

# Gas leaks in Wellesley: What are the health implications?

Regina LaRocque, MD MPH

# Sources

- Physicians for Social Responsibility report, February 2017
- Concerned Health Professionals of New York compendium of scientific, medical and media findings, November 2016
- Union of Concerned Scientists
- Pubmed

# Expansion of Natural Gas Industry

- Natural gas boom in past 15 years
  - Over 15 million Americans now in close proximity to this heavy industry



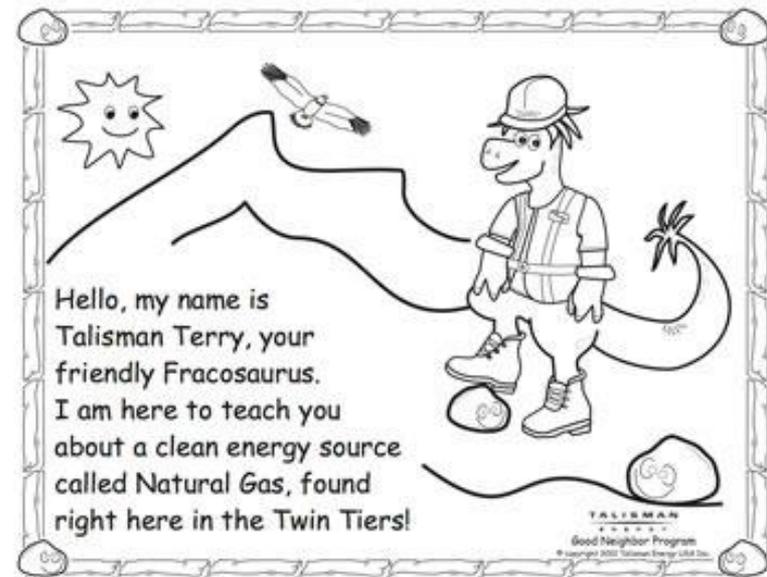
Living close to fracking operations increases the risk of premature birth and congenital heart defects.

# CLEAN & ABUNDANT

Clean and abundant natural gas and natural gas liquids have unlocked exciting new opportunities in energy and petrochemicals



**CLEAN  
ABUNDANT &  
AMERICAN  
RESPONSIBLE  
EFFICIENT**





Journal of Arboriculture 3(8): August 1977

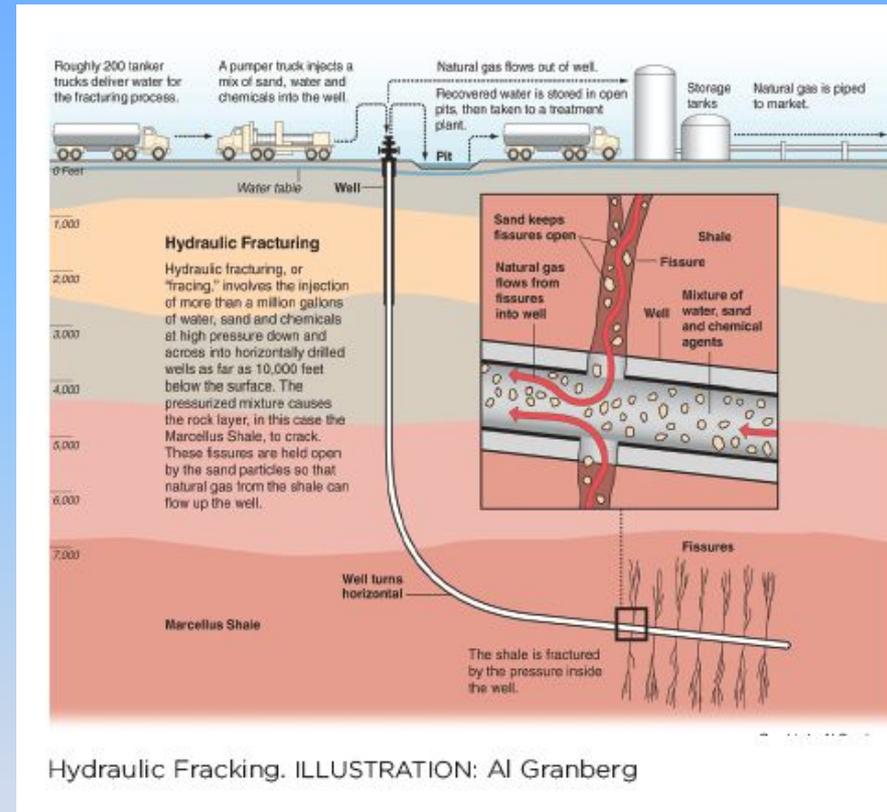
153

## **THE EFFECT OF NATURAL GAS ON TREES AND OTHER VEGETATION<sup>1</sup>**

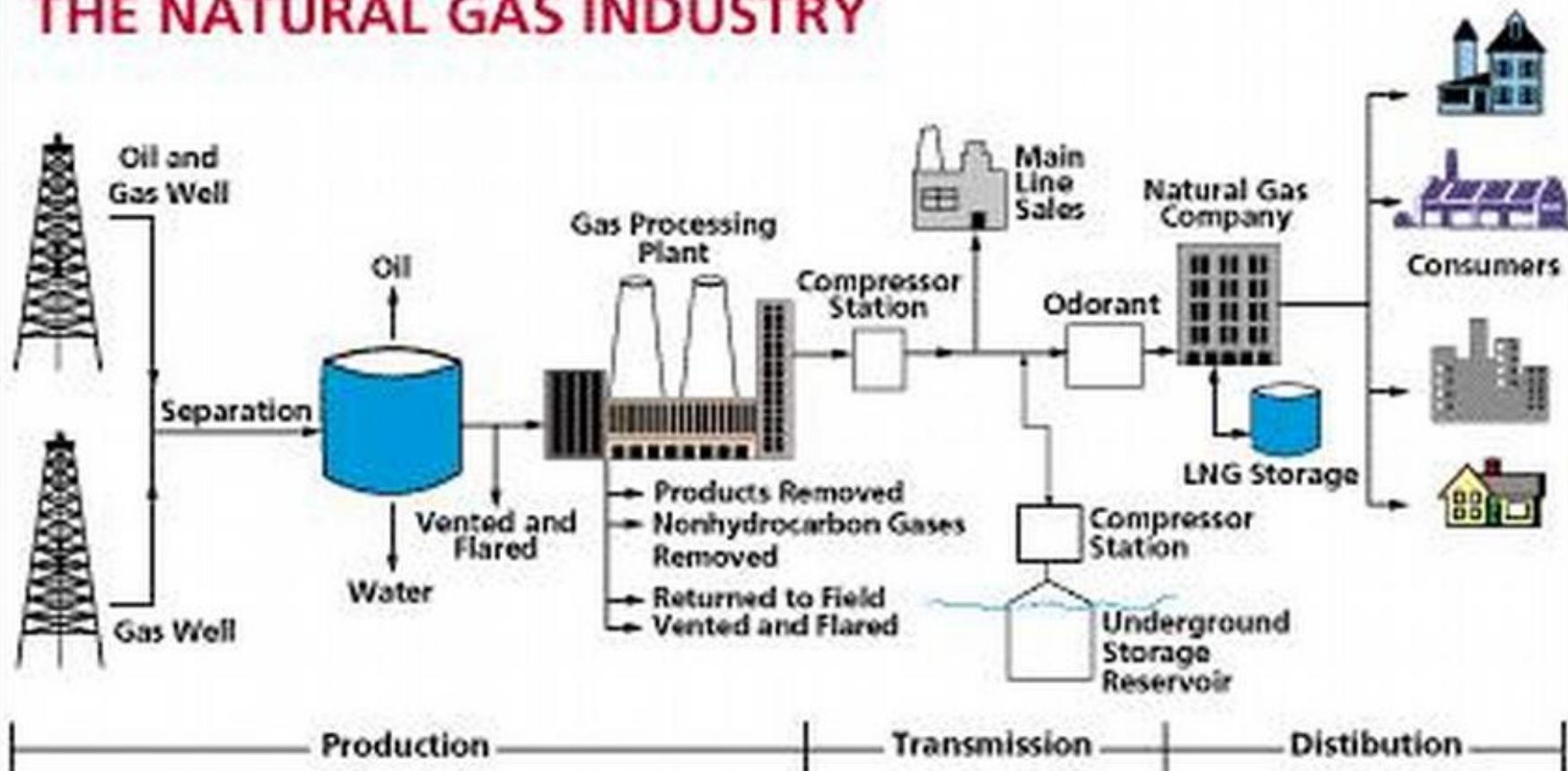
by **Spencer H. Davis, Jr.**

# What is Natural Gas?

- Extracted from complex geologic formations by hydraulic fracturing (fracking)
  - Pumping highly pressurized mixture of chemicals and water into deep underground bands of shale or porous rock to fracture them and release methane

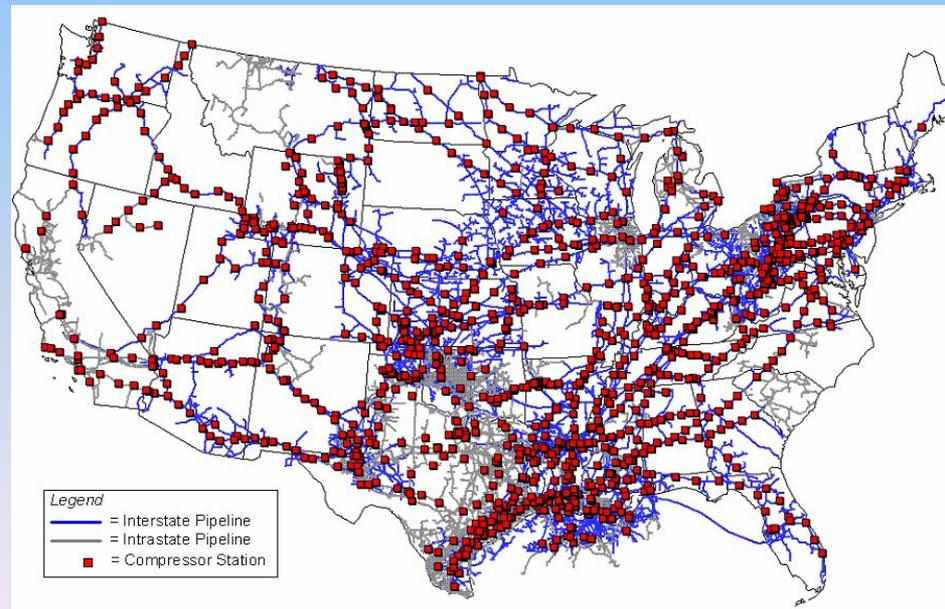


# THE NATURAL GAS INDUSTRY



# Where do 'health' effects occur?

- Near fracking sites (production)
- Processing, transport, and delivery through compressor stations and distribution pipelines



# Barriers to Understanding Health Effects

- Political will
  - The list of chemicals used in fracking fluids is considered proprietary and is not always made public
  - Funding
- Availability of relevant data
- Sample size
- Latency period

# Health Effects of Natural Gas

- More than 900 peer-reviewed scientific publications on environmental, health and societal effects
  - >80% since January 2013
- Many of the chemicals associated with fracking cause cancer, are toxic, or are endocrine-disruptive



Science of The Total Environment

Volume 424, 1 May 2012, Pages 79–87



Human health risk assessment of air emissions from development of unconventional natural gas resources ☆☆☆

Lisa M. McKenzie  , Roxana Z. Witter, Lee S. Newman, John L. Adgate

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# Natural Gas: Criteria Air Pollutants

- Ground-level ozone (“smog”)
- Acid rain
- Respiratory irritants (asthma, reduced lung function)

<b>NITROGEN OXIDES</b>	Decrease oxygen absorption and weakens the lungs. Short-term exposure aggravates asthma. Contribute to the formation of ground-level ozone and particulate matter. <sup>64, 65</sup>
<b>METHANE, ETHANE, PROPANE</b>	May cause rapid breathing and heart rate, clumsiness, emotional upset. At greater exposure, may cause vomiting, collapse, convulsions, coma and death. <sup>66</sup>
<b>FORMALDEHYDE</b>	A known carcinogen. <sup>67</sup> Can cause permanent and irreversible damage to the lungs.
<b>SULFUR DIOXIDE</b>	A major contributor to acid rain. <sup>68</sup> Can cause coughing, wheezing and shortness of breath and worsen asthma <sup>69</sup> and destabilize heart rhythms. <sup>70</sup> It is linked to bronchial reactions, reduced lung function and premature death. <sup>71</sup>

# Natural Gas: Criteria Air Pollutants

- Particulate matter
  - Decreased lung function
  - Aggravated asthma symptoms
  - Heart attacks
  - High blood pressure
  - Children are especially vulnerable



# Natural Gas: Hazardous Air Pollutants

- Volatile organic compounds (benzene, toluene, ethylbenzene and xylene)
  - Affect the nervous system, cause cancer and can cause birth defects
  - No safe level

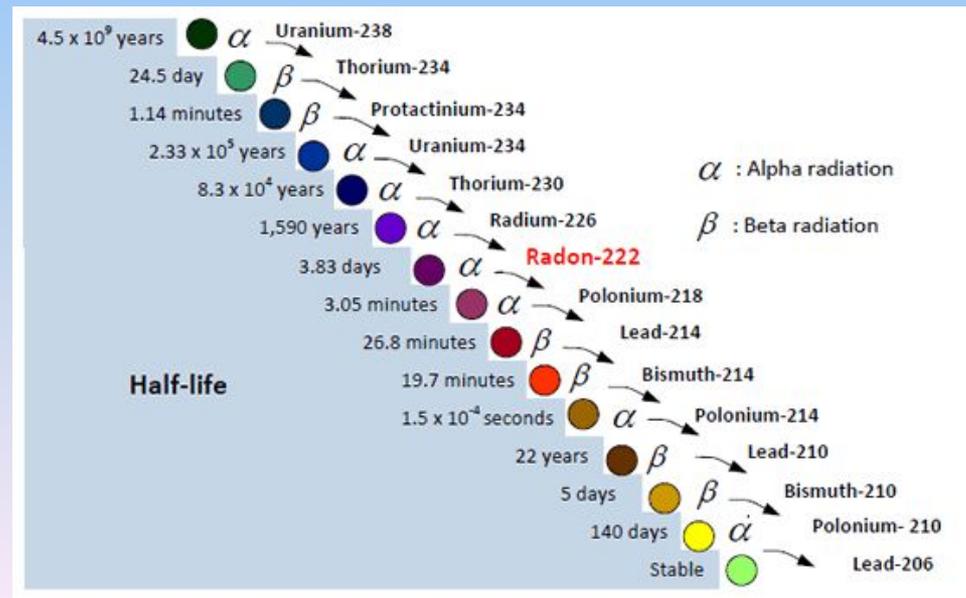


## AIR CONTAMINANTS ASSOCIATED WITH HYDRAULIC FRACTURING

<b>BENZENE</b>	Known carcinogen. May cause anemia; can lessen white blood cell count, weakening the immune system. <sup>58</sup> Prolonged exposure may result in leukemia, reproductive and developmental disorders, and other cancers. <sup>59</sup> There is no known safe level for air exposure. <sup>60</sup>
<b>TOLUENE</b>	Long-term exposure may affect the nervous system and cause miscarriages and birth defects. <sup>61</sup>
<b>ETHYL-BENZENE</b>	Long-term exposure may result in blood disorders. <sup>62</sup>
<b>XYLENES</b>	Short-term exposure to high levels may cause irritation of the nose and throat, nausea, vomiting, and neurological effects. Long-term exposure at high levels may affect the nervous system. <sup>63</sup>

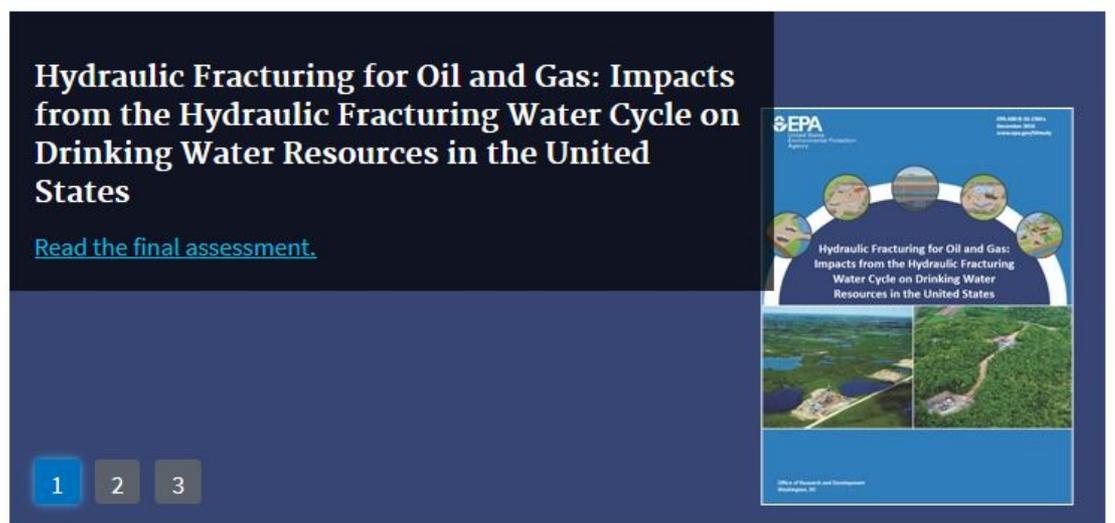
# Natural Gas: Radioactive Substances

- Some shale formations (particularly Marcellus) contain large amounts of naturally occurring radon and other radioactive elements
- Radon is the leading cause of lung cancer in non-smokers
- Radon decays



# Water Contamination

- EPA report (Feb 2017) confirmed that drilling and fracking activities can impact drinking water
- 8.6 million Americans are served by a drinking water source that is located within a mile of a fracking well



# Health Effects Near Fracking Sites

 PLOS ONE

RESEARCH ARTICLE

## Childhood hematologic cancer and residential proximity to oil and gas development

Lisa M. McKenzie<sup>1\*</sup>, William B. Allshouse<sup>1</sup>, Tim E. Byers<sup>2</sup>, Edward J. Bedrick<sup>3</sup>, Berrin Serdar<sup>1</sup>, John L. Adgate<sup>1</sup>

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## Association Between Unconventional Natural Gas Development in the Marcellus Shale and Asthma Exacerbations

Sara G. Rasmussen, MHS<sup>1</sup>; Elizabeth L. Ogburn, PhD<sup>2</sup>; Meredith McCormack, MD<sup>3</sup>; [et al](#)

➤ [Author Affiliations](#)

*JAMA Intern Med.* 2016;176(9):1334-1343. doi:10.1001/jamainternmed.2016.2436

al List > Environ Health Perspect > v.122(4); 2014 Apr > PMC3984231



*Environ Health Perspect.* 2014 Apr; 122(4): 412–417.

Published online 2014 Jan 28. doi: [10.1289/ehp.1306722](https://doi.org/10.1289/ehp.1306722)

Research

PMCID: PMC3984231

## Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado

[Lisa M. McKenzie](#),<sup>✉1</sup> [Ruixin Guo](#),<sup>2</sup> [Roxana Z. Witter](#),<sup>1</sup> [David A. Savitz](#),<sup>3</sup> [Lee S. Newman](#),<sup>1</sup> and [John L. Adgate](#)<sup>1</sup>

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 PLOS ONE

RESEARCH ARTICLE

## Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates

Thomas Jemiellita<sup>1\*</sup>, George L. Gerton<sup>2\*</sup>, Matthew Neidell<sup>3</sup>, Steven Chillrud<sup>4</sup>, Beizhan Yan<sup>1</sup>, Martin Stute<sup>1</sup>, Marilyn Howarth<sup>2</sup>, Pouné Saber<sup>2</sup>, Nicholas Fausti<sup>2</sup>, Trevor M. Penning<sup>2</sup>, Jason Roy<sup>1</sup>, Kathleen J. Propert<sup>1</sup>, Reynold A. Panettieri, Jr.<sup>2\*</sup>

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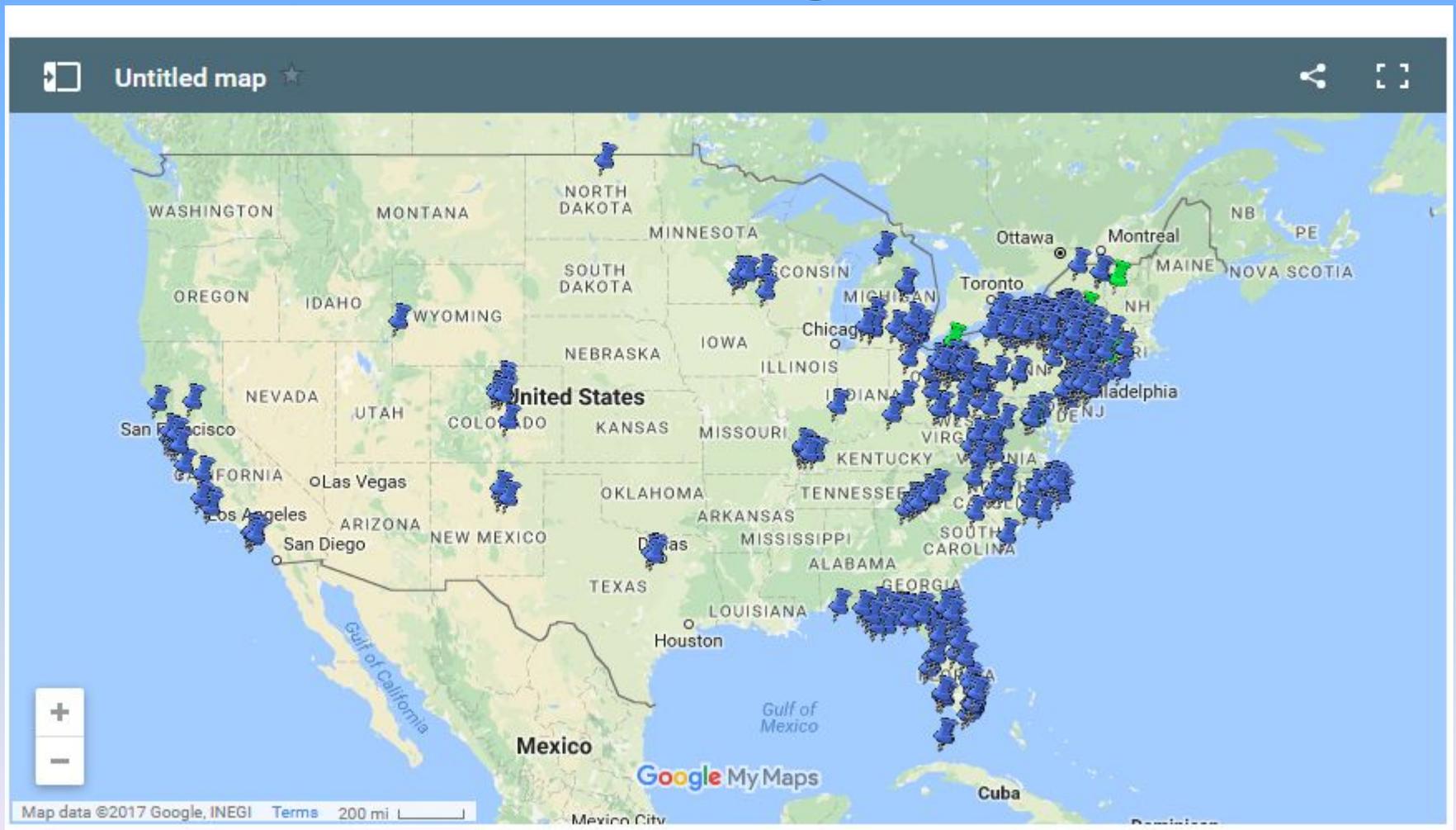
*Epidemiology.* 2016 Mar;27(2):163–72. doi: [10.1097/EDE.0000000000000387](https://doi.org/10.1097/EDE.0000000000000387).

## Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA.

[Casey JA](#)<sup>1</sup>, [Savitz DA](#), [Rasmussen SG](#), [Ogburn EL](#), [Pollak J](#), [Mercer DG](#), [Schwartz BS](#).

➕ [Author information](#)

# Many communities have banned fracking



Source: Food and Water Watch

# Health effects during processing, transport and delivery

Growing body of evidence documents leaks of methane, toxic volatile organic chemicals and particulate matter throughout this infrastructure



# Explosions



Warren, Michigan May 2011

Pipeline and Hazardous Materials Safety Administration recorded 858 serious incidents (involving fatality or injury requiring hospitalization) from 1996-2016.



Milford, Texas November 2013

# Compressor Stations

- People living near compressor stations have reported symptoms ranging from skin rashes to GI, respiratory, neurological and psychological problems.
- Air samples near compressor stations have shown elevated concentrations of many of the dangerous substances associated with fracked gas.

# Distribution Pipeline Leaks

?

# Air Quality Basics

- Clean Air Act requires EPA to set national ambient air quality standards for six common “criteria air pollutants”
  - Ozone, particulate matter, CO, NO, SO<sub>2</sub>, lead
- Concentrations of pollutants are measured at more than 4000 monitoring stations owned and operated mainly by state environmental agencies.



Pollution Levels & Forecast

Air Quality Trends & Data

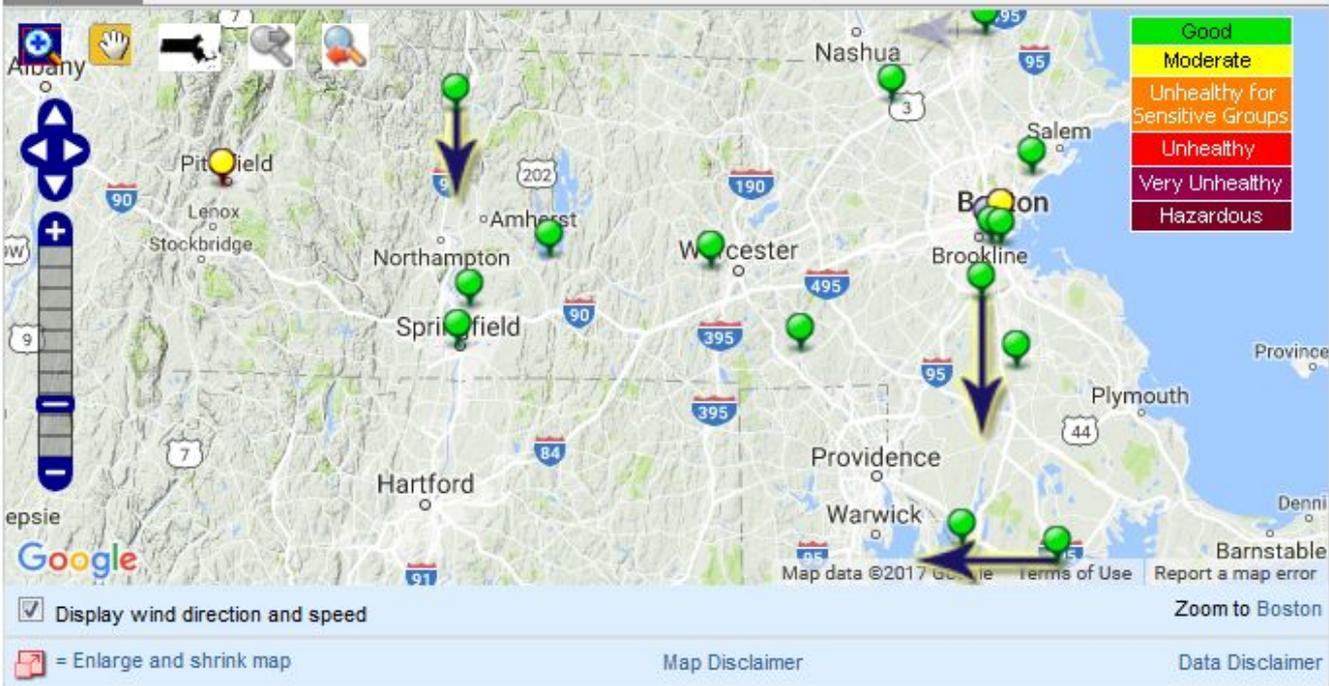
Current Max | Forecast | Ozone | Fine Particles (PM2.5) | CO | SO2 | NO2 |

Home > MassDEP > Air & Climate > Air Quality & Monitoring > MassAir . . .

Current Max Pollution Level (3/14/2017 12PM ~ 1PM)

Map View

Table View



Health Implications

What causes good or bad air?

# Air Quality Basics

- Hazardous air pollutants (HAP)
  - National Air Toxics Assessments
  - Model based on 2011 emissions data
- No data on endocrine-disruptors or radioactive substances

The screenshot shows the EPA website's page for the National Air Toxics Assessment. At the top, the EPA logo and navigation menu are visible. The main heading is "National Air Toxics Assessment". Below this is a map of the United States with a color-coded overlay representing air quality data. A text box on the map reads "National Air Toxics Assessment" and "EPA's comprehensive evaluation of air toxics in the United States". To the right of the map, a text box states: "On December 17, 2015, EPA released the most recent update to the National Air Toxics Assessment (NATA). NATA contains emissions data from 2011 and uses models to make broad estimates of health risks over geographic areas of the country." Below the map and text, there are three buttons: "NATA Overview", "2011 NATA Assessment", and "Quick Links". The "Quick Links" button has a sub-link for "Previous versions of NATA".

# Algonquin Pipeline gas contains benzene

Category	Station C		
Source	WEYM-GR-ST		
	Avg. Hourly	Max. Annual	Max. Hourly
Gas Release	1,747 scfh	15,300,000 scf/yr	975,000 scfh
	81 lb/hr	708,097 lb/yr	46,959 lb/hr
HAP (Total)	0.0472 lb/hr	0.2067 tpy	69.6676 lb/hr
<b>Benzene</b>	0.0076 lb/hr	0.0334 tpy	11.2516 lb/hr

Spectra Energy Partners, ibid. Table G-1C. (PDF pg 752).

# Local gas contains benzene

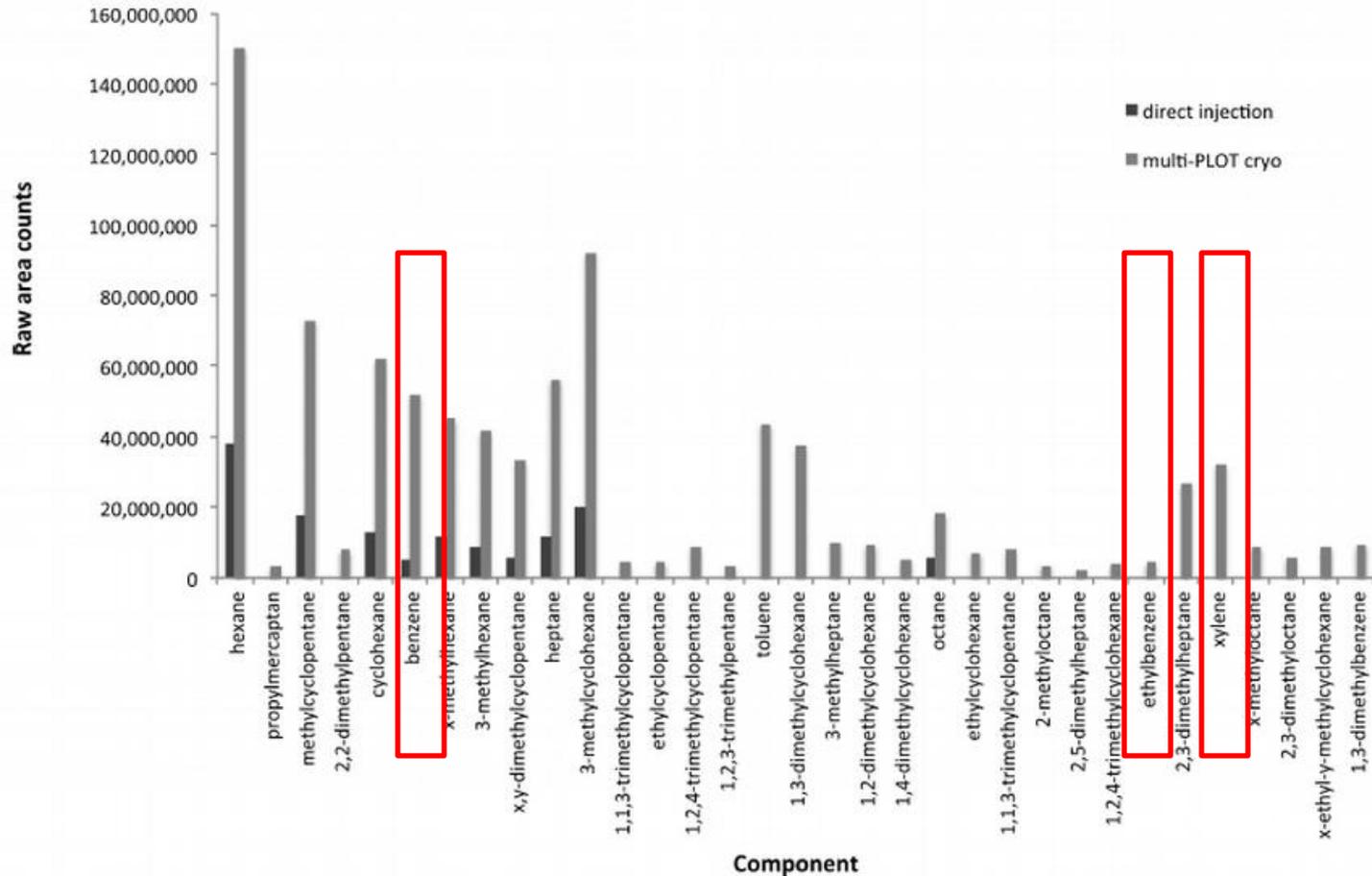


Figure 5. Comparison of GC-MS raw area counts for the  $C_6+$  fraction of natural gas as determined by direct injection and the multi-PLOT-cryo method.



# Pediatric Asthma and Natural Gas

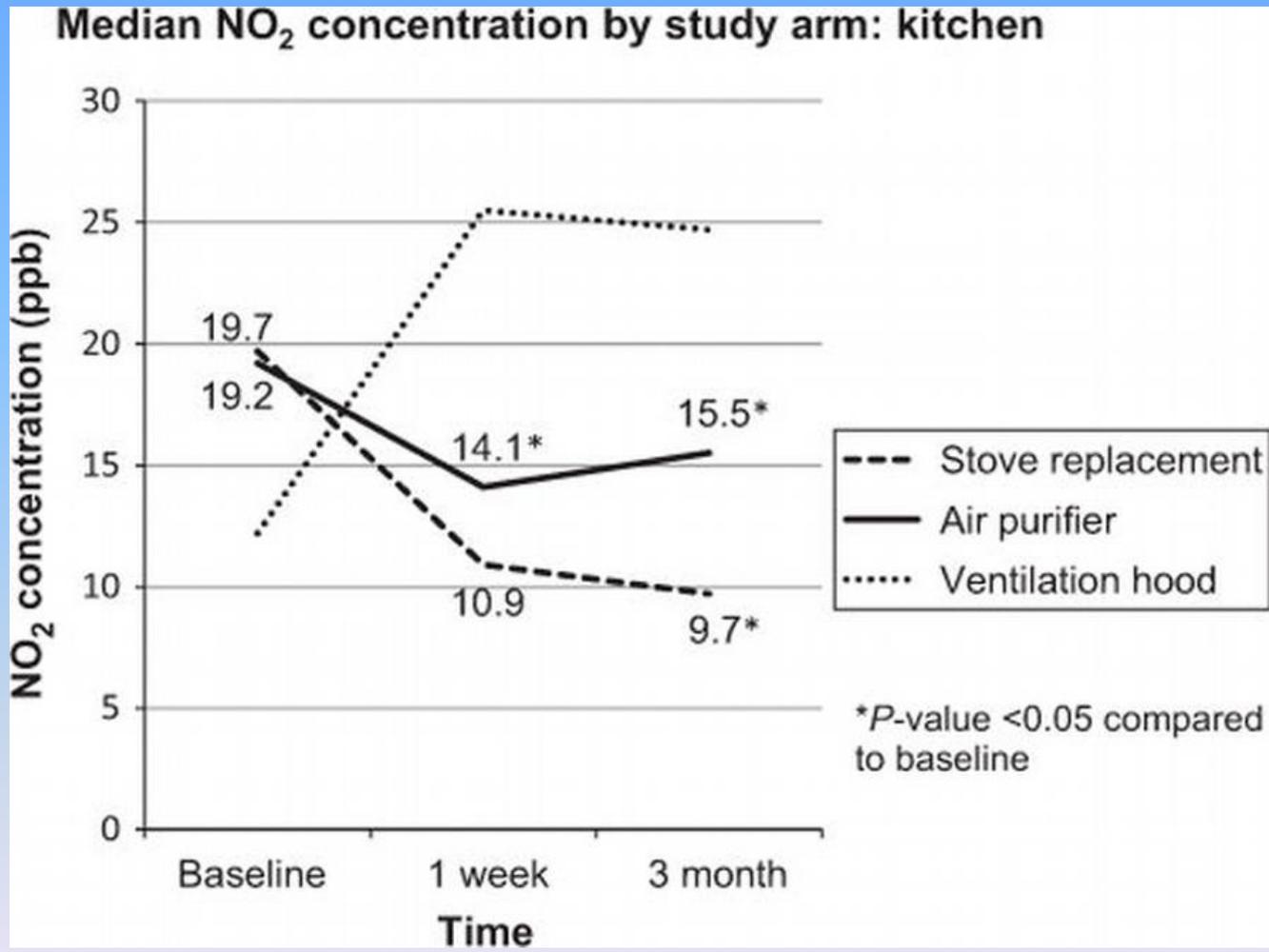
U.S. children under age 6 who live in homes where gas stoves are used for cooking or heating have an increased risk of asthma, wheeze and reduced lung function.

Ventilation of gas stove	No. cases	OR (95% CI)
No	269	1 Ref.
Yes	224	0.64 (0.43, 0.97)*

\*P-value <0.05.

Kile ML, et al. A cross-sectional study of the association between ventilation of gas stoves and chronic respiratory illness in U.S. children enrolled in NHANESIII. Environ Health. 2014 Sep 2;13:71

# Pediatric Asthma & Natural Gas



Paulin, L. M. et al. "Home Interventions Are Effective at Decreasing Indoor Nitrogen Dioxide Concentrations." *Indoor air* 24.4 (2014): 416–424.

# Rethinking the narrative .....



Viscous Black Powder



Dry Black Powder



Wet Black Powder

# Gas Leaks in Wellesley: More Questions than Answers

- Whose health are we concerned about?
- What's in the leaking gas?
- Do proximity to or intensity of leak matter?
- How do local meteorological conditions affect the distribution of leaked gas?
- Are there vulnerable populations?
  - Children, pregnant women, elderly, those with chronic medical conditions

# Recommendations

## (Physicians for Social Responsibility)

- While we still continue to use natural gas, we must reduce its negative consequences as quickly and effectively as possible and reject practices that allow methane and pollutants to enter the environment.
- We must step up the pace of our transition to renewable energy and energy efficiency.

# Recommendations

- AMA resolution (#519) supports “legislation that would require a comprehensive health impact assessment regarding the health risks that may be associated with natural gas pipelines”
- MA HD 3239 – an act relative to the energy facilities siting board (Rep Ed Coppinger)