represents 0.1% of all U.S. E&P companies and 7% of large U.S. E&P companies.

Therefore, HCLLC concludes that it is not appropriate to extrapolate URS' limited dataset to the entire U.S. gas industry.

API reports that 80% of the natural gas wells (exploration and production wells) drilled in the next decade will be hydraulically fractured.<sup>11</sup>

The Energy Information Administration (EIA) reports that between 2005 and 2010, on average, 27,228 gas wells were drilled per year (Table No.1), including 2,043 exploration wells and 25,185 production wells. API has consistently maintained that it will not be possible to implement RECs on most exploration wells and some production wells.

Gas Well Type	Number of Gas Wells Drilled						Average	80% of wells Hydraulically Fractured (using API assumption)
	2005	2006	2007	2008	2009	2010		
Exploration	2,141	2,455	2,796	2,445	1,266	1,156	2,043	1,635
Development	26,449	30,316	30,057	30,447	17,626	16,215	25,185	20,148
<b>Total</b>	<b>28,590</b>	<b>32,771</b>	<b>32,853</b>	<b>32,892</b>	<b>18,892</b>	<b>17,371</b>	<b>27,228</b>	<b>21,783</b>

Number of Gas Wells Drilled from EIA Data: Crude Oil and Natural Gas Exploratory and Development Well Data

API estimates 80% of gas wells will be hydraulically fractured.

Therefore, for the purposes of this analysis, HCLLC used API's 80% hydraulic fracturing assumption multiplied only by the projected number of new production wells (25,185) to estimate the number of new gas wells per year that could potentially require a REC. HCLLC did not include the 2,043 exploration wells because they are typically ineligible for RECs.

$$(25,185 \text{ production wells drilled}) \times (80\% \text{ HF}) = 20,148 \text{ production well REC candidates}$$

If, as ANGA postulates, 92% of all new wells in the U.S. use REC methods, then 18,536 REC jobs would currently be completed annually.

$$(20,148 \text{ total production well REC candidates}) \times (92\% \text{ ANGA assumption}) = 18,536 \text{ REC jobs}$$

Yet, both API and EPA report that currently the U.S. only has a maximum capacity of 4,000 REC jobs per year.

Therefore, ANGA's 92% REC use estimate cannot be accurate on a national scale, unless both API's and EPA's estimates of a 4,000-REC job capacity is incorrect. Instead, it appears that the data provided by seven ANGA member companies are indicative of independent companies that aggressively drill shale gas plays.

<sup>11</sup> [http://www.api.org/policy/exploration/hydraulicfracturing/questions\\_answers.cfm](http://www.api.org/policy/exploration/hydraulicfracturing/questions_answers.cfm).

If API's and EPA's estimates of a 4,000-REC unit capacity are correct, and if REC units are only used on new wells, and not allocated to the recompletion of existing wells, then only 20% of new wells could currently use RECs.

$$4,000 \text{ REC capacity} / 20,148 \text{ REC jobs needed} = 20\% \text{ of wells use REC}$$

Of note, this estimate is a very conservative because companies report to EPA Natural Gas STAR that REC units are, in fact, allocated to recompletions. Therefore, EPA's estimate of 14-19% is on the conservative end of the spectrum.

**Question No. 2:** EPA estimated that 9,175 Mcf total gas/REC (8,258 Mcf methane/REC) could be recovered using a REC, whereas ANGA assumes 765 Mcf/REC. Is EPA's 9,175 Mcf /REC estimate well supported?

ANGA states that EPA's 9,175 Mcf estimate is not representative of the amount of gas that is typically captured during a REC. ANGA asserts that EPA has overestimated the amount of gas recovered by 1200%, and the actual gas volume recovered during a REC is typically 765 Mcf.<sup>12</sup> Incongruously, ANGA reaches this conclusion by relying on gas flow rate data from 98 wells that were determined to be ineligible for RECs.

ANGA's 765 Mcf assumption is based on a 2011 URS study that examined the gas flow rate from 98 wells that were determined to be ineligible for RECs (cases where gas was either flared or vented). While this same 2011 URS study collected data on 1,076 wells that used REC equipment, URS did not report the amount of gas collected by any of the 1,076 REC jobs in its study.

Wells that are not eligible for RECs are commonly low flowrate and low pressure wells, or wells where nearby pipeline infrastructure has not yet been installed. Therefore, by definition, ineligible wells would not be representative of the higher gas flow rate and higher gas pressure wells that would typically use REC equipment.

URS' study only provided data on the flowback duration of wells that used RECs. URS estimates a 5.8 day duration for the average REC job.

API concurs with EPA's estimate of a 3-10 day REC duration, suggesting 7 days as a reasonable average based on its dataset.<sup>13</sup> ANGA's estimate of 5.8 days compares favorably with EPA's estimate of 3-10 days and API's estimate of 7 days.

ANGA's use of a 765 Mcf/REC gas estimate is based on wells that were ineligible for RECs and is not representative of the higher gas flow rate and higher pressure gas wells that would typically use REC equipment.

ANGA's recommendation to use a 765 Mcf estimate for gas produced from a new well during a REC is not supported by the national gas production data shown in Table No. 2 on the following page.

<sup>12</sup> ANGA comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, including URS Study attached dated November 28, 2011.

<sup>13</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Attachment G, p.3.

**Table No. 2: 2009 EIA Data on Distribution of Wells by Production Rate Bracket**

	Number of Gas Wells	Annual Gas Production (Bcf)	Gas Rate per Well per Day (Mcf)	Estimated Gas Rate per Well using ANGA's 5.8 day estimate per REC (Mcf/REC)
EIA reports 378,579 wells in the U.S. that produce less than 765 Mcf over a 5.8 day period	91,005	73	2	14
	45,034	131	8	48
	60,930	358	17	96
	43,009	428	28	162
	32,564	458	39	229
	24,829	451	51	295
	18,967	421	62	360
	21,718	591	76	442
	23,974	841	99	571
	16,539	744	127	734
<b>Subtotal</b>	<b>378,569</b>			
EIA reports 82,819 wells in the U.S. that produce more than 765 Mcf over a 5.8 day period	11,638	645	157	909
	16,083	1,122	197	1,145
	9,959	896	256	1,482
	22,546	3,157	403	2,336
	13,444	3,520	782	4,538
	5,528	2,572	1,545	8,962
	2,038	1,708	3,008	17,446
	816	1,342	6,039	35,028
	460	1,633	11,908	69,064
	247	1,913	22,918	132,922
51	725	46,469	269,517	
9	228	84,082	487,675	
<b>Subtotal</b>	<b>82,819</b>			
EIA reports the average U.S. Gas Rate per Well is 148.5 Mcf/day				
<b>Total</b>	<b>461,388</b>	<b>-</b>	<b>148.5</b>	

\* EIA Data: Natural Gas Annual Supply & Disposition by State

Table No. 2, developed by HCLLC using 2009 EIA data, shows that the national average gas production rate per gas well was 148.5 Mcf/day. Multiplying the average gas well rate by ANGA's estimate of 5.8 days per REC job yields an average gas rate in the U.S. of 861 Mcf/REC per well.

$$(148.5 \text{ Mcf/day average gas rate per U.S. well}) \times (5.8 \text{ days per REC}) = 861 \text{ Mcf per REC}$$

However, REC equipment is not used or targeted to the average aging U.S. gas well. Instead, EPA proposes that REC equipment be used on new well completions and recompletions of existing wells. The gas flow rate of new well completions and recompleted wells is several orders of magnitude larger than the average U.S. gas well flow rate; otherwise, the economics of drilling a new gas well or recompleting a well would not be supported.

As shown in Table No. 2, there are 82,819 wells in the U.S. that produce gas at flow rates exceeding 765Mcf over a 5.8 day REC job period. Due to limited equipment supply, the highest flow rate gas wells are prioritized for RECs. This means the average gas flow rate per REC substantially exceeds 765 Mcf over a 5.8 day REC job period.

Table No. 2 includes a wide range of well ages and gas flow rates, from decades old, low pressure, low flow rate wells to newly drilled wells. Less than 6% of the data in Table No. 2 is from newly drilled wells. Therefore, a 765 Mcf/REC estimate represents a marginal well, not the type of well that is prioritized for a REC.

Additionally, API and EPA point out there is only REC capacity for 15-20% of the eligible wells. Therefore, with a limited current equipment inventory of up to 4,000 jobs per year, or potentially as high as 20,000 jobs per year in the future, the wells prioritized for REC jobs would be substantially higher than 765 Mcf/REC to which optimize the rate of return. Operators would not allocate a limited REC equipment supply to average producing gas well.

For example, a technical paper found on ANGA's website<sup>14</sup> prepared by Carnegie Mellon University uses an average well gas production rate of 300-10,000 Mcf/day for a newly drilled Marcellus Shale well. Using ANGA's recommended REC duration rate of 5.8 days and the Carnegie Mellon University estimate results in a 1,740-58,000 Mcf gas recovery rate. This calculation is much more representative of the current gas well using a REC than 765 Mcf/REC. Of note, Carnegie Mellon University's low-side estimate of 300 Mcf/day is based on an average gas production rate for a well over a 25-year duration. It does not take into account that flow rates peak during the first year of a well's life – the period when RECs are implemented.<sup>15</sup> Therefore, Carnegie Mellon University's analysis shows that a REC on a new Marcellus Shale gas well would substantially exceed 1,740 Mcf.

API's comments on EPA's Regulatory Impact Analysis for the proposed NSPS rulemaking also question EPA's use of 9,175 Mcf/REC (8,258 Mcf methane/REC). API states that this higher gas rate is indicative of higher profitability REC jobs that are currently receiving priority due to the limited REC equipment inventory.<sup>16</sup> API explains that when a larger REC equipment fleet is available, the amount of gas recovered per REC will decline, as less economic jobs are completed. Yet, even at lower gas flow rates, RECs are still predicted to be economical. API's main concerns are the time required to build REC units and the potential for a mandatory REC requirement to slow the drilling and workover pace until sufficient REC units are constructed.

API does not contest EPA's use of 9,175 Mcf/REC (8,258 Mcf methane/REC) for rulemaking purposes, and instead attaches an independent engineering review completed by David Simpson that concludes:

*...we assumed that the EPA estimate of 1.2 MMcf/day and 7 days of flowback (8,400 Mcf per REC) are as reasonable an estimate as anyone is likely to develop.*<sup>17</sup>

Simpson explains that EPA's use of 1,200 Mcf/day (over a 7 day period), for a total of 8,400 Mcf/REC is reasonable because most pipeline gathering systems require a 1,200-1,400 Mcf/day gas flow rate (to flow into the pipeline without additional gas compression equipment).<sup>18</sup>

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<sup>14</sup><http://www.anga.us/media/229762/life%20cycle%20greenhouse%20gas%20emissions%20of%20marcellus%20shale%20gas%20-%20carnegie%20mellon.pdf>.

<sup>15</sup> Jiang, M., Griffin, E.M., Hendrickson, C., Jaramillo, P., VanBriesen, J. and Venkatesh, A., Life Cycle Greenhouse Gas Emissions of Marcellus Shale Gas, Carnegie Mellon University, August 5, 2011, p.4.

<sup>16</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011.

<sup>17</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Attachment G, p. 6.

<sup>18</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Attachment G, p. 4 and 6.

For example, industry data provided to Colorado during the development of Colorado's REC Rule 805 (otherwise known as "Green Completion Rule 805") argued that most gas wells producing less than 500 Mcf/day would not be good candidates for REC, unless compression is added to overcome pipeline backpressure. In response to industry's technical arguments, Colorado limited Rule 805 to require RECs for wells with a gas flow rate of 500 Mcf/day or more.<sup>19</sup>

Therefore, ANGA's position that the average REC job only produces 765 Mcf over a 5.8 day period (132 Mcf/day) is inconsistent with the industry data provided to Colorado showing that a minimum gas flow rate of 500 Mcf/day is required for most RECs. It is also inconsistent with API's data showing that a gas rate of 1,200-1,400 Mcf/day is required for most RECs.

The gas flow rate of 765 Mcf/REC estimated by ANGA is clearly under-predicted. Wells prioritized for REC use would substantially exceed 765 Mcf. The amount of gas produced through a REC unit can be measured by a gas flow meter. It is recommended that ANGA collect data on the amount of gas actually collected during REC jobs and provide that data to EPA.

**Question No. 3:** In 2011 IHS CERA examined EPA's estimate of 9,175 Mcf/REC. Does EPA's 9,175 Mcf/REC (8,258 Mcf methane/REC) estimate have a technical basis?

In 2001, EIA reported that initial gas flow rates from all U.S. wells completed in 1996-2000 was 1,900 Mcf/day/completion.<sup>20</sup> Using the 1,900 Mcf/day/completion estimate and ANGA's assumed 5.8 day REC duration period results in an estimate of 11,020 Mcf of gas recovered per REC. This calculation compares favorably with EPA's estimate of 9,175 Mcf of gas recovered per REC. Of note, EIA's 2001 data is based on new U.S. gas well flow rates and does not include the more recent surge in shale gas wells that produce high initial gas rates.

$$(1,900 \text{ Mcf/day/completion}) \times (5.8 \text{ days/REC}) = 11,020 \text{ Mcf/REC}$$

Additionally, API's comments to EPA support EPA's use of 1,200 Mcf/day (over a 7 day period), for a total of 8,400 Mcf/REC as reasonable estimate.<sup>21</sup>

EPA estimates the cost of a REC job to be \$33,237.<sup>22</sup> Using a conservative gas price of \$4/Mcf, a gas rate of 1,433 Mcf/day/completion would be required to breakeven. Since the average gas rate of 1,900 Mcf/day/completion reported by EIA exceeds the breakeven threshold of 1,433 Mcf/day/completion, the average REC job is predicted to be economic. With a limited equipment supply, the economics of a prioritized well would even be more robust.

$$(\$33,237/\text{REC job})/(\$4/\text{Mcf}) = 8,309 \text{ Mcf}$$
$$(8,309 \text{ Mcf})/5.8 \text{ days per well completion} = 1,433 \text{ Mcf/day/completion}$$

<sup>19</sup> Colorado Oil and Gas Conservation Commission, Rule §805(b)(3).

<sup>20</sup> U.S. Energy Information Administration (EIA), U. S. Natural Gas Markets: Mid-Term Prospects for Natural Gas Supply, <http://www.eia.gov/oiaf/servicerpt/natgas/boxtext.html>.

<sup>21</sup> API Comments to EPA on Docket ID No. EPA-HQ-OAR-2010-0505, November 30, 2011, Attachment G, p. 4 and 6.

<sup>22</sup> EPA, Technical Support Document for Standards of Performance for New Stationary Sources: Oil and Natural Gas Production and Natural Gas Transmission and Distribution; National Emission Standards for Hazardous Air Pollutants From Oil and Natural Gas Production Facilities; and National Emission Standards for Hazardous Air Pollutants From Natural Gas Transmission and Storage Facilities, Docket ID No. EPA-HQ-OAR-2010-0505, 2011, p. 125 of 604.

Data published by ALL Consulting in 2008 show that the average gas rate for shale gas wells in the U.S. ranges from 100 Mcf/day to 3,100 Mcf/day.<sup>23</sup> The low end of the range is based on the Lewis Shale. If the Lewis Shale is excluded, the next lowest gas flow rate is the Woodford Shale at 415 Mcf/day. Lewis Shale wells are unlikely to be candidates for RECs because of low flow rates and pressures; therefore, a range of 415 Mcf/day to 3,100 Mcf/day is evaluated below. Using the 415 Mcf/day to 3,100 Mcf/day estimate and ANGA's assumed 5.8 day REC duration period results in an estimate of 2,407-17,980 Mcf recovered per REC. ALL Consulting's data compares favorably with EPA's estimate of 9,175 Mcf recovered per REC.

$$(415 \text{ Mcf/day/completion}) \times (5.8 \text{ days/REC}) = 2,407 \text{ Mcf/REC}$$
$$(3,100 \text{ Mcf/day/completion}) \times (5.8 \text{ days/REC}) = 17,980 \text{ Mcf/REC}$$

A Simmons & Co. International Report titled U.S. Threshold Gas Prices - Determining Prices Required to Sustain Drilling Key U.S. Gas Plays included data on initial gas production rates.<sup>24</sup> Simmons & Co. International reported the following:

- **Conventional gas wells:** 4,000 Mcf/day rising to 7,000 Mcf/day after well cleanup; producing 5.664 Bcf over 5.25 years on average. Offshore well data was substantially higher at 15,000 Mcf/day climbing to 23,500 Mcf/day after well cleanup.
- **Tight Gas Sand Wells:**
  - Piceance Basin of Western Colorado has a typical initial rate of 1,200 Mcf/day
  - Lobo Trend in South Texas has typical initial rate of 3,000 Mcf/day
  - Uinta Basin of Utah has a typical initial rate of 1,500 Mcf/day

Therefore Simmons & Co. International data shows that even new conventional wells and tight gas sand wells typically produce 1,200 Mcf/day to 15,000 Mcf/day.

$$(1,200 \text{ Mcf/day/completion}) \times (5.8 \text{ days/REC}) = 6,960 \text{ Mcf}$$
$$(7,000 \text{ Mcf/day/completion onshore wells}) \times (5.8 \text{ days/REC}) = 40,600 \text{ Mcf}$$

Data from two independent consultants and the EIA confirm that the typical gas production rate ranges from 2,407 Mcf/REC to 40,600 Mcf/REC.

Please let me know if you have any questions on this memo.

*Susan L. Harvey*

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<sup>23</sup> ALL Consulting, Hydraulic Fracturing Considerations for Natural Gas Wells of the Fayetteville Shale, 2008, p. 5.

<sup>24</sup> <http://www.epmag.com/archives/newsComments/6242.htm#>

