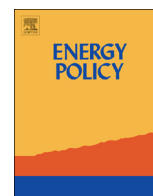




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Hydraulic fracturing chemicals reporting: Analysis of available data and recommendations for policymakers

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HIGHLIGHTS

- 96,449 FracFocus forms were analyzed, including 1,979,128 ingredient records.
- Rates of withheld chemical ingredients are increasing in FracFocus.
- State rules shortened submission time but did not affect data quality or withholding.
- Systems approach reporting reduces withholding by more than four-fold.

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ABSTRACT

Twenty-eight states require disclosure of hydraulic fracturing chemicals. Twenty-three states direct reporting to FracFocus; additionally, companies in other states use this registry. FracFocus contains the most comprehensive dataset on fracturing chemicals but faces data quality and transparency criticisms. In response, FracFocus announced upgrades, and since May 2015, publishes aggregated data. We used Linux and R version 3.2.0 to clean and analyze 96,449 forms submitted between March 9, 2011 and April 13, 2015 for accuracy, completeness, and timeliness. We characterize data, and compare results to state law and industry practice, to suggest how to induce more accurate and complete disclosures. We find that rates of withheld chemical information have increased since 2013, and appear unaffected by different legal requirements. However, when companies report fracturing chemicals without attribution to the specific products in the fracturing fluid (a “systems approach” to reporting), withholding rates drop four-fold. State deadlines shortened reporting timelines, but compliance rates are low absent indication states will enforce. Automatic field population and prompts in FracFocus can reduce data error, while enforcement signals, education, and harmonized requirements may boost compliance and enhance disclosure. Systems reporting should occur, with states retaining authority to request product-specific ingredient lists.

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1. Introduction

1.1. Background

The United States has led the world in annual natural gas production since 2009, and in 2013, was the world’s top oil producer (BP (British Petroleum), 2014; U. S. EIA (Energy Information Administration), 2014). Technological advances in horizontal drilling and hydraulic fracturing have unlocked oil and natural gas reserves in low permeability formations, including shale and tight sands (U.S. EPA (Environmental Protection Agency), 2015a, 2015b, 2015c).

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The unconventional oil and gas boom has generated jobs and wealth (IHS Economics, 2014; U.S. BLS (Bureau of Labor Statistics), 2014), as well as questions about the environmental consequences of such development (Clark et al., 2013; Krupnick et al., 2013; U.S. Geological Survey, 2013). Academic and trade literature have sought to define and quantify potential environmental risks posed by unconventional oil and natural gas production, including water demands (Nicot and Scanlon, 2012), air emissions (Pétron, 2014; Litovitz et al., 2012), wastewater generation (Warner et al., 2013; Jiang et al., 2014), and potential for surface water contamination from chemical and waste water spills (Entekin et al., 2011; Wiseman, 2013), groundwater contamination from faulty well construction (Llewelyn et al., 2015), or both (Vidic et al., 2013). The public “fracking” debate has focused on the fracturing stage of development (Shonkoff et al., 2014; Zoback et al., 2010), when

millions of gallons of water and chemicals are shot into a well at high pressure, to fracture the target formation and enable the release of fossil fuels. In 2005, Congress exempted hydraulic fracturing from federal Safe Drinking Water Act requirements, including disclosure of the chemicals used (Energy Policy Act of 2005, 2005). Opposition to hydraulic fracturing has focused on this exemption (Scientific American editorial board, 2011; New York Times editorial board, 2009), and public opinion polls reveal strong support for chemical reporting requirements (Brown et al., 2013).

In response, since 2010, twenty-eight states have required companies to report and disclose the chemicals used in hydraulic fracturing (Alabama, 2013; Alaska 2014; Arkansas, 2013; California, 2014; Colorado, 2012; Idaho, 2012; Illinois, 2014; Indiana, 2012; Kansas, 2013; Kentucky, 2015; Louisiana, 2011; Michigan, 2011; Mississippi, 2013; Montana, 2011; Nebraska, 2013; Nevada, 2014; New Mexico, 2012; North Carolina, 2015; North Dakota, 2012; Ohio, 2012; Oklahoma, 2012; Pennsylvania, 2012; South Dakota, 2012; Tennessee, 2013; Texas, 2011a, 2011b; Utah, 2013; West Virginia, 2013; Wyoming, 2010). Requirements vary in their timing for submissions, content of submissions, justifications for withholding information, and method of disclosure.

Twenty-three states require or encourage reporting to FracFocus. Additionally, companies in at least four other states use this registry. FracFocus is an online system launched in 2011 and managed by the Ground Water Protection Council (GWPC) and Interstate Oil and Gas Compact Commission (IOGCC) (FracFocus, 2015). Well operators – and in some cases, the service companies that perform the fracturing operation – upload data into the registry for public viewing in well-specific Portable Document Format (PDF) files.

Of the states that direct reporting to FracFocus, Colorado and Pennsylvania placed conditions on their use of FracFocus, requiring the registry to maintain or upgrade certain capabilities (Colorado, 2012; Pennsylvania, 2012). California legislation relies on FracFocus as an interim reporting tool only, until the state creates its own database (California, 2014).

FracFocus contains the most comprehensive dataset on chemical use in hydraulic fracturing. However, it has faced criticisms related to data quality, transparency, and accessibility (Elgin et al., 2012; Konschnik et al., 2013; U.S. DOE (Department of Energy), 2014). One criticism relates to the rate of withheld chemical data (U.S. DOE (Department of Energy), 2014). Based on data scraped from PDF forms submitted between January 2011 and February 2013, the federal Environmental Protection Agency (EPA) calculated that 11% of ingredient records were withheld from FracFocus as proprietary (U.S. EPA (Environmental Protection Agency), 2015a). GWPC found that 16.7% of ingredients were withheld in forms filed between June and December 2013 (U.S. DOE (Department of Energy), 2014). Protection of proprietary information rewards and encourages innovation. However, manufacturers of other proprietary products disclose ingredients while withholding formulas (Ritenbaugh, 2014; Warren, 2011; Warren, 2011).

In 2011, the Secretary of Energy Advisory Board (SEAB) recommended improvements to the environmental performance of shale gas production, including enhanced chemical disclosure (U.S. DOE (Department of Energy), 2011a; U.S. DOE (Department of Energy), 2011b). A 2014 SEAB task force evaluated FracFocus and state disclosure rules, and suggested ways to reduce trade secret claims in the registry (U.S. DOE (Department of Energy), 2014). Meanwhile, EPA issued an Advance Notice of Proposed Rulemaking (ANPR), soliciting input on ways to improve disclosure (U.S. EPA (Environmental Protection Agency), 2014). The ANPR suggested that EPA was poised to fill perceived gaps in FracFocus (U.S. EPA (Environmental Protection Agency), 2014).

In 2015, the Department of the Interior's Bureau of Land Management (BLM) finalized rules governing hydraulic fracturing activities on federal and tribal land (U.S. DOI (Department of the Interior), 2015). BLM's rule directs operators to make disclosures on FracFocus. BLM justified its decision based on pledged improvements to the website, and vowed to “continue to work with FracFocus in coordination with the U.S. Department of Energy (DOE) to ensure that the recommendations of the [SEAB] for improvement of the database are made” (U.S. DOI (Department of the Interior), 2015). Meanwhile, as noted above, Colorado and Pennsylvania law set conditions for continued reliance on FracFocus. Moreover, in early 2015, Pennsylvania announced it would begin building its own fracturing chemical disclosure registry, to replace FracFocus (Ferral, 2015).

To address public concerns, FracFocus managers and states completed one set of upgrades to FracFocus in 2012–13 (known as FracFocus version 2.0 or FF 2.0), and launched a second upgrade in 2015 (FF 3.0). The Harvard Environmental Policy Initiative participated in the 2015 upgrades, and proposed analyzing FF 1.0 and 2.0 forms in response to the SEAB Task Force's recommended audit of FracFocus (U.S. DOE (Department of Energy), 2014).

In the first iteration of FracFocus (FF 1.0), operators filled out Portable Document Format (PDF) forms and submitted them online. GWPC retained form header data in Microsoft SQL but did not receive or store substantive chemical information outside of the PDFs. In November 2012, FracFocus began offering an option to submit data in eXtensible Markup Language (XML). XML became the exclusive format for data entry after June 1, 2013. GWPC stores all FF 2.0 information in Microsoft SQL. Still, until recently, the public could only view FracFocus data in well-specific PDF. Therefore, previous reviews of FracFocus were based on small sample sizes (Konschnik et al., 2013) or data scraped from the PDFs by third parties (Elgin et al., 2012; Greene, 2014; US EPA, 2015a). As of May 2015, FracFocus.org now provides public access to the aggregated dataset, enabling analysis of data across all wells.

1.2. Objectives and contribution of work

We use the aggregated data to quantify certain data errors, calculate the rates of withheld data, and determine when disclosures were made. Our analyses provide a snapshot of the data, and establish a baseline for future comparison with data submitted to FracFocus after the 2015 upgrades.

We compare results over time and between states, and to an EPA analysis of a smaller FF 1.0 data set. We also compare forms containing the “systems approach” method of disclosure—where companies report fracturing chemicals without attribution to the specific products in the fracturing fluid – with those forms reporting chemical ingredients by product. These comparisons could suggest requirements and practices that produce more accurate and complete information going forward for researchers, states, and the public.

2. Methodology and data

We detail the methods for preparing our dataset in “FracFocus Chemical Disclosure Registry 1.0 and 2.0 Data Conversion, Cleaning, and Standardization Methods Paper,” (Methods Paper) (Dayalu and Konschnik, 2015). The Methods Paper and our dataset, which we used for the analyses described herein, are available for review and use at <http://dx.doi.org/10.7910/DVN/EFNV5J>.

2.1. Initial dataset

On April 14, 2015, GWPC provided a Microsoft SQL database

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