

Unfracking the Future:

“We Owe That much and More to our Children”

~Theo Colborn *Our Stolen Future*

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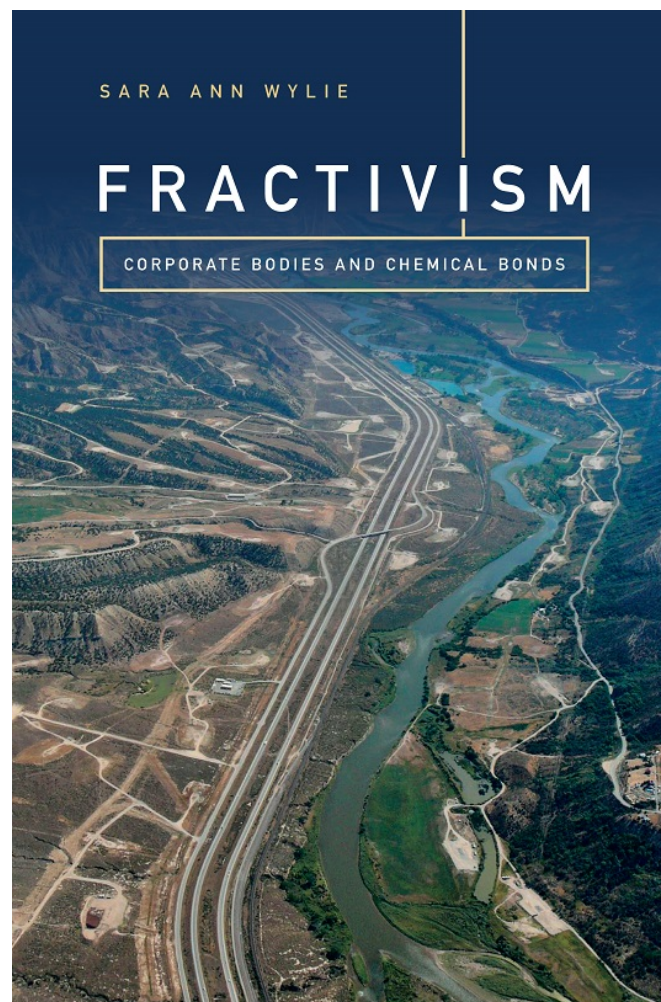
Northeastern University



EDGI-co-founder



Publiclab.org co-founder/organizer



TEDX

The Endocrine Disruption Exchange, Inc.

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CHEMICALS USED IN NATURAL GAS DEVELOPMENT

Introduction, Analysis and Comments

June 29, 2006

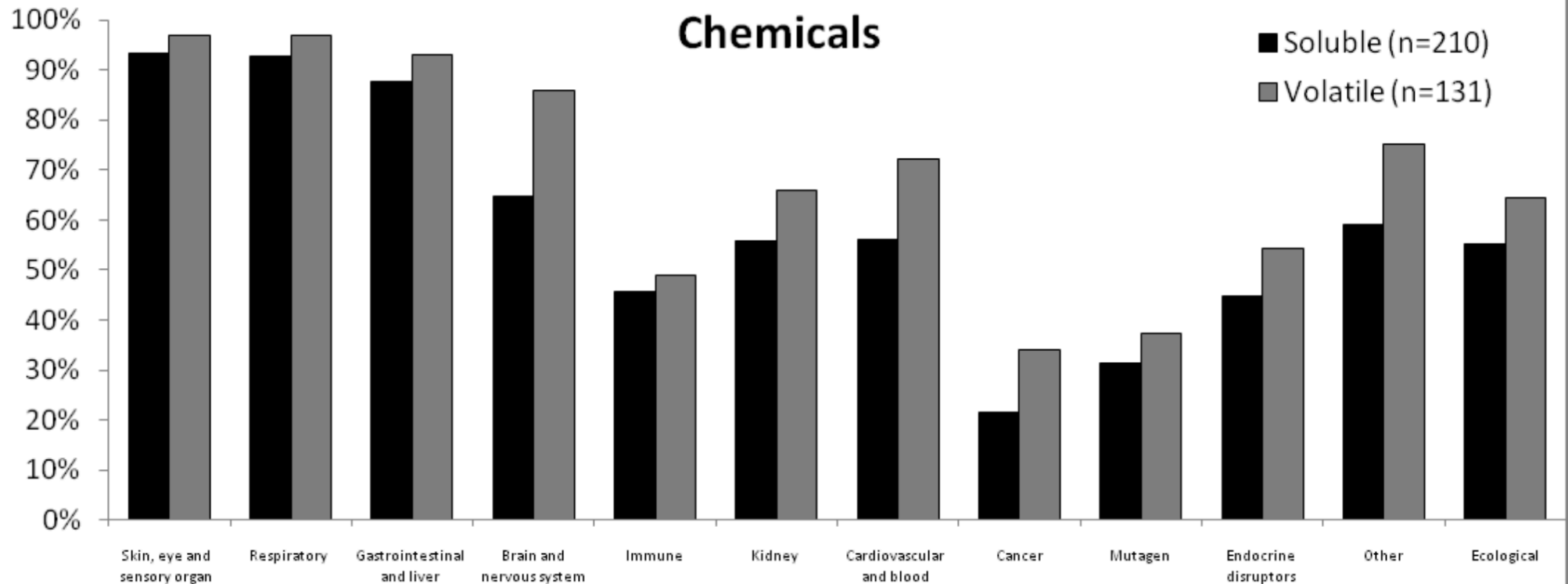
4:30 pm

Introduction

This project was designed to *explore* the health effects of the products and chemicals used in drilling, fracturing (“fracking”), and recovery of natural gas. It provides a *glimpse* at the *pattern(s) of possible health hazards* for those living in proximity to gas development.

Predict Possible Systemic Harms: The Endocrine Disruption Exchange

Figure 4: Profile of Health Effects from Soluble and Volatile Chemicals



A Pattern of Health Problems Related to Oil and Gas Extraction Chemicals that generated grounds for demanding “full disclosure...to protect our watersheds and public health” as “Proper monitoring of air and water cannot be designed without knowing what to look for.”

What were the impacts of the TEDX Database?

COMMITTEE ON ENERGY & COMMERCE DEMOCRATS

SCHEDULE LEGISLATION HEARINGS MARKUPS ARCHIVES SUBCOM

WAXMAN, MARKEY, AND DEGETTE INVESTIGATION FINDS USE OF DIESEL IN HYDRAULIC FRACTURING FLUIDS

Jan 31, 2011

Today Reps. Henry A. Waxman, Edward J. Markey, and Diana DeGette sent a letter to the Environmental Protection Agency Administrator Lisa Jackson regarding the results of an investigation into the use of diesel fuel in hydraulic fracturing fluids.

The congressional investigation finds that oil and gas service companies have injected over 32 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states between 2005 and 2009. In addition, the investigation finds that no oil and gas service companies have sought – and no state and federal regulators have issued – permits for diesel fuel use in hydraulic fracturing, which appears to be a violation of the Safe Drinking Water Act.

Legislative Attention

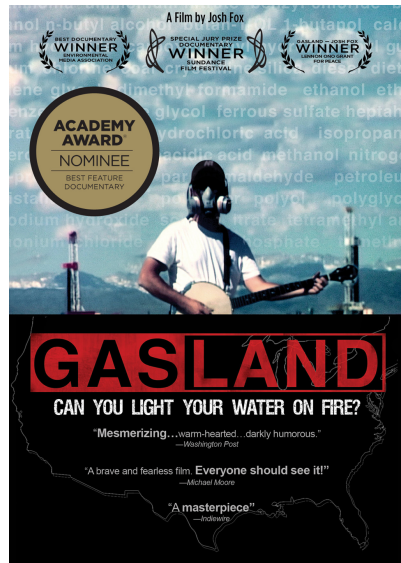


TABLE 1
Hazardous Chemicals in Drilling Fluids with a SCDM Value

Chemical Name	SCDM – Drinking Water (1/28/2004) Concentration in ug/L (MCL)
Benzene	5.0
Toluene	1,000
Ethyl benzene	700
Xylene	10,000
Naphthalene	20
1-Methylnaphthalene	20
2- Methylnaphthalene	150
Fluorenes	1500
Ethylene glycol	73,000
Formic acid	73,000
Methanol	18,250
Ethylene glycol monobutyl ether	18,000
Aluminum oxide	36,000
Arsenic	0.057
Cadmium	5
Copper	1,300
Hydrogen sulfide	10
Iron	11,000
Lead	15
Mercury	0.63
Nickel	730
Vanadium	36
Zinc	11,000

MCL Maximum Contaminant Level (US EPA Drinking Water Regulations)

Figure 10.2 Hazardous chemicals found in hydraulic drilling fluids that are regulated by the Superfund Chemical Data Matrix according to the EPA, the possibility of their presence in drilling fluids allowed EPA investigation into the Pavillion Watershed

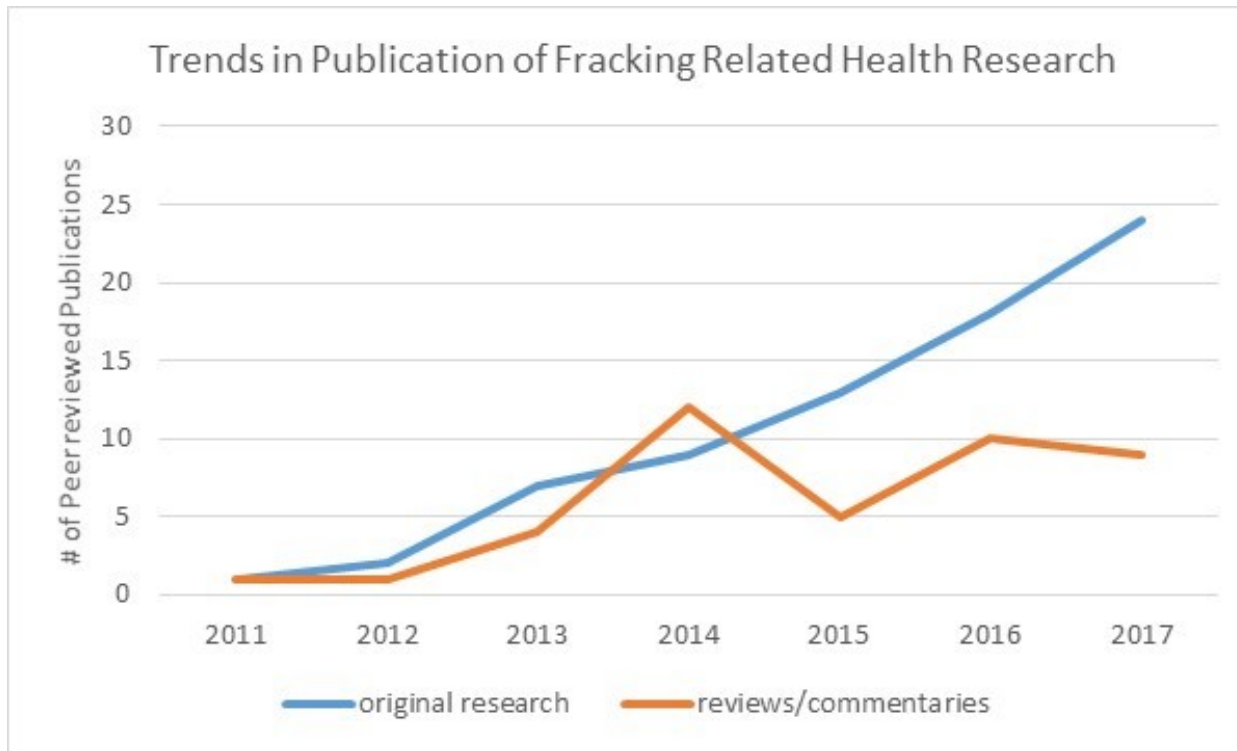


Popular Media

“Additionally, The Endocrine Disruption Exchange (TEDX) has compiled a list of chemicals used in natural gas development in Wyoming. While the TEDX list is comparable to the EPA Study List, it adds several metals that may be found in compounds used in gas well installation and are as follows: aluminum oxide, arsenic, cadmium, copper, iron, lead, mercury, nickel, vanadium and zinc” (EPA Region 8 2009: 8).

Community Empowerment and EPA Research

A Booming Field of Research: TEDX health publications database



“six epidemiologic public health studies demonstrated that people who live in close proximity to multiple oil and gas wells in densely developed shale basins have experienced an increased incidence of childhood leukemia, asthma attacks, congenital heart defects, low birth weight, and preterm birth compared to people who live with no production wells nearby.”

Epstein AC. 2017

[10.1016/bs.apmp.2017.08.002.](https://doi.org/10.1016/bs.apmp.2017.08.002)

<https://endocrinedisruption.org/audio-and-video/fracking-related-health-research-database/search-the-database>

At least 17.6 million Americans lived within a mile of a well of an oil or gas well (Czolowski et. al 2016).

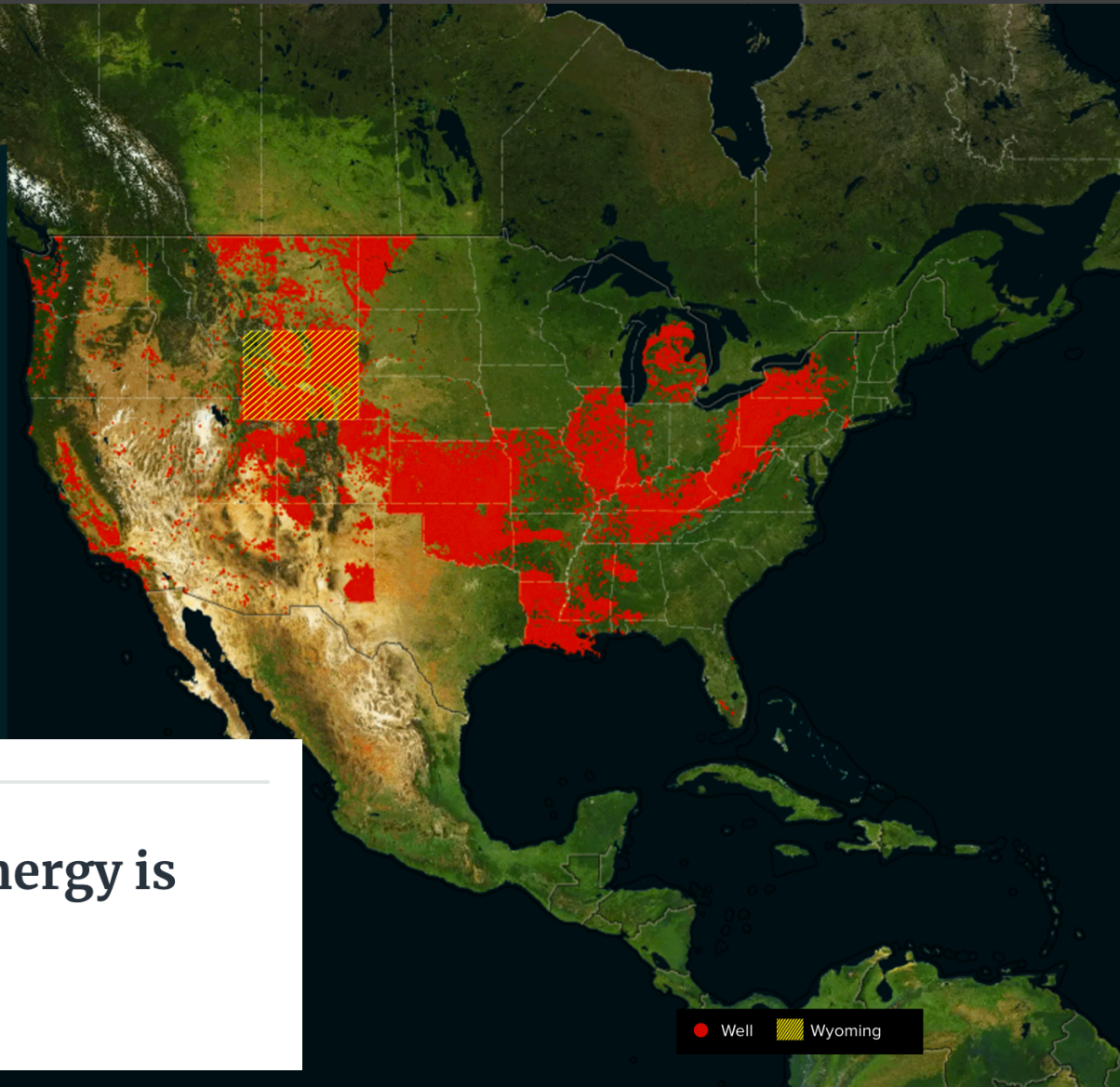
BREATHE — *at your* — OWN RISK

In 2014 the United States led the world in oil and natural gas production due to the unconventional energy extraction nationwide.

“

The golden era of American energy is now underway.”

President Donald J. Trump



White House Briefing statement:

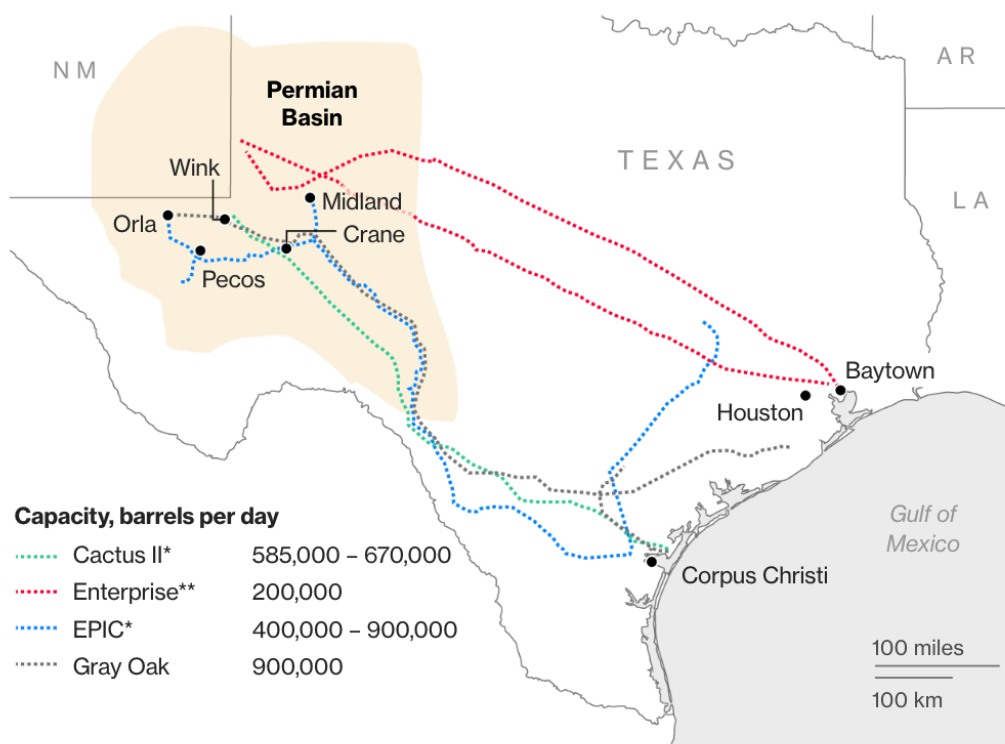
President Donald J. Trump Is Unleashing American Energy Dominance

— ENERGY & ENVIRONMENT | Issued on: May 14, 2019

- American natural gas production jumped to a new high in 2018, marking the second straight year of record production.
- Crude oil production hit a record high last year, leaping past the previous record set in 1970.
- Crude oil production spiked 17 percent in 2018, reaching 10.96 million barrels per day.
- The United States has become the largest crude oil producer in the world.

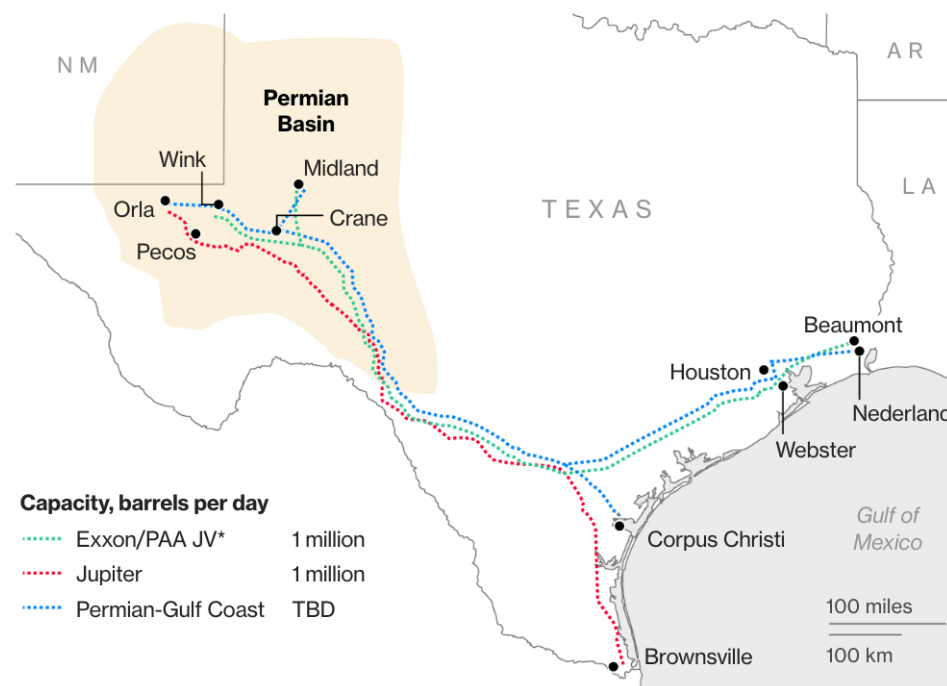
In Houston, the U.S. oil capital, shale executives are trying out different superlatives to describe what's coming. "Tsunami," they call it. A "flooding of Biblical proportions" and "onslaught of supply" are phrases that get tossed around.

Oil Pipelines Set to Open in 2019...



Source: Pipeline companies
 * Early flows to start in 2019, with full service planned for 2020 . ** Enterprise Products Partners plans to convert one of the NGL pipes in those two routes

...And in 2020



Source: Pipeline companies
 * Exxon Plains All American joint venture pipeline path is notional. No route has been announced

<https://www.bloomberg.com/news/articles/2018-11-21/opec-s-worst-nightmare-the-permian-is-about-to-pump-a-lot-more>

RELEASE THE CRACKER!!!

*After Shell's Historic Announcement, Will
Appalachia Become the Next Petrochemical Hub?*

A Special Report Brought to you by Natural Gas Intelligence

In 2015 DOW invested \$ 6 Billion to expand its chemical production facilities in the U.S. by 40 % based on another 10 years of low natural gas costs due to fracking.

<http://www.naturalgasintel.com/cracker-report>

5 new steam crackers will begin operation on the US Gulf Coast by the end of 2019, pushing US ethylene production capacity ahead of consumption capacity for the first time in decades—perhaps for the first time ever.

<https://chemweek.com/CW/Document/102241/Petrochemicals-Growing-pains-for-US-ethylene>



Connecting Shale Gas, Petrochemicals and Oil Production...

TOP 10 ETHYLENE PRODUCERS¹ Table 4

	Company	Sites ²	Capacity, tpy	
			Of wholly owned complexes	Of partially owned complexes
1	Saudi Basic Industries Corp.	15	13,392,245	10,273,759
2	Dow Chemical Co.	21	13,044,841	10,529,421
3	ExxonMobil Chemical Co.	20	12,515,000	8,550,550
4	Royal Dutch Shell PLC	13	9,358,385	5,946,693
5	Sinopec	13	7,895,000	7,275,000
6	Total AS	11	5,933,000	3,471,750
7	Chevron Phillips Chemical Co.	8	5,607,000	5,352,000
8	LyondellBasell	8	5,200,000	5,200,000
9	National Petrochemical Co.	7	4,734,000	4,734,000
10	Ineos	6	4,656,000	4,286,000

¹As of Jan. 1, 2013. ²Wholly owned plus partially owned.

Dow chemical, Royal Dutch Shell, Chevron Phillips and ExxonMobil are a few of the companies making infrastructural and capital investment in U.S. ethylene production to capture low gas prices' market edge (HIS 2012: 30).

<http://www.ogj.com/articles/print/volume-111/issue-7/special-report-ethylene-report/global-ethylene-capacity-poised-for-major.html>

Where the 2020 Dem candidates stand on climate issues

Analysis by The Washington Post.

● AGREE/SUPPORT ● QUALIFIED AGREEMENT ○ DISAGREE/OPPOSE ● NO ANSWER/UNCLEAR



Ban fracking



What Chemicals Are Used

As previously noted, chemicals perform many functions in a hydraulic fracturing job. Although there are dozens to hundreds of chemicals which could be used as additives, there are a limited number which are routinely used in hydraulic fracturing. The following is a list of the chemicals used most often. This chart is sorted alphabetically by the Product Function to make it easier for you to compare to the fracturing records .

<u>Chemical Name</u>	<u>CAS</u>	<u>Chemical Purpose</u>	<u>Product Function</u>
Hydrochloric Acid	007647-01-0	Helps dissolve minerals and initiate cracks in the rock	Acid
Glutaraldehyde	000111-30-8	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Quaternary Ammonium Chloride	012125-02-9	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Quaternary Ammonium Chloride	061789-71-1	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Tetrakis Hydroxymethyl-Phosphonium Sulfate	055566-30-8	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Ammonium Persulfate	007727-54-0	Allows a delayed break down of the gel	Breaker
Sodium Chloride	007647-14-5	Product Stabilizer	Breaker
Magnesium Peroxide	014452-57-4	Allows a delayed break down the gel	Breaker
Magnesium Oxide	001309-48-4	Allows a delayed break down the gel	Breaker
Calcium Chloride	010043-52-4	Product Stabilizer	Breaker
Choline Chloride	000067-48-1	Prevents clays from swelling or shifting	Clay Stabilizer
Tetramethyl ammonium chloride	000075-57-0	Prevents clays from swelling or shifting	Clay Stabilizer

Chemical Use in Hydraulic Fracturing

Introduction to Chemical Use

Why Chemicals Are Used

◀ [What Chemicals Are Used](#)

Chemicals & Public Disclosure

Looking for information about a
well site near you?



Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

TOTAL WELL SITES
REGISTERED

1 2 7 7 8 1

“Opaque Transparency”

Find a Well

Map Search

Search Options Show/Hide

STATE: Choose a State	COUNTY: Choose a State First	WELLS IN COUNTY: Choose a County First	OPERATOR: Choose One
JOB/SUBMITTED DATE: Job Start Date	DATE RANGE: Between	RANGE START DATE: <input type="text"/>	RANGE END DATE: <input type="text"/>
FEDERAL WELL: <input type="checkbox"/>	API WELL NUMBER: <input type="text"/>	WELL NAME: <input type="text"/>	
INDIAN WELL: <input type="checkbox"/>			

CAS Number:

INGREDIENT LIST

Clear Ingredient

SEARCH **RESET**

Displaying 50 of Records

(Note: One search option is required when searching. Click "Reset" to clear and prepare for filter.)

Avidan, M., Etzion, D. & Gehman, J. Opaque Transparency: How Material Affordances Shape Intermediary Work. *Regulation and Governance*. In press.
doi:[10.1111/rego.12217](https://doi.org/10.1111/rego.12217).

FracFocus Clean Up: to demonstrate methods to transform the disclosure vehicle

...FracFocus.org into a usable research database

The screenshot displays the CodeOcean interface for a capsule titled "FracFocus Cleanup - Proof of Concept" by Gary Allison. The interface is divided into three main sections: Files, Commands, and Tabs. The Files section on the left shows a file explorer with a tree view of the project structure, including folders for metadata, environment, code, data, and results. The Commands section in the middle shows a terminal window with the content of the README.txt file. The Tabs section on the right shows a timeline of published versions, with Version 3.0 currently selected and viewed.

Files

- Core Files
- metadata (1.76 KB)
- environment (369 B)
- code (982.61 KB)
 - core (134.34 KB)
 - build_database.py (1.58 KB)
 - Data_Dictionary.txt (6.45 KB)
 - Filtering_costs.ipynb (86.35 KB)
 - Flow_chart_1.pdf (30.12 KB)
 - LICENSE (34.32 KB)
 - README.txt (1.63 KB)
 - run (548 B)
 - Summary_of_cleaned_FF_d... (687.24 KB)
- data (271.04 MB) Manage Datasets
 - CAS_ref_files (2.59 MB)
 - cas_labels.csv (61.25 KB)
 - currentData.zip (268.18 MB)
 - LICENSE (6.4 KB)
 - OperatorName_xlate.csv (77.12 KB)
 - StateName_xlate.csv (1.83 KB)
 - Supplier_xlate.csv (138.6 KB)
 - .gitignore (16 B)
- results

Your files will appear in the timeline.
[View latest results](#)

Commands

README.txt

```
1 README for FF-POC repository and project
2
3 This CodeOcean capsule is a Proof of Concept version
4 of code to transform
5 the online chemical disclosure site for hydraulic
6 fracturing, FracFocus.org,
7 into a usable database. The code demonstrates
8 cleaning, filtering, and
9 curating techniques to yield organized data sets and
10 sample analyses
11 from a notoriously messy collection of chemical
12 records.
13 The sample analyses are available in the results
14 section as jupyter notebooks
15 and downloadable versions of the final data are also
16 available there.
17 For a majority of the records, the mass of the
18 chemicals is calculated.
19 (The FracFocus data used were downloaded June 25,
20 2019).
```

To be included in final data sets,
Fracking events must use water as carrier and
percentages must be
consistent and within tolerance.
Chemicals must be identified by a match with an
authoritative CAS number
or be labeled proprietary.

Further, portions of the raw data that are filtered
out include:
- fracking events with no chemical records (mostly
2011-May 2013).

Reproducibility

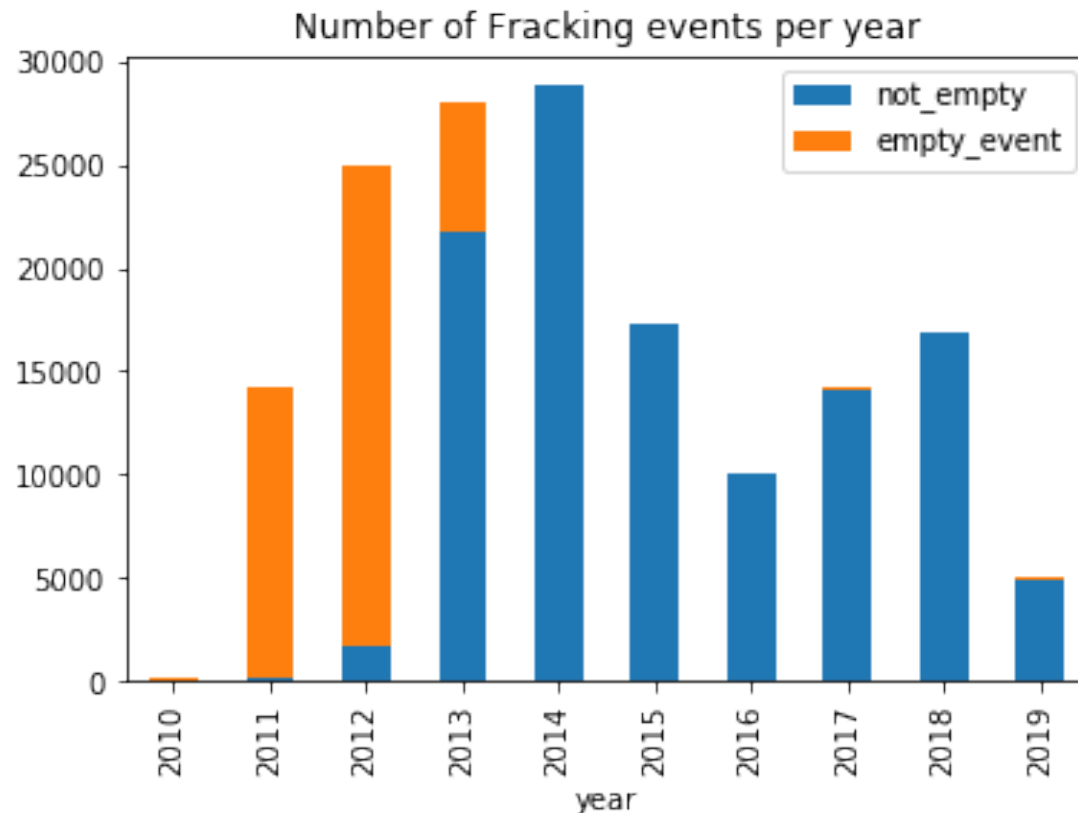
Timeline

- Version 3.0
- Oct 2, 2019
Published Version 2.0
Currently viewing
- Author ran Oct 2, 2019 00:15:40
- Published Result
 - ff_raw_stats.txt (2.98 KB)
 - filtered_df.csv (1000.95 MB)
 - filtered_df.zip (129.78 MB)
 - Filtering_costs.html (374.81 KB)
 - full_df.csv (2.56 GB)
 - full_df.zip (390.82 MB)
 - output (2.39 KB)
 - Summary_of_cleaned_... (978.14 KB)
- Gary W Allison committed Oct 2, 2019
- Version 2.0
- Sep 30, 2019
Published Version 1.0
[Switch to this version](#)

<https://doi.org/10.24433/CO.8896584.v5>

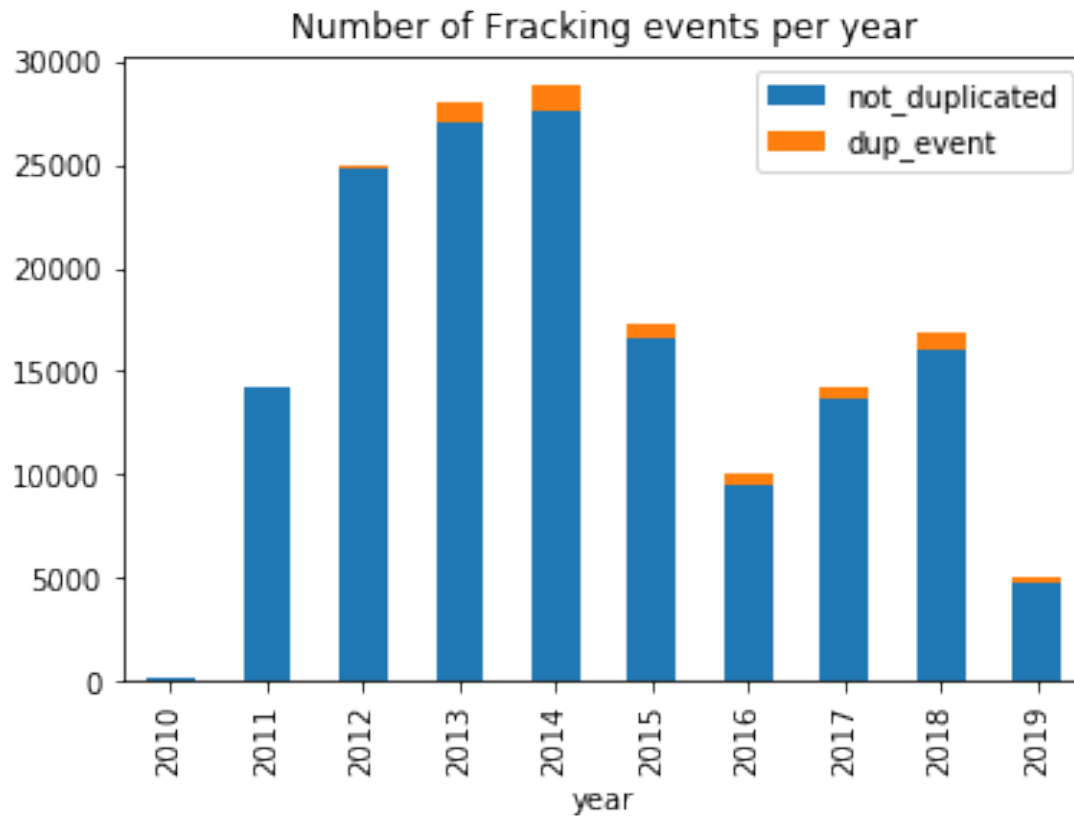
How is this data filtered?

- Removed Events where there is no data on chemicals used or water quantities

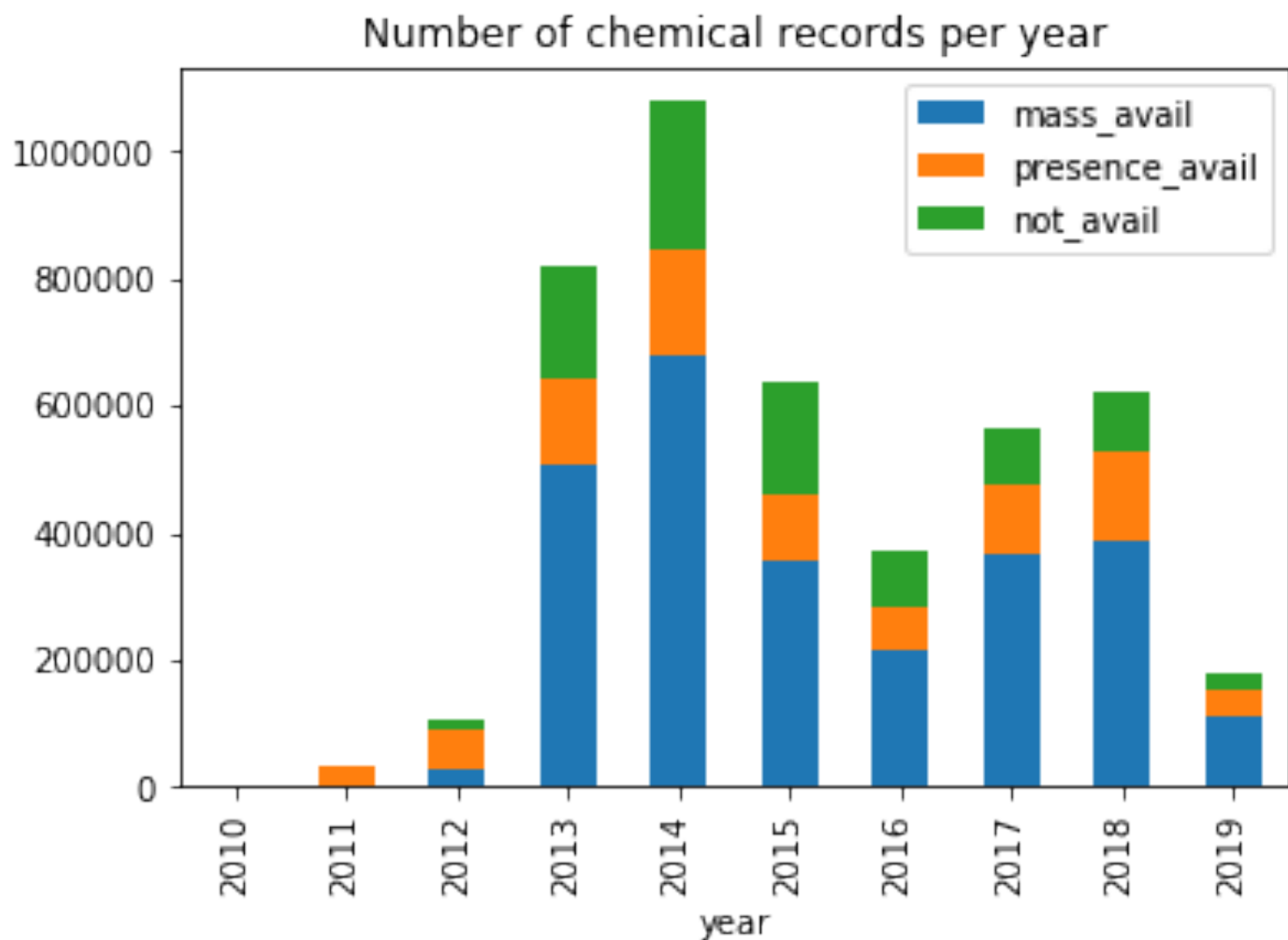


How is this data filtered?

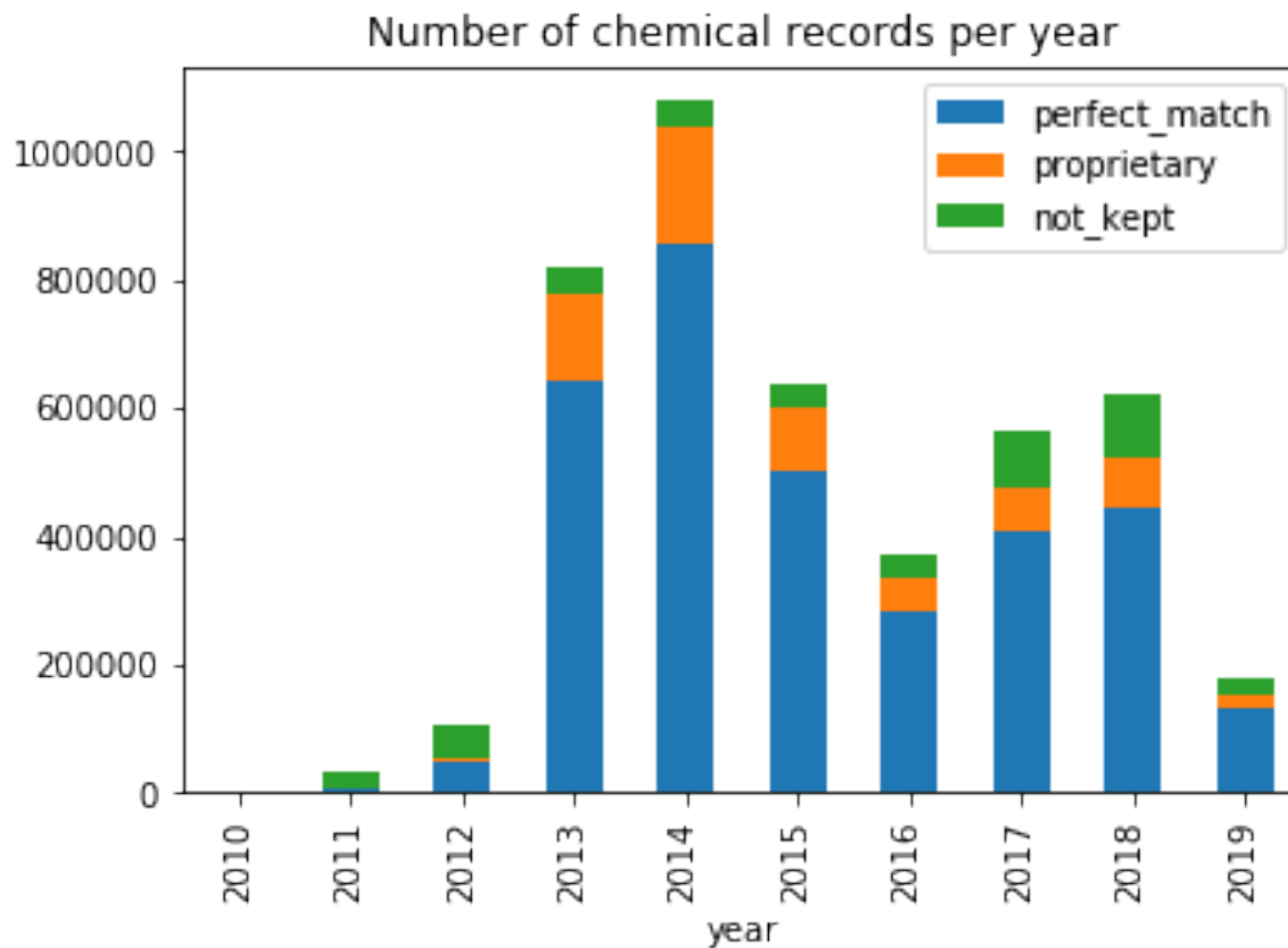
- Removed duplicate events



This is only includes records where water is the main carrier



This is only data from non-proprietary Chemicals



Laura Amos: 2 Butoxyethanol



https://www.earthworksaction.org/voices/detail/laura_amos

Theo Colborn



Laura Amos and a drilling rig on her property

October 22, 2002

Allen Belt
Bureau of Land Management
2505 So Townsend
Montrose, CO 81405

Robert Storch
United States Forest Service
2250 Highway 50
Delta, CO 81416

RE: An Analysis of Possible Increases in Exposure to Toxic Chemicals in Delta County, Colorado Water Resources as the Result of Gunnison Energy's Proposed Coal Bed Methane Extraction Activity

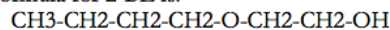
BACKGROUND

Gunnison Energy is proposing to extract coal bed methane in Delta County, Colorado. In its notices to the public it makes claims that "...the threats posed by hydraulic fracturing of CBM wells to USDWs [US drinking water supplies] are low and do not justify additional study." They also claim that the "...fluids used to extract coal bed methane from the ground do not substantially threaten public health." ¹ The following addresses these claims and looks at possible direct and indirect health effects of CBM extraction on the citizens, domestic animals, and wildlife in Delta County.

THE FRACTURING FLUIDS

Gunnison Energy proposes to use a solvent, ethylene glycol monobutyl ether (2-butoxyethanol), hereafter designated as 2-BE, in a liquid fracturing mixture to facilitate the extraction of coal bed methane in Delta County. 2-BE will be present in the liquid component of the fluid at approximately 7 ppm (parts per million) based on data provided to Delta County Commissioners following three local Area Planning Committee meetings by Gunnison Energy Corporation (GEC), May 29, 2002.

The structural formula for 2-BE is:



2-BE is a highly soluble, colorless liquid with a very faint, ether-like odor.² At the concentration it is to be

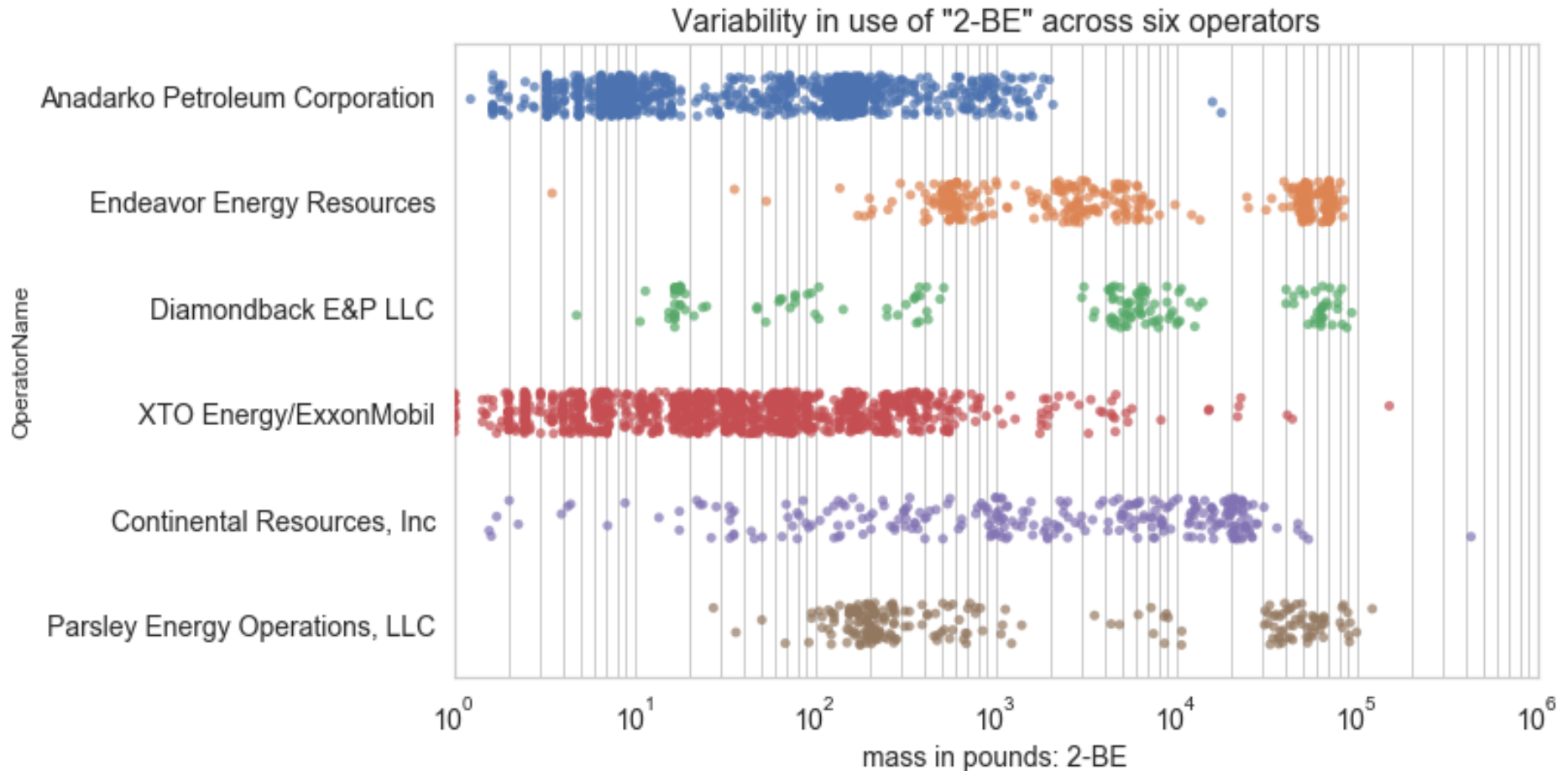
2 BE: 2-butoxyethanol

“Carcinogenicity:

At the end of a two year chronic bioassay, *elevated numbers of combined malignant and non-malignant tumors of the adrenal gland* were reported in female rats and male and female mice...No human epidemiological studies are available...”

2 BE used in 20,384 fracks

June 2013-March 2019



1 operation alone used $\sim 1/2$ a million pounds

2 BE used = 48,982,088.02 lbs



1.5 X weight of the Brooklyn
Bridge (29,370,000 lbs)

- *Sophie Spatharioti Northeastern University and [Microsoft Perspectives Engine](#).*

Total weight of EDCs used in Water based Fracking events

1,749,795,304 lbs
~ 1.7 Billion Pounds
= 4X weight of the
Sear's (Willis) Tower in
Chicago, North
America's second
largest building





Proposal:

- 1) Collaborative, Rapid Interdisciplinary Analysis
- 2) Special Issue or Op Eds
- 3) Consensus Statement
 - In the spirit of the [Wingspread Consensus Statement](#)
- 4) Data Visualization and Physicalization
 - See Chemicals in the Creek

Interested to collaborate on this? Email s.wylie@northeastern.edu

Thank You and Acknowledgements

- *Theo Colborn and The Endocrine Disruption Exchange (TEDX)*
- *Gary Allison FracFocus Clean*
Up: <https://codeocean.com/capsule/4055232/tree/v5>
- *Sophie Spatharioti Northeastern University and Microsoft Perspectives Engine.*
- *The ExtrAct Research Group*
Chris Csikszentmihályi, Dan Ring, Christina Xu, Matt Hockenberry, Lisa Sumi, Jennifer Goldman and Tara Meixsell
- *Earthworks/OGAP—Collaborated with TEDX on the first database of Fracking Chemicals*
- *The Wylie Lab*
- *Laura Amos, Rick Roles and the many others who stories informed and inspired Fractivism*

